R&D at UPM

Part 2

Research Snapshots

newfindings, researchhighlights, newachievements

First Edition



Universiti Putra Malaysia

R&D at UPM

Part 2

Research Snapshots

new findings, research highlights, new achievements

First Edition

R&D at UPM

Part 2

Research Snapshots

newfindings, researchhighlights, newachievements



Universiti Putra Malaysia
43400 UPM, Serdang, Selangor Darul Ehsan

Published By

The Research Management Centre (RMC)
Chancellory
Administration Building
Universiti Putra Malaysia
43400 UPM, Serdang
Selangor Darul Ehsan
Malaysia

Tel: +603 8946 6028 ▪ 8946 6192
Fax: +603 8942 6539

e-mail: rschinfo@admin.upm.edu.my
URL: http://www.admin.upm.edu.my/~research/
http://rmc.upm.edu.my

Copyright © 2004 Universiti Putra Malaysia

ISSN 1675-2236

All Rights Reserved.
No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical photocopying, recording or otherwise, without the prior permission of the Publisher.

Patron & Advisor
Muhamad bin Awang

Editor-in-Chief
Nayan Deep Singh Kanwal

Editors
Mohd. Shahwahid Hj. Othman
Sidek Hj. Ab. Aziz

The publisher of R&D at UPM neither endorses nor is responsible for the accuracy or reliability of any opinion, advise or statement published in this publication. Under no circumstances will the publisher of this publication be liable for any loss or damage caused by your reliance on the advise, opinion or information obtained either explicitly or implied through the contents of this publication.

If you have any comments about this publication, or suggestions for future issues, then please contact the Publications & Promotion Unit at the address above or via email to: ndeeps@admin.upm.edu.my

Printed and bound in Malaysia by *Izshen Associate Sdn. Bhd.*

IN THIS EDITION

BRIEF CONTENTS

Section 1

Abbreviations viii
Foreword ix
Preface xiii

Vision 2

Mission statement 2

Background 3
Objectives
Infrastructure

Teaching 4
Facilities and R&D Capabilities
Centre for External Education
Academic Development Centre (ADC)

Research 5
Research Funding
Research Outputs
Publications
Products and Patents
Research Achievements and Awards
Exhibitions

Human Resource Development 11
Staff Statistics
Inaugural Lectures
School of Graduate Studies
Postgraduate Research
Post Doctorates
National Science Fellowship Scheme

International Linkages 14
Memoranda of Understanding (MOU)

Concluding Remarks 14

Section 2

New findings, Research highlights and New achievements by Research Clusters 17

Agriculture, Food and Forestry
Bioscience and Biotechnology
Health and Allied Sciences
Information Technology and Mathematics
Materials, Energy and Environment
Science and Engineering
Social Science and Humanities

Appendices 467

Appendix 1: A glance at Research Inventions & Innovations at UPM—IRPA RM-8 Ongoing Projects (2001-04)
Appendix 2: Commercialised Products (1996-2004)
Appendix 3: Products, Services and Processes —Patented or Patent-pending, 2003-04
Appendix 4: Awards and Prizes, 2003-04
Appendix 5: Exhibitions and Competitions 2003-04
Appendix 6: Inaugural Lectures, 1989-2004
Appendix 7: Memoranda of Understanding (MOUs) & Memorandum of Agreement (MOAs) 1984-2004

Indices 627

Subject Index
Author Index

Part 1

Section 1

Vision
Teaching
Research
Services
Support Services
Human Resource Development
International Linkages
Future Directions
Concluding Remarks

Section 2

Scientific breakthroughs, New discoveries and Innovations by Research Clusters
Appendices
Indices

LIST OF FIGURES & TABLES

Figures

Fig. 1:	*UPM IRPA Allocation and Number of Projects, RM-8 (2001-2004)*	6
Fig. 2:	*Research Publications at UPM, 2003-04*	7

Tables

Table 1:	*Summary of Awards won in Exhibitions, 2003-04*	10
Table 2:	*Staff Promotions 2003-04*	12
Table 3:	*Experimental Applied Research (EAR) Grants (IRPA RM-8)—2001-2004*	469
Table 4:	*Prioritised Research (PR) Grants (IRPA RM-8)—2001-2004*	501
Table 5:	*Strategic Research (SR) Grants (IRPA RM-8)—2001-2004*	504
Table 6:	*Top Down National Biotechnology Projects under National Biotechnology Directorate (NBD) (IRPA RM-8)—2001-2004*	504
Table 7:	*Fundamental Research (Short-term) Grants—2001-2004*	505
Table 8:	*International Research Grants—2001-2004*	516
Table 9:	*National Research Grants—2001-2004*	517
Table 10:	*Consultancies & Contract Research/IGS Grants—2001-2004*	520
Table 11:	*Products Commercialised, 1996-2004*	529
Table 12:	*Patents / Patent-pending / Trade Marks—2003-04*	533
Table 13:	*List of Awards and Prizes won by UPM Academia by Category—2003-04*	543
Table 14:	*Exhibitions and Competitions 2003-04*	563
Table 15:	*Inaugural Lectures of UPM's Professors by Faculty—1989-2004*	613
Table 16a:	*MOU with international universities and agencies, 1984-2004*	619
Table 16b:	*Memorandum of Understanding / Agreement (MOUs/MOAs) with National Agencies, 1983-2004*	622

ABBREVIATIONS

ADC	Academic Development Centre
EAR	Experimental Applied Research
EOP	End of Project Report
FOR	Field of Research
FRC	Faculty Research Committee
HRD	Human Resource Development
ICT	Information Communication Technology
IMP	Institute of Multimedia and Software *(Institut Multimedia dan Perisian)*
INSPEM	Institute for Mathematical Research
IPR	Intellectual Property Rights
IRPA	Intensification of Research in Priority Areas
ITMA	Institute of Advanced Technology *(Institut Teknologi Maju)*
MASTIC	Malaysian Science and Technology Information Centre
MOSTE	Ministry of Science, Technology and the Environment
MRDCS	Malaysian Research and Development Classification System
MSC	Multimedia Super Corridor
NCSRD	National Council for Scientific Research and Development
NSF	National Science Fellowship
PEKKA	Institute for Community and Peace Studies *(Pengajian Komunit Dan Keamanan)*
PORIM	Palm Oil Research Institute of Malaysia
PPL	Centre for External Education *(Pusat Pendidikan Luar)*
PR	Prioritised Research
R&D	Research and Development
RKI	Rainforest Knowledge Industry
RM-7/7MP	Seventh Malaysia Plan
RM-8/8MP	Eighth Malaysia Plan
RMC *(or PPP)*	Research Management Centre *(Pusat Pengurusan Penyelidikan)*
S&T	Science and Technology
SIRIM	Standard and Industrial Research Institute of Malaysia
SR	Strategic Research
TPU	University Agriculture Park *(Taman Pertanian Universiti)*
UBC	University Business Centre
UPM	Universiti Putra Malaysia
URC	University Research Committee

Foreword

The world comes ever closer. The Internet shows us that every country, region and everyone of us take account of the process of globalization that is becoming an increasingly more natural part of our lives.

We must meet the challenge of global development and global competition. We need not necessarily deplore it when a Malaysian company for instance moves its production away from Malaysia, in order to become established elsewhere in South East Asia. Instead we must build further on the strengths of our researchers and thus attract even more postgraduate students and researchers to Malaysia from abroad. They should come because we have a highly developed infrastructure and, not least, some of the most attractive development environments in the world.

We must strengthen those things we are good at. To get the greatest returns in all areas, we must invest more in research and use our research resources in a more purposeful way. We owe it to the future generations of our young scientists to administer our knowledge as well as possible and thus protect our common welfare. Malaysia must lead the race and the baton is to be handed on to our children and grandchildren.

Fortunately, the international accolades won by many of our prominent scientists demonstrate that, in a number of important areas, the quality of Malaysian research is of international format. But to these positive facts, it must be added that Malaysia can become much better at creating innovative research and at making use of research results to commercialize and patent our products or processes. The strengthening of research depends not only on more money and grants, but also on the optimum utilization of resources; we must constantly renew research and always be prepared for change. This should apply to the recruitment of researchers and to the structure of research itself. Constructive criticism should be welcome.

Research needs a high degree of freedom. Research is a dynamic and creative process in which the education, interests, curiosity and involvement of the individual researcher carry the development forward. It is the return on our investment in these talented persons on which future generations of Malaysia will have to build their lives. An important social goal for research is thus to contribute to the training of graduates and researchers.

The tangible results of research

Research results are for all of us. If research results and new knowledge are to have benefits outside the research community, they must be disseminated -preferably very quickly. This must be our requirement to researchers.

Information alone is not enough. It is important to remember constantly that it is not sufficient to produce and publish many and good research results -they must also be put to use. The government sees only one route to follow: the more effective use of relevant research results. This applies to their use in industry and in the public sector. As it is today, too many research results remain within the researchers' own circles.

Research and Innovation

Investigations show that institutions with their own research and development activities find that the cooperation with the public research system is important for their innovation, i.e. their ability to develop new products and introduce new production processes. The quality of research is marked by innovation, originality and creativity. Research must be relevant in relation to international scientific developments or the needs of the society and the country, including commercial usefulness.

UPM being a professionally strong institution with considerable large infrastructure and financial grants must concentrate on talented young researchers. Improving the quality of our research ought to be a self-increasing process. Excellent research institutions attract bright researchers from at home and abroad and will often be able to raise the professional level in a broad surrounding area. Therefore, we must concentrate on an elite research culture.

Research which breaks new ground cannot, of course, be planned from above. New departures in knowledge are primarily set in motion by the curiosity of researchers themselves and not by planning and control on the part of politicians and administrators. But new departures are helped by the creation of better conditions and by questions and debate initiated from the outside. In this way, decision-makers at all levels gain a better foundation on which to act.

Research must develop freely at the responsibility of the individual researcher within the given framework. In the border area between traditional subjects, a considerable amount of renewal and development of research takes place. The aim, therefore, should be the establishment of mechanisms and models in the research systems, which can flexibly support the activities of researchers and groups of researchers across the existing boundaries between institutions and subjects.

It is widely recognised that the process of innovation does not normally follow a linear model from scientific results via strategic and applied research through technological dissemination systems to applications in industry. Innovation is a process based on both a recognition of commercial possibilities as well as on basic—often well-known—research results. This is an incentive to institutions to enter into networks with various links to the systems of science, technology and innovation.

The increasing establishment of research institutions and centres of excellence at UPM which, in association with the existing research systems at the university, have created a setting providing increased opportunities for cooperation across the research system whilst also promoting mobility.

Innovation includes any form of new thinking based on the production, integration and utilisation of new discoveries in the economic, social and technological areas.

There are noticeable differences between the methods and amounts of innovation in various parts of Malaysian industry—but everyone is faced with a demand to be more innovative. The goal is, therefore, that Malaysian scientists be better at using and combining new knowledge, technology and qualifications in the renewal of products, services and processes.

It is necessary to develop human resources in step with technological development and the changed conditions of production. It is important to take a closer look at how demands as to the qualifications of employees change and at the reasons for, and consequences of, these changes. It is also necessary to be aware that the interplay between technology and qualifications goes in both directions. The development of the qualifications of the work force has an effect on the organisation of work, patterns of investment and technological development.

The rapid development of technology and keen international competition necessitates an improvement of the basis for decision-making in the areas of research and innovation in the public and private sectors of research.

Perhaps that is why innovation, now more than ever, has become vital not only in R&D organisations but education as well.

R&D at UPM, the first edition, Part 1 and 2, have many interesting insights to offer. The book highlights advances in UPM's multidisciplinary cutting-edge research innovations and discoveries that affect the global community. By publishing the work and views of our researchers and scientific investigators, *"R&D at UPM: Creating New Frontiers of Innovative Research* and *Research Snapshots"* contributes to the advancement of knowledge globally and to Malaysia's knowledge-based economy.

I am confident readers will have much to gain from this publication. This book is thus an attempt to encourage the researchers to be even more creative and innovative as it aims at stimulating greater active research and development into new products, patents, innovative technologies and more efficient services. Creating new knowledge, using knowledge to innovate, and thereby bringing tangible benefits to our country are intertwined elements of service. This sense of service will sustain our journey of learning and discovery for many years to come.

Editor-in-Chief
ndeeps@admin.upm.edu.my

Education is the most important basis for social and economic upliftment of any society

Preface

This is the first edition of the *R&D at UPM*. The book is published in *two* parts. *"Part 1: Creating New Frontiers of Innovative Research"*, acclaimed vast popularity and was highly praised by both the scientific community at Universiti Putra Malaysia as well as many techno-entrepreneurs from the outside world. It is based on outputs of long-term research projects conducted at the University during 2002-2003.

Part 1, ***"Creating New Frontiers of Innovative Research"*** consists of two sections and comprises several areas. The first area or *Section 1* begins with a *background* on UPM and elaborates on what UPM has achieved today. The second area deals with *facilities at UPM and R&D capabilities.* The third area deals with *research at UPM* and talks about formation of *research clusters, research funding* and *research outputs* from commercialization of products to patents. The fourth area presents *Services* and talks about university's support services. It also includes establishment of *Research Management Centre* (RMC) and academies such as *Rainforest Academy* and *UPM Sports Academy*. The next area deals with *Human Resource Development* at UPM and includes *postgraduate research, Inaugural lectures, post doctorates* etc followed by *international linkages, research outputs* and *future directions.*

Section 2 or the last area focuses on *latest breakthroughs* and *innovations* in various fields categorized by 7 research clusters. Articles are well written and each article provides an overview of the topic, including photographs, diagrams or illustrations. There is no other such encyclopedia that reaches the depth of this one. It will meet most of the needs of students and general readers.

Part 2, "***Research Snapshots***" contains *research highlights* of R&D projects and *research happenings* from all disciplines. It comprises *two* sections. The *first* section provides updates on information reported in the Part 1 of this book.

The *second* section presents short articles of award winning research projects arranged by research clusters. The summaries presented may not be a complete account of the work begun or completed; rather, they describe some key scientific results and are intended to give the reader an insight into the breadth of the research themes being investigated by UPM scientists. It covers new discoveries in multidisciplinary research at UPM and reports on the latest breakthroughs, innovations and new findings—snapshots of some key projects and activities from faculties, research centres or institutes achieved in 2003.

Appendices are also included to give some statistical information on our contributions to scientific research and development that have received worldwide recognition. Ongoing research projects are highlighted in *Appendix 1*. Commercialized research products for the period between 1996 and 2004 are presented in *Appendix 2* while *Appendix 3* shows a list of Patents awarded. *Appendix 4* highlights awards and prizes won by our scientists during 2003 and 2004. Exhibitions and Competitions for the year 2003-04 where UPM exhibited its innovative research products are given in *Appendix 5*. A list of inaugural lectures of UPM academia is presented in *Appendix 6* and an impressive list of MOUs and MOAs signed between UPM and international / national agencies for the period 1984-2004 is shown in *Appendix 7*.

The book also consists of *author* and *subject indices* to aid in locating a specific entry.

In compiling this book, our aim is to create a reference book that answers the needs of readers, particularly visitors to the university seeking information on innovative research at Universiti Putra Malaysia. This book also targets to attract the attention of other researchers from national and international research organisations and universities, CEOs and top-level business decision-makers in science and technology companies, major R&D firms, government bodies, and other interested individuals. We hope it will thus become the standard reference work on the R&D activities and multidisciplinary leading-edge research done by UPM's distinguished researchers and scientists.

This publication provides the bridge that links the esoteric technicalities of R&D to everyday's life. It presents the significance of current work being undertaken by researchers in a style accessible to the educated layperson. We invite you to this showcase of the range of advanced research associated with Universiti Putra Malaysia.

Last but not the least, we thank the academic staff of the university for their whole-hearted support in facilitating the production of this publication. The second edition of this book will be published in early 2005, which aims to garner greater support from all the academia at UPM. It is hoped that each year new and updated edition will be published henceforth.

Every effort has been made to include the most current and complete information. Articles are edited for clarity and other requirements. The editors welcome comments or corrections to the data presented.

Editors
May 2004

Section 1

EDUCATION Academic excellence is the heart of UPM' global knowledge enterprise where the imparting, creation and application of knowledge interlock into an ongoing cycle.

The University 's broad- based education provides conduits of inter- connectivity bridging disciplines for a more integrated and holistic approach to the acquiring and application of knowledge.



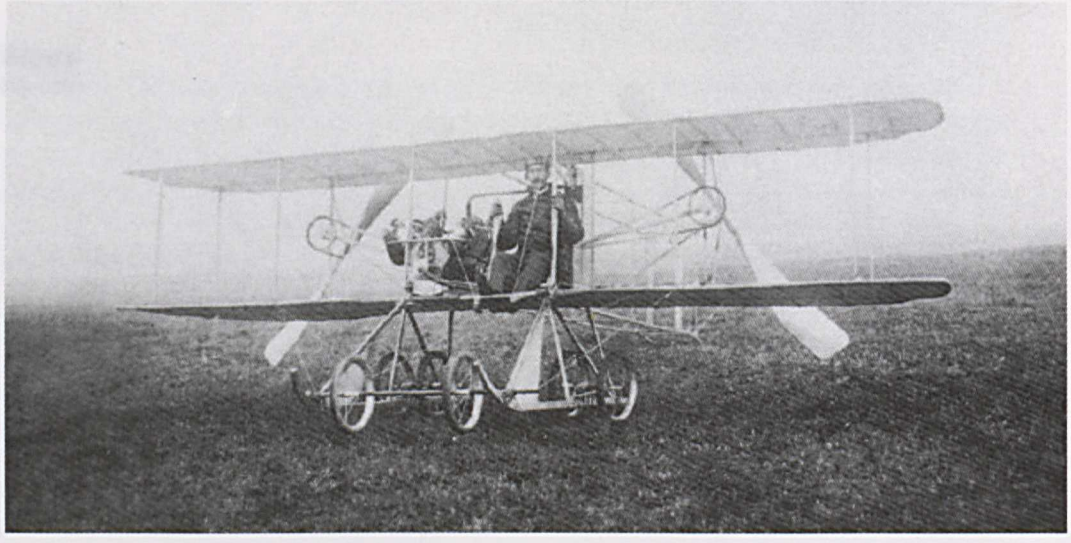
Man's first flight:
December 17, 1903

the Wright Brothers

INNOVATION & CREATIVITY
Orville and Wilbur Wright worked out of a bicycle repair shop to invent the airplane. Departing radically from the conventional theory of their day, the brothers experimented with movable portions of the wing assembly rather than shifts in bodily weight to correct the aircraft 's position in flight.

On December 17, 1903, the first controlled, sustained flight by man in a power- driven, heavier- than- air airplane was made. It changed forever mankind 's spatial concept of the world.

Innovation and creativity will drive education and research at UPM.



Section 1

Towards a WorldClass University

Contents

Vision 2

Mission Statement 2

Background 3

Objectives 3

Infrastructure 4

Teaching

Facilities and R&D Capabilities 4

Centre for External Education 4

Academic Development Centre (ADC) 5

Research

Research Funding 5

Research Outputs 6

Publications 7

Products and Patents 7

Research Achievements and Awards 7

Exhibitions 9

Human Resource Development

Staff Statistics 12

Inaugural Lectures 12

School of Graduate Studies 12

Postgraduate Research 13

Post Doctorates 13

National Science Fellowship Scheme 13

International Linkages

Memoranda of Understanding (MOU) 14

Concluding Remarks 14

VISION

To be a world-class university

MISSION

The mission of UPM is to be a leading centre of learning and research contributing not only towards human advancement and the discovery of knowledge but also to the creation of wealth and nation building.

The level and quality of education of a nation will determine its growth potential

1. BACKGROUND

Universiti Putra Malaysia (UPM) was founded on 3rd April 1997 by renaming Universiti Pertanian Malaysia. Since then, 13 faculties, 6 institutes, 9 centers, 2 academies and 2 schools have transformed UPM to emerge as the largest Science and Technology based university in Malaysia with over 1,600 academic staff, 4,600 supporting staff and about 30,000 students in nearly 77 different programs.

UPM now has two campuses—*Serdang* and *Bintulu*. It is an established University that is committed to excellence in research and to developing and maintaining a culture of research.

Today, university education and research are among the primary forces that create the conditions of globalization. Through scientific discoveries and technological advances as well as the training of cross-cultural talents, universities have become key players in the era of globalization, profoundly affecting industries, services and intellectual capital.

A robust research environment is one of UPM' core strengths. As a lively hub for local and foreign researchers, the university provides a conducive research environment for cultivating varied talents.

The University is constantly seeking ways to increase and enhance its research and is committed to undertaking excellent and internationally recognised research in all fields but particularly those with importance and interest to Malaysia, and in line with country's Vision 2020.

Today, UPM is recognised as a leading university in Malaysia, with a global center of excellence and focusing on quality **teaching**, **research** and **services** through to **human resource development**.

1.1 Objectives

To reinforce the paradigm shift to promoting holistic education, UPM has identified and set up eight 2001-2010 objectives to achieve its vision. Each objective has its own specific goal, and the achievement of this goal can be determined from its strategic implementation and action plan. The objectives are:

1. To produce quality graduates who are competitive and resilient through continual learning;
2. To transform UPM into a renowned research university;
3. To increase UPM's capability as a centre for learning, knowledge generation and agricultural technology;
4. To enhance a quality management system that is effective and efficient, transparent and client-friendly;
5. To develop human resources and to create an excellent professional environment;
6. To promote Information and Communication Technology (ICT) as a culture through e-University;
7. To efficiently and effectively generate and manage University income; and
8. To elevate the position of UPM as a Centre for Professional Development Services and Advanced Education.

1.2 Infrastructure

Universiti Putra Malaysia is reputed as one of the top universities in Malaysia for its academic performance and international recognition. It has the largest student population and the best verdant green campus covering 1,200 hectares, which makes it the biggest university in the country. Its location, adjacent to Putrajaya and Cyberjaya augurs well for UPM to be a University Town within the Multimedia Super Corridor (MSC).

2. TEACHING

The Universiti Putra Malaysia is a university that offers comprehensive courses in all major disciplines, ranging from agriculture, medicine, engineering, information communication and technology, and the sciences to social sciences and business in it's two campuses located in Serdang, Selangor and Bintulu, Sarawak.

UPM is moving towards a more holistic university education that will prepare students to meet the challenges of a knowledge-driven global economy.

2.1 Facilities and R&D Capabilities

Resources and services are the enablers and facilitators that provide the infrastructural support and complementary services critical to the operations of the University. They are also effective co-ordinators fostering synergy within the diverse UPM intellectual community and with the community at large.

UPM has established several facilities to promote R&D. These include: 13-faculties, 6-research institutes, 8-research centres of excellence, 2 academies and a research park.

There are several new projects under way to help enhance excellence in R&D. Amongst them are the RM30 million massive R&D complex at Puchong, the RM5 million Hatchery complex for marine sciences, an agro-gene bank, Laboratory of Immunotherapeutic and Vaccines (LIVE), and a Compressed Natural Gas Laboratory.

The new 620 beds Serdang Hospital in Selangor is also set to open its doors by the end of 2005, although the major building of the complex is almost ready. It will be the first service hospital in the country to cater for UPM R&D needs.

The faculties of Medicine and Health Sciences, Engineering, Design and Architecture, and Modern Languages and Communications are all being transformed to provide enhanced R&D facilities. These are expected to be complete by the middle of the year.

In addition, two new centres, the Centre for External Education, and Academic Development Centre (ADC) were recently established at UPM.

Centre for External Education

The establishment of the Centre for External Education was achieved through the merger of Institute of Distance Education and Learning (IDEAL) with the External Programme Centre. The main aim of the merger is to harness the strength of both centres to create a more viable, competitive and self-financing entity.

Amongst other objectives of the Centre are to ensure that the quality of off-campus academic programmes is on a par with those offered on campus and to develop a flexible and cost-

effective learning and teaching format, as well as to develop ICT-based learning system.1t operates on a cross-functional basis because of some similarities that exist in the former management of the External Programme Centre and IDEAL. The Centre is headed by a director and assisted by two deputy directors with specific job functions who oversee the various units within the centre.

Academic Development Centre (ADC)

The establishment of the Academic Development Centre is the result of a merger between the Knowledge Management Centre and the Teaching and Learning Development department of UPM. The merger involves the reviewing and restructuring of the Centres to ensure the effectiveness of the running of the ADC. With the merger, the ADC will manage seven units including staff development, assessment and training, and e-teaching units.

The main objective of the establishment of ADC is to streamline the functions of both the Knowledge Management Centre, and Teaching and Learning Development department. Amongst the prime functions of the Centre is to systematically utilise and reinforce the usage of information and expertise to increase UPM's response, innovation, credibility and efficiency in managing its responsibilities and to optimise the learning and teaching process strategy focusing on academic staff.

Most of the information under Teaching at Universiti Putra Malaysia has been dealt in *Part 1* of this book, *R&D at UPM: Creating New Frontiers of Innovative Research, First Edition, Editor: Nayan Deep S. Kanwal, published by Research Management Centre (RMC), Universiti Putra Malaysia.*

3. RESEARCH

A robust research environment is one of UPM's core strengths. As a lively hub for local and foreign researchers, the research arena here is conducive for cultivating varied talents. The 13 faculties, 6 research institutes, 8 research centres along with centres of excellence and the newly set up 2 academies consolidate UPM's commitment to world-class research.

UPM encourages intra- and inter- disciplinary collaboration within the University and its associated institutes as well as with other national and international institutions particularly those with whom MOUs have been signed. In addition, UPM is keen to develop exchange programmes and research collaboration with overseas 5* research Universities.

UPM research achievements in the year 2003-04 reflected the versatility of the University's research portfolio. R&D activities were concentrated in about 800 ongoing research projects worth RM225million. See *Appendix 1*.

3.1 Research Funding

In terms of progress and achievement, UPM has always been very active in research. Research at UPM is largely supported by public funds. The Ministry of Science, Technology and the Environment (MOSTE) through Intensification of Research in Priority Areas (IRPA) funds much of UPM's multidisciplinary research. For several years the University has received the highest IRPA research allocation.

Under RM-8, an allocation of about RM171 million for research has been approved for UPM. Out of this, RM68.3 million for research under IRPA programme has been approved to support 416 Experimental Applied Research (EAR) projects, RM35 million for 34 Prioritised Research (PR) projects, RM57.6 million for seven Strategic Research (SR) projects, and RM9.9 million

for eight Top Down National Biotechnology projects under National Biotechnology Directorate (NBD).

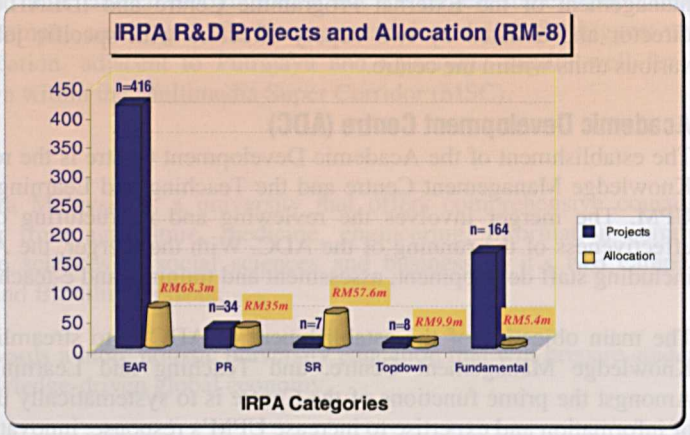


Figure 1.
UPM IRPA Allocation and Number of Projects, RM-8 (2001-2004)[1].

Between 2001 and 2004, UPM also obtained a total of RM5.4m for 164 projects under the fundamental research.

In addition, UPM also garnered about RM24.3 million under International research grants for 21 projects, RM12.9million under other National research grants for 41 projects and RM12.7 million for 107 research projects under consultancies and contract research.

In nutshell, UPM received a total of almost RM225 million under various categories to provide a conducive research environment for cultivating varied talents. See *Appendix 1* for a list of projects by category.

3.2 Research Outputs

The year 2003 saw the emergence of various research outputs. For example, apart from the increase in number of publications in refereed journals and proceedings, research products to be patented also soared from 65 in 2002 to about 100 this year indicative of further enhancing the position of UPM as a centre of R&D in line with it's 6 outlined objectives; to enhance excellence in research and take research effort to new heights.

Our research partnership through commercialization and patenting will bring together our common aspirations, distinctive talents, and ceaseless quest for excellence.

UPM research achievements for 2003 in terms of new findings, research highlights and new achievements are presented in *Section 2* of this book

[1]Values for 1st three years of the 5-year RM-8 period (2001-05).

3.2.1 Publications

Besides promoting research, UPM has emphasised the importance of publishing research findings in international journals. It is noteworthy that between 2003-2004, UPM's scientists have published over 2,827 papers with almost 30% in refereed journals, about 56% of which are in international journals with high citation indices.

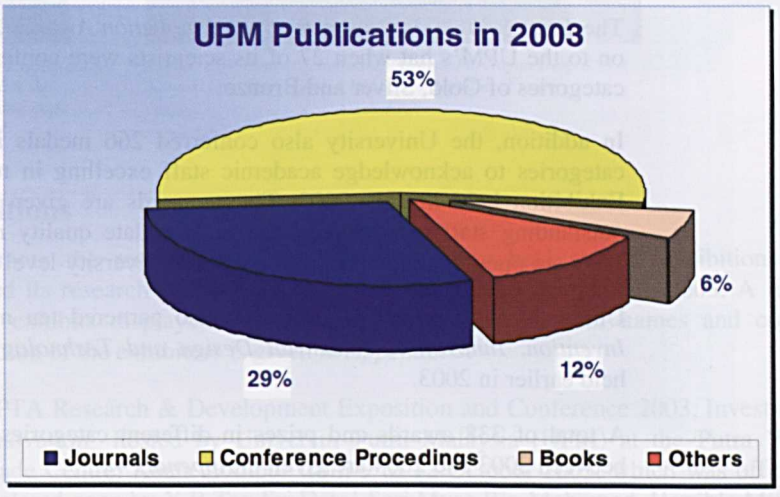


Figure 2.
Research Publications at UPM, 2003-04.

3.2.2 Products and Patents

Under RM-8, the year 2003 saw the emergence of various research out-puts. For example, there was a significant increase from 7 products between 1996 and 2000 to 26 between 2001 and 2004 that were commercialised.

A list of these products is given in *Appendix 2*.

Research products to be patented also soared from 19 in 2000 to about 100 in 2004, and one trade mark indicative of further enhancing the position of UPM as a centre of R&D in line with it's 6 outlined objectives; to enhance excellence in research and take research effort to new heights.

Our research partnership through commercialization and patenting will bring together our common aspirations, distinctive talents, and ceaseless quest for excellence.

Most of the information under this section has been presented in *Part 1* of this book, R&D at UPM: Creating New Frontiers of Innovative Research, First Edition, published by Research Management Centre (RMC), Universiti Putra Malaysia. A list of Patents awarded is presented in *Appendix 3*.

3.2.3 Research Achievements and Awards

It was a proud moment for Universiti Putra Malaysia when 10 of its scientists were conferred 10 medals in different categories at the 32nd International Exhibition of

Inventions, New Techniques and Products held in Geneva from 31 March to 4 April 2004.

Earlier in October 2003, ten UPM scientists were conferred 12 medals and won prizes in different categories at the IPTA Research and Development Exposition 2003 jointly organised by Ministry of Education Malaysia and Public Institutions of Higher Learning and hosted by Universiti Putra Malaysia (UPM) from 9-12 October at PWTC, Kuala Lumpur.

The *Expo S&T 2003 – Invention and Innovation Awards 2003* added another feather on to the UPM's hat when 27 of its scientists were conferred 30 medals in different categories of Gold, Silver and Bronze.

In addition, the University also conferred 266 medals in gold, silver and bronze categories to acknowledge academic staff excelling in research at the UPM R&D Exhibition held in July 2003. These awards are given out annually to recognize outstanding staff achievement and to stimulate quality research in the University. They are open to all faculties, schools and university-level research institutes/centres.

Universiti Putra Malaysia inventors also garnered ten medals at the *International Invention, Innovation, Industrial Design and Technology Exhibition* (ITEX 2003) held earlier in 2003.

A total of 338 awards and prizes in different categories won by UPM's scientists between 2003 and 2004 are given in *Appendix 4*..



Deputy Vice Chancellor (Academic) Prof. Muhamad Awang receiving for UPM the first prize for the Best Booth in the special design category at the IPTA 2003



***UPM's Scientists**—conferred a total of 30 medals comprising 10 Gold, 13 Silver and 7 Bronze at the recently held EXPO S&T 2003Invention and Innovation Awards 2003 held from 7-9 August 2003*



UPM—a pool of talent: our scientists won a total 266 medals comprising 37 Gold, 81 Silver and 148 Bronze at the UPM Invention & Research Exhibition and Awards 2003 held from 8-10 July 2003



A proud moment for our scientists at the I-TEX 2003 Exhibition held from 15-18 May 2003



Besides winning a Gold medal, Professor Ho Yin Wan received Anugerah Ram Rais with RM 1,500.00 cash for the best biotechnology project during I-TEX 2003



From Left: Dr Tan, Prof. Khatijah, Dr. Jamilah and Dr. Raha winners at the I-TEX 2003



International Postgraduate Paper Presentation Award for Nayan Deep S. Kanwal at the International Forum for Urban Landscape Technologies, Lullier, Switzerland



French Government Scholarship Awarded to Nayan Deep S. Kanwal (3rd from right), CIRAD, Montepellier, France

3.2.4 Exhibitions

To promote the research at UPM, the University held several exhibitions and exhibited its research products in the following exhibitions held in 2003. A list of product exhibits displayed at the following exhibitions with names and contact information of the exhibitors is given in *Appendix 5*.

- "IPTA Research & Development Exposition and Conference 2003, Investing in Innovation" hosted by Universiti Putra Malaysia (UPM) at the Putra World Trade Centre, Kuala Lumpur from 9 to 12 October 2003, which was officially declared open by Y.B Tan Sri Dato' Seri Musa Bin Mohamad, Hon'ble Minister of Education, Malaysia.

- "Expo Science & Technology (S&T) 2003 exhibition, Invention and Innovation Awards", a 3-day exhibition held from 7-9th August 2003 held at Putra World Trade Centre (PWTC) Kuala Lumpur, which was officially opened by Y.B. Dato' Hj. Zainal Dahalan, Deputy Minister Science, Technology and Environmental Science.

- "UPM Invention & Research Exhibition and Awards 2003", a 3-day exhibition organised by Research Management Centre, Universiti Putra Malaysia held from 8-10th July 2003 and officially opened by Y.Bhg. Prof. Dato' Dr. Ir. Mohd. Zohadie Bardaie, Vice Chancellor, University Putra Malaysia.

- "14th International Invention, Innovation, Industrial Design and Technology (I-TEX 2003)", a 3-day exhibition organised by Malaysian Invention and Design Society (MINDS) held at Sunway Convention Centre, Malaysia from 16-18 May 2003. The chief guest was Tan Sri Datuk Dr. Augustine S.H. Ong, President, Malaysian Invention and Design Society.

Table 1.

Summary of Awards won in Exhibitions, 2003-04.

No.	Date	Exhibition	Total Exhibits	Awards Won
1.	2004, Mar 31-Apr 4	32nd International Exhibition of Inventions, New Techniques & Products	10	10 Award Winner
2.	2003, Oct 9-12	IPTA Research & Development Exposition	45	12 Award Winner
3.	2003, Aug 7-9	Expo S&T Invention & Innovation Awards	27	30 Award Winner
4.	2003, July 8-10	UPM Invention & Research Exhibition and Awards 2003	470	266 Award Winner
5.	2003, May 16-18	International Invention, Innovation, Industrial Design and Technology Exhibition (ITEX 2003)	20	10 Award Winner



Vice-Chancellor, Dato' Zohadie Bardaie welcomes the Minister of Education, Tan Sri Musa bin Mohamad to the IPTA R&D Exposition 2003 at PWTC, KL on 9 Oct 2003



Dato' Zohadie presents a souvenir to Tan Sri Musa at the opening of the R&D Exposition



Tan Sri Musa accompanied by Dato' Zohadie touring the IPTA exhibits at the main gallery



Deputy Vice-Chancellor (Academic), Professor Muhamad Awang in a lighter mood with a postgraduate researcher Eng.Abdul Hamid at IPTA 2003



Director, RMC Dr. Mohd. Shahwahid explains about Commercialisation of R&D to the minister, Tan Sri Musa while Prof. Shariff looks on during IPTA 2003



Fadzilah Ahmad Din, director, MASTIC shows the MASTIC website to Tan Sri Musa with Prof. Dato' Zohadie at the back



UPM's typical display of exhibits at the EXPO S&T Exhibition



Dr. Mohd. Azmi Lila explains his invention, Novel Polynucelotide Vaccine, NUCLEOCEPTIN™ at the EXPO S&T Exhibition



Dr. Arfah demonstrating her GenerReS Software to the judges at the EXPO S&T 2003Invention and Innovation Awards 2003



***From Left**: Dr. Khanif, Dr. Shahwahid, Vice Chancellor Prof. Dato' Zohadie and Prof. Fatimah at the UPM R&D Exhibition 2003*



***From Left**: Dr. Sidek, Prof. Fatimah, Prof. Ali Hassan with Deputy Vice Chancellor (Academic) Prof. Muhamad Awang at the UPM R&D Exhibition*



Prof. Dato' Zohadie and Dr. Shahwahid with a keen eye on postgraduate research



Dr.Fakhru'l-Razi and his research team comprising postgraduate students from UPM at the I-TEX 2003 held from 15-18 May 2003



Dr.Jalaludin Harun during the I-TEX 2003 Exhibition at Sunway Convention Centre



Dr.Abdul Rahman Ramli with his researchers at the exhibition

4. HUMAN RESOURCE DEVELOPMENT

Building research capacity as well as the identification and nurturing of research potential among young academics is one of the Universities primary goals. UPM actively fosters postgraduate studies and the production of innovative and creative Masters and Doctoral graduates. The government through IRPA and other national and international grants usually commits funds in support of such graduate students.

4.1 Staff Statistics

Currently, there are [2]118 professors, 294 associate professors and 707 lecturers at UPM. About 65% of which are doctorates and 35% comprise masters' qualifications.

Table 2.
Staff Promotions 2003-04

Faculty/Institute/Centre	To Professorships	To Associate Professorships	Total
Agriculture	05	01	06
Computer Science and Information Technology	–	–	–
Design and Architecture	–	–	–
Economics and Management	02	–	02
Educational Studies	03	03	06
Engineering	02	–	02
Food Science and Biotechnology	02	03	05
Forestry	–	01	01
Human Ecology	01	01	02
Medicine and Health Sciences	01	–	01
Modern Languages and Communication	–	01	01
Science and Environmental Studies	04	12	16
Veterinary Medicine	02	05	07
TOTAL	22	27	49

**figures as of April 2004*

4.2 Inaugural Lectures

Among an academic qualification, Ph.D. ranks among the highest. It is a mark of scholarship and academic distinction. Traditionally, on promotion to the rank of professor, an academic is expected to present a public lecture on his/her contributions to science. A total of 74 inaugural lectures of UPM's professors held between 1989-2004 are presented in *Appendix 6*.

4.3 School of Graduate Studies

The Graduate School was formally established on 9 February 1993 and was granted the status equivalent of the Faculty/Centre in UPM. With its establishment, the Graduate School coordinated all postgraduate studies of the university. A central committee headed by the Vice Chancellor, was responsible for the overall activities of postgraduate studies. In November 1982, the committee was upgraded to a Board status.

Effective 1st March 2002, the Graduate School was renamed as School of Graduate Studies. Currently the School of Graduate Studies is managing 8,000 postgraduate students in the university, and hopes to increase the number to 10,000 by the year 2005.

---

[2] *Figures as of April 2004—not including staff on Contract*
Note: On Contract Figures: (Professors=29; Assoc. Prof.=42; Lecturers=54).

4.4 Postgraduate Research

Postgraduate education was introduced initially to train specialists including Scientists, and later professionals. Today postgraduate education is expanding rapidly so much so in certain so-called research universities — the postgraduate enrolment supersedes that of the undergraduates. This trend will continue in the future due to high levels of expertise to manage the knowledge economy. The universities being knowledge repository centres must expand to this challenge by offering more innovative programs at both Masters and Ph.D levels for both categories— traditional and market driven courses.

To foster the spirit of research excellence, UPM has always emphasised on its multi-disciplinary graduate program. More than 50 departments at UPM offer advanced postgraduate education. Besides the Master of Science (MS) and Doctor of Philosophy (PhD) degrees, the university also offers professional degrees such as the Master of Economics, Master of Veterinary Medicine and Master of Business Administration and the Master of Agricultural Science. In 2003, there are about 5,778 postgraduate students enrolled at UPM inclusive of about 868 foreign students from 44 Asian and African countries enrolled for PhD and MS degrees. Of these, 178 are from Indonesia, 81 are enrolled for MS and 97 for PhD followed by 85 from Laos, 69 from Sudan, 60 from Iraq and 59 each from Iran and Yemen.

The first batch of postgraduate students at UPM graduated in 1977. Since then, UPM has conferred postgraduate degrees to about 7,841 students. Of these, there are 7,309 Master degrees, and 532 Ph.Ds for key public or private sector career posts contributing to the progress of the varyingly developed countries of the region.

4.5 Post Doctorates

The government has introduced two new schemes for post doctorates to engage in research to strengthen and forge ahead possible collaborations with the international research community. Under the PASCA scheme, a post doctorate can either be engaged by the MOSTE directly to work for the university or can be employed to undertake research by the university. An applicant for post doctorate must have a Ph.D in a related field from universities recognized by the Malaysian government. The leader of the research project under which the post doctorate would be engaged must have an R&D grant. A post doctorate is usually paid a monthly honorarium between RM2,000 to 4,000.

Currently out of 20 post doctorate applications under MOSTE, 6 have been approved to work for the University. Similarly, out of 9 post doctorate applications under UPM, 7 have been approved.

4.6 National Science Fellowship Scheme

Launched in 1998, The National Science Fellowship (NSF) Scheme is an elite scheme for suitably qualified Malaysian graduates in science, engineering, and technology to pursue post-graduate studies by research at public institutions of higher learning. The main objective of the scheme is to provide training in order to overcome the shortage of researchers in specific priority R&D areas. The R&D areas identified are Advanced Manufacturing Technology, Advanced Materials, Biotechnology, Industrial Pollution Control and Environmental Engineering, Information Technology, Micro-electronics, and Pharmaceuticals. A total of 39 fellowships were offered under the NSF scheme during 2002-03 period.

5. INTERNATIONAL LINKAGES

As UPM heads towards becoming a global knowledge enterprise it gave fresh impetus to its internationalisation drive. Throughout the years, the University lived out its aspiration to be a confluence of local and foreign talents where minds are open and receptive to the richness of cross-cultural exchanges and perspectives. Global benchmarking was the definitive standard as the University took on the challenge of becoming a global player. The University carried out a full program of international engagements covering international outreach, forging win-win strategic alliances and active participation in international academic networks.

Several regional and international links with R&D agencies have facilitated multi-disciplinary, collaborative research as well as greater opportunities for postgraduate and staff training.

5.1 Memoranda of Understanding (MOU)

Propelled by the University's increasing internationalisation, UPM stepped up its ties with members of international academe. During 2003-04 period, it signed a total of 6 Memorandum of Understanding (MOUs) with international universities and agencies that will intensify its academic and research collaboration with its peers abroad. At the same time, UPM also signed Memorandum of Understanding/Agreement (MOUs/MOAs) with 10 national agencies for the same period.

An impressive list of about 132 MOUs signed between UPM and international institutions/ agencies, and 160 MOUs/MOAs signed between UPM and national agencies as of March 2004 is presented in *Appendix 7.*

6. CONCLUDING REMARKS

In this increasingly globalized era, universities are constantly challenged to reflect on and reinvent their educational and research approaches. To stay relevant, universities must rise to this challenge and work in partnership with industries. Universities have the responsibility to provide a stimulating and quality environment for their scientists to develop their capabilities and to hone their competitive advantage for a life of careers in a fast-changing world.

The synergies arising from the multi facet research being conducted at UPM will energize current activities towards new patents and products as well as spur further breakthroughs and innovation in the field and help our scientists to continue to flourish as well as contribute to processes and products that will improve the quality of our lives. Each scientist's contribution towards R&D is an inspiration to us all. Together, we share the responsibility to move this university forward. With vigor, imagination and an enterprising spirit, we strive towards building a world-class university. Knowledge is like a garden...and its bounty is yours.

The university may have a long way to go before reaching this target, but the first step has certainly been taken.

Section 2

RESEARCH The creation of new knowledge is vital in the global knowledge enterprise. UPM recognizes the creative process has become even more critical in the new knowledge-based economy where innovation is a driver of growth.

5. INTERNATIONAL LINKAGES

As UPM [illegible] a global knowledge enterprise it gave fresh impetus to [illegible] the years, the University lived out its aspiration to [illegible] whose minds are open and receptive to the richness of [illegible]. Global benchmarking was the definitive standard as the University [illegible] of becoming a global player. The University carried out a full program of [illegible] covering international outreach, forging win-win [illegible] alliances and active [illegible] in international academic networks.

Several regional and international links with R&D agencies have facilitated multi-disciplinary collaborative research as well as greater opportunities for postgraduate and staff training.

5.1 Memoranda of Understanding (MOU)

Propelled by the University's [illegible] internationalisation, UPM stepped up its ties with members of international academic. During 2003-04 period, it signed a total of 6 Memorandum of Understanding (MOUs) with international universities and agencies that will intensify its academic and research collaboration with its peers abroad. At the same time, UPM also signed [illegible] of Understanding Agreement (MOUs/MOAs) with 10 national agencies for the same period.

An impressive list of about 132 MOUs signed between UPM and international institutions/ agencies, and 160 MOUs/MOAs signed between UPM and national agencies as of March 2004 [illegible]

6. CONCLUDING REMARKS

In this increasingly globalized era, universities are constantly challenged to reflect on and reinvent their educational and research approaches. To stay relevant, universities must rise to this challenge and work in partnership with industries. Universities have the responsibility to provide a stimulating and quality environment for their scientists to develop their capabilities and to hone their competitive advantage for a life of careers in a fast-changing world.

The synergies arising from the multi facet research being conducted at UPM will energize current activities towards new patents and products as well as spur further breakthroughs and innovation in the field and help our scientists to continue to flourish as well as contribute to processes and products that will improve the quality of our lives. Each scientist's contribution towards R&D is an inspiration to us all. Together, we share the responsibility to move this university forward. With vigor, imagination and an enterprising spirit, we strive towards building a world-class university. Knowledge is like a garden...and its bounty is yours.

The university may have a long way to go before reaching this target, but the first step has certainly been taken.

Section 2

New*findings*, Research*highlights*, New*achievements*

Contents

Research Clusters

Agriculture, Food and Forestry	19-107
Bioscience and Biotechnology	109-209
Health and Allied Sciences	211-278
Information Technology and Mathematics	279-336
Materials, Energy and Environment	337-361
Science and Engineering	363-434
Social Sciences and Humanities	435-465

**The contents of this section have been compiled from information submitted by researchers and/or their postgraduate students. While every effort has been made to ensure that the contents are correct, the publishers are unable to accept any liability for any error or omission that may occur.*

Section 2

Contents

Research Clusters

Agriculture, Food and Forestry 19-107

Bioscience and Biotechnology 109-209

Health and Allied Sciences 211-278

Information Technology and Mathematics 279-336

Materials, Energy and Environment 337-361

Science and Engineering 363-434

Social Sciences and Humanities 435-465

The contents of this section have been compiled from information submitted by researchers and/or their postgraduate students. While every effort has been made to ensure that the contents are correct, the publishers are unable to accept any liability for any error or omission that may occur.



Agriculture, Food and Forestry

Agriculture, Food and Forestry

Contents

Agriculture, Food and Forestry

Flower Development of 'Cempedak' 25
A.G. Yunus, Z. Wahab and A.R. Razak

Metarhizium Anisopliae (Deuteromycetes) for Managing Subterranean Termite, *Coptotermes Curvignathus* (Isoptera: Rhinotermitidae) 28
Ahmad Said Sajap, Norazlin Sapuan, Yaacob Abd.Wahab and Halimah Hussin

Optimization of RAPD-PCR Technique on the Identification of Wild Malaysian Giant Prawn, (Macrobrachium rosenbergii de MAN) 29
Aizam, Z. A., M. R. Joseph, I. Patimah and M. Rozihan

Willingness of Local Tourists to Pay for Conservation of Tourism Spots in the Damai District Sarawak 32
Alias Radam, Shazali Abu Mansor, Abas Said and Afizah Merican

Seagrass Fauna:Biodiversity and Ecological Roles 35
Aziz Arshad, Japar Sidik Bujang and Muta Harah Zakaria

Effect of Different Zeolite Concentrations on Survival and Growth of Silver Barb *Barbodes gonionotus* (Bleeker) Larvae and its Role on Water Quality 36
C. R. Saad, A. R. Alimon. and L. Asgari

A Preliminary Study on Exfoliative Vaginal Cytology in Captive Sumatran Rhinoceros (*Dicerorhinus sumatrensis*) 37
Choong Siew Shean, Rosnina Y, Zainal-Zahari Z, and Abd. Wahid H,

Development of Controlled-release Formulation of Herbicide 38
Dzulkefly Kuang Abdullah

Use of Rapid Enzymatic Methods for Monitoring Quality of Seafood Products 39
F. Abu Bakar, C.N.A. Razak, A.B. Salleh and M. Basri

Use of Beneficial Bacteria to Increase Shrimp Production 40
Fatimah Md.Yusoff, M. Shariff T.N Devaraja, Sanjoy Banerjee and Hazel Matias

Barn Owl as Biological Control Agent of Rats in Rice Field 42
Hafidzi Mohd Noor

An Integrated Management for the Control of Bacterial Wilt of Tomato 43
Hiryati binti Abdullah, Mohd. Ghazali Mohayidin, Azizah Hashim and Lee Kam Loong

Value Addition to Pineapple Leaves Residue: I. Extraction of Humic Acid 44
Husni, M.H.A. and O.H. Ahmed.

Amelioration of Soil Acidity in an Acid Sulphate Soil Using Organic Materials 45
J. Shamshuddin, S. Muhrizal, M.H.A. Husni and I. Fauziah

Sheep Farm – a User-Friendly Database Management System for a Small Farm 46
J.M. Panandam

The Enhancement of Stability and Quality Characteristics of 'Keropok Lekor' by the Incorporation of Hydrocolloids 48
Jamilah Bakar, Kyaw Zay-Ya, Russly Abdul- Rahman and Gulam Rusul Rahmat-Ali

The Habit of Malaysian Seagrasses, their Flowers and Fruits 50
Japar Sidik Bujang, Muta Harah Zakaria and Aziz Arshad

Integration of Acoustic and Video Data for Coral Reef Mapping 51
Jefri M.S, Ibrahim H. M, Shattri M, Japar S.B and Yip K.M

Improvement of Flavour Quality of Under-Fermented Cocoa Beans through an Optimaization of Polyphenol 53
Jinap Selamat and Misnawi

Improvement of Cocoa Specific Aroma Precursors of Under-Fermented Cocoa Beans with Carboxypeptidases Addition 55
Jinap Selamat, Yusep Ikrawan, Jamilah Bakar and Nazamid Saari

Mapping Waste Distribution in Intensive Pig Production Areas Using GIS 56
Liang, J.B., Tee, T.P., E.S. Chew, Z.A. Jelan, T.C. Loh and P. Loganathan

Nutritional and Immuno-regulatory Approaches in Abating Bovine Mastitis 58
M.M. Noordin

Somatic Embryogenesis of *Musa acuminata* cv. Mas (AA) 60
Maheran Abd Aziz, Md Humayun Kabir, Mihdzar Abd Kadir and Azmi Abd Rashid

The Effects of Electromagnetic Forces (EMF) on Plants 61
Mahmud Tengku Muda Mohamed

The Use of Chitosan in Extending the Vase Life of Cut Chrysanthemum and in vitro Effect on Colletotrichum gloeosporioides, The Causal Agent of Anthracnose Disease of Papaya 63
Mahmud Tengku Muda Mohamed, Kamaruzaman Sijam, Mohd. Zaki Abd. Rahman, Siti Hajar Ahmad, Eddy Azian and Asgar Ali

Establishment of Regeneration System through Callus Formation for in vitro Selection of Pineapple (*Ananas comosus* L. Merr) 64
Mihdzar Abdul Kadir, Maheran Abdul Aziz, Halimah Saimi, Azmi Abdul Rashid and Mohd. Said Saad

Immediate Effects of Selective Logging on the Feeding Guild of the Understorey Insectivorous Bird Species 65
Mohamed Zakaria Hussin

The Competitiveness of Food Processing Industry in Malaysia 67
Mohd Mansor Ismail and Alias Radam

Effects of Legume Inclusion in Grass-Based Silages 68
Mohd Ridzwan Abd Halim

Production of Soil Amendment from Sewage Sludge by Composting Process 69
Mokhtaruddin, A.M, Fazrul Edlin Saleh, Syed Omar Syed Rastan and Halimi Mohd. Saud

Production of Tropical Fruit Powders Using Spray Drying and Agglomeration Technology 71
Nazimah Sheikh Abdul Hamid, Quek Siew Young, Gulam Rusul Rahmat Ali, Russly Abdul Rahman and Dzulkiflee Mat Hashim

Development of Dimensionally Stable Multilayered Oriented Strand Board from Plantation Species by Phenolic Resin Impregnation 72
Paridah Md. Tahir

Cell Structures of the Peel of Mature Green Banana Musa AAA 'Berangan' 74
Phebe Ding, Siti Hajar Ahmad and Abdul Rahman Abdul Razak

Utilization of Rhizobacteria for Increased Growth of Sweetpotato 77
Radziah Othman and Zulkifli H. Shamsuddin

Selection of Sheep Resistant to Worms 78
Rehana Abdullah Sani and Jothi Panandam

The Role of Metabolic Enzymes in the Development of Resistance in Cocoa Mirid, *Helopeltis Theivora* Waterhouse 79
Rita Muhamad Awang, Dzolkhifli Omar and Tan Soon Guan

Recycling of Crop Residues for Sustainable Crop Production in Maize-Groundnut Rotation System 80
Rosenani Abu Bakar, A.R. Mubarak and Siti Zauyah

Crop Management Practice Affecting Methane Emission on Flooded Rice—The Effect on Four Major Rice Cultivars Planted on Irrigated Paddy Fields in Central Java, Indonesia 81
Rosenani Abu Bakar, Prihasto Setyanto, Khanif Jusop, Che Fauziah Ishak and Rizaldi Boer

The Epidemiology and Pathogenesis of Ovine Footrot in Malaysia 82
S. Jasni, K. Al-Jashamy, A. R. Mutalib, M. L. Mohd. Azmi, Z. Zakaria, S. Z. Ramanoon and A. R. Sheikh-Omar

Roselle and its Benefits 83
Salmah Yusof, Tee Pau Ling and Suhaila Mohamed

Development of Biopesticide for the Control of Soil-Borne Disease 84
Sariah Meon

Tropical Fish Forecasting System (TroFFS) 86
Shattri B. Manor, Lawal Billa, Mohd. Ibrahim Hj. Mohd, Tan Chun Knee, Ahmed Rodzi, Abdul Rashid Mohd. Shariff and Ahmed Kamel Bin Abdul Ghani

Growth and Development of Lowland Chrysanthemums in Relation to Nitrogen Uptake at Different Physiological Stages 88
Siti Aishah H, A.M. Asiah, M.F. Ramlan andT.M.M. Mahmud

Characterization of Banana Cultivars using Molecular markers 89
Siti Khalijah, D. , Nor 'Aini, M. F. and Nor Salina, M.Z.

Health Benefits of Malaysian Edible Plants 90
Suhaila Mohamed, Mohamed Noordin Mustapha, Azmi Lila, Azizah Hamid, Tong Chow Chin, Noor Aini Umar, Razali Muse, Mahinda Abeywardena, Irine Runnie, Paul Roach and Richard Head

Intercropping of Banana and Pineapple in Rubber Smallholding and its Effect on Soil Sustainability on Sloping Land 92
T, Jamal, Adrinal, W.H. Wan Sulaiman and M.F. Ramlan

Manipulation of Very Low Density Lipoprotein Metabolism to Reduce Fat Deposition in Poultry 93
T.C.Loh

Effect of Rootzone Temperature in Aeroponic System for Tulip Production 94
Thohirah Lee Abdullah, Johari Endan, Flora Chin Lee Sa and Lee Cheng Yee

Paclobutrazol: A Potential Retardant for Improved Lodging Resistance in Rice (*Oryza Sativa* L.) 96
Uma Rani Sinniah, Sri Wahyuni, Mohd Khanif Yusof and Rajan Amarthalingam

Robotic and Automation in Agriculture 98
Wan Ishak Wan Ismail, Muhamad Saufi Mohd Kassim and Mohd Hudzari Bin Razali

The Development of Copper Coated Urea Fertilizers for Rice Production 99
Y.M. Khanif and K.L.Tai

Entomopathogenic Fungal Formulations of Mycoinsecticides 100
Yusof Bin Ibrahim

The Search for Appropriate Urea Fertilizer Formulations for Oil Palm at the Main Nursery Stage 102
Zaharah A. Rahman and Abdul Rahman Bah

Available P Dynamics in a Tropical Soil Amended with Natural Organic and Inorganic Fertilizers 103
Zaharah A. Rahman and Abdul Rahman Bah

Isolation and Characterization of Listeria monocytogenes and Other Listeria species from Raw Foods 104
Zaiton Hassan, Gulam Rusul Rahmat Ali, Son Radu, Abdul Reezal Abdul Latif, Endang Purwati, Mohd Nizam Lani, Siti Zulaiha Hanapi, Yousr Abdullah Noaman and Samuel Lihan

Production of Bacterial Inoculants as Biofertiliser and Bioenhance 106
Zulkifli Hj. Shamsuddin and Premalatha Pakirisamy

Flower Development of 'Cempedak'

A.G. Yunus, Z. Wahab and A.R. Razak

The 'cempedak', *Artocarpus integer* Merr. belongs to the family Moraceae and was originated from South-east Asia (Barrau, 1976). It is closely related to jackfruit, *A. heterophyllus* Lam. and both are widely cultivated but very little information is available about the floral biology of 'cempedak'. Corner (1988) described the 'cempedak' flower head as finger-shape and both male and female heads are on the same tree. After flowering, the male heads drop but the female persist and enlarge into the fruit heads.

This paper details the development of the flower as observed under Hi-Scope KH 2700 3D light video microscope system and Joel 6400 Scanning Electron Microscope (SEM). The structural changes of the flower will help in the understanding of the floral biology of the species.

The inflorescences develop inside the elongated dome-shaped bract, which splits open when mature and exposing a successions of 2-3 smaller bracts. Initial floral development is indicated by the formation of rounded protuberances on the surface of the inflorescence. Further development between the male and female flowers differs.

The smallest male inflorescence observed was about 600 um long (Fig. 1A) with apparently smooth surface. As the flower matures, the surface of the inflorescence axis developed into a round protuberance, which later differentiated into a depression, which surround the pointed middle part (Fig. 1B). The edges forms two parts and develop into the perianth, which encloses the middle part that becomes the stamen. At maturity the perianth split open longitudinally across the central region into halves, exposing the anther (Fig. 1C). The perianth is covered by trichomes with stomata interspersed on the surface of the perianth among the trichomes. Each stamen consists of bilobed anther borne on short, stout filament (Fig. 1D). The anther wall is made up of a thick fibrous layer, endothecium (Fig. 1E), suggesting the explosive release of the pollen grains. Each pollen grain is covered by short outgrowth with a round depression (Fig. 1F), indicating the pore for the emergence of pollen tube at pollination.

The initial female flower is similar to that of the male in appearance. When the inflorescence is about 1.2 cm long (Fig.2A) the flower forms elliptical opening at the terminus (Fig.2B), through which the stigma protrudes. At about 8 cm long the perianth opening encloses the base of the stigma (Fig. 2C and 2D, inset). The ovary is located at the base of the perianth, and connected to the stigma by a long style, surrounded by a thick fleshy perianth (Fig. 2D). The surface of the stigma is formed by club-like protuberances arranged at an acute angle to the long axis of the stigma (Fig. 2E). Apparently, the ovary wall develops into a thin papery tissue, covering the ovule (Fig. 2F), which develops into a large seed after successful fertilization. The perianth subsequently developed into the fleshy edible part of the fruit. The aborted flower developed into elongated fleshy fibers interspersed among the developing fruits.

The morphological structure of the flowers, both male and female of 'cempedak' inflorescences suggests that pollination is achieved mainly by wind pollination. Proliferation of flowers on the inflorescence, the abundance and rough surface of the pollen grain in the anther and the explosive nature of the anther wall suggest that 'cempedak' fruit can be formed through wind pollination. The presence of insect possibly improves pollination resulting in a uniform fruit formation.

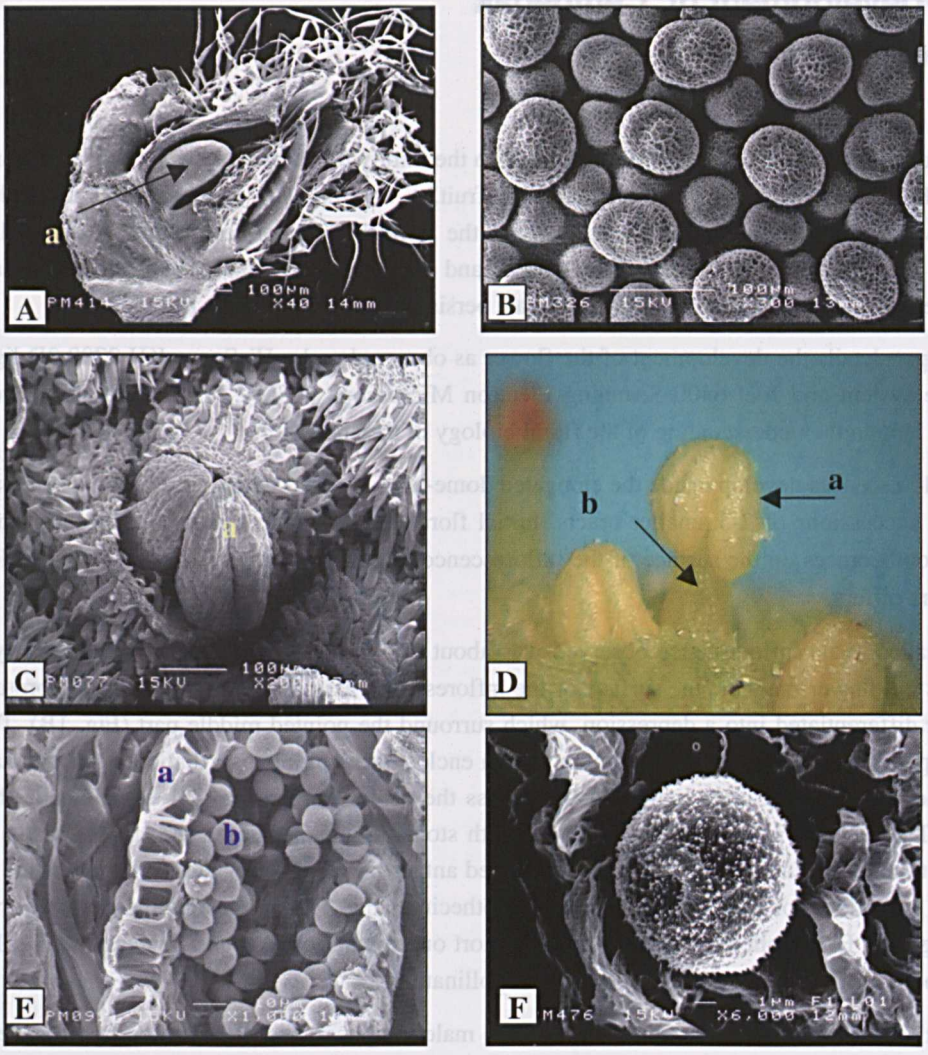


Figure 1. Male Flower

- *A. The youngest male inflorescence (a) enclosed in bract (x40).*
- *B. Surface of older male inflorescence forms protuberances (x300).*
- *C. Anther (a) emerges from the split perianth (b) (x200).*
- *D. Anther (a) on the filament (b) (x200).*
- *E. Cross-section of the anther showing anther wall (a) and pollen grains (b) (x1000).*
- *F. Pollen grain with pore (a) where the pollen tube emerges (x6,000).*

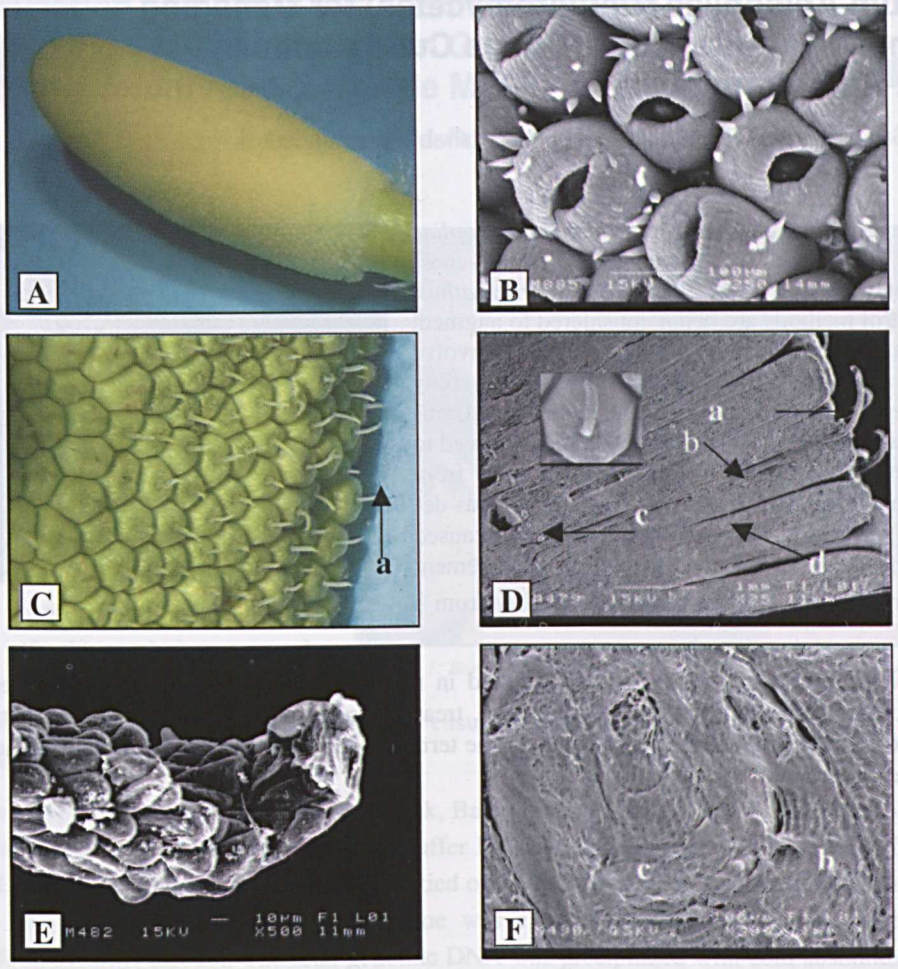


Figure 2. Female Flower

- *A. Young female inflorescence removed from bract (x6).*
- *B. Enlargement of the surface of (A) showing early stage of development (x250).*
- *C. The flower with stigma (a) ready for pollination (x10).*
- *D. Cross-section of the flower showing the stigma (a), style (b) and ovary (c) which is at the base of the perianth (d) (x25). The stigma protrudes from the surface of the perianth (inset, x100).*
- *E. The surface of the stigma is formed from club-shaped structures (x500).*
- *F. The perianth (a) enclosed the ovary (b) which contains the ovule (c) (x300).*

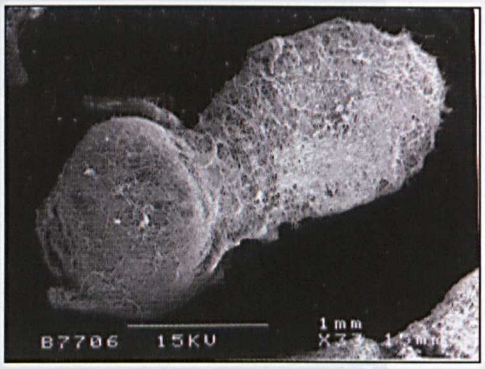
Reader Enquiry
Department of Crop Sciences
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7260
E-mail: agy@agri.upm.edu.my

Metarhizium Anisopliae (Deuteromycetes) for Managing Subterranean Termite, Coptotermes Curvignathus (Isoptera: Rhinotermitidae)



Ahmad Said Sajap, Norazlin Sapuan, Yaacob Abd.Wahab, Halimah Hussin



Strains of the entomopathogens *Metarhizium anisopliae* were isolated from soils and screened for effectiveness against the subterranean termite, *Coptotermes curvignathus*. Biological control methods are being considered to augment current integrated pest management schemes that involve chemical baits and non-repellent termiticides. In this study subterranean termites were exposed in the laboratory strains of *M. anisopliae*. The exposed termites were then allowed to mingle with an equal number of unexposed termites from the same nest and mortality of the combined group was determined. One week after exposure, the fungus had caused significant mortality to the termites. The LT_{50} measurement for the strains ranged from 3 to and 100% mortality from 3 to 7 days.

Exposure of termites to all fungal strains resulted in mortality in excess of that seen in the control groups of unexposed termites. Field trials, using trap, treat and release technique, conducted at two sites show that the selected fungal strains could suppress the termite population. Feeding activities ceased about two months after treatment.

Reader Enquiry
Faculty of Forestry
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7161
E-mail: ahsaid@putra.upm.edu.my

Optimization of RAPD-PCR Technique on the Identification of Wild Malaysian Giant Prawn, (*Macrobrachium rosenbergii* de MAN)



Aizam, Z. A., M. R. Joseph, I. Patimah and M. Rozihan



Figure 1: Berried prawns with eggs at different stages of maturity

Random Amplified Polymorphic DNA (RAPD) analysis appears to be a simple and fast method of measuring genetic variability, which allows detection of polymorhisms in closely related organism, provides a powerful tool for gene mapping, marker-assisted selection in breeding program and pedigree analysis phylogenetic studies of individual and strain identification. Thus, application of the technique can be troublesome and time consuming without the optimization of the PCR that is to ensure the consistency, reproducibility and amplify true genetic variations.

The samples were taken from Sungai Perak, Batu Gajah, Perak, Malaysia. The *Macrobrachium rosenbergii* tissues were preserved in non-frozen buffer DMSO-NaCl (Probestel et al., 1993). The DNA extraction, PCR and electrophoresis works were carried out at the Toxicology Laboratory of Biomedical Faculty, UPM. The *Macrobrachium rosenbergii* tissue was extracted using the standard methods of phenol-chloroform-isoamyl alcohol. The total genomic DNA was precipitated with cold absolute ethanol and suspended in 100 µl of T.E buffer. Purity of the genomic DNA was quantified using UV Spectrophotometer (UV-VIS Kontron).

The PCR amplification was performed in 25 µl of PCR reaction using a reproducible 10 bp of oligonucleotides and amplified following the PCR program (pre-denaturation: 94.0 °C, 05 m', 00 s'; denaturation: 94.0 ° C, 00 m', 30 s'; annealing: 36.0 ° C, 00 m', 30 s'; extension: 72.0 ° C, 03 m', 00 s'; final extension: 72.0 ° C, 02 m', 00 s'). The optimization of PCR reagents was designed as follows: 25 mM $MgCl_2$ (0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5 and 4.0 mM), 1 X PCR buffer $(NH_4)_2$, SO_4 (0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0 µl), 10 mM dNTPs (0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 mM), 5 pmoles primer (2.5, 5.0, 7.5, 10.0, 12.5, and 15.0 pmoles), 20 ng template DNA (5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100 ng), 5.0 U taq polymerase (0.1, 0.2, 0.3, 0.4, 0.5, and 0.6 unit). The optimization of the PCR program was done only on the annealing temperature (35 ° C, 36 ° C and 37 ° C) and cycles numbers (35, 44 and 45 cycles).

The PCR products were separated horizontally in 1.7% of agarose gel at 55V for 2-3 hours and measured with 100 bp plus of DNA ladder. The gel was stained with 0.5 µg/ml ethidium bromides staining (Maniatis et al., 1982) and viewed under Image Master VDS (Pharmacia Biotech). Only reproducible, consistent and clear amplified products were selected for further RAPD analysis.

Results of the PCR optimization showed that the RAPD fragments yielded were vary in concentrations and program used, where the magnesium chloride ($MgCl_2$) optimization at optimum concentration at 3.5 mM. However this concentration was higher than those recommended ratios (1.5 mM at 200 mM of dNTPs concentration) to influence the enzyme activity, increase the T_m of double stranded DNA and form soluble complexes with dNTPs for producing the actual substrate that recognized by the taq polymerase. The optimization of the 1 X PCR buffer $(NH_4)_2SO_4$ indicated only slightly different and able to work well at the optimal range of 2.0 µl. Similarly, the ranges of dNTPs also demonstrated a slight different of the PCR products but produced specific bands at 0.3 mM.

The polymorphisms of the genomic DNA were detected at maximum concentration of 10.0 pmoles of primer. At lower concentrations the primer produced less amount of RAPD bands while at higher concentration, formed more smeared RAPD bands due to the accumulation of primer dimmer. The series of optimized concentrations of total genomic DNA showed that the amplifications have produced visible RAPD bands at 40 ng which, was not differ than those concentrations amplified on *Penaeus monodon*, (20 ng- Garcia and Benzie, 1995; 50 ng- Tassanakajon et al., 1998). The maximum concentration of taqs DNA polymerase was at 1.0 unit, in range of the concentration applying for most assays. Effect of the optimised

PCR program for the annealing temperature and cycles number showed that the pattern of RAPD fragments obtained were reproducible and constant with specific bands (450 to 1100 base pair) at 36 °C and 45 cycles. Those combinations of PCR program were equal with that concentration used in RAPD analysis of *P. monodon* species (Tassanakajon et al., 1998). Basically, at low temperature (35 °C), the PCR products produced were invisible and less in amount while at high temperature (37 °C), the possibility of causing limited activity of annealing occurred.

It was concluded that the final concentration of the PCR reagents (3.5 mM of $MgCl_2$, 2.0 µl of 1 X PCR buffer $(NH_4)_2SO_4$, 0.3 mM of dNTPs, 10.0 pmoles of primer, 40 ng of genomic DNA and 1.0 unit of taqs DNA polymerase.and annealing temperature at 36 ° C and 45 of number of cycles) were able to amplify reproducible, constant and specific RAPD bands and therefore will be applied for RAPD identification of *Macrobrachium rosenbergii*.

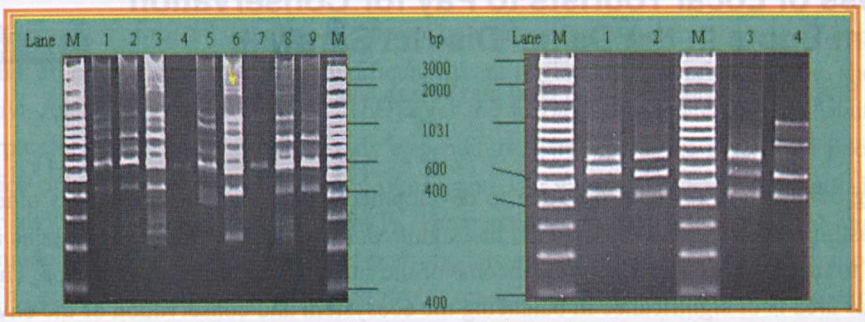


Figure 2: Effects of annealing temperature and number of cycles. 35°C at 35, 40 and 45 (Lane 1, 2 and 3), 36°C at 35, 40 and 45 (Lane 4,5 and 6) and 37°C at 35, 40 and 45 (Lane 7, 8 and 9) in RAPD-PCR analysis of M. rosenbergii and Gene-Ruler (M) (100bp DNA Ladder Plus).

Figure 3: The final concentration of the PCR condition employed in RAPD-PCR analysis of four wild M.rosenbergii (Lane 1, 2, 3 and 4) and Gene Ruler (M)(100 bp DNA Ladder Plus)(Lane 1 and 4)

Reader Enquiry
Department of Agriculture Technology
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7467
E-mail: aizam@putra.upm.edu.my

Willingness of Local Tourists to Pay for Conservation of Tourism Spots in the Damai District Sarawak



Alias Radam, Shazali Abu Mansor, Abas Said and Afizah Merican

The increasing competition for land use, due to development at Damai beaches and its other wilderness within the coastline of Santubong in Sarawak, has significantly agitated wildlife ecosystems and contaminated beaches to the extent of decreasing the income of the surrounding indigenous groups. Thus the ability to conserve this area is of significance in balancing the ecosystem and conservation of the environment for future generations. The objective of this paper is to determine visitor's satisfaction levels through their willingness to pay for the conservation of the Damai Resort district. This study utilizes CVM (Contingent Valuation Method) to measure willingness to pay.

CVM has been widely used to calculate willingness to pay by individuals for products or services obtained. Among other studies using the method are Rendall *et al.* (1974), Bishop and Heberlein (1979), Bishop *et al.* (1983), Seller *et al.* (1986), Cameron and James (1987), Bowker and Stoll (1988), Cameron (1988), McConnel (1990), Balderas and Laarman (1990), Donaldson *et al.* (1997), Rollins (1997), Ryan (1997), Willis and Powe (1998), Hayes and Hayes (1999), Carlson and Johansson-Stenman (2000), Shackly and Dixon (2000), Loomis *et. al.,* (2000), and Scarpa (2000).

In the study undertaken, the Damai Recreational Site was used as a product attribute. The dichotomous choice survey asked respondents if they would pay a certain amount of the price to use the facilities as they are. This particular question format is called a dichotomous choice, since the respondents simply answer "YES" or "NO" at the specified price given. The maximum WTP for the recreational site is not directly observed in the dichotomous choice approach but it can be calculated from the responses. Hanemann (1984) viewed CVM respondents using a utility difference approach when he decided whether to answer, "YES" or "NO" at the price increase. If the utility difference is logistically distributed, a logit model of the probability of YES response is related to the respondent's price as;

$$P = (1 - e^{-x})^{-1} \qquad (1)$$

where x is the estimated regression, 1 is the logit regression equation and P is the probability of accepting the price. The mean WTP is estimated as the area under this probability function. This area shows the proportion of the population who would consume the good at each price level, and their associated utility. The area under the curve is estimated by integration techniques and can be expressed as;

$$E(WTP) = \int_{L}^{U} (1 + e^{\alpha+\beta PRICE})^{-1} \, dPRICE \qquad (2)$$

where, E(WTP) is the probability of saying "YES" and U and L the upper and lower limits of the integration respectively.

The initial estimation of the model using all the socio-economics characteristics as an independent variables reveals that all other variables were insignificant except for income and price. Income shows a ignificant and positive relationship towards WTP. The larger the income, the greater the contribution to one's WTP, as a surplus of family income over family expenditure. The results are given in Table 1. The chi-squared statistics shows that the model is highly significant. The value of McFadden's psudo-R2 is 0.1304 and 0.1286 for logit and probit models respectively. The percent of right prediction is 73.13 and 73.13 per cent for both models. The price and income in both models are significant at five and one percent level, respectively. The results also show the logit and probit models differ slightly in terms of summary statistics. This corresponds with prior work in which neither model dominated the other empirically in the binary dependent variable case (Bowker and Stoll, 1988).

Table 1
Parameter Estimates for CVM

Variables	Logit Model	Probit Model
Intercept	0.1927 (0.424)	0.1262 (0.451)
Price	-0.0694(-4.230)[a]	-0.4122(-4.335)[a]
Income	0.000597(2.420)[b]	0.000345(2.443)[b]
Log-likelihood	-93.2765	-93.3728
McFadden R2	0.1304	0.1286
$\chi 2$	27.9737	27.5862
% Ringgit prediction	73.13	73.13

Note: Figure in parentheses are t-statistics
[a] Significant at 1% level
[b] Significant at 5% level

The calculated mean and median values for WTP are listed in Table 2. The WTP mean is RM11.70 for probit and RM15.11 for logit model. The medians are RMll.40 to RM11.90 for logit and probit respectively. It is shown that the mean WTP is higher than the median and this is consistent with the finding by Hanemann (1984). The median value is preferred to the mean as it measures one's welfare (Bowker and Stoll, 1988). This is due to the sensitivity of mean towards slight changes in the shape of decision distribution from different methods or outliners in the data, while the median is relatively robust. As WTP obtained from the logit model is a more reliable measure, the value of RM11.90 can be taken as the conservative WTP for the preservation of the Damai area.

Table 2
Mean and Median Estimation of WTP for Damai Preservation

Function	Mean WTP	Median WTP
Logit	RM15.11	RM11.90
Probit	RM11.71	RM11.40

The Damai district consists of various beautiful and nature based recreational sites. It has become one of the finest attractions in Sarawak and the pride of the state for many years. This area needs protection from many types of harmful activities and modernization.

As discussed, RM11.90 is the median WTP value. At present most of the tourist spots charge an entrance fee of between RM5 to RM10. The amount could be collected by dividing the whole Damai resort into specific areas (e.g. beach, mangrove swamp, mountain range, etc.). The current environmental condition in Damai is still pristine and undefiled (the mangrove swamps, beaches, and mountain treks), as it has yet to be fully developed into a tourist attraction. As such, each individual area of interest could be developed accordingly with the level of WTP as indicated in this study.

If the authorities were to collect this fund, they could preserve and protect Damai while also improving public facilities such as toilets, pedestrian path, signboards, rubbish bins etc. In addition, the fund could be used to educate the public on the importance of preserving the environment. Indirectly, through such efforts, the relationship of one's satisfaction derived from their visit to Damai will more or less determine their WTP to preserve the areas. The responsibility of protecting and preserving nature resources and its wildlife such as Damai, does not solely rest with the authority, it involves strategic co-operation between the authority and the public. By charging a small fee to the area, the problems associated with managing the public good could be minimized.

Reader Enquiry
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7775
E-mail: alias@eco.upm.edu.my

Seagrass Fauna: Biodiversity and Ecological Roles

Aziz Arshad, Japar Sidik Bujang and Muta Harah Zakaria

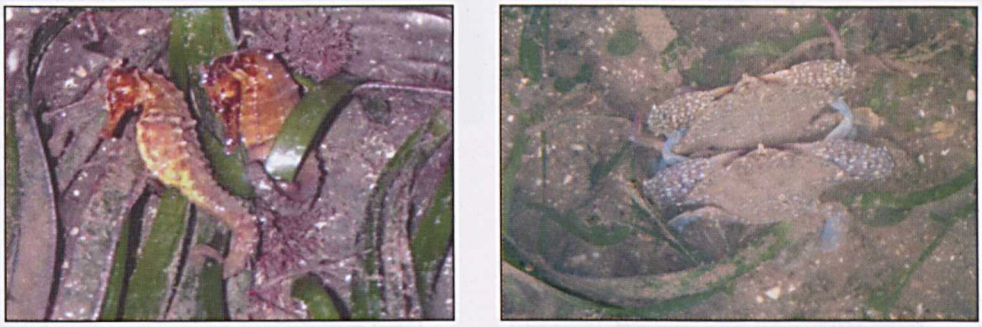
Award Winner

A project is designed to investigate and study the biodiversity and ecological importance of seagrass fauna in the Peninsular Malaysia. Seagrass is one of the important aquatic ecosystems that have been recognized as the center of biodiversity for marine organisms and are also habitats for large numbers of marine fishes and invertebrates. Unfortunately, many of these species are threatened with extinction because of the lacking in knowledge on its ecological function and mainly also due to the less conservation efforts and recognition been put on seagrass habitats.

Much of the lost of seagrass habitat has been for short-term economic gain, which is now affecting important small-scale fishermen and declining in catches and abundance. The major threats to seagrass ecosystem include sedimentation, sand mining, conversion for port development and pollution (oil, refuse and effluent).

Properly managed seagrass habitats can provide long-term and direct economic benefits as well as maintaining habitat for the high biodiversity. Sustainable industries would include small boat-sized fishermen, better survival rate for fisheries recruitment, ideal for eco-tourism and good for the regulated production of chemical and medicinal products. In addition, seagrass habitats are well known to support inshore fisheries (nursery grounds for fish, shrimps and crabs), education and scientific tool in resource management and genetic resource and biodiversity.

Malaysian seagrass habitats are highly productive ecosystem, with at least 150 species of fish, 32 species of plants, 55 species of shrimps and 10 species of birds and mammals. Besides, there are also numerous numbers of unidentified species found inhabiting seagrass areas. Seagrass habitats compare well with coral reefs and mangroves as centers for biodiversity and important gene pools.



Many dwellers of commercial importance (e.g. seahorse-Hippocompus kuda; crabs-Portunas pelagicus) adopted seagrass areas as their breeding ground due to maximum protection and abundant of food.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6613
E-mail: azizar@fsas.upm.edu.my

Effect of Different Zeolite Concentrations on Survival and Growth of Silver Barb *Barbodes gonionotus* (Bleeker) Larvae and its Role on Water Quality



C. R. Saad, A. R. Alimon. L. Asgari

Intensive marine and brackish water shrimp farms commonly use large quantities of zeolites in ponds with the aim of removing ammonia through ion exchange, providing physical cover over sediments to prevent leaching of metabolites into the water column, removing suspended solids, and improving water colour and diatom blooms. Zeolites have the capacity to remove ammonia and other nutrients/metabolites from fresh waters by ion exchange and absorption. Larvae of silver barb *B. gonionotus* were stocked at $25L^{-1}$ in 10L tanks and were offered six various concentrations of zeolite including 0, 2, 4, 6, 8 and 10 g/liter in triplicate for 18 days.

Larval growth and survival were generally higher for those treated by different zeolite concentrations. Significant lower survival and growth were recorded on larvae without zeolite treatment. Negative correlation was found between Ammonia concentration and zeolite level. Lower ammonia in higher zeolite treated tanks, indicated the strong positive effect of zeolite on water quality. Results of this study demonstrated the high potential of zeolite in larviculture and hatchery production of freshwater fish industry in Malaysia.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7470
E-mail: cheroos@agri.upm.edu.my

A Preliminary Study on Exfoliative Vaginal Cytology in Captive Sumatran Rhinoceros (*Dicerorhinus sumatrensis*)

Award Winner

Choong Siew Shean, Rosnina Y, Zainal-Zahari Z, Abd. Wahid H,

Exfoliative vaginal cytology was performed on three female Sumatran rhinoceros in order to determine the cellular compositions of the lining of the vaginal wall. Vaginal flushing and aspiration were done to obtain vaginal cells, and then stained with Modified Shorr's trichrome stain. Examination of vaginal smears revealed that the vaginal cells of Sumatran rhinoceros were similar to that of bitches comprising parabasal, small intermediate, large intermediate, superficial and cornified cells. Parabasal, small intermediate and large intermediate cells were classified as non-keratinised cells, whereas the keratinised cells are comprised of the superficial and cornified cells. Classification of these various cells were done in order to facilitate data analysis. Trends of changes in the percentages of keratinised and non-keratinised cells were observed in all three animals.



Plate 1: Photomicrograph of parabasal cells (P) stained with Modified Shorr's in vaginal smears of Sumatran rhinoceros (X400)

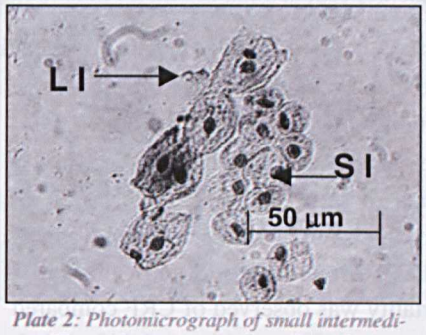


Plate 2: Photomicrograph of small intermediate (SI) and large intermediate (LI) cells stained with Modified Shorr's in vaginal smears of Sumatran rhinoceros (X400)

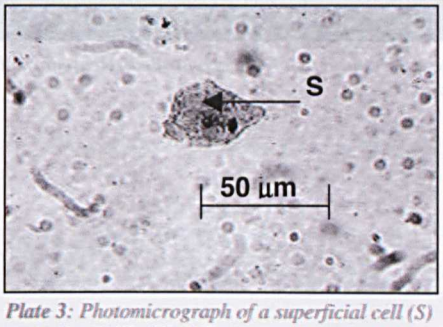


Plate 3: Photomicrograph of a superficial cell (S) stained with Modified Shorr's in vaginal smears of Sumatran rhinoceros (X400)

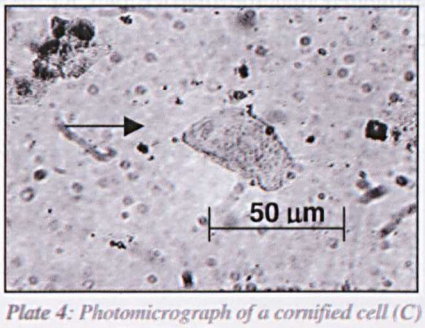


Plate 4: Photomicrograph of a cornified cell (C) stained with Modified Shorr's in vaginal smears of Sumatran rhinoceros (X400)

Reader Enquiry
Department of Clinical Studies
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8328
E-mail: rosnina@vet.upm.edu.my

Development of Controlled-release Formulation of Herbicide

AwardWinner

Dzulkefly Kuang Abdullah

In recent year the important of efficiency of application of pesticides becomes more apparent in the height of problems of environmental contamination and effect on non-target and beneficial organisms. An effective approach to overcome these problems is through the use of controlled-release formulation. Controlled-release formulations (CRF) of diuron and alachlor were prepared using sodium alginate or pectin as a matrice and kaolin or agricultural by-products empty fruit bunch, sawdust and paddy husk as inert materials. The release rates of diuron and alachlor from the CRF in distilled water were determined by chemical assay using a high performance liquid chromatography with ultra-violet detector. The CRF with pectin as matrice showed initial release of active ingredient faster than the CRF with alginate as matrice. The release of diuron and alachlor reached maximum 24 and 48 hours respectively following placement in distilled water.

The efficacy of the controlled-release formulations and conventional formulation (CF) of diuron and alachlor were than evaluated against *Paspalum conjugatum* and *Diodia ocimifolia* in glasshouse. Based on percent mortality of *D. ocimifolia* and *P. conjugatum*, the pectin based CRF showed similar efficacy compared with the conventional formulation indicating high initial release of active ingredient from these formulations. Significant higher seedling mortality was observed of CRF compared with the conventional formulation at 2 months after treatment indicating prolong efficacy of CRF. The results indicated that the matrice of CRF influenced the release and efficacy of diuron and alachlor.



Alginate-agricultural by-product controlled-release formulation of diuron

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

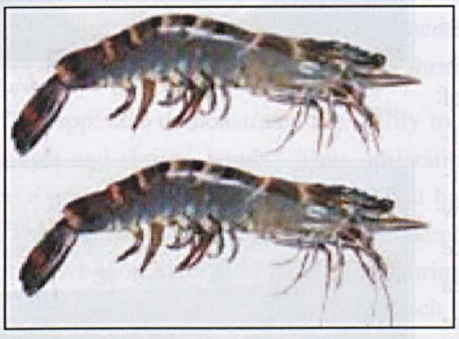
Tel: +603 8946 8328
E-mail: zolkifli@agri.upm.edu.my

Use of Rapid Enzymatic Methods for Monitoring Quality of Seafood Products

Award Winner

F. Abu Bakar, C.N.A. Razak, A.B. Salleh and M. Basri

Use of enzymatic methods through the use of biosensor in the form of oxygen electrode offered excellent alternative methods for determination of histamine in prawns and other seafood products. The experimental results showed there was an increase of histamine during storage as measured by the oxygen electrode signal using the enzyme diamine oxidase within 10 minutes per analysis. Very good correlation of above 0.98 with the high performance liquid chromatography (HPLC) analyzer was obtained for all samples during ambient storage, 10°C and icing. Recovery percentages of about 100% for values of histamine in between 0-200 µg/g were obtained for the freshwater prawns samples.





The use of oxygen electrode also shows the characteristics of high sensitivity, efficiency, reliability and stability comparable to that of the HPLC procedure. Thus suggesting it to be as a rapid method for monitoring not only quality of prawns but in general for monitoring the quality and spoilage of other seafood products.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8376
E-mail: fatim@fsb.upm.edu.my

Use of Beneficial Bacteria to Increase Shrimp Production

Fatimah Md.Yusoff, M. Shariff T.N Devaraja, Sanjoy Banerjee and Hazel Matias

Award Winner

Shrimp is an important commodity in Malaysia that generated more than RM473 million from a production of approximately 16,000 tonnes in 2000. There are more than 7,000 ha of shrimp farms with about 7,400 ponds along the coastal areas, both in the East and West Malaysia with an average production rate of 2.2 tonnes/ha. Currently, shrimp industry is plagued with problems related to bad water quality and diseases. The increase in production has not been proportionate to increased pond acreage mainly because of the unsustainable pond management practices. Absence of defined regulations on the use and discharge of water in aquaculture industry has resulted in self-eutrophication. Water for the farms is usually drawn during the high tide when the water quality is good and the raw effluent is discharged at the same site as the water intake during low tides. After a number of years, the coastal area experiences organic pollution due to untreated aquaculture effluents coupled with discharge from other agro-based industries such as pig farming, rubber and oil-palm industries in the upstream. Generally, the production in new ponds is higher than in aging ponds due to environmental degradation.



Inhibitory effect of beneficial bacteria on pathogenic vibrio



Shrimp fed with beneficial bacteria shows better growth

Declining shrimp production needs to be addressed at the root level. Shrimp industry needs a sustainable supply of good quality water and thus the act of discharging untreated effluents into estuaries and coastal waters should be ceased. However, water treatment incurs high cost, and if enforced, the fledgling industry like shrimp culture will become unattractive to investors. New technologies using cheap raw materials need to be investigated. One such technology is the use of beneficial microbes in high density to increase the degradation of organic matter in shrimp ponds. Coupled with adequate aeration, microorganisms could bioremediate the pond environment by accelerating the mineralization process under aerobic condition. In this way, toxic metabolites, such as ammonia and hydrogen sulphide commonly found in shrimp ponds, would be reduced.



Bacterial consortium for higher shrimp production in commercial ponds

The use of imported commercial microbial products in improving water quality and controlling microbial infections in shrimps has shown promising results. However, these products showed insignificant increase in shrimp production, probably due to unsuitable environmental conditions for the proliferation of exotic microorganisms. For bio-safety reasons as well as to avoid sudden changes in the microbial flora of the ecosystem, our research focused on the use of indigenous microorganism to improve water quality in shrimp culture ponds and to enhance shrimp health. In addition, the use of imported bacterial products adds to the import bill of the country.

Indigenous *Bacillus* spp. isolated from local marine waters were used as potential candidates for the bioremediation product and their selection was based on their ability to secrete extracellular enzymes, express competitive exclusion, high survival rate, non-pathogenic to shrimp larvae, and ability to grow fast. The effect of combination of two *Bacillus* spp. showed that rate of ammonia reduction was higher compared to individual species under simulated shrimp pond conditions. In addition shrimp fed with bacterial additives showed better growth and survival compared to the control fed with commercial shrimp feed. Furthermore, shrimp fed on bacterial supplemented diet had higher survival rate when challenged with the white spot syndrome virus (WSSV) whereas shrimp fed on artificial diet showed higher mortality.

Bacillus spp. also demonstrated the ability to suppress the growth of pathogenic bacteria isolated from *Artemia* cyst and shrimp ponds. Thus, utilization of these bacteria for biocontrol of pathogenic vibrios might be a good alternative to antibiotics that has ecotoxicological implications and ill effects on human health. These bacterial have been proven to be non-pathogenic to shrimp and might be useful in formulating an effective bioremediation product for shrimp culture. In addition, the same bioremediation products can be used in other aquaculture activities such as fish/shrimp hatchery, aquarium, and other aquaculture systems.

Research is now being conducted to mass-produce the bacteria consortium for commercial purposes.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6621
E-mail: fatimahmy@fsas.upm.edu.my

Barn Owl as Biological Control Agent of Rats in Rice Field

Hafidzi Mohd Noor

The role of barn owl *Tyto alba* in controlling rice field rats in paddy fields was investigated based on the census of barn owl population, damage census on rice crop and baiting requirements in Selangor, where the barn owl project has been implemented, over the period from 1997 to 2000. Rice crop loss due to rat activities at the start of the implementation of the project ranged from 5 to 10%, but was maintained at less than 1% throughout the census period. Monthly occupancy rates and proportion of nest boxes with eggs and owlets showed that barn owl population dynamics coincides with the rat reproductive cycle.



Barn Owl

Modelled under two management strategies; one that relies entirely on baiting and another that integrates baiting with the natural propagation of barn owls, *Tyto alba,* shows that the need for baiting when integrated with barn owl is reduced by more than 80%. The barn owl, *Tyto alba,* therefore can increase rice production and at the same time reduce the risk of environmental hazards from excessive use of rodenticides

One factor that may determine population size of the barn owl is nest box density. Nest site has been reckoned as an important population-limiting factor. In order to determine an owl density that is viable for a sustainable rat control, home range study using radio telemetry was conducted. Results show the home ranges of breeding females are relatively small i.e. less than 3 ha. Females occupying neighbouring nest boxes maintained exclusive ranges, which is an indication of territorial behaviour. However males ranged over extensive area and their presence are tolerated by unrelated females. This shows that a high density of boxes can be built in rice field to increase population of birds for adequate control of rats.

The use of barn owl as biological control agent of rats is becoming an attractive option in most rice field ecosystem is Southeast Asia. Efforts of propagating the owl in the rice fields in Sarawak are currently underway. Trials have also been conducted in parts of Indochina, and in South Asia. The owls have also been propagated in Africa as well as Australia for rodent control in various field crops.

Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

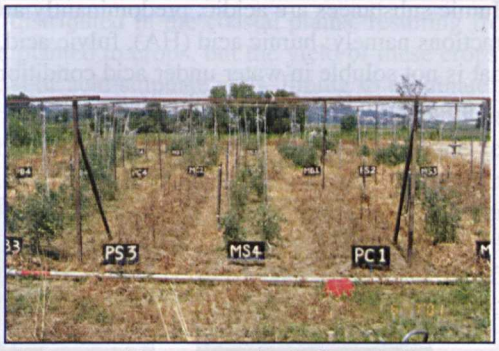
Tel: +603 8946 6983
E-mail: hafidzi@agri.upm.edu.my

An Integrated Management for the Control of Bacterial Wilt of Tomato

Award Winner

Hiryati binti Abdullah, Mohd. Ghazali Mohayidin, Azizah Hashim and Lee Kam Loong

A study was conducted to evaluate the effect of two tomato varieties, MT 11 and Pearl, treated with combination of two strains of *Pseudomonas putida*, Ca $(NO_3)_2$ and with/without Stonier's medium, on the incidence of bacterial wilt in the field. Tomato seeds were bio-primed with combined strains of antagonist, KTS 26 and AC 1. Four-week old seedlings were transplanted to the field, which were artificially infested with the pathogen, to ensure even and high inoculum density. Application of Ca $(NO_3)_2$ were done before and after transplanting. Stonier's medium was applied 4 days before transplanting. For each variety, non-treated plants served as control.



An Integrated Management for the Control of Bacterial Wilt of Tomato

The antagonist and Ca $(NO_3)_2$ treatments were not able to provide any resistance to the susceptible Pearl tomato variety, which, recorded 100% infection. However, the two treatments with the MT 11, bio-primed with the combined strains of antagonist, treated with Ca $(NO_3)_2$ and with or without Stonier's medium, could significantly reduce bacterial wilt incidence by 29 and 31% respectively, when compared to the MT 11 control. Their yields were also significantly higher by 114 and 121% for treatment without and with Stonier's medium, respectively. However, no significant difference was observed between the two treatments, indicating that the Stonier's medium did not enhance the antagonistic capability of the antagonists. This result corroborated the results of the greenhouse trials (unpublished data). The study shows that under high disease pressure, higher resistance in the variety used is essential for the integrated control measure to be highly effective.

Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

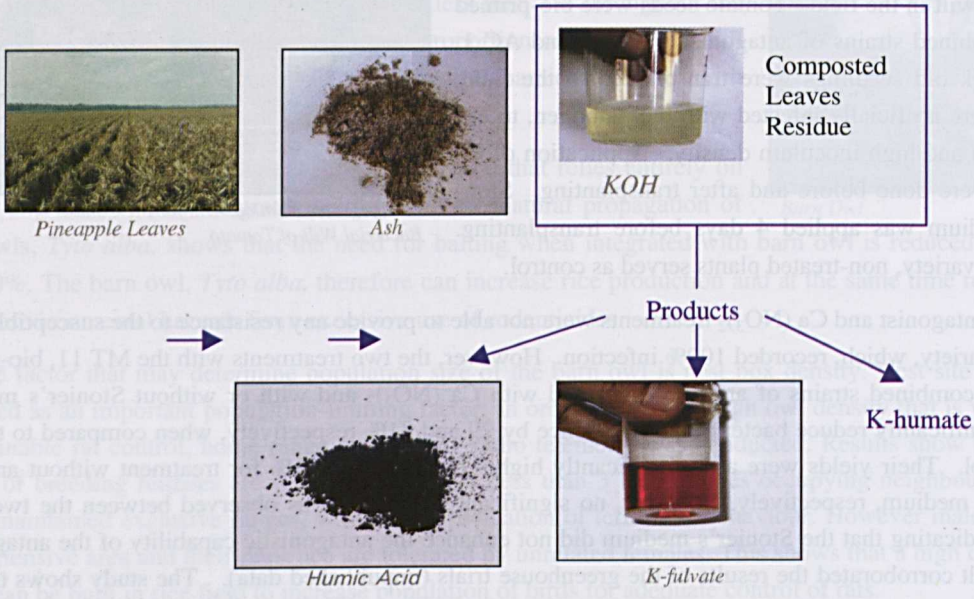
Tel: +603 8946 7231
E-mail: hiryati@agri.upm.edu.my

Value Addition to Pineapple Leaves Residue: I. Extraction of Humic Acid

AwardWinner

Husni, M.H.A. and O.H. Ahmed.

Humic substances are acidic, predominantly aromatic, and hydrophobic. They are grouped into three main fractions namely: humic acid (HA), fulvic acid, and humin. Humic acid is the fraction of humic substances that is not soluble in water under acid conditions (pH 1 to 2) but becomes soluble at higher pH. Humic acids are proven metal complexing agent, good dispersants and can act as redox agents.



Reactants and Products

Potassium hydroxide (0.1M KOH) from incinerated pineapple leaves extracted 20% HA from composted pineapple leaves residue while that of analytical grade (0.1 M KOH) extracted 30%, however, the elemental composition (C, H, N, O, and S), the functional groups (carboxylic, phenolic OH, and total acidity), and the spectra characteristics of the HA extracted using these extractants were generally similar. Potassium hydroxide from ashed pineapple leaves can therefore be used to extract reasonable amount of HA without appreciably altering the elemental and functional groups constitution as well as the spectra characteristics of this humic substance. The potential of using KOH extracted from incinerated pineapple leaves for the extraction of humic substances therefore looks promising. Useful products such as K-humate, and K-fulvate were also produced.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6961
E-mail: husni@agri.upm.edu.my

Amelioration of Soil Acidity in An Acid Sulphate Soil Using Organic Materials



J. Shamshuddin, S. Muhrizal, M.H.A. Husni and I. Fauziah

In Peninsular Malaysia, acid sulphate soils are commonly distributed in the coastal plains, resulting from seawater inundation over the years. Some of these soils are planted to crops, but the yield of these crops is low attributed to acid soil infertility especially Al toxicity. For acid sulphate soils, liming to eliminate Al toxicity is uneconomical. Application of organic materials to overcome the Al toxicity is considered a better option. Research conducted worldwide to determine the efficacy of organic matter to ameliorate acid sulphate soil infertility is few. Hence, this study was carried out to fill the gap in knowledge. The organic materials tested in this study were peat, green manure, rice straw, chicken dung, palm oil mill effluent and peat in combination with the organic materials. Nil treatment and lime were included in this study as the control treatments. Mung bean and cocoa seedlings were planted on the treated soils to determine the efficacy of the organic materials as amendments.

In some of the treatments, soil pH increased significantly. The highest pH increase was in the green manure treatment where a value of 4.88 was recorded. The pH increase was in part due to production of ammonia during mineralization of the green manure. The results also showed that Al was reduced substantially by addition of organic materials especially green manure and green manure mixed with peat. The mixture of peat and organic materials significantly lowered total and monomeric Al concentrations in the soil solution. Peat mixed with organic materials (especially green manure and rice straw) synergistically promoted complexation and chelation of monomeric Al, presumably forming Al-organic acid complex in the soil.

As a result of the organic materials treatment, mung bean grew better than the nil treatment. The reason being a better condition for growth was achieved when the organic materials reacted with the acid soil. This is shown by pH increase and elimination of Al. The relative root length (RRL) of mung bean was negatively correlated with various Al indices. The RRL of mung bean increased with decreasing total and monomeric Al concentration, monomeric Al activities, Al^{3+}, (Al^{3+} + $AlOH^{2+}$ + $Al(OH)_2^+$), ($3Al^{3+}$ + $2AlOH^{2+}$ + $Al(OH)_2^+$), aluminium activity ratio (AAR) and aluminium activity equivalent ratio (AER). The monomeric Al activities and Al^{3+} activities to maintain 90 % RRL were respectively 1.21 and 0.35 µM. These values are regarded as the critical values for the growth of mung bean on the acid sulphate soil under the condition set by the organic matter treatment.

Likewise, cocoa seedlings were able to grow better under the organic materials treatment. The best cocoa seedlings root growth was found for the peat treatment alone. The relative top dry weight of cocoa seedlings was negatively correlated with Al^{3+} as well as Al^{3+} $Al(OH)^{2+}$ + $Al(OH)_2^+$ activity in the soil solution. The critical values for these soil solution attributes were 10 and 15 um, respectively.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6985
E-mail: samsudin@agri.upm.edu.my

Sheep Farm – a User-Friendly Database Management System for a Small Farm



J.M. Panandam

Livestock research and breeding farms require a database management system (DBMS) to facilitate accurate and organised documentation and easy access of data. Many available DBMS are neither custom-made nor user-friendly. They also, generally, lack in-built data validation feature that ensures the validity of the stored information. This project aimed to develop a user-friendly DBMS for a sheep research farm, with in-built data validation features.

The DBMS developed is called SHEEP FARM (Figure 1). SHEEP FARM is based on the operational and research activities of sheep breeding programmes in two universities. It caters for records on general information of individual animals, breeding activities, and reproductive and growth performance (Figure 1). It is structured using Microsoft Access. SHEEP FARM is a user-friendly DBMS with screen displays and dialogues designed to facilitate easy data entry and access (Figure 3). Programs have been incorporated for auto-generation of related information. An important feature of SHEEP FARM is that it automatically validates the data upon entry by conducting range, plausibility and sequence tests, and by testing for duplication (Figure 4). In addition to storage of data, the SHEEP FARM may be used to generate reports on herd structure and herd dynamics, and list data in the form as required for statistical analysis (Figure 5).

SHEEP FARM has logical data independence; application programs may be modified without affecting the data storage and the programs, in turn, are unaffected by extension to the data structure. This feature enables SHEEP FARM to be customised for sheep research farms under management systems other than the one for which it was developed, and even for farms with different research requirements. Although SHEEP FARM has been developed for research purpose, it may be extended to meet more farm management requirements. A security control procedure may also be incorporated into the system to prevent unauthorised access to all or part of the database.



Figure 1. The main menu of SHEEP FARM

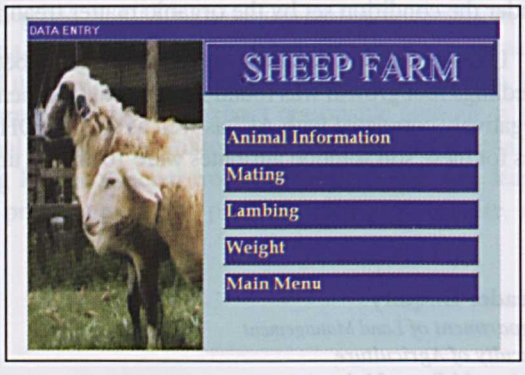


Figure 2. The data entry menu showing the types of data stored



Figure 3. User-friendly data entry menu, facilitated with pop-up menu

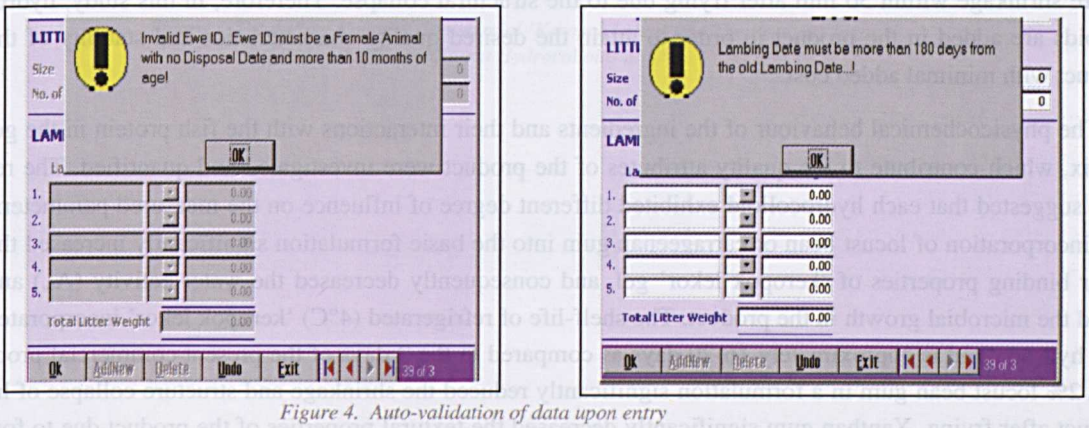


Figure 4. Auto-validation of data upon entry

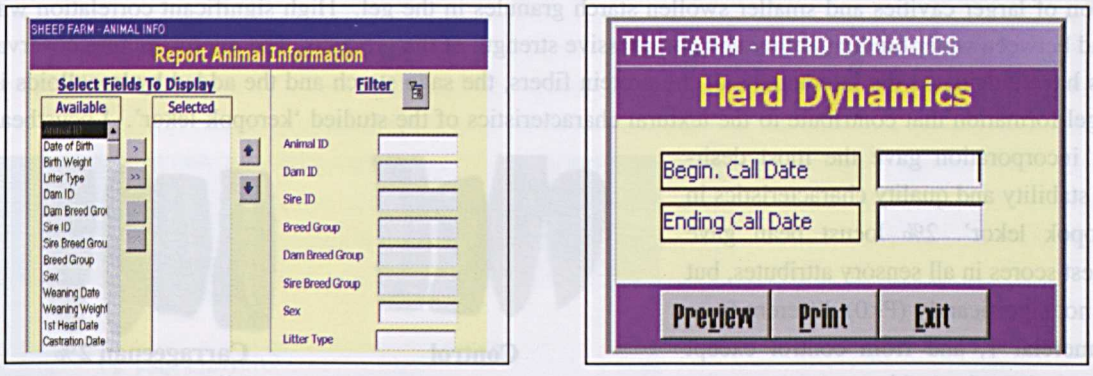


Figure 5. Easy retrieval of selective data and generation of reports

Reader Enquiry
Department of Animal Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6896
E-mail: jothi@agri.upm.edu.my

The Enhancement of Stability and Quality Characteristics of 'Keropok Lekor' by the Incorporation of Hydrocolloids

Award Winner

Jamilah Bakar, Kyaw Zay-Ya, Russly Abdul- Rahman and Gulam Rusul Rahmat-Ali

In food industries, hydrocolloids are used as water binder and gel former in order to increase the physical stability of gel based products. Besides fish flavour and odour, texture of the 'keropok lekor' has been identified as one of the main quality characteristics of the product. The fish content of 'keropok lekor' varies from 20%-70% of the total weight, and higher fish content will reduce the profit margin. During frying, the 'keropok lekor' gel expanded and it may explode. The fried product of existing formulation will undergo severe shrinkage within 30 min after frying due to the structural collapse. Therefore, in this study, hydrocolloids are added in the product in order to attain the desired quality characteristics and stability of the product with minimal added cost.

The physicochemical behaviour of the ingredients and their interactions with the fish protein in the gel matrix, which contribute to the quality attributes of the product were investigated and quantified. The results suggested that each hydrocolloid exhibited different degree of influence on the measured parameters. The incorporation of locust bean or carrageenan gum into the basic formulation significantly increased the water binding properties of 'keropok lekor' gel, and consequently decreased the water activity (A_w) and retard the microbial growth in the product. The shelf-life of refrigerated (4°C) 'keropok lekor' incorporated with hydrocolloid is approximately 16-20 days as compared to the 2 days of the present commercial products. 2% locust bean gum in a formulation significantly reduced the shrinkage and structure collapse of he product after frying. Xanthan gum significantly decreased the textural properties of the product due to formation of larger cavities and smaller swollen starch granules in the gel. High significant correlation was found between water binding ability and compressive strength of the products. The microstructure observations have elucidated the interactions of the protein fibers, the sago starch and the added hydrocolloids in the gel formation that contribute to the textural characteristics of the studied 'keropok lekor'. Locustbean gum incorporation gave the most desirable stability and quality characteristics in 'keropok lekor'. 2% locust bean gave highest scores in all sensory attributes, but was not significantly ($P<0$) different from commercial 1, and from control except texture. Based on this study, it can be recommended that the incorporation of locust bean followed by carrageenan at 2% level can improve quality and stability of the 'keropok lekor'. Perhaps, a combination of xanthan and locust bean or carrageenan gum that cause synergetic effect on texture and stability of 'keropok lekor' can also be looked into.

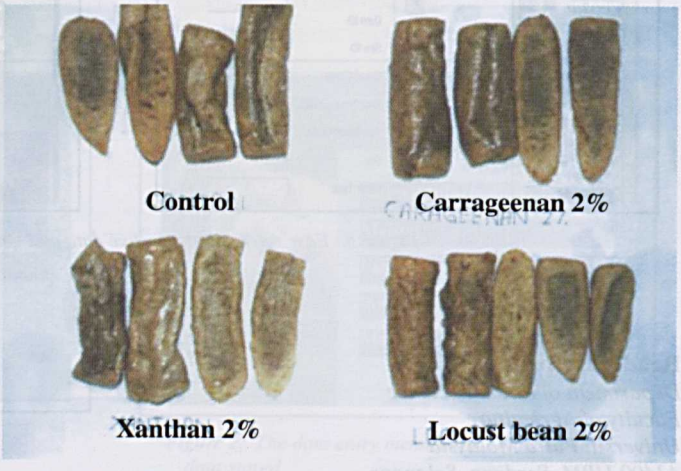


Figure1: Fried 'Keropok Lekor' after 30 mins at room temperature

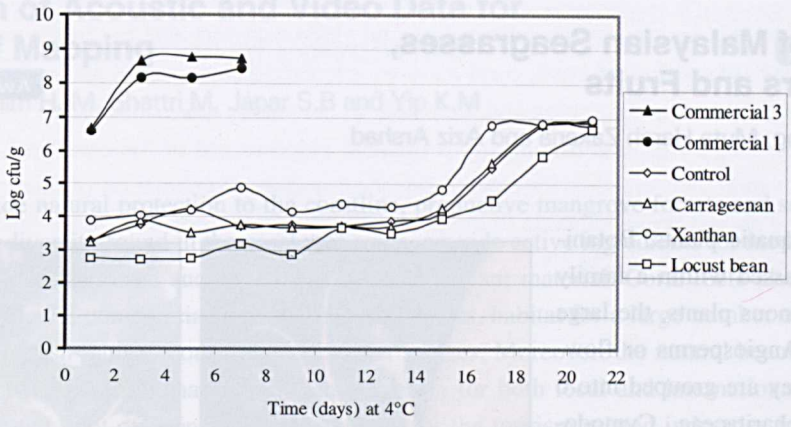


Figure 2: Total Plate Count of Commercial 'Keropok Lekor' and The Products Incorporated with 2% of Different Hydrocolloids at 4 °C

Reader Enquiry
Department of Food Technology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8396
E-mail: ajamilah@putra.upm.edu.my

The Habit of Malaysian Seagrasses, their Flowers and Fruits



Japar Sidik Bujang, Muta Harah Zakaria and Aziz Arshad

Seagrasses are aquatic plants. Botanically they are classed within a family of monocotyledonous plants, the large sub-division of Angiosperms or flowering plants. They are grouped into 6 families; Hydrocharitaceae, Cymodoceaceae, Posidoniaceae, Ruppiaceae, Zannichelliaceae and Zosteraceae. Worldwide, there are 16 genera of seagrasses with 67 species. In the monograph, Seagrasses of the World by den Hartog (1970), records of Malaysian seagrasses were limited to seven species occurring in restricted places, e.g. Port Dickson, Negeri Sembilan, Pulau Tinggi, Johore in Peninsular Malaysia; Bintulu river estuary in Sarawak and Pulau Sibuan in Sabah. "One wonders whether seagrasses in Malaysia are extremely rare or absent or have been overlooked by botanists".



Flowers are rarely encountered in some seagrass species such as Halophila decipiens and Thalassia hemprichii

Our group involvement in Seagrass Research started in 1996. Since then, we have discovered a large number of new localities for seagrasses occurring along the Malaysian coast. To date there are 14 known species of seagrasses in Malaysia. In addition to some primary information about their habits, we are presenting component of the plants i.e. flowers and fruits that are rarely encountered in some of the seagrass species.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6626
E-mail: japar@fsas.upm.edu.my

Integration of Acoustic and Video Data for Coral Reef Mapping



Jefri M.S, Ibrahim H. M, Shattri M, Japar S.B and Yip K.M

Coral reef provide natural protection to the coastline, productive mangrove forests and seagrass beds. The high level of biodiversity found in the coral reef areas, provide active ingredients for medicine and cosmetics and corals have been used successfully as bone transplant material. Coral reefs also provide nursery ground for juveniles of commercially important fish species, habitat for a large number of fish species and more than 30% of fish landed consists of coral reef species. Moreover, the natural beauty of coral garden surrounded by colourful fishes has become an attraction for both local and international tourists and has successful generated a lot of economic opportunities for the tourism related industries in Malaysia. However, at present, many coral reefs are damaged by various factors including the indiscriminate development of the coastal zone, pollution, unsustainable tourism development and the occasional rise of sea surface temperature.

In order to protect and manage coral reefs, traditional methods are used for detecting and monitoring corals distribution and health. These traditional methods employ direct observations such as line transect, belt transect and manta tow using scuba diving and snorkelling gear. These methods are costly and time consuming and require special observers trained in scuba diving and coral reef methods. This constraints calls for the development of a new coral reef assessment /mapping method. Acoustic technology is a feasible alternative to these methods for monitoring coral reef features. A better alternative is acoustic technology incorporated with video survey. This has proved to be a cost-effective and time-efficient tool for reef survey, change detection and management. This technology consists of integration of several types of systems such as underwater video camera, digital camera, global positioning system and an echo sounder, which operate with Windmill software. The underwater camera and digital camera record coral images with GPS synchronous time stamp to determine the primary benthic cover at sample location. With the GPS signal correction system presently installed in the both the Straits of Malacca and the South China Sea, GPS signals can be corrected to accuracies of 1 to 5 m. Thus this system provide a low-cost method using the public domain software for accurate sea floor mapping.Integration of acoustic data, GPS and digital video picture is a new technique for coral reef mapping in this region. Pulau Payar Marine Park was selected as study area, being the only Marine Park Island located the northwest of Peninsular Malaysia.

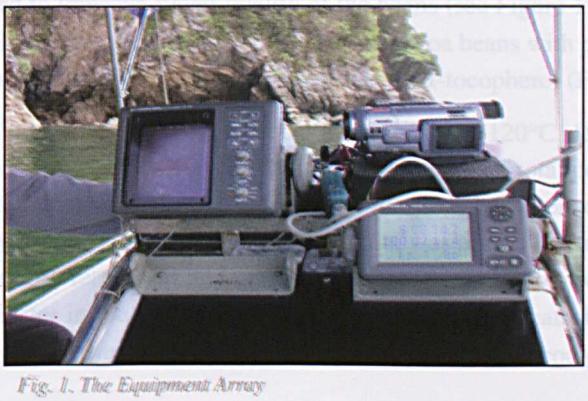


Fig. 1. The Equipment Array

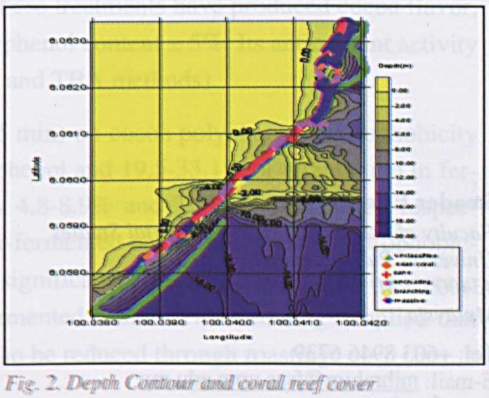


Fig. 2. Depth Contour and coral reef cover

Combinations of this hydro acoustic information and video data was able to classify common reef substrates such as live hard coral, dead coral, coral massive, encrusting coral, sands, and rocks. The advantages of this system are low cost, not complex and were able to cut survey time drastically. This method is also useful for satellite imagery ground truthing. A permanent video record of the coral reef area surveyed is also obtained for visual identification for change detection studies. Combination of this system with satellite remote sensing should prove valuable to the authorities in their efforts to manage this valuable coastal resource more efficiently and effectively.





Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6739
E-mail: mibrahim@fsas.upm.edu.my

Improvement of Flavour Quality of Under-Fermented Cocoa Beans through an Optimaization of Polyphenol

Jinap Selamat and Misnawi

Malaysia is well known as one of the main world producer of cocoa products and is the biggest in Asia. Due to the cocoa bean's production shortage, this country is currently importing ± 44,000 tonnes annually from Indonesia constitute about 57% of the total Malaysian import. However, most of the Indonesian cocoa beans are under-fermented, which are characterized by low cocoa aroma intensity with excessive astringency and bitterness and still contain high concentration of polyphenols. Cocoa bean polyphenols have gained much more attention, owing to their antioxidant capacity and their possible beneficial implications in human health, such as in the treatment and prevention of cancer, cardiovascular disease and other pathologies. Therefore, a study has been carried out to improve flavor quality of under-fermented cocoa beans without affecting beneficial values of the polyphenols.



R&D is an integral activity in producing high quality products



Good quality of cocoa fruit followed by proper processing technology would produce high quality cocoa products

Results of the study showed that the unpleasant astringency of under-fermented cocoa beans is due to precipitation of salivary proline-rich protein on the tongue by cocoa polyphenol, whereas the low cocoa aroma intensities is due to undeveloped aroma precursors namely hydrophobic amino acids, hydrophilic peptides and reducing sugars during beans processing. Remaining indigenous key enzymes, i.e. polyphenol oxidase, aspartic endoprotease, carboxypeptidase, and invertase, and/ or exogenous enzymes could be employed to improve flavor quality of the beans (see Figure 1). These treatments have produced cocoa flavor, which are comparable to well-fermented cocoa beans with polyphenol content ± 5%. Its antioxidant activity was still high and better than the activity of α-tocopherol (FTC and TBA methods).

Study on the effects of cocoa liquor roasting (120°C, 15-45 min) on cocoa polyphenol, hydrophobicity and its impact on its flavor showed that 2.6-3.3% of total polyphenol and 19.5-33.1% of total tannin in fermented cocoa liquor, decreased upon roasting; however, only 4.8-8.9% and 2.3-7.5% decreases, respectively of total polyphenol and total tannin, was present in under-fermented beans. Polyphenol hydrophobicity in both fermented and under-fermented cocoa liquors was significantly decreased; the rate of decrease was faster in the under-fermented cocoa beans than that of fermented beans. These findings implied that excessive astringency in under-fermented cocoa liquor could also be reduced through roasting

treatments; however, its quantity is not much affected by roasting treatment. Sensory evaluation results showed that the astringency flavor has decreased with longer roasting time.

Further study on the effect of polyphenol on flavor formation during roasting showed that excessive polyphenol in cocoa liquor (> 100 g kg^{-1}) inhibited formation of cocoa flavor due to its interaction with flavor precursors mainly peptides and free amino acids. Pyrazines, the major cocoa aroma compounds, were produced inversely with polyphenol content in cocoa liquor, and sensory evaluation results showed that the excessive polyphenol was not only inhibited flavor formation, but also impaired sensory perception of cocoa liquor.

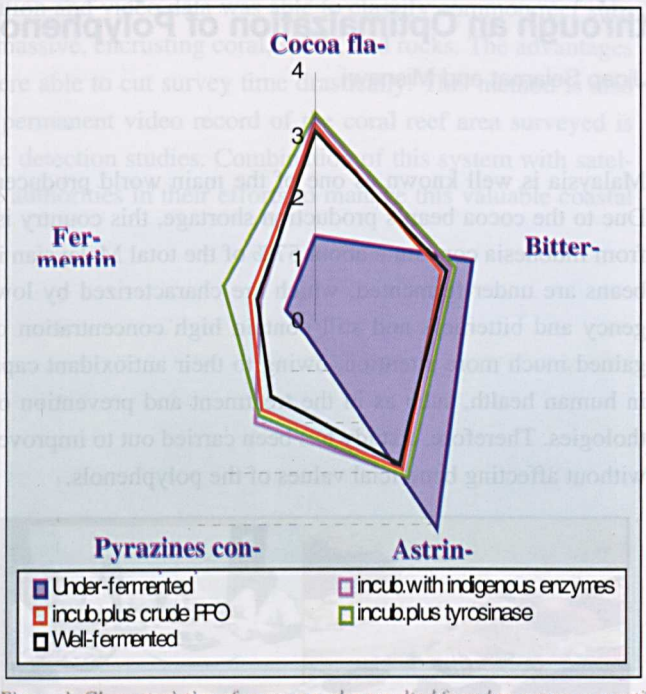


Figure 1. Characteristics of cocoa powder resulted from key enzymes reactivation through incubation of under-fermented cocoa beans

Study on the antioxidant activity of cocoa liquor after roasting showed that under-fermented cocoa liquor lost its antioxidant activity significantly during roasting, although its activity was still high and better that of α-tocopherol.

Reader Enquiry
Department of Food Science
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8368
E-mail: jinap@putra.upm.edu.my

Improvement of Cocoa Specific Aroma Precursors of Under-Fermented Cocoa Beans with Carboxypeptidases Addition

AwardWinner

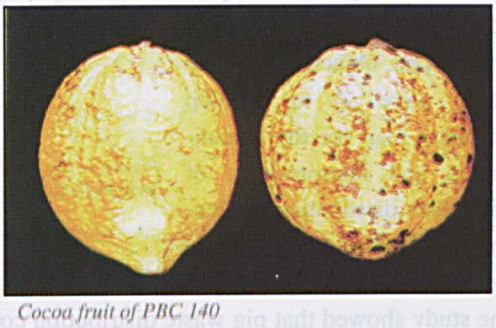
Jinap Selamat, Yusep Ikrawan, Jamilah Bakar and Nazamid Saari

Cocoa specific aroma differentiation is very much influenced by processing especially fermentation and drying. Since Malaysia is not self-sufficient in cocoa bean supply and has to rely on imported beans especially from Indonesia; however, these beans are highly under-fermented and therefore has low cocoa aroma with excessive taste of bitterness and astringency.



Under-fermented cocoa beans

Aroma precursor precursors in cocoa beans namely free amino acid, and hydrophilic peptides are produced during fermentation and the early stage of drying by the action of endogenous enzymes. Aspartic protease is responsible for the first part of protein degradation to produce hydrophobic peptides and hydrophilic free amino acids. Carboxypeptidase would react on the peptides to produce hydrophilic peptide and hydrophobic free amino acids.



Cocoa fruit of PBC 140

Using carboxypeptidase B from porcine and carboxypeptidase Y from baker's yeast, cocoa aroma of the under fermented beans was improved and hydrophobic free amino acids (alanine, valine, isoleucine, leucine, phenylalanine and tyrosine) were predominantly produced. The peptide patterns of the samples treated with carboxypeptidases were very similar with those of the control. During prolong incubation, these enzymes resulted an increase in the concentration of methylpyrazines in the samples. The action of carboxypeptidases on hydrophilic oligopeptides at their carboxyterminal ends has produced oligopeptides, which are mostly hydrophilic oligopeptides and hydrophobic free amino acids. However, carboxypeptidase B from porcine prancreas was shown to be more prominent in producing cocoa-specific aroma. Study on flavour quality showed that carboxypeptidases addition did not have effect on the flavour quality. All samples treated had bitter, astringent, acid and low cocoa flavour compared to reference.

Reader Enquiry
Department of Food Science
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8368
E-mail: jinap@putra.upm.edu.my

Mapping Waste Distribution in Intensive Pig Production Areas Using GIS

AwardWinner

Liang, J.B., Tee, T.P., E.S. Chew, Z.A. Jelan, T.C. Loh and P. Loganathan

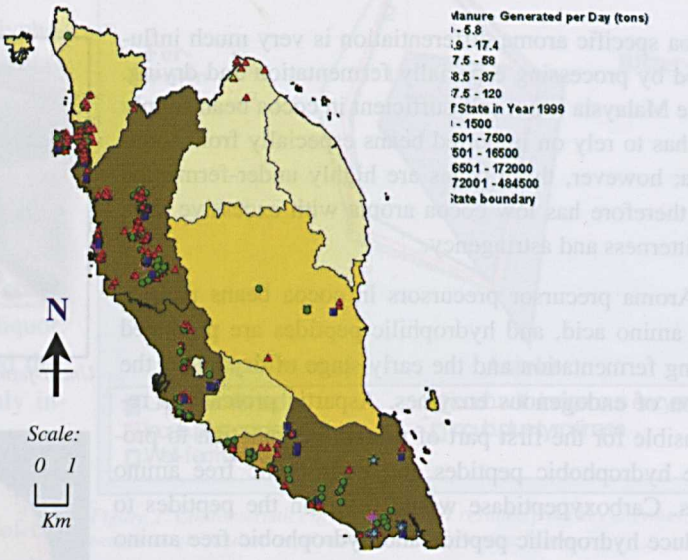


Figure 1. Pig production location, number of SPP and daily manure generation of individual farm in Peninsular Malaysia

Approximately 30% of the total 28,000 tons livestock manure excreted daily in Peninsular Malaysia are from pig farms. Majority of the wastes are not fully utilized and thus serves as a source of environmental pollutant. Geographical Information System (GIS) could serves as an information management tool for monitoring of the impact of the wastes on the environment. The objectives of the study were (i) to develop thematic map for the visualization and interpretation of pig waste distribution in Peninsular Malaysia and (ii) to develop a GIS database for monitoring and decision making relating to pig waste management. Results of the study showed that pig waste distribution could be mapped out based on standing pig population (SPP), farm size or wastewater discharge. In Peninsular Malaysia, most of the pig production areas were concentrated along the west coast, with Penang, Perak, Selangor and Johore having the highest SPP and volume of daily manure generation rate. Since most of the farmers use lagoon system to treat the wastewater, their design and operational management affect efficiency of the lagoon system. Data or information on farm and animal production inventories, manure generation rate, wastewater emission rate, waste distribution of manure over available land, farm waste treatment facilities for West Malaysia, especially in Kampung Selamat, Seberang Perai Utara, Penang have been developed and transformed into individual thematic layer in GIS environment.



Figure 2. Attribute data and image from GIS database

Reader Enquiry
Department of Animal Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6898
E-mail: jbliang@agri.upm.edu.my

Nutritional and Immuno-regulatory Approaches in Abating Bovine Mastitis

M.M. Noordin

For the fiscal year of 1998, the Malaysian dairy industry could only supply 4.5% (30.83 million litres) of the total demand leading to an importation amounting to more than RM1 billion. Of the total yield, almost 70% came from the small holders. The ever-increasing local demand for milk, healthy milk-products and development of an integrated system with cheap fodder production, is an opportunity for this industry to advance into the millennium with great success. To turn this into a reality, an effective measure on the control of one of the factors contributing to low productivity, mastitis is therefore of utmost importance.

The enigmatic bovine mastitis continues to be a major welfare concern and economic importance to the dairy industry worldwide. Attributable significant economic losses due to mastitis include reduced milk yield, poor quality milk, condemnation of antibiotic-contaminated milk, treatment and replacement costs of non-productive animals. Research on mastitis in Malaysia was not only conducted on a small-scale and retrospective basis but was conducted more than two decades ago. Possibly, the data generated from those studies are not longer valid and relevant due to drastic changes in the animal industry with respect to urbanization and management practices.

Thus, a more comprehensive and scientific research is required in mastitis research. This will elucidate the current scenario of mastitis in the local industry. Such approach will also generate sufficient and valid data that can be extrapolated into the future needs and scenario of the dairy industry.

Preliminary research conducted at UPM has shown that greatest incidence of mastitis is predominantly seen in nutritionally deficient cows that also had impaired udder macrophage function. Although earlier research conducted has documented correlation between mastitis and poor nutrition, reports on its correlation with udder macrophage activity is lacking. There is a likelihood of abating mastitis in Malaysia via manipulation of the nutritional status of cows.

This warrants for an extensive research on mastitis so as to improve the current status of the local dairy industry and to enrich the scientific knowledge on new developments in mastitis research. The main aim of this project is to boost the sluggish local dairy industry by increasing milk production via abatement of mastitis and the production of safe and wholesome milk (antibiotic free) with the following objectives:

To characterise mammary gland resistant responses and virulence factors of mammary gland pathogens in the development of mastitis;

To develop modulation techniques of host responses to mastitis pathogens on dairy food safety.

The benefits from this research project will be:

1. Impact on Malaysian economy – the success of the research will save the country of no less than RM 1 billion/year. Apart from this, the aim of achieving a total milk production of 45.31 and 61.95 million litres in the year 2005 and 2010, respectively is a feasible target (Dasar Pertanian Negara 3).

2. Impact on dairy farmers - maximising profit through less cases of mastitis (less treatment and replacement cost), higher productivity (high quality, antibiotic-free, less discarded milk) and optimal utilisation of land (integrated farming).

3. Development of the local (dairy) food industry – not only this sector can save cost with less importation but can produce a more locally demand added-value products (flavoured milk, cheese, butter, yoghurt and ice-cream) that is cheaper, wholesome and healthy.

Reader Enquiry
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

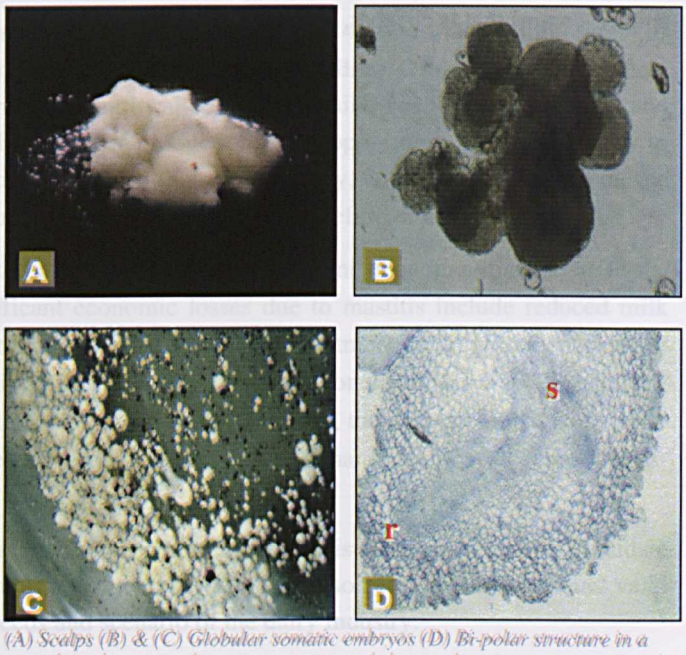
Tel: +603 8946 8313
E-mail: noordin@vet.upm.edu.my

Somatic Embryogenesis of *Musa acuminata* cv. Mas (AA)

Maheran Abd Aziz, Md Humayun Kabir, Mihdzar Abd Kadir and Azmi Abd Rashid

Award Winner

Conventional breeding of banana particularly for resistance against *Fusarium* wilt and improved post harvest qualities is extremely difficult due to high sterility and polyploidy nature of the crop. Biotechnological approaches for genetic improvement of the crop such as through genetic transformation, somatic hybridisation, somaclonal variation and *in vitro* mutagenesis are most relevant. However, the implementation of such techniques requires an efficient *in vitro* plant regeneration system. *In vitro* plant regeneration through somatic embryogenesis is an ideal pathway as plants produced are of single cell origin and non-chimeric. To date there is no single report on complete recovery of plants through somatic embryogenesis in our local bananas. This study was attempted to establish somatic embryogenesis in banana cv. Mas using shoot tip-derived scalps, immature male flowers, *in vitro* corm slices and immature ovules. Scalps and immature male flowers were the most responsive, producing embryogenic structures, which were histologically confirmed to be somatic embryos by the presence of a bipolar structure. Shoot tip explants underwent the following developmental stages of scalp, meristematic globules and embryogenic cell suspension to form somatic embryos. Immature male flowers underwent an embryogenic callus stage to form somatic embryos. The somatic embryos from scalps germinated to form roots while that of immature male flowers germinated into shoot-like structures. The recovery of a complete plant through germination of somatic embryos is the most ideal and efforts are at present focused in achieving it with emphasis on somatic embryos from immature male flowers.



(A) Scalps (B) & (C) Globular somatic embryos (D) Bi-polar structure in a somatic embryo, r and s represent root and shoot pole

Reader Enquiry
Department of Crop Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6924
E-mail: maheran@agri.upm.edu.my

The Effects of Electromagnetic Forces (EMF) on Plants

Mahmud Tengku Muda Mohamed

Award Winner

A study was conducted to look at the impact of electromagnetic forces (EMF) from high voltage lines (HVL) on plants, and also soil contamination with heavy metals under HVL and around the pylons. This study was carried out in three different areas *viz.* impact on plant growth and development, plant protein and biochemical changes, and heavy metals contamination from the lines and pylons.

The effect of EMF on growth and mineral uptake of plants varied among crops and length of exposure. Growth can be enhanced or depressed depending on EMF strength and crops. The nutrient absorption and it accumulation in plant tissues seemed to be inconsistent. The effects of a prolong exposure found to be attributed to some differences. The above considerations indicate the need for repeated studies over several life cycles to get better knowledge and understanding on the behaviour of plants grown under influence of EMF. This suggestion was made based on inconsistent results from our studies that had been conducted either at existing farms or under semi-controlled conditions. Further research on EMF effect on other crops as well is imperative so as to ensure the safety of the products under EMF influential.

As indicated from the results, the products from sample plants cultivated under HVL lines are safe to be consumed, although there was considerable potential depression or enhancement in element absorption upon longer exposure to EMF. Agriculture activities under HVL lines should be promoted as to utilize the available lands for food production as being urged by the government.

In the young oil palm plants, higher chlorophyll content was found in the leaves of plants grown nearest to the lines. This will enhance photosynthetic activity, which can lead to higher growth. However, the reverse was observed with the 7-year old palm where decreased in chlorophyll, protein content and increase in peroxidase enzyme activity was observed which indicated that the plant was under stressful conditions.

In Chinese cabbage, plants found directly under the lines had increased chlorophyll content that will lead to higher photosynthetic activity, which eventually enhance growth.

Nevertheless, no alarming manipulations of the genetic materials from exposure to EMF were observed in the plant species studied except with peroxidase, an enzyme related to stress where an extra isozyme was observed in young oil palm. Since this enzyme is only related to stress, this observation is not worrisome.

High electric field (EF) pulsing of seeds was found to enhance subsequent growth of soybean and *Oncidium taka* (orchid) plantlets grown using tissue culture technique. This aspect can be studied further to realise the potential of using simulated EF as a tool to increase productivity of economically important crops. Optimization of the dosage and exposure period needed to promote growth inevitably warrant refinement.

Metals contamination under pylon and erosion of Al from HVL due to rainfall at this point in time is negligible. The study area has low heavy metals concentration, except for Zn. Comparatively, extractable Zn concentration in soil under pylon is consistently high, but the concentrations are still within acceptable range according to certain standards. This is probably because of the initial washings of Zn by rain from pylons and insulator components (one time erosion). Although Zn concentrations under pylons were high,

there were no increase in Zn content in soil with increasing pylon age, therefore, we suspect very minimal ongoing erosion, if any, from pylons. Aluminium concentrations at control area for soil and plant were higher than that of under HVL area, therefore, it is quite remote to consider that there is erosion of HVL by rainwater. Further more, there was no increase in Al concentration under HVL compared to that of control with increasing age of HVL (7 to 35 years)

Acid rain with pH values equal to or less than 4 eroded more Al ions. Human activities around HVL that could potentially affect the pH of precipitation need to be overseen. HVL that passes through such areas need to be constantly monitored due to higher degree and rate of corrosion.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7308
E-mail: mahmood@agri.upm.edu.my

The Use of Chitosan in Extending the Vase Life of Cut Chrysanthemum and *in vitro* Effect on *Colletotrichum gloeosporioides*, The Causal Agent of Anthracnose Disease of Papaya

Award Winner

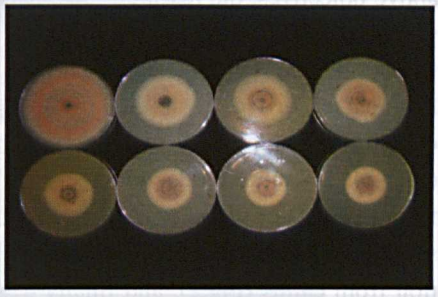
Mahmud Tengku Muda Mohamed, Kamaruzaman Sijam, Mohd. Zaki Abd. Rahman, Siti Hajar Ahmad, Eddy Azian and Asgar Ali

A study was carried out to look at the potential use of chitosan as a vase life preservative. Chitosan was used to control pathogenic fungi and bacterial found in the vase solution after a substantial period of time the flowers were held in the vases. The chrysanthemum (*Dendranthema morifolium* Ramat) cut flowers were treated with chitosan at 0, 25, 50, 75 and 100 mg L^{-1} dissolved in 0.05% ascorbic acid and displayed in the environmental conditions, 25°C±2°C, 70% RH and 15 µmol m^{-2} s^{-1} light intensity from cool-white fluorescent lamps for 12 hours. The results showed that chitosan contained preservative vase solutions at 25 and 50 mgL^{-1} significantly increased water uptake, fresh weight and delaying wilting of cut flowers compared to the control. However, chitosan at higher concentrations, 75 and 100 mg L^{-1} were not effective in controlling vase life of the cut flowers. The former two concentrations were also found to be able to reduce the number of bacterial colonies and inhibited the fungal growth found in the vase solutions. *In vitro* observations found that chitosan at 50, 75 and 100 mgL^{-1} inhibited the diameter of mycelial growth 2 days after incubation as well as reducing bacterial colonies.

Another study was also carried out to evaluate the effects of chitosan on anthracnose caused by *Colletotrichum gloeosporioides* in Papaya fruits *in vitro*. More than 50% inhibition of *Colletotrichum gloeosporioides* mycelium was found in petriplates when 1.75% chitosan was incorporated in the media. It was found that the chitosan markedly reduced the mycelium growth of *C. gloeosporioides* with the greater effect at higher concentrations. After seven days when the control reaches the end of plate, the diameter of fungal colony (PDA) containing 0, 0.3, 0.5, 0.75, 1. 1.25, 1.5and 1.75% chitosan were 80, 49.9, 50.3, 44.6, 46, 42.2 and 38.7mm, respectively.



Cut chrysanthemums in different concentrations of chitosan being displayed in the Postharvest Lab.



Chitosan markedly reduced the mycelium growth of C. gloeosporioides along with increased concentrations (Left to right, up and down)

Reader Enquiry
Department of Crop Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7308
E-mail: mahmood@agri.upm.edu.my

Establishment of Regeneration System through Callus Formation for *In Vitro* Selection of Pineapple (*Ananas comosus* L. Merr)

Award Winner

Mihdzar Abdul Kadir, Maheran Abdul Aziz, Halimah Saimi, Azmi Abdul Rashid and Mohd. Said Saad

Pineapple industry has always been important in Malaysia with the export value exceeding RM 80 million a year. Shortage of high quality planting materials has limit the growth and expansion of the pineapple industry. This research was conducted to establish *in vitro* selection procedures with the objectives of producing new superior pineapple varieties and providing sufficient amount of high quality planting materials for the farmers.



Fig 1: The establishment of in vitro plantlets or globular like structures

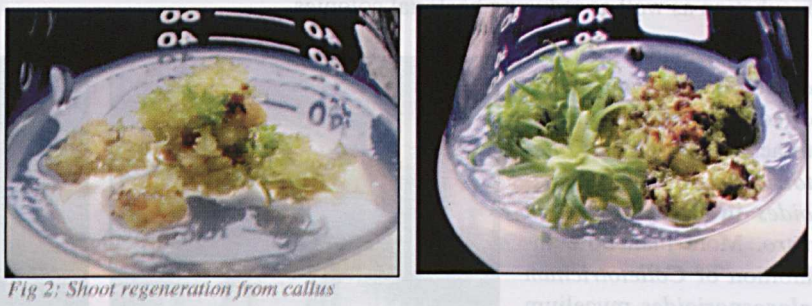


Fig 2: Shoot regeneration from callus

In order to accomplish the above objectives, the research was conducted in four stages which include 1) the establishment of *in vitro* plantlets or globular like structures (Fig. 1). 2) callus production from plantlets or globular like structures 3) shoot regeneration from callus (Fig.2), and finally 4) selection for superior genotypes through *in vitro* mutation. Establishment of plantlets and globular like structures have been achieved successfully by growing pineapple explants in the presence of cytokinins. Highest percentage of callus production was observed from *in vitro* explants cultured on media containing 4 mgL^{-1} of NAA (38.46%). Currently experiments were conducted to develop shoot regeneration system from callus (stage 3) and once the regeneration system has been accomplished future research will concentrate on the development and selection of superior genotypes.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

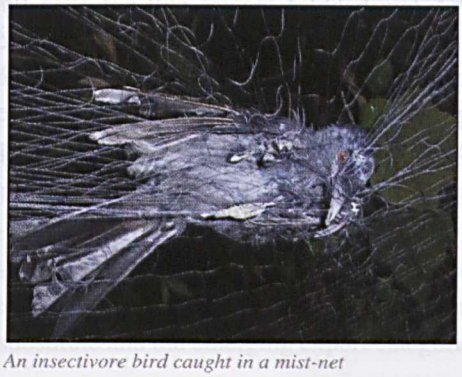
Tel: +603 8946 6931
E-mail: mihdzar@agri.upm.edu.my

Immediate Effects of Selective Logging on the Feeding Guild of the Understorey Insectivorous Bird Species

Award Winner

Mohamed Zakaria Hussin

Many of the wildlife species such as birds (e.g babblers, flycatchers and broadbills) in the tropic prefer to occupy the primary rainforests as their main habitat (Zakaria and Nordin 1998). Although the primary forest in the world is being destroyed everyday and will become a secondary forest, the forest is still able to provide food source and shelter for many wildlife species to survive (Zakaria and Francis 2001). One of the important impacts of primary forest destruction on bird population is a decrease in species number and change in bird community (Zakaria and Francis 2001). Understorey species have been suggested to be affected mostly when the forest structure is altered (Zakaria et al. 2002). This is because understorey species are highly sensitive to high temperature and light intensity. Moreover, the forest regeneration rates will remain a long time before it can recover to original condition.



An insectivore bird caught in a mist-net



A common understorey insectivore/frugivore bird in logged forest



Stachyris poliocephala (Grey-headed babbler = Rimba Kepala Kelabu)



Pycnonotus atriceps (Black-headed bulbul = Merbah Siam Kepala Hitam)

This study examined in detail the feeding guilds of understorey insectivorous birds in primary forest (before logging). The same study was repeated immediately after the forest was logged and the information obtained was compared to see whether there were any changes to the feeding guilds. This study was conducted in Ulu Muda Forest Reserve, Kedah, Malaysia. The area was considered a primary hill forest that covers an area of 791.2 ha. The main objective of this study is to determine the changes of feeding guild of the understorey insectivorous birds before and immediately after logging. Mist-netting method was used to obtain the information on the birds. Pre-logging data collection was conducted from January to December 1997. Post-logging data collection was started from January to December 2000 that is immediately after the completion of logging activities 1.

Results indicated that before logging, 70.3% of the understorey birds were dominated by insectivore group and insectivore/frugivore (16.0%) and frugivore groups (5.1%). However, the insectivore/frugivore group dominated the area immediately after logging (47.3%), followed by insectivore (28.2%) and nectarivore/insectivore/frugivore groups (13.0%). Analysis of feeding guild also shows that primary forest was dominated mainly by the species that belongs to arboreal foliage gleaning insectivore (33.3%), but they decreased to 29.6% in area immediately after logging. In term of the number of individuals, 37.7% of the insectivore guild was recorded in primary compared to only 14.8% in logged area. The arboreal foliage gleaning insectivore/frugivore was found to be higher in term of number of species (28.2%) and individuals (47.3%) in area immediately after logging. Therefore this study suggested that logging has changed the feeding guild structures of the understorey insectivorous birds.

Some species showed positive while others showed negative impacts due to logging. It has been suggested that the changes may be due to alteration in microclimate condition (temperature, light intensity and humidity). Large gaps may increase the temperature, increase light intensity and lower the humidity of the forest interior. It was found that some species, particularly the understorey insectivore babblers and flycatchers could not tolerate harsher environment. A few babbler species will not even fly across sunlit patches. However, species from the insectivore/frugivore (bulbul species) and nectarivore/insectivore/frugivore (flowerpecker/sunbird species) groups were recorded higher following logging. This suggested that most of the species from these guilds could tolerate the harsh microclimate condition in logged forest. They also have been observed to feed on insects and small fruits of secondary plants.

Reader Enquiry
Department of Forest Management
Faculty of Forestry
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7203
E-mail: mzakaria@agri.upm.edu.my

The Competitiveness of Food Processing Industry in Malaysia



Mohd Mansor Ismail and Alias Radam

The competitiveness of manufacturing industry has become an extremely important topic in Malaysia. It is particularly important for food processing industry because the scheduled liberalization of trade preferences under the World Trade Organisation and Asean Free Trade Area would bring about greater challenges to Malaysian food producers. Before penetrating a wider range of markets, Malaysian food processors have yet to identify competitive food sub-sectors. This study attempts to evaluate the competitiveness of selected food products using two indicators, that is, rate of productivity growth and market share. Productivity growth for selected food sub-sectors is assessed using the Non-Parametric Malmquist Index Approach of Total Factor Productivity growth. Selected food products that sustain a high level of productivity growth may be considered viable to compete with foreign products in the domestic and/or overseas market. The purpose of this study is to analyse the sources of productivity growth in the food processing industry over the period, 1973 to 1995.

The results indicate that most of the Malaysian food sub-sectors experienced low productivity growth except for Meat, Palm oil, Palm kernel oil, Ice cream, Milk and Fish sub- sectors. The market share for selected food sub-sectors is assessed using Revealed Comparative Advantage (RCA). Results of the study indicate that major exports from Malaysia show declining competitive advantage even though they are competitive at the sectoral level. It can be deduced that Malaysia has competitive advantage in the traditional export category (cocoa, palm oil, pepper, pineapple and coconut) but competitive disadvantage in the import substitute and the emerging export categories (beef, rice, wheat and milk).

Reader Enquiry
Department of Agriculture and Bio Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7455
E-mail: mmi@agri.upm.edu.my

Effects of Legume Inclusion in Grass-Based Silages



Mohd Ridzwan Abd Halim

Fast growing fodder grasses such as elephant grass (*Pennisetum purpureum*) can be ensiled when cut after about 5-6 weeks of regrowth but often the silages based solely on grass have low protein and soluble sugar content which makes their quality rather poor. This study was aimed at determining whether addition of gliricidia and leucaena foliage can improve the quality of silages based on King grass and Dwarf Napier. In experiment I the ratio of legume to grass was varied at levels of 0, 20, 30 and 40 percent by weight. Subsequently in experiment II the proportion of legumes was fixed at 30 percent as this was shown to be the optimum ratio of legume to grass. In the second experiment, treatments comprised of grass silage with the addition of urea, urea and molasses in addition to legume-grass silages. This was to evaluate the effects of legume inclusion compared with urea/molasses as additives.



Chopping



Dwarfnapier

The results show that for both King grass and Dwarf Napier, addition of legumes had some beneficial effects on the quality of silage produced. Inclusion of legumes resulted in reduced pH, especially for Dwarf Napier where pH remained at a high of 5.53 without legumes but was reduced to 4.42 and 4.66 after inclusion of 30% gliricidia and leucaena, respectively. Soluble sugar levels also increased for King grass when legumes were incorporated. Crude protein increased with addition of legumes. King grass silage without legumes had crude protein level of 5.33% but this increased to 9.08% when leucaena was incorporated. Dwarf Napier silage mixed with 30% leucaena had a protein level of 12.01%. The second experiment substantiated the benefits of legume inclusion shown in experiment I. The quality of legume-grass silage was better than pure grass silages with addition of urea or molasses.

Reader Enquiry
Department of Soil Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7259
E-mail: ridzwan@agri.upm.edu.my

Production of Soil Amendment from Sewage Sludge by Composting Process

Award Winner

Mokhtaruddin, A.M, Fazrul Edlin Saleh, Syed Omar Syed Rastan and Halimi Mohd. Saud

High pathogen and heavy metal contents in the sludge limits it use as a soil amendment. Composting under conducive conditions can develop thermophilic temperatures ranging from 55°C to 75°C sufficient to kill most of the pathogens (Metcalf and Eddy, 1991). The final product produced is stable, safe and easy to handle, and can be beneficially applied to land. Thus the objective of this study is to search for a suitable composting formulation for production of a soil amendment from sewage sludge.

It was found that with addition of suitable additives, the sludge can be converted to a safe soil amendment by composting. Out of the seven formulations tested, it was found that the best one was the mixture of sludge to sawdust (2:1, sludge: sawdust)+Beneficial Microorganism+Molasses+Rice bran. This composting formulation was able to increase the composting temperature >55° C for an extended period. This high compost temperature resulted in substantial reduction in microbial population in the sludge compost especially the pathogenic coliforms. The resultant compost is also friable and easy to handle and bagging.



Plate 1: Preparation of compost mixture

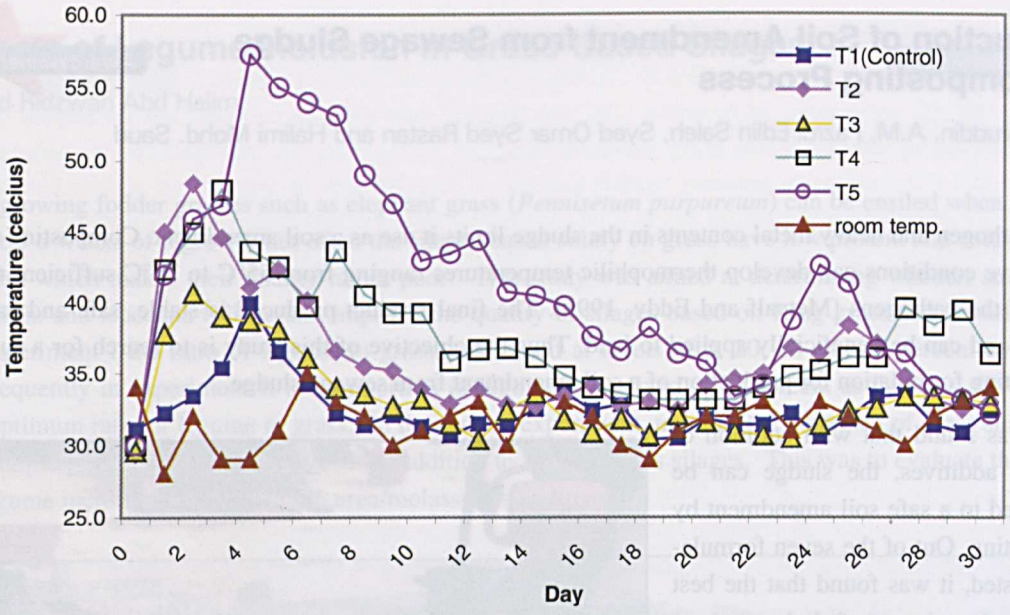


Fig.1: Temperature variation during composting

In conclusion, it is possible to convert the raw sewage sludge into a safe soil amendment by composting. The composted sludge is low in pathogens, friable and easy to handle and has potential to be used for reclamation of degraded land and as bulking and mulching material in landscaping and hydro seeding for slope stabilization.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6976
E-mail: mmokhtar@agri.upm.edu.my

Production of Tropical Fruit Powders Using Spray Drying and Agglomeration Technology

Nazimah Sheikh Abdul Hamid, Quek Siew Young, Gulam Rusul Rahmat Ali, Russly Abdul Rahman, Dzulkiflee Mat Hashim

Dried fruit concentrates contain a high percentage of fruit solids. Scientific studies now show how compounds found in fruit - specifically anthocyanin and phytochemicals - offer a range of functional health benefits. Fruit powders contain many of the essential phytonutrients and anti-oxidants the body needs to remain healthy. They add natural colour and are an excellent addition to dry mixes, confectionery products, nutraceutical products and beverages. Fruit powders may be easily dissolved or blended with other fruit flavours. The final product is delivered as a free-flowing powder which retain a much more natural flavour.

The fruit powder is full flavoured and ideal for inclusion with products or fruit drinks. Dried fruit powders may produce a wealth of exotic flavours, at a very competitive price. The dried fruit powder is easier to transport than purees or fruit juices and also offers easier storage. The advantages of fruit powder include; solubility and reconstitution, cost effectiveness, concentrated taste and flavour, as well as guaranteed minimum shelf life of one year from date of manufacture. Applications of fruit powder include use in instant soups, snacks, bakery, beverage, dairy, candy, ice-cream, baby food, pasta, etc. Spray drying and freeze-drying are the major process employed to produce dry flavourings. Processing of tropical fruit flavours into the powder form enables the industry to diversify products made from these seasonal fruits in order to penetrate international markets. This is in line with the Third National Agricultural Policy (1998-2010), which encourages new product innovations to convert raw materials especially tropical fruits like pink guava, pineapple star fruit and mango to higher value end products.

Good rehydration and retention of aroma and nutrients are essential in dried fruit powders. Glycosidic non-volatile flavour precursors may generate aroma-active volatiles through thermal treatments or acid and enzymic hydrolyses. Commercial enzymes containing high glycosidase activities may enhance the flavour of the pressed juice by the hydrolysis of the glycosidic aroma precursors present in all fruits. A juice concentrate having a good flavour is essential in producing a fruit powder of high quality. Volatile aroma components (about 60 – 80%) can be retained in the dried product by the mechanism of encapsulation. Flavour encapsulation offers many advantages. One of them is that it could retain the volatile compounds and protect the flavour from undesirable interactions with the food and other flavour component. It also guards against light-induced reaction or oxidation to control the release of flavour (Reineccius, 1991). Retention of the volatiles is explained on the basis of the selective diffusion theory. As the drying proceeds, the diffusivity of the aroma components in the dried matrix is reduced more sharply than water diffusivity.

Instant properties of the tropical fruit powder involve its ability to dissolve in water. Each particle has to be wetted, sunk in the liquid, and dissolved. Properties like wettability, sinkability, dispersibility and solubility are of importance for the reconstitution process. The transformation of single particles into porous agglomerates is known as the instantizing process (Masters, 1991). Good rehydration of the spray-dried fruit powders is attributed to the porous structure of the dried particles. The porous structure allows the quick entry of water and subsequent sink, and the dispersion and dissolution of the solids. The agglomeration process changes the characteristics of the powder to such an extent that wetting, sinking, and dispersing are increased to a point where reconstitution occurs quickly.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

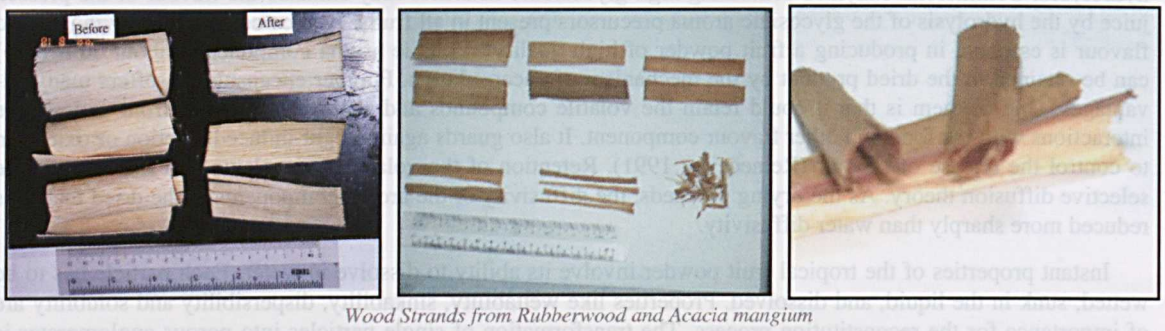
Tel: +603 8946 8386
E-mail: nazimah@putra.upm.edu.my

Development of Dimensionally Stable Multilayered Oriented Strand Board from Plantation Species by Phenolic Resin Impregnation

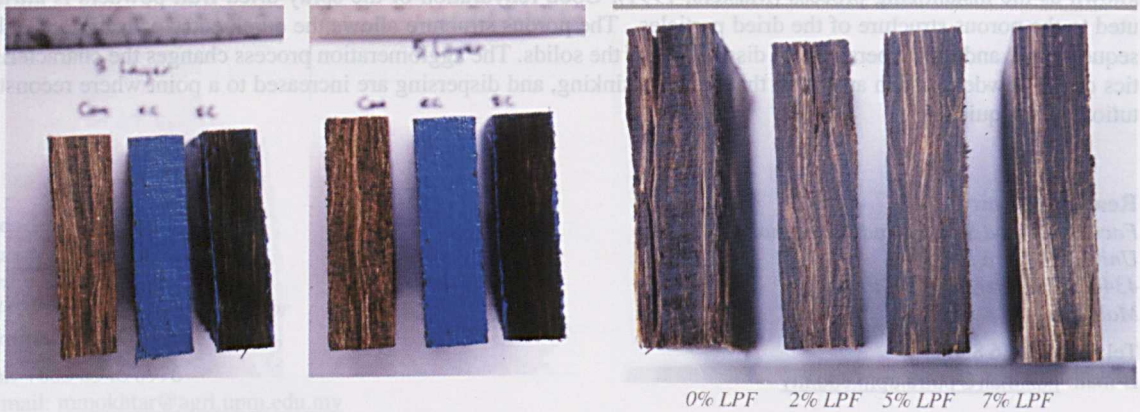
Award*Winner*

Paridah Md. Tahir

Wood composite panels such as plywood, particleboard and oriented strand board (OSB), are known to be hygrothermal-viscoelastic materials. The load-carrying capacity of these materials would be changed substantially when they are subjected to changing relative humidity. Since OSB is normally used as floor sheathings or as concrete form works, it is most likely being exposed to high moisture surroundings for a long period of time. Hence, the evaluation of physical properties of the board under moisture influence such as thickness swelling, linear expansion and water absorption are crucial. This study was carried out to investigate the effectiveness of pre-treating the wood strands with low molecular weight phenol formaldehyde (LPF) resin to improve the dimensional stability of oriented strand board (OSB). Three- and five-layered OSBs were fabricated from *Acacia mangium* and *Hevea brasiliensis* wood strands by first impregnating them with LPF resin. The LPF-coated strands were left for air dry prior to spraying with 5% w/w conventional PF resin. The properties of the OSB were evaluated in accordance with the Japanese Industrial Standard, JIS A5908 - 1994. The origin of thickness swelling (TS) was determined by coating method where the edges and surfaces of the panel were coated with oil-based pigmented paint. To assess the degree of TS, the OSB specimens were sliced/sectioned into four layers through the thickness direction of the panel and were subjected to 24 hours cold water soaking.



Wood Strands from Rubberwood and Acacia mangium



0% LPF 2% LPF 5% LPF 7% LPF

The results show that the higher density layer experienced relatively higher TS. The a verage Pearson correlation between board density and TS were > 0.90 suggesting that there was a positive relationship between board density and thickness swelling. Impregnating the wood strands with LPF had significantly improved the TS to < 5%, at the same time enhanced the strength of the boards. Between Rubberwood and *Acacia mangium*, the later showed significantly higher improvement in both the strength (MOR) and the stiffness (MOE) of the board. Although the internal bond (IB) strength was reduced, increasing the hot pressing time from 3.5 min to 7 min improved the bonding tremendously.

Reader Enquiry
Department of Forest Production
Faculty of Forestry
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7187
E-mail: ftahir@forr.upm.edu.my

Cell Structures of the Peel of Mature Green Banana *Musa* AAA 'Berangan'

Phebe Ding, Siti Hajar Ahmad and Abdul Rahman Abdul Razak

Stomatal density/unit area of fifteen different locations on the peel of mature green 'Berangan' banana was determined. The mid region of green mature Berangan was fixed and processed to examine the cell structures using light microscope and scanning electron microscope. Fruit of Berangan consist of the peel, peel-pulp transition and pulp regions. Epidermal cells formed the outer layer of peel and were covered by cuticles and wax. Stomatal density of Berangan was 400 stomata/cm^2. Inclusions that appeared in the peel were i) vascular bundles surrounded by a ring of laticiferous ducts, ii) tannin bodies and iii) cells containing raphide.

Ninety-nine percent of the overseas market for Malaysian banana is confined to two neighbouring countries, Singapore (80%) and Brunei (19%). Only 1% of the banana reached Hong Kong, Taiwan and Japan. The restricted market for Malaysian banana is attributed to the lack of post harvest technology to withstand the long shipping time to the distant market. Several attempts were made to adopt the postharvest technology for Cavendish to local bananas such as 'Mas' and 'Berangan'. However, despite minor modifications to the adopted technology, it appears not be suitable to the local varieties. Very little is known about the relationship between structures and functions of cells in the banana fruit. This paper examined the surface cell structures of Berangan with emphasis on the peel.

Berangan of green mature stage, with fingers weighing 90–100 g each and free from mechanical injury, insect and fungal damage were used in the experiment. Stomatal densities/unit area of fifteen different locations on the peel was assessed using nail varnish technique and counted with optical compound microscope. The peel thickness was measured at the mid region of fruit using vernier calliper. Transverse section at mid region of fresh fruit was observed under Hi-Scope, HIROX, Japan. Samples of the peel and the outer part of the pulp, measuring 0.5 cm x 1 cm, were cut from the mid region of the fruit and fixed in Bouin's fixative. The block was divided into two groups. Only one group was post fixed in 1% osmium tetroxide dissolved in 1% cacodylate buffer. Then, dehydrated through graded series of ethanol to absolute ethanol. Tissues post fixed in osmium tetroxide was CPD and subsequently prepared for SEM viewing under JOEL 6400 SEM. The second group of tissue blocks was processed for wax embedding and sectioned with microtome for histological studies.

The Berangan banana finger is a berry fruit since it develops parthenocarpically from the inferior ovary. The fruit is made of pulp enclosed in a thick layer of peel. The peel is the ovary wall. The peel was 0.35 cm thick and consisted of a layer of epidermal, hypodermal and transition cells linking the peel to the pulp (Plate 1). The hypodermal and transition cells were parenchymatous cells. Intersperse in the rows of hypodermal cells were i) vascular bundles surrounded by a ring of laticiferous ducts, ii) tannin bodies and iii) needle shaped inclusions of cells. The parenchymatous cells at the peel-pulp transition region contained starch granules of irregular shapes, ranging from spheroid to oval or elongated.

SEM examination of the peel revealed that epicuticular cells were arranged in rows with a layer of unstructured ridges of thick wax deposition giving papillae surface topography (Plate 2A). The epicuticular

cells were hexagonal in shape and helped in strengthening cell structures. There was no set pattern of stomatal arrangement. The stomata were elliptical in shape with guard cells surrounded by subsidiary cells (Plate 2B). The extended wings were pronounced.

The vascular bundles consisted of large metaxylem vessels, protoxylem and phloem. Xylem tracheid, which was a water-conducting tissue, form ladder like series called scalariform. The lignified fibers ensheathed the vascular bundle and provided mechanical support for the peel. Laticiferous or latex vessels formed rings around the vascular bundles. These vessels contained tannins and exuded latex when wounded. Idioblast cells could be easily found in Berangan banana peel. These cells contain raphide, a long, thin crystal with pointed end composed of calcium oxalate. Idioblast cells were larger with thicker cell wall than other parenchymatous cells.

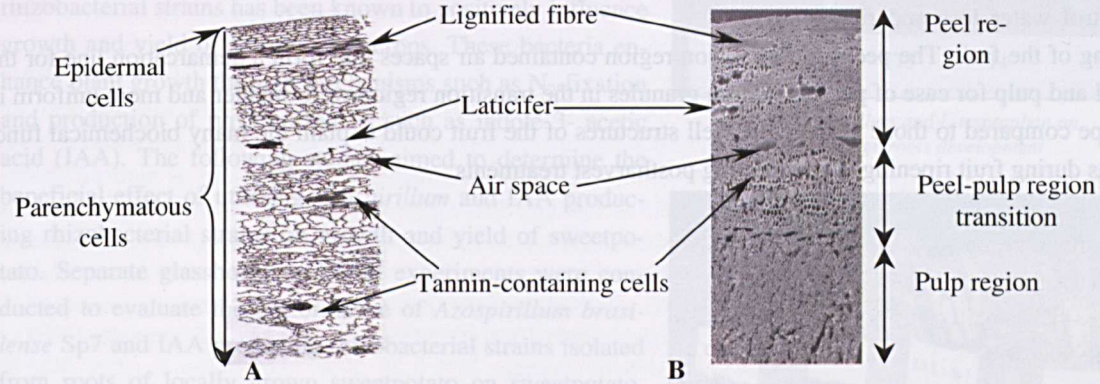


Plate 1. Longitudinal section of mature green Berangan banana
A. Light micrographs-camera lucida drawing (x400)
B. Scanning electron micrographs (x27)

Cells at the innermost portion of the peel showed beehive structures with hexagonal shape when sectioned longitudinally. Tannins were detected also in small-scattered isolated cells with dense contents occurring in the outer and middle peel not associated with vascular bundles. Starch granules and air space appeared in the transition region. Pulp of mature green Berangan was full of starch granules ranging from oval to irregular shapes with oval and elongated forms being predominant. The surface of the mature green banana starch granules appeared smooth. The sizes were also variable, 61% of the granules were 21-35 µm in length and 56% were 6-15 µm in width. Tannins with dense contents were detected also in small-scattered isolated cells in the pulp. Tannin, a polyphenol, contributed to the astringency taste in fruits. The existence of this tannin in Berangan banana also caused severe browning in mature green fruit.

This study showed that fruit of Berangan consists of peel, peel-pulp transition and pulp regions. The stomatal density of Berangan was less than Cavendish. Stomata were thought to be the principal route for gaseous exchange. The stomatal densities could affect postharvest treatments to control water loss and ripening of the fruit. The peel-pulp transition region contained air spaces that form a demarcation line for the peel and pulp for ease of peeling. Starch granules in the transition region were smaller and more uniform in shape compared to those in the pulp. Cell structures of the fruit could explain the many biochemical functions during fruit ripening, thus affecting postharvest treatments.

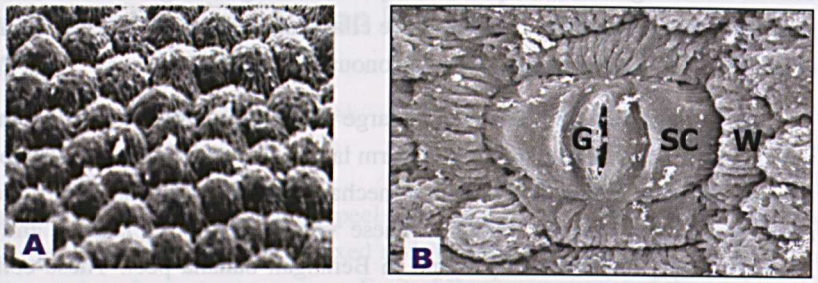


Plate 2. Scanning electron micrographs of the peel of mature green Berangan banana
A. Papillae surface topography (x 400)
B. Stomatal complex
G: guard cell, SC: subsidiary cell, W: extended wing (x1,300)

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

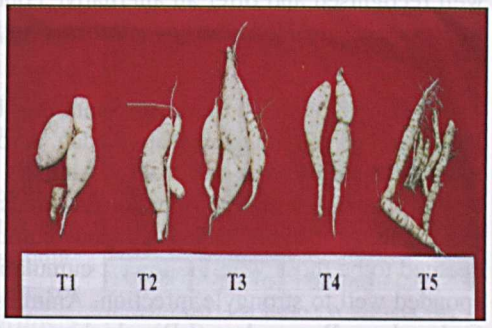
Tel: +603 8946 6960
E-mail: phebeding72@hotmail.com

Utilization of Rhizobacteria for Increased Growth of Sweetpotato

AwardWinner

Radziah Othman and Zulkifli H. Shamsuddin

Commercial production of sweetpotato requires high fertilizer input that can finally lead to environmental problem and high production cost. One of the methods to sustain production of sweetpotato is through application of beneficial micro organisms such as plant growth-promoting rhizobacteria (PGPR). Application of *Azospirillum sp* and several rhizobacterial strains has been known to positively influence growth and yield of several field crops. These bacteria enhance plant growth through mechanisms such as N_2-fixation and production of phytohormones such as indole 3- acetic acid (IAA). The following studies aimed to determine the beneficial effect of utilizing *Azospirillum* and IAA producing rhizobacterial strains on growth and yield of sweetpotato. Separate glasshouse and field experiments were conducted to evaluate the performance of *Azospirillum brasilense* Sp7 and IAA producing rhizobacterial strains isolated from roots of locally grown sweetpotato on sweetpotato. The effect of fertilizer nitrogen and tryptophan as a precursor to IAA biosynthesis on plant growth and yield was also evaluated.



Effect of Azospirillum and L-tryptophan on sweetpotato storage roots development



Effect of Azospirillum on sweetpotato yield

Our studies showed that inoculation of sweetpotato Gen-Gendut with *Azospirillum* Sp7 significantly increased yield of tubers. Plants inoculated with the bacteria together with tryptophan and 1/3 of N gave the highest tuber dry weight compared to non-inoculated plants. Inoculation also increased the uptake of N, P and K in shoots and production of IAA in soil. Application of 1/3 N to inoculated plant resulted in growth comparable to that with full fertilization. Inoculation of plants with SPR100 strain in the presence of tryptophan produced higher shoot growth and tuber yield and promoted early tuber development. Utilization of rhizobacteria has the potential to increase growth and yield of sweetpotato at reduced N fertilizer application.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6980
E-mail: radziah@agri.upm.edu.my

Selection of Sheep Resistant to Worms



Rehana Abdullah Sani and Jothi Panandam

Genetically determined differences in the resistance of animals to gastro-intestinal nematode infections are well recognised and offer an alternative control procedure. The objective of this study was to select sheep for resistance to *Haemonchus contortus* and to investigate the inheritance of that resistance in their offsprings.

The breed of sheep used was Santa Ines belonging to Ladang Pembiakan Bebiri, Jabatan Perkhidmatan Haiwan Malaysia at Gajah Mati, Kedah. A total of 57 animals were selected from a population of 123 three month-old lambs from two flocks. Animals were categorised based on their faecal egg counts (FEC) following naturally acquired infection. Animals were ranked according to their individual FECs for each sampling date. At the end of the field study cumulative ranking was obtained. High responder lambs (HR) were deemed to be those with the lowest cumulative FEC ranking (mean epg < 2725) or those lambs which, responded well to strongyle infection. Animals with highest overall ranking (mean epg > 3675) were classified as Low Responders (LR) which were more susceptible to strongyle infection. The selected animals were treated to remove the field infection and subsequently infected with larvae of *Haemonchus contortus* to study their response to experimental infection. Based on their responses to the field as well as experimental infections, the animals were classified as HR and LR. Upon attaining sexual maturity HR males were mated with HR females and LR males were mated with LR females. The offsprings of these matings, at 3-4 months old, were challenged with infective larvae to confirm their responder status and hence the inheritance of resistance. The lambs were also weighed pre-infection and post-infection for a period of 12 weeks. FECs of HR animals at pasture was significantly ($P<0.001$) lower than that of LR animals. FECs of HR animals was also significantly less than the herd average.

Following challenge infection the differences in FEC between the HR and LR animals were significantly different post-infection.

The FECs of the pedigrees showed that sires and ewes who are high responders produced offsprings who have similarly low FECs. Conversely parents who are low responders produced lambs with high FECs.

In the present study there was no significant difference in body weights of lambs between the responder animals. Genetically resistant lambs had no significant growth rate advantage over their susceptible counterparts when both genotypes grazed together under the same nematode challenge.

The appearance of a trend of higher FEC among the LR animals when compared to HR animals suggest that it is possible to segregate animals into high and low responders based on FECs and that FEC can be used as an indicator for resistance. This study shows that it is possible to select and breed *Haemonchus contortus* resistant lines of Santa Ines sheep. Resistant lines of sheep are of economic interest in areas where production losses due to helminthosis are severe.

Reader Enquiry
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8289
E-mail: rehana@vet.upm.edu.my

The Role of Metabolic Enzymes in the Development of Resistance in Cocoa Mirid, *Helopeltis Theivora* Waterhouse

AwardWinner

Rita Muhamad Awang, Dzolkhifli Omar and Tan Soon Guan

Topical bioassays were conducted to evaluate the toxicity of deltamethrin, cypermethrin, γ-HCH and chlopyrifos against 3 populations of *H. theivora* namely the cocoa populations (Serdang, Selangor) and Sungai Tekam, Pahang) and tea population (Banting, Selangor). The synergistic effects of piperonyl butoxide (PBO), maleic acid diethyl ether (MADE) and s,s,s-tributyl phosphorotrithioate (DEF) were also tested using similar technique. Based on the LD_{50} values, the toxicity of the insecticide tested for the Serdang and Sungai Tekam populations were chlopyrifos > γ-HCH > cypermethrin > deltamethrin; for the Banting population was γ-HCH > cypermethrin > chlorpyrifos > deltamethrin. The most toxic insecticide was chlopyrifos with LD_{50} value of 3.028×10^{-2} mg/L for the Sungai Tekam population. The synergism of PBO on cypermethrin was higher compared to other insecticides tested. Cypermethrin showed synergistic values of 13-fold followed by γ-HCH and chlorpyrifos with synergistic values of 7 and 6-fold, respectively for Sungai Tekam population. The DEF gave a synergistic value of 4-fold against all populations tested while MADE gave a synergistic value of 6-fold against Sungai Tekam population. These results showed that monooxygenases were very active in the Sungai Tekam population. The increased in synergism of DEF indicated there were increase in enzyme activities of esterases.

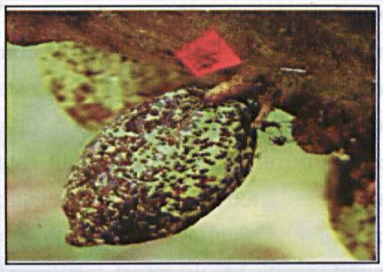


Fig.1: Damage symptom on cocoa pods



Fig.2: Damage symptom on young cocoa shoots

These results indicated that this enzyme could also have played a role in metabolism of chlorpyrifos, cypermethrin and deltamethrin for all the population tested. The resistance ratio of 25-fold for cypermethrin in the Banting population and 13-fold for chlopyrifos in the Sungai Tekam population were higher compared to Serdang population (susceptible population). The Sungai Tekam population showed increasing tolerance towards the insecticides tested compared to Banting and Serdang populations. Results indicated the impending resistance in the mirids. Formulation of chemical management is necessary to be integrated into the pest management of the pest. Effective resistance management in agricultural insect pests depends on early detection of the problem and rapid assimilation of the information on the resistant population.

Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7244
E-mail: rita@agri.upm.edu.my

Recycling of Crop Residues for Sustainable Crop Production in Maize-Groundnut Rotation System



Rosenani Abu Bakar, A.R. Mubarak and Siti Zauyah



Recycling of Crop Residues for Sustainable Crop Production

Burning is a common practice in Malaysian farms, to control weeds and pests. This renders the C and N sequestered in the biomass to be lost, apart from contribution to pollution. A long-term field experiment was established in February 1997 to investigate the contribution of crop residues to the N – economy of a maize-groundnut rotation system. The experiment consisted of three treatments: (i) T1 – recommended rate of chemical fertilizer with residue, (ii) T2 – recommended rate of chemical fertilizer without residue and (iii) T3 – combination of organic fertilizer (chicken manure) and chemical fertilizer with residue. In order to investigate the N contribution, derived from the first crop (maize) residue to subsequent crops, the 1st maize crop was labelled with ^{15}N in the T1 and T2 treatments. The first crop was sown in March 1997 and ^{15}N-labelled N fertilizer (ammonium sulphate, 9.82% a.e.) was applied (60 kg ^{15}Nha-1) to the T1 and T2 treatments in a microplot (4m x 4m) within each yield plot (20m x 8m), to generate labelled maize residue. At the same time 90 kg Nha^{-1} unlabelled N fertilizer was applied to supplement the recommended N rate for maize of 150 kg Nha^{-1}.

Recoveries of fertilizer ^{15}N by the first crop ranged from 19.3% to 21.6%. In the following crop the recoveries of applied fertilizer ^{15}N were only 5.1% and 5.6% in plants of T1 and T2 treatment plots and trace recoveries of ^{15}N in the subsequent crop. However, fertilizer ^{15}N retained in the soil after harvest of the first crop was 35.3 – 43.8% whereas after the 2nd crop there was 33.0% in crop residue treated plots and 26.2% in plots where crop residues were removed. Nitrogen and K uptake by the subsequent crops were significantly higher in crop residue treatments (T1 and T3) whereas P, Ca and Mg were not significantly affected by application of crop residues. Soil pH and physical characteristics were not changed after four crop residue applications. However, soil available P and exchangeable K were significantly higher in plots with crop residues. The contribution of crop residues to the crop yield was not significant after 6 crop cycles. Crop response to crop residue incorporation may be more significant in the long-term.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6981
E-mail: rosenani@agri.upm.edu.my

Crop Management Practice Affecting Methane Emission on Flooded Rice—The Effect on Four Major Rice Cultivars Planted on Irrigated Paddy Fields in Central Java, Indonesia

AwardWinner

Rosenani Abu Bakar, Prihasto Setyanto, Khanif Jusop, Che Fauziah Ishak and Rizaldi Boer

Field experiment was conducted under tropical condition to understand the mechanism of rice cultivar differences in methane (CH_4) emission. Four rice cultivars were studied. The cultivars are, Memberamo, Cisadane, IR64 and Way Apo Buru. These cultivars were the commonly planted by farmers in flooded rice of Central Java, Indonesia.

The objectives of this study are to determine the effect of rice cultivars on CH_4 emission from flooded rice and to develop crop management strategies with low emitting rice cultivars while sustaining high yield. The CH_4 emissions were determined in the wet season of 2001/02 (November-February) using an automated closed chamber technique in an irrigated field condition. Farmyard manure at the rate of 5 t ha^{-1} was given to the plots to ensure carbon was not limited. The mean CH_4 emission was highest in the plot with the variety Cisadane (94.8 kg CH_4 ha^{-1}), and the lowest with the variety IR64 (37.7 kg CH_4 ha^{-1}). While the plots treated with Memberamo and Way Apo Buru variety resulted an intermediate emission at the average of 61.1 and 58.9 kg CH_4 ha^{-1}, respectively. There was no significant difference between the varieties. The yield of Memberamo, Cisadane, IR64 and Way Apo Buru were 5882, 5764, 5873 and 6065 kg ha^{-1}, respectively. Plant parameter consists of weight and lengths of root, biomass and tiller number were also determined at 17, 36 and 57 days after transplanting (DAT). Statistical analysis shows that there was no significant difference in the root weight and length among cultivars at 0-10 cm and 10-20 cm depth. However, Cisadane variety gave the highest dry matter weight (222 g $hill^{-1}$) at 57 DAT compared to the other varieties (175-190g $hill^{-1}$). Plant tiller does not show significant differences between the cultivars. This finding provides important information in developing mitigation strategies with the approach of using rice cultivars.



Crop Management Practice Affecting Methane Emission



Crop Management Practices

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

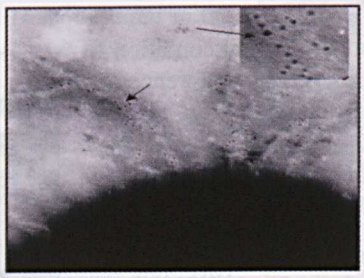
Tel: +603 8946 6981
E-mail: rosenani@agri.upm.edu.my

The Epidemiology and Pathogenesis of Ovine Footrot in Malaysia

Award Winner

S. Jasni, K. Al-Jashamy, A. R. Mutalib, M. L. Mohd. Azmi, Z. Zakaria, S. Z. Ramanoon and A. R. Sheikh-Omar

The current study attempts to elucidate the prevalence and virulence of locally isolated strains of *D. nodosus* and the pathogenesis of the resulting disease lesion. Eight sheep farms were infected with *D. nodosus*. Five serogroups namely A, B, C, F and I as well as eight serotypes namely A1, A2, B1, B2, C1, F1, F2 and I were identified.

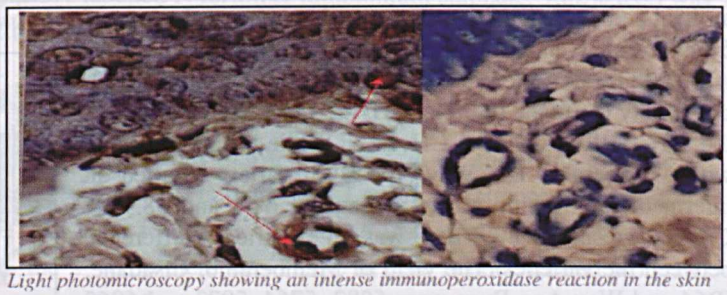


Negative stained ofvirulent strain serogroup B of D. nodosus. Note the fimbriae are labelled with numerous 5 nm gold probes (arrows)



TEM of foot of sheep experimentally infected with virulent strain D. nodosus showing the gold labelling the bacterium with the gold probes 5nm in an intracellular space

Virulent footrot observed was characterised by a grossly progressive separation of the horny tissues from the soft tissues. In severe cases, there was almost a complete separation of the wall from the under running structures.



Light photomicroscopy showing an intense immunoperoxidase reaction in the skin

Scanning electron microscopy showed that virulent *D. nodosus* produced a severe zone of lysis appearing as a surface depression around bacteria in the horny layer of the interdigital skin of the hoof. Transmission electron microscopy showed a degeneration of the basal cell layer and the basement membrane in both the epidermis and dermis.

Immunohistochemistry observations were found to be inadequate to validate the relationship between the lesions seen in the footrot and *D. nodosus* virulence. Specific reaction was labelled in intracellular components and the matrix of epidermis and dermis of the interdigital skin. Immunoperoxidase and immunogold staining techniques were developed to detect and localize *D. nodosus* for both light and electron microscopy. *Dichelobacter nodosus* antigen labelled with 5 nm gold particles was observed in the intracellular space of the epidermis. Immunostaining reaction of benign footrot lesions was less intense than of virulent footrot in the interdigital skin layers. We believe this is the first time that immunoperoxidase and immunogold labelling have been used in the ultrastructure study of footrot lesions.

Reader Enquiry
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

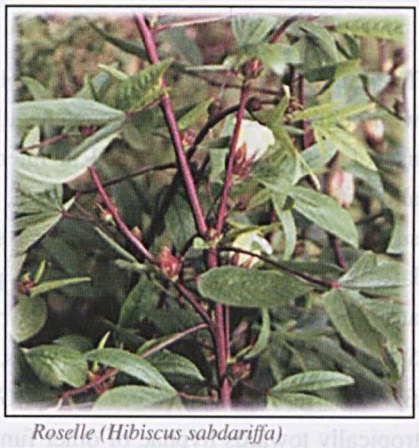
Tel: +603 8946 8307
E-mail: jasni@vet.upm.edu.my

Roselle and its Benefits

Salmah Yusof, Tee Pau Ling and Suhaila Mohamed

Award Winner

Roselle (*Hibiscus sabdariffa*) is a new commercial crop of Malaysia. It is mostly grown in the east coasts of the peninsular. The crop now receives a lot of attention because of its potential health benefits, which are not known to many.



Roselle (Hibiscus sabdariffa)

The research revealed that besides other components, Roselle contains high phenolic components namely anthocyanins. It also contains higher amount of ascorbic acid and vitamin A compared to the imported fruits like strawberry, raspberry and blueberry. The anthocyanins in Roselle contribute to the fresh natural colour. Thus currently there is a demand for Roselle to be used as a colouring agent in various products. Roselle anthocyanin has also been shown to act as antioxidant. The antioxidative activity is higher compared to BHA and ∝-tocopherol. Roselle also has been shown to be able to control cholesterol level and reduce gain in weight.

Reader Enquiry
Department of Food Technology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8410
E-mail: salmahy@putra.upm.edu.my

Development of Biopesticide for the Control of Soil-Borne Disease



Sariah Meon

The increasing damage to crops by plant pathogens coupled with public concern about human health, environment and the use of pesticides has resulted in intensive research towards alternative methods of disease control, aimed at low input and sustainable agriculture. *Trichoderma* species have been isolated from rhizosphere of crop plants having strong antagonistic activities against soil-borne pathogens, such as *Sclerotium rolfsii, Pythium splendens, Fusarium oxysporum fsp cubense, Rhizoctonia solani* and *Ganoderma.* They grow tropically towards hyphae of other fungi, coiled around them in a lectin-mediated reaction, and degrade cell wall of the target fungi. This process (mycoparasitism) limits growth and activity of plant pathogenic fungi. In addition to, and in conjunction with mycoparasitism, they produce antibiotics, and are good competitors for nutrients and space.



Biological seed treatment for controlling Rhizoctonia rot



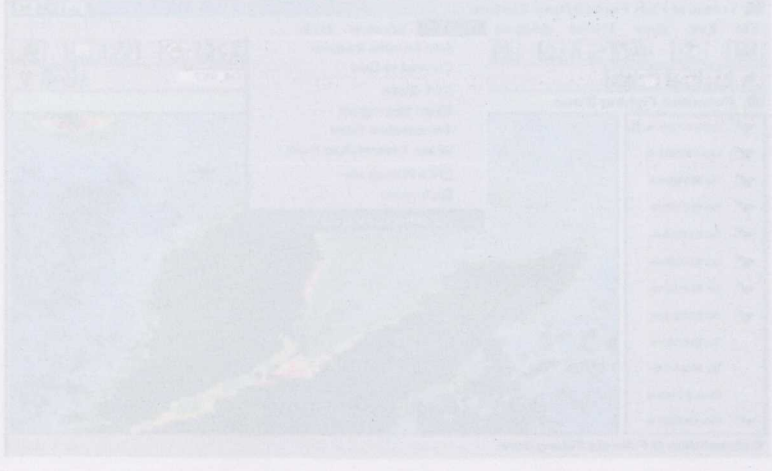
Delivery system of biopesticide-Biological seed treatment



Effect on plant growth

Air-dried preparation of the biopesticide used in seed treatment or as additive to cultivation mixes protect the spermatosphere, roots and subterranean parts of crop plants against infection by soil-borne pathogens. Improved the keeping quality and viability of *Brassica* seeds, and protect the germinating seeds against *Pythium* damping-off, due to its ability to colonize, compete for nutrients and directly parasitizing the pathogen. Losses due to seedling disease were reduced by about 65%. When used as additive to potting mixes, improved vegetative growth of cauliflower and tomato raised in soil less mix under controlled environment. Soilless mixes are inert cultivation substrates (coconut dust, paddy straw, palm oil mill effluent), which lack microorganisms beneficial for plant growth or as bioprotectants against soil-borne pathogens. The microbial preparation has the potential for field application as incorporation into individual planting holes can holes can reduced incidence of *Sclerotium* blight disease by 30% in field grown chilli plants. The microorganisms can proliferate and survive in the rhizospheres and on roots of the tested plants, maintaining an effective population until 5-7 weeks after application. The use of *Trichoderma* preparations, which are

efficacious and environmentally friendly, can provide options for growers to be less dependent on pesticides. They have more specific effects, with only the target pathogen being affected, leaving other beneficial organisms and a diverse biotic community intact to provide for healthier growth.

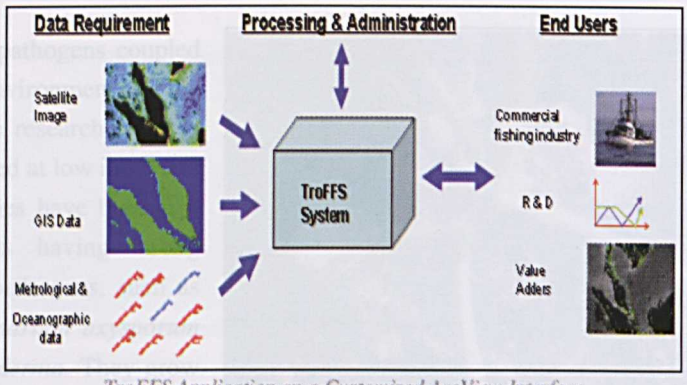


Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7247
E-mail: sariah@putra.upm.edu.my

Tropical Fish Forecasting System (TroFFS)

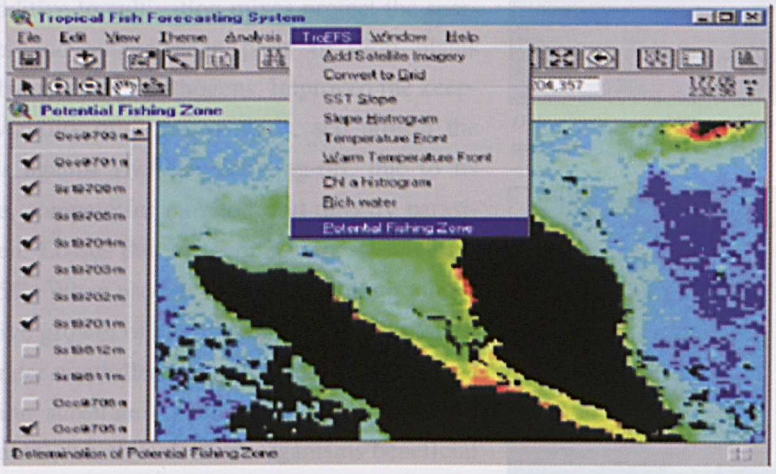
Shattri B. Manor, Lawal Billa, Mohd. Ibrahim Hj. Mohd, Tan Chun Knee,
Ahmed Rodzi, Abdul Rashid Mohd. Shariff and Ahmed Kamel Bin Abdul Ghani

The extensive commercial fishing interest in the South China seas has necessitated the development of this Tropical Fish Forecasting System (TroFFS). Increasingly there has been a need for a sustainable planning and management approach not only to check the depletion of fish stocks but also to help the fishing industry forecast potential fishing areas.

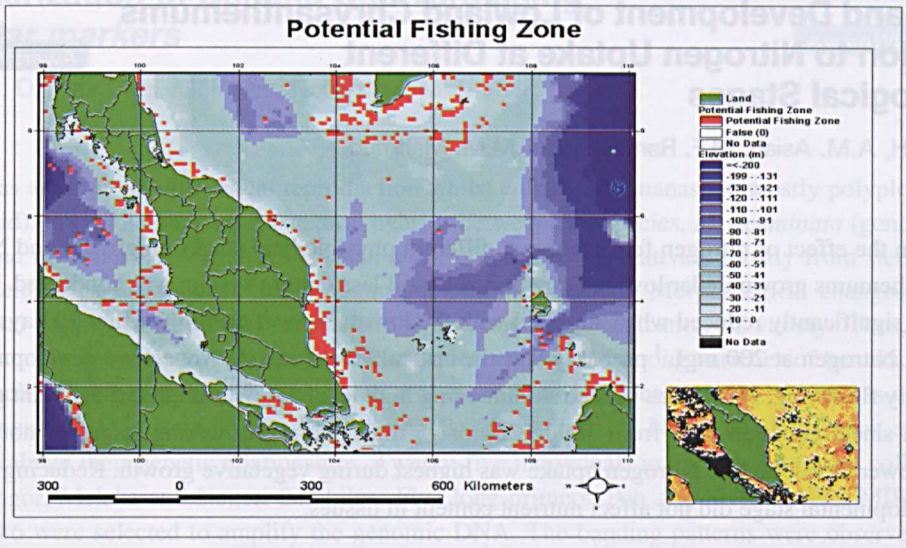


TroFFS Application on a Customized ArcView Interface

TroFFS combine cutting edge spatial information technology using advance GIS modelling and remote sensing (RS) image classification techniques on a customized GIS ArcView platform. The system is designed to processes near-real time satellite imagery (raster) of oceanographic and metrological data and GIS data (vector). It has a carefully calibrated fish forecasting model and other parameters/ indicators that are sensitive to the identification of sea surface temperature (SST), chlorophyll-a, upwelling areas to mention a few. Through this advanced GIS and RS spatial modelling techniques, maps of the potential fish abundant areas in the South China Sea are developed.



The Maps of Potential Fishing Zone Generated by TroFFS



The Maps of Potential Fishing Zone Generated by TroFFS

This system promises remarkable improvement in the monitoring, management and exploitation of fish in the South China Sea. Where as in the past energy, time and huge costs were spent in extensive search for fertile fishing grounds; with the application of TroFFS maps of potential fishing zone can be generated, thus reducing time and costs on extensive sea search. Different monitoring and management scenarios can also be generated for evaluation.

Reader Enquiry
Department of Civil Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6369 / 7247
E-mail: shattri@putra.upm.edu.my

Growth and Development of Lowland Chrysanthemums in Relation to Nitrogen Uptake at Different Physiological Stages



Siti Aishah H, A.M. Asiah, M.F. Ramlan and T.M.M. Mahmud

The study on the effect of nitrogen fertilization at different physiological stages on growth and N uptake of cut chrysanthemums grown under lowland conditions in soil less culture system was conducted. Early plant growth was significantly reduced when supplied with the lowest N level during the first 20 days of vegetative growth. Nitrogen at 200 mgL^{-1} probably was the critical level for early vegetative development. However, for early flowering, 300 N was needed. Maintaining high levels of N through out the plant growth was not required since reduction of N from 300 to 200 or 75 mgL^{-1} during flowering stage did not jeopardize plant and flower development. Nitrogen uptake was highest during vegetative growth. Reducing N levels at flower developmental stage did not affect nutrient content in tissues.

Reader Enquiry
Department of Crop Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

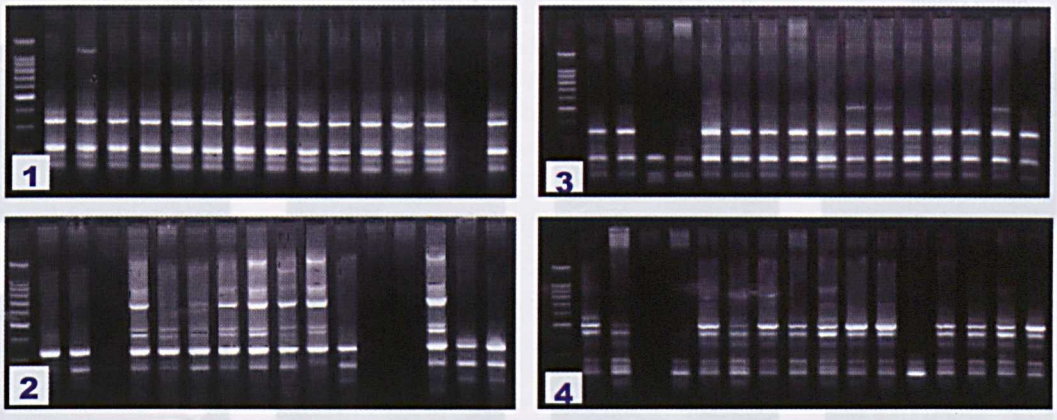
Tel: +603 8946 6946
E-mail: aishah@agri.upm.edu.my

Characterization of Banana Cultivars using *Molecular markers*



Siti Khalijah, D., Nor 'Aini, M. F. and Nor Salina, M.Z.

Wild bananas are diploid with sexual reproduction whilst cultivated bananas are mostly polyploid (triploid and tetraploid). Polyploid bananas are natural hybrids between two species, *M. acuminata* (genome A) and *M. balbisiana* (genome B). Varieties of bananas are propagated vegetatively mostly from sterile triploid. They are identified mainly on the basis of morphological characters. Morphological changes caused by environmental factors can be major obstacles to the accurate identification of variety. Thus, molecular markers become reliable tools to detect genetic variation within and among varieties of banana. LP-RAPD (random amplified polymorphic DNA) analysis was carried out on eight varieties of bananas namely Mas (AA), Berangan (AAA), Raja (AAB), Rastali (AAB), Awak (ABB), Nipah (BBB), Kapas and Nangka (AAB) to evaluate their genetic relationships. Twenty-five individuals in each variety were collected from Perak, Selangor, Melaka and Negeri Sembilan. Five long-primers, Peh A3, ERICIR, PUCMIF, BOXAIR and PEH A#6 were selected to amplify the genomic DNA. The banding patterns were observed and analyzed.



The results showed that the largest fragment was 2500 bp while the smallest was 100 bp. Primer Peh A3 was found to be the most polymorphic whereas primer ERICIR was the least polymorphic primer. The highest genetic distance was observed between Berangan and Nipah with a genetic distance of 0.825 while the lowest genetic distance was 0.727 between Kapas and Awak. The dendrogram revealed three major clusters. The first major cluster consists of Berangan, Rastali, Mas, Nangka and Raja. The second cluster made up of Kapas and Awak while Nipah variety was distinctly separated from the two clusters. Thus, the results suggest that the clustering of these bananas following their common genome compositions.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6638
E-mail: sitikd@fsas.upm.edu.my

Health Benefits of Malaysian Edible Plants

Suhaila Mohamed, Mohamed Noordin Mustapha, Azmi Lila, Azizah Hamid, Tong Chow Chin, Noor Aini Umar, Razali Muse, Mahinda Abeywardena, Irine Runnie, Paul Roach and Richard Head

The bioactivities of various natural antioxidants from tropical Herbs were studied. Their bioactivities include anti-infective (antimicrobial, anti fungal; insecticidal); cardiovascular (hypocholesterolaemic, hypoglycaemic and blood vessel relaxation, LDL oxidation and receptor upregulation), cytotoxic and antitumour effects were studied.



Malaysian Vegetables with Flavonoid ingredient/Polyfenol and their health effects on animals

Most of the Tropical Edible plants extracts with high antioxidative polyphenols content inhibited blood LDL oxidation. The highest antioxidative activity was from *betel leaf* (94%), followed by *cashew shoots, mint leaves, rattan shoots* and *palm frond (6%)*. Inhibition of TBARS formation basically followed the trend of conjugated dienes formation. Four of the plant extracts (*mints, semambu, cash ew* and *noni*) significantly upregulate the LDL receptor above than control by 49% to 67%, *mints* being the highest followed by the other three. *Noni* and *betel leaf* exhibited extremely contrasting results with regard to the inhibition of LDL oxidation and the upregulation of LDL receptor, while *Japanese mints, cashew* and *semambu* had similar activities in both assays. The present results suggest that the upregulation of LDL receptor was not significantly correlated to inhibition of LDL oxidation, hence may be influenced by other factors. Oxidation of Low-density lipoprotein LDL is implicated in the development of atherosclerosis and dietary antioxidants may provide useful therapy in prevention of LDL oxidation and associated cardiovascular diseases.

Some of the Tropical Edible plants extracts exhibited more than 50 % relaxing effect on aortic ring preparations. Only two extracts *(P. betle and C. citrates)* showed more than 50% relaxing effect on mesenteric artery preparations. The relaxing effect on the aortic ring preparations were mainly endothelium-dependent, and mediated by nitric oxide (NO). The relaxing effects in the mesenteric artery preparations showed lower effects of NO and prostanoids but high effects of endothelium-dependent hyperpolarizing factors (EDRFs). With seven out of nine plant extracts showing a strong vasorelaxing effect and a high phenolic content, this study demonstrated a positive association between diets rich in vegetables and reduced risk for several chronic diseases such as hypertension, diabetes, atherosclerosis and coronary artery disease. Commonly, patients with these diseases show decreased endothelium-dependent vasodilative capacity and responses. It is possible that the protective effects of the vegetables come from their abilities to protect and/or improve the endothelial functions. Certain polyphenols have very strong antiinfective properties.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8391
E-mail: suhaila@fsb.upm.edu.my

Intercropping of Banana and Pineapple in Rubber Smallholding and its Effect on Soil Sustainability on Sloping Land



T, Jamal, Adrinal, W.H. Wan Sulaiman and M.F. Ramlan

Experiments on intercropping of banana and pineapple and intercropping of immature rubber with banana and pineapple consisting of standard erosion plots and on-farm research respectively were carried out. The objectives of this study were to evaluate the effect of intercropping and slope positions on soil structure attributes and soil erosion. The experiments focused on evaluating some soil properties that were closely related to soil structure such as bulk density, soil aggregate stability, soil organic matter and its effect on runoff, and soil loss. The influence of root biomass on the above properties was also studied.

Results indicated that banana when intercropped with pineapple showed optimum performance in improving soil structure attributes particularly in increasing soil organic matter and aggregate stability. Due to better and thicker canopy coverage and as well as the role of their root network in building good soil structure, the combination of banana and pineapple is more effective in reducing runoff since this system provided a better protection for soil surface against impact of raindrops and improved soil infiltrability. It was found that the low soil erosion occurred under pineapple, and banana-pineapple intercropped whilst the high soil erosion occurred under rubber. Soil loss was closely related to root biomass, soil organic matter, and aggregate stability of the soil. In terms of slope position, results showed that, middle slope had lowest bulk density and highest soil organic matter content and percent soil aggregation indicating the convex nature of the landscape. As indicated by the results, higher deterioration of soil properties occurred on the upper slope compared to other slope positions and high soil erosion observed to be on the upper slope position.

In conclusion, it was shown that the combination of pineapple and banana during rubber replanting is highly recommended for soil and economic sustainability in farmers' smallholding in the sloping areas.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6972
E-mail: jamal@agri.upm.edu.my

Manipulation of Very Low Density Lipoprotein Metabolism to Reduce Fat Deposition in Poultry

T.C.Loh

In birds, fats that accumulate in adipose tissue are generally synthesized from liver or derived from dietary fat. *De novo* lipogenesis is very limited in bird's adipose tissue. Fatty acids synthesized in liver are assembled into very low-density lipoprotein (VLDL) in the form of triacylglycerol and transported to adipose tissue for storage. Several methods are currently available for the purification of VLDL from plasma. The most commonly used procedures are isolation of VLDL using sequential or one-step gradient ultracentrifugation. However, high salt concentration and high centrifugal forces may cause losses of some lipoprotein components and modification of lipoprotein structure, i.e. apolipoproteins C and E. Other reported methods include size exclusion chromatography using agarose column. However, this method is very time consuming (36-48h per sample). Some workers reported that high performance liquid chromatography (HPLC) could be used to separate lipoproteins. However, they found that the matrix in the column interact with the lipoprotein particles and resulting poor recoveries as well as clogging of the column. Another study showed that isolation of human lipoprotein can be carried out using fast protein liquid chromatography (FPLC) and the method is precise and reliable. The cholesterol contents of LDL and HDL in human and rabbit plasma purified by FPLC are highly correlated to values obtained by ultracentrifuge method and by precipitation with dextran sulfate/$MgCl_2$.

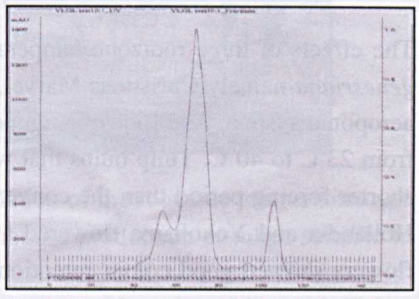


Fig.1: Chromatogram of chicken isolated by FPLC

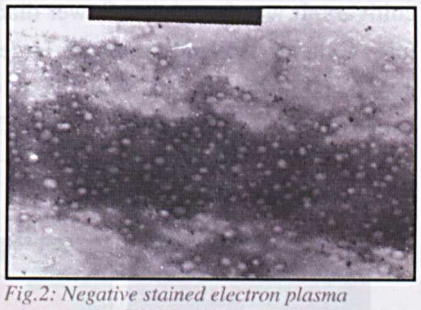


Fig.2: Negative stained electron plasma micrograph of VLDL. X30,000

The purpose of this study was to study the isolation of chicken's VLDL by using FPLC and to determine the relationships among plasma lipids, VLDL lipids and abdominal fat deposition in commercial broiler and village chicken. The VLDL was isolated by FPLC (Figure 1) and the molecules were eluted with decreasing particle size and the particle size was determined (Figure 2) with a diameter of 46.8±8.6nm. Commercial broiler deposited significantly ($P<0.001$) more fat than AK at weeks 3 and 6. Plasma TAG concentration for CB was significantly lower ($P<0.05$) than AK chicken at week 3. However, VLDL TAG concentration was not statistically significant ($P>0.05$) between these two lines. Plasma ($P<0.001$) and VLDL ($P<0.05$) TAG for CB were significantly lower than AK at week 6. This could be explained by either a decrease in secretion of TAG from the liver into the circulation or an increase in uptake of TAG from the blood into the adipose tissue and thus resulted in a lower concentration of TAG in plasma. Additionally, there was a significant negative relationship between VLDL TAG concentration and fat deposition at week 3 ($R=-0.45$, $P<0.05$) but not at week 6 ($R=-0.22$, $P>0.05$).

Reader Enquiry
Department of Animal Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6899
E-mail: tcloh@agri.upm.edu.my

Effect of Rootzone Temperature in Aeroponic System for Tulip Production

Award Winner

Thohirah Lee Abdullah, Johari Endan, Flora Chin Lee Sa and Lee Cheng Yee

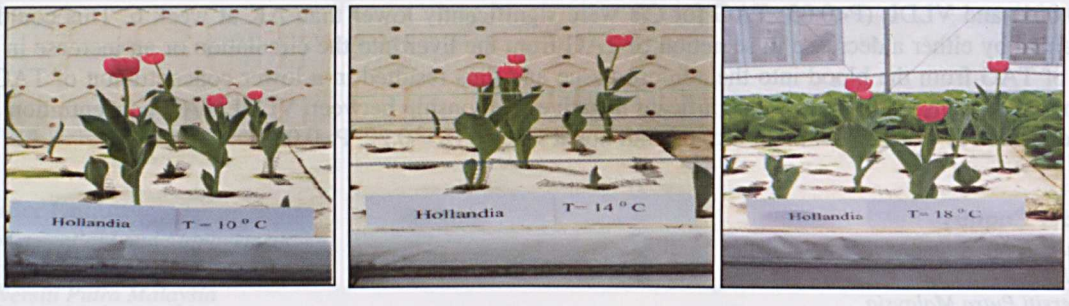
The effects of three rootzone temperatures on the growth and flowering of four tulip cultivars of *Tulipa genesriana* namely Christmas Marvel, Hollandia, Leen Van Der Mark and Yokohama were studied using aeroponic system. The rootzone temperatures were 10^0C, 14^0C and 18^0C and ambient temperature ranged from 23^0C to 40^0C. Tulip bulbs that were cured at 90C for 15 weeks flowered successfully and at a much shorter forcing period than the conventional way of planting for two of the four cultivars tested. Cultivar Hollandia and Yokohama flowered after forcing time of 17 days. They are tolerant to stem topple and flowers showed good colour retention. However, flowering was aborted for cultivar Leen Van Der Mark and Christmas Marvel, as they are more heat sensitive. The desirable plant height was achieved for cultivar Hollandia and Yokohama. They were no significant differences between interactions of temperatures and cultivars. It was found that flower diameter was more influenced by cultivars instead of rootzone temperature. Cultivar Hollandia has the largest flower diameter of 5.3cm, with cultivar Leen Van Der Mark at 4.4cm and lastly Yokohama at 3.7cm. Generally, flower quality was better at trough temperature 10^0C with better percentage of flowering, better flower colour and stronger plant with narrow leaves.

The Cultivars Selected for Greenhouse Forcing Under Aeroponics Production

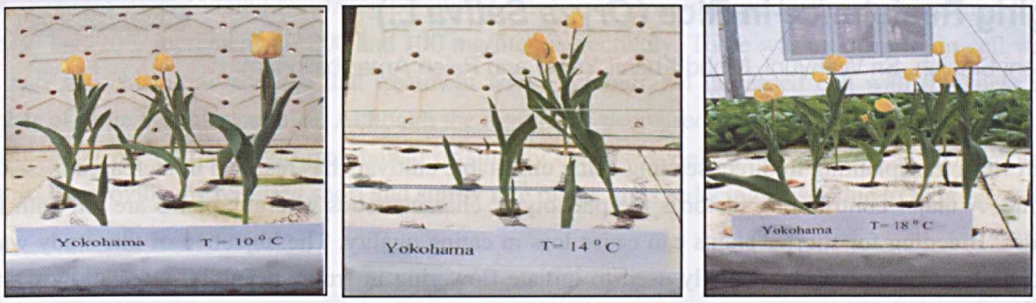


Christmas Marvel *Hollandia* *Leen Van Der Mark* *Yokohama*

The successfully flowered variety – Hollandia with temperature at 10°C, 14°C and 18°C



The successfully flowered variety- Yokohama with temperature at 10° C, 14° C and 18 °C



The study indicated that it is possible to grow tulips with manipulation of the rootzone temperature and selected heat tolerant cultivar. Thus, it serves as a platform for greenhouse production of tulips suitable to Malaysian climate.

Reader Enquiry
Department of Crop Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6947
E-mail: thohirah@agri.upm.edu.my

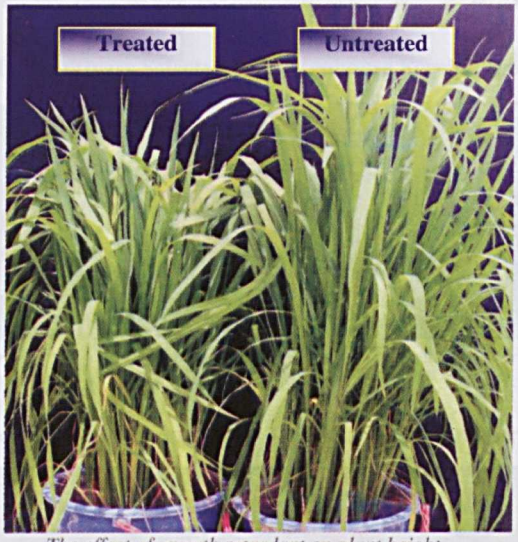
Paclobutrazol: A Potential Retardant for Improved Lodging Resistance in Rice (*Oryza Sativa* L.)



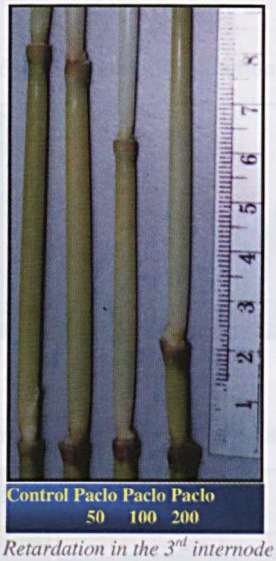
Uma Rani Sinniah, Sri Wahyuni, Mohd Khanif Yusof and Rajan Amarthalingam

The shift from transplanting to direct seeding using unsuitable cultivars has resulted in increased losses due to lodging. A major contributing factor is the phenotypic characteristics whereby plants are tall with long internodes. Breeding for shorter plants can cause loss in eating quality. The objective of this study was to use Paclobutrazol, a hormone normally used to initiate flowering in fruits, to inhibit elongation of internodes thus, resulting in shorter plant with better ability to withstand lodging.

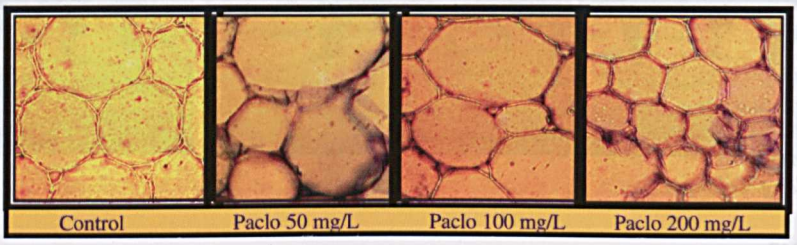
Rice plants of cultivar MR 219 were grown in a screen house and standard practice for crop establishment was employed. The treatments were applied as foliar spray at panicle initiation at concentrations of 50, 100, and 200 mg/liter. Measurements included plant height, internode length, culm length and diameter at harvest. Cell wall constituent of the stem i.e. cellulose, hemi cellulose and lignin was measured and the stem histology was studied. Lodging resistance was measured using two parameters i.e. bending and breaking resistance. Flag leaf area, chlorophyll content, photosynthetic rate and yield was determined to ensure that there was no detrimental effect of the treatment on the yield.



The effect of growth retardant on plant height



Retardation in the 3rd internode



The effect of Paclobutrazol on parenchyma cells

Paclobutrazol retarded all internodes, with increased retardation at higher concentrations, but increased culm diameter. Both lodging resistance parameters measured gave improved values as compared to control with 30 and 20% increment for 200 and 100 mg/liter respectively. There was an increase in cell wall content and stem histology showed that treatment with Paclobutrazol increased cell wall thickness and the number of large vascular bundles. Although the treatments decreased flag leaf area but it increased chlorophyll content per unit area and maintained or slightly increased yield. Paclobutrazol at 100ppm has good potential to provide the required short and sturdy rice plants, thus reducing losses due to lodging.

Reader Enquiry
Department of Crop Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6948
E-mail: umarani@agri.upm.edu.my

Robotic and Automation in Agriculture

Wan Ishak Wan Ismail, Muhamad Saufi Mohd Kassim and Mohd Hudzari Bin Razali

Award Winner

The research involves development of intelligent Bio production Robot to be used in agricultural practices. The robot designed is based on the principles of robotic technology with artificial intelligence, electronic sensing, remote data acquisition system, inter-robot communication and Automated guided vehicle (AGV).



Robotic and Automation in Agriculture

The concept of automated guided vehicle is applied to the tractor. The tractor supplies the hydraulic power requirement for the robot arm and also acts as a travelling device for the robot. The movement of the robot and the tractor is controlled through wireless radio modem, remote data acquisition and computer system. A camera connected to computer system acts as the vision system for the robot to handle the real time image transfer. The "robot eye" of the agriculture robot predicts the actual distance of the object target. Stereo pair of *videogrammetry* technique and triangulation takes the distance measurement of object target. By "clicking" the image displayed on user interface, the "eye of robot" using D-EYE digital camera to coordinate measurement displays the scene covered on developed user interface created using Visual Basic V6.

Reader Enquiry
Institute of Advanced Technology (ITMA)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7553 / 7560
E-mail: wiwi@putra.upm.edu.my

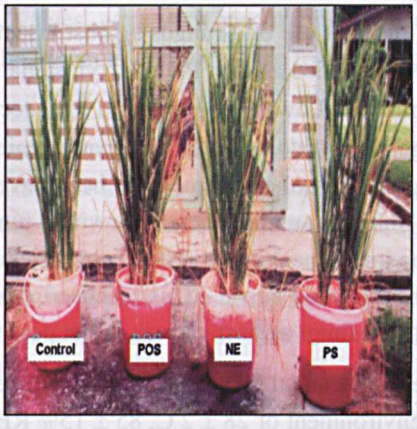
The Development of Copper Coated Urea Fertilizers for Rice Production

Award*Winner*

Y.M. Khanif and K.L.Tai

Urea is the main fertilizer used in the rice production throughout the world. Like other N fertilizers, the efficiency of urea in rice soils is generally low due to high losses through volatilization, denitrification and leaching. Slow release fertilizers can be used to minimize loss of N. The largest rice growing area in Malaysia is located in the Muda Irrigation Scheme, Kedah. Recent investigations indicated that there are deficiencies of Cu in soils of many sites in this 95,000 ha. irrigation scheme. Therefore Cu fertilization is important to meet the crop requirement. Since the amount of Cu needed is small conventional methods of fertilizer application is not feasible.





This study utilizes the technique of Cu-coated urea whereby slow release of N with the addition of Cu through copper coating will increase the rice yield. Further in this study, palm oil sludge (POS), neem oil (NE) and palm stearin (PS) were used as materials and Cu carrier, while the source of Cu used was copper sulphate. Results showed that as compared to urea alone, all amended Cu-coated urea fertilizers resulted in a significantly higher dry matter yield, N uptake and Urea-N utilization efficiency by rice crop. Using soils of the Kangar series POS, NE and PS increased the yield by 34% (2.19kg ha^{-1}), 29% (2.02kgha^{-1}) and 23%(1.86kg ha^{-1}) respectively over the control.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6975
E-mail: khaniff@agri.upm.edu.my

Entomopathogenic Fungal Formulations of Mycoinsecticides



Yusof Bin Ibrahim

Synthetic chemical insecticides have been the mainstay of insect pest control for more than 50 years. However, the increasing cost of development, pest resistance and resurgence and increased awareness of the environmental effects of excessive dependence on these chemicals have ensured a continuing interest in alternative forms of pest control. Biological control agents such as entomopathogenic fungi have played important roles in the history of microbial control of insects. The first practical attempt was conducted by Metschnikoff in 1879, and then repeated by Krassilstichik in 1888, when *Metarhizium anisopliae* was used against the cockchafer larvae, *Anisoplia austriaca*, and the weevil, *Cleonus punctiventris* (Robert & Humber, 1981).

In Malaysia, the first use of a fungus against insects was reported by Ooi (1979) when *Entomophthora sphaerosperma* was applied against Plutella xylostella. The second publication was only available 14 years later when Ibrahim and Low (1993) reported the successful use of *Beauveria bassiana* and *Paecilomyces fumosoroseus* against *P. xylostella*. Entomopathogenic fungi are gaining increasing attention worldwide as agents for biological control and some have been developed for large-scale commercial production as mycoinsecticides. Uniquely, unlike bacteria or virus, fungi do not have to be ingested; hosts are invaded directly through the integument or natural openings such as spiracles. Therefore, they can infect non-feeding stages such as the eggs and pupae. This manuscript presents a summary of my works on selected isolates of entomopathogenic fungi against various insect pests and mites.

Insects, Mites and Fungal Culture: Cultures of insects and mites were maintained in the laboratory under an ambient environment of 28 ± 2 C, 85 ± 15% RH and 12 h photoperiod. When required distilled water and 5% (w/v) honey were also provided separately as food for the adult insects. All the fungal isolates were maintained on PDA or SDA in the Entomology Laboratory of the Department of Plant Protection, Faculty of Agriculture, Universiti Putra Malaysia. Fungal inocula were prepared from 3-4 week old sporulating cultures suspended in 0.05% aqueous Tween 80. A Neubauer haemocytometer was used to estimate the respective initial conidial concentrations and subsequent appropriate dilutions were prepared thereof.

Dosage-Mortality Bioassay: As a general approach, the test insects were placed either on a "leaf preparation" or on a leaf disc as in the case of spider mites. The dosage-response assays included at least seven inoculum dosages plus a sterile cont rol of 0.05% aqueous Tween 80. Inoculation was done by spraying a minimal amount, 0.05 ml or less of the conidial suspension with a Sigma® hand atomiser that delivered an even droplet spray of 79 µm (VMD). Mortality, including moribund individuals, was recorded daily for 4-12 days depending on the test subjects. The EC_{50}s and LT_{50}s are obtained through a probit programme (S103, Statistical Research Service, Canada DOA, unpublished) based on probit analysis by Finney (1971).

Formulations and Field Trials: Four formulations of microbial control agents have been developed. Dust, wettable powder and oil formulations use conidia as the infective agent, while granular formulation used mycelia as the source of inoculum. Tests for their favourable physical traits and shelf life are still in progress. Field trials have been carried out against *P. xylostella, Crocidolomia binotalis, Phyllotreta striolata* and *Aleurodicus dispersus*. Similar experiments are currently being conducted against *Polyphagotarsonemus latus* and Tetranychus urticae Koch complex, followed by *Epilachna indica* and the aphids in the future. Please refer to Ibrahim & Low (1993), Ibrahim & Yew (1994), Ibrahim & Hashim (1998), Ibrahim & Tan (1999), Ibrahim & Liu (2001), Hashim & Ibrahim (2002), Priyatno & Ibrahim (2002, 2003), Ibrahim & Yeong (2002), Ibrahim (2002) and Ibrahim & Nugroho (2002) for further details.

Dosage-Mortality Bioassay: In general, all the three species of fungi inflicted significant mortality on the insects and mites tested. A concentration of 2×10^7 conidia mL^{-1} was adequate to provide good kill, and significant relationships at $P = 0.05$ were obtained between log concentration and probit mortality values for all the three fungal species. This indicates that infections increased significantly with increasing concentration. The median effective concentrations, EC_{50} values, were very encouraging; generally reached 3 days after treatment (refer to LT_{50}s). This enhances the potential and the desire to minimise the use or replace chemical application by microbial control.

Formulations and Field Trials: Field tests using formulated conidia has been limited to cabbage caterpillars, flea beetles, whiteflies, termites, stored products insects and mites. Conidia *of P. fumosoroseus* in Vesawit® palm oil (rf. no. 2) worked very well against *C. binotalis* but not as encouraging against *P. striolata* and *A. dispersus*. The granular formulations were more successful against the termites (rf. no. 12). Current field tests with the wettable powder formulation have shown encouraging recovery of broad mite infested chilli shoots sprayed with *B. bassiana* and *P. fumosoroseus*, while the rice worm *Corcyra cephalonica* was very susceptible to the dust formulations of *B. bassiana* and *P. fumosoroseus*.

Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7249
E-mail: yusofib@agri.upm.edu.my

The Search for Appropriate Urea Fertilizer Formulations for Oil Palm at the Main Nursery Stage



Zaharah A. Rahman and Abdul Rahman Bah



Nursery experiment to evaluate urea fertilizer formulations on oil palm

Raising robust oil palm seedlings requires adequate moisture and nutrient supply especially that of N. However, high N losses severely restrict the use of urea as a source of nitrogen. Urea-based compound formulations incorporating K, Ca and/or Mg have the potential of enhancing urea-N utilization, but information on their efficacy is scanty. Compound (15:15:15) and bulk blended urea–based NPK and a bulk blend of gypsum urea were evaluated with 3-months old oil palm seedlings on a Typic Kandiudult (Rengam series) over a 7-months period. The normal recommended N rate and half of it were used for the urea NPK fertilizers, and only the normal rate for gypsum urea. Nitrogen uptake and utilization from the fertilizers was quantified by the ^{15}N isotope dilution technique. Dry matter yield was not significantly different among the fertilizer treatments independent of the rate applied, but nitrogen utilization was markedly greater at the half rate of application (60% versus 33-38%). Much higher N concentration, uptake and N utilization efficiency (%NUE) was obtained with gypsum urea most likely because of Ca minimizing volatilization of urea-N. There were no differences in N uptake between bulk blend urea and urea-based NPK for both rates of application. Overall, gypsum urea showed greater potential as a source of N as well as Ca for oil palm seedlings on this soil.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6932
E-mail: zaharah@agri.upm.edu.my

Available P Dynamics in a Tropical Soil Amended with Natural Organic and Inorganic Fertilizers

AwardWinner

Zaharah A. Rahman and Abdul Rahman Bah

Alleviating P deficiency with natural inorganic phosphates and organic residues has significant economic and environmental advantages in the tropics. But more insight into P dynamics in this system is required for successful adoption of the technology.



Glasshouse experiment on P dynamics in soil amended with organic and inorganic fertilizers

This was studied in an amended Ultisol (Bungor series) in laboratory incubation and glasshouse experiments. Treatments were a factorial combination of green manures, GMs (*Calopogonium caeruleum*, *Gliricidia sepium* and *Imperata cylindrica)* and phosphate rocks (PRs) from China and Algeria replicated 3 times. The GMs were labelled with ^{33}P in the glasshouse trial. Olsen P, mineral N, exchangeable Ca and pH were monitored in the incubation at 0,1,2,4,8,16,32 and 64 weeks after establishment (WAE). Soil P fractions were also determined after 64 WAE. Phosphorus available from the amendments at 4, 8, 15, and 20 WAE, was quantified by ^{33}P-^{32}P double isotopic labelling in the glasshouse using *Setaria sphacelata* (Setaria grass) as test crop. Olsen P was unaffected by P fertilizers alone, and hardly changed within 16 WAE in the legume GM and legume GM+P treatments, which coincided with NH_4-N build-up and the elevation of soil pH. Afterwards Olsen P and exchangeable Ca increased as NH_4-N and soil pH declined. The legume GMs augmented reversibly sorbed P in the Al-P and Fe-P fractions resulting in high residual effect, whilst fertilizer-P was irreversibly retained. GM-P availability was very low (< 4%), but GMs enhanced PR solubility and mobilized soil P irrespective of quality, probably by the action of organic acids. Soil P mobilizing capacity was dependent on GM characteristics and ranked Gliricidia<Imperata< Calopogonium, and appears to be reduced by Ca content. The results are further evidence of the importance of the soil P mobilization capacity of organic components in integrated P management systems.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6932
E-mail: zaharah@agri.upm.edu.my

Isolation and Characterization of *Listeria monocytogenes* and Other *Listeria* species from Raw Foods



Zaiton Hassan, Gulam Rusul Rahmat Ali, Son Radu, Abdul Reezal Abdul Latif, Endang Purwati, Mohd Nizam Lani, Siti Zulaiha Hanapi, Yousr Abdullah Noaman and Samuel Lihan

Consumption of foods with *Listeria monocytogenes* can cause two types of human infection; listeriosis (invasive and severe) and listerial gastroenteritis (mild with flu-like symptoms). Individuals with impaired immunity such as the foetus, newborn infants, pregnant women, elderly, and person with weakened immune system are at risk at acquiring listerial infection.

Under this research, a number of established methods were evaluated for the isolation of *L. monocytogenes* and other *Listeria* species from various food sources. Although the FDA, USDA or modified USDA methods can be used for the isolation of *L monocytogenes,* the modified FDA method was found to give higher recovery of *Listeria* species other than *L. monocytogenes* for raw frozen beef, raw fresh beef and poultry. Initial incubation of samples at 4°C for 24h followed by one-step pre-enrichment using FDA modified method (LEB without supplement) and streaking on PALCAM agar instead of Listeria selective agar (LSA), followed by confirmation using biochemical tests, Microbact 12Lkit, Serobact and CAMP test resulted in the isolation and identification of seven *Listeria* species namely, *L. monocytogenes, L. ivanovii, L. seeligeri, L. innocua, L. welshimeri, L. grayi* and *L. murrayi* from beef and poultry samples. Six *Listeria* species were identified from fermented fish (pekasam) namely, *L. monocytogenes, L. ivanovii, L. seeligeri, L. innocua, L. welshimeri,* and *L. dentrificans.* The contamination rate with *L. monocytogenes* in poultry was 93% (28/30), frozen beef was 74% (17/23), fresh beef was 43% (10/23) and fermented fish was 10% (3/30). 17% (34/200) of fresh prawns (*Penaeus indicus*) was positive for *Listeria* using USDA method (Canadian version) of which 7% (14/200) of the isolates was *L. monocytogenes.* Plasmid was detected in 56% of *L. monocytogenes* isolates from beef and poultry and 2% from prawns with plasmid size ranging from 1.8 to 35.8 MDa. All *L. monocyogenes* isolate were highly resistant to antibiotics bacitracin, ceptazidime, nalidixic acid, ceftriaxone, cephalothin, nitrofurantoine and sulfamethozole. Isolates from prawns were further characterized by specific PCR probe (with primer LM1 and LM2) to detect the presence or absence of hemolysin gene of which 52.8% (19/36) of the isolates contained the gene. The combination of the RAPD patterns obtained using different primers (GEN15001, GEN15002, GEN 15009 and GEN15010) could distinguish all characterized *L. monocytogenes* and other *Listeria* species isolates and from the dendrograms generated all *Listeria* isolates can be discriminated and clustered according to their species and food sources.

Table 1: Pathogenic and non-pathogenic *Listeria* species

	Pathogenic (hemolytic)	Non-pathogenic (non-hemolytic)
1.	Listeria monocytogenes (animal and human)	L. innocua
2.	*L. ivanovii* (animal)	*L. grayi*
3.	*L. seeligeri* (animal)	*L. welshimeri*
4.	-	*L. murrayi*
5.	-	*L.dentrificans*

Table 2: Prevalence of Listeria species from different sources

	Food sources	*L. monocyto-genes*	*L. ivanovii*	*L. innocua*	*L. grayi*	*L. wel-shimeri*	*L. seeligeri*	*L. murrayi*	*L. dentrifi-cans*
1.	Raw frozen beef	61%	57%	71%	50%	43%	8%	29%	nd[a]
2.	Raw fresh beef	30%	39%	43%	17%	40%	4%	1%	-
3.	Raw fermented fish	12%	57%	56%	56%	nd	20%	nd	48%
4.	Raw chicken satay	31%	7%	8%	15%	1%	nd	nd	nd
5.	Raw beef satay	24%	nd	8%	10%	nd	nd	nd	nd

[a]*nd = not detected*

RAPD fingerprinting method allows typing of both pathogenic and not pathogenic *Listeria* species, and therefore can be used for epidemiological studies much better than plasmid profiling and antibiotic resistance patterns.

Reader Enquiry
Department of Food Science
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8392 / 8383
E-mail: zaihas@fsb.upm.edu.my

Production of Bacterial Inoculants as Biofertiliser and Bioenhancer



Zulkifli Hj. Shamsuddin and Premalatha Pakirisamy

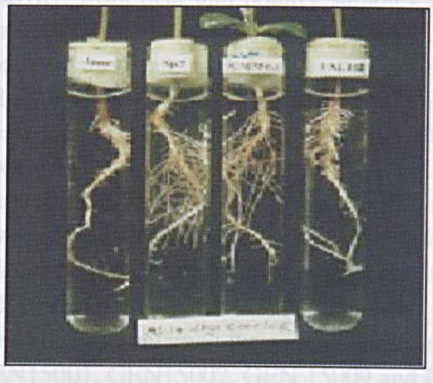
In Malaysia there are limited sources of bacterial inoculants as biofertilizer (provide plant nutrients) and bioenhancer (increase plant growth). Several experiments were conducted to produce these inoculants namely the isolation of bacteria, the carrier, the shelf life, and the efficacy on economic crops.

Several locally isolated strains were chosen for identification and characterization. The strains were identified with morphological and biochemical tests followed by molecular PCR finger printing. 16S rRNA confirmed the results. Two strains that showed promise as PGPR (Plant Growth Promoting Rhizobacteria) were *Bacillus sphaericus* UPMB10 and *B. subtilis* UPMB13.

Subsequently, an inoculant was developed for UPMB10 strain using 2L fed-batch fermenters. Cultivation was optimized using glycerol + yeast extract as substrates which improved cell productivity three-fold. Two carriers, ground oil palm frond (GOPF) and commercially available compost, were identified to provide maximum growth (10^8 cfu/g carrier) and the longest shelf life (9 months) with optimized temperature (30° C) and moisture content (pF 2.19).



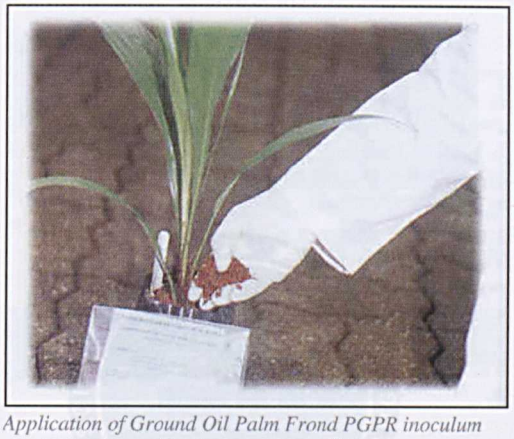
Inoculant application efficacy: 10^8 to 10^9 cfu applied at planting of banana seedlings (nursery stage) and reinoculated monthly



Inoculation with RGRP promotes roots development and vegetable soybean compared with un-inoculated controls (side tubes)

In the inoculation test, these bacterial inoculants were tested on oil palm (o.p) seedlings and bananas. The 260d o.p seedlings grown as in normal commercial production could fix N_2 (25-50% Ndfa; nitrogen derived from atmosphere) and produce higher root growth, and nutrient uptake (P,K, Ca). Similarly, growth of inoculated (UPMB10) banana seedlings to fruiting showed 37-39% Ndfa.

Strain UPMB10 also produced additional benefits as a bioenhancer by increasing bunch yield (35-51%), photosynthetic rate (25%), Ca uptake, and root (33-44%) and shoot (123-202%) growth.



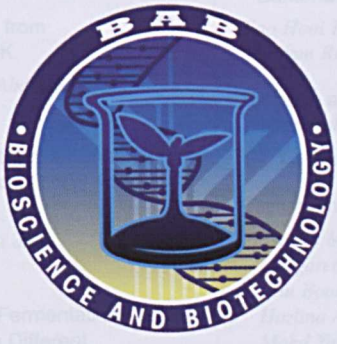
Application of Ground Oil Palm Frond PGPR inoculum carrier to young oil palm nursery seedlings

In conclusion, these results strongly indicated the viability of using UPMB10 with composed GOPF as the inoculant carrier to commercially produce bacterial inoculant for various economic crops, namely oil palm and bananas.

Reader Enquiry
Department of Land Management
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6990
E-mail: zulsham@agri.upm.edu.my

Production of Bacterial Inoculants as Biofertiliser and Biostimulant



Bioscience and Biotechnology


Bioscience and Biotechnology

Contents

Bioscience and Biotechnology

Enzymatic Synthesis of Palm Based Surfactants 115
Abu Bakar Salleh, Rashidah Abdul Rahim, Raja Noor Zaliha Abd Rahman and Mahiran Basri

Enzymatic Synthesis of Palm Based Amino Acid Surfactants: Scale-Up of Optimized Process 117
Abu Bakar Salleh, Soo Ee Lin, Raja Noor Zaliha Abd Rahman and Mahiran Basri

Organic Solvent Tolerant Protease from *Pseudomonas aeruginosa* strain K 118
Abu Bakar Salleh, Raja Noor Zaliha Abdul Rahman, Mahiran Basri and Lee Poh Geok

Production of Solvent (acetone-butanol-ethanol) by *Clostridium acetobutylicum* Using Local Raw Materials as Substrate 119
A.B. Ariff, M.S. Madihah, A.A. Suraini and M.I.A. Karim

Kinetics and Modelling Kojic Acid Fermentation by *Aspergillus Flavus* 44-1 Using Different Carbon Sources 120
A.B. Ariff, M. Rosfarizan, M.A. Hassan and M.I.A. Karim

Cellulase with High Level of ß-glucosidase Produced by *Chaetomium globosum* using Delignified Oil Palm Empty-Fruit-Bunch-Fibre as Substrate 122
Arbakariya Ariff and Mohamed Ismail Abdul Karim

Freeze Drying of Lactic Acid Bacteria (Probiotic) with Maximum Residual Activity 123
Arbakriya Ariff, Mohd Rizal Kapri, Rosfarizan Mohamad, Raha Abdul Rahim and Hirzun Mohd Yusof

The Effects of Plant Based Protein on the Performance of *Macrobrachium Rosenbergii* (De Mann) 124
C. R. Saad, Z.A. Aizam, M. Rozihan and M.R. Joseph

A Molecular Analysis of a Style Specific Promoter of Tomato 126
Choong Chieh Wean, Chan Pick Kuen, Siti Suhaila bt Abdul Rahman, Rofina Yasmin Othman and K. Harikrishna

Nontoxic Glucose Fatty Ester from Palm Oil 128
Dzulkefly Kuang Abdullah, O.J. Obaje and Hamdan Suhaimi

Trichoderma Harzianum for the Control and Prevention of Basal Stem Rot Disease of Oil Palms 129
Faridah Abdullah

The study of a Novel Biopreservative, Nisin, produced by Lactic Acid Bacteria Isolated from Malaysian Ikan Rebus 131
Foo Hooi Ling, Lee Yock Ann, Son Radu, Raha Abdul Rahim and Gulam Rusul Rahmat Ali

Molecular and Biochemical Characterization of Bacteriocin and Hydrolytic Enzymes of Lactic Acid Bacteria 133
Foo Hooi Ling, Son Radu, Norihan Mohd. Saleh and Gulam Rusul Rahmat Ali

Emodin, a potential larvicide from *Ploiarium alternifolium* (Theaceae) 137
G.C.L. Ee and K.N. Ng

Transforming Fats and Oils The Green Way 138
Hasanah Mohd Ghazali, Kamariah Long, Lai Oi Ming, Margaret Liew Yoon Bing, Mariam Mohd. Ismail, Chu Boon Seang, Pauline Chew Xui Sim, Tee Seok Bee, Hazlina Ahamed Zakeri, Ker Yee Ping, Salmah Yusof, Mohd Yazid Abd. Manaf, Yaakob Che Man and Dzulkifly Mat Hashim

Systematic Deletion of ORF and Protein Localization Towards the Elucidation of Function of *Saccharomyce cerevisiae* Genes 140
Hirzun Mohd Yusof, Raha Abdul Rahim and Clemente Michael Wong Viu Ling

Probiotic for Poultry 141
Ho Yin Wan, Norhani Abdullah, Kalavathy Ramasamy and S. Jalaludin

Development of High Quality Writing and Printing Paper Using Kenaf (*Habiscus cannabinus*) Fibre 143
Jalaluddin Harun

Simple Technique of Antigen Purification and the Production of Monospecific Polyclonal Antiserum for Citrus Tristeza Virus (CTV) 144
Kamaruzaman Sijam, Nurhadi, Inon Sulaiman and Maheran Abdul Aziz

A Study on Gene Expression During Oil Palm Floral Development Via The Generation of Expressed Sequenced Tags (ESTs) and Suppression Subtractive Hybridization Techniques 146
Lee, Y.P., Kwan, Y.Y, Shahrul, S.H.R, Ho, C.L, Tan Siang Hee and Harikrishna K.

Direct Fermentation of Gelatinized Sago Starch to Solvent (Acetone Butanol-Ethanol) by *Clostridium Acetobutylicum* P262 148
Madihah M.S., Ariff A.B., Suraini A.A and Karim M.I.A.

Synthesis of Optically Pure (-)-menthyl butyrate by Immobilized Lipase 150
Mahiran Basri, Abu Bakar Salleh, Raja Noor Zaliha Abd Rahman, Basyaruddin Abd. Rahman and Siti Salhah Othman

Development and Commercialization of Transgenic Orchids 151
Maziah Mahmood, Janna O. Abdullah, Tan Chon Seng, Mohamad Puad. A., Tee Chong Siang and Wee Chien Yeong

Development of Biochemical Indicators for Early Detection of Drought, Salinity and Aluminium Toxicity Stresses in Plants 152
Maziah M., Suzita S., Zulkifli S. and Nor'aini F.

Production of Triterpenes in *Centella asiatica* (Pegaga) in vitro Cultures 153
Maziah M., Anna, L.P.K. and Bala, I.

Genetic Engineering of Bananas for Fusarium wilt Disease Resistance 155
Maziah Mahmood and Sreeramanan Subramaniam

Enhancement of Bioactive Metabolites in *Centella asiatica* (Pegaga) Cell Cultures 157
Maziah M., Anna, L.P.K. and Bala, I.

Potential Anti-tumor Compound Production from Cell Cultures of *Eurycoma longifolia* (Tongkat Ali) 159
Maziah Mahmood, Rosli Noormi, Chan Kit Lam and Azimahtol Hawariah Lope Pihie

Commercial Production of *Eurycoma longifolia* (Tongkat Ali) Seedlings using Tissue Culture Techniques 161
Marziah M. and Sobri H.

Bioreactor Composting of Selected Organic Sludges 162
Mohd. Ali Hassan, Mohamed Ismail Abdul Karim, Arbakariya Arif and Azni Idris

Lactic Acid Production from Kitchen Garbage 163
Mohd. Ali Hassan, Yoshihito Shirai and Mohamed Ismail Abdul Karim

Towards Zero Discharge for the Palm Oil Industry 164
Mohd.Ali Hassan, Mohamed Ismail Abdul Karim, Yoshihito Shirai, Noraini Abdul Rahman, Phang Lai Yee and Arbakariya Ariff

Measuring Cost Efficiency in Malaysian Oil and Fat Industry: A Data Envelopment Analysis (DEA) Evidence 165
Mohd Ghazali Mohayidin and Mohamed Osman Ahmed Bushara

Towards Improving Attractive Fruit Colour 166
N.M. Saleh, U.K.Hanapi and M. Hashim

Plantaricin: A Potential Biopreservative 168
C.V. Suppramaniam, G.R. Rahmat Ali, R.A. Rahim and N.M. Saleh

Isolation of Membrane Bound Polyphenol Oxidase and Peroxidase from Metroxylon Sagu 171
Nazamid bin Saari, Jinap Selamat, Jamilah Bakar and Galila Hassan Onsa

Production of Recombinant Human Protein in *E. coli* 173
Ng Chyan Leong, Julia Ibrahim, Raha Abdul Rahim, Ho Chai Ling and Hirzun Mohd Yusof

Characterization and Comparison of Expressed Sequence Tags (ESTs) from cDNA Clones of Oil Palm (*Elaeis guineensis*) Flower and Root System by Single-Pass Sequencing 174
Ng WH, Meilina Ong, K. Harikrishna and Tan SH

Enhancing the Nutritive Value and Utilisation of Tropical Feeds 175
Norhani Abdullah, Ho Yin Wan and Sieo Chin Chin

Effects of Supplementation of a New *Mitsuokella sp.* Culture and Natuphos® Phytase on the Performance and Nutrient Utilisation of Broiler Chickens 176
Norhani Abdullah, Ho Yin Wan and Lan Ganqui

Detection of Lard and Randomised Lard as Adulterants in Refined-Bleached-Deodorized Palm Oil by Differential Scanning Calorimetry 177
O.M. Lai, J.M.N. Marikkar, H.M. Ghazali and Y.B. Che Man

Characterization and Molecular Cloning of an Erythromycin Resistance Plasmid of *Lactococcus lactis* 178
Raha A.R., E. Ross, K. Yusoff, M.Y. Manap and A. Ideris

Thermostable T1 Lipase from Locally Isolated *Bacillus Sp* Strain T1: A Molecular Approach Toward High Level Expression 179
Raja Noor Zaliha Raja Abdul Rahman, Abu Bakar Salleh, Mahiran Basri and Leow Thean Chor

An Extremely Thermostable Serine Protease from *Bacillus Stearothermophilus* F1 180
Raja Noor Zaliha Raja Abd. Rahman, Abu Bakar Salleh, Mahiran Basri, Che Nyonya Abd. Razak and Mohd. Basyaruddin Abdul Rahman

Correlation Between Oil Content and DN Values 182
Rashid Shariff, Nor Aizam Adnan, Radzali Mispan, Shattri Mansor, Rohaya Halim and Roop Goyal

Production of *Bacillus Subtilis* Culture as Beneficial Microorganism for Aquaculture Industry 183
Rosfarizan Mohamad Arbakariya Ariff, Hirzun Mohd Yusoff, Raha Abdul Rahim and Mohamed Ismail Abdul Karim

Biotransformation of Various Carbon Sources to Kojic Acid by Cell- Bound Enzymes of *Aspergillus* Flavus 185
Rosfarizan Mohamad

Efficient Development of DNA Microsatellite Loci for Mungbean, *Vigna radiata* 186
S.V. Kumar, S.G Tan, S.C. Quah and K. Yusoff

Effectiveness of b-Glucanase-Producing *Lactobacillus* Strains in Improving the Growth Performance of Broilers 188
Sieo Chin Chin, Norhani Abdullah and Ho Yin Wan

Development of Recombinant Mite Allergens from *Tyrophagus putrescentiae* for Diagnosis of Allergic Diseases 189
Sew YS, Chew FT, Kulaveerasingam H. and Tan SH

Sago Starch-Based Foam 190
Sharifah Kharidah Muhammad, Zulkafli Ghazali, Kamaruddin Hashim, Muhammad Ali Hassan and Benchamaporn Wongsuban

Detection and Molecular Epidemiology of Toxigenic *Vibrio Cholerae* O139 and O1 in the Seafood Marketed in Malaysia 192
Son Radu and Mitsuaki Nishibuchi

Development of the methods for rapid detection and Molecular Typing of *Escherichia coli* O157:H7 194
Son Radu and Mitsuaki Nishibuchi

Isolation and Characterization of Cyclodextrin Glycosyltransferase (CGTase)- Producing Microbes 195
Suraini Abd. Aziz

Very Low Density Lipoprotein Metabolism in Commercial Broilers and Village Chicken 197
T.C. Loh, B.K. Tan, H.L. Foo, N. Abdullah , Idrus, Z. and Ramlah, H.

Development of Advance Statistical Models Based on Electronic Nose (zNose™) Method to Monitor Rancidity and Authenticity of Vegetable Oil Products 200
Tan Chin Ping

Recent Developments in Differential Scanning Calorimetry for Analysis of Edible Oils and Fats 201
Tan Chin Ping and Yaakob B. Che Man

Characterization of Locally Isolated Yeast Strain Towards Industrial Application 202
Tan Li Lung, Raha Abdul Rahim, Arbakariya Ariff and Hirzun Mohd Yusof

An Efficient Method of Developing DNA Microsatellite Markers for *Mystus nemurus* (Ikan Baung) 203
Tan Soon Guan, Siti Shapor Siraj, Khatijah Yusoff, Sahar Usmani, Chan Soon Choy and Hoh Boon Peng

Antimicrobial and Genotoxic Activities of Flavonoid Isolated from Some Selected Medicinal Plants 205
Umi Kalsom Yusuf, Faridah Abdullah, Khairuddin Itam, Umi Salamah Hassan, Mohd. Aspollah Sukari and Abdul Manaf Ali

In Vitro Production of *Oncobasidium theobromae* Talbot and Keane Basidiospores for Screening Disease Resistance 207
Zainal Abidin Mior Ahmad and Ganesan S/O Vadamalai

Development of an Open-ended Coaxial Probefor the Determination of Moisture Content of Oil Palm Fruits 209
Zulkifly Abbas and You Kok Yeow

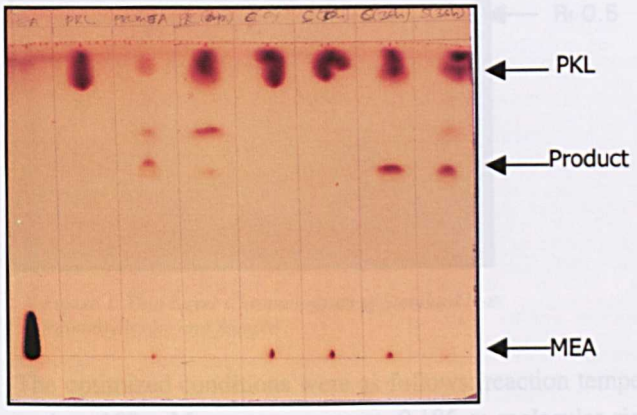
Enzymatic Synthesis of Palm Based Surfactants

AwardWinner

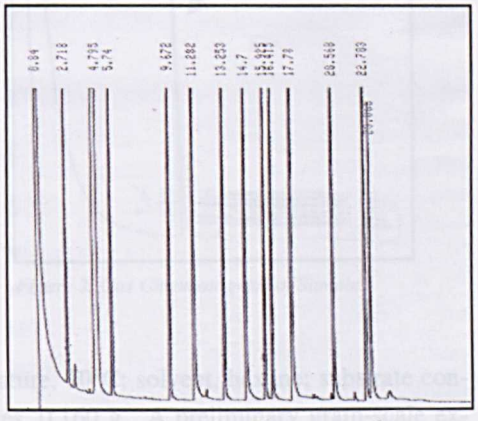
Abu Bakar Salleh, Rashidah Abdul Rahim, Raja Noor Zaliha Abd Rahman, Mahiran Basri

Fatty monoethanolamides, derived from a reaction between triglyceride, palm kernel olein (PKL) or free fatty acids and primary amine alcohol, monoethanolamine (MEA) can be synthesised enzymatically, under milder conditions than the energy intensive chemical reaction.

Mixture of palm based fatty monoethanolamide was successfully obtained from the reaction between PKL and MEA in the presence of enzyme with better yield than the control experiment (without enzyme). The various individual fatty monoethanolamides were also obtained from the reaction between free fatty acids (C_{10}-C_{18}) and MEA after the isolation and purification processes. The various fatty monoethanolamides were used as standards for the analysis of product mixture. Fatty monoethanolamides were characterised by infra-red spectroscopy (IR), thin-layer chromatography (TLC), nuclear magnetic resonance (NMR) and gas chromatography (GC). Gas chromatograph was also used for the quantitative analysis to calculate percent yield by using internal standard method. Few types of enzyme were screened in the amidation reaction. It was found that immobilised enzymes such as Lipozyme IM, Novozyme 435, Amano PS-C lipase and AH-lipase produced better yield compared to the native enzyme, *Candida rugosa*.



A = MEA
B = PKL
C = PKL Monoethanolamide
D = PKL (with enzyme only)
E = control (0 time)
F = test sample (0 time)
G = control (36 hours)
H = test sample (36 hours)



Quantitative Analysis: Gas Chromatography (GC)

GC chromatogram for standards of individual fatty acid and fatty monoethanolamide

1. Solvent (hexane)
2. Capric acid,
3. 1-hexadecene (IS),
4. Lauric acid,
5. Myristic acid,
6. Capramide,
7. Palmitic acid,
8. Lauramide,
9. Oleic acid,
10. Stearic acid,
11. Myristamide,
12. Palmitamide,
13.Oleamide,
14. Stearamide

The results in the screening of enzyme indicated that the yield varied when different enzymes were used in the reaction mixtures. Better yield was obtained when the substrates ratio of 1:3 (PKL: MEA) was used as compared to the ratio of 1:1. It was also found that enzymes have different rates of obtaining the maximum yields. In the study, Amano PSC-lipase was observed to have good selectivity towards C_{18} fatty acid when both free fatty acid and triglyceride (PKL) were used in the amidation reaction. In the study on the effect of temperature, the optimal yield for the PKL monoethanolamide was achieved at 60°C reaction temperature when both enzymes, Novozyme 435 and PSC-lipase were used. The yield increased ± 40-50% from the control reaction. However, the yield decreased in the presence of Novozyme 435 and PSC-lipase (14.8% and 2.6%, respectively) at temperature above 60°C, due to the temperature effect on enzyme activity. In the time course study, the optimal yield was obtained after 24h incubation time, whereas the yield for the reaction in the absence of enzyme still increased until 96 hours. The optimal ratio of substrates (PKL: MEA) was 1:5. The increase of monoethanolamine used could increase the solubility of reactants and products. In the reaction mixture, increasing the mole ratio of PKL: MEA to 1:5 increased the yield to six fold than the yield of that PKL: MEA at mole ratio 1:1. Lipase worked better in hydrophobic solvents, which have higher log P compared to hydrophilic solvents. Hexane appeared to be the best solvent for amidation reaction in the system. The reaction mixture gave the best yield when 0.1g molecular sieves were added. The yield obtained at the optimal condition in the presence of enzyme was 90%, 35% higher than that of the control experiment. In the kinetics studies, the K_m value for PSC-lipase was slightly lower than that of Novozyme 435 when triolein ($C_{18:1}$) was used as substrate in the reaction mixture.

Reader Enquiry
Department of Biochemistry and Microbiology /
Enzyme and Microbial Technology Research Laboratory
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8090
E-mail: abubakar@ibs.upm.edu.my

Enzymatic Synthesis of Palm Based Amino Acid Surfactants: Scale-Up of Optimized Process



Abu Bakar Salleh, Soo Ee Lin, Raja Noor Zaliha Abd Rahman and Mahiran Basri

Amino acid surfactants, with their antimicrobial activity, biocompatibility and excellent skinfeel, have immense potential for use as emulsifiers and preservatives in food, cosmetic and personal care products. The ecological disadvantages and non-selectivity of their chemical synthetic method with petroleum based raw materials have in recent years motivated the development of enzymatic processes employing more biodegradable oleochemicals as substrate. One such abundant source of oleochemical in Malaysia is palm oil. From trials with a range of amino acids, L-lysine was selected as the model amino acid substrate, and, its Lipozyme-catalyzed reaction with palmitic acid, one of the more prevalent fatty acids in palm oil, was optimized.

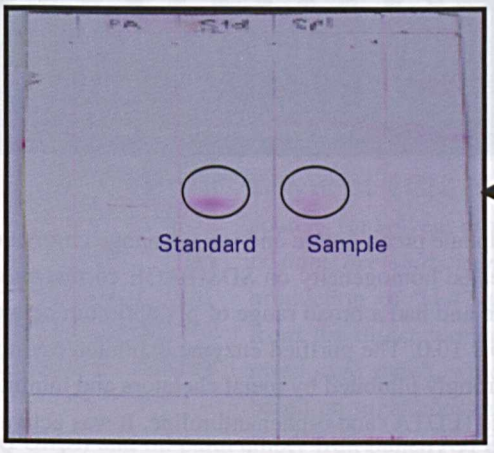


Figure 1. Thin Layer Chromatogram of Standard N-ε-Palmitoyllysine and Sample

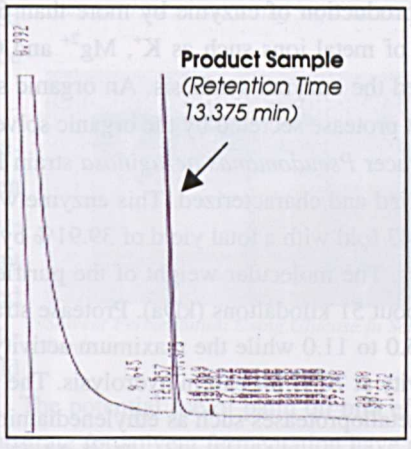


Figure 2. Gas Chromatogram of Sample

The optimized conditions were as follows: reaction temperature, 70°C; solvent, hexane; substrate concentration, 100 mM; enzyme amount, 0.186 g; molecular sieves, 0.160 g. A preliminary gram-scale experiment under these conditions yielded 0.747 g of the product N-palmitoyllysine. Analysis of the white crystals on thin layer and gas chromatography and infrared spectroscopy revealed good correlation with its commercial standard.

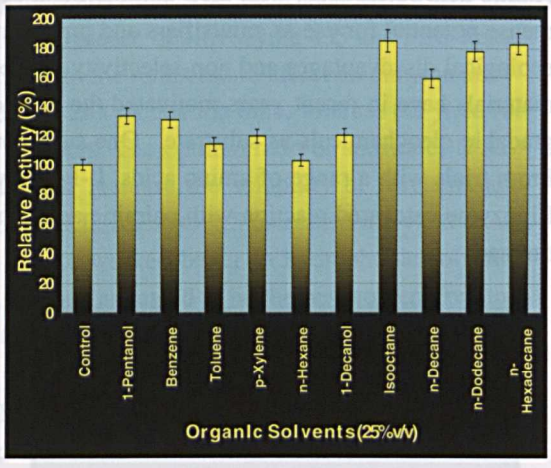
Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8090
E-mail: abubakar@ibs.upm.edu.my

Organic Solvent Tolerant Protease from *Pseudomonas aeruginosa* strain K



Abu Bakar Salleh, Raja Noor Zaliha Abdul Rahman, Mahiran Basri and Lee Poh Geok



Organic solvent stability of purified protease

Maximum protease activity was achieved with sorbitol as the sole carbon source, followed by starch and lactose at pH 7.0 and 37°C. The best organic and inorganic nitrogen sources were casamino acids and sodium nitrate, respectively. Tryptone, soytone and yeast extract supported protease production while corn steep liquor and beef extract inhibited the protease activity. The presence of amino acids inhibited the production of enzyme by more than 62%. Addition of metal ions such as K^+, Mg^{2+} and Ca^{2+} maximized the enzyme synthesis. An organic solvent tolerant protease secreted by the organic solvent tolerant producer *Pseudomonas aeruginosa* strain K has been purified and characterized. This enzyme was purified 124.43 fold with a total yield of 39.91% by ammonium sulphate precipitation and ion-exchange chromatography. The molecular weight of the purified enzyme revealed homogeneity on SDS-PAGE corresponding to about 51 kilodaltons (kDa). Protease strain K was stable and had a broad range of pH optimum between pH 5.0 to 11.0 while the maximum activity exhibited at pH 10.0. The purified enzyme exhibited optimum activity at 70°C for casein hydrolysis. The protease was strongly inhibited by metal chelators and inhibitors of metalloproteases such as ethylenediaminetetraacetic acid (EDTA) and o-phenanthroline. It was activated by several metal ions such as Zn^{2+}, Mg^{2+}, Ba^{2+} and Sr^{2+} and denaturing and reducing agents such as 6 M urea, Triton-X-100 and Tween 20. Thiol reducing agents such as DTT, 2-mercaptoethanol and SDS had partially inactivated the protease activity. Organic solvent tolerant protease produced by *P aeruginosa* strain K was activated in the presence of organic solvents, especially with log *P* values equal or more than 4.0.

Activation effect of the enzyme activity were 1.10, 1.59, 1.20, 1.49 and 1.52 times more stable compared to the control for 1-decanol, isooctane, decane, dodecane and hexadecane, respectively.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8090
E-mail: abubakar@ibs.upm.edu.my

Production of Solvent (acetone-butanol-ethanol) by *Clostridium acetobutylicum* Using Local Raw Materials as Substrate



A.B. Ariff, M.S. Madihah, A.A. Suraini and M.I.A. Karim

The production of solvent (acetone, butanol and ethanol) has a long history as a successful industrial fermentation process, which has been widely employed during the first and second world wars. However, the importance of this process declined rapidly after 1950, as the solvent could be produced more economically from petroleum by petrochemical process. Following the oil crisis in 1973, the synthetic route to solvent become much more expensive and recent development in the field of biotechnology has resulted in a renewal interest in the fermentation route as a possible source of solvent production.



Solvent Fermentation Using Sago Starch



Solvent Fermentation Using Glucose In Schott Bottle



2L Stirred Tank Fermenter

Our study is focussing on the feasibility of using local carbon and nitrogen sources for solvent production by *Clostridium acetobutylicum*. Total solvent production of 24.47 g/l was obtained from the direct fermentation of gelatinised sago starch, which gave the yield based on sugar consumed of 0.45 g/g. The potential use of palm oil mill effluent (POME) and oil palm empty fruit bunch (OPEFB) fibre as substrate for solvent fermentation have also been studied. These cellulosic substrates were first hydrolysed enzymatically to fermentable sugars prior to use in fermentation, which gave total solvent production and yield of 2.5 g/L and 0.11 g/g, respectively. The use of fishery washing water also gave comparable solvent production to the fermentation using yeast extract.

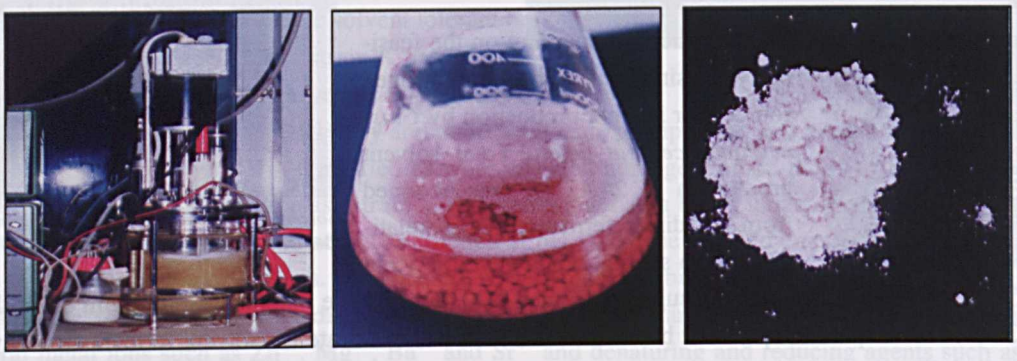
Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8342
E-mail: arbarif@putra.upm.edu.my

Kinetics and Modelling Kojic Acid Fermentation by *Aspergillus Flavus* 44-1 Using Different Carbon Sources

A.B. Ariff, M. Rosfarizan, M.A. Hassan and M.I.A. Karim

Kojic acid production by *Aspergillus flavus* strain 44-1 using different types of carbon source (glucose, starch hydrolysate from enzymatic hydrolysis of sago starch, sucrose, fructose and gelatinized sago starch) was carried out in 250 mL shake flask, 2 L, 8 L and 50 L stirred tank fermenters. The experimental data from batch fermentation and resuspended cell system were analysed in order to form the basis for a kinetic model of the process. Unstructured model based on logistic and Luedeking-Piret equations was found suitable to describe growth, substrate consumption and kojic acid production by *Aspergillus flavus* in batch and also resuspended cell system using either glucose or sucrose. From the modelling, it was found that kojic acid production by *A. flavus* was non-growth associated process. The kinetic parameter values for each fermenter were calculated from the modelling and they were be used to verify the experimental data using various types and concentration of carbon source.



Kojic acid production (23.5 g/L) using 100 g/L sago starch in a shake flask was comparable to fermentation of glucose (32.5 g/L) and starch hydrolysate (27.9 g/L) but in the 8 L and 50 L fermenter kojic acid production was greatly reduced due to non-optimal aeration conditions. Fed-batch fermentation with intermittent feeding of concentrated sago starch (140 g/L) can be employed to improve direct fermentation of sago starch to kojic acid by about 4 times higher as compared to batch fermentation. *A. flavus* was also capable to utilise sucrose for kojic acid fermentation where the highest production (40.23 g/L) in 2 L fermenter was obtained at 150 g/L sucrose. Kojic acid production (10.25 g/L) was greatly reduced in fermentation using fructose as the sole carbon source. Scaling-up based on a constant impeller tip speed (1.65 m/s) together with optimal DOT and pH control strategies was successfully used for kojic acid fermentation in 50 L fermenter using glucose and sucrose as carbon sources.

Kojic acid fermentation by *A. flavus* can be divided into two phases; growth and production phase. The culture pH during growth phase influenced the performance of kojic acid fermentation to a further extend than did the pH during the production phase. The fermentation without pH controlled (started with an initial culture pH 3) showed higher kojic acid production than single-phase pH controlled fermentation at a range of pH 2.2 – 4.0. Comparable kojic acid production to fermentation without pH controlled was obtained in two-phase pH controlled fermentation (started with initial culture pH, without control during growth phase and switched to 3 during production phase). Efficient conversion of glucose to kojic acid was achieved in a resuspended cell system, in a solution containing only glucose with citrate buffer at pH 3.5 and 30°C. The rate of glucose conversion to kojic acid was increased with increasing glucose concentration up to 100 g/L, suggesting that the biotransformation of glucose to kojic acid by the cell-bound enzymes followed the Michaelis-Menten enzyme kinetic models. The value of K_m and V_{max} for the reaction, as determined by using Langmuir plot, was 10.042 g/L glucose and 0.076 g/L.h, respectively.

Effective method for purification of kojic acid from the fermentation broth has also been developed, where dry kojic acid powder with more than 99% purity has been obtained. At present, research on the enzymatic modification of kojic acid to better commercial products, such as kojic palmitate, is being carried out.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8342
E-mail: arbarif@putra.upm.edu.my

Cellulase with High Level of ß-glucosidase Produced by Chaetomium globosum using Delignified Oil Palm Empty-Fruit-Bunch-Fibre as Substrate

AwardWinner

Arbakariya Ariff and Mohamed Ismail Abdul Karim

A substantially large amount of a complete set of cellulases (maximum activity of FPase, carboxymethyl-cellulase and β-glucosidase is 1.4, 30.8 and 9.8 U/ml, respectively) can be produced by *Chaetomium globosum* strain 414 when grown in delignified oil palm empty fruit bunch fibre (OPEFB) fibres and peptone as the carbon and nitrogen sources.



2L stirred tank fermenter



10 cm OPEFB



2 mm OPEFB

The cellulases produced by this locally isolated fungus contained a high level of β-glucosidase compared to those reported in the literature. This means that the cellulase produced by *C. globosum* is superior compared to cellulases produced by other fungal-producing-cellulases. The most important property in the saccharification of cellulose is the ability of cellobiohydrolase to act synergistically with endoglucanase to hydrolyse crystalline cellulose, since neither is effective on its own. During the reaction, cellobiose is produced and becomes inhibitory to both types of cellulase and, hence, β-glucosidase is required to hydrolyse cellobiose to relieve the inhibition. The yield and productivity achieved by this fungus have been further increased through medium and culture conditions optimization, pretreatment of OPEFB and also by using stirred tank bioreactor with optimal operating conditions. Cellulase enzyme has also been purified and tested for enzymatic saccharification of OPEFB to fermentable sugars.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8342
E-mail: arbarif@putra.upm.edu.my

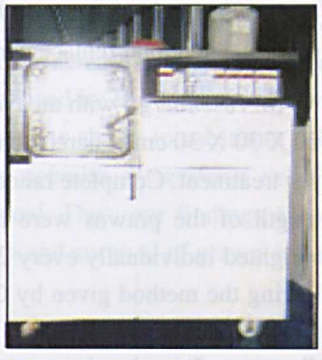
Freeze Drying of Lactic Acid Bacteria (Probiotic) with Maximum Residual Activity

Award Winner

Arbakriya Ariff, Mohd Rizal Kapri, Rosfarizan Mohamad, Raha Abdul Rahim and Hirzun Mohd Yusof

Freeze-drying has been used in a number of applications for many years, most commonly in the food and pharmaceutical industries. Freeze-drying involves the removal of water or other solvent from a frozen product by a process called sublimation. Sublimation occurs when a frozen liquid goes directly to the gasseous state without passing through the liquid phase. In contrast, drying at ambient temperatures from the liquid phase usually result in changes in the product, and may be suitable for some materials.

In the study undertaken, reseach was focussed on the development of freeze drying method for the preparation and formulation of product containing live probiotic bacteria for commercial applications. Research activities includes; (1) optimisation of drying condition on minimising dehydration inactivation, (2) effect of dehydration conditions on leakage of essential cell components through the membrane, (3) feasibility of using cheap and locally available protective carbohydrate or stabilizer to mantain the activity and stability of the freeze-dried bacterial cells, (4) interaction between stabilizers and cell physiological and membrane damage using microscopic examination, and (5) storage study.



Pilot scale freeze dryer

From this study, several freeze-dried products, formulated using locally produced lactic acid bacteria and locally available stabilizers, for various commercial uses (human, aquaculture and chicken) have been developed. The morphological changes that occured on the lactic acid bacteria powder after being freeze-dried, which was examined under scanning electron microscope, with different cryoprotectants and stabilizing agents have been carried out. The differences in microstuctures of different cryoprotectants and stabilizing agents, reflects the physical properties of the dried-powders. Hence, the suitable cryoprotectants and stabilising agents to be used in freeze drying of different lactic acid bacteria can be chosen. Result from SEM analyses can be also be used to optimise the formulation and process variables. The products developed can be stored at room temperature with only 10% loss in viability after 6 months. In addition, in freeze-drying, the material does not go through the liquid phase. Thus, it allows the preparation of a stable product that is easy to use and aesthetic in appearance.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8342
E-mail: arbarif@putra.upm.edu.my

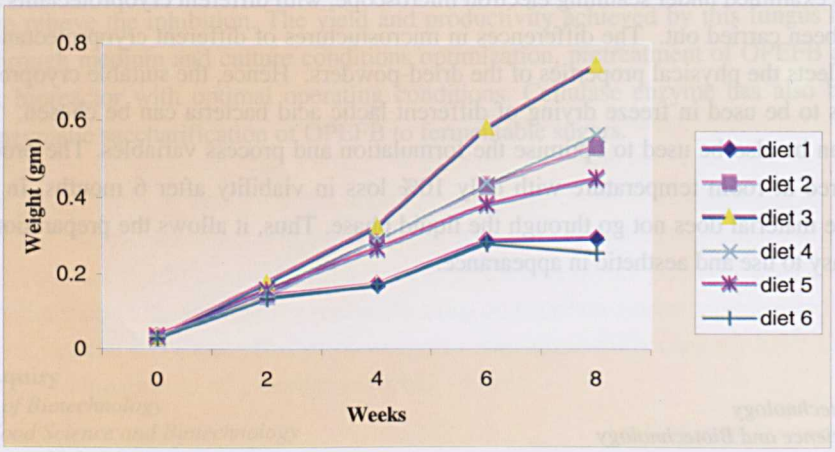
The Effects of Plant Based Protein on the Performance of *Macrobrachium Rosenbergii* (De Mann)



C. R. Saad, Z.A. Aizam, M. Rozihan and M.R. Joseph

The freshwater prawn, *M. rosenbergii*, has been studies and developed over the past 20 years throughout the world and received considerable attention for its attractive characteristics as an aquaculture species. This species is also widely cultured (55,443 ton/year; FAO, 1998), although much less than marine shrimp (around 900,000 tons/year; FAO, 1998). Knowledge of the nutritional requirement of *M. rosenbergii* is necessary for the development of cost-effective diets, which can be formulated with some flexibility in the choice of ingredients. Research has provided some information concerning nutrition requirements (Tidwell et al, 1993; Tidwell et al, 1994; Cavalli et al, 1999). The objective of our study was to evaluate the effects of partial and total replacement of fishmeal with soybean meal in diets.

M. rosenbergii with an average orbital length 16.2±0.20mm and weight 0.03±0.002g were conducted in 60 X 30 X 30 cm concrete tanks. The experiment was conducted with six treatments with three replications per treatment. Complete randomized design was employed in all treatments. Initial body weight and orbital length of the prawns were recorded prior to commencement of the experiment. All the prawns were weighted individually every 2 weeks (14 days) interval. Specific growth, survival rate were estimated following the method given by Chiu (1989). Food conversion ratio (FCR), protein efficiency ratio (PER) and proximate composition were estimated following the method described by AOAC (1985). Experimental diets were formulated to contain 40% crude protein. Prawns were fed a percentage of body weight based on a feeding schedule reported by D' Abramo et al. (1989). All data on growth, survival, FCR, PER and carcass composition were analyzed using 1 way ANOVA and the differences between the means were tested using Duncan's New Multiple Range Test (Duncan, 1955)



Growth, survival, food conversion ratio and protein efficiency ratio of *M. rosenbergii* fed with varying percentages of soybean meal after 56 days of feeding. During the period of study, there were significant differences ($P<0.05$) in terms of body weight between diet 2, 3, 4 and 5 with diet 1 and 6. Diet 3 showed the highest mean final body weight with the value 0.74g followed by diet 4, 2, 5,1 and 6 with value of 0.56g, 0.54g, 0.44g, 0.29g and 0.25g respectively (Fig. 1). The specific growth rate in diet 3 was higher and showed significant difference ($P<0.05$) compared to other diets. The survival rate in diet 3 was satisfactory as it was closed to diet 6. Similar studies have also been conducted by Tidwell et al. (1993) where they also observed higher survival rate during the utilization of soybean meal by replacing fishmeal. Tai (1991) found that post larvae have *M. rosenbergii* attained higher growth and survival rate in cage culture than those of ponds and tanks. No significant differences ($P>0.05$) were observed in food conversion ratio (FCR) and protein efficiency ratio (PER) for all the treatments. It was shown that diet without the addition of soy bean meal and fish meal did not produce high growth performances as compared to diet with the combination of both ingredients. Forster and Beard (1973) also found that there was increase in weight of *Palemon serratus* when a complete substitution of fishmeal with soy bean meal. Increase in weight is found to be dropped when the level of soybean in formulated feed is increased or reduced by less than 40%. Lawren et al (1986) found that the level of soy bean meal of 20 – 50% in diet have the ability to substitute fish and shrimp meal without any effect on the growth and survival of *Penaeus schmitti, P. setiferus and P. vannemei* during their study about replacement of fish meal by soy bean meal. Thus, our findings agree with other aquaculturists that soybean meal has profound effect on the growth and survival of prawn and it may reduce the production cost as well.

Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6955
E-mail: cheroos@agri.upm.edu.my

A Molecular Analysis of A Style Specific Promoter of Tomato

Choong Chieh Wean, Chan Pick Kuen, Siti Suhaila bt Abdul Rahman, Rofina Yasmin Othman and K. Harikrishna

Transcriptional control is an important component that mediates gene expression in important biological processes such as growth and development. Gene expression involves a series of complex interactions between cis-regulatory elements in the DNA and protein trans-regulatory elements. Interactions between cis- and trans-regulatory elements will in turn determine the activation or inactivation of transcription of a gene. An in depth understanding of the mechanisms controlling tissue specific and temporal patterns of gene expression will facilitate the development of a designer transcription systems capable of driving the desired tissue specific and temporal gene expression patterns. In order to develop the necessary tools for this system the tomato ChiP promoter was used as a model study system. This promoter drives the stylar transmitting tissue specific expression of an endochitinase *Chi2;1* only at late stages of flower development.



Figure 1: Preliminary mobility shift assay on one of the putative positive clones isolated from b-galactosidase assay (Yeast –1- hybrid) demonstrating a shift on a promoter fragment 4. 1).fragment 4 only, 2).fragment 4 and protein extract from clone 8, 3) fragment 4, protein extract clone 8 and competitor, and (4) fragment 4, host protein extract and competitor.

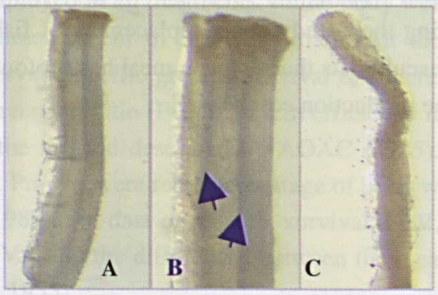


Figure 2: GUS-staining of pistil longitudinal sections with X-gluc showing blue staining in the style, especially along the transmitting tract. (A) Longitudinal section of the GUS-stained pistil. (B) Close-up of the GUS-stained pistil. The arrows are indicating blue-stained transmitting tract of the style. (C) Negative control of a GUS-stained pistil.

In order to identify the cis- and trans-regulatory elements within the promoter, several experiments were performed where promoter deletions in transgenic plants and in yeast were used to identify cis acting and trans acting elements. In addition to this a pistil specific subtractive cDNA library was constructed in order to facilitate the isolation of pistil predominant transcription factors. Preliminary analysis of transgenic plants has demonstrated that a promoter fragment of 435bp could drive correct GUS expression in stylar tissue. Therefore the cis-regulatory element/s that are responsible for the specific pattern of expression of this gene is located within this 435bp fragment of *ChiP*. From use of the Yeast-one hybrid technique, 38 putative clones were identified and characterized. The DNA binding capacity of one of the clones was demonstrated by using a mobility shift assay and indicated that this gene may encode a transcription factor that binds specifically to a fragment of *ChiP*. DNA sequence analysis of pistil predominant genes identified from the suppression subtraction library allowed identities of some of the genes to be ascribed and they consisted of pathogenesis related genes, some housekeeping genes, a kinase, genes involves in metabolism, putative transcription factors, some unknown genes and some novel genes with no significant homology. Further analysis is underway to confirm DNA binding as well as the cis acting binding sequence. These factors will be used to facilitate the development of a customized transcription system capable of directing the expression of the appropriate gene to the appropriate tissue.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8344
E-mail: krisna@ibs.upm.edu.my

Nontoxic Glucose Fatty Ester From Palm Oil

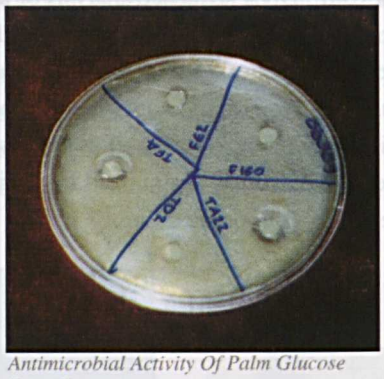
Dzulkefly Kuang Abdullah, O.J. Obaje and Hamdan Suhaimi

Award*Winner*

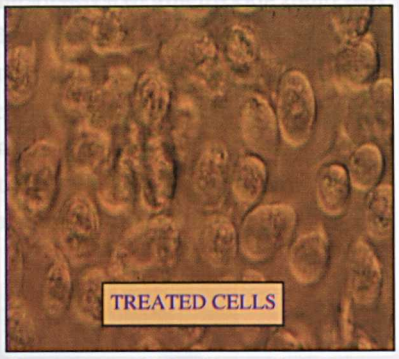
Carbohydrate based surfactants are derived from natural renewable resources and are biodegradable. Their potential applicatipons are in food, cosmetic and pharmaceutical industries. However, the current methods of production, using toxic solvents, hindered their uses in food and pharmaceutical areas.



Palm Glucose Fatty Ester (Product)



Antimicrobial Activity Of Palm Glucose Fatty Ester



Noncytotoxic of Palm Glucose Fatty Ester

In this project, we have successfully developed one stage, solventless interesterification techniques for the synthesis of palm glucose fatty esters, thus avoiding toxic solvents. After separation and purification, two products were obtained and identified. These products show good emulsifying properties, antimicrobial activities and noncytotoxic. We have also developed a novel HMBC-NMR technique, based on substituents induced chemical changes, to identify the position and number of substituents on the glucose ring of the interesterified products. This project received two international awards, from the American Oil Chemists' Society, for outstanding contribution in natural biodegradable surfactant.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6783
E-mail: dzulkif@putra.upm.edu.my

Trichoderma Harzianum for The Control and Prevention of Basal Stem Rot Disease of Oil Palms

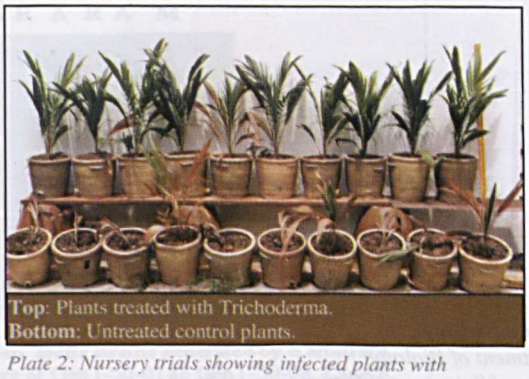
Faridah Abdullah

Malaysia is the world's leading producer of palm oil. However, the palm that produces it is notoriously susceptible to 'basal stem rot' (BSR), a disease with no known cure. BSR is typified by an internal rotting of the palm tissues, causing the palm to fracture at the base and collapse. The economic losses incurred can be significant when infected palms are in their prime production stage. Traditionally, chemical agents are used to control plant diseases but in this particular case, no fungicide has yet met recommendations for the control of BSR. Most of the trials carried out by chemical agencies and MPOB showed that the treatments were either ineffective, effective to a limited extent only, or inconclusive. Thus, the fact remains that this disease, which has been detected as early as 1927 in Malaysia, is slowly but surely becoming a threat simply because there is no agent that can stop its advancement.

Fungi belonging to the genus *Trichoderma* have been known to be antagonistic towards many fungal pathogens and are therefore potential biological control agents. In USA as in many other parts of the world, the use of biological agents to control plant diseases is already recommended as an alternative to chemical use. Many *Trichoderma*-based formulations have met the stringent Food and Drug Agency (FDA) requirements and are already commercially available in the market. Examples of are Bio-Trek™ 22G, (Wilbur-Ellis Co.) a granular product based on *Trichoderma* used in the control and prevention of turf diseases. SoilGard™ (sold by Thermo-Trilogy Co.) was formulated from *T. virens* to control a range of fungal pathogens such as *Pythium*, *Rhizoctonia* and *Fusarium*. Other *Trichoderma*-based products include trade names such as Gliogard™, Binab-T™, PlanterBox™, etc. Clearly, the use of biological agents is the way of the new millennium because of its negligible effects on the environment. Chemical usage results in residues accumulation, resistance in, and resurgence of the pathogen. The use of biological agents is target-specific (as opposed to broad-spectrum effect of chemicals) and they are found naturally, not synthesised.



Plate 1: A fallen oil palm resulting from rotted tissues at the palm



Top: Plants treated with Trichoderma.
Bottom: Untreated control plants.

Plate 2: Nursery trials showing infected plants with treatment (top) and without treatment bottom)

With this approach in view, studies were made to screen for isolates of *Trichoderma* that were effective against *Ganoderma boninense*, the causal pathogen of basal stem rot of oil palms. Several trials using native *T. harzianum* were carried out using since 1996. This research found a particular strain of *T. harzianum* able to effectively suppress growth of *Ganoderma boninense*, in *in vitro* laboratory studies followed by *in vivo* nursery trials. The principle of its treatment is to put back the spores in the infected soils, only in significantly in larger quantities. From repeated nursery trials, treatment by spore suspension conferred protection of between 80 to 90%, compared to non-treated controls, which showed 100% mortality during the period, studied.

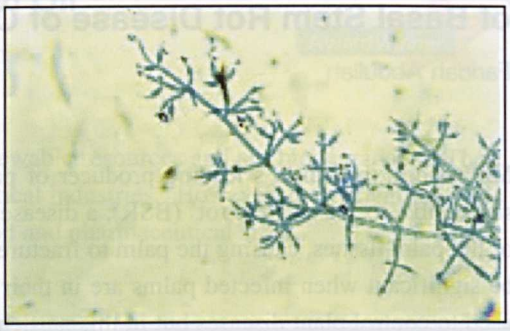


Plate 3: A magnified micrograph of T.harzianum

The product developed is *T. harzianum* spores, which are environmentally-friendly, target-specific and are safe to humans, animals and plants. It has potential to be developed as a biotechnological product with oil palm growers as the direct beneficiary, who are by tradition, the nation's largest importer of chemical fertilizers and control agents.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6620
E-mail: fidah@fsas.upm.edu.my

The study of a Novel Biopreservative, Nisin, produced by Lactic Acid Bacteria Isolated from Malaysian *Ikan Rebus*



Foo Hooi Ling, Lee Yock Ann, Son Radu, Raha Abdul Rahim and Gulam Rusul Rahmat Ali

The bacteriocin production of Lactic Acid Bacteria (LAB) isolated from Malaysian food, "Ikan Rebus" was investigated in this study. Seven out of eight LAB isolates were confirmed to be able to produce bacteriocin. The cell free supernatant bacteriocin of the highest bacteriocin producer (*Lactococcus. lactis* subsp. *lactis* RW 18, CFS bacteriocin RW 18) was able to tolerate wider pH range, from pH 3.0 to pH 7.0, and higher temperature range, from 50 °C to 90 °C at pH 6.5. The wider pH and temperature stability will warrant and facilitate wider application of this bacteriocin as biopreservative in food industry. The CFS bacteriocin RW 18 also demonstrated a broad-spectrum antagonistic activity, which was potent against gram-positive bacteria including *Listeria monocytogenes*, *Enerococcus faecalis*, *Enterococcus faecium*, *Pediococcus acidilactici* and *Lactobacillus pentosus*.

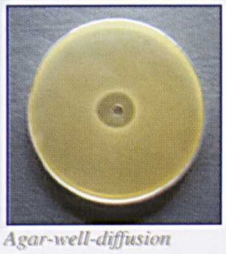
Screening Methods for Bacteriocin Production



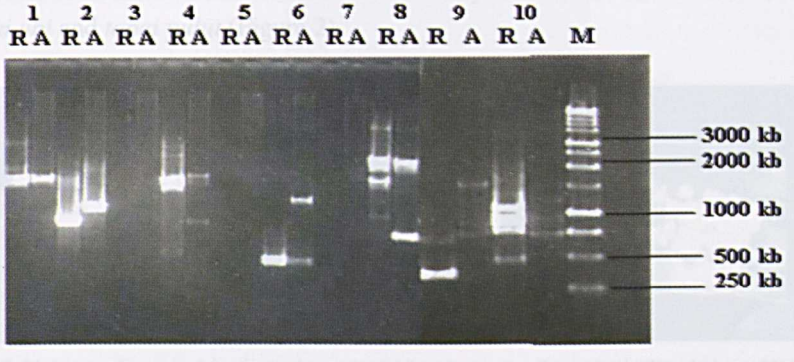
Spot-on-lawn Method



Flip-Streak Method



Agar-well-diffusion Method



RAPD fingerprinting profile of *Lc.lactis* subsp. *lactis* strains generated by 8 arbitrary primers. Number 1 to 10 represent for primers of Gen1-50-01 to Gen1-50-08. Lane R, DNA fingerprinting of *Lc. lactis* subsp. *lactis RW18* and Lane A, DNA fingerprinting of *Lc. lactis* subsp. *lactis ATCC 11454*. Lane M, 1 kb ladder (Promega, USA) The electrophoresis was performed in 1.2% agarose gel at 70V.

The study of the effect of hydrolytic enzymes indicated that CFS bacteriocin RW 18 was a proteinaceous compound and most likely to contain lipolytic and glycolytic moiety. The CFS bacteriocin RW 18 was further purified to apparent homogeneity by a procedure involving 0-60 % ammonium sulphate precipitation, cation-exchange chromatography and gel flitration chromatography with 0.9 % yield and 3210 purification fold. The molecular mass of purified bacteriocin RW 18 was estimated to be 3.9 kDa and 4.0 kDa, respectively, as analysed by Tricine SDS-PAGE and gel filtration chromatography. The isoelectric point of the purified bacteriocin RW 18 was estimated to be more than 9.30, demonstrating a strong cationic characteristic. The relative activity of purified bacteriocin RW 18 was enhanced 100 % when Bovine Serum Albumin was added (0.08 µg/µl -0.33 µg/µl), whereas a higher relative activity of 300 % was obtained when 0.08 µl/µl and 0.15 µl/µl of glycerol was added respectively. Genetically, bacterioicn nisin A gene (*nisA* gene) was detected in *Lc. lactis* subsp. *lactis* RW 18 by PCR amplification with a pair of *nisA* structural gene specific primers. The RAPD-PCR fingerprinting analysis revealed that *Lc. lactis* subsp. *lactis* RW 18 was genotypically different from bacteriocin nisin producer, *Lc. lactis* subsp. *lactis* ATCC 11454, suggesting *Lc. lactis* subsp. *lactis* RW 18 was a new nisin A producer.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8343
E-mail: hlfoo@fsb.upm.edu.my

Molecular and Biochemical Characterisation of Bacteriocin and Hydrolytic Enzymes of Lactic Acid Bacteria

Foo Hooi Ling, Son Radu, Norihan Mohd. Saleh and Gulam Rusul Rahmat Ali

Lactic Acid Bacteria (LAB) are a group of Gram positive and non-sporulating microaerophilic bacteria (Figure 1) that are generally capable of producing lactic acid. LAB enjoy GRAS (generally regarded as safe) status. Health benefits and potential of LAB have been recognised for a long time. Several genera of LAB have been extensively used throughout the world to produce foods that are safe, tasty and nutritive with extended shelf life. Fermentation process represents one of the oldest known techniques for food preservation. Bacteriocins, one of the LAB metabolites, are believed to have vast potential as safe biopreservative, whereas hydrolytic enzymes of LAB can be utilised for the development of food ingredients or food processing aids to improve the flavour and quality of foods. The information pertaining to the use of LAB in Malaysian foods is limited. Therefore, several studies were conducted under this project in order to protect and fully exploit our rich bioresources for the benefit of Malaysian foods and related industries. The outcomes of this project are as follows:

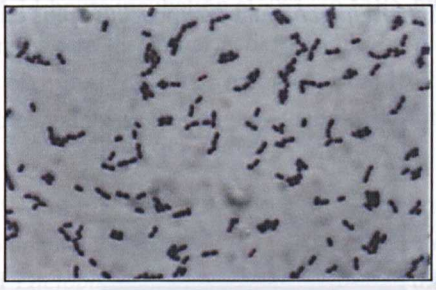


Fig 1. Light micrograph (x 100) of a Gram-stained LAB, Lactobacillus plantarum

Several species of LAB have been isolated from Malaysian foods, such as *cili bo*, *tempeh*, *ikan rebus*, *tempoyak*, *tapai ubi* and *tapai pulut* (Figure 2).



Fig 2. Malaysian fermented foods employed for LAB isolation. (a) Tempeh, (b) Tapai ubi and (c) Tapai pulut

Isolated LAB were identified and characterised phenotipically (carbohydrate metabolism pattern and microscopic observation) and genetically (random amplified polymorphic DNA analysis, RAPD) (Figure 3).

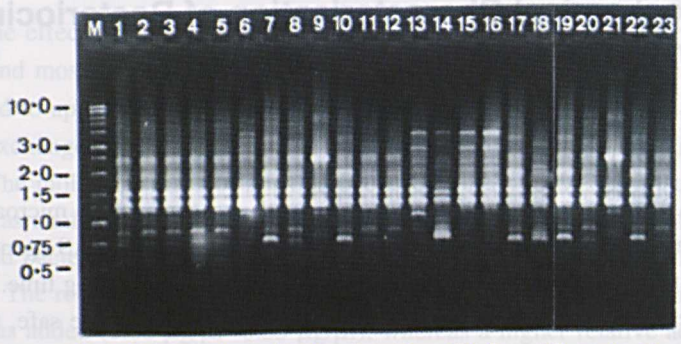


Fig 3. RAPD analysis of LAB isolated from Cili Bo and Tempeh with primer GEN 25014. Lane M, 1 kb Lambda ladder molecular size marker; Lane 1-18, LAB isolated from Cili Bo; Lane 19-23, LAB isolated from Tempeh

Plantarisin BS2, bacteriocins (secondary metabolite) that produced by *Lactobacillus plantarum* BS2, was shown to be coded by chromosomal DNA. This bacteriocin gene was successfully cloned (Figure 4) and sequenced. This bacteriocin gene showed 32% similarity to Plantarisin S. The study of the expression of the cloned bacteriocin gene in *Escherichia coli* and *Lactococcus sp.* is currently undertaken.



Fig 4. Molecular analysis of gene encoded for plantaricin S isolated from Lactobacillus plantarum BS 2. M, λ ladder DNA/HindIII molecular size marker; Lane 1, Clone4 uncut plasmid DNA, Lane 2, Clone 4 plasmid DNA digested with NcoI/NdeI restriction enzyme, Lane 3, PCR amplification of ~600 fragment; Lane 4, Concentrated PCR product. Clone 4 is the cloned plasmid DNA containing the ~600bp fragment in JM109 Escherihia coli cells. It is compared with PCR product (without cloning), the size is approximately the same. Therefore, this shows the correct fragment has been cloned

Nisin-like bacteriocin that produced by *Lactococcus lactis* subsp. *lactis* RW 18 isolated from *Ikan rebus* was purified to apparent homogeneity using fast protein liquid chromatography (Figure 5). The nisA gene of this LAB was also isolated and sequenced. RAPD-PCR fingerprinting analysis showed that this locally isolated LAB was not a *Lc.lactis subsp. lactis* ATCC 11454, which is nisin producer.



Fig 5. Purification and characterisation of bacteriocin produced by Lactococcus lactis subsp. lactis RW 18 isolated from Ikan rebus. Clear zone formation was observed for electrophoresed purified bacteriocin using direct activity gel analysis. The molecular mass of bacteriocin was estimated to be 3.9 kDa by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) and gel filtration chromatography respectively. Lane D, desalted ammonium sulfate precipitated bacteriocin; Lane R, bacteriocin pooled after Resource-S chromatography; Lane S, bacteriocin pooled after Superose-12 prep XK 16/70 column chromatography

The highest production of bacteriocin by *Lactobacillus plantarum* 1 – RS5, which was also isolated from *ikan rebus,* was detected at 14 hours incubation at 28°C in MRS media with initial pH 6.0. This bacteriocin is a very stable compound where the initial activity could be recovered after being treated at high temperature (50°C - 100°C) for 60 min, pH2 – 9 or being kept for 15 days at -20°C, 4°C and 10°C respectively. This bacteriocin also stable against methanol and ethanol, but not to acetone, acetonitrile, n-heksane, isopropanol and butan-1-ol.

Endopeptidases, one of the hydrolytic enzyme that can be used to derived food flavouring agents from protein sources, was purified to apparent homogeneity from *Lactococcus lactis* subsp. *lactis* RI 11 isolated from *Ikan rebus* (Figure 6) and *Lactobacillus plantarum* TL-1 isolated from *Tempeh*. Endopeptidase that purified from *Lc. lactis* subsp. *lactis* RI 11 was believed to contain several isozymes, which were able to be active at wider range of pH and temperature (10°C, 50°C and 90°C; pH 3.5, 6.5 and 9.5). The endopeptidase purified from *Lb. plantarum* TL-1 was optimally active at pH 7, pH 9.0 and 40 °C. The molecular mass for both endopeptidases was smaller than 15 kDa and demonstrated high substrate affinity for oxidised insulin β-chain as compared to angiotensin.

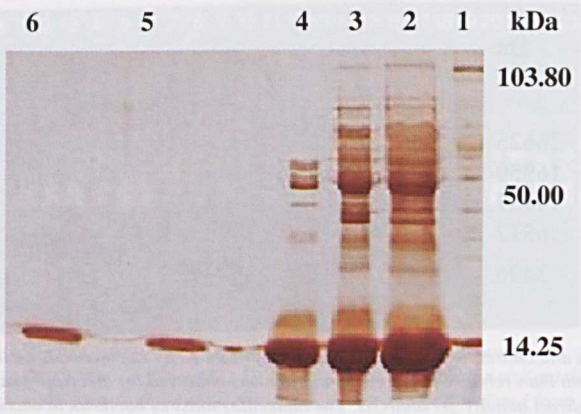


Fig 6. Purification and characterisation of endopeptidase produced by Lactococcus lactis subsp. lactis RI 11 isolated from Ikan rebus. SDS-PAGE analysis of fractions pooled during purification of Lc. lactis subsp. lactis RI 11. Electrophoresis was performed on a 15 % gel, stained with silver staining. Lane 1, BDH broad range molecular mass marker; Lane 2, crude cell extract (80 µg); Lane 3, ammonium sulphate fraction (10 µg); Lane 4, fractions pooled after Resource Q chromatography (13 µg); Lane 5, fractions pooled after Resource S chromatography (3 µg); Lane 6, fraction pooled after Superose-12 chromatography (3 µg).

Extracellular lipase, hydrolytic enzyme that can be applied in dairy and detergent industry, were screened from 13 LAB isolated from Tempeh. The highest extracellular lipase activity was produced by Pediococcus acidilactici TP 6. This lipase was found to be optimally active at pH 8.0 and 37 oC. The molecular mass of purified lipase estimated by gel filtration chromatography was 20 kDa.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8343
E-mail: hlfoo@fsb.upm.edu.my

Emodin, a Potential Larvicide from *Ploiarium alternifolium* (Theaceae)

G.C.L. Ee and K.N Ng

The genus *Ploiarium* belongs to the Theaceae family. *Ploiarium alternifolium* (Vahl.) Melanch is locally known as "Jinggau" in Sarawak. "Jinggau" is one of the most common trees in secondary forests and on sandy and acid soils in Southern Sarawak, Malaysia. The leaves are eaten raw as salad and have a pleasant sharp taste. The wood is commonly used as fence and pepper posts. It is also popularly used as firewood. *P. alternifolium* has been found through phytochemical studies to contain secondary metabolites that can be grouped as geranyl anthraquinones, anthraquinonyl xanthones, triterpenoid benzoates and bixanthones. Anthraquinone is the main group of the quinones. Besides the natural quinones, a dianthraquinone has also been isolated.



Flower of Ploiarium alternifolium

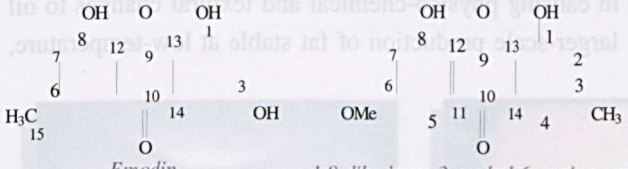


Young seeds of Ploiarium alternifolium



Leaves and shoots of Ploiarium alternifolium

Our recent chemical investigations on the stem bark of *Ploiarium alternifolium* (Theaceae) have yielded the anthraquinone emodin and it's derivative1, 8-dihydroxy-3-methyl-6-methoxyanthraquinone.These two compounds have not been reported to be present in this plant. Structural elucidations of these compounds were achieved using Nuclear Magnetic Resonance spectroscopy, while Mass Spectrometry gave the molecular masses. The crude extracts were found to be moderately bioactive against the larvae of *Aedes aegypti* with LC_{50} values of 90-130 µg/ml. However, emodin gave a very low LC_{50} value of 2.79 µg/ml in the larvicidal bioassay indicating it to be a potential natural larvicide against the Dengue Fever mosquito larvae.



Emodin *1,8-dihydroxy-3-methyl-6-methoxy-anthraquinone*

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

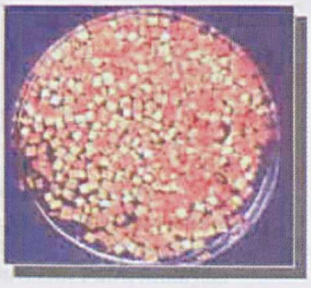
Tel: +603 8946 6785
E-mail: gwen@fsas.upm.edu.my

Transforming Fats and Oils The Green Way

Hasanah Mohd Ghazali, Kamariah Long, Lai Oi Ming, Margaret Liew Yoon Bing, Mariam Mohd. Ismail, Chu Boon Seang, Pauline Chew Xui Sim, Tee Seok Bee, Hazlina Ahamed Zakeri, Ker Yee Ping, Salmah Yusof, Mohd Yazid Abd. Manaf, Yaakob Che Man and Dzulkifly Mat Hashim

Changing the physico-chemical properties of fats and oils can widen their applications in the food industry. A green technology called enzymatic interesterification was used to do this. Briefly, this reaction allows the fatty acids of oils or a mixture of oils to be inter- changed. A catalyst is needed to accelerate the rate of reaction. In biotechnology, the best candidate is a group of enzymes known as lipases. Lipases are protein molecules and are natural, biodegradable, renewable, and perform catalysis under mild conditions. Compared to other catalysts, enzymes catalyse a more directed reaction, forming more specific end products. Interesterification does not cause the formation of *trans* fatty acids that are usually formed when oils are hardened by hydrogenation e.g. during the manufacture of margarine. These fatty acids may adversely affect the levels of cholesterol in the blood. Some products that can be produced using lipase-aided interesterification of fats and oils are margarine, shortenings, and confectionery fats.

Under this study, the interesterification performance of several immobilised microbial lipases on the production of hard fat feedstock for margarine and shortenings, low-temperature stable palm oil, and replacement fat for processed cheese and ice cream were evaluated. The study also involved the use of naturally immobilised (cell wall-bound) lipases produced by several microorganisms isolated from local sources. Microbial lipases were immobilised first onto Celite, dried and then added to reaction mixtures composed of oils/fats, with or without the addition of exogenous fatty acids. The mixtures were incubated at 40-60°C and shaken at 200 rpm for up to 24 hours, after which the enzyme was removed. After some purification process, the physical and chemical properties of the reaction mixtures were analysed. Among these were their fatty acid composition, triglyceride (TG) profiles, melting points, melting and cooling behaviour, polymorphic forms and solid fat content. Interesterification of palm stearin (PS) with palm kernel olein (PKO), sunflower oil or anhydrous milk fat (AMF) show that two lipase sources - *Pseudomonas* and *Rhizomucor miehei* - were superior to the others in causing physico-chemical and textural changes to oil mixtures. The lipase from *R. miehei* was used in larger-scale production of fat stable at low-temperature,



Naturally immobilized lipase



Margarine



Shortening

margarine, liquid shortening, fat replacer in processed cheese and ice-cream These were evaluated chemically, physically and sensorily after their preparation and following storage. These products were generally softer and smoother compared to products produced from non-interesterified oils/fats. Storage studies indicated that the margarine was stable to oxidation and discolouration. Lower concentrations of palm stearin are recommended to obtain softer margarine. Sensory evaluation of the processed cheese indicated a promising technology, as the texture, flavour and colour were acceptable. The production of liquid shortening (for frying) and ice-cream mixes was also successfully executed.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

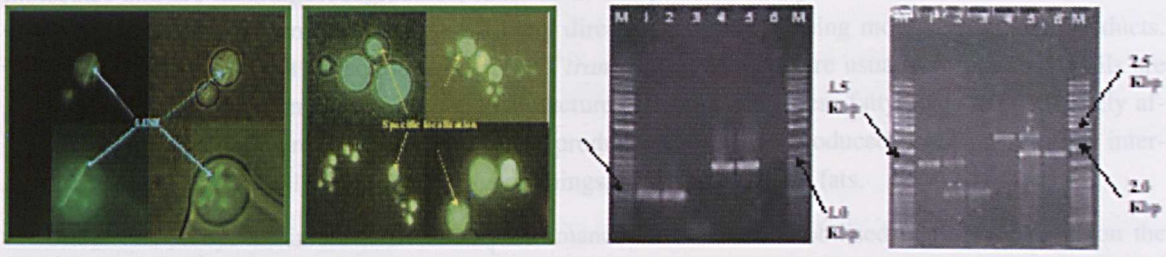
Tel: +603 8946 8348
E-mail: hasnah@fsb.upm.edu.my

Systematic Deletion of ORF and Protein Localization Towards the Elucidation of Function of *Saccharomyce cerevisiae* Genes



Hirzun Mohd Yusof, Raha Abdul Rahim and Clemente Michael Wong Viu Ling

The sequencing project of *Saccharomyces cerevisiae* genome predicted the present of more than 6000 genes or Open Reading Frames (ORFs) in it. At present, more than 60% of these have their function elucidated. In this project, we are trying to decipher the function of two of the hypothetical ORFs (YIR010W & YOR228C) through bioinformatics and experimentation approaches. The bioinformatics provided the biological data like gene sequence and prediction (glycosylation sites) through pattern recognition.



Systematic deletion

In experimentation, so far we have created deletion mutants for both ORFs. The PCR-based site-directed mutagenesis was achieved with the process of homologous recombination. PCR was carried out to verify the correct replacement of the deletion cassette into the ORFs' loci to confirm deletion of the gene. Tetrad analysis showed that the YIR010W is an essential gene for vegetative growth, while YOR228c is a non-essential gene. Both ORFs were cloned into expression vectors carrying the GFP fusion gene in both the N-terminal and C-terminal directions. The GFP tagging of the proteins enable their subcellular localization. Both gene products were well localized, where YOR228c protein was seen in the vacuole of the yeast cell while YIR010W protein seems to be associated with the spindle. However further confirmation works need to be done, through the used of specific monoclonal antibodies or known gene products from the similar locale, before any firm conclusion can be drawn.

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6421
E-mail: hirzun@hotmail.com

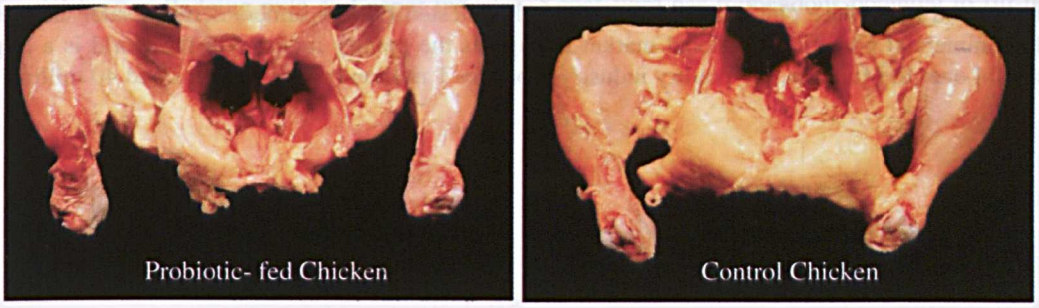
Probiotic for Poultry

AwardWinner

Ho Yin Wan, Norhani Abdullah, Kalavathy Ramasamy and S. Jalaludin

For more than 50 years, antibiotics have been used as growth promoters in livestock production. However, in recent years, there is a growing concern on the continuous feeding of sub-therapeutic levels of antibiotics to livestock which may result in the presence of antibiotic residues in animal products and the development of antibiotic-resistant bacteria that are dangerous and potentially lethal when transmitted to humans. Such negative potential motivated many developed countries, such as the US, the European Union and Japan to either severely restrict or totally ban the use of antibiotics in animal feeds as a growth promoter. This led to considerable interest to find other ways to achieve the same growth promotion without the use of antibiotics. Probiotics, which are viable friendly bacterial cultures that have a beneficial effect on the health of a host when taken as a feed supplement, have been considered as a substitute for the antibiotic growth promoters.

The product developed by us at the Institute of Bioscience, Universiti Putra Malaysia, is a probiotic for poultry which can be used as a natural substitute for the antibiotic growth promoters to increase performance in chickens (broilers and layers) and as a hypolipidaemic agent to reduce fat and cholesterol in broilers, and cholesterol in egg yolk. It consists of a mixture of 12 *Lactobacillus* strains isolated from the intestines of local chickens. The *Lactobacillus*-probiotic is in a powder form, made up of viable freeze-dried *Lactobacillus* strains mixed in cornstarch. Viability of the *Lactobacillus* strains in the mixture is maintained at a high level – at about 1 x 10^9 viable cells per gram. Only a low dosage of 0.1% of the probiotic is required to be incorporated into the feed daily.



Large fat deposition in the control chicken compared to the reduced fat deposition in the probiotic-fed chicken

Twelve feeding trials have been carried out to evaluate the effects of the *Lactobacillus*-probiotic, used in place of antibiotic growth promoters, to enhance the growth performance and feed efficiency of broiler chickens and laying hens. Results from the feeding trials consistently showed that probiotic-fed broiler chickens have better growth performance, feed efficiency and immune response, less mortality rate, less pathogenic bacteria and noxious bacterial enzymes in their intestinal tract, and less body fat and cholesterol than the control broilers fed without probiotic. When compared to antibiotic-fed broiler chickens, probiotic-fed chickens also have better growth performance, feed efficiency and immune response, and less mortality rate. Similarly, supplementation of the probiotic to laying hens also improves the growth performance, feed efficiency, egg production, especially at the initial laying period, egg weight and egg size, and lowers the cholesterol level in egg yolk at the initial laying period. The egg weight is increased by 1.1 gram per egg, and there is a shift from small and medium to large and extra large eggs in the probiotic-fed hens.

Although imported commercial probiotics are available in Malaysia and are used by some swine farmers, inconsistent results of using probiotics in poultry production have been a constraint to the promotion of their use. Variations in the foreign microorganisms and decreasing viability in local hot and humid conditions probably led to the inconsistent results in using imported probiotics in the poultry industry. However, the results from all our feeding trials consistently showed that our *Lactobacillus*-probiotic supplemented to chickens significantly improves their performance and feed efficiency, and can be used as a replacement for antibiotic growth promoters. The probiotic also has a hypolipidaemic (fat and cholesterol-reducing) effect on the chickens. The probiotic developed from our research, which consists of a combination of 12 *Lactobacillus* strains isolated from the intestines of local chickens (host-specific), has an advantage over other single-strain probiotic or strains isolated from other sources (non-host-specific). As the gastrointestinal tract is a complex and hostile environment, a multi-strain probiotic is more effective in influencing the microbial ecology of the host, particularly if it is intended to generate a beneficial impact on the intestinal microflora. If the probiotic strains are host-specific, as ours are, the chances of them surviving and proliferating in the intestinal environment of the chicken are even better.

The *Lactobacillus*-probiotic contributes not only economic benefits to the poultry industry, but also health benefits to society as a whole. Probiotic-fed broiler chickens, and eggs produced by probiotic-fed hens are considered safe and healthy food as they are antibiotic-free and have low fat and cholesterol. Cost of production is lowered since performance and feed efficiency of the chickens are enhanced. Additional profit can be obtained from premium price of antibiotic-free, low fat and cholesterol broiler chickens and eggs. Increase in egg production and egg size will further enhance profit.

The *Lactobacillus*-probiotic has great commercial potential as many countries have banned or severely restricted the use of antibiotics in animal feeds, and other countries that have not done so will eventually follow suit. The poultry industry, at present, is under pressure to seek a substitute for antibiotics as a growth promoter, and to produce chickens with less fat and cholesterol as consumers demand safer and healthier food. Commercial potential for global market is huge as the poultry industry in the world is a large and successful one. In Malaysia, the poultry industry produces 1 million broiler chickens and 40 million eggs a day.

Reader Enquiry
Digestive Microbiology Unit
Enzyme and Microbial Technology Laboratory
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8067, 8946 8071
E-mail: *ywho@ibs.upm.edu.my*

Development of High Quality Writing and Printing Paper Using Kenaf (*Habiscus cannabinus*) Fibre



Jalaluddin Harun

Kenaf, a non-wood plant fiber used for pulp and papermaking has two fiber components, different morphologically and chemically. The objective of this research is firstly to provide kraft pulping at differences active alkali charges and evaluate handsheet properties and secondly to explain the influence of kenaf fibers (bast, core and whole stalk) morphology on strength properties. The pulping experiments led to the conclusion that bast fibers are relatively easy to delignify during pulping, followed by the whole and the core kenaf fractions. The Duncan's Multiple Range Test indicated that the differences in the mean values of the all kraft-pulping properties at various stages of active alkali charge are significant at 95% confidence interval. Core fibers have the highest strength properties and followed by whole stalk and bast fibers. It was expected that bast fiber exhibit the highest tear index and bulk amongst other pulps of kenaf studied. For optimal utilization of kenaf as a raw material for pulp and papermaking, the bast and core fractions should be processed separately and then blended, as per requirement. In general, morphological factors are more important than chemical factors during the development of paper strength properties in kenaf fibers.

Pulp and Paper Industry in Malaysia is valued at RM 5.4 billion in the year 2001. However, Malaysia only possesses one integrated Pulp and Paper mill using mixed tropical hardwood as base raw material. Hence, with timber certification and eco-labelling becoming important, we need to search for alternative raw material for our fledging pulp and paper industry. Kenaf fibre has tremendous potential to fill-in the gap.

Reader Enquiry
Institute of Advanced Technology (ITMA)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7538
E-mail: jalal@forr.upm.edu.my

Simple Technique of Antigen Purification and the Production of Monospecific Polyclonal Antiserum for Citrus Tristeza Virus (CTV)



Kamaruzaman Sijam, Nurhadi, Inon Sulaiman and Maheran Abdul Aziz

The difficulty in purification of citrus tristeza virus (CTV) is due to the relatively low concentration of the virus and the presence of proteins, polysaccharides, and the presence of phenolic substances such as tannins. Even though methods have been developed for the removal of contaminating host plant impurities present in the virus suspension, some materials of plant origin frequently accompany the purified virus even after high-speed centrifugation.

In this study, coat protein (CP) as highly purified antigen can be produced by simple technique without using ultracentrifuge and electroelutor. Semi purified virus was obtained by low speed centrifugation combined with polyethylene glycol (PEG) precipitation. Final purification was done by sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) of semi purified virus, cutting out the protein band containing CP and eluting the protein with elution buffer, resulting in highly purified CP as final immunogen. The simplicity of the method described in this study is technically reliable due to the use of monospesific CTV protein and economically acceptable because the antigen can be prepared without a wide range of equipment. Advantages of this technique are: 1) virus loss during purification could be minimized and resulted no detectable plant contaminants by reducing the number of steps during purification procedure, 2) able to recover sufficient CTV-CP with less degraded CP preparation to be used as an immunogen following a minimal purification schedule, and 3) highly purified antigen can be obtained. With the starting material of 50 g of bark citrus tissue, 750 µg of eluted CP as highly purified antigen was produced. Immune response in female White Leghorn chicken can be generated with only 200 µg of eluted CP. From 30 g of immature egg yolk of immunized chicken, 37 mg of monospecific polyclonal antiserum containing IgY was produced.

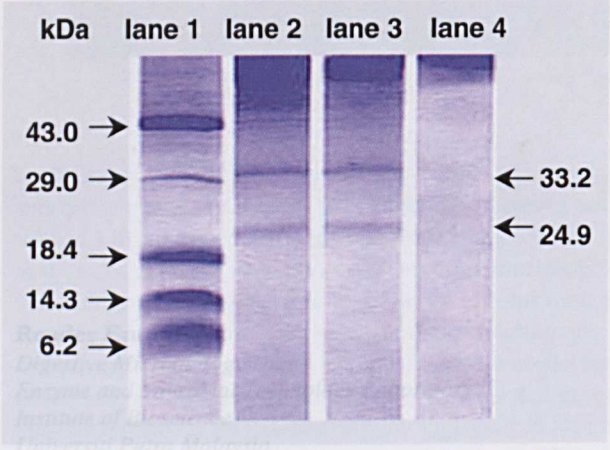


Figure 1. SDS-PAGE pattern of viral proteins purified from Citrus Tristeza Virus isolates. Lane 1: Molecular weight standard, lane 2: severe isolate, lane 3: moderate isolate and lane 4: Healthy samples

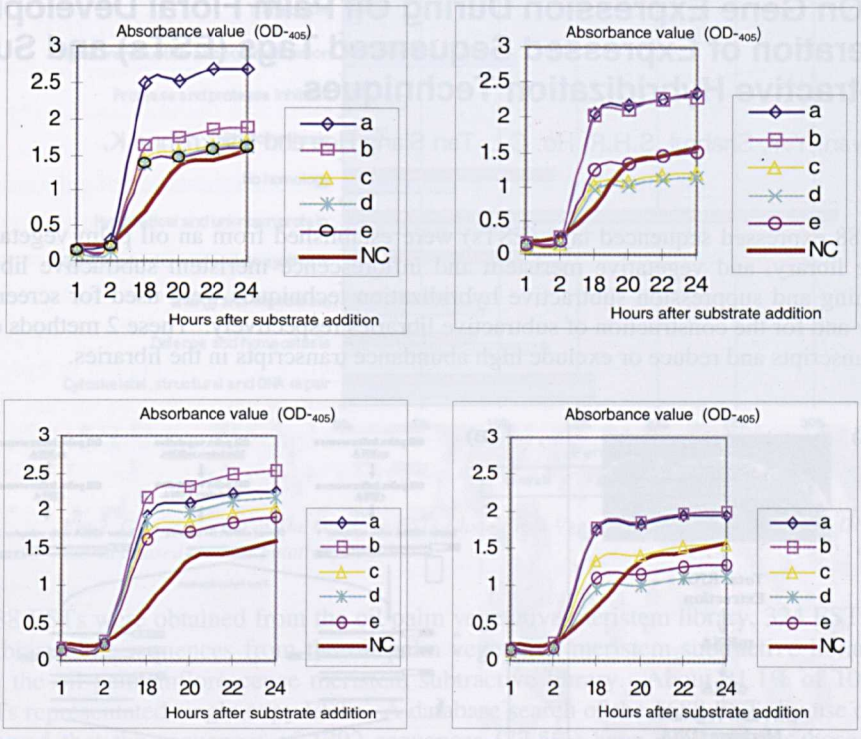


*Figure 2. Absorbance values for purified preparation of Citrus Tristeza Virus to the immunoglobulin and enzyme conjugate of various dilutions in double antibody sandwich enzyme-linked immunosorbent assay. IgY was diluted at A: 10^{-1}; B: 10^{-2}; C: 10^{-3}; D: 10^{-4}. Conjugate was diluted at **a**: 1:100; **b**: 1:500; **c**: 1:1,000; **d**: 1:1,500, **e**: 1:2,000 and **NC**: Negative control*

Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7234
E-mail: kama@agri.upm.edu.my

A Study On Gene Expression During Oil Palm Floral Development Via The Generation of Expressed Sequenced Tags (ESTs) and Suppression Subtractive Hybridization Techniques

Lee, Y.P., Kwan, Y.Y, Shahrul, S.H.R, Ho, C.L, Tan Siang Hee and Harikrishna K.

A total of 1688 expressed sequenced tags (ESTs) were established from an oil palm vegetative meristem library, ovule library, and vegetative meristem and inflorescence meristem subtractive libraries. Cold-plaque screening and suppression subtractive hybridization techniques were used for screening a regular cDNA library and for the construction of subtractive libraries respectively. These 2 methods enrich for low abundance transcripts and reduce or exclude high abundance transcripts in the libraries.

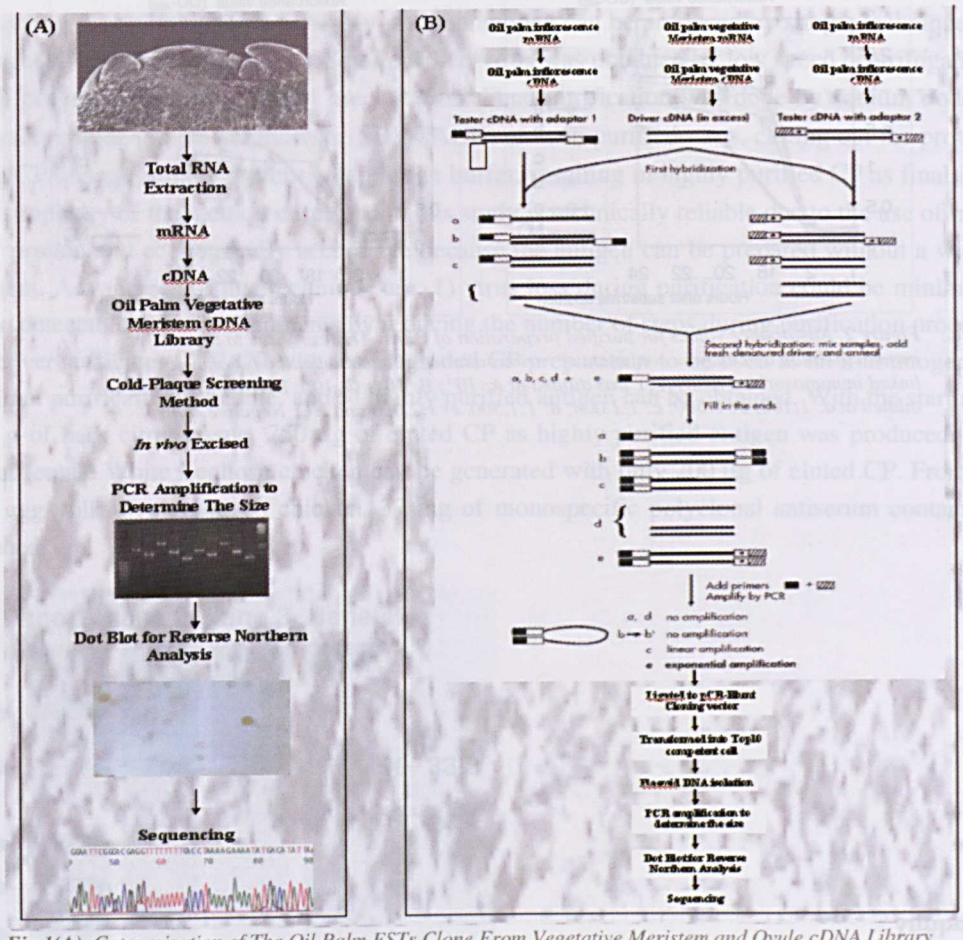


Fig.1(A). Categorization of The Oil Palm ESTs Clone From Vegetative Meristem and Ovule cDNA Library based on their putative functions

(B). Graphic presentation of the (A) regular cDNA library and (B) subtractive library construction

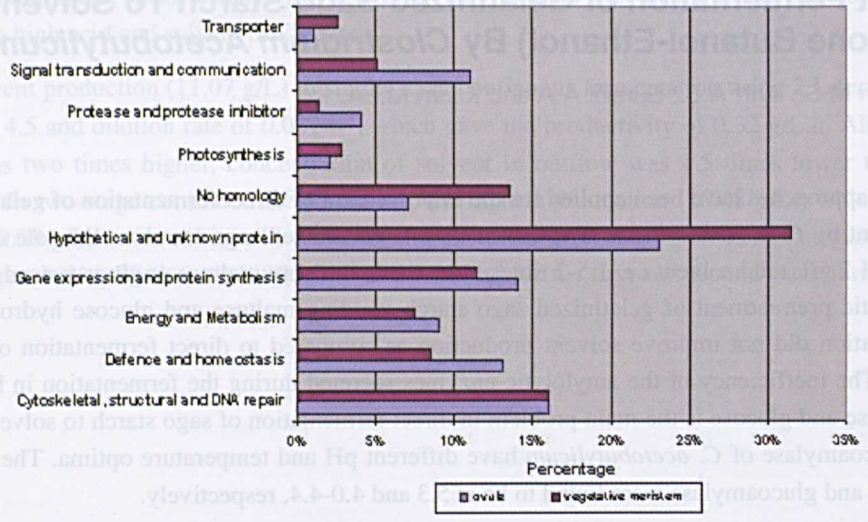


Fig.2. Categorization of The Oil Palm ESTs Clone From Vegetative Meristem and Ovule cDNA Library based on their putative functions

About 1088 ESTs were obtained from the oil palm vegetative meristem library, 324 ESTs from the oil palm ovule library, 192 sequences from the oil palm vegetative meristem subtractive library and 84 sequences from the oil palm inflorescence meristem subtractive library. About 81.1% of 1088 vegetative meristem ESTs representated single copy ESTs. A database search of the 1688 ESTs by use of the BLAST algorithm showed that the sequences of 1292 sequences (77.5%) have similarity to those of registered genes from various organisms including higher plants, mammals and yeasts, while 396 (22.5%) are novel. Out of 1088 vegetative meristem ESTs 16% of the sequences encode proteins involved in cell structure, cytoskeleton, and DNA repair, 12 % of the sequences encode proteins involved in gene expression and protein synthesis and 1% are involved in signaling processes. A different distribution of gene function was observed with the ovule tissue. About 11% of the 324-ovule sequences encoded proteins that are involved in signaling and communication. 14% of the ovule sequences encoded proteins involved in the gene expression and protein synthesis.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8344
E-mail: krisna@fsb.upm.edu.my

Direct Fermentation of Gelatinized Sago Starch To Solvent (Acetone Butanol-Ethanol) By *Clostridium Acetobutylicum* P262

Madihah M.S., Ariff A.B., Suraini A.A and Karim M.I.A.

Several approaches have been applied for the improvement of direct fermentation of gelatinized sago starch to solvent by *C. acetobutylicum*. The use of 30 g/L gelatinized sago starch as the sole carbon source produced 11.2 g/L total solvent *i.e.* 1.5-2 times more than with pure maltose or glucose used as carbon sources. Enzymatic pretreatment of gelatinized sago starch yielding maltose and glucose hydrolysate prior to the fermentation did not improve solvent production as compared to direct fermentation of gelatinized sago starch. The inefficiency of the amylolytic enzymes secreted during the fermentation in hydrolyzing starch to maltose and glucose is the main problem in direct fermentation of sago starch to solvent. The α-amylase and glucoamylase of *C. acetobutylicum* have different pH and temperature optima. The pH optima for α-amylase and glucoamylase were found to be at 5.3 and 4.0-4.4, respectively.



Production of solvent 500 mL Schott bottle using 30g/L sago starch (11.0 g/L) was comparable to fermentation using corn starch and about two times higher than potato and cassava starches. At a range of sago starch concentration investigated (10 to 80 g/L), the highest solvent production (18.8 g/L) was obtained at 50 g/L. A mixture of yeast extract and ammonium nitrate produced total solvent (18.8 g/L) of about 6 times higher than that obtained in fermentation using yeast extract alone. Individual concentration of nitrogen and carbon influenced solvent production to a greater extent than carbon to nitrogen (C/N) ratio. In fermentation without pH control using 2 L stirred tank fermenter, initial pH 6 gave the highest solvent production (14.13 g/L) with the productivity of 0.5 g/L/h. Excessive acid production (32 g/L) was obtained in fermentation where pH was controlled at 6.0 during the acidogenic phase which reduced solvent production significantly (7.1 g/L). In order to reduce acid accumulation, the fermentation where pH was allowed to decrease naturally by self-acidification during acidogenic phase was suggested. Solvent production was also reduced when pH during the solventogenic phase was controlled at 4.5 to 6.5. Substantial improvement of solvent production was achieved in fermentation where pH was not controlled during acidogenic phase (initial pH was 6) and then the pH was controlled at 5.5 during solventogenic phase. Using this pH control strategy, the productivity (0.79 g/L.h) was improved by 1.6 times as compared to fermentation without pH control, though the final solvent concentration (16.82 g/L) was about the same. The activities of enzymes relevant to solvent fermentation were also determined during the fermentation. The highest crotonase and phosphate butyryltransferase activity was observed in fermentation where pH was controlled at 5 during acidogenic phase, which was corresponded to fairly high acid accumulation but low solvent



production. On the other hand, specific activity of β-hydroxybutyryl-CoA was the highest at pH 5.5, which was corresponded to high acid and solvent production.

The highest solvent production (11.07 g/L) in single-stage continuous fermentation using 2 L fermenter was obtained at pH 4.5 and dilution rate of 0.037 h^{-1}, which gave the productivity of 0.32 g/L.h. Although the productivity was two times higher, concentration of solvent in outflow was 1.5 times lower than in batch fermentation. In two-stage continuous fermentation, the highest production (10.48 g/L), which gave the productivity of 0.39 g/L.h, was achieved by maintaining the pH at 4.5 for both fermenter stages, while the operation was operated at dilution rate of 0.08 h^{-1} and 0.037 h^{-1} for the first and second stage fermenter, respectively.

Reader Enquiry
Fermentation Technology Unit
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8341
E-mail: FTC@time.net.my

Synthesis of Optically Pure (-)-menthyl butyrate by Immobilized Lipase



Mahiran Basri, Abu Bakar Salleh, Raja Noor Zaliha Abd Rahman, Basyaruddin Abd. Rahman and Siti Salhah Othman

The increasing understanding of the mechanism of drugs, pesticides and hormones interaction on a molecular level has led to the increasing awareness of the significance of chirality as the key to the efficacy and safety of many of these products. Only one stereoisomer (enantiomer) of these substances is required for efficacy and safety, and the other stereoisomer is either inactive or may be toxic. The (-)-menthol and its esters for example, are more important and had been widely used as component of candy, sweets, chewing gums, beverages, cosmetics, therapeutically as local mild anesthetics, antipuritic, analgesic and tobacco products due to their distinct cooling and refreshing effect which is lacking in the (+)-menthol and its esters. The pure enantiomers can be prepared by separation of the racemic compounds by chemical methods. However, the laborious steps and the expensive and sometimes toxic chemicals needed to produce enantiomers meant much higher production costs.

In this project, we are developing an alternative method, which is using enzymes as biocatalysts to produce enantiomers via asymmetric synthesis. Besides being known for their mild and environmental-friendly reaction, enzymes especially lipase from the *Candida rugosa* spesies are also known for their regio-, substrate- and enantioselectivity. Herein, the optically active (-)-menthyl butyrate were synthesized by enantioselective esterification of racemic (±)-menthol and butyric anhydride using lipase from *Candida rugosa* immobilized onto various inexpensive, commercially available supports such as polymer beads to anionic clay. Immobilization was done through a simple physical adsorption method. The effect of immobilization on lipase enantioselectivity and activity were investigated. High yield and optical purity of the product was achieved when immobilized lipase were used in the reaction. The immobilized lipases also retained high catalytic activity and show an increased stability compared to the native lipase. For example, the reaction with the presence of immobilized lipases exhibited continuous production of esters even after 75 hours of reaction time.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

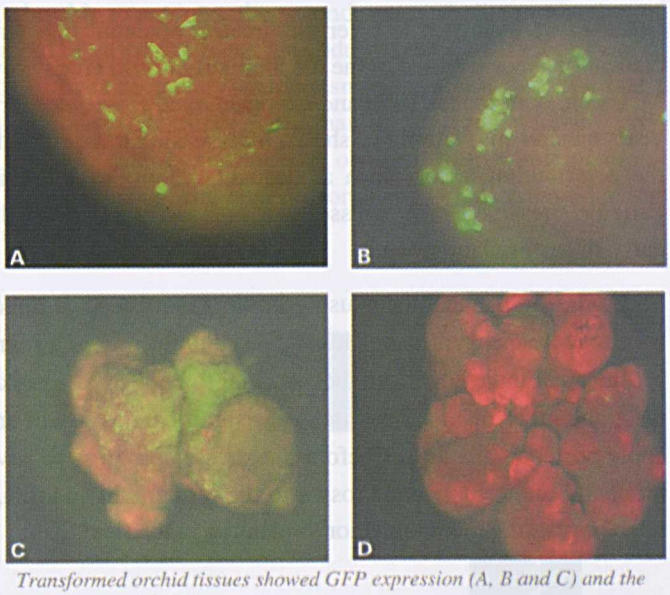
Tel: +603 8946 6603
E-mail: mahiran@fsas.upm.edu.my

Development and Commercialization of Transgenic Orchids



Maziah Mahmood, Janna O. Abdullah, Tan Chon Seng, Mohamad Puad. A., Tee Chong Siang and Wee Chien Yeong

Orchids have become an important export commodity in Malaysia. Orchids are valued for their incredible range of diversity in size, shape, and colour. Known for their long lasting blooms, orchid rank as the top among all flowering plants. With ever changing tastes and preferences of consumers, there is an urgent need for new or improved varieties with new colours or size complementing existing hybrids that have been in the market. Conventional breeding and selection has been difficult or impossible, costly and time-consuming and always hampered by genetic sterility. Currently, genetic engineering presents a new approach to orchid improvement. It relies on the manipulation of genes and no longer depends on sexual reproduction for transferring genes and generating new genotypes.



Transformed orchid tissues showed GFP expression (A, B and C) and the negative control (D)

This study involved the establishment of a transformation system for commercial orchid hybrids (Oncidium and Dendrobium). The antisense of partial cloned gene fragment of CHS and DFR had been used for genetic transformation of Oncidium Taka and Dendrobium Sonia 17. The regeneration system of both hybrids from callus is also established and had been used for the genetic transformation studies. Currently, GFP gene was also included in the study as a non-destructive reporter gene and potential selectable marker gene for replacement of antibiotic selection. The present of various genes (CHS, DFR, GFP and GUS) in the plant tissues was demonstrated using the PCR technique. A fluorescence microscope can be used to see the expression of GFP gene easily, thus GFP could be used as a potential tool to observe the ability of gene expression in the plant. We are currently multiplying our transgenic plantlets in vitro and waiting for field evaluation for changing of flower colour.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Development of Biochemical Indicators for Early Detection of Drought, Salinity and Aluminium Toxicity Stresses in Plants



Maziah M., Suzita S., Zulkifli S. and Nor'aini F.



Banana was identified to offer the greatest potential for commercialization since it is one of the most important fruit crops grown in Malaysia, both for the local and export market. However, in recent years banana cultivation has shown a decreasing trend. It is due to the contribution factors such as drought, salinity and aluminium toxicity stresses. These stresses are not easily observed during early stages of plant growth.

Studies in banana plants using in vitro systems have indicated that the activities of peroxidase and nitrate reductase enzymes are closely linked to the drought, salinity and aluminium toxicity conditions. These biochemical indicators have the potential to be used as diagnostic tools in early detection of stresses in banana and other plants. This finding is significant as it will enable farmers especially plantation sectors to apply corrective measures before the stresses progress to advanced conditions. This finding will also significantly reduce economic losses to the farmers. In addition, this protocol can be used in selecting stress tolerant planting materials prior to planting in the field.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Production of Triterpenes in *Centella asiatica* (Pegaga) *In vitro* Cultures



Maziah M., Anna, L.P.K. and Bala, I.

Plant secondary metabolism is very important as the source of many fine chemicals such as drugs, dyes, flavors and fragrances. It is thus of interest to be able to engineer the secondary metabolite production of the plant cell factory, for instance to produce more of a fine chemical, to produce less of a toxic compound, or even to make new compounds. Engineering of plant secondary metabolism is feasible nowadays, but it requires knowledge of the biosynthetic pathways involved. Since more than 90% of commercially produced phytochemicals cannot be synthesized in the laboratory and must be obtained from whole plant resources, plant cell and tissue culture methods have gained considerable importance towards the production of several biopharmacologically useful substances.

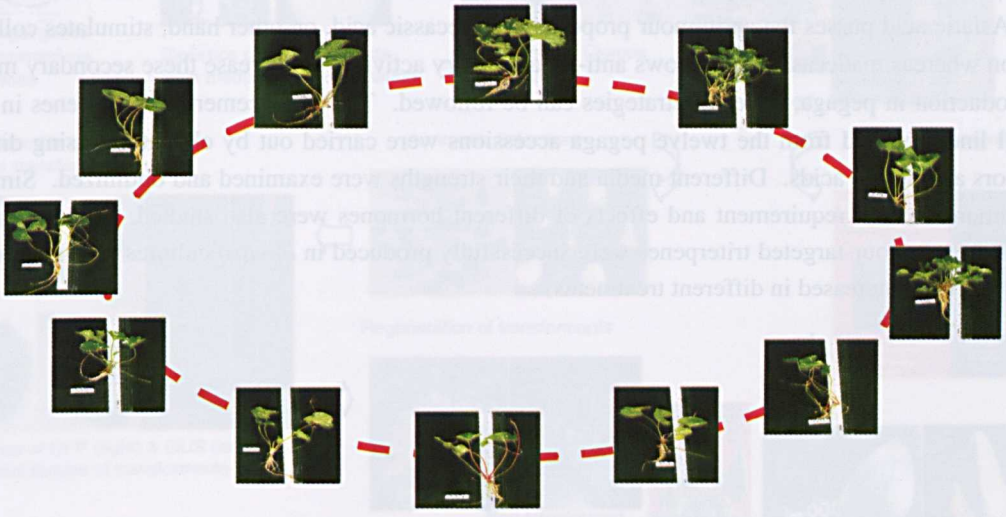


Figure 1: Twelve accessions of Centella asiatica



Figure 2: Callus cultures

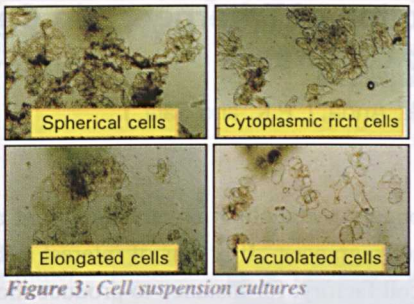


Figure 3: Cell suspension cultures

Development of a commercially viable process for the production of pharmaceutically related products using tissue culture techniques and bioreactor technology

Centella asiatica or pegaga as called in local language is a herbaceous plant of the Umbelliferae family. There are several biopharmacologically useful substances extracted from pegaga such as Asiatic acid, madecassic acid, asiaticoside and madecassoside. Asiaticoside had been associated with wound healing whilst Asiatic acid posses the antitumour properties. Madecassic acid, on other hand, stimulates collagen I secretion whereas madecassic acid shows anti-inflammatory activity. To increase these secondary metabolites production in pegaga, different strategies can be followed. The enhancement of triterpenes in callus and cell lines selected from the twelve pegaga accessions were carried out by elicitation, using different precursors and amino acids. Different media and their strengths were examined and optimized. Similarly, the optimum sucrose requirement and effects of different hormones were also studied. Results obtained revealed that the four-targeted triterpenes were successfully produced in *in vitro* cultures and their concentrations could be increased in different treatments.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

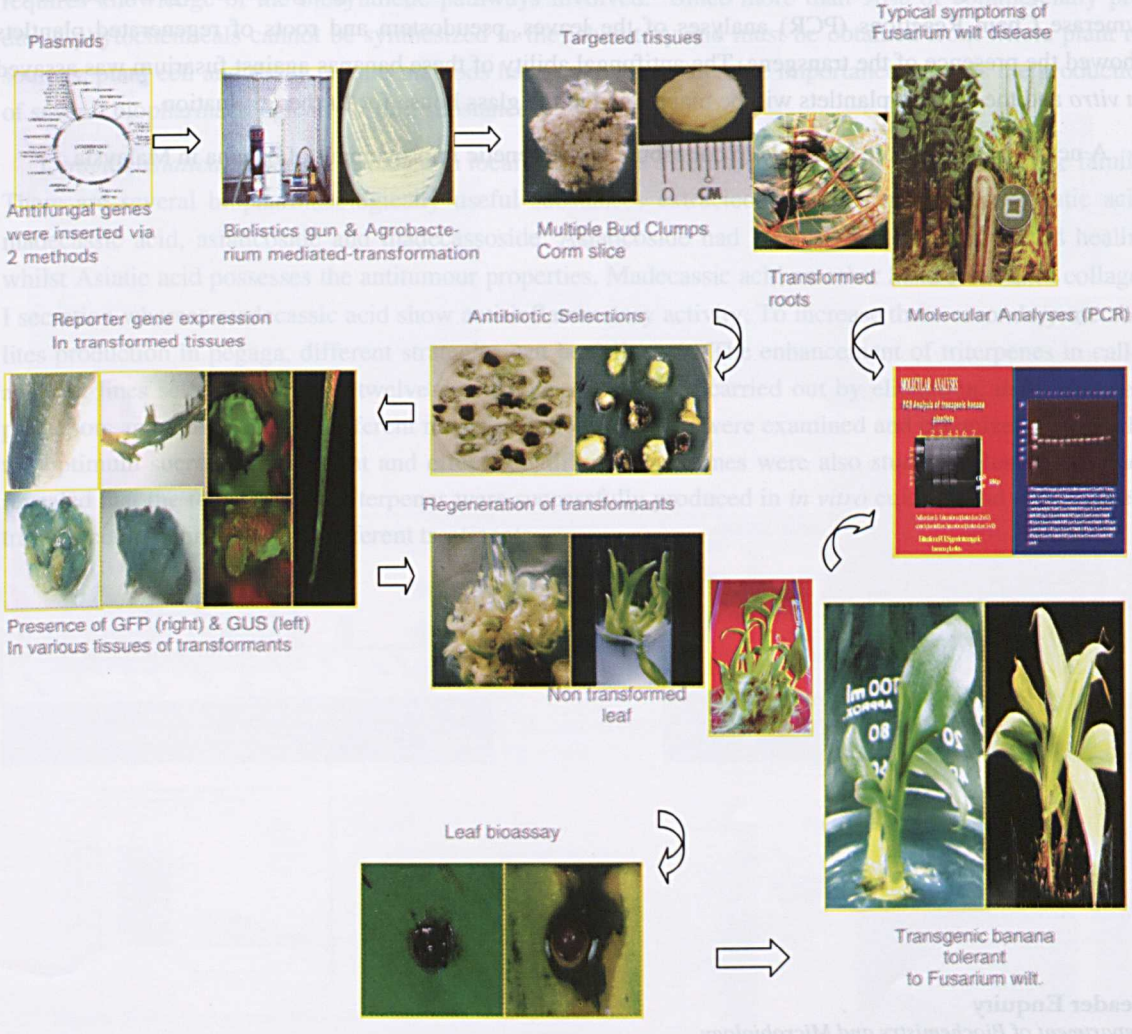
Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Genetic Engineering of Bananas for *Fusarium* wilt Disease Resistance

Award Winner

Maziah Mahmood and Sreeramanan Subramaniam

Fusarium wilt caused by the soil inhibating fungus, *Fusarium f.sp. cubense* is a major factor limiting commercial banana production in Malaysia. Control measures involving field sanitation, soil fumigation, organic amendments and crop rotation are generally non-effective. The only effective method of controlling fusarium wilt is the planting of new resistant varieties.



Production of banana cultivars with tolerant *to Fusarium*

The development of a genetic engineering system for the plant regeneration of transformed tissues into whole plants is essential in producing commercialisable transgenic banana of disease resistance. *Agrobacterium* –mediated gene transfer and microprojectile bombardment are used to introduce genes that encode proteins with antifungal properties such as *Chitinase*, *β-1,3- Glucanase* and *Thaumatin-Like Proteins* (TLPs) into banana tissues. However, combinations of the defense gene products have shown considerably more promise in reducing disease than single transgene introductions.

Multiple bud clumps (Mbcs) and corm slices of banana were used as target tissue to receive these genes. Screening in antibiotic selection media (Kanamycin, hygromycin, basta and geneticin) and the presence of reporter genes (GFP and GUS), used to detect the inserted antifungal genes in targeted tissues. Polymerase Chain Reactions (PCR) analyses of the leaves, pseudostem and roots of regenerated plantlets showed the presence of the transgene. The antifungal ability of these bananas against fusarium was assayed *in vitro* and the tolerant plantlets will be maintained in the glass house for further evaluation.

A new tool is therefore available to contribute to the genetic improvement of banana in Malaysia.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Enhancement of Bioactive Metabolites in *Centella asiatica* (Pegaga) Cell Cultures



Maziah M., Anna, L.P.K. and Bala, I.

Plant secondary metabolism is very important as a source of many fine chemicals such as drugs, dyes, flavors and fragrances. It is thus of interest to be able to engineer the secondary metabolite production of the plant cell factory, for instance to produce more of a fine chemical, to produce less of a toxic compound, or even to make new compounds. Engineering of plant secondary metabolism is feasible nowadays, but it requires knowledge of the biosynthetic pathways involved. Since more than 90% of commercially produced phytochemicals cannot be synthesized in the laboratory and must be obtained from whole plant resources, plant cell and tissue culture methods have gained considerable importance towards the production of several biopharmacologically useful substances.

Centella asiatica or pegaga as called in local language is a herbaceous plant of the Umbelliferae family. There are several biopharmacologically useful substances extracted from pegaga such as Asiatic acid, madecassic acid, asiaticoside and madecassoside. Asiaticoside had been associated with wound healing whilst Asiatic acid possesses the antitumour properties. Madecassic acid on other hand stimulates collagen I secretion whereas madecassic acid show anti-inflammatory activity. To increase these secondary metabolites production in pegaga, different strategies can be followed. The enhancement of triterpenes in callus and cell lines selected from the twelve pegaga accessions were carried out by elicitation, using different precursors and amino acids. Different media and their strengths were examined and optimized. Similarly, the optimum sucrose requirement and effects of different hormones were also studied. Results obtained revealed that the four-targeted triterpenes were successfully produced in *in vitro* cultures and their concentrations could be increased in different treatments.

Figure 1: 12 accessions of *Centella*

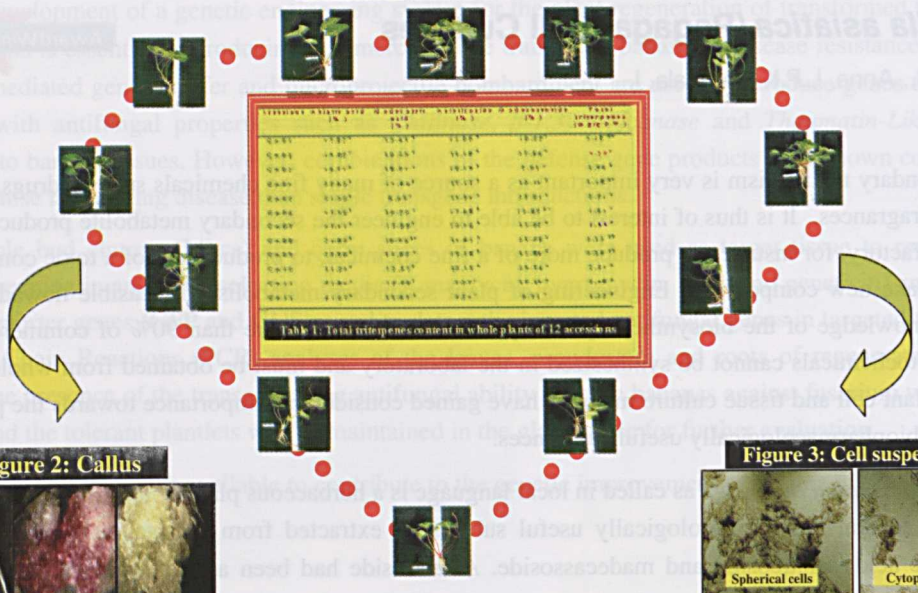


Table 1: Total triterpenes content in whole plants of 12 accessions

Figure 2: Callus

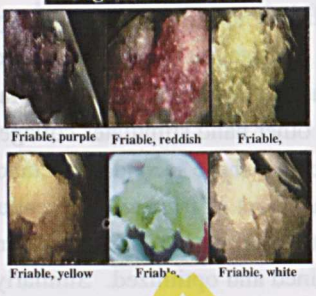


Figure 3: Cell suspension

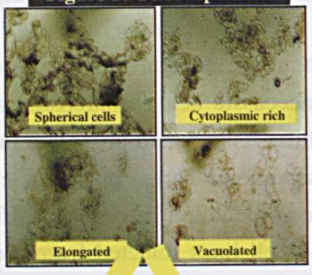




Figure 4: Effects of optimized culture conditions, precursor, elicitor and amino acid on asiaticoside, madecassoside, asiatic acid and madecassic acid production in callus cultures of *C. asiatica*.

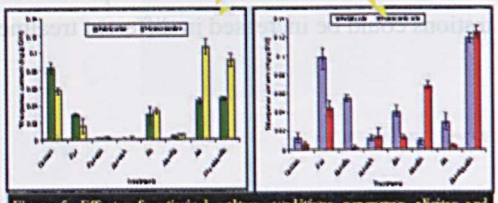


Figure 5: Effects of optimized culture conditions, precursor, elicitor and amino acid on asiaticoside, madecassoside, asiatic acid and madecassic acid production in cell suspension cultures of *C. asiatica*.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Potential Anti-tumor Compound Production from Cell Cultures of *Eurycoma longifolia* (Tongkat Ali)

Award*Winner*

Maziah Mahmood, Rosli Noormi, Chan Kit Lam, Azimahtol Hawariah Lope Pihie

Plant bioactive compounds have been used extensively in pharmaceutical industries. Some of these compounds cannot be synthesized in laboratories. As parent plant materials are not always available and some are endangered due to severe over collection, plant tissue culture offers an alternative approach for the production of these secondary products. *Eurycoma longifolia* known locally as Tongkat Ali is popular for its aphrodisiac property and treatment of other diseases. Its usage in treating other ailments and diseases such as cancer still unclear due to the lacking of scientific data. Recently, an important alkaloid 9-methoxycanthin-6-one was observed to possibly have an anti-proliferative effect in ovarian cancer cells.



Figure 2: Tongkat Ali callus

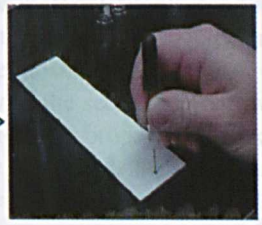


Figure 3: Spotting a TLC plate with sample



Figure 1: Tongkat Ali Plant

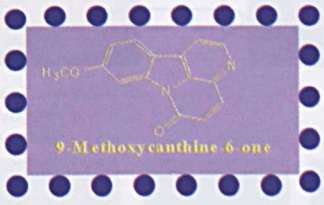


Figure 8: 9-methoxycanthin -6-one structure



Figure 4: Running the TLC plate on solvent

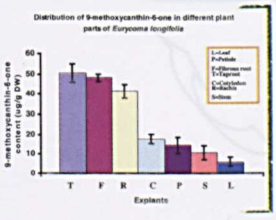


Figure 7: 9 methoxycanthing-6 one content µg/g dry weight

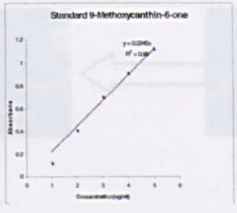


Figure 6: Graph Standard 6-methoxycanthin

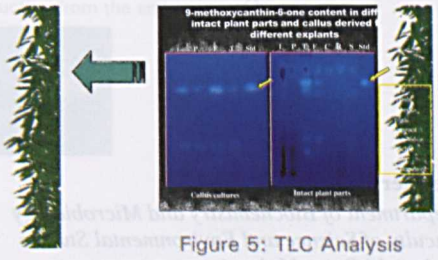


Figure 5: TLC Analysis

This compound was also found to produce in cell culture of *Eurycoma longifolia*. Semi-quantitative analysis using spectrophotometer revealed that 9-methoxycanthin-6-one is present in significant quantities in tap root, fibrous root and rachis intact tissues. Preliminary studies also showed the presence of 9-methoxycanthin-6-one in callus tissues derived from difference explants with the highest concentration detected in fibrous root-derived callus. The successful production of 9-methoxycanthin-6-one in *in vitro* cultures brought about a potential large-scale production using bioreactor technology.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

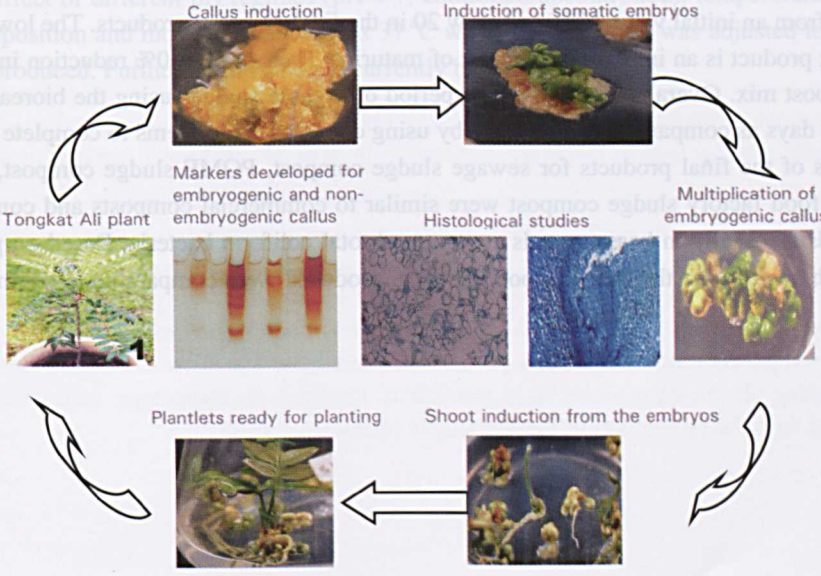
Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Commercial Production of *Eurycoma longifolia* (Tongkat Ali) Seedlings using Tissue Culture Techniques

AwardWinner

Marziah M. and Sobri H.

Eurycoma longifolia Jack, commonly known as Tongkat Ali in Malaysia, belongs to the family Simaroubaceae. For centuries, it is regarded as a medicinal plant in the South East Asia region. Every part of the plant has medicinal properties, the roots are used as tonic after childbirth, for reducing fever, to cure mouth ulcers and to treat intestinal worms. Reports have shown that the roots contained quassinoid compounds, which are effective for eliminating malarial parasites. Currently, this plant owes its popularity for its aphrodisiac claim. Since this plant possesses many medicinal values, it may lead to excessive gathering of the plants from its natural habitat. The widely utilization of this plant causes the need of the plant to be multiplied. Therefore, the utilization of this plant needs to be balanced with the conservation to maintain its population and diversity. The plant is uprooted in the process of separating the root, which resulted in serious shortage of plants. Due to the poor seed set and infrequent flowering, there is an immediate need for the establishment of plantations to sustain the plant's raw material supply for the growing herbal industry. Tongkat Ali products account for 30% of the annual trade value of locally produced herbs in Malaysia, which is approximately $ 30 – 40 million. Although the most common method of propagation Tongkat Ali is through seeds, being a recalcitrant plant, the viability of the seeds is very low. Micropropagation via somatic embryogenesis provides an alternative approach to mass propagate Tongkat Ali. It is a rapid process, which can produce thousands of embryos in a single flask and, therefore, has the potential to provide unlimited supply of high quality seedlings of the best-selected genotypes availble.



Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6703
E-mail: marziah@fsas.upm.edu.my

Bioreactor Composting of Selected Organic Sludges

Mohd. Ali Hassan, Mohamed Ismail Abdul Karim, Arbakariya Arif and Azni Idris

Organic sludges such as palm oil mill effluent (POME) sludge, food factory sludge, sewage sludge and leachate sludge can be composted using bioreactor or windrow systems. In this study, organic sludges were composted with shredded wood and sawdust as bulking agents.

The objective is to develop an appropriate bioreactor composting system for several selected organic sludges. The bioreactor used is a modified cement mixer, with the drum insulated with 1.0 cm polystyrene to reduce heat loss. The aeration, pH, temperature, C/N ratio and moisture content were controlled and monitored during the fermentation phase of the composting process. A good compost product was obtained with a ratio of 3:1 (w/w) of sludge to bulking agent. For the composting of sewage sludge, POME sludge, food factory sludge and leachate sludge, the fermentation phase took 5, 5, 10 and 13 days respectively in the bioreactor. The fermentation phase could be reduced by the addition of 1% effective microbes (EM) as dry inoculum to the initial mixture. The pH for all the final compost products were between pH 6.0-8.0. The highest temperature achieved during the composting process of POME sludge and sewage sludge reached 60°C when heated air was supplied and controlled by a heat gun. Thermophilic condition in the composting process was very important to kill the harmful pathogens, to reduce fermentation phase period and also to maintain optimum moisture content in the compost product. The moisture content (wet weight basis) during the composting of all these sludges were between 50-70% without added water. The C/N ratio was reduced from an initial value of 30 to below 20 in the final compost products. The low C/N ratio of the final compost product is an important indicator of maturity. There was a 50% reduction in weight from the original compost mix. Overall, the composting period of organic sludges using the bioreactor system took around 30-40 days as compared to 60-90 days by using conventional systems to complete the process. The characteristics of the final products for sewage sludge compost, POME sludge compost, leachate sludge compost and food factory sludge compost were similar to commercial composts and complied to the US EPA standards especially in heavy metals content and total coliform bacteria. Based on planting out performance with spinach, all the four compost products produced were comparable to commercial composts in the market.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8352
E-mail: alihas@fsb.upm.edu.my

Lactic Acid Production from Kitchen Garbage

Mohd. Ali Hassan, Yoshihito Shirai and Mohamed Ismail Abdul Karim

In Malaysia, the production of municipal solid waste is 0.8 kg/person/day. More than 30% of this municipal solid waste is kitchen refuse. Being of food origin, this waste is non-toxic and rich in both carbon and nitrogen. Due to the warm tropical environment, biodegradation occurs immediately after disposal. Kitchen refuse is normally placed inside large plastic bags where it undergoes natural fermentation. These bags are collected once every 2-4 days depending on the municipality. Generally the final disposal is in landfills where the organic matter is eventually decomposed to biogas. Landfill operators currently charge about RM 30 per ton for this treatment. Rather than paying for the treatment and wasting away the rich organic sources, we propose to use kitchen refuse as fermentation medium to produce value-added products.

In this work we focus on producing organic acids, particularly lactic acid, from kitchen refuse in Malaysia. Our eventual objective is to produce polylactate, the biodegradable polymer, from lactic acid. The results so far have been quite promising. The time course for organic acids production in a enclosed plastic bag at 30°C showed that within 4 days, more than 25 g/L organic acids was produced, with 22 g/L lactic acid. Interestingly, this is about the same duration between the disposal of kitchen refuse in the individual houses to the time that it arrives at the landfill sites. We also confirmed that the about 20 g/L lactic acid was present in the leachates from the garbage trucks. Treatment of kitchen refuse was also carried out to investigate the effect of different pH regimes (pH 4-7, controlled/uncontrolled), temperature (30 °C, 37 °C and 45 °C), composition and inoculum seeding. At 37 °C when the initial pH was adjusted to pH 7, 65 g/L lactic acid was produced. Further optimisation is currently being performed.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8352
E-mail: alihas@fsb.upm.edu.my

Towards Zero Discharge for the Palm Oil Industry

Mohd.Ali Hassan, Mohamed Ismail Abdul Karim, Yoshihito Shirai, Noraini Abdul Rahman, Phang Lai Yee and Arbakariya Ariff

Currently palm oil mill effluent (POME) is treated mainly to remove its high biological oxygen demand (BOD) in order to meet discharge standards prior to disposal. The most common treatment system presently employed in Malaysia for POME is the anaerobic ponding system whereby the biogas produced is released into the atmosphere, causing environmental pollution due to greenhouse effect. However, with its high organic content (more than 20,000 mg/L BOD) and being non-toxic, POME could serve as a suitable carbon source in fermentation systems for the production of value-added compounds. This would also help to reduce the environmental pollution due to the release of methane and carbon dioxide. Furthermore, it would be in line with the concept of clean processing or zero emission system.

Our research team has developed an integrated process incorporating the controlled anaerobic treatment of POME to produce organic acids, recovery of the organic acids and finally fed-batch production of biodegradable plastics (polyhydroxyalkanoates or PHA) under open and non-sterile conditions. We have studied the different components of this zero emission system separately. The overall mass balance for a typical palm oil mill was obtained based on the production figures as well as the conversion and yield factors. For a typical mill processing 60 tons fresh fruit bunch per hour or 81000 tons fresh fruit bunch per year, 200 tons cell mass containing PHA could be produced annually. Since the cell PHA content was about 50-60%, about 100 tons PHA could be obtained per year upon recovery. The clean water could be partly recycled (15000 tons per year) and the remainder safely discharged due to its low BOD of 80 mg/L. The energy required could be generated within the mill itself, since the palm oil industry is an energy-surplus industry. Therefore no additional outside energy is necessary for our proposed system. The by-product in the form of dewatered digested solids could be utilised as a fertiliser either in the palm oil plantation or sold. Based on our research, we have successfully produced organic acids from POME which were used as fermentation substrates to produce bioplastics. We have also succeeded in applying the evaporation system for the recovery of organic acids as well as bioplastic production in an open non-sterile fermentation.

Results showed that by evaporation, the organic acids could be concentrated to 100 g/L for use as substrates for the fed-batch fermentation. Upon condensation of the steam, the BOD of the water was low enough for it to be either recycled or discharged. The concentrated organic acids were successfully converted to PHA by *Alcaligenes eutrophus* under a non-sterile fermentation system when the initial cell density was kept high at 4 g/L. A repeated fed-batch system was also performed to obtain a high cell inoculum and to mimic to operation of a large PHA production fermenter. The success of these operations suggests that by integrating all these processes, it is possible to establish an appropriate zero emission system for POME coupled with the production of biodegradable plastics.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8352
E-mail: alihas@fsb.upm.edu.my

Measuring Cost Efficiency in Malaysian Oil and Fat Industry: A Data Envelopment Analysis (DEA) Evidence



Mohd Ghazali Mohayidin and Mohamed Osman Ahmed Bushara

Competitiveness of an industry over time is determined by its efficiency and productivity. The general objective of this study is to measure the economic efficiency of individual firms in the Malaysian oil and fat industry. The paper is divided into two major components. The first component deals with cost efficiency measurement of the Malaysian oil and fat industry, which is decomposed into technical and allocative efficiencies. This is done with explicit aim of evaluating the competitiveness of the industry since 1985s. The data used were a complete panel of annual observations on four decision-making units (DMU) for 12 years each, thus comprising 48 observations at 5-digit level of the international standard of industrial classification (SIC) for Malaysian four sectors of oil and fat industry observed from 1985-1996. These data were derived from Census of the Manufacturing Industries, conducted each year by the Department of Statistics (DOS).

The second component of this paper deals with the application of the piece-wise cost or overall economic efficiency (DEA) frontier model. The main purpose of this component is to provide meaningful insights regarding the economic performance of this industry over time. The mean cost-inefficiencies of Malaysian oil and fat industry in the 12 different years (1985 - 1996) tended to increase from 1988 to 1991. After 1991, the mean cost-inefficiencies decreased slowly until 1996 when the inefficiencies went up slightly. The major contributor to this inefficiency was technical inefficiency. The most cost inefficient sector was palm oil followed by the other oil and fat sector. Based on the results, it could be concluded that improvement in allocative efficiency requires first or second best pricing of final products; while improvement in technical efficiency requires cost minimization by the incumbent firms.

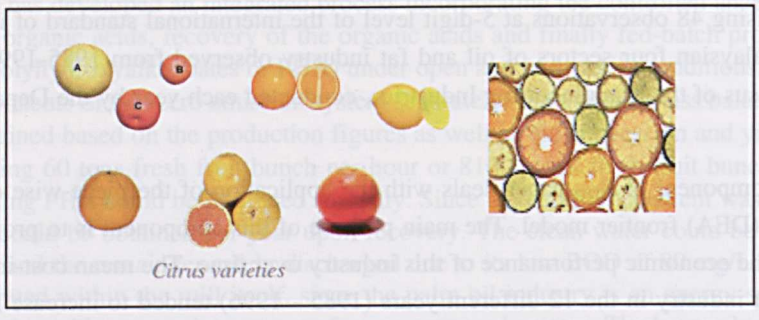
Reader Enquiry
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6175
E-mail: mghazalim@putra.upm.edu.my

Towards Improving Attractive Fruit Colour

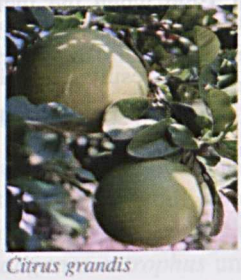
N.M. Saleh, U.K.Hanapi and M. Hashim

AwardWinner

Pummelo (*Citrus grandis* L. Osbek) contains several phytochemicals and nutraceuticals that have antioxidant properties and reportedly reduce the risk of cardiovascular diseases and some forms of cancer. Like other citrus fruits, pummelo has great potential for commercial exploitation. In order to increase the present market, local and overseas, for *Citrus grandis* fruit, molecular technologies appear, to be useful tool for producing more attractive fruit colour. Genetic engineering has opened up new ways for the improvement of fruit colour. This technique is currently being applied in pummelo fruit and would be applicable to other plants in the future.

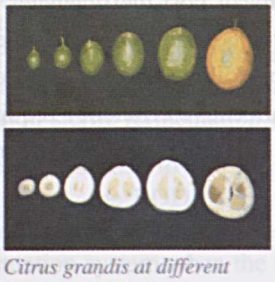


Citrus varieties



Citrus grandis





Citrus grandis at different developmental stages

There are three types of natural pigments in plant, viz. flavonoids, carotenoids and betalains. Among the three main pigments, orange colour of all citrus fruits, both flavedo and internal juice vesicle, is due to the presence of carotenoids in the plastids. Unlike *Citrus unshiu* and other orange coloured citrus fruits, *Citrus grandis* (pummelo) do not change its flavedo colour during the process of fruit maturation. However, yellowing of flavedo may be observed in overripe pummelo fruit. This is due to the gradual disintegration of chlorophyll present in the flavedo, paralleled with the continuous decrease in total carotenoids. A great deal remains to be learned about carotenoid biosynthesis and its accumulation in citrus fruit. Carotenoid synthesis in the biological system requires enzymes such as geranylgeranyl pyrophosphate synthase (*ggps*), phytoene synthase (*psy*), phytoene desaturase (*pds*), zeta-carotene desaturase (*zds*), lycopene cyclase (lyc) and carotene hydroxylase (*chx*). However, special attention was focused only onto three of the genes (*psy, pds* and *lyc*) that are directly involved in the carotenoid pathway. *Citrus grandis* var. Shatian were obtained from MARDI Jelebu. Tagging and collection of the fruits at different developmental stages i.e. 1,2,3,4,5

and 6 months were carried out to ensure the correct developmental stage of the fruits. Nucleic acids, RNA and DNA were extracted from the flavedo of *Citrus grandis* for molecular analysis. Polymerase Chain Reaction technique (PCR) using specific primers were carried out to determine the presence of genes involved in orange colour in citrus fruits. Confirmation of these genes were done using transformation technique and DNA sequencing. In addition, cDNA library of the matured pummelo fruit were also constructed. The library was then used for screening the gene of interest involved with fruit color. Expression levels of the various genes involved in the carotenoid biosynthesis were also checked using Northern Blotting. The involvement of the genes in the conversion of the green to orange colour during citrus fruit maturation process is currently being investigated. Eventually, transformation of *Citrus grandis* will be carried out to determine the expression of orange colour in the flavedo of pummelo fruits. We hope that the genetic improvement of pummelo flavedo from green to orange colour will further boost the fruit industry and strengthen Malaysia's position as an exporter of pummelo.

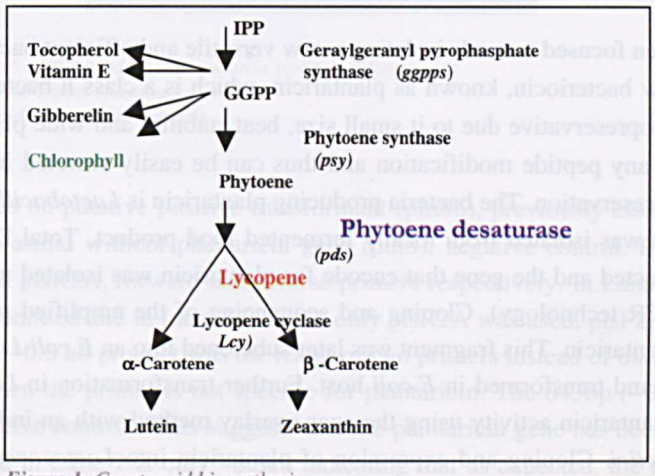


Figure 1: Carotenoid biosynthesis

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8357
E-mail: norihanms@putra.upm.edu.my

Plantaricin: A Potential Biopreservative



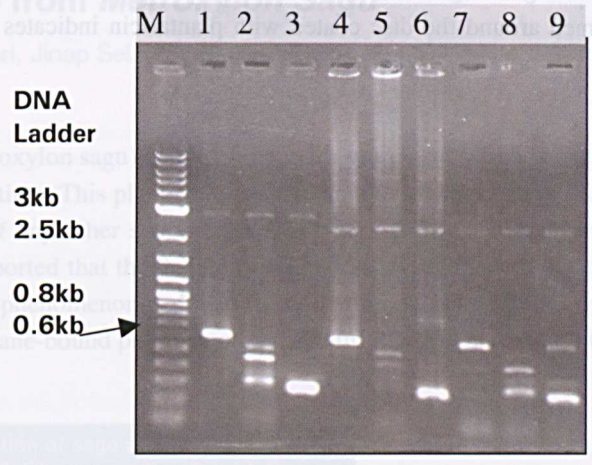
C.V. Suppramaniam, G.R. Rahmat Ali, R.A. Rahim and N.M. Saleh

Food preservation has been increasingly important in every country to prevent the remerging of harmful bacteria that causes food spoilage. It was discovered that bacteriocins have the potential to inhibit these pathogenic bacteria. In some countries, the use of antibiotics is prohibited in food and it is being substituted with nisin, the only commercially available bacteriocin. Nisin has been toxicologically tested and approved for prevention of spore outgrowth and toxin production by *Clostridium botulinum* in processed cheese and cheese spreads. Nisin has been used for a number of other applications, including extension of shelf life of dairy products and prevention of spoilage of canned foods in some countries. However, nisin is not effective at high pH and disintegrates when used in combination with phospholipids from food product such as meat.

Thus, efforts have been focused towards isolating a new versatile and efficient bacteriocin to act as food biopreservative. This new bacteriocin, known as plantaricin, which is a class ll bacteriocin, shows greater potential over nisin as biopreservative due to it small size, heat stability and wide pH tolerant. This bacteriocin does not undergo any peptide modification and thus can be easily secreted into liquid culture and purified for use in food preservation. The bacteria producing plantaricin is *Lactobacillus plantarum*, a lactic acid bacteria (LAB) that was isolated from locally fermented food product. Total DNA of *Lactobacillus plantarum* BS2 was extracted and the gene that encode for plantaricin was isolated using nucleic acid amplification technique (PCR technology). Cloning and sequencing of the amplified product confirmed the fragment isolated was plantaricin. This fragment was later subcloned into an *E.coli-Lactococcus* expression shuttle vector, pMG36e and transformed in *E.coli* host. Further transformation in *Lactococcus lactis* will enable the analysis of plantaricin activity using the agar-overlay method with an indicator microorganism i.e. *Pediacoccus acidilactici.* Cloning and expression of plantaricin into *Lactococcus* (GRAS -Generally Regarded As Safe) microorganism will enable the use of this LAB as a potential natural food preservative.

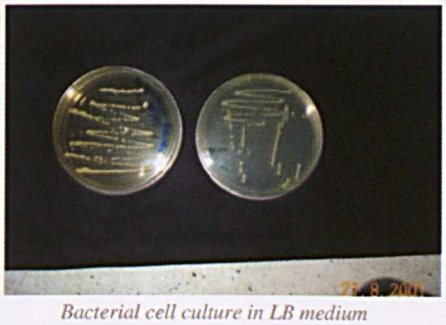
Currently, the application of class ll bacteriocins as biopreservative in both raw and processed food showed that it is non-immunogenic and are susceptible to proteolysis by trypsin and chemotrypsin. These properties of class ll bacteriocin coupled with the use of GRAS microorganism as host, which can co-exist in harmony with the natural inhabitants of the human gut system, will facilitate the development of an effective and natural food preservative. At present, a further analysis towards the development of this biopreservative is in progress.

Nucleic acid amplification of positive clones with suitable controls using PCR technology

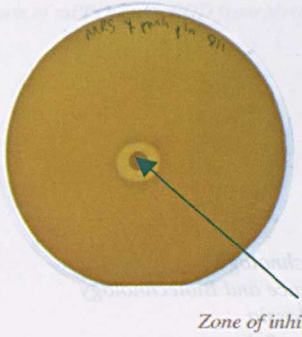


Lane M: λHindIII/EcoR1
Lane 1-Lane 3: plasmid Plns6 (PCR product from putative positive colony)
Lane 4-Lane 6: plasmid pGEM-T/plnS (positive control)
Lane 7-Lane 9: plasmid pMG36e (negative control)

PCR was performed on putative positive transformant (plnS6), previously cloned, positive control and pMG36e expression plasmid without plantaricin gene (plnS), negative control. Primers used in the PCR process are plsF2A and plsR2A, forward and reverse primers respectively. In Lanes 2,5 and 7 only plsF2A was used and plsR2A omitted and in Lane 3,6 and 9, only plsR2A was used, plsF2A was omitted. This was done to ensure that the ~0.6 kb product was the result of two primers instead of one. If single primer amplified a ~0.6 kb band, then the primer is not specific for plantaricin. The 643bp (~0.6kb) band in Lane 4 is similar to Lane 1 (positive control). This suggests that the plantaricin gene has been successfully cloned in *E.coli*. While, the band in Lane 7 is only ~0.5kb indicating that as expected, the negative control did not amplify the desired fragment of ~0.6kb. Sequencing result of this fragment (0.6 kb) confirmed the plantaricin gene has been cloned. To further the expression study, this plasmid construct was transformed in *Lactococcus lactis*, a food-grade microorganism.



Bacterial cell culture in LB medium



Zone of inhibition

Bacteriocin activity is observed using the agar-overlay method containing indicator organism i.e. *Pediacoccus acidilactici.* The halo formed around the disc coated with plantaricin indicates the inhibition of susceptible microorganism.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

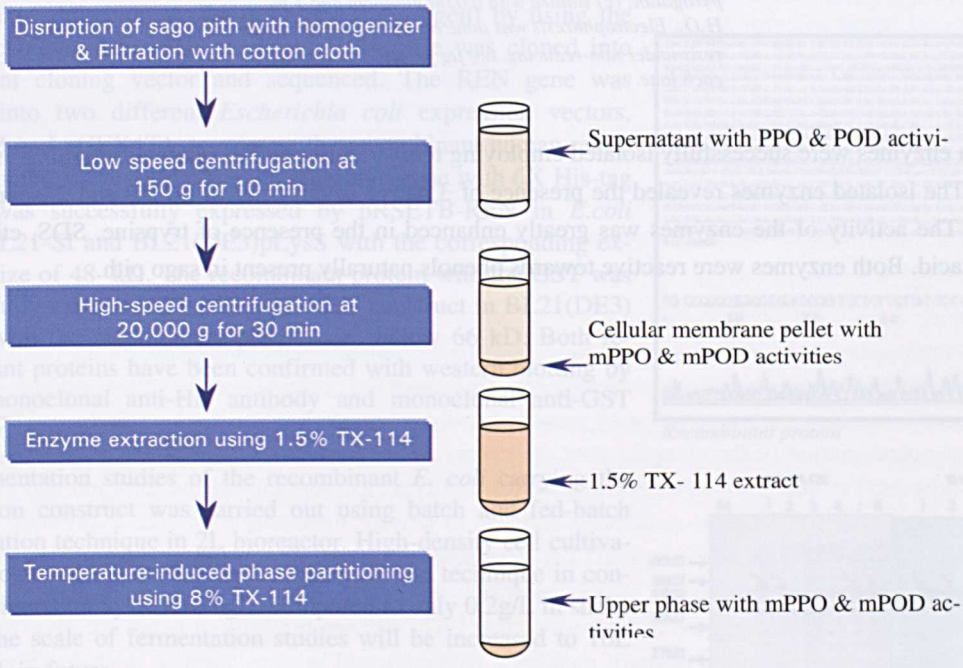
Tel: +603 8946 8358, 8946 8353
E-mail: norihanms@putra.upm.edu.my

Isolation of Membrane Bound Polyphenol Oxidase and Peroxidase from *Metroxylon Sagu*

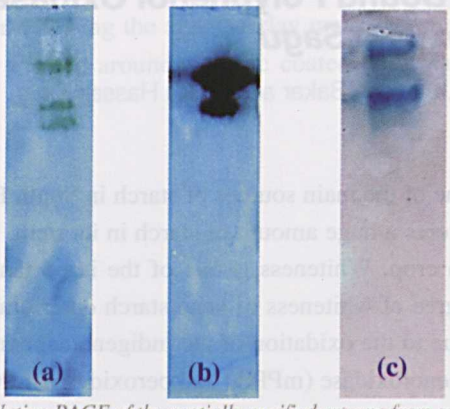
AwardWinner

Nazamid bin Saari, Jinap Selamat, Jamilah Bakar and Galila Hassan Onsa

Sago palm (Metroxylon sagu) is one of the main sources of starch in South East Asia exploited by mankind from prehistoric time. This plant stores a huge amount of starch in its stem, with exceptionally higher yield level than that of any other starch crop. Whiteness is one of the important parameters for a commercial starch. It was reported that the degree of whiteness of sago starch deteriorates markedly upon storage and processing. This phenomenon is due to the oxidation of the indigenous phenols that are believed to be mediated by membrane-bound polyphenoloxidase (mPPO) and peroxidase (mPOD).



Flow chart showing the steps of isolation and partial purification of mPPO and mPOD from Metroxylon sagu using temperature-induced phase partitioning technique



Native-PAGE of the partially purified enzyme from sago log: (a) stained with 0.1 M catechol; (b) stained with 0.1 pyrogallol; (c) stained with 0.03M guaiacol and 1 % H_2O_2. Electrophoresis was done on 10 % gel electrophoresis under non-reducing. 6.0 µg protein was applied in each lane.

Both enzymes were successfully isolated employing temperature induced phase partitioning using triton X-114. The isolated enzymes revealed the presence of 3 native isoenzymes of mPPO and 2 isoenzymes of mPOD. The activity of the enzymes was greatly enhanced in the presence of trypsine, SDS, ethanol and linoleic acid. Both enzymes were reactive towards phenols naturally present in sago pith.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8385
E-mail: nazamid@putra.upm.edu.my

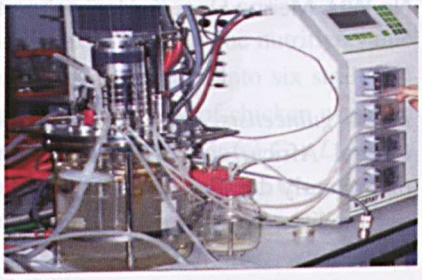
Production of Recombinant Human Protein in *E. coli*

Ng Chyan Leong, Julia Ibrahim, Raha Abdul Rahim, Ho Chai Ling and Hirzun Mohd Yusof

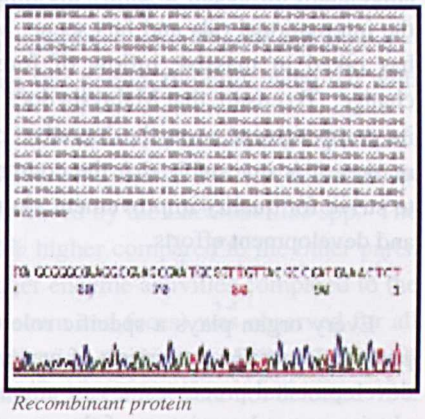
Renin is an important hormone in kidney regulating the renin-angiotensin system; which plays an important role in human blood pressure. It is a highly specific endopeptidase cleaving the Leu-Leu bond in angiotensinogen to generate angiotensin I. Isolation of renin from the organs including kidney is extremely difficult due to its very low concentration and its instability. Therefore, recombinant protein technologies are used to produce the recombinant human renin.

In this study, the precursor renin gene (REN) was isolated from the human adult kidney cDNA library (Invitrogen) by using the PCR technique. The PCR amplified REN gene was cloned into pCRBlunt cloning vector and sequenced. The REN gene was cloned into two different *Escherichia coli* expression vectors, pRSETB and pGEX4T1, to express the recombinant human renin. The recombinant protein of the human renin gene with 6X His-tag fusion was successfully expressed by pRSETB-REN in *E.coli* stains BL21-SI and BL21(DE3)pLysS with the corresponding expected size of 48 kD. The recombinant protein with the GST was successfully expressed by pGEX4T-REN construct in BL21(DE3) pLysS with the recombinant protein size below 66 kD. Both recombinant proteins have been confirmed with western blotting by using monoclonal anti-His antibody and monoclonal anti-GST antibody.

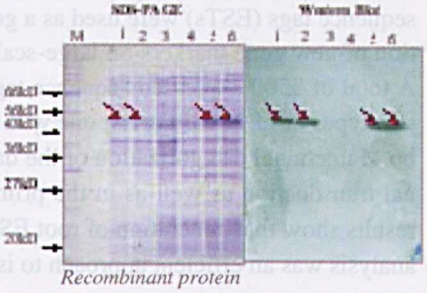
Fermentation studies of the recombinant *E. coli* carrying the expression construct was carried out using batch and fed-batch fermentation technique in 2L bioreactor. High-density cell cultivation is achieved by employing fed-batch culture technique in controlled bioeractor system to 6g/L compared to only 0.2g/L in shake flask. The scale of fermentation studies will be increased to 10L and 100L in future.



2L Bioreactor system use in the project



Recombinant protein



Recombinant protein

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6421
E-mail: hirzun@hotmail.com

Characterization and Comparison of Expressed Sequence Tags (ESTs) from cDNA Clones of Oil Palm (*Elaeis guineensis*) Flower and Root System by Single-Pass Sequencing

Ng WH, Meilina Ong, K. Harikrishna and Tan SH

Elaeis guineensis, originated from West and Central Africa, cultivated as an ornamental tree in early decades, has become an essential commodity crops in Malaysia. For many years now, palm oil has been the leading vegetable oil traded in the world market. Ever since palm oil began to enjoy the limelight at the international oils and fats scene, Malaysia has raked in massive inflow of foreign exchange. To ensure that Malaysia does not lose its competitiveness on the lucrative palm oil market, it is investable that the country needs to strive for quality improvement via research and development efforts.

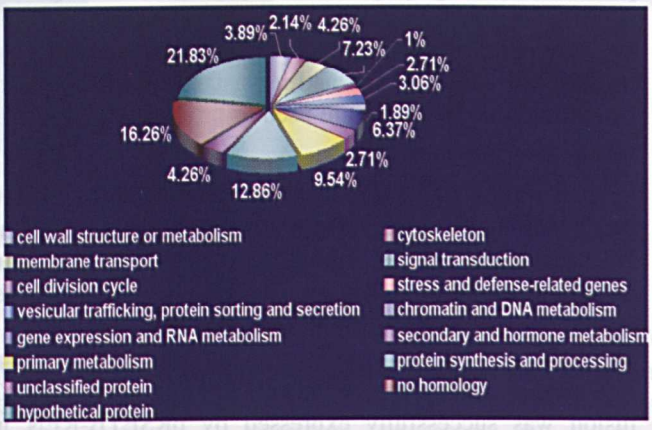


Fig 1. Functional Characterization of Putatively Identified Oil Palm Root Systems ESTs

Every organ plays a specific role that contributes to the development of a plant. Root is an essential part of a plant for absorption of water and nutrient. To dissect the molecular mechanisms underlying these developmental processes, a vast amount of genetic resources are required as markers that would enable to obtain a complete picture of the complex root developmental processes in oil palm. Therefore, expressed sequence tags (ESTs) were used as a genetic resource in this project to facilitate the isolation and identification of new gene markers on large-scale basis and also to provide information on gene expression patterns. A total of 3500 expressed sequence tags (ESTs) were generated from 4500 randomly selected clones, from two types of cDNA libraries; one with cDNA insert above 1000 bp and the other between 500 bp and 1000 bp. Functional categorization of the database-matched ESTs showed majority of genes are involved in signal transduction as well as in the primary metabolic pathways and in translation of mRNAs (Fig1.). The results show that generation of root ESTs by partial sequencing of random clones along with the expression analysis was an efficient approach to isolate genes that are functional in plant root of large scale.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8358, 8946 8353
E-mail: tsianghe@fsb.upm.edu.my

Enhancing the Nutritive Value and Utilisation of Tropical Feeds



Norhani Abdullah, Ho Yin Wan, Sieo Chin Chin

Transformed *Lactobacillus* spp. probiotic strains were used as feed additives to improve the nutritive value of feed in chicken. β-glucanase gene from *Bacillus amyloliquefaciens* was introduced into six strains of *Lactobacillus* spp. previously isolated from the chicken intestinal tract. Seven groups of chicken were fed for 2 weeks with: (a) commercial diet (C) + *L. brevis* C10b3; (b) C + *L. crispatus* I12b3; (c) C + *L. brevis* I23b3; (d) C + *L. fermentum* I25b3; (e) C + *L. brevis* I211b3; (f) C + *L. brevis* I218b3 and (g) C only (control). The strains were added at a concentration of 10^9 cfu/g. At day 1, the chickens were fed with 1 ml of either water (for control group) or the *Lactobacillus* strains suspended in water at a concentration of 10^9 cfu/ml. Two hours after the chicken were fed on the last day of feeding the experimental diets, feeds were removed and the cages cleaned. Fresh fecal droppings were collected and three birds were slaughtered from each group (0 day). Gizzard, duodenal, ileal, jejunal and cecal samples were collected and kept at –20°C. Similar sampling was repeated for 4 consecutive days. During this period, the birds were fed with the control diet.

The results showed that enzyme activity was not detected in birds fed control diet, but was observed in birds fed experimental diets. This indicates that the enzymes were produced by the *Lactobacillus* spp. The enzyme activities detected in ileum and jejunum were at least 13-30% higher compared to the other parts. Birds fed with C10b3 and I211b3 showed significantly ($p<0.05$) higher enzyme activities compared to the other groups. Drastic drop in enzyme activity (in ileum, jejunum, cecum and feces) was observed for all the treatment groups 24 h after removal of the experimental diets, indicating the low number of the *Lactobacillus* spp. present. All the bacterial strains were washed out, as enzyme activities were not detected 48 h after removal of the experimental diets. Hence, to maintain enzyme activities, the *Lactobacillus* strains have to be supplemented continuously to the birds.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6710
E-mail: norhani@fsas.upm.edu.my

Effects of Supplementation of a New *Mitsuokella* sp. Culture and Natuphos® Phytase on the Performance and Nutrient Utilisation of Broiler Chickens



Norhani Abdullah, Ho Yin Wan and Lan Ganqui

The effects of freeze-dried active *Mitsuokella* sp. culture (FD-AMC) and Natuphos® phytase (a commercial phytase) supplementations on the performance, nutrient utilisation, ash content and mineral concentrations of tibia, and plasma P, Ca, Zn and Mn concentrations in 360 broiler chickens (Avian-43) fed corn-soybean meal diets were evaluated from 1– 21 days of age. Each chick was weighed and assigned randomly to 24 cages of 15 chicks each. Six cages were used for each diet. The four dietary treatments were: (1) low available-P (aP) feed (0.21% aP) + 2.0% inactivated *Mitsuokella* sp. culture (IMC) obtained by drying at 65 °C for 72 h, (2) low-aP feed + 2.0% FD-AMC (equivalent to 500U phytase/kg feed), (3) low-aP feed + 2.0% IMC + 500U Natuphos® phytase/kg feed, and (4) normal-aP feed (0.44% aP) + 2.0% IMC. The FD-AMC, IMC and Natuphos® phytase were mixed daily with diets at feeding time. Feed was provided *ad libitum*.

The results showed that supplementation of FD-AMC or Natuphos® phytase to low-aP diet improved the feed intake, feed conversion rate, body weight gain and retention of P, Ca and Mn; increased the tibia ash content, Ca and P concentrations in the dry matter (DM) of tibia, and P and Zn concentrations in plasma; and reduced the P excretion (mg P/bird/day) of chickens. Chicks fed low-aP diet without supplementation excreted 58.8% and 45.9% more P compared to those fed low-aP diet with FD-AMC or Natuphos® phytase, respectively. Chicks receiving low-aP diet with FD-AMC or Natuphos® phytase had similar performance as those receiving normal aP diet. However, the P excreted (mg P/bird/day) by chicks consuming normal-aP diet was more than twice of those excreted by chicks consuming low-aP diet supplemented with FD-AMC or Natuphos® phytase. Supplementation of FD-AMC to low-aP improved the apparent metabolisable energy value of the diet, retention of Cu and Zn, and digestibility of N and DM, but Natuphos® phytase supplementation only improved the digestibility of DM.

The results also showed that FD-AMC supplementation was more efficient in improving the dietary nutrient utilisation in broiler chickens than the commercial Natuphos® phytase.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6710
E-mail: norhani@fsas.upm.edu.my

Detection of Lard and Randomised Lard as Adulterants in Refined-Bleached-Deodorized Palm Oil by Differential Scanning Calorimetry

O.M. Lai, J.M.N. Marikkar, H.M. Ghazali and Y.B. Che Man

Food adulteration is a commonly encountered problem in food trade and industry. Almost all foodstuffs present a quality problem but even more so when they have a high intrinsic commercial value. Therefore, monitoring of adulteration practices has become essential to protect consumers and food industries. The fats and oil industry is no exception to this. Adulteration has been a problem in the fats and oil industry for a long time. It is sometimes deliberate and sometimes accidental. Palm oil may also pose similar adulteration problems with commonly found animal fats such as lard. Apart from this, the Islamic and the Orthodox Jewish religions prohibit the consumption of products containing pork and lard.

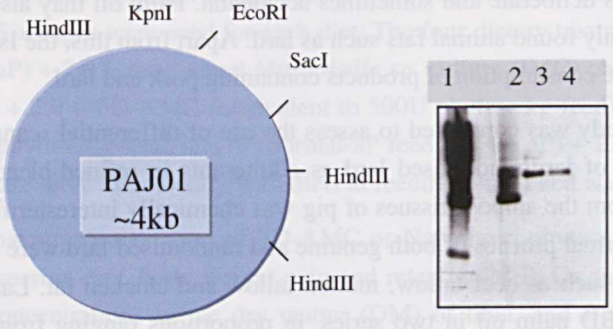
Thus, in our work, a study was conducted to assess the use of differential scanning calorimetry (DSC) for detecting the presence of lard/randomised lard as adulterants in refined-bleached-doedorised (RBD) palm oil. Lard extracted from the adipose tissues of pig was chemically interesterified using sodium methoxide as catalysts. DSC thermal profiles of both genuine and randomised lard were compared with those of other common animal fats such as beef tallow, mutton tallow and chicken fat. Lard and randomised lard were then blended with RBD palm oil in two series, in proportions ranging from 0.2 to 20% and DSC analyses were obtained. The DSC cooling profiles of adulterated RBD palm oil samples showed an adulteration peak corresponding to lard/randomised lard in the low temperature region. This peak was confirmed as an indicator of the presence of lard in RBD palm oil since similar experiments carried out using other common animal fats such as mutton tallow, beef tallow and chicken fat showed that the lard adulteration peak could be distinctly identified. Using this method, a detection limit of 1% lard/randomised lard was reached ($p < 0.0001$)

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8347
E-mail: lom@putra.upm.edu.my

Characterisation and Molecular Cloning of an Erythromycin Resistance Plasmid of *Lactococcus lactis*

Raha A.R., E. Ross, K. Yusoff, M.Y. Manap and A. Ideris

Most of the plasmid molecular studies currently underway are geared towards the construction of improved vectors for use in the various food industries and vaccine development. However, although plasmid vectors for various applications in bacteria have already been constructed (2), the development of cloning and expression vectors in Gram positive bacteria is still lacking. Due to the advanced usage and interest in these bacteria, the need to develop a variety of plasmid vectors arises.



In our study, a small molecular weight plasmid designated pAJ01, harboring an erythromycin resistant gene, was isolated from *Lactococcus lactis*. Restriction enzyme digestions of pAJ01 with BamHI, SalI, PstI, BclI, EcoRV, ScaI and XbaI were unsuccessful, suggesting that sites for these enzymes are not present. The plasmid could be linearized by restriction enzymes EcoRI, KpnI and SacI producing a fragment of approximately 4 kb on agarose gel electrophoresis. Additional digestions with HindIII and HaeIII produced three bands of 2.5 kb, 1.0 kb and 0.5 kb and two bands of 2.9 kb and 1.1 kb respectively, supporting the suggested molecular size of pAJ01. Double digestions were also carried out using different sets of restriction enzymes. Those analyses therefore allow for the construction of a putative restriction map of the plasmid pAJ01. The high copy number, small molecular weight and the presence of an erythromycin gene suggest the potential use of pAJ01 as a cloning vehicle in Lactococcus. The number of unique restriction sites can also be used to insert DNA into this plasmid.

A shuttle-cloning vector, pAJ02, for use in *L. lactis* and *E. coli* was then constructed by cloning this plasmid into pUC19. The presence of the erythromycin resistant gene in pAJ01 creates a possibility of having an easily selectable marker in both *Lactococcus* and *E. coli*. The erythromycin resistant gene carried by plasmid pAJ02 was expressed in both *L. lactis* and *E. coli* through the induction of subinhibitory levels (5 µg/ml and 150 µg/ml) of erythromycin. This is important because other antibiotic resistant genes such as kanamycin and ampicillin, which are easily selectable markers in *E. coli* and *B. subtilis*, turned out to be problematic markers for selection in *L. lactis* (16). Since selection for erythromycin is much more efficient in *L. lactis*, we can in the future further reduce the size of this vector by deleting out the ampicillin gene, thus improving the manipulative capability of the plasmid.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8539
E-mail: raha@fsb.upm.edu.my

Thermostable T1 Lipase From Locally Isolated *Bacillus* Sp Strain T1: A Molecular Approach Toward High Level Expression

AwardWinner

Raja Noor Zaliha Raja Abdul Rahman, Abu Bakar Salleh, Mahiran Basri and Leow Thean Chor

A thermostable lipase producer was screened and isolated from Havy's Palm Oil Mill in Semenyih, Selangor. The crude lipase from *Bacillus* sp. strain T1 was active over wide temperature range with an optimum of 70°C and stable up to 60°C for 30 min. Besides, crude lipase from this isolate exhibited an optimum pH of 9. Direct cloning and expression of T1 lipase was conducted by designing a set of degenerate primers based on reported thermostable lipases from database. Sequence analysis of T1 lipase gene revealed an open reading frame of 1,251 bp in length, which codes for 417 amino acids. The deduced molecular mass of T1 lipase was around 46 kDa. It contained conserved pentapeptide Ala-Xaa-Ser-Xaa-Ala with Ala replaced the first Gly residue.

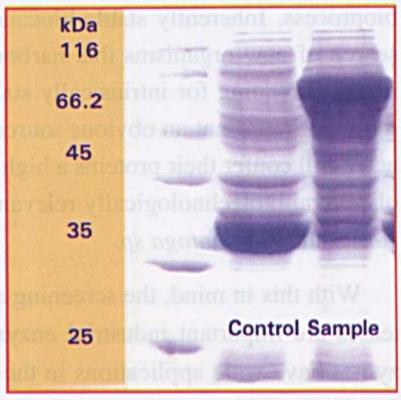


Figure 1: Expression of thermostable T1 lipase gene with pGEX-4T1 vector in prokaryotic system

Four kinds of expression systems were tested for thermostable lipase expression. Among them, relatively high level expression was detected with expression vector pGEX-4T1 (22.391 U/ml) with 150 folds increased in lipase activity when induced with 1mM of IPTG as inducer for 12 h compared to wild-type bacteria.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6713
E-mail: rnzaliha@fsas.upm.edu.my

An Extremely Thermostable Serine Protease From *Bacillus Stearothermophilus* F1

Raja Noor Zaliha Raja Abd. Rahman, Abu Bakar Salleh, Mahiran Basri, Che Nyonya Abd. Razak and Mohd. Basyaruddin Abdul Rahman

Biocatalysts are inherently labile; therefore its operational stabilization is of paramount importance for any bioprocess. Inherently stable biocatalysts are well appreciated and systematic effort is being done in the search of new organisms that harbor them. The potential of extremophiles has only recently been recognized. Screening for intrinsically stable biocatalysts is a prominent area of research in biocatalysis. Thermophiles represent an obvious source of thermostable enzymes, being reasonable to assume that such character will confer their proteins a high thermal stability. This is certainly so, as can be appreciated in the case of several biotechnologically relevant enzymes from the hyperthermophilic archaebacteria *Pyrococcus furiosus* and *Thermotoga sp.*

With this in mind, the screening and isolation of thermophilic proteolytic bacteria was carried out. Proteases are important industrial enzymes where several thousand tones are produced annually. These enzymes have wide applications in the food, detergent and leather industries. During our screening program for thermophilic protease producer, we isolated a *Bacillus stearothermophilus* strain F1 which not only could grow up to 80°C but also produced remarkable amount of protease activity under alkaline conditions. This *B. stearothermophilus* strain F1 is different from other strains reported so far and this is the first report of an alkaline protease produced by *B. stearothermophilus* species under alkaline condition (1,23). The optimum growth temperature of the bacteria was at 70°C and no growth was observed at 45°C. This strain was able to grow within a broad pH range of 5.0 and 11.0 and produced optimum protease yield at pH 10.0 in peptone medium at 60°C (2).

Protease from *B. stearothermophilus* F1 had been purified, characterized and identified as a heat stable alkaline protease (3). The purified protease, which is a serine-type enzyme, was optimally active at pH 9.0 and was stable for 24 h at 70°C and in the pH range from 8.0 to 10.0 (3). Comparative studies were carried out with two commercial proteases; thermolysin and subtilisin. Thermolysin, a metalo-protease produced by *B. thermoproteolyticus*, and subtilisin, a serine protease produced by *B. licheniformis* had been thoroughly investigated. The optimum temperature for protease from *B. stearothermophilus* F1 was around 85°C (4). The optimal temperature for thermolysin and subtilisin were 80°C and 60°C, respectively, which were in agreement to previous report. It is clear that the protease of *B. stearothermophilus* F1 has a higher optimum temperature than thermolysin and subtilisin (4). The stability of protease F1 was monitored over the temperature range of 80°C, 85°C and 90°C. The enzyme exhibited a high degree of thermostability [$t_{½}$ (80°C) =10 h, (85°C) = 4 h, (90°C) = 25 min., (95°C) = 8 min]. The comparative data on the stability of protease F1, thermolysin and subtilisin was compared. At 80°C, thermolysin and subtilisin were completely denatured within 4 h and 1 h, respectively (4). Subtilisin was reported to be stable for only 1 h at 50°C. Consequently, for higher temperatures only thermolysin was used for comparison. As reported earlier, thermolysin could only retain only 50% of initial activity for 1 h exposure at 80°C. Thus the thermostability profile of protease F1 indicated that this enzyme was much thernostable than the commercial proteases (thermolysin and subtilisin). It is also more stable than proteases from other strain of

B. stearothermophilus. In addition, protease F1 was not only stable at elevated temperatures but also retained its stability at low storage temperature. Protease F1 in Tris-HCL buffer, stored for 168 h at 4°C showed only minor changes in activity with no effect observed on thermostability (4). The above finding showed that, the alkaline protease produced *by B. stearothermophilus* F1 had remarkable characteristics that can be marketable as industrial enzyme.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6713
E-mail: rnzaliha@fsas.upm.edu.my

Correlation Between Oil Content and DN Values

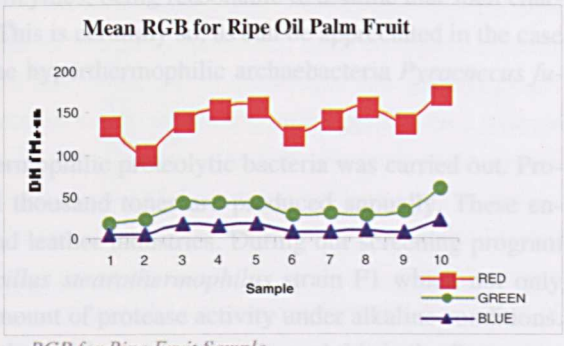
Rashid Shariff, Nor Aizam Adnan, Radzali Mispan, Shattri Mansor, Rohaya Halim and Roop Goyal

This research investigates the correlation between oil content in the oil palm fruit against the color of the oil palm fruit. Images from samples of oil palm fruits were acquired using a camera with proper lighting and angle. Image processing and analysis of the samples was carried out. Physical measurements of the amount of oil content in the fruit were carried out by chemical analysis.

This study revealed that there is a high positive correlation between the color of the oil palm fruit and the amount of oil in the fruit. This study will be of help in increasing the efficiency of quality harvesting and grading of oil palm fresh fruit bunches (ffb).



Ripe *Over-ripe* *Under-ripe*



RGB for Ripe Fruit Sample

Reader Enquiry
Department of Biological and Agricultural Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6414, 8656 7126
E-mail: rashid@eng.upm.edu.my

Production of *Bacillus Subtilis* Culture as Beneficial Microorganism for Aquaculture Industry

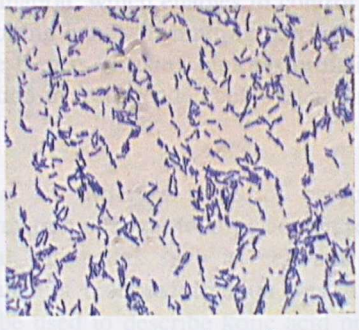
AwardWinner

Rosfarizan Mohamad Arbakariya Ariff, Hirzun Mohd Yusoff, Raha Abdul Rahim and Mohamed Ismail Abdul Karim

Bacillus subtilis is a gram-positive bacterium in the family of *Bacillaceae*. It is a spore-forming bacterium that is characterised by its rod-shaped structure. As opposed to the strictly aerobic strains of *Bacillus* (such as *B. badius* or *B. gordonae*) or the facultative anaerobes (such as *B. popilliae* or *B. validus*), *B. subtilis* can grow, albeit weakly, in the absence of oxygen (particularly if nitrate is present) even though it is generally considered to be an aerobe. The doubling time of *Bacillus subtilis* is 30 min. It is also characterised by the fact that it produces acid from a variety of sugars, including glucose. The process of sporulation begins at the end of exponential growth and requires approximately 8 to 10 h to complete under standard laboratory conditions. Endospores in *Bacillus subtilis* are generally oval and do not swell from the mother cell. The spore has the following characteristic; i) are very robust, ii) can be stored dry for at least 2 years, iii) are compatible with a wide range of chemical products, and iv) survived for extended periods once applied to seed, potting soils or plant surfaces. *Bacillus subtilis* has been claimed as beneficial microorganism for various fields. This bacterium is widely used as fungicide, where the vegetative cells is capable to grow rapidly to colonise the growing root and other plant surfaces. Growth of this bacterium actively competes for nutrients and space, thereby out-competing deleterious organisms such as soil-borne fungal pathogens.



Single colonies of Bacillus subtilis on agar plate



Gram's stain showing the Bacillus subtilis as gram-positive bacteria

From the clinical study it was found that the cell wall components of ingested *Bacillus subtilis* are able to activate nearly all systems of the human immune defence, including the activation of at least three specific antibodies (IgM, IgG and IgA secretion) which are highly effective against many of the harmful viruses, fungi and bacterial pathogens which regularly attempt to invade and infect the human system. *B. subtilis* is also capable to produce Bacitracin, an antibiotic widely used for topical therapy such as for skin and eye infections. Bacitracin is also used as antibiotic and growth promotant for chickens, swine and cattle. *Bacillus subtilis* is used widely today in Germany, France and Israel, where safe, effective all-natural therapeutic products are more highly esteemed by the health-savvy public than the more expensive synthetic drugs espoused by the orthodox medical establishment with all of their dangerous side effects. In short, the incredible *Bacillus subtilis*, which is commonly found in soil, continues to benefit mankind ever since its discovery in 1941.



Cultivation of B. subtilis using 10 L stirred tank fermenter



Harvesting shrimp from a pond

Our research is focussed on the development of industrial cultivation method for large-scale production of *B. subtilis* culture that was isolated from a local prawn pond. This bacterium is used as salutary feed-additive for prawn in the form of living cells for improvement of prawn growth and thus, the productivity of the pond is increased significantly. The industrial medium for *B. subtilis*, based on cheap and locally available sources, have been developed and optimized. The mode of fermenter operation, based on continuous and fed-batch culture equipped with process control, for high-density cell cultivation of *B. subtilis* with maximum activity and stability has been proposed.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

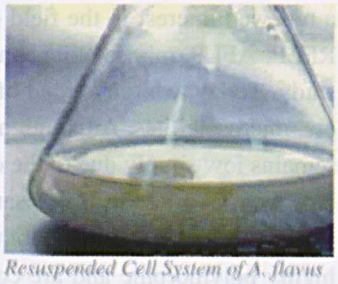
Tel: +603 8946 8419
E-mail: rosfa@hotmail.com

Biotransformation of Various Carbon Sources to Kojic Acid by Cell- Bound Enzymes of *Aspergillus Flavus*

AwardWinner

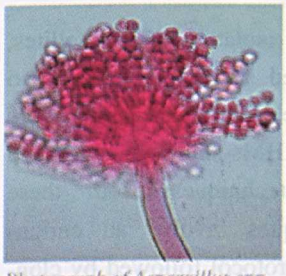
Rosfarizan Mohamad

During kojic acid fermentation by *Aspergillus* spp, it is synthesised by direct conversion of glucose through multistep enzyme reaction. The enzyme system involved in kojic acid biosynthetic pathway was found to be very stable under a chemically defined resuspended cell system at a wide pH range. This unusual stability of the relevant enzymes suggested that the cell mycelia of kojic acid-producing fungus could be used for biotransformation of glucose or other carbon sources to kojic acid. This biotransformation process may be more suitable for the production of kojic acid rather than the conventional batch submerged fermentation posing several engineering problems related to the fungal culture.



Resuspended Cell System of A. flavus

One of the problems in conventional batch kojic acid fermentation is the production of pigments as by product that increased the steps and cost of purification process. The use of resuspended cell system for biotransformation of carbon source to kojic acid may be used to produce kojic acid solution free from pigments, which make the purification process much easier and enable to produce high quality kojic acid. In addition, the biotransformation process using resuspended cell system may also be more suitable for the efficient use of the stable cell-bound enzyme for kojic acid production as compared to conventional batch fermentation. The secondary metabolism of kojic acid formation, which enables to control the growth and mycelial turn-over during the production phase, by controlling a growth-limiting nutrient and appropriate culture conditions, could be considered as other desirable factors of using biotransformation process. To our knowledge, detail reports of kojic acid biotransformation in resuspended cell system are not available in the literature.



Photograph of Aspergillus spp.

In this project, the effect of different types of carbon source was investigated on the biotransformation of sugar to kojic acid in resuspended cell system. The effect of several parameters such as cell and carbon source concentration on the performance of biotransformation was investigated. The kinetics and models that can be used to describe kojic acid production using resuspended cell system were proposed. The properties of cell bound enzyme for the biotransformation of glucose and sucrose to kojic acid such as K_m and V_{max} values from the experiments were determined.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8419
E-mail: rosfa@hotmail.com

Efficient Development of DNA Microsatellite Loci for Mungbean, *Vigna radiata*

S.V. Kumar, S.G Tan, S.C. Quah and K. Yusoff

Recently, there has been an explosion in the usage of DNA markers and a renewed interest in the field of population genetics. Markers such as RFLP, AFLP, minisatellites and RAPD have contributed greatly to its study. Today, we see a trend of moving towards another class of markers, microsatellites. Although not new, the popularity of microsatellites remains low simply due to the cost and time involved in isolating them. However, despite this, microsatellites still remain the best-known DNA marker system compared to the others because they are abundant, highly polymorphic and are codominant. All obstacles are now in the past as our lab has successfully developed and improved upon several methodologies which allow the efficient isolation of microsatellite markers in several animal and plant species thus reducing the effort needed for their development.



Plate 1: Mungbean accession V 3476 used in microsatellite loci isolation

We have embarked on a project to isolated microsatellite markers from mungbean (*Vigna radiata*) due to the absence of DNA sequence data. Mungbean was chosen as a study organism due to three reasons. Firstly, it has a short life span, therefore it is easy to study the inheritance of traits and markers over generations. Secondly, although it is a naturally self-pollinating plant, it is easily cross-pollinated, thus making it easy to plan breeding and crossbreeding programs. Thirdly, a diverse germplasm collection of mungbean is available, therefore making introgression of particular traits of importance from wild *Vigna* to cultivated mungbean possible. For these reasons, mungbean could serve as a model organism in the genetic study of other commercially important legumes.

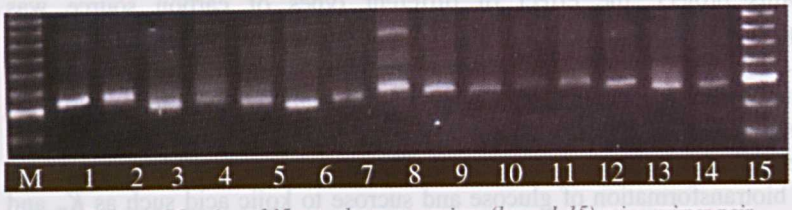


Plate 2: PCR amplification of 15 mungbean accessions (lanes 1-15) using primer pair LR738A. Lanes M are 20 bp DNA ladders

For isolating microsatellites, we used several methods. Two that were highly successful were the RAHMs and the 5'-anchored PCR techniques. Both these techniques involve an enrichment protocol followed by cloning of PCR products into the TOPO TA cloning vector and subsequently DNA sequencing of plasmids from positively identified clones. The DNA sequences we obtained (mungbean accession V3476) had been submitted to GenBank and the accession numbers for 41 sequences we deposited had been assigned. From the DNA sequences, a total of 107 microsatellite loci were identified in the mungbean genome. Of these, 51 primer pairs were designed flanking the microsatellite loci. These microsatellite primers were then used to study the population structures of local wild *Vigna* from 7 locations in Peninsular Malaysia: Banting, Bentong, Triang, Merapoh, Tangkak, Beranang and Putrajaya. The wild species are especially important since desirable genes from them could be incorporated into cultivated varieties to enhance their commercial values. The same primer pairs were also used to evalute the genetic relatedness among 45 accessions of cultivated mungbean obtained from the AVRDC. The need to evaluate genetic diversity and relatedness is

crucial so that breeding programs can be done effectively and efficiently with genetic insights. In order to maximise their usefulness, we have used the mungbean primers pairs to amplify microsatellite loci in several closely related species. Some primers pairs, were successful in amplifying loci of wild *Vigna* species, black gram, azuki bean, rice bean, French bean, long bean, kidney bean, soy bean and chick pea.

This result is of great importance since we now do not have to isolate and develop microsatellite markers for the above species.

Reader Enquiry
Department of Biology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6640
E-mail: sgtan@fsas.upm.edu.my

Effectiveness of β-Glucanase-Producing *Lactobacillus* Strains in Improving the Growth Performance of Broilers



Sieo Chin Chin, Norhani Abdullah and Ho Yin Wan

Application of enzymes as feed additives is common in the livestock industry, especially in poultry. They are used mainly to eliminate the antinutritional factors (ANFs) present in the diets of the birds. These antinutritive carbohydrates are undesirable as they yield viscous solution upon solubilization and this would indirectly reduce the digestion and absorption of all nutrients in the diets. In most cases, enzyme additives such as β-glucanase and xylanase were used to overcome these problems. However, the enzymes used must be able to sustain the rigorous feed processing and survive through the gastrointestinal tract of the chicken. The enzymes must remain active and be able to exert their functions in the digestion of feed after a series of pH fluctuations and actions of proteolytic enzymes in the intestine of the chicken.

In view of this, the present study was carried out to evaluate the feasibility of using six *Lactobacillus* strains as an alternative "carrier" to deliver a heterologous β-glucanase gene from *Bacillus amyloliquefaciens* into the gastrointestinal tract of chicken. The effectiveness of the β-glucanase-producing *Lactobacillus* strains (*L. brevis* C10b3, *L. crispatus* I12b3, *L. brevis* I23b3, *L. fermentum* I25b3, *L. brevis* I211b3 and *L. brevis* I218b3) in improving the growth performance of the chickens was also determined. Results from the *in vivo* study carried out to determine the persistence of each of the β-glucanase-producing *Lactobacillus* strains in the gastrointestinal tract of the chickens showed that the enzyme produced by all the strains was detected in all parts of the gastrointestinal tract. Although most of the β-glucanase-producing *Lactobacillus* strains could not persist for more than 24 h in the gastrointestinal tract, enhanced growth of the broilers was obtained through daily feeding of the birds with these *Lactobacillus* strains. Feed efficiency of the broilers was also significantly improved by supplementing the diet of the birds with the β-glucanase-producing *Lactobacillus* strains.

The results of the study indicated that the *Lactobacillus* strains could be a potential candidate as an alternative "carrier" for enzyme(s), and other genes, if necessary.

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6702, 8946 8071
E-mail: ccsieo@fsas.upm.edu.my

Development of Recombinant Mite Allergens from *Tyrophagus putrescentiae* for Diagnosis of Allergic Diseases

AwardWinner

Sew YS, Chew FT, Kulaveerasingam H ,Tan SH

Mites have been increasingly recognized as a cause of allergy in asthmatic and rhinitic patients in tropical and subtropical regions. The aim of this study was to characterize and evaluate the allergenic components of dust mite, *Tyrophagus putrescentiae* and to identify the genes encoding allergens from this mite species in order to construct the recombinant allergens of *Tyrophagus putrescentiae* as a diagnostic kit for allergic diseases.



Fig. 1: A storage mite, Tyrophagus putrescentiae

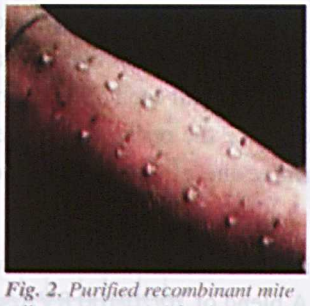


Fig. 2. Purified recombinant mite allergens are used for Skin Prick Test for the allergy diagnosis

Dot blot screening revealed that 49.7% of 141 patient sera showed the presence of specific IgE towards TP mite components. We observed after immunoblotting, there were 16 IgE binding components present in TP with molecular weights ranging from 14 to 78kDa. Two major allergens of TP with molecular weight 15kD and 77kD that showed higher frequency of IgE binding (>90%) were determined. Results of TP ESTs showed that approximately 65% of the 2217 clones matched known genes and were categorized into 10 functional groups with 7% of the ESTs clones recognized as putative allergens. The putative allergens represented 27 different kinds of allergens from mites, cockcroaches, parasites, pollens, egg and plants. The majority of those allergens were house dust mite allergens (69%) and they are from the group of 1, 2, 3, 4, 5, 6, 7, 8, 10, 12, 13, M-177, Mag, Mag 29 and 98kDa. The full length of TP ESTs clones that were determined putatively as allergens were subsequently amplified out by using Polymerase Chain Reaction. The full length of TP ESTs clones those were determined putatively as allergens were subsequently cloned into pGEM-T Easy Vector System and followed by high expression vector, pET-32 to study the expression of recombinant TP allergens. The purified recombinant allergens not only serve as a accurate and specific tool in patient-based tests such as skin prick test for allergy diagnosis, but also offer the exciting possibility of developing prophylactic allergen vaccines and new forms of allergen immunotherapy.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 836
E-mail: tsianghe@fsas.upm.edu.my

Sago Starch-Based Foam

Sharifah Kharidah Muhammad, Zulkafli Ghazali, Kamaruddin Hashim, Muhammad Ali Hassan and Benchamaporn Wongsuban

AwardWinner

Owing to the rapid population and economic growth, many countries are faced with environmental problems such as that related to garbage disposal. One of the items that contribute further to this problem would be the foam used in packaging. The development of biodegradable foam would thus be a step forward in the right direction to overcome the aforementioned problem. Utilization of annually renewable agriculturally derived products such as starch as extenders and replacements for synthetic, petroleum-based polymer is currently an active area of research. Use of polysaccharides in plastics not only reduces our dependence on petrochemical-derived monomers, but the polysaccharide portion will also biodegrade, causing the finished plastic article to lose its integrity and be reduced to small particles. Electron beam irradiation of polymer has been employed in the production of foam. High-energy radiation typically produces free radicals, which can readily interact with each other forming crosslinks and strengthening the polymer structure. Crosslinking will also enhance the resistance of the foam to thermal collapse. Therefore, the objective of this study was to determine the effect of irradiation dose on the properties of starch/polyvinyl alcohol (PVA) foam.

Nitsei Sago Industries Sdn. Bhd., Mukah, Sarawak donated Sago starch and PVA was purchased from Kuraray Poval Co.Ltd. A blend of 20/20/100 PVA/sago/water was prepared by mixing 20 parts of PVA and 20 parts of sago starch in 100 parts of water at 80°C. The blend (30 ml) was poured into a square petri dish (10x10 cm), and irradiated at 10, 15, 20, 25 or 30 kGy. Foams were then produced from these irradiated blends using microwave heating for 5-8 minutes. In this study, the distilled water acted as the blowing agent. Morphology of the foam was determined using a JOEL 6400 (Japan) scanning electron microscope with an accelerating voltage of 15 kV. The percentage linear expansion was obtained on foaming the sago/PVA blend in a microwave. The unfoamed blends were ruled with a line across using a fine oil pen. Each line was measured before and after foaming. The percentage linear expansion was calculated as follows:

$$\text{Percentage linear expansion} = \frac{(\text{Length after foaming} - \text{Length before foaming}) \times 100}{(\text{Length before foaming})}$$



Figure 1: Scanning electron micrographs of sago/PVA foams prepared from blends irradiated at 10 to 30 kGy

Figure 1 shows the morphology of foams produced. At an irradiation dosage of 10 kGy, opened-cell foam was obtained. This was due to the fact that the crosslinkings in the blends were not sufficient thus the wall of the foam cells was not strong enough to hold in the air pressure. When blends were irradiated at 15 kGy, they formed foams with the highest linear expansion (see Figure 2) and closed-cell foams were obtained. This suggests that optimum crosslinking in the blend was attained. In comparison with closed-cell foamed polymers, opened-cell foams have a higher absorption capacity for water and moisture, a higher permeability to gas and vapour, and less effective insulation capabilities for either heat or electricity. When blends were irradiated at 25 and 30 kGy, they formed foams that were shrunken due to thermal collapse. This was due to excessive crosslinking, which had occurred in the blends. The finding suggests that there is a need to control the degree of crosslinking in the blends in order to achieve the desired properties of the end products. Blends irradiated at 15 kGy can be moulded into sheets, egg trays and other trays.

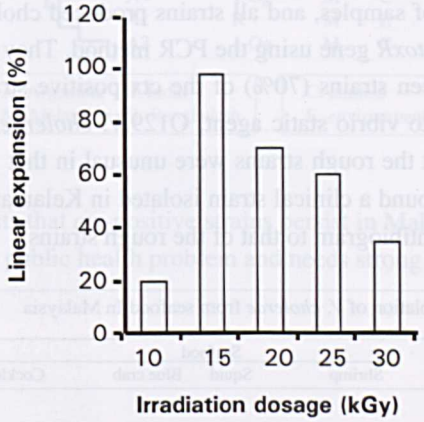


Figure 2: Linear expansion of sago starch-based foam by using microwave

An electron beam irradiation dose of 15 kGy was found to be suitable in the production of sago/PVA foam because the biggest foam cell size was obtained. In addition, the foam cells were of closed-cell type, which has better properties than opened-cell foam.

Reader Enquiry
Department of Food Science
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8389
E-mail: kharidah@fsb.upm.edu.my

Detection and Molecular Epidemiology of Toxigenic *Vibrio Cholerae* O139 and O1 in the Seafood Marketed in Malaysia

Son Radu and Mitsuaki Nishibuchi

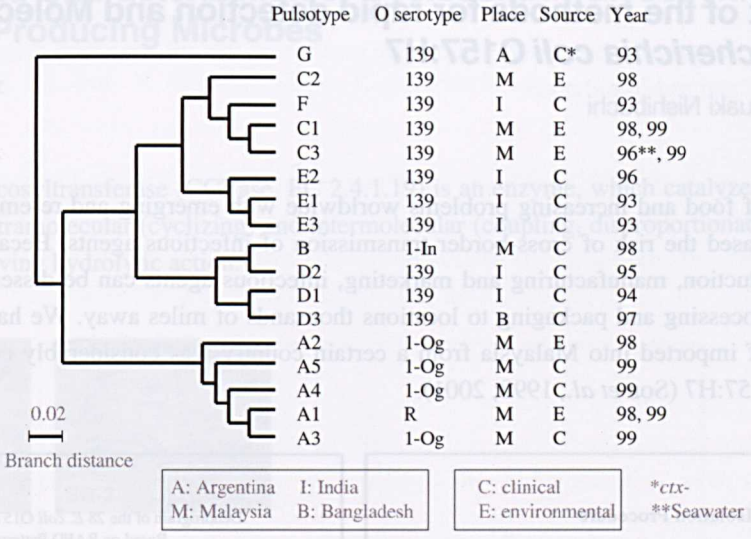
In 1998, we isolated *Vibrio cholerae* O139, O1 and non-O1 strains from the environment in Malaysia (Son *et al.*, 1998; 1999). We therefore surveyed the seafood marketed in various parts of Malaysia for *Vibrio cholerae* in the period between August 1998 and September 1999. Isolated strains were analyzed extensively in the following year. Alkaline peptone enrichment procedure was employed, and enrichment broth was incubated at 42°C for selective isolation of *Vibrio cholerae*. Shrimp, shellfish and related seafood amounting to 768 samples were examined. Twenty *ctx*-positive strains of O139, O1 and rough serotypes were isolated from various kinds of samples, and all strains produced cholera toxin *in vitro*. Identification was confirmed by detection of the *toxR* gene using the PCR method. They also carried the *tcp* gene encoding toxin-coregulated pilus. Fourteen strains (70%) of the ctx-positive strains had the *rfb* gene of the O1 type. Many strains were resistant to vibrio static agent, O129.*V. cholerae* O139 strains and rough strains exhibited similar antibiograms, but the rough strains were unusual in that they lacked toxin-linked cryptic (TLC) element. Interestingly, we found a clinical strain isolated in Kelantan, Malaysia that lacked the TLC element and showed very similar antibiogram to that of the rough strains.

Isolation of *V. cholerae* from seafood In Malaysia

Location	Seafood			
	Shrimp	Squid	Blue crab	Cockle
SELANGOR				
Serdang	2 (R x 1)	0	15 (O139 x 2, R x 1)	6 (R x 2)
Selayang	12 (O139 x 1, R x 1)	0	0	0
Petaling Jaya	0	4 (O1 x 1)	0	5 (O139 x 3)
Kembangan	0	0	10	6 (O139 x 1)
Bangi	0	0	0	0
Kajang	0	0	0	0
PENANG	6	0	0	0
SARAWAK	31 (O139 x 7)	0	0	0

ctx + strains: O1, O139, R (= rough)

We compared the *ctx*-positive environmental strains along with representative clinical strains isolated in India, Bangladesh and Malaysia in the past by various DNA fingerprinting techniques to speculate the origin of the *ctx*-positive environmental strains. These strains were classified into 5 types by an arbitrarily primed PCR method, 6 types by a ribotyping method, and 7 types by a pulsed field gel electrophoresis method. A dendrogram was constructed from the PFGE profiles. The O139 strains isolated from Malaysian seafood and seawater were very closely related to the O139 strains isolated from a patient in India in 1993. The result suggests that the Malaysian strains may have been introduced from India earlier and that they have persisted in Malaysian environment since then. *V. cholerae* O1 Ogawa and rough strains isolated from seafood and a patient in Malaysia were related, suggesting that the environmental strains may have been the source of infection.



The result of this study suggests that *ctx*-positive strains persist in Malaysian environment and contaminate seafood. This is an important public health problem and needs strong attention.

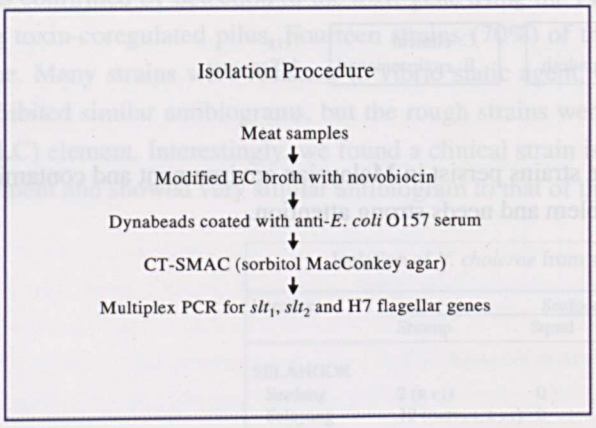
Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

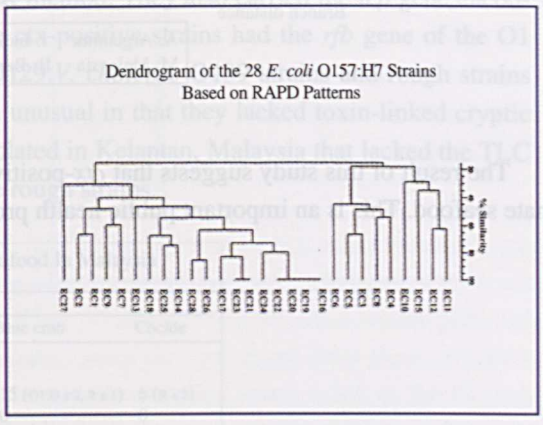
Tel: +603 8946 8364
E-mail: son@fsb.upm.edu.my

Development of the methods for rapid detection and Molecular Typing of *Escherichia coli* O157:H7

Son Radu and Mitsuaki Nishibuchi

The globalization of food and increasing problems worldwide with emerging and re-emerging foodborne diseases have increased the risk of cross-border transmission of infectious agents. Because of the global nature of food production, manufacturing and marketing, infectious agents can be disseminated from the original point of processing and packaging to locations thousands of miles away. We have previously reported that the beef imported into Malaysia from a certain country was considerably contaminated with *Escherichia coli* O157:H7 (Son *et al.*, 1998; 2001).





A rapid method has therefore been developed by us to detect this pathogen in meat samples. We established an isolation procedure that included immunomagnetic separation method and a new multiplex PCR method for screening the isolated strains. Meat samples (beef tenderloin and chicken meat burger) purchased from supermarkets were examined by this procedure, and 28 strains of *E. coli* O157:H7 were isolated. All strains carried slt_1, slt_2 or both genes and 60-Mda plasmids. The isolated strains were resistant to various antibiotics to different degrees. Fingerprinting analysis by random amplification of polymorphic DNA (RAPD) using a selected primer and by pulsed field gel electrophoresis (PFGE) of *Xba*I digest distinguished isolated strains into many types, indicating that the isolated strains were from various origins. These fingerprinting methods will be useful for epidemiological investigation in Malaysia.

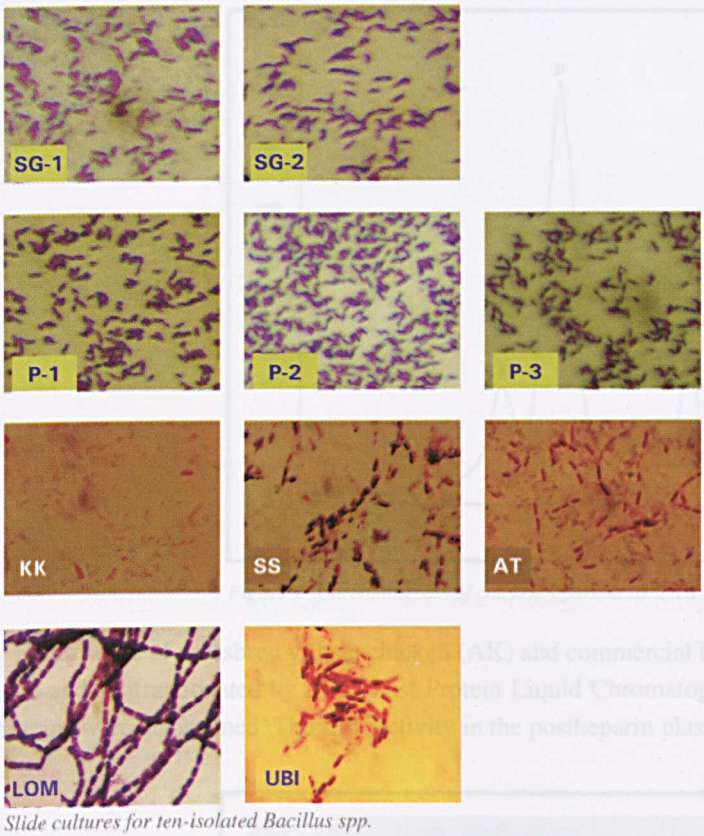
Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8364
E-mail: son@fsb.upm.edu.my

Isolation and Characterization of Cyclodextrin Glycosyltransferase (CGTase)- Producing Microbes

Suraini Abd. Aziz

Cyclodextrin glycosyltransferase (CGTase, EC 2.4.1.19) is an enzyme, which catalyzes the degradation of starch through intramolecular (cyclizing) and intermolecular (coupling, disproportionation) transglycosylation as well as having hydrolytic action.



Slide cultures for ten-isolated Bacillus spp.

CGTase producing alkalophillic bacteria were isolated from 5 types of soils and were characterized morphologically and biochemically. From the 5 isolates, 4 were confirmed from the *Bacillus spp.* strain. These isolates were further tested on their enzyme activity. The optimum culture condition for all 5 isolates were to be cultivated at 37°C, 300 rpm, maintained at pH 6.0 to pH 7.0 and cultured aerobically. All 5 isolates were assayed for the production of CGTase and amylase enzyme and at the same time were tested for the presence of glucose and reducing sugar. Enzyme produced were extra cellular enzyme that enables the conversion of starch to cyclodextrin mainly the β–CD. The highest activity for the production of β-CD was obtained from sample SS (*Bacillus cereus*) i.e 134.3 µg/ml at day 5 using Medium 1. Medium 1 proves to be a better growth medium for all 5 isolates. Enzymes obtained from these isolates should be purified for better yield and optimization of cultivation media need to be done for production of cyclodextrin.

Slide cultures were done in order to pre-characterise the isolated bacteria obtained before further identification. Figure shows the observations obtained and found that all the strain proved to be *Bacillus* strain, gram positive and rod-like shaped.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8363
E-mail: suraini@putra.upm.edu.my

Very Low Density Lipoprotein Metabolism in Commercial Broilers and Village Chicken

AwardWinner

T.C. Loh, B.K. Tan, H.L. Foo, N. Abdullah , Idrus, Z. and Ramlah, H.

Very low-density lipoprotein (VLDL) triacylglycerol (TAG) concentration has been used as an indicator of fatness in broilers. The objectives of this project were to study the relationships among plasma, VLDL, VLDL subfractions lipids, postheparin plasma lipoprotein lipase (LPL) activity and fat deposition in two different breeds of chickens and to characterise their VLDL apolipoprotein.

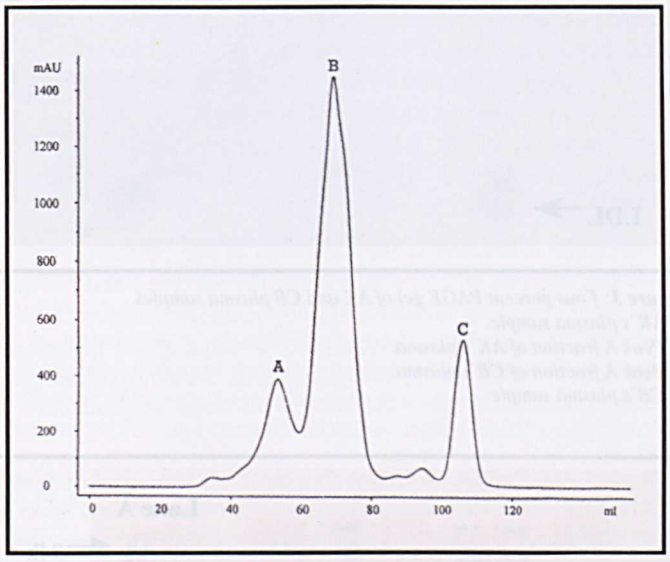


Figure 1: Chromatogram of chicken's plasma isolated by FPLC

Both sexes of crossbred village chicken (AK) and commercial broiler (CB) were used. VLDL was separated and subfractionated by using Fast Protein Liquid Chromatography. Lipid compositions and apolipoproteins were determined. The LPL activity in the postheparin plasma was also determined.

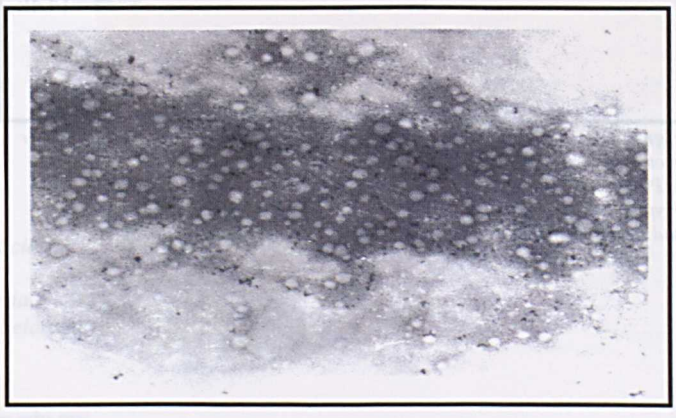


Figure 2: Negative stained electron micrograph of peak A (X30,000)

The body weight (BW) and feed intake (FI) of CB were significantly higher than that of AK but the feed conversion ratio was significantly lower. Fat deposited was positive significant correlated with BW and FI.

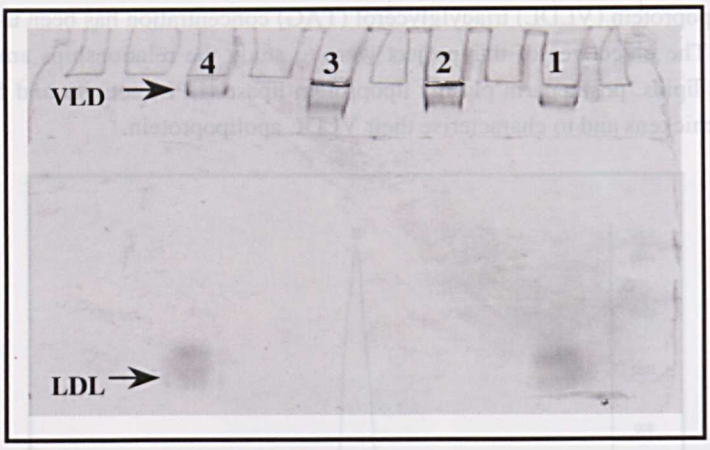


Figure 3: Four percent PAGE gel of AK and CB plasma samples.
1: AK's plasma sample.
2: Peak A fraction of AK's plasma.
3: Peak A fraction of CB's plasma.
4: CB's plasma sample

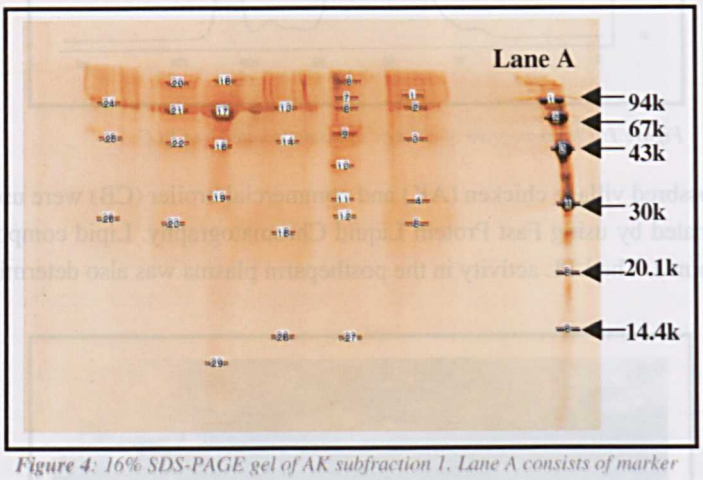


Figure 4: 16% SDS-PAGE gel of AK subfraction 1. Lane A consists of marker proteins:
1. Phosphorylase b, 2. Albumin, 3. Ovalbumin, 4. Carbonic anhydrase, 5. Trypsin inhibitor, 6. a-Lactalbumin. Band 15 is apo AI, band 10 is apo AIV and bands 4, 11 and 19 are apo E. The other bands are other proteins

Subfraction 2 contains more apo E that believed to enhance the lipolysis process in human. LPL prefer to act on larger, TAG-rich particle. From the present study, CB showed a significant higher proportion of subfraction 2, bigger VLDL particle size and higher postheparin plasma LPL activity than AK. All these lead to a higher fat deposition of CB than that of AK. These result further shown by the lower VLDL TAG concentration of CB. CB, which had a higher LPL activity and proportion of subfraction 2, caused a faster catabolism of TAG and more fatty acids were released for fat deposition. AK and CB seem to have similar type of apolipoproteins in both subfractions. Apo AIV and apo E were present in both subfractions of AK and CB.

Reader Enquiry
Department of Animal Science
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6899
E-mail: tcloh@agri.upm.edu.my

Development of Advance Statistical Models Based on Electronic Nose (zNose™) Method to Monitor Rancidity and Authenticity of Vegetable Oil Products

Tan Chin Ping



Quantitative determination of the composition and properties of both raw materials and processed oil products is important from the viewpoint of quality and safety of the food. Food analysis thus presents several challenges, in large part because analyte in the wide range of foods available, from fluid products such as vegetable oil, is complex and non-homogeneous. Quality control testing in the edible oil industry has been based upon traditional analytical methods that require hours, if not days, to complete. In recent years, the edible oil industry is increasingly adopting food safety and quality management systems that are more proactive and preventive than those used in the past. Thus, in turn, has provided an impetus of developing newer and improved detection methods and technologies that are "cheaper, better, and faster".

A perennial problem in the food industry is the formation of the off-flavors due to the degradation, in particular the oxidation, of fats and oils or lipids. It is generally accepted that the main reactions in oxidative deterioration of foods occurs between unsaturated fatty acids and oxygen. This leads to a range of aldehydes, ketones, and short-chain fatty acids, which give to range of off-flavors described variously as beany, green, metallic, oily, fishy, bitter, fruity, soapy, painting, greasy, oxidized, or rancid. The problem of rancidity covers most food types and needs monitoring at all stages of production from raw materials to final products.



Edible Vegetable Oil

Authenticity is an issue of major concern across the food industry. For example, wine is marketed based upon country and region of production and upon grape type. There is a very large difference in price between wines from different countries, making fraud a high possibility. Similar issues are of concern in the fats and oils industry with respect to vegetable oil types and with respect to country of origin and seasonal problem.

A new electronic nose simulating the response from up to 500 sensors is providing food manufacturers, quality control specialists, and olfaction expects with new investigative tools[1]. The zNose™ can also provide a recognizable visual image of vapor mixtures containing hundreds of different chemical species in 10 seconds or near real time. This electronic nose is designed to quantify and characterize all types of smells universally. Much of the research in the food science area concerns food quality. Therefore, the development of various instrument techniques based on zNose™ method to assess food quality parameters is in great demand. With the development of this instrumental method with high accuracy, reproducibility and reliability, we are able to eliminate the use of time- and chemical-consuming, tedious and high cost chemical methods.

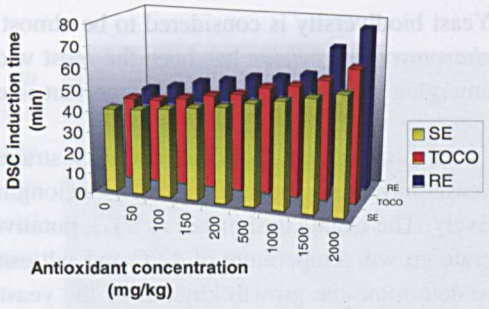
Reader Enquiry
Department of Food Technology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8418
E-mail: tancp@fsb.upm.edu.my

Recent Developments in Differential Scanning Calorimetry for Analysis of Edible Oils and Fats

Tan Chin Ping and Yaakob B. Che Man

Instrumental techniques of analysis have now moved from the confines of the chemistry laboratory to form an indispensable part of the analytical armoury of many researchers involved in the field of oils and fats. Differential scanning calorimetry (DSC) is one of the most frequently used analytical instruments in the field of oils and fats. Today, it is already an established technique for characterizing the physical properties of many materials. The possibility of using DSC to characterize oils and fats has been realized for over 50 years. The wide variety of different applications investigated during this period reflects the diversity and complexity of oils and fats materials, as well as the versatility of the DSC technique.



Scatter plot showing DSC onset time versus antioxidant concentration Abbreviations: SE, sage extract; TOCO, tocopherol; RE, rosemary extract

Today, differential scanning calorimetry (DSC) is used in virtually every area of modern science and technology. In the field of oils and fats, the thermal behavior of edible oils and fats continues to be an interesting subject of active research and debate. These thermal behaviors are fundamental subjects to elucidate the oils and fats physical and chemical properties. The versatility of DSC has been demonstrated in this work. In this study, a number of different palm oil products have been characterized in term of their thermal properties. Thorough investigations were also directed towards obtaining basic information about the relationship between thermal profile and chemical composition of these oil products.

In another study, a simple and reliable DSC method was developed for monitoring the oxidation of frying oils. The study revealed that the DSC could be a reliable and efficient alternative to existing methods for monitoring the extent of lipid oxidation in palm oil. We have also developed new calorimetric techniques for determining three important quality indices in deep-fat frying industry namely, total polar compounds (TPC), free fatty acid (FFA) content, and iodine value (IV) of heated RBD palm olein using the DSC thermal profiles. The studies have shown that all DSC methods developed were comparable to the standard American Oil Chemists' Society (AOCS) methods. We also developed a new method for measuring the antioxidant activity in RBD palm olein ($RBDPO_O$) using DSC. The results indicated that DSC is a valuable technique in the development and optimization of antioxidant system for RBD palm olein. Furthermore, the isothermal DSC method was applied to obtain the kinetic data for lipid oxidation of $RBDPO_O$.

These observations strengthen the premise that DSC is an efficient and accurate method for analyzing palm oil products. It could be used for routine analysis in the palm oil industry. In addition, the DSC method offers an alternative for the analysis of palm oil products due to its appreciable timesaving, small samples with minimal preparation and free of toxic chemicals usage.

Reader Enquiry
Department of Food Technology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8371
E-mail: yaakub@fsb.upm.edu.my

Characterization of Locally Isolated Yeast Strain Towards Industrial Application



Tan Li Lung, Raha Abdul Rahim, Arbakariya Ariff and Hirzun Mohd Yusof

Yeast biodiversity is considered to be almost untapped from a biotechnological viewpoint. Although *Saccharomyces cerevisiae* has been the most widely studied and exploited yeast species, other yeasts are fast emerging as microorganisms of important scientific and commercial value.

In this research, five different yeast strains were isolated from several aquatic and food sources. These yeasts have since been identified as belonging to the genus of *Rhodotorula*, *Pichia* and *Candida* respectively. The isolate designated as YL3, putatively known as a haploid strain of *Pichia ohmeri*, is able to tolerate growth temperature of 42°C and salt osmolarity of 2.5M NaCl. Fermentation studies were carried out to determine the growth kinetics of the yeast. The studies include growth on different carbon source and nitrogen source, different concentration of carbon source as well as growth at different agitation speed using bioreactor system. Due to its ability to grow on methanol, growth studies on methan4ol were also carried out.

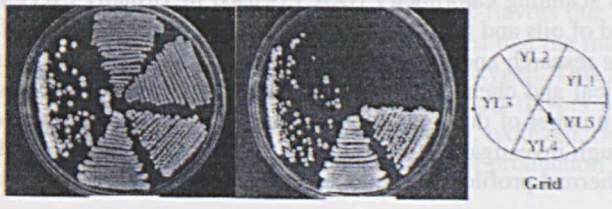


Fig.1. Comparative growth of five yeast isolates on YPD following 48h of incubation at 30°C (A), and 37°(B). The isolates are shown in the grid indicated.

Genetic characterization was also initiated by carrying out mutagenesis of the strains. Mutants of YL3 were generated using UV mutagenesis and replica plating technique. Preliminary characterizations of these UV-treated mutants lead to the isolation of 7 auxotrophic mutant with different amino acid biosynthesis defects; 20 temperature sensitive (*ts*) mutants; and 16 osmotic sensitive (*os*) mutants. The stable auxotrophs included two *adenine-deficient*, one *methionine-deficient* and one *histidine-deficient* mutant. Among the *ts* mutation observed, 3 are absolute/tight *ts* mutants and 10 are leaky *ts* mutants. Work is in progress to construct a THS3 wild-type genomic library in YEplac112 (a 2-micron, *TRP1* plasmid based yeast-*E.coli* shuttle vector). The various types of mutants will be further investigated by temperature and osmolarity shift experiments, followed by nuclear staining visualization techniques.

Reader Enquiry
Fermentation Technology Unit
Enzyme and Microbial Technology Laboratory
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8656 6421, 8946 8359
E-mail: hirzun@hotmail.com

An Efficient Method of Developing DNA Microsatellite Markers for Mystus nemurus (Ikan Baung)

AwardWinner

Tan Soon Guan, Siti Shapor Siraj, Khatijah Yusoff,Sahar Usmani, Chan Soon Choy and Hoh Boon Peng

The river catfish *Mystus nemurus* is widely distributed in Southeast Asia and due to its excellent flesh quality it is a popular freshwater food fish. Five populations of this species from Peninsular Malaysia had previously been typed using 16 protein level allozyme loci and the dominant DNA level markers, random amplified polymorphic DNA and amplified fragment length polymorphisms.



Plate 1: Morphology of Mystus nemurus.

This project's main objective was to develop another class of DNA markers, microsatellites, which are very powerful tools for genetic studies being codominant markers but none was available for this species until our work. We utilized two techniques, RAHM based on the use of RAPD primers and RAM based on the use of random microsatellite sequences as primers for the polymerase chain reaction (PCR) amplification of catfish DNA. Both these procedures are shortcuts to the conventional method for DNA microsatellite sequence isolation and in our hands they proved to be very efficient procedures. We were able to isolate over 401 microsatellite sequences and designed primer pairs for 156 of them. The PCR amplification conditions were optimized so that each primer pair only amplified one locus (gene) in the catfish genome. Thus far we have used 68 primer pairs (loci) in our studies of catfish populations from Perak, Kedah, Terengganu, Johor, Selangor and Sarawak. All these loci were found to be polymorphic, thus we were able to obtain gene frequency data based upon which genetic distance values among the populations were calculated.

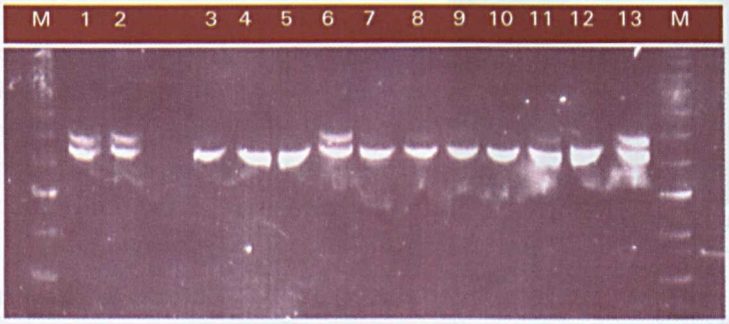


Plate 2: Microsatellite profile of M.nemurus samples from Perak using primer pair MnBP13. Lanes 1 to 13 are microsatellite profiles of samples from Perak; Lane M are 20 bp marker. PCR product was separated by electrophoresis on an 8% non-denaturing polyacrylamide gel

The genetic distance values were used to generate a dendrogram of genetic relationships among the populations. Cross breeding among the most distantly related populations would be expected to result in maximum hybrid vigor. Our microsatellite development procedure has been found to be useable also for mung bean, oil palm and arowana while the catfish loci we developed are being used in a gene-mapping project.

Reader Enquiry
Department of Biology
Faculty of Science and Envoronmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6640
E-mail: sgtan@fsas.upm.edu.my

Antimicrobial and Genotoxic Activities of Flavonoid Isolated From Some Selected Medicinal Plants

AwardWinner

Umi Kalsom Yusuf, Faridah Abdullah, Khairuddin Itam, Umi Salamah Hassan, Mohd. Aspollah Sukari and Abdul Manaf Ali

Some members of the flavonoids have been known to possess antifungal (Swiader and Lamer-Zarawska, 1996), antimicrobial and anti-inflammatory activities. In addition, methylated flavones and hydroxylated flavonols were found to induce abnormalities in cell division and chromosome aberration. These effects have been ascribed to the blockage of DNA synthesis or inhibition of microtubular development in mitotic spindle formation (Cody *et al.*, 1986). The primary aim of this project was to extract and identifiy flavonoid compounds from some selected medicinal plants. The identified flavonoid from these selected plants has also been tested for their antimicrobial and genotoxic activities.

Five flavonoid components were isolated identified from the flower of *Carthamus tinctorius* and two components were identified from the leaves of *Azadirachta excelsa.*

Flavonoids quercetin-3-glucoside, quercetin-rutinoside, kaempferol-3-glucoside, kaempferol-3-rutinoside and 6-hydroxykaempferol present in the flower of *C. tinctorius* showed the present of genotoxic activities. These flavonoid components caused cell divison abnormalities in *Allium cepa* root tips. The types of abnormalities observed were stickiness, spindle disturbances, bridges and chromosome laggards. The percentage of cell abnormalities also increased with the increased concentration of the components used. Most of the abnormalities were observed during metaphase.

The components could be considered as a stathmokinetic agent because of its effect on the spindle function.

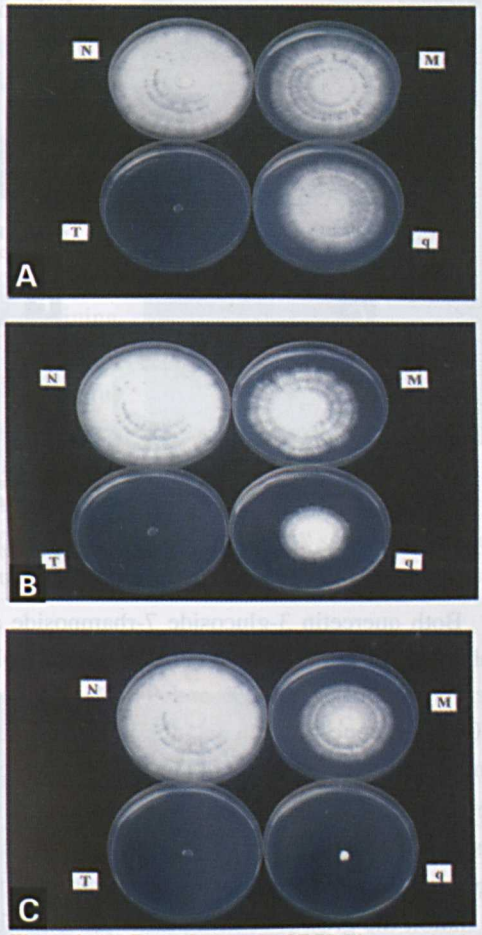


Figure 1: (A) Example growth of EGB 01 on myricetin 3,7-rhamnoside (q) at 0.5 mg/mL concentration; (B) at 1.0 mg/mL concentration; (C) at 3.0mg/mL concentration.

N = water (negative control), M = crude extract, T = Tilt 250EC (positive control).

Both myricetin 3,7-dirhamnoside and quercetin 3-glucoside-7-rhamnoside components identified from the leaves of *A. excelsa* were assayed for their antimicrobial activity according to Agarawal's method (Agarawal, 1977). The antifungal activities of the two components were tested against 3 selected plant pathogenic fungi. In this assay, 3.0 mg/mL of myricetin 3,7-dirhamnoside and quercetin 3-glucoside-7-rhamnoside were sufficient to prevent growth of the three pathogenic fungi when spotted onto the plates.

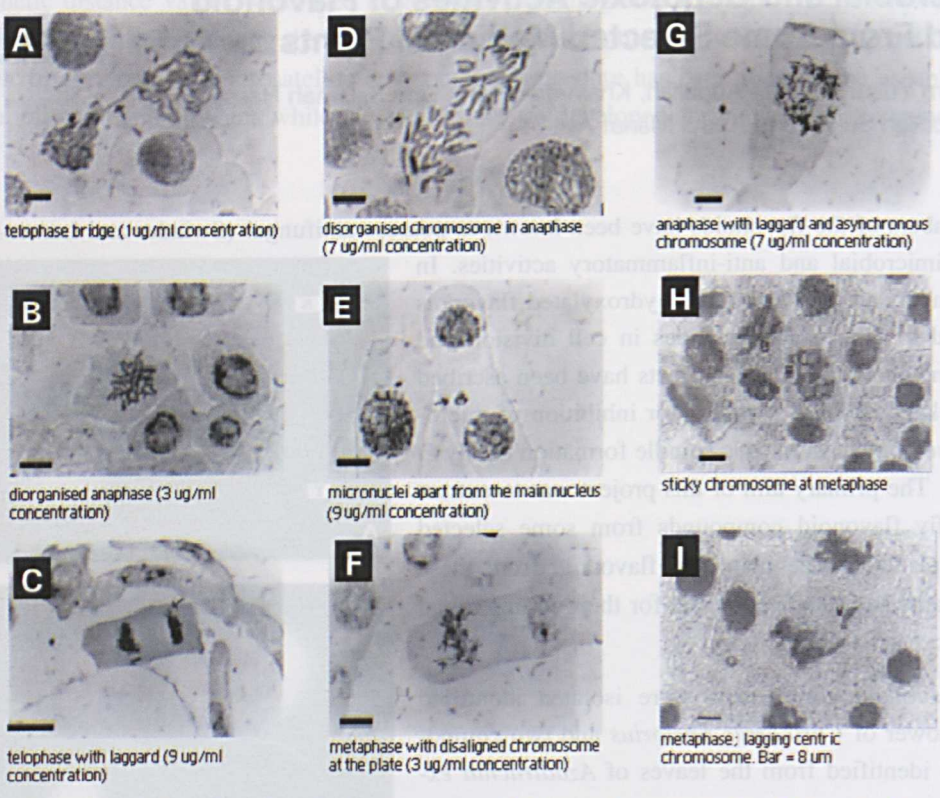


Figure 2: (A-I) Examples of mitotic aberrations caused by flavonoid components from C. tinctorius flower

Both quercetin 3-glucoside 7-rhamnoside and myricetin 3,7-dirhamnoside showed highest percentage inhibition of radial growth (PIRG) against isolates *Phellinus noxius* (99.6% and 92.4% inhibition), *Ganoderma boninense* (99.4% and 94.8% inhibition) and *Rigidoporous lignosus* (both 87.8% inhibition) at 3.0mg/mL concentration. At the lowest concentration 0.5 mg/mL, both compounds tested, exhibited anti-fungal activities against all pathogenic fungi tested with the percentage inhibition of radial growth, ranging between 15.2 to 20.5% inhibition. For comparison purposes, the known fungicide Tilt® 250EC which is responsible in part for the resistance in crops to the pathogenic fungus *Ganoderma* sp. and *Rigidoporus lignosus* (Jollands, 1983) were also tested. It required at least 0.1 mg/mL of this substance were necessary to inhibit the growth of *R. lignosus* (69% inhibiton) and *Ganoderma* sp. (43% inhibition). Thus, the study also suggests that certain flavonoid derivatives exhibit antifungal properties, in addition to anti-insect defence, in the plants in which they accumulate.

Reader Enquiry
Department of Biology
Faculty of Science and Envoronmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6642, 8946 6604
E-mail: umikal@fsas.upm.edu.my

In Vitro Production of *Oncobasidium theobromae* Talbot and Keane Basidiospores for Screening Disease Resistance



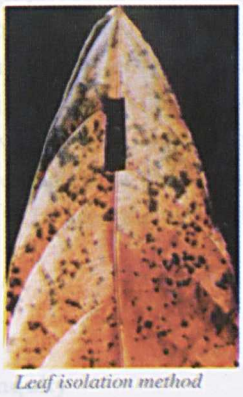
Zainal Abidin Mior Ahmad and Ganesan S/O Vadamalai

Oncobasidium theobromae Talbot and Keane is the pathogen of vascular-streak dieback (VSD), a devastating disease of cocoa in Asia. It is a basidiomycete fungus, which thrives, in the internal living stem and leaf tissues. Since chemical and cultural controls are ineffective, planting disease resistant cocoa appears to be the only long-term practical control measure. However, there is a need for alternative screening method to replace conventional field resistance screening, which normally takes several years to select new cocoa clones.

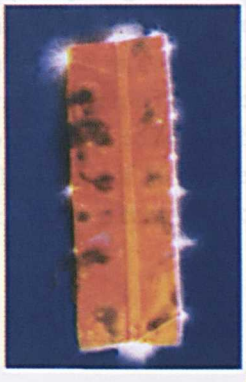


VSD symptom on cocoa leaf

A possible method is to artificially inoculate cocoa clones with infective basidiospores. In relation to this is the problem of obtaining basidiospores under field conditions and synchronizing their availability with susceptible cocoa. This study provides a solution by the successful production of sufficient and consistent amount of basidiospores achieved by exposing *O. theobromae* cultures to saturated moist air. They were viable and agar plugs or suspension containing basidiospores were proven to be infective when inoculated on young leaf flushes of cocoa seedlings. A solution containing glycerol, MES buffer and Tween 20 was found to be suitable and non-damaging for storing basidiospores under liquid nitrogen for long periods.



Leaf isolation method





Pure culture of O.theobromae on CCM



In vitro sporulation method





Immature and mature in vitro basidiospores of O.theobromae

The research results provide a break through for the development of a rapid artificial inoculation method for mass screening cocoa against VSD. The method can also be used to complement the more tedious screening of using *in vitro* cocoa callus.

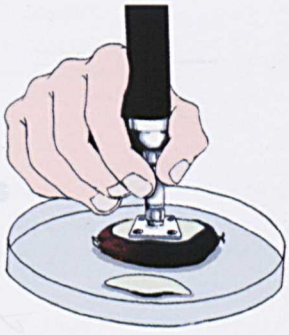
Reader Enquiry
Department of Plant Protection
Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7250
E-mail: zainal@agri.upm.edu.my

Development of an Open-ended Coaxial Probefor the Determination of Moisture Content of Oil Palm Fruits

Zulkifly Abbas and You Kok Yeow

The conventional method to determine ripeness of the oil palm bunch is by using the number or percentage of detached fruits per bunch. However the method has the disadvantage that it does not relate to oil quality and quantity. Previous work has shown a close relationship between oil content and moisture content during fruit development. Thus, the oil content and subsequently the time to harvest the fruit bunch can be determined from moisture measurements.



An open-ended coaxial probe for quick and accurate determination of moisture content in oil palm fruits

The measurement of moisture content using microwave method is widely known to be accurate and rapid. However not all microwave techniques are suitable for single fruit measurements due to small sample size. The microstrip sensor based on attenuation measurement has been successfully used to determine the amount of moisture content in the oil palm fruits. Unfortunately, the sensor requires laborious sample preparation where the fresh mesocarp of the oil palm fruit has to be separated from the nut and cut into small pieces and crumbled to form a semi-solid sample.

In this work, an open-ended coaxial probe has been developed for quick and accurate determination of moisture content in oil palm fruits. A quasi-static model has been used to determine the complex permittivity of the oil palm fruits in the frequency range between 2 GHz and 4 GHz. The predicted amount of moisture content was found by optimizing the values of permittivity from the quasi-static model with a dielectric mixture model developed using the moisture content values obtained from standard oven drying method. Finally, regression analysis was carried out to establish the relationship between the predicted and measured values of the amount of moisture content. The equation has been used to determine the amount of moisture content in the oil palm fruits for 50 different fruit samples of various degree of ripeness and was found to be accurate within ±5 % when compared to oven drying method.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6690
E-mail: za@fsas.upm.edu.my



Health and Allied Sciences

Contents

Health and Allied Sciences

A Stable Hybridoma Clone Secreting Monoclonal Antibody Against Breast Cancer 215

Abdul Manaf, Muhajir Hamid, Ong Boo Kean, Siti Aishah Mohd Ali and Khatijah Yusoff

Association of Provisional new emm Type Opacity Factory Negative Group A *Streptococci* strain ST4529 with Septicemia 216

Abdul Manaf Ali, Majid Eshaghi, Faridah Jamal and Khatijah Yusoff

Cytolytic Effects of Local Newcastle Disease Virus (Strain V4) on Leukemic Cell Line CEMSS 217

Abdul Manaf Ali, Madihah Zawawi, Abdul Rahman Omar, Khatijah Mohd.Yusoff and Aini Ideris

Molecular Diagnosis of Candidiasis and Characterization of Candidal Virulence Factors 219

Chong, P.P., Wong, S.F., D'Silva E.C., Phan, C.L., Cheang, P.S., Seow, H.F., Tan, B.C., Shamsudin, M.N., and Rosli, R.

Genetic Distance Between Clinical and Environmental Isolates of *Vibrio parahaemolyticus* from Peninsular Malaysia by RAPD Analysis 221

Hassan Mohd. Daud, Najiah Musa, Mohamed Shariff and Mohd-Azmi Mohd Lila

Effect of *Azadirachta indica* (neem) in the Male Rat Reproductive System 222

Hazlinda Binti Abdul Razak, Sabrina Bt Sukardi and Noraihan Nordin

Development, Adaptation and Assessment of Herbal Medicine and Product in the Promotion Health (PR 40204) 225

J. Suherman, R. Asmah, O. Fauziah and I. Patimah

Tumour-Marker Enzyme Activities and Confocal Microscopy of Induced Liver Cancer Rats Supplemented by Strobilanthus Crispus 226

J. Suherman, R. Asmah, O. Fauziah and I.Patimah

Flow cytometry: Applications in Clinical Diagnosis and Research 227

Maha Abdullah, Leong C.F, Cheong Soon Kheng, Seow Heng Fong

Application of Genomics for Characterization of Local Clinical Bacterial Pathogens 229

Mariana N. Shamsudin

Development of a Single Tube Molecular System for the Rapid Identification of *Staphylococcus aureus* and Multiple Drug Resistant Strains 231

Mariana Nor Shamsudin, Neela, V., Amghalia, W.M.Z. Somarny, Son Radu, Rozita Rosli and Raha Abdul Rahim

Bioavailability Studies of Iron from *Spirulina Platensis* Using Haemoglobin Repletion and Caco-2 Cell Culture System 234

Maznah Ismail, Hishamuddin Omar and Loh Su Peng

An Outcome Evaluation of Nutrition Promotion Programme among Malaysian Primary School Children: A Helic Study 236

Maznah Ismail, Siti Sabariah Buhari, Zalilah Mohd Shariff, Normah Hashim, Laily Paim, Norlijah Othman, Mohd. Sham Mohd Kassim, Rozita Abdul Talib, Abdul Wahab Jantan and Zabidi Azhar Mohd Hussin

Potential Health Benefits of *Strobilanthes Crispus* 238

Maznah Ismail, Abdul Salam Abdullah, Azlina Mohd Danial, Elezabeth Manickam and Asmah Yahaya

Locally Grown Microalgae as Functional Food 239

Maznah Ismail, Hishamudin Omar, Abdul Salam Abdullah, Rehir Dahalan and Loh Su Peng

The effect of *Channa striatus* (Haruan fish) and *Curcuma longa* (Turmeric) on PGP 9.5 Immunoreactive Nerve Fibre in Osteoarthritis 240

Michelle N.Y.T and Shanthi G.

Bioindicator of Oil Pollution 242

Mohamed Shariff Bin Mohamed Din, Fennie Fong Kah Ling, Mohd Azmi Bin Mohd Lila and Raha Binti Abdul Rahman

Typhoid fever in Malaysia: Clinical analysis of children admitted to Institute Paediatric Wards, HKL 244

Nelli Yohana Mohd Said, Norlijah Othman and Kamarul Azahar Mohd Rozali

The Development of Filter Aids and Enzyme Immobilization Carriers from Oil Palm Shells 245

O.M. Lai, M. Shanthi, M.Z. Hussein, K. Long and H.M. Ghazali

The Influence of the Use of Document Holder on the Percentage Maximum Voluntary Contraction (MVC) on the Trapezius Muscle Activity Among Female Office Workers 246

Rosnan Hamzah, Norhasnizah Ahmad, Jefferelli Shamsul Bahrin and Nasaruddin Abdul Aziz

Development of a Non-Radioactive Diagnostic Method for Fragile X Syndrome 247

Rozita Rosli and Sharizah Alimat

The Effect of Selected Synthetic Compounds on the Expression of Oncogenes in Human Breast Cancer and Human Malignant Glioma Cell Lines *In Vitro* 249

Rozita Rosli, Cheah Pike See, Shaban Awidat, Nurmawati Syakroni, Norshariza Nordin, Karen Crouse and Peter Pook

Cytotoxicity and Apoptosis Induction Potential of Flavokawin B in Tumour and Transformed Normal Cell Lines 250

Rozita Rosli, Nasir Umar-Tsafe, Habsah Mohammed, Nordin Haji Lajis, Mohamed Saifulaman Mohamed-Said and Leslie Charles Lai

A Potential DNA Vaccine against *Vibrio cholerae* 252

Rozita Rosli, Mariana Nor Shamsudin, Lama Hamadneh, Syahrilnizam Abdullah and Hon Sook Kit

Exclusive Intronic Point Mutations of the p53 Gene in Invasive Ductal Breast Carcinoma Samples 254

Rozita Rosli, Norshariza Nordin, Ng Kee Seong and Sabariah Abdul Rahman

Injury Mechanisms of Cervical Spine in Motorcycle Accidents 255

S.S. Ooi, S. V. Wong, M.M.H Megat Ahmad, A.A. Azhar, J.S. Yeap, Harwant Singh and R.S. Radin Umar

A Simple Method to Isolate the Outer Acrosomal Membranes of Paddy Rat Spermatozoa 257

S.Sukardi and M.S. Wang

Detection of Human Papilloma Virus Type 16 in Cervical Intraepithelial Neoplasia and Invasive Carcinoma using type specific Polymerase Chain Reaction and Dot Blot Hybridisation 258

Sabariah A.R, Nor Rizan K., Abd Manaf A., Khatijah M.Y., and Siti Aishah M.A

A Study on 33kilodalton Outer Membrane Protein (OMP) of *Pasteurella Multocida* 6:B As A Potential Vaccine Candidate 260

Saharee A.A., Z.A.Zamirah,M. Ramlan, N. Muniandy, M. Zamri-Saad and C.T.N.I. Fatimah

Antibiotic - Fed Chickens – Increase in Antibiotic Resistant *Escherichia Coli*? 261

Saleha, A.A, Tin Tin Myaing, Ganapathy, K.K. and Zulkifli, I

Pathogenesis of Hepatitis B Virus Infection and *Hepatocellular Carcinoma* 263

Seow Heng Fong

Mechanisms of Disease and Drug Resistance in Leukaemia 264

Seow Heng Fong and Maha Abdullah

Cytokines: Potential Products for New Generation Vaccine and Gene Therapy 265

Seow Heng Fong, Chia Chok Seng, Kechen Ban, Harjit Singh and Hairuszah Ithnin

Bone Modeling around Orthopedic Implants 267

Seyed Alireza Asgari

McCarthy Scores (MSCA) and Academic Performance Among Primary School Children in Kuala Lumpur, Malaysia 269

Shamsul B.S., Zailina H., Josephine Y., Jamal H.H. and Ariffin O.

The Excretion of Taurine and Creatine from Male Sprague-Dawley Rats Treated with Benoxaprofen 270

Sharida Fakurazi, Caldwell, J, Corcoran, C., Beckwith-Hall, B. and Goldin, R. D.

Inducible Nitric Oxide Synthase Inhibitors From Plants: Potential Anti-Inflammatory Therapeutic Agents 272

Syahida Ahmad, Arbaah Mohd Salleh, Faridah Abas, Daud Israf, Nordin Hj Lajis and Khozirah Shaari

Display of Hepatitis B Surface Antigen on Bacteriophage M13 273

Tan W.S., Yusoff K., Nathan S., Kok W.L. and Ong S.T.

Appropriateness of Emergency Upper Gastrointestinal Endoscopy in a Tertiary Hospital 274

Yunus Gul, Prasannan S. and Jabar M.F.

Pharmacotherapy for Chronic Haemorrhagic Radiation Proctitis 275

Yunus Gul, S. Prasanna and A.R.H Shaker

Dietary Calcium Intake and Bone Mineral Density Among Malay Postmenopausal Women 277

Zaitun Yassin, Rani Sarmugam, Suriah Abdul Rahman, Mirnalini Kandiah, Chee Siew Swee, Chan Siew Pheng, Rokiah Pendek and Chan Yoke Mun

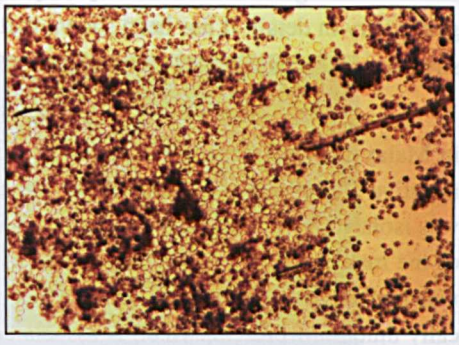
A Stable Hybridoma Clone Secreting Monoclonal Antibody Against Breast Cancer



Abdul Manaf, Muhajir Hamid, Ong Boo Kean, Siti Aishah Mohd Ali and Khatijah Yusoff

A stable hybridoma clone C2E7 was established as a result of fusion between the lymphocytes of Balb/c mice sensitized with the MCF-7 breast carcinoma cell line and Sp2/0-Ag14 myeloma cells using polyethylene glycol. The presence of antibodies was tested by using Cell (MCF-7) – ELISA. A stable clone (C2E7) was selected due to the high percentage positive well (100%) after five limiting dilutions and secreted IgM monoclonal antibody (Mab) with λ light chain. The Mab produced by C2E7 reacted very strongly to the human breast cancer cell lines MCF-7 and T47-D but showed negligible reactivity against other human cancer cell lines. The reactivity of Mab produced by C2E7 was markedly reduced by trpsin but not by priodate or neuraminidase. Therefore, the epitope recognized by Mab is not a carbohydrate or glycoprotein but an endopeptide consisting of arginine and lysine side chains. The hybridoma clone was capable of growing and secreting antibody in serum free medium (ERDF) supplemented with insulin, transferrin, ethanolamine and selenium.

Immunohistological studies showed that the Mab reacted to lobular breast and fibroadenoma cancer tissues at the cytoplasmic region. No staining was observed when tested against normal mammary tissue or tissues from uterine leiomyoma, stomach showing intestinal metaplasia, cervical carcinoma, tonsillitis, neurofibroma and ductal pappiloma of the breast.



European Collection of Animal Cell Cultures Centre has accepted this hybridoma clone as a cell deposit patent for Applied Microbiology and Research United Kingdom with Accession number 94091419.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8341
E-mail: manaf@putra.upm.edu.my

Association of Provisional new *emm* Type Opacity Factory Negative Group A Streptococci strain ST4529 with Septicemia



Abdul Manaf Ali, Majid Eshaghi, Faridah Jamal and Khatijah Yusoff

The Group A Streptococci (GAS) is responsible for a variety of diseases in human worldwide such as rheumatic fever and toxic shock syndrome worldwide. They have been divided into two distinct groups, OF positive and OF negative strains based on their ability to produce apoproteinase that causes mammalian serum to increase in opacity. They are also typed based on the T and M antigenic phenotypes. GAS express a range of cell surface and extra cellular products which have the potential to act as virulence factors of which the M protein which is encoded by *emm* gene is the most important one. *emm* genes are located in the *mga* regulon locus and are flanked by the *mga* and *scpA* genes. The M protein blocks antiphagocytosis *via* the alternative complement pathway. Based on the antigenic specificity of the M proteins, GAS can be divided into more than 100 M types, provisional types and *emm* types. Complete sequencing of these *emm* and *emm*-like genes show that they all possess a similar overall structure while relationships between these genes vary in detail. It has been shown that there are significant differences in OF positive and OF negative streptococcal strains based on variation in the M protein signal region as well as C repeat regions.

Group A *Streptococcus* strain ST4529 is a provisional new *emm* type, which has been recently reported in Malaysia. This strain was found to be opacity factor (OF) negative with a T1 phenotype. Usually, OF negative strains with T1 phenotypes are associated with acute rheumatic fever. However, strain ST4529 was isolated from the blood of a patient with septicemia. Comparison of the deduced amino acid sequence of the mature hypervariable N-terminus of ST4529 showed only 43% identity with that of M5, the closest matched OF negative strain with a T1 phenotype. Thus, ST4529 most probably encodes a new serospecifically unique M protein, which is associated with septicemia rather than pharyngitis infections. The strains with these phenotypes are very important because their sequences should be considered for developing of any anti-streptococcal vaccines.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8341
E-mail: manaf@putra.upm.edu.my

Cytolytic Effects of Local Newcastle Disease Virus (Strain V4)on Leukemic Cell Line CEMSS



Abdul Manaf Ali, Madihah Zawawi, Abdul Rahman Omar, Khatijah Mohd.Yusoff and Aini Ideris

Newcastle disease (ND) is a highly contagious, generalized virus disease of domestic poultry and wild birds characterized by gastro-intestinal, respiratory and nervous signs. NDV is classified as a member of the order *Mononegavirales*, family *Paramyxoviridae*, subfamily *Paramyxovirinae,* initially, was placed within the genus *Rubulavirus* (DeLeeuw and Peeters, 1999). Newcastle disease virus (NDV) vaccine, MTH-68, has been reported to be effective in some patients with advanced cancer who have exhausted conventional cancer treatment (Csatary *et al.,* 1999). NDV strain 73-T was used for the treatment of athymic mice with subcutaneous IMR-32 human neuroblastoma xenografts, which resulted in complete tumour regression after a single local injection of the virus. In clinical trials for humans, NDV strain 73-T replicated in tumour of a patient with cervical cancer and reduced the size of the tumour. Based on these studies, NDV has a great potential to be an anti-cancer agent and could be the choice of treatment for cancer patients all around the world as it (NDV) excels as an oncolytic agent. This paper reports the cytolytic effects of NDV strain V4-UPM on leukemic cell line CEMSS.

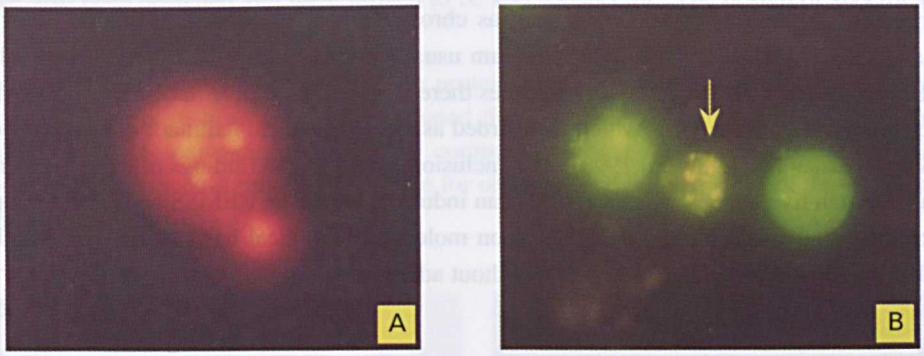


***Figure 1**: Cells stained with acridine orange and propidium iodide viewed under fluorescence light (A) late stages of apoptosis and (B) cell showing compaction and margination of nuclear chromatin (arrow); the earliest recognizable stage of apoptosis.*

Inoculation of live NDV strain V4-UPM, a heat resistant variant of V4-Que, showed cytolytic effects on CEMSS cells and could be seen in cells inoculated with virus titres at as low as 51.2 HAU and as soon as 12 hours post inoculation. The morphological changes observed include the condensation of the cytoplasm and budding of the cell as a whole to produce membrane-bounded apoptotic bodies. Results obtained from cytotoxic assay shows that a titre of 327.68 HAU of the virus reduces the cell population to 50% viability. Further morphological identification of cells undergoing apoptosis using the differential uptake of dyes acridine orange and propidium iodide (Figure 1) were performed on cells with and without inoculation of the virus at the CD50 titre. The early apoptotic cells whose membranes are still intact but have started to fragment their DNA still has green nuclei but the chromatin condensation were visible as bright green patches in the nuclei. Late apoptosis showing bright red a cell surrounded with apoptotic bodies was also observed in cells inoculated with the virus.

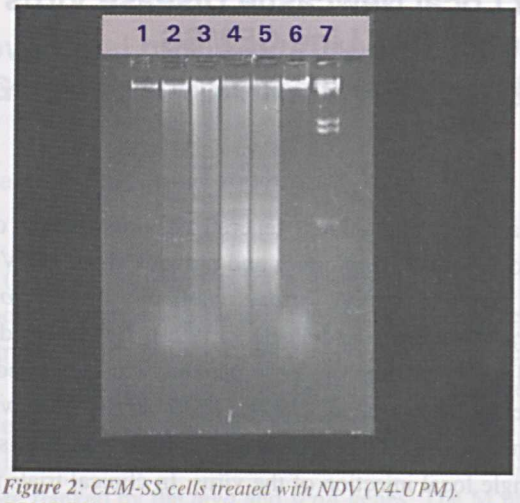


Figure 2: CEM-SS cells treated with NDV (V4-UPM). PBMC DNA (Lane 1); CEM-SS at 12 h PI (lane 2); 24 h PI (lane 3); 48 h PI (lane 4) and 72 h PI (lane 5); CEM-SS without treatment (control) (lane 6); DNA marker (lane 7).

Morphological changes observed suggests that the mode of killing is apoptosis or programmed cell death. Morphological features of apoptosis such as chromatin condensation, compaction of cytoplasmic organelles and dilation of the endoplasmic reticulum usually coincide with the internucleosomal cleavage of DNA into fragments of 180 to 200bp or multiples thereof, produces a DNA laddering profile (Figure 2), as seen in cells treated with the virus which is regarded as the biochemical hallmark of apoptosis (Cohen *et al.*, 1992, Schwartzman & Cidlowski, 1993). In conclusion, based on the findings of these experiments, the mechanism by which live NDV strain V4 (UPM) can induce cytolysis on CEMSS cells is via apoptosis. As its virulence versus attenuation can be explained on molecular biological basis, it may be possible to develop or select highly oncolytic strains of NDV without adverse toxicity.

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8341
E-mail: manaf@putra.upm.edu.my

Molecular Diagnosis of Candidiasis and Characterization of Candidal Virulence Factors



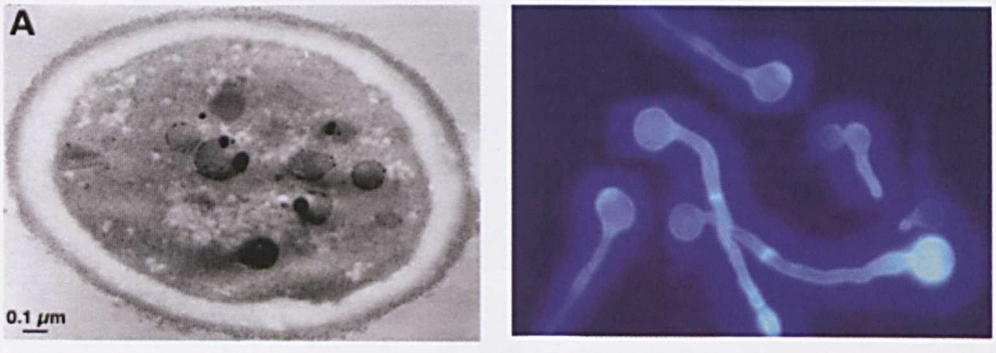
Chong ,P.P., Wong, S.F., D'Silva E.C., Phan, C.L., Cheang, P.S., Seow, H.F., Tan, B.C., Shamsudin, M.N., and Rosli, R.

Candidiasis is a wide spectrum of infections caused by the fungal *Candida* species. It can be mucosal (superficial) or systemic and invasive. The latter usually occur in immunocompromised patients. Between 20% and 40% of mycoses in patients with haematological malignancies are disseminated, and more than 70% of these are fatal. The invasive infections are not only hard to treat, but also difficult to detect and diagnose. Various virulence factors, most significantly the secreted aspartyl proteinases and the phospholipases have been shown to have direct involvement in the pathogenesis process.

The objectives of the project include development of rapid diagnostic methods for early detection of candidiasis, specifically invasive candidiasis; molecular characterization of the virulence factors in order to elucidate the mechanisms of pathogenesis, and investigation of the expression of azole-drug resistance genes to enhance our understanding on the resistance mechanisms.

This present research effort has produced a nested PCR method that is rapid, sensitive and specific for detecting *Candida albicans* DNA from clinical specimens. PCR primers specific for *C. glabrata*, and *C. krusei* have also been designed and were proven to be species-specific. The design of specific primers for other species is currently being pursued.

Homologue fragments of genes encoding the proteinase and phospholipase of *Candida tropicalis* and *Candida parapsilosis* have been successfully cloned through the homology approach. The cloned genes were verified by DNA sequencing followed by comparison of the sequences to the Genbank database. These cloned fragments would serve as a baseline for obtaining the full sequence of these genes from local *Candida* isolates.



Candida species: members of the family Cryptococcaceae. Considered to be an opportunistic pathogen of human



Detecting Candida albicans directly from clinical specimens

The expression of the antifungal resistance genes of *Candida* species were investigated in the azole-resistant isolates by semi-quantitative RT-PCR. The result showed that 3 out of 4 isolates had overexpression of the resistance gene. DNA sequencing of the genes revealed potential mutation hot-spots which could be correlated with resistance. Nonetheless, sequencing of more isolates is planned in the future in order to reflect a stronger correlation between the hotspot mutations and the resistant phenotype.

Thus, novel primers for detection of *Candida albicans*, *C. glabrata* and *C. krusei* and initial characterization of the virulence factors have been successfully performed.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8520
E-mail: cpp@medic.upm.edu.my

Genetic Distance Between Clinical and Environmental Isolates of *Vibrio parahaemolyticus* from Peninsular Malaysia by RAPD Analysis



Hassan Mohd. Daud, Najiah Musa, Mohamed Shariff and Mohd-Azmi Mohd Lila

Vibrio parahaemolyticus is considered as one of the most pathogenic bacterium causing vibriosis in brackish and marine fish as well as in cultured shrimp in Malaysia. It is a natural inhabitant of estuarine and marine environments. This study was conducted to determine the genetic distance between the clinical and environmental isolates of *V. parahaemolyticus* from different places in Peninsular Malaysia using RAPD analysis. Ten isolates were obtained; four clinical isolates (numbered F1 to F4) from diseased fish, and six environmental isolates (W1 to W6) from pond water of shrimp farms. RAPDistance program (version 1.04) was used to analyze the RAPD patterns of the isolates and dendrogram was constructed from the combined results of two primers using NJTREE (Neighbour-Joining Tree) algorithm. Dendrogram elucidated a tree of two main clusters (A and B). Cluster B was subdivided into B1, B2 and B3. Isolates F1, W3 and W5 were clustered in A, isolates W1 and W2 in B1, isolates F2, F3, F4 and W6 in B2, and isolate W4 in B3. This indicated a close genetic distance between the clinical isolates (F2, F3 and F4) except isolate F1, which was close to environmental isolates W3 and W5. Isolates F2, F3 and F4 were close to isolate W6. Isolates W1, W2 and W4 were genetically far from any clinical isolates.

The close genetic distance between some clinical and environmental isolates of *V. parahaemolyticus* suggested that the strains present in the environments could become pathogenic under certain circumstances.

Reader Enquiry
Department of Veterinary Clinical Studies
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8246
E-mail: hassan@vet.upm.edu.my

Effect of *Azadirachta indica* (neem) in the Male Rat Reproductive System



Hazlinda Binti Abdul Razak, Sabrina Bt Sukardi and Noraihan Nordin

Fertility of male mammals can be determined by sperm motility, concentration and morphology. Many studies have been carried out to study the effect of *Azadirachta indica* on the reproductive system of the male rat such as testosterone level and sperm morphology. In this study, *Azadirachta indica* leaf extract or popularly known as neem or 'semambu' leaf was used to determine the effect on morphology, live / dead (viability) and concentration of rat spermatozoa.

Twenty-eight male rats were used for this research. The rats were divided into two group i.e control group and test group. The group for control was given tap water and the test group was given aqueous neem leaf extract (0.8 % w/v) for 35 days. Initial body weight was taken before and after the experiment. At the end of the experiment, rats were killed with chloroform and the weight of their testes recorded. Sperm sample was collected from the cauda epididymides. Concentration of sperm was counted using the Haemocytometer and Eosin-Negrosin stain was used to determine sperm morphology and live / dead (viability) under light microscope.



Figure 1. Bar chart showing live/dead (viability) of spermatozoa in control and test animals

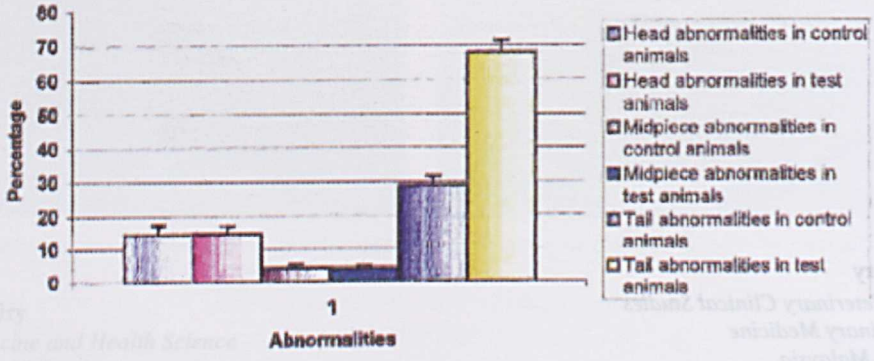


Figure 2. Bar chart showing abnormalities of spermatozoa in control and test animals

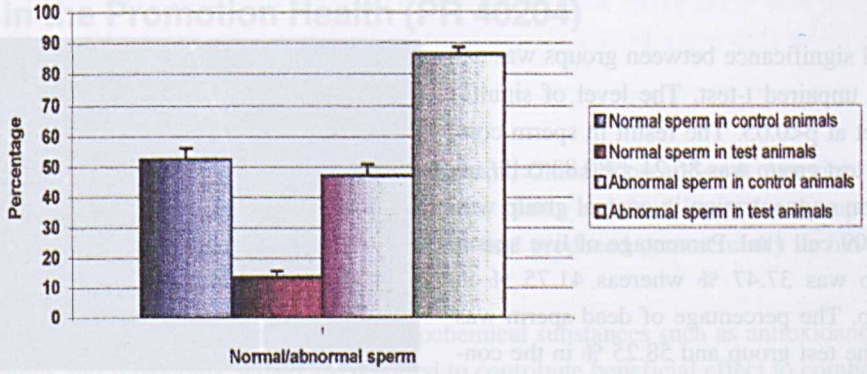


Figure 3. Bar chart showing normal/abnormal of spermatozoa in control and test animals

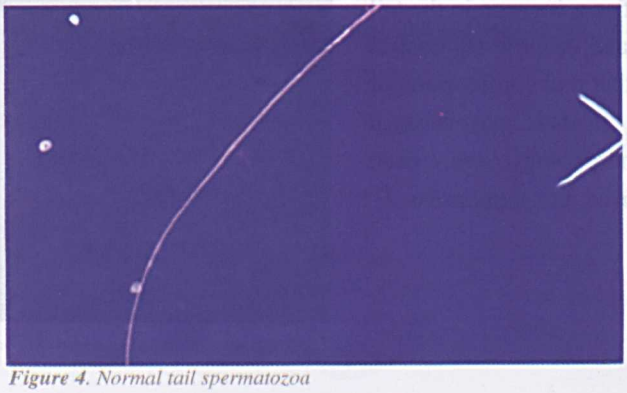


Figure 4. Normal tail spermatozoa

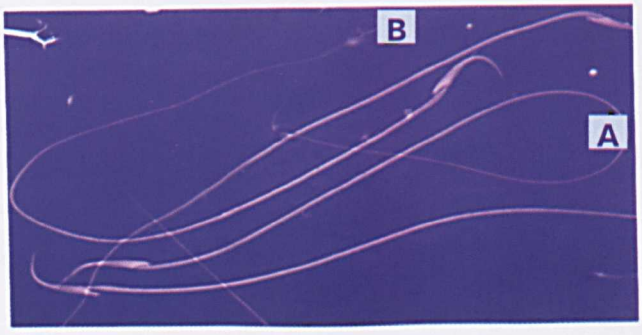


Figure 5. Simple bent tail and coiled spermatozoa.
A. Simple bent tail spermatozoa;
B. Coiled tail spermatozoa.

Statistical significance between groups was assessed using unpaired t-test. The level of significance was set at $p<0.05$. The result in sperm concentration in test group was 86.21 ± 80.83 cell / ml whereas sperm concentration in control group was 115.36 ± 99.09 cell / ml. Percentage of live sperm in test group was 37.47 % whereas 41.75 % in control group. The percentage of dead sperm was 62.54 % in the test group and 58.25 % in the control group. Percentage of abnormalities in the test group was 86.61 % and control group was 47.34 %. Many sperm abnormalities were seen in the tail i.e. 67.82 % for test group and 28.79 % for control group. The result suggests that oral consumption of aqueous neem extract for 35 days may cause a reduction in the normal morphology, live / dead (viability) and concentration of rat spermatozoa.

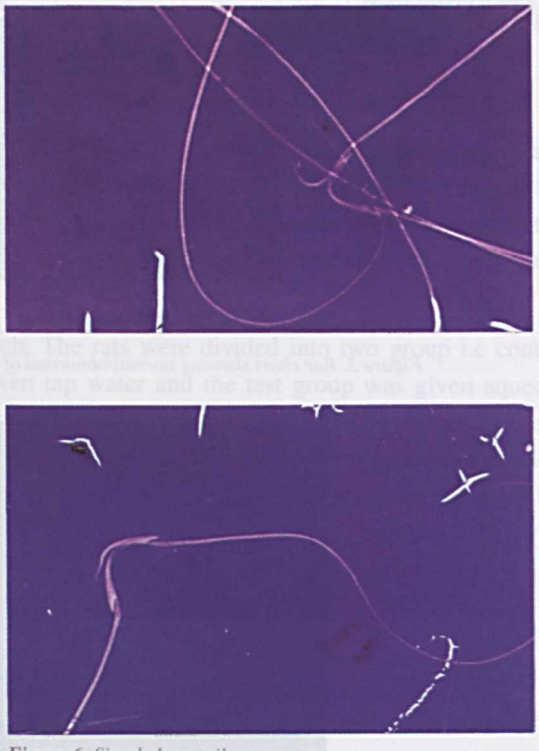


Figure 6. Simple bent tail spermatozoa

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 2050 1011 x 118
E-mail: hazlinda@medic.upm.edu.my

Development, Adaptation and Assessment of Herbal Medicine and Product in the Promotion Health (PR 40204)

J. Suherman, R. Asmah, O. Fauziah and I. Patimah

Majority of health food items are imported from Indonesia, China, Korea, South America, Australia and USA. Malaysia traditionally have been using local herbs, plants and food items for therapeutic purposes and these resources have not been studied scientifically and produced commercially as has been done in other countries.

Medicinal plants contain different types of phytochemical substances such as antioxidant vitamins, antioxidant minerals and flavonoids, which are reported to contribute beneficial effect to combat chronic diseases. Based on previous experiments, *L. inermis* and *S.crispus* have been reported to be a potential anticancer component. Production of health food product from these local plants is a vision in supplying the local market with local food to replace the imported stuff that is flooding the Malaysian market.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8443
E-mail: asmah@putra.upm.edu.my

Tumour-Marker Enzyme Activities and Confocal Microscopy of Induced Liver Cancer Rats Supplemented by *Strobilanthus Crispus*

J. Suherman, R. Asmah, O. Fauziah and I.Patimah

Strobilanthus crispus is one of Malaysian herbs that has been used as Malay traditional medicine. *In vitro* and *in vivo* experiments have been done from this plant to study for possible source of anti cancer agents. The effects of administration of *Strobilanthus crispus* on hepatocarcinogenesis in rats induced by diethylnitrosamine (DEN) and 2-acetylaminofluorene (AAF) were investigated by the determination of plasma and liver gamma-glutamyl transpeptidase (GGT), cytosolic glutathione S-transferase (GST) and microsomal uridine diphosphoglucuronyl transferase (UDPGT). The *in vivo* studies were done on male *Sprague Dawley* rats weighing 120-160 g. The rats were divided into four treatment groups: a control group on a basal diet, a group fed a basal diet supplemented with water extracts (5%) of *Strobilanthus crispus*, a group treated with DEN/AAF and a group treated with DEN/AAF and supplemented with *Strobilanthus crispus* water extracts. The rats were sacrificed after 14 weeks. Treatment with DEN/AAF caused increased in GGT, GST and UDPGT activities when compared to controls. These increases were also observed when *Strobilanthus crispus* was supplemented with DEN/AAF but the increases were less when compared to the rats receiving DEN/AAF only. Histological examination by confocal scanning laser microscope (MRC 1024) showed that the normal hepatocytes were well organized and well arranged. The cell membranes were markedly clear and the nuclei were uniformly round. The hepatocytes of rat liver treated with *Strobilanthus crispus* showed normal liver cells. There was disarrangement of hepatocytes of liver given DEN/AAF. The cells appeared swollen with spaces in the cytoplasm and occasionally the plasma membrane is disrupted. Cancer hepatocytes supplemented with *Strobilanthus crispus* appeared normal and the cell membrane and nuclear membrane were well intact and pronounced.

This study showed that *Strobilanthus crispus* could be a possible source for anticancer agent.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8443
E-mail: asmah@putra.upm.edu.my

Flow cytometry: Applications in Clinical Diagnosis and Research

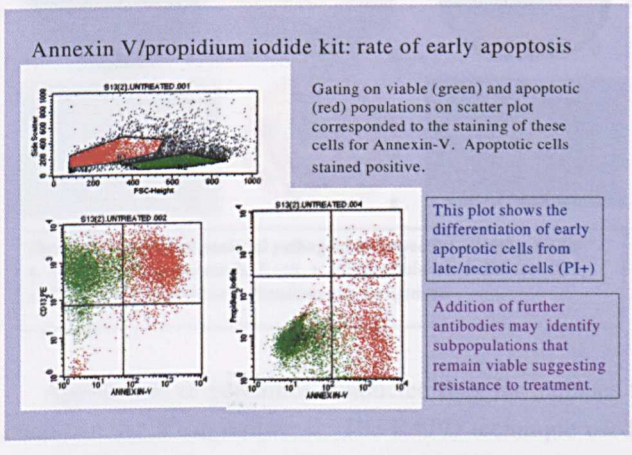


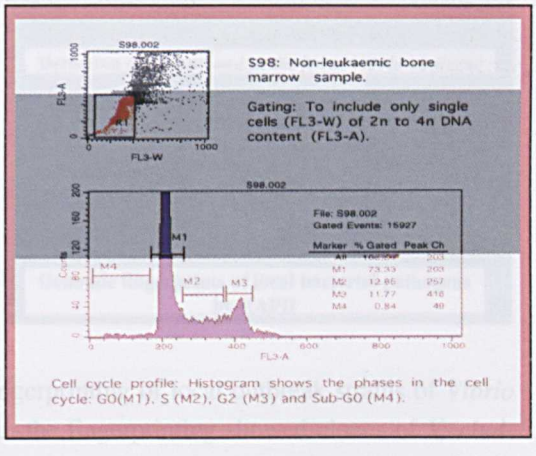
Maha Abdullah, Leong C.F, Cheong Soon Kheng, Seow Heng Fong

Flow cytometry is a rapid and reliable technique to detect protein expression on a cell and has gained wide acceptance since it became commercially available in the early 1970's. It can be applied as long as cells are in suspension (single) and the antibody of interest can be tagged to a fluorochrome. DNA content can also be analyzed by staining with DNA dyes that autoflouresce. The intensity of fluorescence increases with the amount of DNA (ploidy).

In Malaysia, flow cytometry has been in use in hospitals for at least 10 years. Clinical application had focused on lineage identification of acute leukaemia and determination of immune status by monitoring CD4 lymphocytes levels in the blood of AIDS and other immuno-compromised patients. More recently, flow cytometry has proven indispensable in quantifying CD34 expressing cells for successful stem cell transplantation in leukaemia patients.

Elsewhere, the every day use of flow cytometry is more comprehensive where lymphomas and leukemias are not only intensively studied for surface markers of diagnostic but also prognostic value. Ploidy and cell cycle analysis of cancers is the major diagnostic use. In special labs, specialized work such as HLA typing is done.





Flow cytometry in our study indicated that it could relatively be carried out easily in the following.

1. Bcl-2, as a possible prognostic marker in acute leukaemia: This is determined by the median fluorescence intensity (MFI) and not percentage of positive cells. Both parameters are available in the software program. Since cells are analyzed individually, only the leukaemic blasts are gated (to exclude normal, contaminating cells), and the median intensity obtained is more representative.

2. Cell cycle analysis was used to assess the degree of cell proliferation and grading of the cancer progression. DNA analysis on flow cytometry fulfills both criteria at the same time. Cell cycle profile provides proliferation information, while sub-G_0 values represents rate of apoptosis.

3. Ploidy: a prognostic marker in acute lymphoblastic leukaemia. DNA staining provide information on the DNA content of the cells studied. Abnormal peaks are detected from cell cycle profiles.

4. Rate of apoptosis: Annexin V staining. Annexin-V binding was successfully applied and the apoptotic index obtained.

5. Cell signaling pathways: Uses antibodies that recognises phosphorylated components of the signaling pathway. This is able to reveal activation of a particular pathway from the many that exists. Potential for monitoring drug treatment.

Our studies have enhanced our knowledge on the pathogenesis of leukaemia and information on possible prognostic markers as well as responsiveness to chemotherapeutic drugs.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946
E-mail: mahaabdullah@yahoo.com

Application of Genomics for Characterization of Local Clinical Bacterial Pathogens

Mariana N. Shamsudin

In recent years, emerging microbial threats have become an important problem worldwide. These infections include cholera; Group A streptococcal infection, and enterohaemorrhagic *E. coli*. In Malaysia, disease trend during the period 1983 to 1989 has been an increase in foot and water-borne diseases like cholera, food poisoning, viral hepatitis and typhoid. Main challenges to overcome the infectious disease are to prevent the infection from emerging and to contain it should it emerge. The health-based approach to prevent emergence include strategies of developing an efficient and effective surveillance system to monitor such emerging infections. The main challenge in diagnosis lies in rapid detection of bacteria cells in a mixed infection. In the upper respiratory tract infection as an example, many rapid streptococcal antigen detection tests commercially available have a high degree of specificity, but sensitivity in clinical practice is low. Rapid detection and correct identification of bacteria in a very short time at a lower cost is very crucial for the diagnosis of many infections and diseases. In the advent of molecular biology techniques, use of bacterial genomics has been shown to be a powerful tool for various purposes.

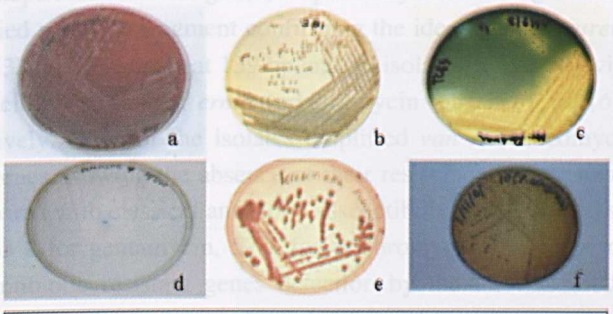
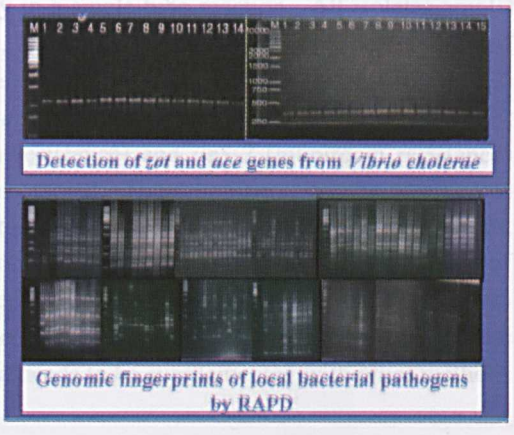


Plate cultures of local bacterial pathogens in respective selective media
a. *Staphylococcus aureus*, **b.** *E.coli*, **c.** *Vibrio cholerae*, **d.** *Salmonella* **sp.**
e. *Klebsiella pneumoniae* **f.** *Pseudomonas aeruginosa*



Application of genomics conducted thus far includes fingerprinting of local outbreak strains of *Vibrio cholerae* and *V. alginolyticus*. The RAPD technique used in the fingerprinting showed clones of *V. cholerae* isolates in the year 1996 exhibited different fingerprint pattern than those isolated in the year 2001. The genomic fingerprint also differentiated the *V. cholerae* species to the *V. alginolyticus*. The pathogenic mechanism based on genomics characterization showed presence of enterotoxin genes namely, *ctx* B, *zot* and *ace* genes. The sequence, cloning and expression of some of these genes were successfully carried out. In addition, the genomics of other bacterial pathogens studied included *Staphylococcus aureus*, *Streptococcus pyogenes*, *S. viridans*, *Klebsiella pneumoniae*, *E. coli*, *Salmonella typhimurium* and *Pseudomonas aeruginosa*. The fingerprinting by RAPD showed very high molecular diversity among local bacterial pathogens. Each genus exhibited fingerprint pattern that varied from other genera. Molecular diversity within each species was low. The RAPD genomic fingerprint also generated some genetic marker band. This genetic marker band can be used for rapid diagnostic identification of each genus.

In addition presence of virulent genes in the genome of *Staphylococcus aureus, Streptococcus pyogenes* and *Pseudomonas aeruginosa* were detected. Many isolates of *S. pyogenes* screened carried *emm1* gene and only one isolate carried *speC* gene. The *emm1* gene is the M-protein gene and *speC* gene is the pyrogenic exotoxin C gene. For *S. aureus* detection of the *tst* gene showed negative results. The *tst* gene is responsible for the toxic shock syndrome (TSS). *S.aureus* were positive on the detection of the *sei* gene. The *sei* gene is usually found in the food poisoning isolates such as faecal specimens. *P. aeruginosa* isolates showed presence of the virulent genes -*toxA* and *lasB* genes in all isolates. Presence of virulent genes in the genome can be used for purposes such as development of molecular or subunit vaccine.

Therefore, information from the genomic characterization of these local pathogens have potential usage in the development of rapid diagnostic method for identification of the pathogens, vaccine development, as well as understanding epidemiological strains and development of epidemiological markers.

Reader Enquiry
Department of Clinical Laboratory Science
Faculty of Medicineand Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8496
E-mail: mariana@medic.upm.edu.my

Development of a Single Tube Molecular System for the Rapid Identification of *Staphylococcus aureus* and Multiple Drug Resistant Strains

Award Winner

Mariana Nor Shamsudin, Neela, V., Amghalia, W.M.Z. Somarny, Son Radu, Rozita Rosli and Raha Abdul Rahim

Staphylococci are etiologic agents of infectious processes, with *Staphylococcus aureus* being the most important human pathogen of this group causing skin and soft tissue infections, endocarditis, and bacterimia with metastatic abscess formation and a variety of toxin-mediated diseases. Multiple drug resistant *S. aureus* is one of the most common nosocomial pathogen worldwide whereby one of the major causes of intensive care unit (ICU) mortality and morbidity is nosocomial infection. The timely identification of this pathogen and detection of antibiotic resistant strains is one of the most important functions of the microbiology laboratory.

This study reports the development of a Single Tube PCR system for the diagnosis of *S. aureus* and the detection of antibiotic resistance genes harbored by some clinical isolates. This system was designed to identify *S. aureus* at species level and to detect methicillin, gentamycin, erythromycin, vancomycin and mupirocin resistant genes, respectively from a single colony in a single tube reaction. All isolates amplified a 108 bp fragment confirming the identity of *S. aureus*, 23 isolates produced a band at the position of 533bp, 28 isolates at 139 bp and 30 isolates at 174 bp evidencing the presence of *mecA* (methicillin or oxacillin resistance), *ermA* (erythromycin reistance), *aac(6')-aph(2'')*(gentamycin reistance) genes, respectively. None of the isolates amplified *van A* (vancomycin resistance) and *ileS-2* (mupirocin resistance) genes showing the absence of their resistance in the isolates studied. These genotypic results when compared with classical antibiotic susceptibility tests showed some dissimilarities, namely, 40% for methicillin, 63% for gentamycin, 57% for erythromycin, 0% for vancomycin and mupirocin. The high incidence of antibiotic resistant genes detection by the PCR method could be that this method is highly sensitive whereby the presence of a few copies of the genes can be detected but not exhibited phenotypically by the antibiotic susceptibility assay. Hence, the phenotypic method needs to be supplemented with other methods to be applied in a clinical laboratory.

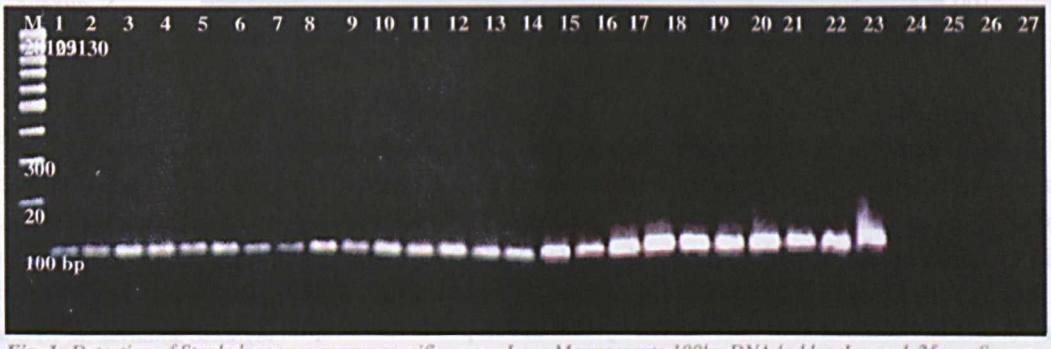


Fig. 1: Detection of Staphylococcus aureus specific gene. Lane M represents 100bp DNA ladder. Lanes 1-25 are S. aureus isolates, lanes 26-30 represents Vibrio cholerae, Streptococcus pyogenes, Escherichia coli and Klebsiella pneumonia and Salmonella thyphimurium, solates. All the S. aureus isolates have a single band at position 108 bp. The band appears slightly above 100bp in the 100 bp ladder marker

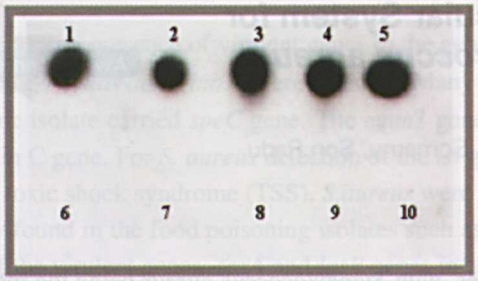


Fig. 2: Dot 1 is the positive control DNA , dot 2-4 are the DNA of S. aureus isolates and dot 6, 7 and 8 are Vibrio cholerae, Streptococcus pyogenes, Eschericia coli and Klebsiella pneumonia and Salmonella thyphimurium DNA respectively

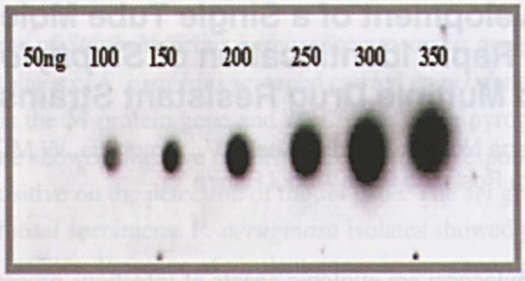


Fig. 3: Minimum concentration required for the DNA (100ng) to hybridize with the probe

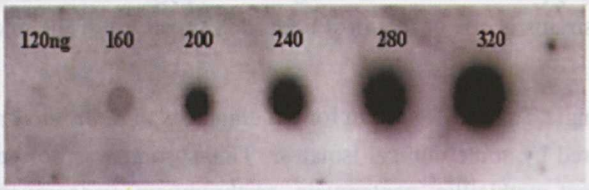


Fig. 4: Minimum concentration required for the probe (200 ng) to hybridize with the DNA



Fig. 5: Lane M – 100bp DNA ladder. Lanes 18 represents Staphylococcus aureus isolates

A method incorporating DNA amplification and dot blot hybridization for the detection and identification of *S. aureus* to the species level is described, using a set of primers from the highly conserved region. The novel rapid identification procedure, based on dot blot of horseradish peroxidase labeled PCR product to strip immobilized DNA that is innovated can detect *S. aureus* from any clinical or environmental isolates. The sensitivity and specificity of these primers and probes were tested against more than 100 isolates of clinical and environmental *S. aureus*. The system developed offers a rapid, simple, specific, and accurate detection of multiple antibiotic resistant genes in *S. aureus* and thus could be systematically applied as a diagnostic test in clinical microbiology laboratories, facilitating the design and used of antibiotic therapy.

This product has very high commercial potential of rapid diagnostic kit, as this will detect *S. aureus* accurately in a very short time in comparison to other commercially available techniques. The research carried out can be utilized as knowledge gathered towards better preparation of the country for any potential *S. aureus* outbreaks.

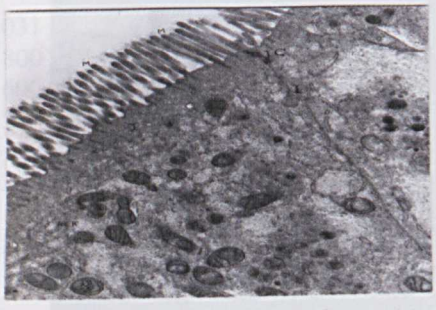
Reader Enquiry
Department of Clinical Laboratory Science
Faculty of Medicineand Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8497
E-mail: mariana@medic.upm.edu.my

Bioavailability Studies of Iron From *Spirulina Platensis* Using Haemoglobin Repletion and Caco-2 Cell Culture System

Maznah Ismail, Hishamuddin Omar and Loh Su Peng

Iron deficiency and anemia remain an important public health problem worldwide affecting as many as 4-5 billion people both in the affluent societies and the developing countries. There are functional consequences inflicted by iron deficiency and anemia among which are impairment of cognitive development, diminished learning ability, reduced working capacity, decreased immune functions and increased risk of death associated with pregnancy and childbirth. Apart from increased requirement, bioavailability of iron from food sources in particular of plant origin may play a key role in deciding the iron status of an individual. It has been recommended that people who could not meet their iron requirement from the diets to take supplement for both the prevention and treatment of condition. Oral iron supplementation has been important for this purpose, however it may have some disadvantages. There are also other approaches that have been used in improving iron intake and absorption. One of the alternatives is the use of phytoplankton, a microalgae that is already popular in many Asian countries as a food supplement. They are not only rich in iron but also an excellent source of other nutrients. However despite renewed interest in phytoplankton as nutrient sources, little is known about the extent of bioavailability of these nutrients. In addition interactions between these nutrients and other dietary factors, which may impinge on their absorption, are also not well known.





Caco-2 cells displaying enterocytic characteristics, which may be used as a tool to study bioavailability (Maznah, I. 1999)



We have therefore investigated the bioavailability of iron from *Spirulina platensis* and the effect of other nutrients namely, calcium, zinc and vitamin A and other dietary factors on its absorption by means of hemoglobin repletion in rats, a tracer study in mice and Caco-2 cell culture system (Maznah, I.,1999). *Spirulina* had been cultured by our team member in UPM.Results from these studies had shown that iron was highly bioavailable from *Spirulina* to rats, since the absorption of iron from the algae was equal to that from iron sulphate. In comparison the absorption of iron from other plants such as spinach was not as good. Furthermore the amount of iron added to the experimental diets from ferrous sulphate was twice the amount added from *Spirulina*. And as such *Spirulina* can be said to be more efficient in the repletion of iron. While absorption of iron from *Spirulina* by human will likely to be less than by rats, it nevertheless appears that *Spirulina* is a fairly concentrated source of available iron. The presence of calcium in the diet tended to decrease iron bioavailability. High calcium intake depressed iron bioavailability in rats at least at two stages; a decrease in iron solubility in the intestinal digesta, accompanied by an inhibition of the mucosal transfer. The more inhibitory effect of calcium on *Spirulina* compared to $FeSO_4$ may be due to different dosages used ($FeSO_4$ had twice the iron level than *Spirulina*) (Maznah, I. et al., 2000). Comparison between sources of *Spirulina* had shown that the repletion efficiency of our own locally cultured *Spirulina* was not much different from the imported commercial product.

In conclusion *Spirulina* is probably a good source of iron, although more expensive than organic iron tablet. However it contains not just iron but also other nutrients, and therefore may be used as a multi-supplement.

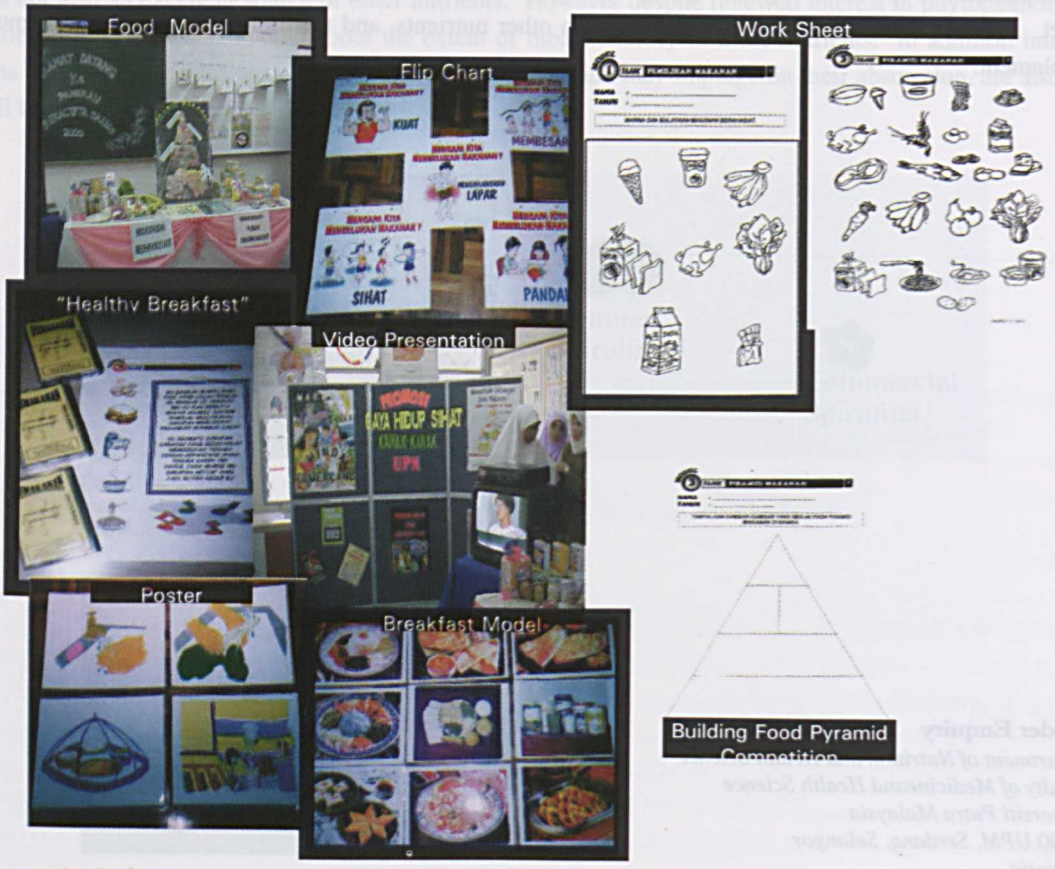
Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicineand Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8483
E-mail: maznah@medic.upm.edu.my

An Outcome Evaluation of Nutrition Promotion Programme among Malaysian Primary School Children: *A Helic Study*

Maznah Ismail, Siti Sabariah Buhari, Zalilah Mohd Shariff, Normah Hashim, Laily Paim, Norlijah Othman, Mohd. Sham Mohd Kassim, Rozita Abdul Talib, Abdul Wahab Jantan and Zabidi Azhar Mohd Hussin

School-aged children undergo rapid development and at this age in their life cycle nutritional requirements are increased while food habits are established. Experiencing and eating diverse food at this age help to promote desirable eating behaviour (Birch, I., 1987), which will continue to later life. On the other hand inadequate nutrition during this age may lead to poor growth and decreased academic performance. Furthermore poor childhood nutrition plus poor physical activity may lead to increased risk for cardiovascular disease (CVD) in adulthood (Hetzel, B.S & Berenson, G.S., 1987). Promoting a healthful diet and a regular physical activity among children is therefore an important public health agenda. School can be an ideal setting in which to promote healthful diet and physical activity since these topics are normally taught as part of the health education curriculum.



Intervention Package

This study on integrative approach on health promotion among Malaysian children, otherwise known as the *Helic* study. Researchers from public universities, UPM, USM, UIAM and UKM as well as from the Ministry of Education were involved in this project. Its main objective was to assess the effectiveness of a comprehensive and multidisciplinary school based health intervention programme which included physical activity, smoking and nutrition, aimed at promoting healthy lifestyle among eight and thirteen years olds. The study was conducted at 4 centres in 4 different states, 2 urban schools each in Selangor and Wilayah Persekutuan Kuala Lumpur and 2 rural schools each in Pahang and Kelantan with 8 schools, altogether. Second year pupils were randomly selected with the total sample size of 705. Nutrition knowledge, attitude and practice were assessed using a set of questionnaire containing 3 constructs: *Foods for health*, *nutrition and health* and *nutrition and academic achievement* before and after intervention of 6 weeks and 6 months. Intervention package was varied which included teachers' module, children's module and worksheet, songs, video presentation, exhibition and numerous competitions. Findings indicated that there were significant increases in knowledge and practice for both experimental and control groups even only after 6 weeks of intervention. However, the increase in both knowledge and practice was significantly higher for experimental groups than for the control groups. Further analysis had shown that respondents within the 0-25th and 26-50th percentiles based on pre-intervention scores for knowledge and practice had improved scores, whereas those in the 76-100th percentile had shown declining scores at post-intervention. Comparing among the constructs, it was found that scores on *nutrition and health* showed the highest increase.

In conclusion this study had shown that knowledge and practice of the respondents have been improved by the intervention. This intervention package, which has been designed as a part of the current physical education curriculum, can be a useful model in promoting healthy lifestyle among school children in Malaysia.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8483
E-mail: maznah@medic.upm.edu.my

Potential Health Benefits of *Strobilanthes Crispus*



Maznah Ismail, Abdul Salam Abdullah, Azlina Mohd Danial, Elezabeth Manickam and Asmah Yahaya

Plants have played a significant role in maintaining human health and improving the quality of human life for thousand of years. WHO estimated that about 80% of the world's inhabitants rely on the traditional medicine for their primary health care, and most of this therapy involves the use of plant extracts or their active components. One such plant is *Strobilanthes crispus* ZII 109 (L.) Bremek or *Saricocalyx crispus* ZII 109 (L.) Bremek (Acanthaceae). It has been used extensively in herbal preparations locally or in Indonesia among others as antidiabetic, diuretic, antilytic and laxative. Despite the popular usage little scientific data is available and as such this research programme was carried out with the intention to investigate health benefits of it's leaf extract and its potential use as a herbal tea. The first project involved chemical analysis and antioxidant activities of the leaf extract. The other two projects concentrated on the hypocholesterolemic and anti-carcinogenic effects of the leaf extracts.

Strobilanthes crispus extract (SCE) was shown to have high mineral content especially potassium, calcium, sodium and iron. High values of both water-soluble ash and alkalinity of the ash indicated high quality of the oven-dried leaves. Tannin and caffeine content was low but catechin and alkaloid levels were considerably higher than a popular imported Yerbamate herbal tea. An infusion of SCE leaves (5% w/v) was able to suppress the cancer effect of DEN and AAF-induced rats significantly higher than glycyrrhizin by measurements of tumour marker enzymes. Similarly SCE (5% w/v) was shown to have reduced oxidative stress of hypercholesterolemic induced rats by comparing plasma antioxidant status (FRAP, TBARS) and antioxidant enzyme activities. SCE has presented potential health benefits, which is due to its high antioxidant activity especially its catechin. Consumption of SCE (5 g/day) as a herbal tea could contribute to additional nutrients and antioxidants needed in the body to enhance the defence system, especially toward the incidence of degenerative diseases.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8483
E-mail: maznah@medic.upm.edu.my

Locally Grown Microalgae As Functional Food

Maznah Ismail, Hishamudin Omar, Abdul Salam Abdullah, Rehir Dahalan and Loh Su Peng



Microalgae such as Spirulina and chlorella has been promoted as a functional food with claim of high mineral content and other nutrients. Apart from its good nutritional composition many preclinical studies have suggested that Spirulina cells have therapeutic properties. Because of this claim Spirulina and Chlorella are highly consumed by the locals as food supplement. However, these microalgae are imported from various countries and thus attempts had been made to culture these microalgae locally either in fresh or brackish waters.

The objectives of this research programme were to explore the possibility of mass cultivation of these microalgae and further investigated its potential health benefit in alleviating nutritional iron deficiency. Mass cultivation of Spirulina and Chlorella locally showed a promising future as most of the parameters needed for the cultivation are found abundantly in Malaysia. Waste from palm oil affluent which can be obtained easily, provided an economical means for the mass cultivation of Spirulina and Chlorella beside the sunlight that is available all year round. We also investigated the potential health benefits of the microalgae compared to those found in the market.

In this study, iron bioavailability from Spirulina and Chlorella was determined using Caco-2 cell culture system, Haemoglobin repletion in anaemic rats and a tracer study. Our findings have shown that Hb regeneration efficiency (HRE) by Spirulina was double that of ferrous sulfate. *In vitro* studies showed that the iron bioavailability of these microalgae is comparable to that of ferrous sulfate and the iron availability is not significantly affected by nutrients that are shown to inhibit iron availability in ferrous sulfate.

In conclusion, the nutritional and economic potentials of microalgae are not few. In perspective, microalgae may play different and important roles in providing highly nutritious product of great value not only to human health but to our economy as well.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8483
E-mail: maznah@medic.upm.edu.my

The effect of *Channa striatus* (Haruan fish) and *Curcuma longa* (Turmeric) on PGP 9.5 Immunoreactive Nerve Fibre in Osteoarthritis

AwardWinner

Michelle N.Y.T and Shanthi G.

Osteoarthritis (OA) is a chronic disorder characterized by softening and disintegration of the articular cartilage. There is a wide range of treatment available to minimize symptoms such as pain and stiffness as well as preventing further joint damage in OA, such as NSAIDs and Acetaminophen. However, these drugs are known to cause serious side effects such as gastro toxicity and renal toxicity. Therefore, natural remedies such as *Curcuma longa* (turmeric) and *Channa striatus* (haruan) extracts should be seek as alternatives to these drugs as they are known to be safe and may have significant utility in the treatment of OA. The current work was done to see the ultrasound, radiograph and innervation changes after treatment with *Channa striatus and Curcuma longa.*

Osteoarthritis was induced on the right stifle joint of rabbits by transecting the anterior cruciate ligament. Rabbits were left for 8 weeks to develop OA prior to treatment. Rabbits were fed with *Channa striatus* and *Curcuma longa* extracts for 9 weeks, whereas the control group was left untreated. Radiograph and ultrasound were performed throughout the experiment. Synovial membrane biopsies were obtained upon euthanasia for immunohistochemistry staining.

Immunohistochemistry staining for PGP 9.5 immunoreactive fibres



Fig. 1 Normal: *Nerve fibres were found more in the subintimal layer of the synovial membrane*

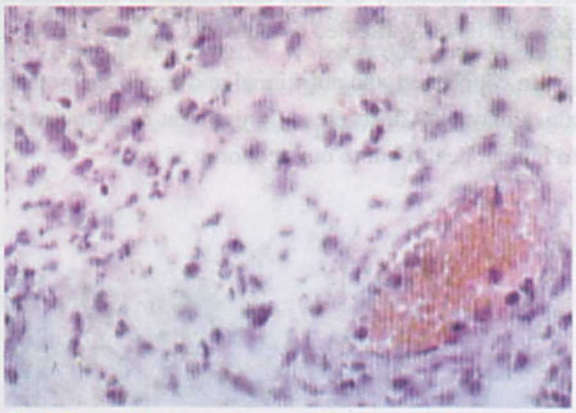


Fig. 2 Control: *No nerve fibres were found in the subintimal layer of the synovial membrane. However, it was heavy infiltrated with inflammatory cells*

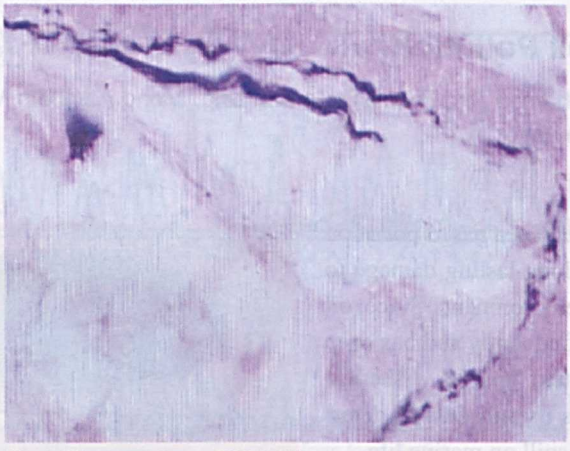


***Fig. 3 Channa striatus**: PGP 9.5 immunoreactivity in the sub-intimal layer was similar to that found in the normal synovial membrane*

Ultrasound could detect the development of OA as early as the 3rd week after induction of OA. The changes include narrowing of joint space and irregular bone surface in both control and treatment groups. Radiograph could detect changes only after the 7th week such as soft tissue swellings and reduction in joint space. In the treated groups, there were reductions of soft tissue swelling and new bone growth at the femoral condyle. The new bone formation can be also being observed clearly in the control groups. The innervations of the synovial membrane were studied using antisera against protein gene product 9.5 (PGP 9.5), which is a neuronal marker for sensory and motor nerve fibres. In the normal synovial membrane there was huge number of PGP 9.5- immunoreactive nerve fibres found. However, in the control group, there were no nerve fibres found. The synovial membrane obtained from the treated group showed remarkable change. PGP 9.5-immunoreactive nerve fibres were found in the intimal and subintimal layer of the synovial membrane. The number of nerve fibres found in the normal synovial membrane was more compared to treated group. However, the *Channa striatus* treated group the number of PGP 9.5- immunoreactive nerve fibres were more compared to the *Cucuma longa* treated groups.

The results showed that ultrasound is a better diagnostic tool for early detection of OA compared to radiograph. The increase in nerve fibres in the synovial membrane does indicate that the joint is healing. Therefore, *Channa striatus* extract can be a better possible alternative treatment for OA if compared to *Curcuma longa*, as it could reduce soft tissue swelling and increase the number of nerve fibres in the synovial membrane.

Reader Enquiry
Department of Veterinary Pathology and Microbiology
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8302
E-mail: shanti@vet.upm.edu.my

Bioindicator of Oil Pollution

Mohamed Shariff Bin Mohamed Din, Fennie Fong Kah Ling, Mohd Azmi Bin Mohd Lila and Raha Binti Abdul Rahman

Oil spill is the major cause of sea based pollution and it can lead to severe long-lasting damage to the marine and coastal environment. Since oil spill in the Straits occurs frequently and has been affecting coastal ecosystem marine fisheries, biomarkers could serve as useful tools to determine the impact of the oil spill on marine life.

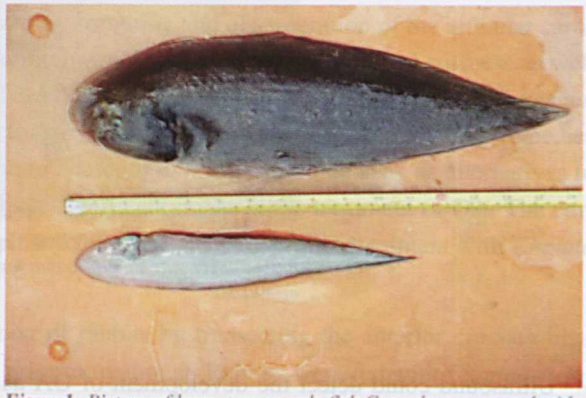


Figure1: Picture of large-tongue sole fish Cynoglossus macrolepidotus found in the Strait of Malacca

Though the effect of pollutant at the cellular and molecular level is not well documented, the study of carcinogenesis in fish has recently begun to gain considerable importance as a means of monitoring harmful substances in the environment. The presence of chemical pollutants such as polycyclic aromatic hydrocarbons (PAHs) had been implicated in the aetiology of carcinogenesis in fish liver. In animal exposed to chemical carcinogens, the most frequently detected oncogenes in tumours include the *ras* family of proto-oncogenes (Ha-*ras*, Ki-*ras*, and N-*ras*). *Ras* gene activation appears to be a common event of carcinogenesis in flatfish hepatic tumour.

The present study was undertaken to identify and analyse partial ki-*ras* proto-oncogene fragment amplified from the liver DNA of Malaysian flatfishes; the Malayan flounder (*Pseudorhombus malayanusi*) and the large-scale tongue sole (*Cynoglossus macrolepidotus*) collected from the Straits of Malacca. A polymerase chain reaction (PCR) product was obtained by using a designed (L6) and degenerated fish-specific (F0) primer set from the *ras* gene of Dab (*limanda-limanda*) from GeneBank.

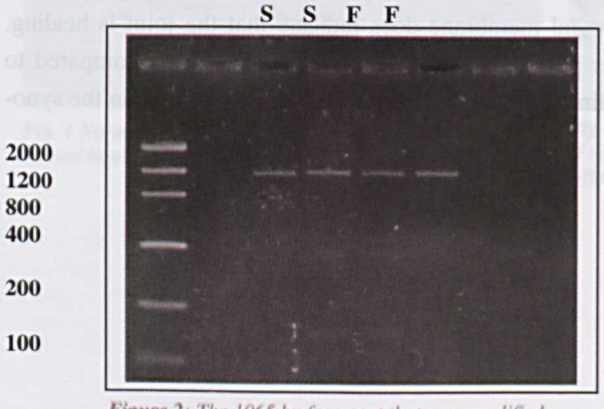


Figure 2: The 1065 bp fragment that was amplified using F0L6 primer set

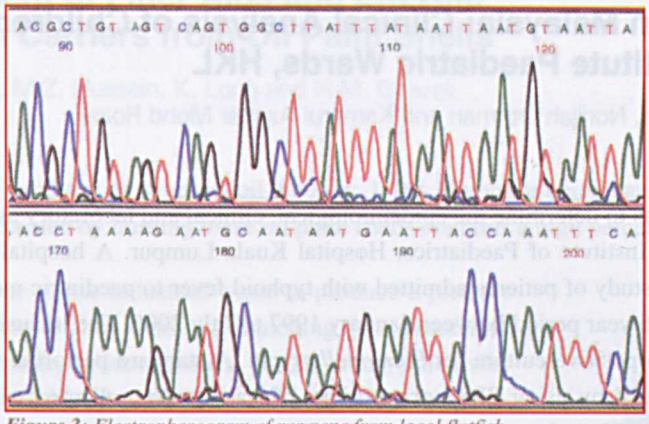


Figure 3: Electropherogram of ras gene from local flatfish

```
                    [GENETYX-MAC: Multiple Alignment]
                                                    12 13
Sample 1     1 NNNNNNNNNNNNNNNCTTGTAGTGGTGGGAGCTGGTGGCGTTGGCAAGAGCGCTCTTACC 60
Sample 2     1 NNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNNTGGTGGCGTTGGCAAGAGTGCCCTGACT 60
DAB          1 NNNNNNNNNNNNAAGCTTGTAGTGGTGGGAGCTGGTGGTGTTGGCAAGAGCGCACTTACC 60
European F1  1 ATGACAGAATATAAGTTGGTAGTGGTGGGAGCTGGTGGTGTTGGCAAGAGCGCACTTACC 60
European F2  1 ATGACCGAGTACAAGCTGGTGGTGGTGGGGGCTGGAGGTGTGGGGAAGAGCGCTCTCACC 60
European F3  1 ATGACGGAATATAAGCTGGTGGTGGTGGGAGCTGGAGGCGTGGGCAAGAGTGCACTCACC 60
English L    1 ATGACAGAATATAAGTTGGTAGTGGTGGGAGCTGGTGGCGTTGGCAAGAGCGCACTTACC 60
                ..... .. ..
```

***Figure4**: Comparative nucleotide sequence analysis of the fish Ki-ras proto-oncogenes from +1 to +60 of exon 1. The nucleotide sequences of Malayan flounder (Sample 1) and large-scale tongue sole (sample 2) are shown together with the corresponding DNA region of fishes for which sequence information is available. Changes at 3rd position of codon 12 & 13 were observed and it represent synonymous changes but unlikely to affect functions of p21 protein as glysine residues were produced and homology was 100% compared with partial ki-ras genes of other flatfishes. (N=non-identified nucleotide)*

The 1060 bp region of PCR product from the primers was amplified and used to determine the first exon of the ki-*ras* gene. The finding revealed that there was nucleotide difference at the third nucleotide of codon 12 and 13, however the amino acid residue was not changed. In the present study, the primer F0L6 worked well.

Reader Enquiry
Department of Veterinary Clinical Studies
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8286, 8948 8246
E-mail: shariff@vet.upm.edu.my

Typhoid Fever in Malaysia: Clinical Analysis of Children Admitted to Institute Paediatric Wards, HKL



Nelli Yohana Mohd Said, Norlijah Othman and Kamarul Azahar Mohd Rozali

The aim of this study was to determine the epidemiological, clinical and laboratory aspects of typhoid fever in children admitted to Institute of Paediatrics, Hospital Kuala Lumpur. A hospital-based cross-sectional design was used in this study of patients admitted with typhoid fever to paediatric medical wards, Hospital Kuala Lumpur over a 3.6 year period between January 1997 to July 2000. The inclusion criteria for typhoid patients were those with positive culture for *Salmonella typhi*. A standard performa was used for data collection. Data was analysed by using SPSS programme. 62 cases were collected within the study period. Both sexes were equally affected (male: female; 1:1). The age range was from 5 months to 12 years; two peak age distribution was observed (2 to 4 years and 7 to 12 years respectively). The ethnic breakdown was as follows: 39 Malays (62.9%), 13 Indians (21.0%), 3 Chinese (4.8%) and 5 others. All the patients had fever (100%) as presenting symptom. Other common symptoms were abdominal pain (88.7%), diarrhoea (79 %), vomiting (71%) and unproductive cough (66.1%). Abdominal tenderness (88.7%), hepatomegaly (71%) and splenomegaly (53.2%) were the leading clinical signs. Step ladder pattern of fever and rose spot were not observed in any of the patients. All patients had positive blood culture for *Salmonella typhi*. The Widal test results were as follows: 16 patients (25.8%) had titre of 100, 26 (41.91/o) had titre of 200 and the remaining (29%) had titre of above 200. 35 cases (56.4%) had anaernia, 17 (274%) had leucopenia and 13(21%) had thrombocytopenia on admission. Chloramphenicol was used in more than half of the patients. Clinical relapse occurred in 6 patients. 3 patients developed complications; 2 survived (bronchopneumonia and acute cholecystitis respectively) while one succumbed of disseminated intravascular coagulation (DIVC).

As a conclusion, children within 2 to 4 years and 7 to 12 years of age were most affected. Fever was observed in all patients. Abdominal pain, diarrhoea, vomiting and unproductive cough were other common presenting symptoms. The leading clinical signs were abdominal tenderness, hepatomegaly and splenomegaly. Widal Agglutination test result higher than 1/200 '0' titre should not be relied upon as diagnosis of typhoid fever. Typhoid fever appears to be a mild disease in the study population.

Reader Enquiry
Department of Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 2050 1005
E-mail: nor@medic.upm.edu.my

The Development of Filter Aids and Enzyme Immobilization Carriers from Oil Palm Shells



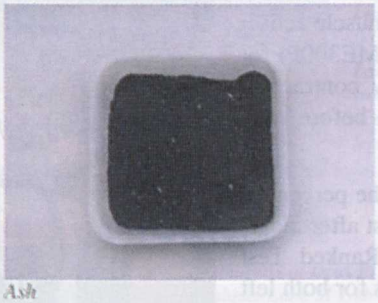
O.M. Lai, M. Shanthi, M.Z. Hussein, K. Long and H.M. Ghazali

Oil palm shells are by-products of the palm oil industry. It has low value and creates a waste disposal problem. The ash that is obtained by burning these oil palm shells contains a high percentage of silica.

This study was done to use industrial waste to produce a product that is of commercial importance. Currently, smelting quartz sand and alkali at a high temperature produces silica. In this study, silica was extracted from the ash of the oil palm shells by using a low temperature alkali extraction method. The silica will then be used to immobilize enzymes, where the activity of the immobilized enzyme will be tested and compared to commercial carriers. Silica will also be used in the treatment of used frying oil to remove free fatty acids (FFA). Removal of FFA will increase the life of the oil.



Oil palm shells



Ash



Silica

This study shows the potential of using silica extracted from oil palm shells ash by a low energy chemical method, to produce filter aids and enzyme carriers.

Reader Enquiry
Department of Biotechnology
Faculty of Food Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8347
E-mail: lom@fsb.upm.edu.my

The Influence of the Use of Document Holder on the Percentage Maximum Voluntary Contraction (MVC) on the Trapezius Muscle Activity Among Female Office Workers

Award Winner

Rosnan Hamzah, Norhasnizah Ahmad, Jefferelli Shamsul Bahrin and Nasaruddin Abdul Aziz

Video display terminal (VDT) use often result in trapezius muscle strain. This study hopes to determine whether the use of document holder will result in reduction of %MVC (Maximum Voluntary Contraction) that in turn will reduce localized muscle fatigue. Fifty female office workers from the Administrative Division of Universiti Putra Malaysia were selected through random sampling. Data for sociodemographic characteristics were collected using questionnaire Respondents where asked to type a prescribed standard text for 10 minutes. A computer workstation was arranged for this exercise. This exercise was to be repeated twice within duration of one week. The first exercise was done to simulate an individual current working method and the second exercise involved the use of document holder. The document holder was placed at the left side parallel to the VDT. Trapezius muscle activities were recorded using surface electromyography (EMG ME300P) for the whole duration of the exercise. Maximum voluntary contraction (MVC) was used as reference contraction and was taken before each test was conducted.



Document holder placed at the left side parallel to the monitor



Reduction in trapezius muscle activity reduces muscle strain and symptoms of neck and shoulder pain

Result shows that there was a significant reduction in the percent of maximum voluntary contraction (%MVC) in the second test after modification as compared to the first test. Wilcoxon Sum Ranked Test showed that the significant difference between the two tests for both left trapezius muscle (First Test: 36.69 %MVC, Second Test: 26.69 %MVC, $Z = -3.67$, $p < 0.001$) and right trapezius (First Test: 43.18 %MVC, Second Test: 33.44 %MVC, $Z = -3.49$ $p < 0.001$). Results indicate that while ensuring that the visual angle is less that 15 degrees and using a document holder, the muscle activity of trapezius muscle is reduced.

It can thus be concluded that the reduction in trapezius muscle activity will reduce muscle strain and symptoms of neck and shoulder pain.

Reader Enquiry
Department of Community Health
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

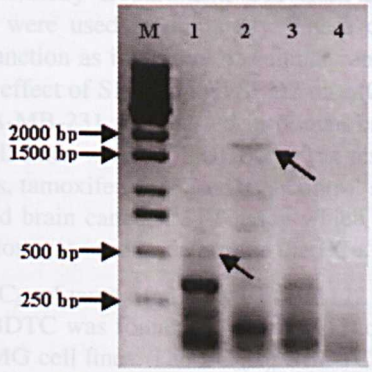
Tel: +603 8946 8532
E-mail: rosnan@putra.upm.edu.my

Development of a Non-Radioactive Diagnostic Method for Fragile X Syndrome



Rozita Rosli and Sharizah Alimat

Fragile X syndrome is the most common form of familial inherited cause of mental retardation, with an estimated prevalence of 1 in 2000 males and 1 in 4000 females. It is caused by the expansion of the CGG repeat in the FMR1 gene on the X chromosome. It takes its name from the appearance of the X chromosome that shows a fragile site close to the telomere at the end of the long arm of chromosome X (Xq 27.3). This syndrome is difficult to diagnose in infants and the physical features gradually accumulate with age. The common symptoms for Fragile X syndrome are learning difficulties, long face, large ears, flat feet, autistic-like behaviours and hyper-extensible joints. Macroorchidism is a common finding in post-pubescent of the affected individuals. The number of repeats varies in normal individuals as well as individuals with premutations and full mutations.



Lanes 1 and 2 contain DNA obtained from female suspected to have Fragile X (CGG> 50 repeats).

Lane 3 contains DNA (CGG < 5 repeats) from female control.

Lane 4 contains a negative control (non-template control). Black arrows indicate the higher molecular weight expansion bands

***Figure a**: PCR analysis of DNA in suspected Fragile X syndrome individuals Lane M 1 kb ladder*

In this study, a molecular diagnosis method for Fragile X syndrome was optimised in which Polymerase Chain Reaction (PCR) was utilized. In Malaysia, due to the lack of awareness of this syndrome, many are misdiagnosed or undiagnosed. Thus, there is a need for a diagnostic method to be established in Malaysia since the cost is high for tests sent overseas.

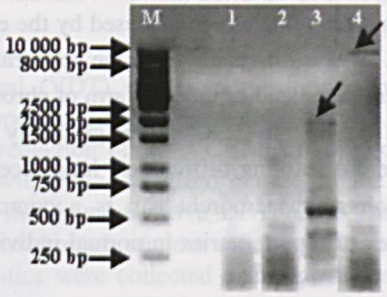


*The **M1 lane** contains 100bp DNA ladder. PCR was performed using DNA from a known positive Fragile X male (**lane 1**), **lane 2** contains a normal person (CGG> 50 repeats) and **lanes 3** and **4** contains two suspected Fragile X male, (CGG < 200 repeats). **Lane** M, 1 kb ladder.*

Black arrows indicate the higher molecular weight bands as a result of expansion due to Fragile X syndrome

***Figure b**: PCR amplification the Fragile X region*

This research was helpful in understanding this syndrome and in developing a clinically useful, rapid and non-radioactive molecular diagnosis of Fragile X syndrome. Additional work on understanding the function of the FMR1 gene in humans in the hopes of developing Fragile X treatment are currently underway including using the proteomics approach.



Lane M, 1 kb DNA ladder.

Lane 1, negative control (non template control).

Lane 2, normal individual (CGG< 50 repeats).

Lanes 3 and 4, show distinct bands, arrows at approximately 2000bp and 9000 bp, respectively, represent full mutation allele (more than 200 CGG repeats)

Figure c: Detection of Fragile X suspected using PCR analysis

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8480
E-mail: rozita@medic.upm.edu.my

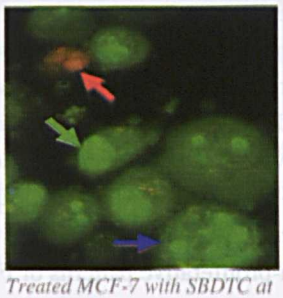
The Effect of Selected Synthetic Compounds On the Expression of Oncogenes in Human Breast Cancer and Human Malignant Glioma Cell Lines *In Vitro*

Award Winner

Rozita Rosli, Cheah Pike See, Shaban Awidat, Nurmawati Syakroni, Norshariza Nordin, Karen Crouse and Peter Pook

An effective low dose of synthetic compounds is essential in conducting clinical studies in the treatment of human breast cancer and brain cancer.

Thus, an investigation of the cytotoxic effects of selected synthetic compounds on human breast cancer cell lines and human malignant glioma cell lines were carried out. Three dithiocarbazone derivatives, namely SBDTC, SBD2 and SMDB-cd which were synthesized in-house at the Chemistry Department, Universiti Putra Malaysia were used in this study. These compounds function as inhibitors of cellular replication. The effect of SBDTC and SBD2 on MCF-7 and MDA-MB-231 were tested in human breast cancer cell lines whereas SMDB-cd was tested on A172 and U87MG human glioblastoma cell lines. In both cases, tamoxifen was used as a control since it is the current drug of choice for the treatment of breast cancer and brain cancer. MTT assay which is a rapid and sensitive assay for measuring cell survival and proliferation was used to determine the EC_{50} of treated cell lines.



Treated MCF-7 with SBDTC at EC_{50}

*The **red** arrow shows a necrotic cell. The red colour was produced by PI stain which penetrated into the nuclear matter when the cell membrane integrity was disturbed.*

*The **green** arrow shows a healthy cell.*

*The **blue** arrow shows an apoptotic cell with fragmented nucleus and condensed chromatin*

The EC_{50} of tamoxifen on MCF-7, A172 and U87MG were at 5.5µg/ml, 7.5µg/ml and 5.0µg/ml respectively. SBDTC was found to be cytotoxic towards the MCF-7 cell line and SMDB-cd against both A172 and U87MG cell lines. The EC_{50} of SBDTC on MCF-7 was 6.62µg/ml whereas the EC_{50} of SMDB-cd on A172 and U87MG were 0.7µg/ml and 0.2µg/ml respectively. In addition, the mode of cell death was evaluated using DNA laddering and acridine orange and propidium iodide staining (AO/PI). The effect of the compounds towards the cell lines was also studied by monitoring the expression of *c-fos*, *c-myc*, *c-erbB-2* and *bcl-2* oncogenes in MCF-7 and MDA-MB-231. The expression of *Epidermal Growth Factor Receptor (EGFR)* and *Mouse Double Minute 2 (MDM2)* genes in A172 and U87MG cell lines were also performed. Ribonucleic acid (RNA) from the treated and untreated cells was extracted and reverse transcribed into complementary deoxyribonucleic acid (cDNA) before subjecting to PCR. The expression of *c-erbB-2* and *c-fos* were suppressed in MCF-7 cell lines at 6.62µg/ml and 2.00µg/ml respectively. In addition, *EGFR* and *MDM2* were suppressed in both A172 and U87MG.

Further work on elucidating the mechanisms of action at the molecular level is being carried out.

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8480
E-mail: rozita@medic.upm.edu.my

Cytotoxicity and Apoptosis Induction Potential of Flavokawin B in Tumour and Transformed Normal Cell Lines



Rozita Rosli, Nasir Umar-Tsafe, Habsah Mohammed, Nordin Haji Lajis, Mohamed Saifulaman Mohamed-Said and Leslie Charles Lai

Flavokawin B is a hydroxychalcone isolated from a local plant species, *Alpinia zerumbet* of the Zingiberaceae family. It has been shown to have anti-oxidant properties. The aim of this study was to assess the cytotoxic and apoptotic effects of Flavokawin B on 12 human tumour, 1 transformed normal human and 2 transformed normal animal cell lines. Flavokawin B (0.1 - 100 μM) was used to treat the cell lines. Over a standard 3 to 4 days' exposure, Flavokawin B inhibited the growth of all these cell lines. MTT cytotoxicity screening assay was then conducted in order to assess the cytotoxic-indices of Flavokawin B. Caco-2, CEM-SS, MCF-7, T-47D and U87MG were found to be the five most sensitive cell lines, with IC_{50} values of 6.53 ± 0.81, 2.00 ± 0.41, 7.67 ± 0.71, 8.67 ± 1.40 and 14.00 ± 3.00 μM respectively. Dose-response and time-course anti-proliferative patterns of Flavokawin B, using trypan-blue viability exclusion, were then established for these 5 cell lines. Apoptosis induction was then assessed first by life-culture monitoring for the classical nuclear condensation and cell-blebbing in all 15 cell lines. Nucleoprotein fluorescence analysis was then carried out to establish the apoptotic frequencies of all the 15 cell lines, using acridine orange and propidium iodide inclusion/exclusion. Combined image captures of fluorescein isothiocyanate and tetramethyl rhodamine isothiocyanate fluorescence spectra were used to analyse the apoptotic effects. Five of the 15 cell lines were found to significantly induce apoptosis at the frequencies of 70.67 ± 7.51 %, 68.17± 6.81 %, 57.5 ± 4.82 %, 52.83 ± 3.62 % and 49.33 ± 7.32 %, for Caov-3, CEM-SS, CHO, HL-60 and MDA-MB-468, respectively, with the maximal apoptotic frequency effect on the human ovarian carcinoma cell line (Caov-3). All the significant apoptosis results were then confirmed by agarose gel electrophoresis looking for the presence of DNA-laddering, which is the classical hallmark of apoptosis.

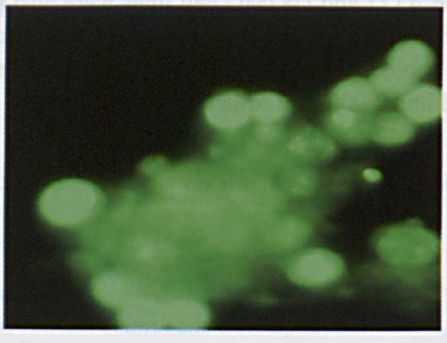


Plate 1. *A clump of Flavokawin B treated Caov-3 cells (50 mM, 96h, 40X, FITC spectrum), showing only viable and apoptotic cells*

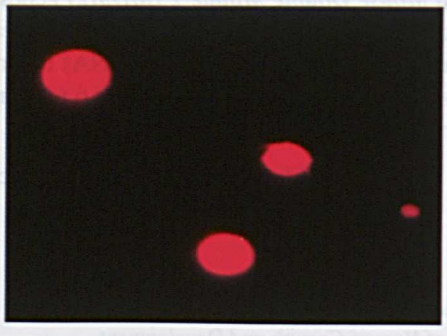


Plate 2. *Flavokawin B treated Flavokawin B treated Caov-3 cells (50 mM, 96h, 40X, using TRITC spectrum) showing only the necrotic cells*

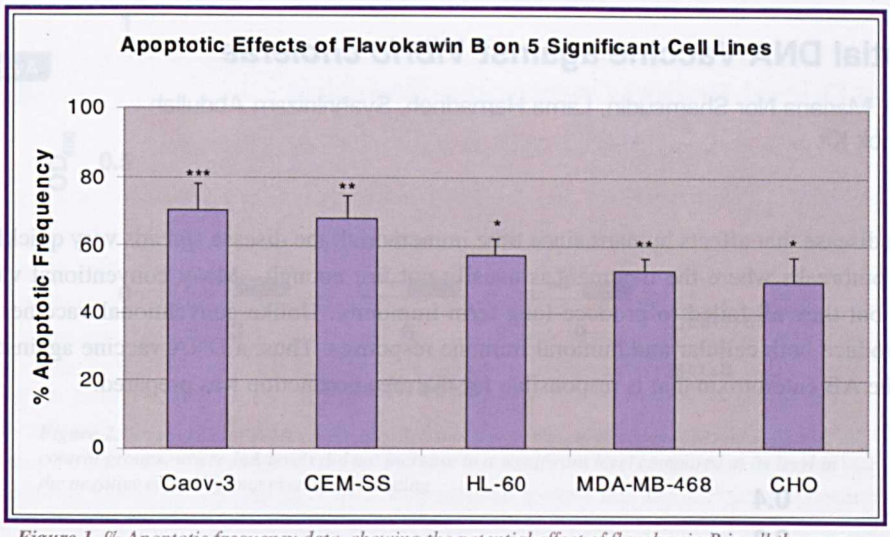


*Figure 1. % Apoptotic frequency data, showing the potential effect of flavokawin B in all the apoptotic-sensitive cell lines with ≥ 50 % induction frequency counted per 500 total cells. Statistical significance were tested using One-way ANOVA (*P < 0.05; **P < 0.01; ***P < 0.001)*

In conclusion, the cytotoxic and apoptotic effects of Flavokawin B make it potentially an interesting antineoplastic agent.

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8480
E-mail: rozita@medic.upm.edu.my

A Potential DNA Vaccine against *Vibrio cholerae*



Rozita Rosli, Mariana Nor Shamsudin, Lama Hamadneh, Syahrilnizam Abdullah and Hon Sook Kit

Cholera is a disease that affects humans since time immemorial; the disease spreads very quickly especially in times of outbreaks where the treatment is usually not fast enough. Many conventional vaccines have been tested but they all failed to produce long-term immunity. Unlike conventional vaccines, DNA vaccines can produce both cellular and humoral immune responses. Thus, a DNA vaccine against the subunit toxin B of the AB enterotoxin that is responsible for diarrhea production was prepared.

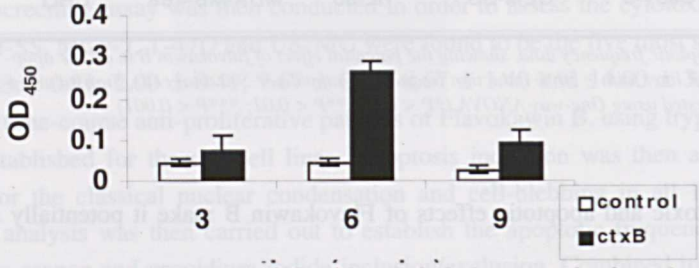


Figure 1: IgG antibody levels after 3, 6 and 9 weeks for both vaccinated and negative control groups. IgG level increased after 6 weeks to a significant level but declined after the second booster injection

The gene for subunit toxin B was chosen as a candidate antigen for the vaccine because it facilitates the entry of the A subunit to the cells but it is does not have any enterotoxic activity and at the same time it is immunogenic. Initially, genomic DNA from several local clinical isolates of *Vibrio cholerae* were screened for the ctxB gene[(1)]. The gene was then cloned in pVax1 vector and was successfully expressed *in vitro* using the eukaryotic COS-7 cell line[(2)]. Next, the potential vaccine (pVax/ctxB) and the negative control (pVax1) were tested *in vivo* using Balb/c mice. The mice were intramuscularly injected with either the pVax/ctxB vaccine construct or pVax1 as the negative control. In the first vaccinated group, two injections were given spaced 3 weeks apart, while the second group was given three injections spaced 3 weeks apart. Subsequently, the mice were challenged with clinical isolates of *V. cholerae* after 3 weeks. Antibody titre levels for both IgG and serum IgA were monitored using ELISA, and showed high production of IgG after the first booster injection with no significant change of IgA levels. However, after the second booster injection, the titre levels for both IgG and IgA declined. This was accompanied by the death of 2 mice in the first vaccinated group, and all the mice in the control group after the bacterial challenge. In the second group, none of the mice survived in both vaccinated and control groups.

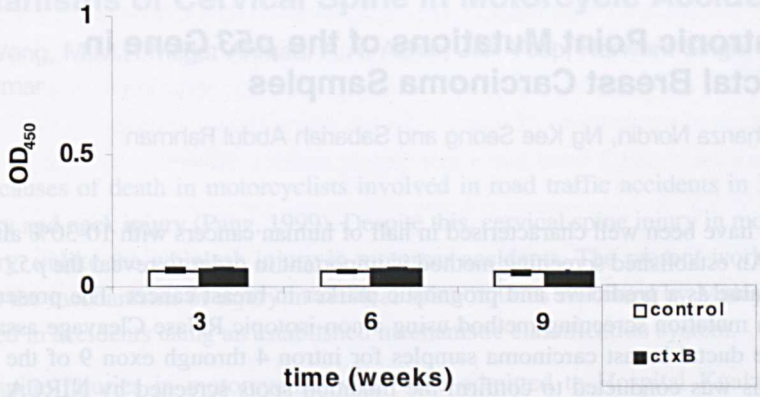


Figure 2: Serum IgA antibody levels after 3, 6 and 9 weeks for both vaccinated and negative control groups, where IgA levels did not increase to a significant level compared to its level in the negative control group even after boosting

With this partial protection obtained using intramuscular injection, current work is focussed on developing the DNA vaccine to be delivered through the oral route.

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

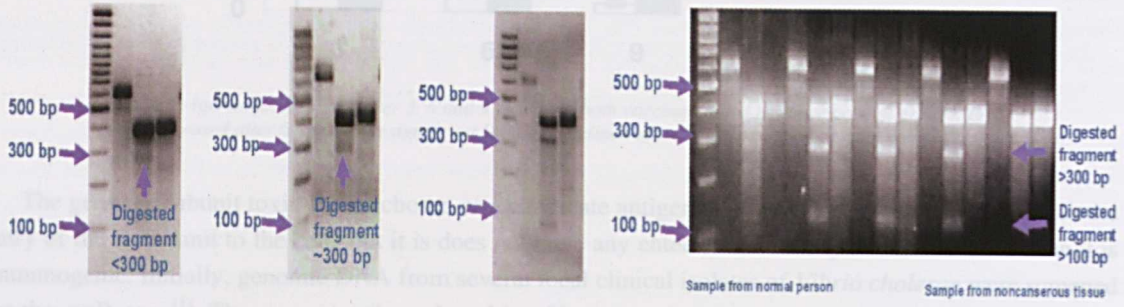
Tel: +603 8946 8480
E-mail: rozita@medic.upm.edu.my

Exclusive Intronic Point Mutations of the *p53* Gene in Invasive Ductal Breast Carcinoma Samples



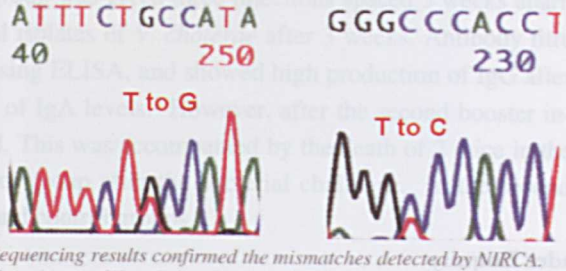
Rozita Rosli, Norshariza Nordin, Ng Kee Seong and Sabariah Abdul Rahman

Alterations of *p53* have been well characterised in half of human cancers with 10-30% alterations in breast carcinoma cases. An established screening method is important in order to reveal the *p53* mutation patterns to strengthen its value as a predictive and prognostic marker in breast cancer. The present study has managed to establish a mutation screening method using a non-isotopic RNase Cleavage assay (NIRCA) from thirty-one invasive ductal breast carcinoma samples for intron 4 through exon 9 of the *p53* gene. DNA sequencing analysis was conducted to confirm the mutation spots screened by NIRCA. Interestingly, all samples investigated showed intronic alterations with no mutation detected in the mutation hotspots of exons 5-8. Two intronic mutation hot spots were identified in the samples. Five samples have a transversion of T to G at nucleotide 2702 and ten have a transition of T to C at nucleotide 2682. Another sixteen samples have two alterations, among which four samples have a transition of T to C at nucleotide 2682 with a deletion of G at nucleotide 2470, and twelve samples have transitions of T to C and transversions of T to G at nucleotide 2682 and 2702, respectively. These two alterations would indicate polymorphisms for intron 7 in the *p53* for breast cancer.



RNAse Digestion: The smaller fragments (<300 bp, ~300bp, 100 bp) indicate the digested fragments after digestion of RNA heteroduplex with RNAse

This revelation of the polymorphism patterns may be significant in understanding the biology of breast cancer, especially among the Malaysian population.



Sequencing results confirmed the mismatches detected by NIRCA. Transitions of T to C at nucleotide 2682 and transversions of T to G at nucleotide 2702 were identified in samples with fragments >100 bp, ~300 bp and <300 bp. The circles show the double peaks for the mismatches indicating that the samples used were heterozygous samples

Reader Enquiry
Department of Human Growth and Development
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8480
E-mail: rozita@medic.upm.edu.my

Injury Mechanisms of Cervical Spine in Motorcycle Accidents

S.S. Ooi, S. V. Wong, M.M.H Megat Ahmad, A.A. Azhar, J.S. Yeap, Harwant Singh and R.S. Radin Umar

The three major causes of death in motorcyclists involved in road traffic accidents in Malaysia are head injury, chest injury and neck injury (Pang, 1999). Despite this, cervical spine injury in motorcyclists is not a well-studied injury, unlike the whiplash injury in motorcar accidents. The present work focuses on retrospective study on the mechanisms of injury in cervical spine injuries sustained by Malaysian motorcyclists who were involved in accidents using an established mechanistic classification system.

All cervical spine injuries in motorcyclists who were admitted to Hospital Kuala Lumpur between January 1, 2000 and December 31, 2001 were included in the study. Based on the medical notes, radiological investigations (X-rays, CT and MRI scans), patient interviews and police reports, the mechanism of injuries were formulated using the classification. The authors also recorded the Abbreviated Injury Score (AIS) for each patient.

Throughout the period of study in the orthopaedic wads of General Hospital Kuala Lumpur, there were 70 patients successfully identified as sustaining cervical injury and admitted to the orthopaedics' wad under MVA (Motor Vehicle Accident) category. Apart from that, 45.7% of the medical records have successfully been traced and identified as motorcyclists, who sustained injuries from road accident. As the data collected from 32 medical reports, 96.97% of them have record of neither neck injury history nor diseases, which associate with bone deformities. 72.7% of the victims were aged 16 to 29.

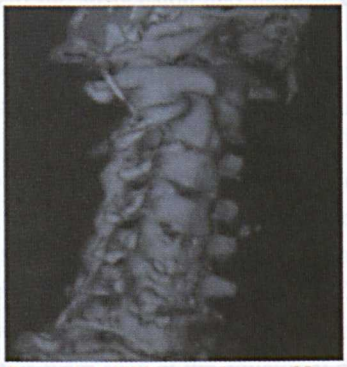


Figure 1: A MRI image showing C5-C6 subluxation

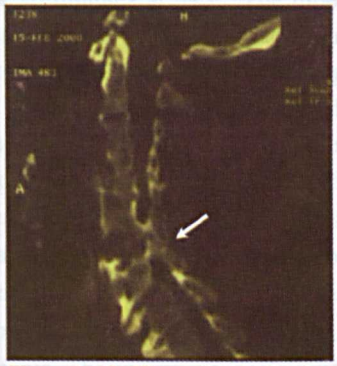


Figure 2: 3D CT scan image showing a compression fracture at C5, C6 and C7 cervical bones

32 motorcyclists sustained 44 fractures and 18 dislocations to the cervical spine during the study period. The distribution of the fractures was one C1, three C2, two C3, eight C4, eleven C5, eleven C6 and eight C7 fractures. The distribution of the dislocations was one C1-C2, three C2-C3, two C3-C4, two C4-C5, six C5-C6 and four C6-C7 dislocations. Thus, the C5 and C6 spine and their junction accounted for 45.2% of all the injury. In terms of mechanisms of injuries, 5 were lateral flexion injuries, 17 flexion injuries, 9 axial compressions, 5 extension and 3 were horizontal impact injuries. However, most of the injuries were the result of two or more forces.

Three patients had an AIS score of one, 17 patients a score of two, 7 had a score of 3, 1 had a score of 4 and 5 had a score of 5. Thus 18.2% of the patients also have other life threatening injuries. AIS score with 2 and above should be categorized as major injury, and AIS score with 4 and above should be categorized as severe injury since they caused neurological problems and bring threat to life.

The C5, C6 and the intervertebra joint between C5-C6 were the most frequently injured location sustained by motorcyclists, which constituting about 45.16% of all the injury frequency location and the flexion and axial compression were the most frequent mechanisms, in which the motorcyclists faced with in road crashes. With an improved understanding of the mechanisms of injury, steps can now be taken to help reduce the incidence and severity of cervical spine injuries to motorcyclists.

Reader Enquiry
Department of Mechanical and Manufacturing
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

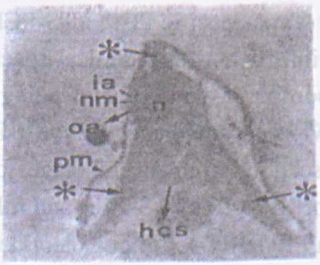
Tel: +603 8946 6339
E-mail: wongsv@eng.upm.edu.my

A Simple Method to Isolate the Outer Acrosomal Membranes of Paddy Rat Spermatozoa

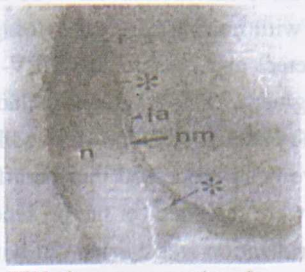
AwardWinner

S.Sukardi and M.S. Wang

Acrosomal exocytosis is an event preceding fertilization and this process needs an influx of calcium. Studies have shown the presence of calcium-binding proteins in the outer acrosomal membrane (OAM) of spermatozoa with a paddle-shaped head e.g., ram.



TEM of transverse section of Spermatozoa head



TEM of transverse section of Spermatozoa head (no OAM)



Pure acrosomal pellet showing electron dense acrosomal vesicles

We report here a technique to isolate the OAMs of paddy rat spermatozoa, which has a falciform head. The OAM from the cauda epididymal sperm was extracted using a non-cationic surfactant Benzethenium chloride (Hyamine 1622). The sperm was prepared by cooling and then spinning to remove debris. Hyamine was added to the suspension and incubated for 90 minutes at 39^{0}C. The tubes were agitated intermittently to aid in loosening the membranes. The tubes were then spun slowly to sediment the heads and float the outer acrosomal membranes. The supernantant collected was further centrifuged on a two layer discontinuous sucrose gradients. There were four bands obtained after centrifugation, the acrosomal fragments are located in the third band. This band was further ultracentrifuged to pellet the fragments. Transmission electron microscopy procedures were carried out to see the ultrastructure of the sperm before hyamine treatment, the acrosomal fraction and the resulting sperm pellet. The washed sperm before hyamine treatment still contained the plasma membranes (PM) and the outer acrosomal membranes (OAM). The acrosomal pellets showed vesicles and fragments of OAM arranged in sheets or clusters while the sperm pellet showed loss of both PM and OAM leaving the inner acrosomal membranes and the separation of both membranes were seen at the equatorial segments. The sperm suspension was also stained with Giemsa to see presence of the OAM. Approximately 70% of the spermatozoa not treated with Hyamine still have their OAM intact while 90% of spermatozoa treated with Hyamine have only equatorial segment staining denoting the loss of the OAM. The acrosomal pellet showed dense Giemsa staining.

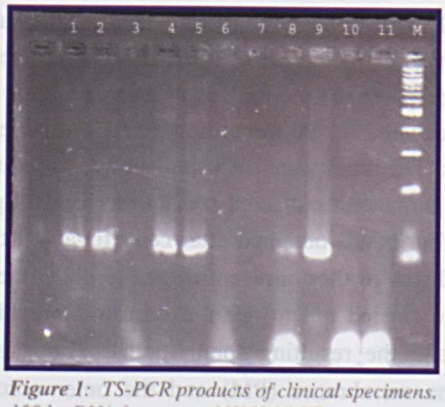
Reader Enquiry
Department of Biomedical Science
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8461
E-mail: sabrina@medic.upm.edu.my

Detection of Human Papilloma Virus Type 16 in Cervical Intraepithelial Neoplasia and Invasive Carcinoma using type specific Polymerase Chain Reaction and Dot Blot Hybridisation



Sabariah A.R, Nor Rizan K., Abd Manaf A., Khatijah M.Y., and Siti Aishah M.A

Human papillomavirus type 16 (HPV-16) is known to cause cervical inflammatory changes, cellular atypia, intraepithelial neoplasia (CIN) and invasive carcinoma. HPV-16 is the most common genital HPV and is found in up to 45% of young women with normal cervical cytology. Type-specific PCR (TS-PCR) and dot-blot hybridization were used to detect and confirm the HPV-16 infection within clinical specimens. The TS-PCR used targets a 100 bp fragment. This fragment include portion of the E7 open reading frame (ORF) of HPV-16, those identical to the patterns of CaSki-derived HPV-16 (positive control). All 10 clinical specimens are biopsies, which have been processed into paraffin sections from several stages of CIN and also invasive carcinoma, and they were screened for the presence of HPV-16 by TS-PCR and followed by dot-blot hybridization. Dot-blot hibridization was carried out with a PROHPV-E7 oligonicleotide probe for confident detection of the physical status of HPV-16 DNA in the clinical specimens.

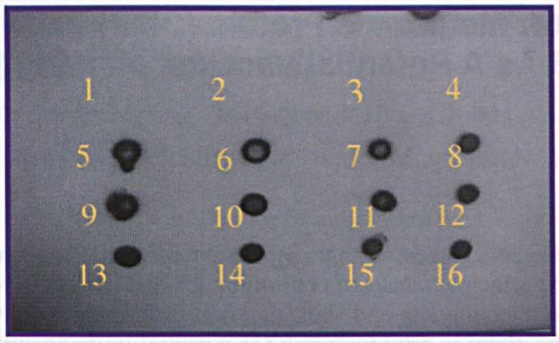


***Lane 0**: Negative control (reagents without DNA);*
***Lane 1**: Positive control (CaSki DNA);*
***Lane 2, 4, 5, 8** and **9**: Clinical samples were positive for HPV-16-E7;*

***Lane 3, 6, 7, 10** and **Lane 11**: Clinical samples were negative for HPV-16-E7.*

***Lane M**: 100 bp ladder.*

Figure 1: TS-PCR products of clinical specimens. 3% Metaphor gel with 100 bp DNA fragment of HPV-16-E7



Spots 1 and 2: Negative control (without DNA),

Spots 3 and 4: Negative TS-PCR products,

Spots 5 and 6: Positive control (CaSki DNA),

Spots 7 and 8: Clinical sample no. 2,

Spots 9 and 10: Clinical sample no. 4,

Figure 2. A representative of dot blot hybridization of the TS-PCR products with specific probe PROHPV16-E7

The results indicate that TS-PCR is a rapid, sensitive and reliable detection method for HPV-16.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8501
E-mail: sab@medic.upm.edu.my

A Study on 33kilodalton Outer Membrane Protein (OMP) of *Pasteurella Multocida* 6:B As A Potential Vaccine Candidate



Saharee A.A., Z.A.Zamirah,M. Ramlan, N. Muniandy, M. Zamri-Saad and C.T.N.I. Fatimah

Pasteurella multocida 6:B is the causative agent of haemorrhagic septicaemia (HS), a frequently fatal disease of cattle and buffalo. Vaccination is the principal means of controlling the disease. However, problems such as thick consistency, local reaction to injection site and short duration of immunity delivered by the present vaccine are still encountered. Hence, there is need to search for potential immunogen to be developed into better subunit vaccine. The 33kiloDalton (kDa) OMP could be an excellent candidate for subunit vaccine since it is the major protein band of crude OMP (Figure 1, arrow). Hence, the objectives are (a) to isolate and purify and, (b) to characterise it, to enable us to study its potentiality.

The 33kDa OMP was purified from the crude extract using modified cylindrical preparative SDS-PAGE (Figure 2). The 33kDa OMP band on the cylindrical SDS-PAGE gel (Figure 3, arrow), was excised and the protein was eluted out from the excised gel.

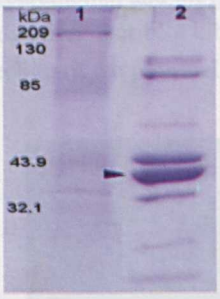


Figure 1

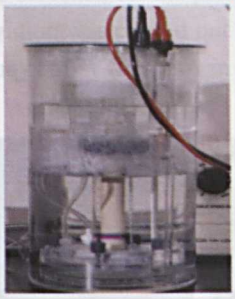


Figure 2

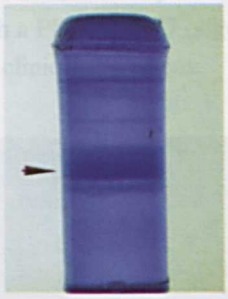


Figure 3

Protection studies such as active protection study; passive immunisation and also bactericidal assay were conducted to determine the potentiality of the 33kDa OMP in conferring protection against challenge with *P. multocida* 6:B. However, the results obtained from these studies showed that the 33kDa OMP conferred low protection capacity against challenge with live *P. multocida* 6:B in mice.

The 33kDa OMP was subsequently submitted for amino acid sequencing and composition analysis. The first six residues of 33kDa OMP are alanine (A)- threonine (T)- valine (V)- tyrosine (Y)- asparigine (N) and glutamine (Q). For the composition analysis, the protein comprised 18.64% acidic, 13.7% basic and 26.33% hydrophobic residues. The overall amino acid composition was similar to protein H, the major OMP of *P. multocida,* which was previously described as pore protein of Gram-negative bacteria, or simply known as porin.

From the findings above, it could be concluded that the 33kDa OMP of *P. multocida* 6:B is not protective, therefore making it unsuitable for a vaccine candidate. However, more studies on characterisation of this OMP need to be carried out before concluding that this protein is a porin of *P. multocida* 6:B.

Reader Enquiry
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6032
E-mail: abdaziz@vet.upm.edu.my

Antibiotic - Fed Chickens – Increase In Antibiotic Resistant *Escherichia Coli?*

AwardWinner

Saleha, A.A, Tin Tin Myaing, Ganapathy, K.K. and Zulkifli, I

Each year, more than 8.5 million kg of antibiotics are fed to cattle, pigs and chickens. At the same time, studies observed a steady and alarming increase in infections in man not responding to these same antibiotics.

The objective of this study was to compare the occurrence of antibiotic resistant *Escherichia coli* isolates in chickens given feeds supplemented with antibiotics (flocks A, B, C) and without antibiotic (flock D) at one-day-old to slaughter age.

The *E. coli* isolates were then subjected to antibiotic susceptibility test against twelve antibiotics, namely cephalaxin (Cx), cepahalothin (Ce), chloramphenicol (Ch), ciprofloxacin (Ci), enrofloxacin (En), nalidixic acid (Na), neomycin (Ne), novobiocin (Nv), streptomycin (St), tetracycline (Te), trimethoprim (Tr) and vancomycin (Va).

The results on the resistance of *E. coli* isolates to these antibiotics are as shown in the table below:

Flock	Age	No. of *E.coli* isolates	Resistance of *E. coli* to antibiotics	Range of no. of antibiotics *E.coli* isolates resistant to (highest % of resistance)
A	One-day-old	36	100% to Nv, Va; to 10 other antibiotics = 0% (Ce) – 92%	4-10 (18% to 9 antibiotics)
	21-dayold	50	100% to Cx, St, Te, Tr, Va; to 6 other antibiotics = 72 – 98%	9-12 (58% to12 antibiotics)
	42-day-old	50	100% to Na, Te, Tr; to 9 other antibiotics = 58 – 98%	8-12 (44% to 12 antibiotics)
B	One-day-old	28	100% to Va; to 11 other antibiotics = 0% (Ce) – 98%	3 - 9 (18% to 5 antibiotics)
	21-dayold	50	!00% to Ne, Na, Te, Va; to 8 other antibiotic =, 60 – 98%	6-12 (30% to 12 antibiotics)
	42-day-old	50	!00% to Na; to 11 other antibiotics = 72–98%	5-12 (30% to 12 antibiotics)
C	One-day-old	1	None	0
	21-dayold	50	94% to Na; to 11 other antibiotics = 34–92%	2, 5-12 (34% to 12 antibiotics)
	42-day-old	50	100% to Va; to 11 other antibiotics = 60–98%	5-12 (32% to 12 antibiotics)
D	One-day-old	42	93% to Na; to 11 other antibiotics = 17–90%	2-3, 5-11 (26% to 6 antibiotics)
	21-dayold	50	84% to Te; to 11 other antibiotics = 2– 82%	1-10 (30% to 6 antibiotics)
	42-day-old	50	100% to Na, Va; to 11 other antibiotics = 12–96%	3-11(24% to 7 antibiotics)

Samples of feed and water in flock D were tested and found antibiotic resistant coliforms

The study suggested that colonization by antibiotic resistant *E. coli* in chickens may not only result through antibiotic supplements given in the feed but also from acquisition of these organisms in the environment, such as the hatcheries environment, through handling, during transportation and the farms environment.

It also appeared that *E. coli* isolated from flocks given commercial feed with antibiotics showed higher percentage of resistant bacteria as well as the probability of these bacteria acquiring resistance to more antibiotics than chickens given feed without antibiotics.

These *E. coli* may transfer their antibiotic resistance to other bacteria in the gastrointestinal tract – the great concern is over the transfer of antibiotic resistance to food borne enteropathogens, in particular those of public health importance.

Detailed studies are required to further investigate these findings.

Reader Enquiry
Faculty of Veterinary Medicine
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6032
E-mail: abdaziz@vet.upm.edu.my

Pathogenesis of Hepatitis B Virus Infection and Hepatocellular Carcinoma

Seow Heng Fong

Hepatitis B virus (HBV) causes acute and/or chronic hepatitis and is associated with hepatocellular carcinoma (HCC). It is still a major public health problem with currently 300 million HBV carriers worldwide. The objectives of our project are to determine the hepatitis B virus variants in our local population and to establish an *in vitro* infection system for this virus. The establishment of an *in vitro* cell culture system for HBV infection is very important because it is an essential tool for the development of new antiviral strategies against hepatitis B virus infection and for studying the molecular events in viral replication. Historically, the major obstacle in the study of HBV has been the inability to infect animal model system due to strict virus-host range. It has been suggested that the tissue and species specificity of HBV infection may be due to the preferential attachment of the HBV envelope proteins onto the plasma membrane of human hepatocytes that lead to viral entry and replication. Many potential cellular receptors have been shown to interact directly or indirectly with the viral envelope proteins. As there are a high number of cases of hepatitis B virus positive hepatocellular carcinoma, it is important to study the changes in immune response in tumour immunity.

This study has allowed the use of a cell culture system to study the cellular changes following hepatitis B virus infection. Therapeutic targets blocking the signals transduced by the virus could be potential drugs for the treatment of chronic hepatitis B. The initial effects of the hepatitis B virus antigens, HBX and HbeAg expression on cell lines have been investigated.

The determination of the hepatitis B virus nucleotide sequence has important implications for vaccination and therapeutic strategies. This study has given us the tool to further investigate cellular aberrations of hepatitis B virus infection. The role of hepatitis B virus in the development of the complication of this liver disease needs to be studied.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8511
E-mail: shf@medic.upm.edu.my

Mechanisms of Disease and Drug Resistance in Leukaemia

Seow Heng Fong and Maha Abdullah

Leukaemia is a type of malignancy that involves a series of white blood cells, which show varied sensitivity to conventional chemotherapeutic regimes. Malignancy may arise from the failure of a cell to undergo apoptotic cell death or proliferation. The reason for tumour growth could be due to an imbalance of cell proliferation and death. The objective of this project is to study to whether there is a dysregulation of the apoptotic pathway and cytokine expression in leukaemia, the reasons for occurrence of relapse and resistance to chemotherapeutic drugs

The technique of immunophenotyping, cell cycle and apoptosis by flow cytometery was established. The results indicate that the cells were expressing a number of cytokines and anti-apoptotic and pro-apoptotic molecules such as bcl-2 and bax, respectively. Some of the cells in culture undergo cell death spontaneously and others survive. The reasons are unclear and currently being investigated. Studies are currently underway to determine the profile of gene and protein expression of blasts from patients at initial diagnosis, at relapse and resistance to chemotherapeutic drugs.

This study gives more knowledge of useful prognostic markers for diagnostic purposes and mechanisms involved in survival of cancer cells as well as resistance to chemotherapeutic drugs. It gives us a better insight to tumour immunopathogenesis and drug resistance. This is important, as it will help in the design of new therapeutic strategies in the future. In addition, we can apply the *in vitro* bioassay to test chemosensitivity of the cancer cells from patients for the selection of appropriate chemotherapeutic drugs. These tests are useful for the clinical management of patients.

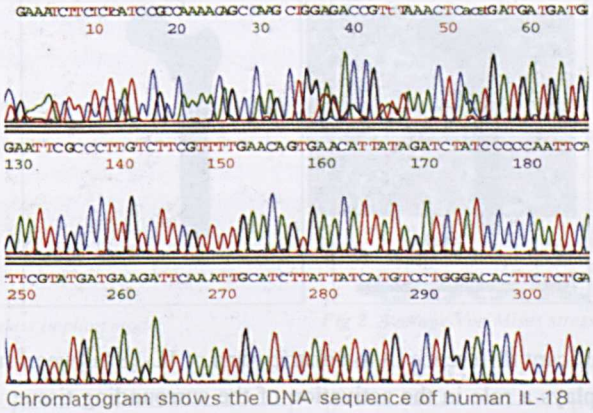
Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8511
E-mail: shf@medic.upm.edu.my

Cytokines: Potential Products for New Generation Vaccine and Gene Therapy



Seow Heng Fong, Chia Chok Seng, Kechen Ban, Harjit Singh and Hairuszah Ithnin

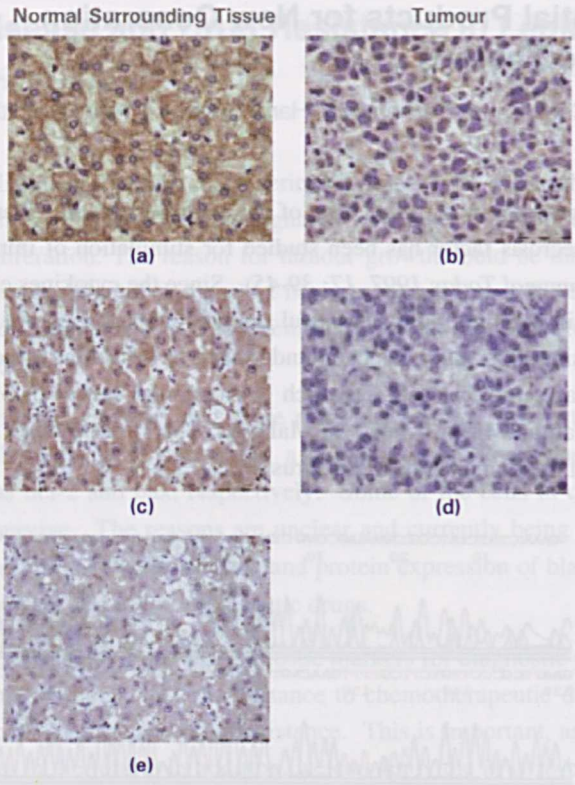
Cytokines play an important role in the regulation of the immune system. Many cytokines such as IL-2, interferon-γ and tumour necrosis factor has been studied for stimulation of immune responses against tumours (*Musiani et al., Timmunol Today 1997, 17: 39-45*). Since the cytokines expressed at the tumour site may play important roles in determining a successful immune response against tumours as well as cancer pathogenesis and progression, this study has been undertaken to determine the expression of IL-18, IFN-γ and IL-10 in hepatocellular carcinoma (HCC) which is a common cancer in Malaysia and other parts of Asia such as China, Taiwan and Hong Kong. In Malaysia, a large proportion of HCC occurs in patients who are chronic carriers of the human hepatitis B virus.



Chromatogram shows the DNA sequence of human IL-18 cDNA

We have cloned the human IL-18 c DNA and produced the recombinant protein for production of IL-18 antibodies. RNA isolated from a cell line and reverse transcription-PCR was performed to obtain the IL-18 amplicon. The PCR product was cloned into pTrcHis2TOPO vector for expression in *E.coli*. The nucleotide sequence confirmed the presence of the IL-18 cDNA in this plasmid. Recombinant protein was purified using the Talon resin. Antibodies against the recombinant IL-18 were raised in rabbits. The IgG fraction was obtained using the Thiophilic resin and then used for the immunohistochemical staining.

A significantly higher number of IL-18 positive specimens were found in the hepatocytes of apparently normal surrounding tissue (13/17; 76.5 %) compared to the tumour (6/17; 35.3%; P= 0.018). In contrast, the number of specimens with positive immunoreactivity to the antibody against the Th1 cytokine, IFN-γ expression in the hepatocytes was lower. Only one specimen from the apparently normal surrounding tissue (1 out of 17; 5.9 %) and three other specimens from the tumour portion (3 out of 17; 17.6 %) had positive immunoreactivity. Using the Spearman correlation test, no correlation between IL-18 expression in the tumour portion and clinicopathological factors was found. There was also no correlation found between IL-18 and IFN-γ expression



IL-18

Thus, we found a significant difference in the distribution of IL-18 between surround tissue and tumour and speculate that IL-18 plays a role in the activation of the surrounding tissue. A poor Th1 response to the tumour was found. These new findings provide additional information on the type of cytokines expressed in the tumour microenvironment. This gives us a further understanding of the role of cytokines in the pathogenesis of cancer, which is critical for the development of effective immunotherapeutic approaches for cancer therapy.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8511
E-mail: shf@medic.upm.edu.my

Bone Modelling around Orthopaedic Implants

Seyed Alireza Asgari

AwardWinner

THA, Total Hip Arthroplasty, is a success story to relieve pain. Currently the most successful Hip implants reside inside the patient's body for not more than 20 years. This encourages the research to find new and novel means of enhancing the performance of hip implants. The common point of view is that the implant will alter the natural loading mechanism of bone and therefore lead to bone resorption. The challenge is to introduce the new and novel designs. This can be related to new geometry and/or new material properties for implant. In order to investigate the new ideas, Finite Element Methods can be used effectively as a design tool, while *in vivo* (inside human body) experiments are expensive and dangerous to the human lives.

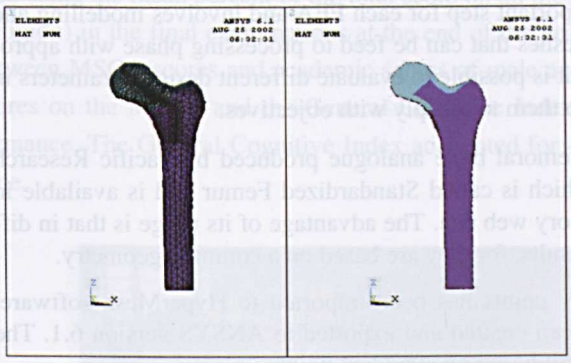


Fig 1. Schematic view of stemless implant model

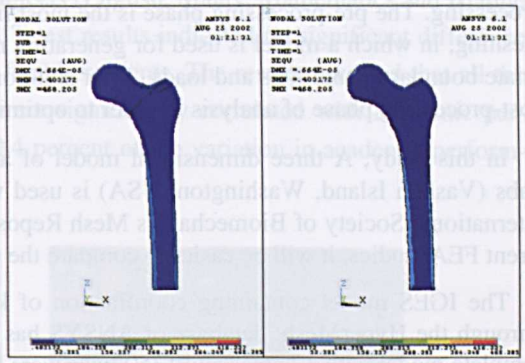


Fig 2. Average Von Mises stresses in stemless Plant

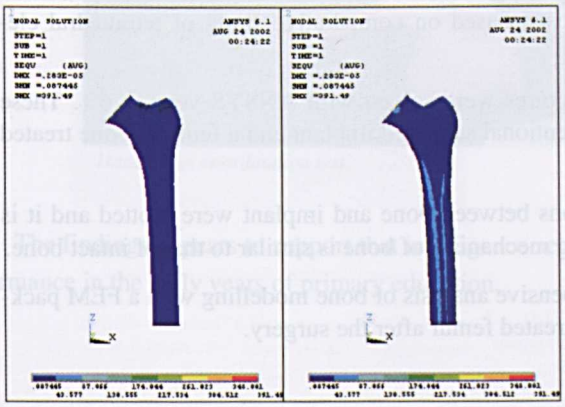


Fig 3. Average Von Mises stresses in conventional implants

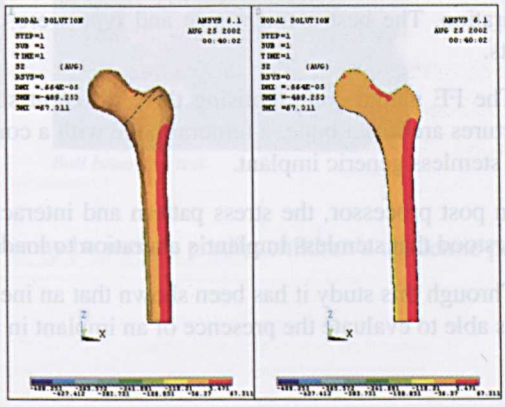


Fig 4. Distribution of axial load over the stemless implant and bone

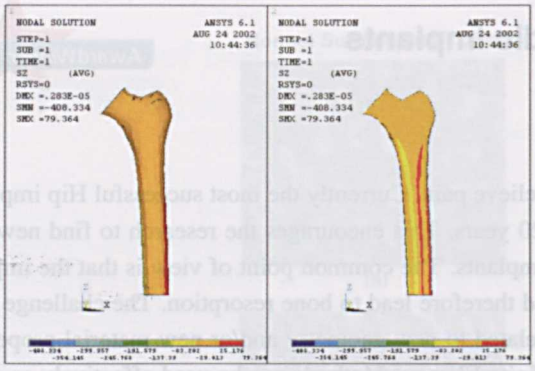


Fig 5. Distribution of axial load over the conventional implant

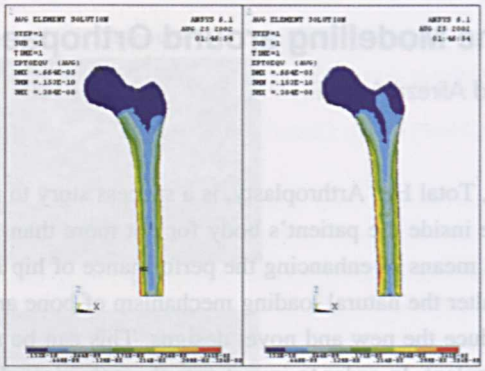


Fig 6. Equivalent Von Mises strain in stemless implant and bone

Generally, a Finite Element Analysis includes three phases, pre-processing, processing and post-processing. The pre-processing phase is the most important step for each FEA and involves modelling and meshing, in which a model is used for generating meshes that can be feed to processing phase with appropriate boundary conditions and loads. After solution it is possible to evaluate different design parameters in post-processing phase of analysis in order to optimise them to comply with objectives.

In this study, A three dimensional model of a femoral bone analogue produced by Pacific Research Labs (Vashon Island, Washington, USA) is used which is called Standardized Femur and is available in International Society of Biomechanics Mesh Repository web site. The advantage of its usage is that in different FEA studies, it will be easier to compare the results, for they are based on a common geometry.

The IGES model containing coordination of key points has been imported to HyperMesh software. Through the HyperMesh, database of ANSYS has been created and exported to ANSYS version 6.1. The complete model with 12 areas and 1350 lines were built based on 3067 key points.

In order to apply the constraint of analysis on the distal end of the femur, the distal end was cut off and the model was meshed proximally. It was done in two approaches of map meshing and automatic mesh generation. The best element size and type were chosen based on comparative study of tetrahedral elements.

The FE model compromising three different structures were solved with ANSYS version 6.1. These structures are intact bone, a femoral bone with a conventional stemmed implant and a femoral bone treated with stemless generic implant.

In post processor, the stress pattern and interactions between bone and implant were plotted and it is understood that stemless implant's alteration to loading mechanism of bone is similar to that of intact bone.

Through this study it has been shown that an inexpensive analysis of bone modelling with a FEM package is able to evaluate the presence of an implant in a treated femur after the surgery.

Reader Enquiry
Spatial and Numerical Modelling Laboratory
Institute of Advance Technology (ITMA)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +017 340 5416
E-mail: asgari@itma.upm.edu.my

McCarthy Scores (MSCA) and Academic Performance Among Primary School Children in Kuala Lumpur, Malaysia



Shamsul B.S., Zailina H., Josephine Y., Jamal H.H. and Ariffin O.

The objective of this study was to determine the relationship between scores on McCarthy Scales of Children's Abilities (MSCA) and academic performance of school children. A total of 112 first and second graders aged 6 to 8 1/2 years old from two primary schools in Kuala Lumpur, Malaysia were selected as subjects for this study. This selection was based on a random sampling stratified proportionally according to school and sex. The MSCA was administered to 59 male and 53 female students. The test battery was translated from English to Malay and adapted to suit the local situation. Academic performance was measured using the mean percent of the total score on all the subjects (English, Malay, Mathematics and Islamic Religion) in the final examinations at the end of the year. T-test results indicated no significant difference between MSCA scores and academic scores of male and female students. The results revealed that all the scores on the MSCA and the General Cognitive Index were significantly correlated with academic performance. The General Cognitive Index accounted for 10.4 percent of the variation in academic performance.



Hand –eyes coordination test



Ball bouncing test

The findings appears to support that intelligence scores may be used to predict children's academic performance in the early years of primary education.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8532
E-mail: shambs@medic.upm.edu.my

The Excretion of Taurine and Creatine from Male Sprague-Dawley Rats Treated with Benoxaprofen



Sharida Fakurazi, Caldwell, J, Corcoran, C., Beckwith-Hall, B. and Goldin, R. D.

The objective of the present study was to investigate the presence of hepatotoxic biomarkers present in male Sprague-Dawley rats using NMR- based approach after the administration of benoxaprofen. Benoxaprofen (BNP; Opren, Oraflex) is a hepatotoxic NSAID, withdrawn from clinical use after fatal cholestatic jaundice was seen in the elderly patients. Adduct pattern induced following the administration of this drug was also investigated.

Male Sprague-Dawley rats (200-250g) were divided into 4-5 rats housed individually in metabolism cages and acclimatised for 24 h for the collection of pre-treatment urine. Rats were injected intraperitoneally with 200 mg/kg BNP or dose vehicle at 500µl/rat. Urine samples were collected over dry ice during the following period after dosing: 0-8, 8-24, 24-32, 32-48, 48-72, 72-96, 96-120 h. All animals were sacrificed 120 h after dosing and livers were removed after death and fixed in 10% (v/v) formol saline. Samples were analysed using Bruker AMX 600MHz spectrophotometer to detect the presence of biomarkers for hepatotoxicity.

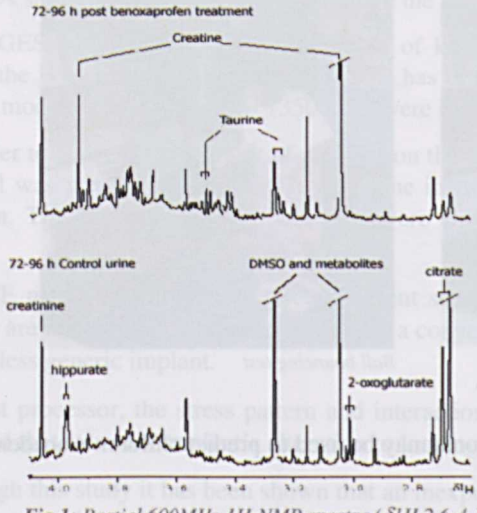


Fig.1: Partial 600MHz 1H-NMR spectra (δ1H 2.6-4.1) of urine from rats treated with either a single dose of 200 mg/kg benoxaprofen (upper trace) or 10% DMSO/tricaprylin

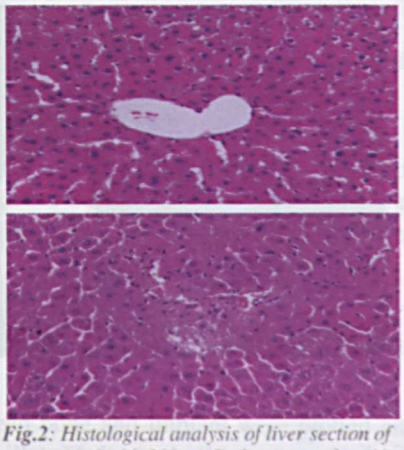


Fig.2: Histological analysis of liver section of rats treated with 200 mg/kg benoxaprofen. Necrotic tissue was detected at the centrilobular region of liver section from rat treated with 200 mg/kg benoxaprofen at 24 h (bottom). Normal hepatocytes were seen with liver section of the control group even at 120 h (top)

Another group of rats divided into groups of 3-5, given a single (0-200mg/kg) dose of BNP in 10%(v/v) dimethyl sulfoxide (DMSO) intraperitoneally, at 500µl/rat. Control animals received the appropriate dose vehicle in the same manner. After 24h, the animals were sacrificed and their livers were removed. Livers were fixed in 10% (v/v) formol saline and subcellular fractions were produced from the remainder of the liver.

The metabolic profile of BNP-treated rats differed from that of controls. The presence of taurine and creatine, found to be elevated in the treated animals compared to the excretion of both metabolites in the controls. The reduction of citrate and 2-oxoglutarate excretions in the treated groups may have suggested the possibility of impairment of mitochondria function in the treated animals.

Subcellular fractions subjected to SDS-PAGE and probed with specific BNP antibody revealed protein adducts ranging from 60-200 kDa. Major adducts of 110 and 200 kDa were densely expressed in the 600 x *g* fraction and were also present in the mitochondrial or microsomal fraction. These adducts were localised in the cytosol and at higher doses, adducts were observed in the nuclei. The hepatotoxicity seen in rats after BNP treatment may be due to the impairment of mitochondrial function as well as the formation of adducts with endogenous proteins, which subsequently leading to the disruption of cell function and hepatotoxicity.

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8570
E-mail: sharida@medic.upm.edu.my

Inducible Nitric Oxide Synthase Inhibitors From Plants: Potential Anti-Inflammatory Therapeutic Agents



Syahida Ahmad, Arbaah Mohd Salleh, Faridah Abas, Daud Israf, Nordin Hj Lajis and Khozirah Shaari

In the field of inflammation research, inducible nitric oxide synthase (iNOS) is an important pharmacological target, since overproduction of nitric oxide (NO) after induction of this enzyme seems to be associated with numerous pathological conditions. NO released from cells can be detected and quantified photometrically as its stable product nitrite by a simple colourimetric reaction (Griess reaction).

The aim of this study is to modify the assay for rapid screening of local plants that may contain inhibitors of NO production. A total of 40 plant extracts were tested for *in vitro* NO inhibitory activity in the murine macrophage cell line, RAW 264.7 following triggering of iNOS with both bacterial lipopolysaccharide (LPS, 5ug/ml) and interferon-γ (IFN-γ, 100 U/ml). Out of a total 40 local methanolic plant extracts tested six species showed inhibitory activity without concomitant cytotoxicity. *Walsura pinnata*, *C. erythrocarpus*, *M. subunifoliolata*, *Clausena excavata*, *Melicope ptelefolia* and *Persicaria tenella* showed strong inhibitory activity (inhibition ≥80%). *Kopsia dasyrachis* methanolic extracts were moderately active (inhibition ≥60-79%).

These findings are new and therefore these plants make good candidates for further isolation of bioactive compounds for drug development.

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8063
E-mail: daud@ibs.upm.edu.my

Display of Hepatitis B Surface Antigen on Bacteriophage M13

AwardWinner

Tan W.S., Yusoff K., Nathan S., Kok W.L. and Ong S.T.

Hepatitis B is a major public health problem worldwide. The disease may lead to the development of chronic liver diseases, cirrhosis and hepatocellular carcinoma. The PreS domain of hepatitis B virus is involved in virion assembly and attachment to a hepatocyte receptor during infection.

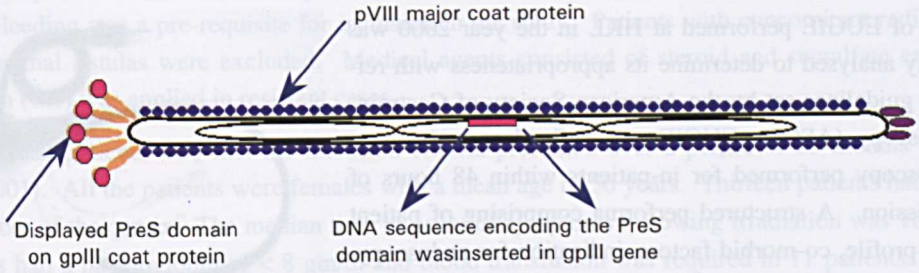


Fig. 1: A schematic diagram of the M13 bacteriophage.

The DNA sequence encoding the PreS domain was inserted into the gpIII gene of M13 bacteriophage. As a result the PreS domain was fused to the gpIII protein an displayed at the tip of the bacteriophage.

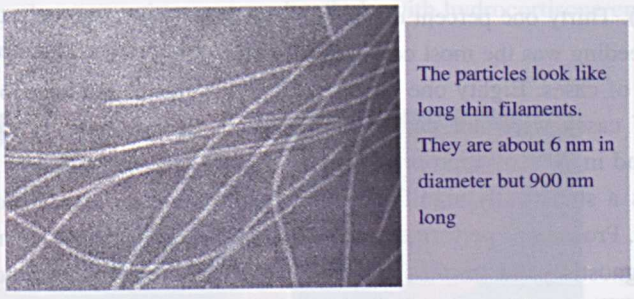


Fig. 2: An electron micrograph of M13 bacteriophage particles

In order to study the functions of this region, we fused it to the gpIII protein of bacteriophage M13 that allows the fusion protein to be displayed at the tip of the filament. The phage-displayed PreS regions may be used in place of soluble forms of the surface antigens in detection assays to aid the diagnosis of hepatitis B, and also would provide an alternative means to study its interactions with the nucleocapsid and hepatocytes.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6715
E-mail: wstan@fsas.upm.edu.my

Appropriateness of Emergency Upper Gastrointestinal Endoscopy in a Tertiary Hospital



Yunus Gul, Prasanna S. and Jabar M.F.

Published guidelines for emergency upper gastrointestinal endoscopy (EUGIE) is lacking but essential to maintain standards of healthcare. The aim of this study was to determine the appropriateness of EUGIE with respect to available accepted guidelines.

All cases of EUGIE performed at HKL in the year 2000 was retrospectively analysed to determine its appropriateness with reference to the guidelines set by the American Society of Gastrointestinal Endoscopy (ASGE). EUGIE was defined as early, non-elective endoscopy performed for in-patients within 48 hours of hospital admission. A structured performa comprising of patient demographic profile, co-morbid factors, indication for endoscopy, endoscopic diagnosis and/or therapy was used to obtain data from retrieved case notes.



Endoscopic diagnosis kit

Only 668 (59%) complete patient files were available for analysis. The median age of patients was 55 years (range 12-90 years). Thirty one percent of patients had a previous oesophago-gastro-duodenoscopy. Upper gastrointestinal bleeding was the most common indication for EUGIE (61%) while dyspeptic symptoms accounted for 16% of cases. Eighty one percent of cases were judged appropriate by ASGE guidelines. However, 43% of cases were not performed for acute haemorrhage or acute pain. Significant diagnostic yield was found in 70% of appropriately indicated EUGIE compared to 36% in cases deemed inappropriate. There was a statistically significant relationship between appropriateness and significant diagnostic yield *($p<0.05$)*. Procedures performed for haematemesis, melaena and symptomatic anaemia led to greater significant diagnostic yield *($p<0.05$)*. There was no difference in the yield between working–hours and after-hours EUGIE *($p>0.05$)*.

Although the majority of EUGIE appeared to be appropriate, a large proportion of them were elective cases. EUGIE performed for appropriate indications especially for bleeding yields more significant findings. Refinements to published guidelines should be made to serve as protocol in ensuring cost-benefit and quality assurance for emergency endoscopy services.

Reader Enquiry
Department of Surgery
Faculty of Medicine and Health
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8063
E-mail: yunus@medic.upm.edu.my

Pharmacotherapy for Chronic Haemorrhagic Radiation Proctitis



Yunus Gul, S. Prasanna and A.R.H Shaker

We assessed the effectiveness of pharmacotherapy (sucralfate and steroid enemas) in the management of chronic haemorrhagic radiation proctitis (CHRP)to determine if more specialised forms of intervention and surgery could be avoided.

A prospective evaluation of all patients referred to our unit with CHRP was performed. Symptom of rectal bleeding was a pre-requisite for inclusion in the study. Patients with concomitant radiation induced recto-vaginal fistulas were excluded. Medical agents consisted of steroid and sucralfate enemas. Rectal formalin (4%) was applied in resistant cases.

Fourteen patients who met the inclusion criteria presented over a period of 23 months (July 1999 to June 2001). All the patients were females with a mean age of 56 years. Thirteen patients had radiotherapy for cancer of the cervix. The median time to onset of symptoms following irradiation was 16 months. Six patients had a haemoglobin of < 8 gm/dl and blood transfusion was required in 11 patients. Five patients initially treated with hydrocortisone enemas prior to their referral had this treatment continued and the remaining 9 patients were administered sucralfate enemas. Two patients administered hydrocortisone enema continued bleeding and were managed with sucralfate enema and formalin respectively. Over a mean follow up period of 6 months, one patient managed entirely with hydrocortisone enema and two patients administered sucralfate enemas had recurrent rectal bleeding.

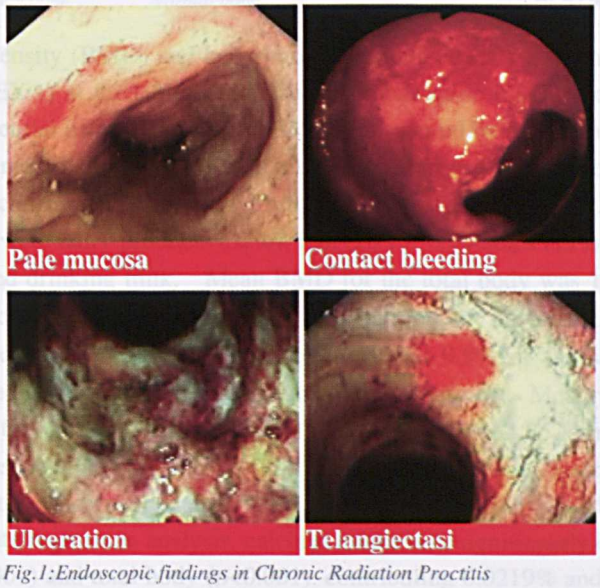


Fig.1:Endoscopic findings in Chronic Radiation Proctitis

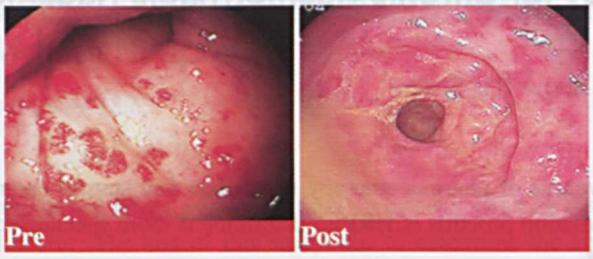


Fig.2: Endoscopic appearances before and after sucralfate therapy

Even though our cohort of patients is small with a short follow-up period, we conclude that the majority of patients with CHRP can be managed successfully with medical therapy. We recommend sucralfate enemas as the initial form of treatment followed by local formalin application in cases of primary treatment failure.

Reader Enquiry
Department of Surgery
Faculty of Medicine and Health
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

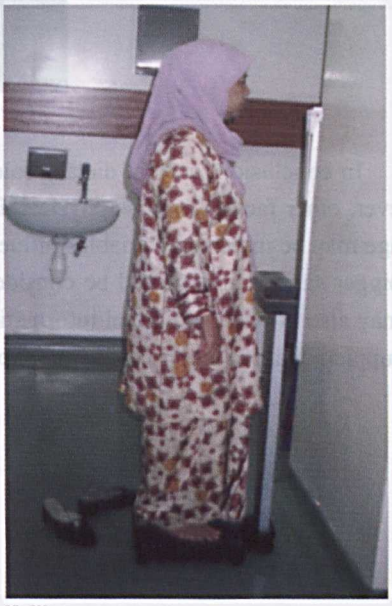
Tel: +603 8946 8063
E-mail: yunus@medic.upm.edu.my

Dietary Calcium Intake and Bone Mineral Density Among Malay Postmenopausal Women

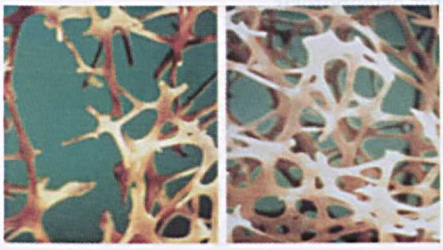


Zaitun Yassin, Rani Sarmugam, Suriah Abdul Rahman, Mirnalini Kandiah, Chee Siew Swee, Chan Siew Pheng, Rokiah Pendek and Chan Yoke Mun

The objective of this study was to investigate the relationship between dietary calcium intake and bone mineral density (BMD) among Malay postmenopausal women. A total of 113 women aged between 50 to 65 years old were recruited in the Klang Valley, as part of a two-year randomized clinical trial to study the effectiveness of calcium supplementation among postmenopausal women. Calcium intake was assessed using 3-days food record and a semi-quantitative food frequency questionnaire (SFFQ).



Ht Wt measurement



Lacy bone *Normal bone*

Bone mineral density (BMD) and bone mineral content (BMC) were measured with dual-energy x-ray absorptiometry (DEXA) at three sites: total body, lumbar spine L2-L4 and hip, using the Lunar DPX-IQ scanner. Other potential determinants of BMD were measured by anthropometry or questionnaires. Based on the 3-days food record, the mean calcium intake varied from 106.5 mg to 1778 mg with a mean of 542.7 mg. The mean calcium intake estimated from the SFFQ was 648.46 mg. The main sources of dietary calcium in the diet were dairy products (32%), fish (20%), vegetables (11%) and nuts (8%). About 68% of the subjects reported drinking milk. Mean BMD for the total body was 1.06 ± 0.06 g/cm^2, lumbar spine was 0.98 ± 0.13 g/cm^2, right hip was 0.87 ± 0.11 g/cm^2 and left hip was 0.88 ± 0.11 g/cm^2. According to the t-score classification (WHO, 1994), 1.8%, 9.7% and 0.9% of the subjects were considered to be osteoporotic for the total body, lumber spine and hip, respectively. Mean weight was 61.9 ± 10.93kg and height was 1.52 ± 0.04m. Body Mass Index (BMI) was 26.9 ± 4.85 kg/m^2 and WHR was 0.81 ± 0.07. Calcium intake was positively correlated with BMD for total body, lumber spine L2-L4, femoral neck, wards and trochanter. However, none of the bivariate correlation was significant ($p>0.05$). Using the stepwise multivariate regression analysis, calcium intake was significantly correlated with BMD of lumber spine L2-L4 ($p<0.001$) and total body ($p<0.001$), contributing 0.0219% and 0.0118% towards the variation in the BMD at these sites, respectively.



Measurement of BMD

In conclusion, current dietary calcium intake was found to be affecting BMD at specific sites. However, other factors such as physical activity, body composition, reproductive history, hormonal status and age may be important variables influencing BMD among postmenopausal women. These factors, including bigger sample size should be considered in future studies. The results of the two years intervention trial may also provide additional information, which may be useful to assess the usefulness and effectiveness of supplementation among the aging population at risk for osteoporosis.

Reader Enquiry
Department of Nutrition and Health Science
Faculty of Medicine and Health
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 9369, 8946 8502
E-mail: zaitun@medic.upm.edu.my



Information Technology and Mathematics

In conclusion, current dietary calcium intake was found to be affecting BMD at specific sites. However, other factors such as menopausal status and age may be important variables influencing BMD among postmenopausal women. These factors, including bigger sample size should be considered in future studies. The results of the two years intervention trial may also provide additional information, which may be useful to assess the usefulness and effectiveness of supplementation among the aging population at risk for osteoporosis.

Reader Enquiry
Department of Nutrition and Health Sciences
Faculty of Medicine and Health
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8368, 8946 8369
E-mail: salmah@medic.upm.edu.my

Contents

Information Technology and Mathematics

SMS Gateway Interface 283
Abdul Rahman Bin Ramli and Beh Kok Siang

Defining the Incomplete Gamma Function as Distribution 284
Adem Kilicman and Anwar Jabor Fawakhreh

Mappings on Some Generalizations of Lindelof Spaces 287
Adem Kilicman and Anwar Jabor Fawakhreh

Neutrix Modelling for Distributional Equations and Convolution Products 288
Adem Kilicman

WebEd – Platform Independent Web-based Distance Learning System 291
Borhanuddin Mohd Ali, V. Prakash, Yem Poh Cheang and Ku Day Chyi

Automating the Graphics of Newton Polyhedron 293
Emizul Ezani Binti Zulkifli

Optimizing the Solution of the Lecture Timetabling Problem by Using Genetic Algorithms Technique 295
Fahrul Hakim bin Ayob@Huyop, Md. Nasir bin Sulaiman and Mohamed Othman

Carbon Nanotube (CNT) and Carbon Nanofiber (CNF) Synthesis by the FC-CVD Technique for Nanotechnology Research Applications 297
Fakhru'l-Razi Ahmadun, Iyuke Sunny Esayegbemu, Abdul Ghani Liew Abdullah, Faizah Mohd Yasin, Muataz Ali Atieh, Maan Fahmi Alkatib and Abdul Hamed Belal Danna

Embedded Singly Diagonally Implicit Runge-Kutta Method for the Integration of Stiff Ordinary Differential Equations 299
Fudziah Ismail and Mohamed Suleiman

Comparison of Interpolations Used in Solving Delay Differential Equations Runge-Kutta Method 300
Fudziah Ismail, Raed Ali Al-Khasawneh

Webcasting of Lectures in UPM 301
Makhdzir bin Mardan and Mohd Zul b. Mohd Yusoff

Limited Modified BFGS Method for Large-scale Optimization 302
Malik Hj. Abu Hassan, Mansor Monsi and Leong Wah June

The Significance of Vibrato on the Perception of Violin Timbral Quality 303
Michele Law Soo Ling

A Cubic Analogue of RSA Cryptosystem 305
Mohamad Rushdan Md Said

Malay-English Cross-Language Information Retrieval 307
Muhamad Taufik Abdullah, Hjh. Fatimah Dato' Ahmad, Ramlan Mahmod and Tengku Mohammed Tengku Sembok

A Note on the Convolution in the Mellin Sense with Generalized Functions 308
Muhammad Rezal Kamel Ariffin and Adem Kilicman

Genetic Algorithm (GA) Based Heuristic Approach to Solve Capacitated Multi-Plant, Multi-Item, and Multi-Period Production and Distribution Planning Problems with Inter-plant Transfers 309
Murali Sambasivan and Salleh Yahya

The Spatial Distribution of Intentional Oil Spills in the Straits of Malacca 311
Murugeson Kallianna and Mahendran Shitan

Inter-Satellite Handover for Non-GEO Satellites Using Adaptive Steered Beams (ASB) Algorithms 313
Nor Kamariah Noordin, Borhanuddin Mohd Ali, Sabira Khatun, Ratna Kalos Zakiah Sahbudin, Ng Chee Kyun and Aduwati Sali

A Study on User Satisfaction Towards Job Recruitment System (ICIS 2000) by Students' Stream at UPM 315
Noraini Che Pa, Haji Hasan Selamat, Azrina Kamaruddin, Fatimah Khalid

Numerical Analysis Online Learning 316
Norazak Bin Senu, Bachok M. Taib, Azmi Jaafar and Ismail Abdullah

Neural Network for a Word Retrieval System from a Database 318
Nur Izura binti Udzir, Md. Nasir Sulaiman, Ali Mamat, Ramlan Mahmod and Fatimah Ahmad

Chromatic Equivalence Classes of Certain Generalized Polygon Trees 320
Peng Yee Hock and Omoomi Behnaz

An Improved Public Key Cryptography Based on The Elliptic Curve 322
Ramlan Mahmod and Essam Faleh Al-Daoud

Wireless File Transfer Using Bluetooth Technology 323
Ratna Kalos Zakiah, Goh Kean Jeet, Sabira Khatun and Ng Chee Kyun

Multi-layer Neural Network for Colour Recognition 325
Razali Yaakob, Md. Nasir Sulaiman, Ramlan Mahmod, Abd. Rahman Ramli and Mahmud Tengku Muda Mohamed

The Development of Coursewave for Virtual School 327
Rusli Hj. Abdullah

Animated Calculus 329
Rustem Suncheleev

Remote Control Light Switch 330
Sabira Khatun, Nor Kamariah Noordin, Ratna Kalos Zakiah Sahbudin, M. Hasbullah Md. Marham, Fazirul Hisyam Hashim and Noor Asmawati Samsuri

Network Independent Video on Demand System (VoD) Software 331
Sabira Khatun, Ong Kar Chun, Ng Chee Kyun, Aduwati Sali and Hasniza Hambali

Parallel Computation on Weather Prediction using Two Levels Barotrophic Model 332
Susila Bahri, Bachok M. Taib, Rodzita Johari and Fudziah Ismail

Algorithm Synthesis for Modelling Cyclic Processes 333
Thomas S. Y. Choong

Development of Interactive Physics Multimedia Modules (Mechanics) 334
Zaidan Abdul Wahab and Zainal Abidin Sulaiman

Development of Web Based Automation System for the Study of Superconducting Magnetic Levitation Phenomena 335
Zainal Abidin bin Sulaiman, Abdul Halim Shaari, Ionel Valeriu Grozescu, Zaidan Abdul Wahab and Teh Jia Yew

SMS Gateway Interface



Abdul Rahman Bin Ramli and Beh Kok Siang

SMS Gateway Interface is a system that provides remote monitoring and controlling via GSM Short-Message-Service (SMS). Through SMS, one can switch lights on and off, turn music on or off, ring a bell or other devices that connected to the system. The state of each device connected to the system can also be requested and send as SMS. The system is also capable of interfacing to alarm systems, sensors and panic switches. In the event of any conditions triggered, a customizable SMS message will be send to predetermine mobile number/operation center.

The advantage of the system is that the sender can be anywhere in the world as long as their mobile phone in service. The low costs of sending SMS also a major advantage of this system. Security is done through checking the CLIP of each SMS.

This system is inclusive of both hardware and software components. In order to have the system running, a GSM SIM card and a mobile phone are required to send and receive SMS. The SIM card could be prepaid or postpaid of any mobile telco. The subscriber number of this SIM card will be the number where SMS commands will be send. A PC that running our SMS Gateway Software will constantly monitor for any SMS and control our micro-controller board which interface to devices that to be controlled.

Reader Enquiry
Department of Computer and Communication
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6852, 019 352 0254
E-mail: arr@eng.upm.edu.my

Defining the Incomplete Gamma Function as Distribution

Adem Kilicman and Anwar Jabor Fawakhreh



The incomplete Gamma function $\gamma(\alpha,x)$ is defined for $\alpha>0$ and $x\geq 0$ by

$$\gamma(\alpha,x)=\int_0^x u^{\alpha-1}e^{-u}du, \tag{1}$$

the integral diverging for $\alpha\leq 0$. We note that if $\alpha>0$, then on integration by parts, we see that

$$\gamma(\alpha+1,x)=\alpha\gamma(\alpha,x)-x^{\alpha}e^{-x} \tag{2}$$

and so we can use equation (5) to extend the definition of $\gamma(\alpha,x)$ to negative, non-integer values of α. In particular, it follows that if $-1<\alpha<0$ and $x>0$, then

$$\gamma(\alpha,x)=\alpha^{-1}\gamma(\alpha+1,x)+\alpha^{-1}x^{\alpha}e^{-x}$$

$$=-\alpha^{-1}\int_0^x u^{\alpha}d\left(e^{-u}-1\right)+\alpha^{-1}x^{\alpha}e^{-x}$$

and on integration by parts, we see that

$$\gamma(\alpha,x)=\int_0^x u^{\alpha-1}\left(e^{-u}-1\right)du+\alpha^{-1}x^{\alpha}.$$

More generally, it is easily proved by induction that if $-r<\alpha<-r+1$ and $x>0$, then

$$\gamma(\alpha,x)=\int_0^x u^{\alpha-1}\left[e^{-u}-\sum_{i=0}^{r-1}\frac{(-u)^i}{i!}\right]du+\sum_{i=0}^{r-1}\frac{(-1)^i x^{\alpha+i}}{(\alpha+i)i!} \tag{3}$$

We now define the distribution x_+^{-m} by

$$x_+^{-m}=\frac{(-1)^{m-1}}{(m-1)!}(\ln x+)^{(m)}$$

for $m=1,2,\ldots$ and we define the distribution $\gamma(-m,x_+)$ by

$$\langle\gamma(-m,x+),\varphi(x)\rangle=N-\lim_{\epsilon\to 0}\int_{\epsilon}^{\infty}\varphi(x)\int_{\epsilon}^{x}u^{-m-1}e^{-u}du\,dx \tag{4}$$

for $m=0,1,2,\ldots$ and arbitrary φ in D, the space of infinitely differentiable functions with compact support.

Note that the definition of x_+^{-m} given here is not the same as Gel'fand and Shilov's definition of x_+^{-m}, which we will denote by $F(x_+,-m)$. it is easily shown that

$$x_+^{-m}=F(x_+,-m)+\frac{(-1)^m\phi(m-1)}{(m-1)!}\delta^{(m-1)}(x), \tag{5}$$

for $m = 1, 2, \ldots$, where

$$\phi(m) = \begin{cases} 0, & m = 0, \\ \sum_{i=1}^{m} i^{-1}, & m > 0. \end{cases}$$

Theorem 1.

$$N - \lim_{\epsilon \to 0} \int_{\epsilon}^{\infty} \varphi(x) u^{\alpha} du\, dx = \frac{\langle x_+^{\alpha}, \varphi(x) \rangle}{\alpha + 1} \tag{6}$$

if $-r < \alpha < -r + 1$ for $r = 1, 2, \ldots$and

$$N - \lim_{\epsilon \to 0} \int_{\epsilon}^{\infty} \varphi(x) \int_{\epsilon}^{\infty} u^{-1}\, du\, dx = \langle \ln x_+, \varphi(x) \rangle, \tag{7}$$

$$N - \lim_{\epsilon \to 0} \int_{\epsilon}^{\infty} \varphi(x) \int_{\epsilon}^{\infty} u^{-k}\, du\, dx = -\frac{\langle F(x_+, k-1), \varphi(x) \rangle}{k+1}$$

$$+ \frac{(-1)^k \langle \delta^{(k-2)}(x), \varphi(x) \rangle}{(k-1)(k-1)!} \tag{8}$$

for $k = 2, 3, \ldots$ and arbitrary φ in D

Definition 1. The distribution $\chi(-m, x_+)$ is defined by

$$\langle \chi(-m, x_+), \varphi(x) \rangle = N - \lim_{\epsilon \to 0} \int_{\epsilon}^{\infty} \varphi(x) \int_{\epsilon}^{\infty} u^{-m-1} e^{-u}\, du\, dx \tag{9}$$

for $m = 0, 1, 2, \ldots$

Theorem 2. $\chi(0, x_+)$, is the locally summable function

$$\int_0^{x_+} u^{-1}(e^{-u} - 1) du + \ln x_+ \tag{10}$$

and $\chi(-m, x_+)$, is the distribution

$$\langle \chi(-m, x_+), \varphi(x) \rangle = \int_{\epsilon}^{\infty} \varphi(x) \int_{\epsilon}^{x_+} u^{-m-1} \left[e^{-u} - \sum_{i=0}^{m} \frac{(-u)^i}{i!} \right] du\, dx +$$

$$-\frac{(-1)^i}{i!(m-i)}\sum_{i=0}^{m-1}\langle F(x_+,m-i),\varphi(x)\rangle +$$

$$-\sum_{i=0}^{m-i}\frac{(-1)^m}{i!(m-i)(m-i)!}\langle\delta^{(m-i-1)}(0),\varphi(x)\rangle$$

$$+\frac{(-1)^m}{m!}\langle\ln x_+,\varphi(x)\rangle,$$

Reader Enquiry
Department of Mathematics
Faculty of Science andEnvironmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6813
E-mail: akilic@fsas.upm.edu.my

Mappings on Some Generalizations of Lindelof Spaces

Adem Kilicman and Anwar Jabor Fawakhreh

AwardWinner

Let A ⊂ X and let C be a class of subsets of X such that

$$A \subset \bigcup \{B : B \in C\}$$

then C is called a cover of A if each member of C is an open subset of X then C is called an open cover.

If C contains a countable (or finite) subclass, which is also a cover of A, then C is said to be reducible to a countable (or finite) cover, or C is said to be a countable (or finite) subcover.

Later compactness was generalized to countable compactness and we have the following definition.

A space X is countably compact if every countable open cover of X has a finite subcover.

Then we have the following implication:

Compact $\Rightarrow$ countable compact

The idea of Lindelof property came later by dealing with open covers to get countable subcover. Thus the idea of Lindelof property was first introduced from studying compactness property.

A topological space (X, τ) is said to be Lindelof if every cover of the space X has a countable subcover.

Since the relation between compactness and Lindelof property is very strong, where every compact space is Lindelof but not the converse. Many properties of compact spaces were generalized onto Lindelof spaces.

Several authors for different reasons and purposes studied generalizations of Lindelof spaces. Some of these generalizations depend on the type of covers as in 1959 Frolik introduced the notion of weakly Lindelof space. In 1982 Balasubramanian introduced and studied the notion of nearly Lindelof spaces. In 1984 Willard and Dissanayake gave the notion of almost Lindelof spaces and in 1996 Cammaroto and Santoro studied and gave further new results about these generalizations of Lindelof spaces. In 1996, Cammaroto and Santoro introduced some generalizations of spaces depending on regular covers, namely: nearly regular Lindelof, almost regular Lindelof and weakly regular Lindelof spaces. In fact Cammaroto and Santoro studied some properties of almost regular Lindelof spaces and its subspaces.

In this work we study, mappings and some decompositions of continuity on these spaces in order to prove that these properties are topological properties. We show that some proper mappings preserve these topological properties such as: δ-continuity preserves nearly Lindelof property. θ-continuity preserves almost Lindelof property. R –maps preserve nearly regular-Lindelof and weakly regular-Lindelof properties. Moreover, we give some conditions of continuity preserve some of these covering properties under these covering properties under certain conditions.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6813
E-mail: akilic@fsas.upm.edu.my

Neutrix Modelling for Distributional Equations and Convolution Products

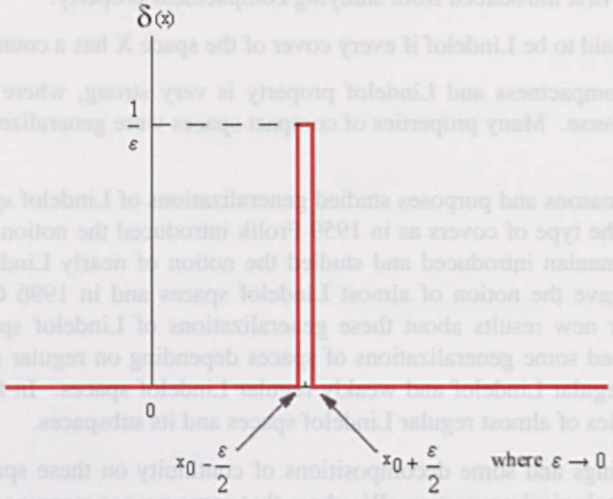
Adem Kilicman

Although now known as the Dirac delta function, the delta function $\delta(x)$ can be said to have been first introduced by Kirchoff. He defined $\delta(x)$ by

$$\delta(x) = \lim_{\mu \to \infty} \pi^{-1/2} \mu \exp(-\mu^2 x^2)$$

It is easily seen that $\delta(x) = 0$ for $x \neq 0$ and $\delta(0) = \infty$.

The delta function, also known as the unit impulse function, is important in the study of phenomena of an impulsive nature, such as the action of heat flow over a very short time interval or over a very small region. As $\delta(x)$ is undefined at $x = 0$ it is not an ordinary function in the sense as used in calculus, instead it is called a *generalised function*. Actually the concept of a generalised function is due to a branch of mathematics known as the *theory of distributions* today.



Graph of the delta function

Later it was proved that the delta function is in some sense the derivative of the Heaviside function $H(x)$. Dirac considered the delta function $\delta(x)$ to represent a unit point charge at the origin and the derivative

$\delta'(x)$ of $\delta(x)$ to represent a dipole of unit electric moment at the origin. Higher derivatives of $\delta(x)$ can be used to represent more complicated multiple--layers and have been used in the physical and engineering sciences for some time.

Further study was done by Sobolev in 1936 with his theory of generalized functions or distributions where Sobolev defined the main operations on distributions, such as the derivation and the product by infinitely differentiable functions, and used them for a study of partial differential equations.

However, it was not until 1950 when Schwartz published his theory of distributions that a really comprehensive and mathematically account was given. After the Schwartz work, the theory of distributions has led to the essential progress in several mathematical disciplines and such as the theory of partial differential equations and mathematical physics. In general, Schwartz's well-known result is on the property of distribution theory that multiplication of distributions is not possible in general, can not be easily given a meaning to product of arbitrary distributions. This fact is an obstacle to the usage of distributions in the theory of nonlinear equations and the theory of generalized coefficients equations and in particular, one arrives at the impossibility to give a meaning to such objects as

$H(x)\,\delta(x), x^{-s}\,\delta^{(r)}(x)$ and $\delta^{(r)}(x)\,\delta^{(s)}(x)$

Where δ is the delta function and H is the Heaviside function, are of the special interest to physicists and widely used, for example, in quantum theory. The problem proved to be very natural and to have a lot of applications. Therefore it has attracted attention at once after the creation of the distributions theory.

Now let D be the space of infinitely differentiable functions with compact support and let D' be the space of distributions defined on D. Then if f is an arbitrary distribution in D', we define

$f_n(x) = (f * \delta_n)(x) = \langle f(t), \delta_n(x-t) \rangle$

for n=1,2, … . It follows that $\{f_n(x)\}$ is a regular sequence of infinitely differentiable functions converging to the distribution f(x).

Although it seems impossible to give a suitable definition which will define the product of any two distributions, it is possible to define the product of a distribution f and an infinitely differential function g then the product fg = gf is defined by

$\langle fg, \varphi \rangle = \langle gf, \varphi \rangle = \langle f, g\varphi \rangle$

for all φ in D.

In physics, the products of distributions such as Hδ or δ^2 can be interpreted in many different ways. In the literature, several definitions have been proposed for δ^2 ranging from

$\delta^2 = 0, c\,\delta, c\,x^{-2}, c\,\delta + 1/2\pi i\,\delta', \text{to } c\,\delta + c'\,\delta'$

with arbitrary constants c, c'. This has opened up a new area of mathematical research, with many attempts to try and give a satisfactory definition for the product of two distributions.

Still there were some distributions, for example the product of $\ln^p |x|$ and δ (x) for p=1,2, … which did not exist in the sense of above definitions. In order to compute highly singular products, another generalization of product, the neutrix product was introduced by Fisher, which is based on the concept of neutrix limits due to van der Corput. The essential use of the neutrix limit is to extract the finite part from a divergent quantity as one has usually done to subtract the divergent terms via rather complicated procedures in the renormalization theory. In fact we can consider the neutrices as the generalization of the Hadamard finite parts.

Since theory of distributions is a linear theory. We can extend some operations to D' which are valid for ordinary functions such operations are called regular operations such as addition, multiplication by scalars. Other operations can be defined only for particular class of distributions or for certain restricted subclasses of distributions; these are called irregular operations.

Now our main aim in this study is to extend these irregular operations to broader classes of distributions, using van der Corput's neutrix modeling. We will also try to give some applications of distributions in Finance and Economics by using the neutrix product modelling.

Reader Enquiry
Department of Mathematics
Faculty of Science andEnvironmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6813
E-mail: akilic@fsas.upm.edu.my

WebEd – Platform Independent Web-based Distance Learning System



Borhanuddin Mohd Ali, V. Prakash, Yem Poh Cheang and Ku Day Chyi

WebEd 2000 is a platform-independent Web-based distance learning environment that enables delivering of conventional lecture notes over the web and provides various tools to help in managing and maintaining course materials in a server *(Fig 1)*. It also enables traditional asynchronous communications to be done via e-mail, bulletin board, and announcements. Additionally, it provides a tool to monitor students' activity in accessing the WebEd2000 *(Fig 2)*.

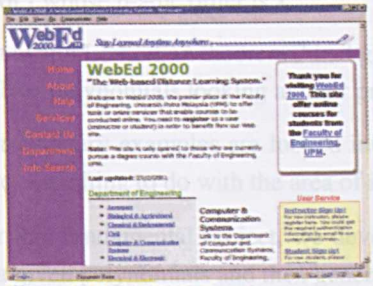


Figure 1. WebEd2000 Portal

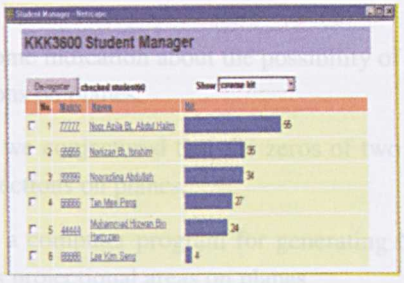


Figure 2. Students WebEd2000 activity monitoring

Being an extension of the previous of the earlier version called WebEd, which employed Java/CGI, this version provides significant improvement in various aspects, such as system performance, usability, scalability, security, reliability and stability.

WebEd 2000 is mainly developed using the combination of Java servlets and JavaScript technologies. The server-side servlets, together with the binary format random access file, are used to process various client request and store data, while the client-side JavaScript is used to enable DHTML features and perform less security concern processes such as generating an input dialogue box, hence lessening the workload of the server in relative. The system architecture is shown in *Fig. 3*.

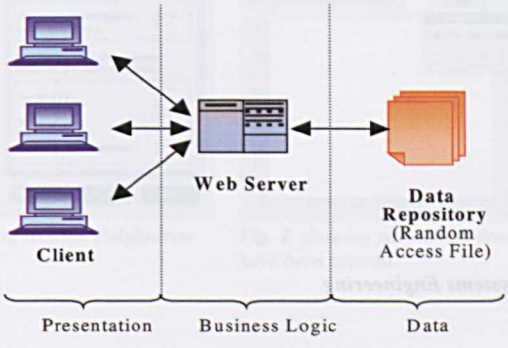
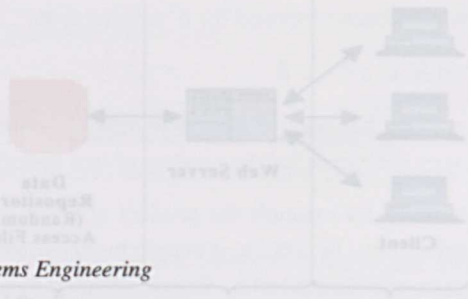


Figure 3. WebEd2000 Systems Architecture

Finally, WebEd2000 can easily be set up and deployed in any platform with minimal modifications. Flexibility is achieved by utilizing Java technology for the system applications and random access file for the system data repository. It is this platform neutrality of Java bytecodes and binary file format that makes WebEd 2000 a completely platform independent Web-based distance learning environment.



Reader Enquiry
Department of Communication Systems Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6443
E-mail: borhan@eng.upm.edu.my

Automating the Graphics of Newton Polyhedron

Emizul Ezani Binti Zulkifli

AwardWinner

In one variable case, the number of zeros with certain p-adic order can be determined quite easily. The determination of the number of zeros in the two variable cases is yet to be found.

Koblitz discusses the Newton polygon method for polynomials and power series in $\Omega_p[x]$, where $\Omega_p[x]$ is an algebraic field extension of Q_p. Here estimates concerning zeros of polynomials are derived from the properties of the associated Newton polygon. He shows for example that if λ is the slope of a segment in the Newton polygon of a polynomial f with difference m in the x-coordinate of its ends points, then there are m zeros of f whose p-adic order is λ.

Mohd Atan and Loxton, in theorem 2 had given some indication about the possibility of obtaining zeros of two variables polynomials looking at their projections on planes.

A few preliminary examples are looked into and we conjectured that the zeros of two variables polynomials have something to do with the area of its projections on planes.

First, for this fundamental project, we developed a computer program for generating Newton polyhedrons from a given polynomials and then generated its projectional areas on planes.

Application of computer automation technology was used for the visualization of Newton Polyhedron. Basis of product development is the innovation of this application and the development of the product benefits the country and its people with minimal cost and maximum efficiency. This project has potential in the enhancement of research in mathematics, which develops mindsets on the theory of numbers. The development of application is also affordable to be commercialised according to the nearest actual situation.

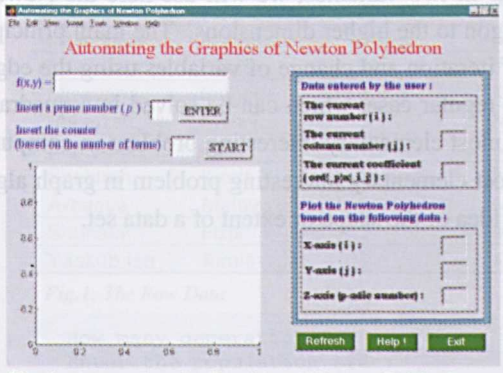


Fig. 1: Automating the Graphics of Newton Polyhedron System main interface

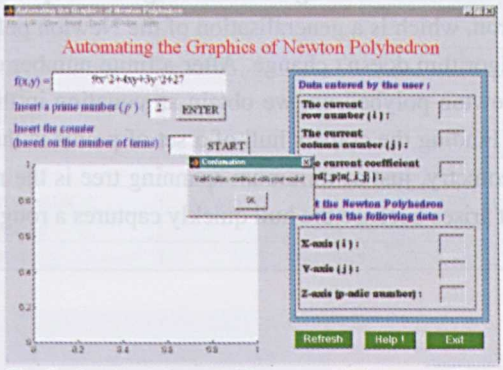


Fig. 2 showing polynomial function and chosen p-adic have been entered

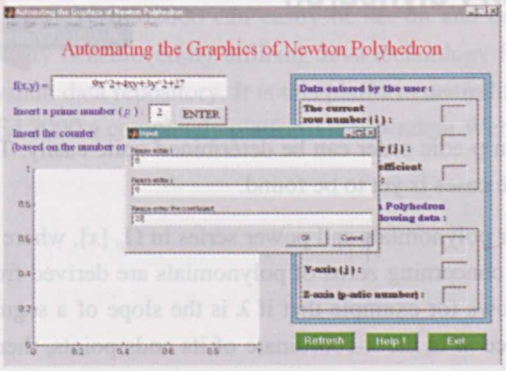


Fig. 3: User needs to enter the related information based on the number of terms

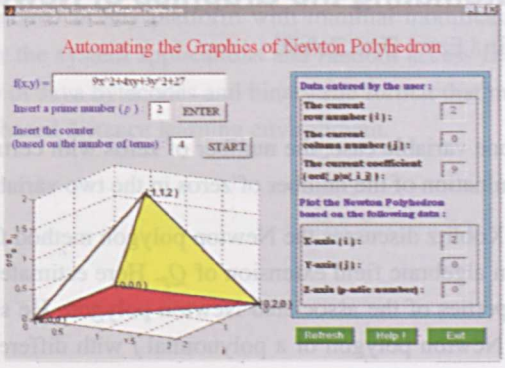


Fig. 4: The plotted Newton Polyhedron

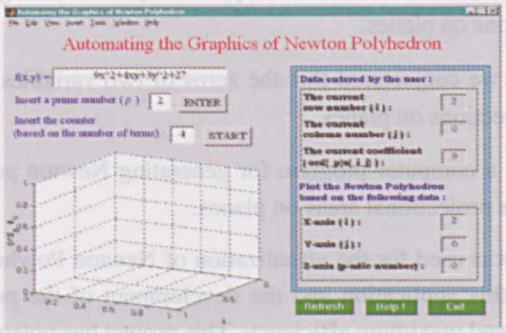


Fig. 5: Refresh action

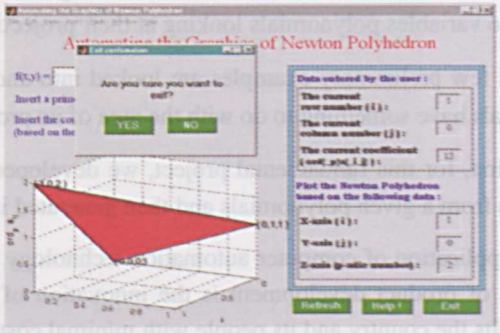


Fig. 6: Exit confirmation window

This program is designed for the formal solutions of multivariate algebraic equations. Its main feature is to compute the terms of the solutions expressed under the form of series with exponents in a cone. Similarly to the well-known algorithm for algebraic equations in two variables, we will use here the Newton polyhedron, which is a generalisation of the Newton polygon to the higher dimensions. The main principle on the algorithm doesn't change. After a finite number of iteration and change of variables using the edges of the Newton polyhedron, we obtain an equation in the regular case, which can be solved in a quadratic manner. Finding the convex hull of a set of points is the most elementary interesting problem in computational geometry, just as minimum spanning tree is the most elementary interesting problem in graph algorithms. It arises because the hull quickly captures a rough idea of the shape or extent of a data set.

Reader Enquiry
Institute of Mathematical Research (INSPEM)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 4149 9102, 019 289 6568
E-mail: emynani@yahoo.com

Optimizing the Solution of the Lecture Timetabling Problem by Using Genetic Algorithms Technique



Fahrul Hakim bin Ayob@Huyop , Md. Nasir bin Sulaiman and Mohamed Othman

Lecture timetabling system is the problem of assigning times and places to many separate lectures. This timetabling has to satisfy a few constraints concerning times, subjects and places from clash. The system that has been created is a simulation of a simple lecture timetabling for a small faculty by using artificial intelligence's heuristic method called Genetic Algorithms (GA). In GA, the term 'chromosomes' is used to represent the solution of a problem. With the existence of a few functions that support GA in problem optimization, the chance of getting healthier chromosomes is high. These functions enhance the chromosomes' fitness function cost by reducing penalty cost from one generation to the others. Ultimately, this system has proved the effectiveness of GA in a problem optimization.

The potential of this project can be seen in the technical perspective The performance of the system can be upgraded in parallel and distributed environment and the Interface should be added for the user-friendliness. The complexities can be reduced by combining all the faculties' lecture timetabling.

Lect. Name	Subject	Semester	Subject	Semester	Subject	Semester
Azman Abu	Fizik	1	Matematik	2		
Badrul Rais	Matematik	1	Fizik	2		
Suhaimi	Kimia	1	Inggeris	1		
Shuhairul	Kimia	2	Inggeris	2		
Muzaffar	Melayu	1	Melayu	2		
Ramli Ali	Fizik	3	Matematik	3		
Yunus Alif	Fizik	4	Matematik	4		
Hakim Nun	Kimia	3	Kimia	4		
Norlia Atan	Inggeris	3	Melayu	3		
Norashikin	Inggeris	4	Melayu	4		
Irdawaty	Fizik	5	Fizik	6		
Intan Hani	Matematik	5	Matematik	6		
Mustaza	Kimia	5	Inggeris	6		
Mizayana	Inggeris	5	Kimia	6		
Rohaizah	Melayu	5	Melayu	6		
Sameerah	Fizik	1	Matematik	1		
Shahirah	Kimia	1	Inggeris	1		
Arbaaya	Melayu	1	Matematik	1		
Shuhaini	Fizik	1	Inggeris	1		
Yaakub Isa	Kimia	1	Kimia	1	Inggeris	1

Fig.1: The Raw Data

```
How many generations?:
Enter the population size:
Enter the crossover rate (0.0 - 1.0):
Enter the mutation rate (0.0 - 1.0):
How many PS code involved?
How many subject involved?
How many lecturers involved?
According to your PS code, you may NEED at least 3 classrooms
How many classrooms involved?
```

Fig.2: Screen that prompts for input parameters

```
0 clash.
At generation 22
At population 2
The fittest chromosome as below
35 34 10 27 3 11 28 7 33 21 0 18 37 0 23 40 16 .......31 18 4 33

MONDAY
 time          8-9              9-10             10-11         11-12          12-1
1-2            2-3              3-4
 Room1 melayu1Arbaaya englis1Shahira melayu2Muzaffa englis5Mizayan matema1BadrulR
fizik_3RamliAl kimia_6Mizayan kimia_2Shuhair
 Room2 fizik_5Irdawat _FREE___FREE__ melayu3NorliaA fizik_1Shuhain _FREE___FREE__
matema5IntanHa kimia_1YaakubI kimia_4HakimNu
 room3 matema4YunusAl englis3NorliaA matema1Sameera fizik_2BadrulR _FREE___FREE__ eng-
lis6Mustaza englis2Shuhair matema1Arbaaya

TUESDAY
 Room1 englis1Shahira matema1Sameera _FREE___FREE__ fizik_5Irdawat matema6IntanHa
fizik_1Sameera _FREE___FREE__ kimia_1YaakubI
 Room2 _FREE___FREE__ _FREE___FREE__ _FREE___FREE__ englis1Suhaimi melayu1Muzaffa eng-
lis2Shuhair englis4Norashi _FREE___FREE__
 Room3 _FREE___FREE__ _FREE___FREE__ kimia_1Suhaimi _FREE___FREE__ _FREE___FREE__ ki-
mia_3HakimNu _FREE___FREE__ _FREE___FREE__

WEDNESDAY
 Room1 matema3RamliAl kimia_4HakimNu _FREE___FREE__ kimia_5Mustaza englis1Suhaimi ki-
mia_1YaakubI kimia_1Suhaimi matema4YunusAl
 Room2 _FREE___FREE__ melayu5Rohaiza _FREE___FREE__ fizik_2BadrulR _FREE___FREE__ me-
layu3NorliaA melayu4Norashi fizik_3RamliAl
 Room3 fizik_1Sameera fizik_1Shuhain englis1Shahira melayu1Arbaaya _FREE___FREE__
matema2AzmanAb _FREE___FREE__ _FREE___FREE__

THURSDAY
 Room1 matema3RamliAl matema1Arbaaya englis2Shuhair _FREE___FREE__ kimia_6Mizayan me-
layu6Rohaiza englis4Norashi fizik_4YunusAl
 Room2 fizik_6Irdawat englis6Mustaza fizik_1Shuhain fizik_5Irdawat kimia_3HakimNu
fizik_3RamliAl melayu2Muzaffa kimia_2Shuhair
 Room3 kimia_1YaakubI matema2AzmanAb melayu5Rohaiza matema1BadrulR englis1Shuhain
matema5IntanHa fizik_1AzmanAb melayu1Muzaffa

FRIDAY
 Room1 _FREE___FREE__ matema1Arbaaya matema4YunusAl fizik_4YunusAl kimia_1YaakubI
matema3RamliAl englis3NorliaA melayu5Rohaiza
 Room2 matema1BadrulR englis4Norashi _FREE___FREE__ fizik_1AzmanAb melayu4Norashi
matema2AzmanAb englis6Mustaza fizik_6Irdawat
 Room3 _FREE___FREE__ kimia_3HakimNu kimia_1Suhaimi englis5Mizayan _FREE___FREE__ eng-
lis1Shuhain englis1Suhaimi kimia_1YaakubI

SATURDAY
 Room1 melayu1Muzaffa fizik_4YunusAl kimia_4HakimNu fizik_1AzmanAb kimia_5Mustaza
matema5IntanHa
 Room2 _FREE___FREE__ melayu1Arbaaya _FREE___FREE__ matema6IntanHa melayu6Rohaiza me-
layu4Norashi
 Room3 englis5Mizayan fizik_6Irdawat fizik_1Sameera melayu3NorliaA fizik_2BadrulR ki-
mia_1Shahira
```

Fig.3: An example of display generated by the system

Reader Enquiry

Department of Telecommunication and Networks
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6542
E-mail: hakim@fsktm.upm.edu.my

Carbon Nanotube (CNT) and Carbon Nanofiber (CNF) Synthesis by the FC-CVD Technique for Nanotechnology Research Applications



Fakhru'l-Razi Ahmadun, Iyuke Sunny Esayegbemu, Abdul Ghani Liew Abdullah, Faizah Mohd Yasin, Muataz Ali Atieh, Maan Fahmi Alkatib and Abdul Hamed Belal Danna

Research on new materials technology is attracting the attention of researchers all over the world. Developments are being made to improve the properties of the materials and also to find alternative precursors that can bestow desirable properties on the materials. Great interest has recently developed in the area of nanostructured carbon materials. Carbon nanofibers/nanotubes (CNF/CNT) are fascinating carbon materials with many potential applications, e.g. Field Emission Displays (FEDs), hydrogen storage, catalyst or catalyst support nanocomposites etc. Various methods have been successful in making carbon fiber, filament and nanotube materials for more than 20 years ago.

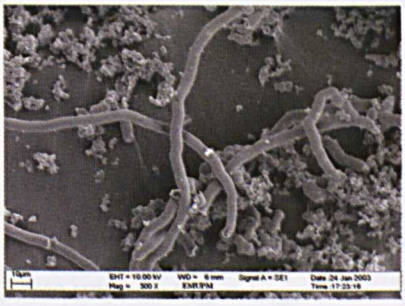


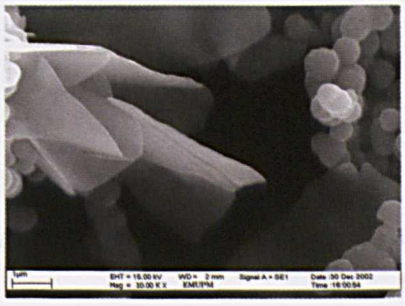
FC-CVD set-up for CNTs and CNFs production

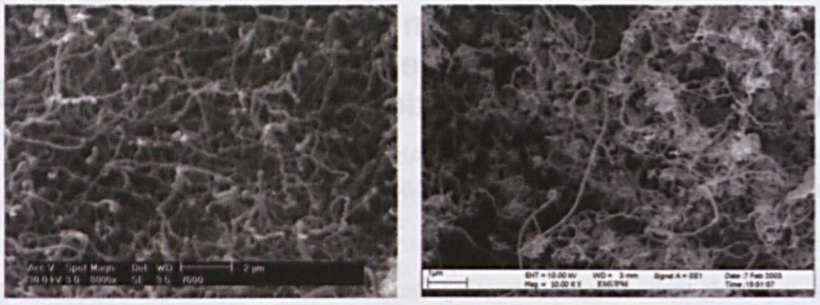


Poster showing nanotechnology applications

In order to follow up with the existing trend in technology, the Department of Chemical and Environmental Engineering, University Putra Malaysia (UPM), initiated research on carbon nanotubes production. This research requires the setting-up of an equipment called the Chemical Vapor Deposition (CVD). CNFs and CNTs in the present study were produced using the floating catalytic chemical vapour deposition (FC-CVD) technique and it was conducted in a horizontal tubular furnace. The tubular furnace was a ceramic tube of 50 mm in diameter and 900 mm in length.







SEM photographs showing CNTs and CNFs of various diameters (15 – 175 nm)

The results obtained from the experiments conducted at our laboratories to produce carbon nanotubes and nanofibers were successful. Carbon nanofibers (CNFs) and carbon nanotube (CNTs) have been produced by using benzene as the carbon source with a suitable catalyst precursor, while a carrier gas was used to carry the vapor mixture to the furnace. The temperature for the synthesis was varied between 800 - 1150 ^{0}C to produce carbon nanotubes (CNTs) and nanofibers (CNFs). The carbon nanotubes and nanofibers produced were accompanied with some impurities, which require some improvement on the operating conditions. The diameters of the carbon nanofibers and carbon nanotubes are distributed in the range of 15 - 175 nm.

Reader Enquiry
Department of Chemical and Environmental Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8656 7120
E-mail: fakhrul@eng.upm.edu.my

Embedded Singly Diagonally Implicit Runge-Kutta Method for the Integration of Stiff Ordinary Differential Equations



Fudziah Ismail and Mohamed Suleiman

Fourth order, five stage embedded in fifth order six-stage Singly Diagonally Implicit Runge-Kutta (SDIRK) method are derived and their regions of stability are determined. Numerical results of these methods are presented and compared with the results obtained when the same systems are solved using Rabeh's third order four-stage in fourth order five stage SDIRK method.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6821
E-mail: fudziah@fsas.upm.edu.my

Comparison of Interpolations Used in Solving Delay Differential Equations Runge-Kutta Method



Fudziah Ismail, Raed Ali Al-Khasawneh

Delay differential equations are solved using embedded Singly Diagonally Implicit Runge-Kutta (SDIRK) method (3,4) in (4,5). The approximation of the delay term is obtained by Newton divided difference interpolation and interpolation developed by In't Hout. Numerical results based on these two types of interpolation are compared. The stability polynomial and the stability regions of SDIRK method (2,2) using In't Hout interpolation for the delay term are presented.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6821
E-mail: fudziah@fsas.upm.edu.my

Webcasting of Lectures in UPM

Makhdzir bin Mardan and Mohd Zul b. Mohd Yusoff

The Internet technology has significantly changed the total landscape of the global education market in that global competition is prompting universities to reconfigure the fabric of teaching-learning.

Project on web casting of selected subjects is being implemented in order to provide supplementary media for teaching-learning. Utilizing both audio streaming and world-wide-web technology, traditional lectures on widely subscribed lectures like *Tamadun Islam, Kenegaraan* and *Tamadun Asia* can be web cast live or delay via the web server. Live or stored lectures can be played as scheduled on the web page. Such possibility enables the implementation of the concept of anytime-anywhere education.

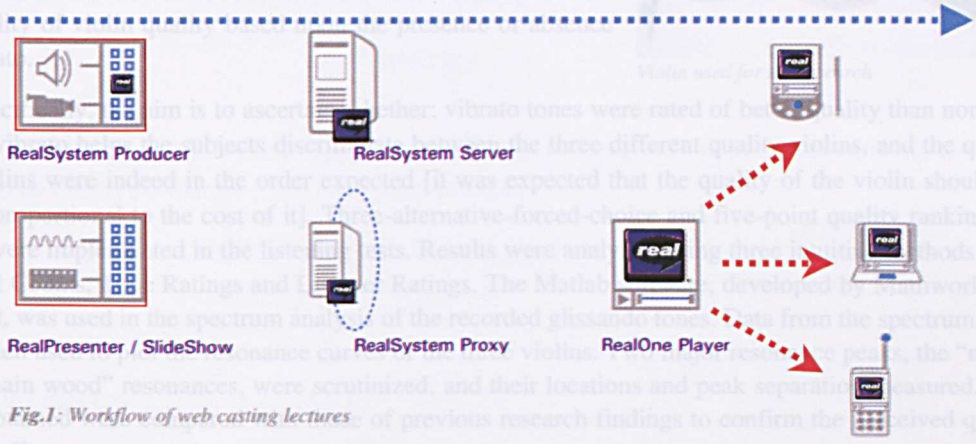


Fig.1: Workflow of web casting lectures

The process of webcasting lectures involves the audio video recording, digitizing and editing the contents of lectures from tapes, and equalized to achieve the right balance and quality. *A RealServer* software is installed on the workstation to function as web server. An encoding software (*RealVideo Encoder*) is installed to stream lecture materials to the server. A user needs a *RealPlayer* to play the contents. Several technical adjustments, adaptation and web-designing skills are needed to operate the webcasting. On the whole the webcasting technology presents yet another possibility of retrieving lectures at any convenient time despite having the constraints of time, cost and convenience.

Reader Enquiry
Institute of Multimedia and Software
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8431, 8946 6090
E-mail: makhdzir@imedia.upm.edu.my

Limited Modified BFGS Method for Large-scale Optimization



Malik Hj. Abu Hassan, Mansor Monsi and Leong Wah June

In this research, a limited modified BFGS method for solving large-scale unconstrained optimization problems is proposed. The proposed algorithm generates quasi-Newton directions using a modified BFGS method suggested by Biggs (1973). The modified BFGS method is then extended to the limited memory version. In order to use only minimum storage for the modification, the modification is only applied to the last BFGS corrections. Numerical results indicate that an improvement is achieved.

Reader Enquiry
Institute of Multimedia and Software
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8431
E-mail: malik@fsas.upm.edu.my

The Significance of Vibrato on the Perception of Violin Timbral Quality

Michele Law Soo Ling

Award Winner

This research seeks to verify the assumption that the presence of vibrato assists listeners in "hearing" the resonance structure of a violin, hence facilitating judgments concerning violin timbral quality. Three violins of different costs, ranging from RM3,000 to RM60,000 were used. Glissando tones, and individual vibrato and non-vibrato tones from each violin were recorded and stored in a computer for analysis. Listening tests using the recorded vibrato and non-vibrato tones were conducted to test the discernibility of violin quality based upon the presence or absence of vibrato.



Violin used for the research

Specifically, the aim is to ascertain whether: vibrato tones were rated of better quality than non-vibrato tones, vibrato helps the subjects discriminate between the three different quality violins, and the quality of the violins were indeed in the order expected [it was expected that the quality of the violin should be directly proportional to the cost of it]. Three-alternative-forced-choice and five-point quality ranking procedures were implemented in the listening tests. Results were analyzed using three intuitive methods namely, Overall Counts, Tone Ratings and Listener Ratings. The Matlab software, developed by Mathworks Incorporated, was used in the spectrum analysis of the recorded glissando tones. Data from the spectrum analysis were then used to plot the resonance curves of the three violins. Two major resonance peaks, the "main air" and "main wood" resonances, were scrutinized, and their locations and peak separation measured. The results obtained were compared with those of previous research findings to confirm the perceived quality of each violin.



Recording of the violin tones

Results of the listening test indicated that tones with vibrato were indeed rated superior to non-vibrato tones and that the presence of vibrato allows for more accurate discrimination of violin quality. However, the qualities of the violins were perceived to be rather close and hence there were instances where the qualities of two of the three violins were confused with each. Nevertheless, a ranking of quality was achieved. Additionally, the assumed relationship between cost and quality was disproved, leading to speculations that perceived quality may be dictated by subjective or even cultural preferences of the listener. The resonance curve analysis showed that there were indeed three violins of different qualities. Ranking of the violins in both the listening test and the resonance curve analysis in terms of quality were in agreement, showing firstly, that the quality of a violin may be

obtained from certain stable features within its resonance curves, and secondly, that vibrato assists in emphasizing the resonance structure allowing the ear to discern these signature features and hence, the quality of the violin.

Reader Enquiry
Department of Music
Faculty of Human Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8431, 012 692 2344
E-mail: law_Michele@yahoo.com

A Cubic Analogue of RSA Cryptosystem

Mohamad Rushdan Md Said



A public-key cryptosystem is developed which is derived from the third order linear recurrence relation and analogous to the RSA and LUC cryptosystems. The explicit formulation involves a generalisation of the rule for composition of powers,

$$V_{ed}(P,Q,R) = V_d(V_e(P,Q,R), V_e(Q,PR,R^2), R^k).$$

and of the calculus of the Euler totient function which underlie the algebra of the RSA cryptosystem.

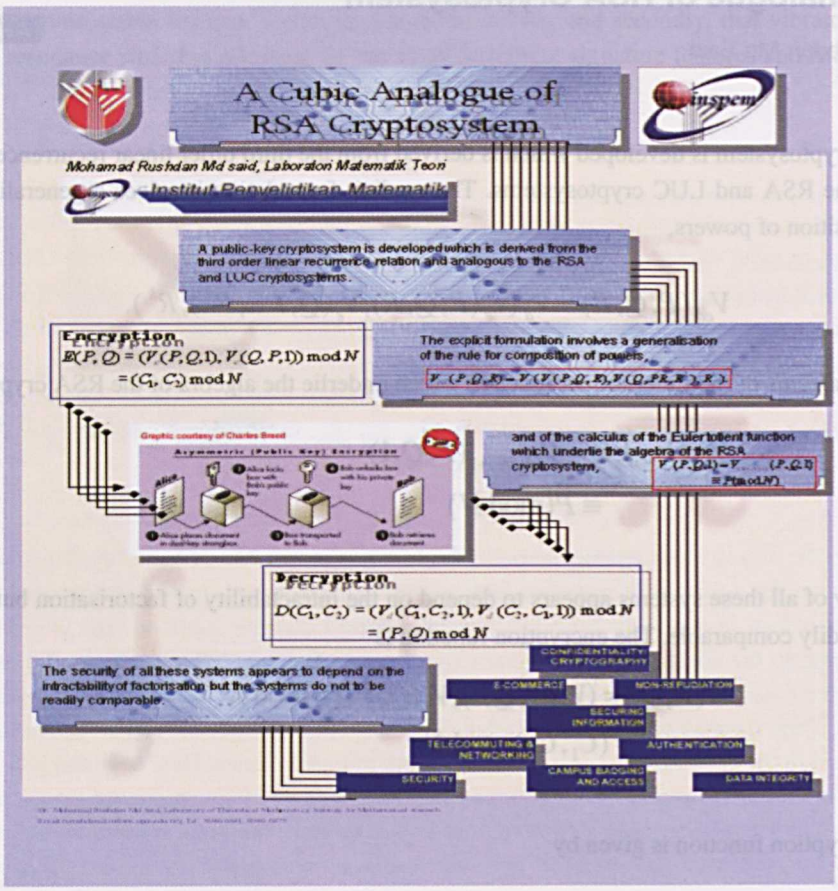
$$\begin{aligned} V_{ed}(P,Q,1) &= V_{k\Phi(N)+1}(P,Q,1) \\ &\equiv P(\mathrm{mod}\, N) \end{aligned}$$

The security of all these systems appears to depend on the intractability of factorisation but the systems do not to be readily comparable. The encryption function is

$$\begin{aligned} E(P,Q) &= (V_e(P,Q,1), V_e(Q,P,1)) \bmod N \\ &= (C_1, C_2) \bmod N \end{aligned}$$

and the decryption function is given by

$$\begin{aligned} D(C_1,C_2) &= (V_d(C_1,C_2,1), V_d(C_2,C_1,1)) \bmod N \\ &= (P,Q) \bmod N \end{aligned}$$



Reader Enquiry
Institute of Mathematical Research
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8431
E-mail: mrushdan@inform.upm.edu.my

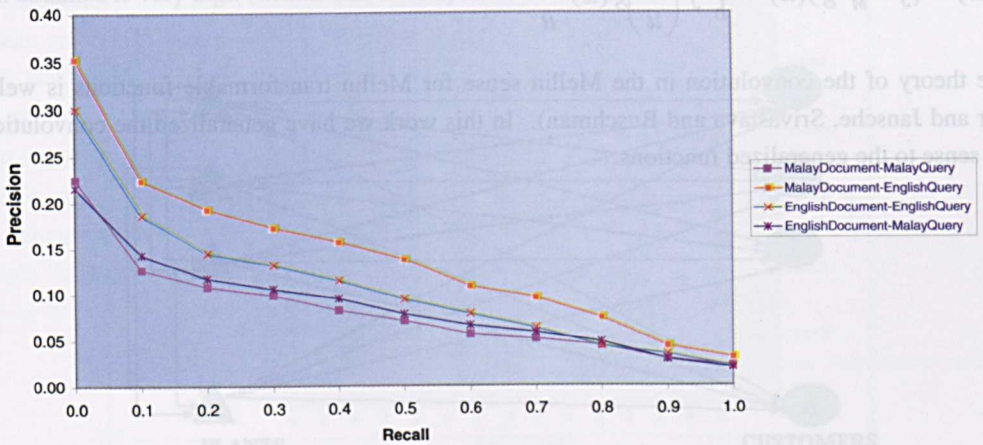
Malay-English Cross-Language Information Retrieval



Muhamad Taufik Abdullah, Hjh. Fatimah Dato' Ahmad, Ramlan Mahmod and Tengku Mohammed Tengku Sembok

Cross-language information retrieval refers to retrieval when the query and the database are in different languages. This form of retrieval is increasingly relevant, as network-based resources become commonplace and increasing amount of online documents available in foreign language. In cross-language information retrieval, users are allowed to build a query in their native language to search documents written in another language and utilize the retrieved result.

The Malay-English cross-language information retrieval system is developed based on latent semantic indexing method. This method is a variant of the vector space method in which a low-rank approximation to the vector space representation of the database is employed. The main idea in latent semantic indexing model is to map each document and query vector into a lower dimensional space that is associated with concepts. This is accomplished by mapping the index term vectors into this lower dimensional space. The claim is that retrieval in the reduced space may be superior to retrieval in the space of index terms.



Malay-English Mono and Cross-Language Information Retrieval

This research has evaluated the performance of latent semantic indexing in monolingual and cross-language retrieval on Malay and English documents. Experiments are performed on the Malay and English translations of Quranic documents. The sets of queries used are natural language queries written in Malay and English. The results of monolingual experiment show that the performance of the English information retrieval is better than the Malay information retrieval. The results of cross-language experiment reveal that the Malay cross-language system performs better than the English cross-language system.

Reader Enquiry
Department of Multimedia
Faculty of Computer Science and Information
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6571
E-mail: taufik@fsktm.upm.edu.my

A Note on the Convolution in the Mellin Sense with Generalized Functions



Muhammad Rezal Kamel Ariffin and Adem Kilicman

The classical convolution given by

$$h(x) = (f * g)(x) = \int_{-\infty}^{\infty} (x-t)g(t)dt$$

is widely accessible in many literatures including its extension to generalized functions (Gelfrad and shilov, A. Zemanian). Another form of convolution is given by the Mellin convolution (i.e. convolution in the Melllin sense), which is given by

$$h(x) = (f *_M g)(x) = \int_0^{\infty} f\left(\frac{x}{u}\right) g(u)\frac{du}{u}$$

The theory of the convolution in the Mellin sense for Mellin transformable functions is well known (Butzer and Jansche, Srivastava and Buschman). In this work we have generalized the convolution in the Mellin sense to the generalized functions.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

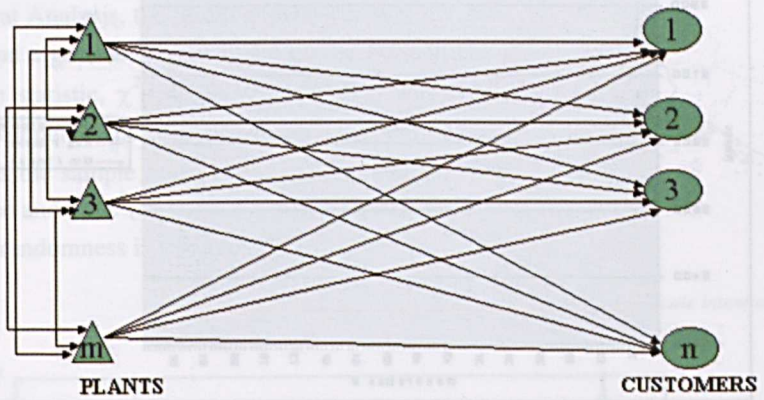
Tel: +603 8946 6838
E-mail: rezal@fsas.upm.edu.my

Genetic Algorithm (GA) Based Heuristic Approach to Solve Capacitated Multi-Plant, Multi-Item, and Multi-Period Production and Distribution Planning Problems with Inter-plant Transfers



Murali Sambasivan and Salleh Yahya

This paper addresses scheduling of lot sizes in a multi-plant, capacitated environment with inter-plant transfers. A real world problem in a company manufacturing steel rolled products provided motivation to this research. Relaxation of the capacity constraints gives rise to incapacitated lot-sizing problem. Sambasivan Murali (1994) has studied the incapacitated problem in detail. He has derived properties of optimal solution and based on these properties has re-formulated the problem into a set of *m*-shortest path problem with common fixed charge constraints. He has also developed a "good" solution procedure to solve this special network problem. Extensive experimentation with the solution procedure has shown that the quality of the solution obtained is very high (within 0.25% of optimal solution).

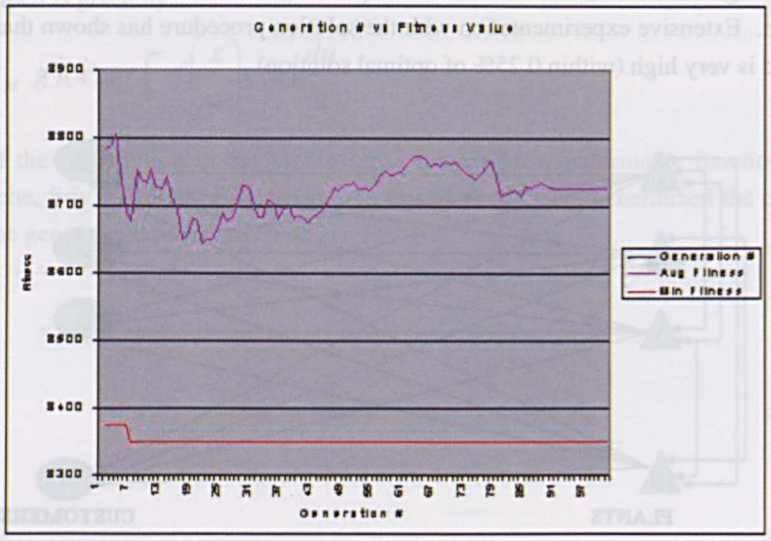


Pictorial Representation for The Multi-Plant Lot Sizing Problem

Ever since Goldberg (1989) popularized Genetic Algorithm (GA) to solve optimization problems, many optimization problems have been solved effectively using GA. This research uses this novel approach (GA) to solve multi-plant, capacitated, production and distribution planning problems. In GA definition of chromosome plays a vital role. The chromosomes are defined as strings of '1's and '0's denoting if a setup has been made (1) or not (0) in a plant during a period. Capacitated lot sizing problems are easy to solve once the setups made are known and the procedure developed by Sambasivan Murali (1994) is used to solve. The algorithm uses three genetic operators during each generation: reproduction, cross over, and mutation. Reproduction is accomplished based on fitness values (objective function value) of chromosomes; cross over and mutation are accomplished based on random numbers.

NATURAL	GA
Chromosome	String of '0's and '1's
Gene	Feature, Character
Allele	Feature Value
Fitness Value	Objective Function Value
Genotype	Structure (same as string)
Phenotype	Decoded structure
Epistasis	Nonlinearity

Comparison of Natural and Ga Terminology



Population Generation vs Fitness Values

This paper also addresses the computational complexity of the capacitated problem and also the motivation behind the multi-plant problem. The GA-based heuristic has been coded using FORTRAN LF95 and few instances of the problem have been solved. In general, GA-based heuristic has been found to provide "good" solutions for multi-plant, capacitated lot sizing problems with inter-plant transfers.

Reader Enquiry
Graduate School of Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7698, 8946 7704
E-mail: murali@econ.upm.edu.my

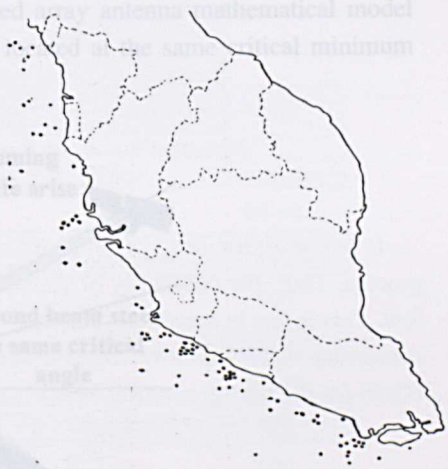
The Spatial Distribution of Intentional Oil Spills in the Straits of Malacca



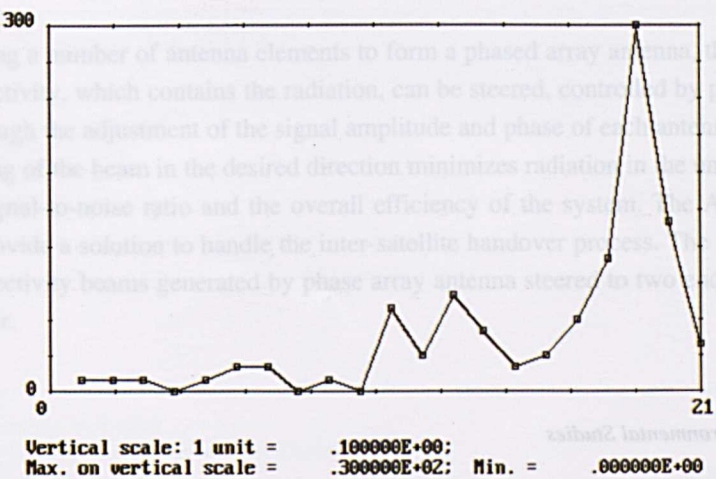
Murugeson Kallianna and Mahendran Shitan

The Straits of Malacca is one of the busiest shipping lanes in the world and hence the threat of oil spills due to collision or otherwise is very real. The Straits of Malacca is also an important source of revenue to the country. There are also some exotic tourist spots on the west coast of Peninsular Malaysia exposed to the straits. Therefore, it is of vital importance that the eco-system of the straits be maintained and managed. Hence, in this research we investigated the intentional oil spills in the Straits of Malacca.

The data set used in this study is for the period from 1976 to 1998 and is obtained from MASDEC. The proportion of intentional oil spills and their source were computed. Time series plots as well as spatial plots were done. In the figure, the **black dots** indicate intentional oil spilled areas. Quadrat Analysis and Variance-Mean ratio were used in order to investigate the spatial distribution. In Quadrat Analysis, the Straits of Malacca was divided into 46 quadrats and a goodness of fit based on the Poisson Distribution using the statistic, $\chi^2 = \Sigma\ (fr - NP(r))^2 / NP(r)$ was computed. We also computed the variance-mean ratio defined as $I = s^2/m$, where m is the sample mean of the quadrat counts, s^2 is the sample variance and $I \sim c^2(N-1)$. If $I > c^2_a(N-1)$, then the hypothesis of spatial randomness is rejected.

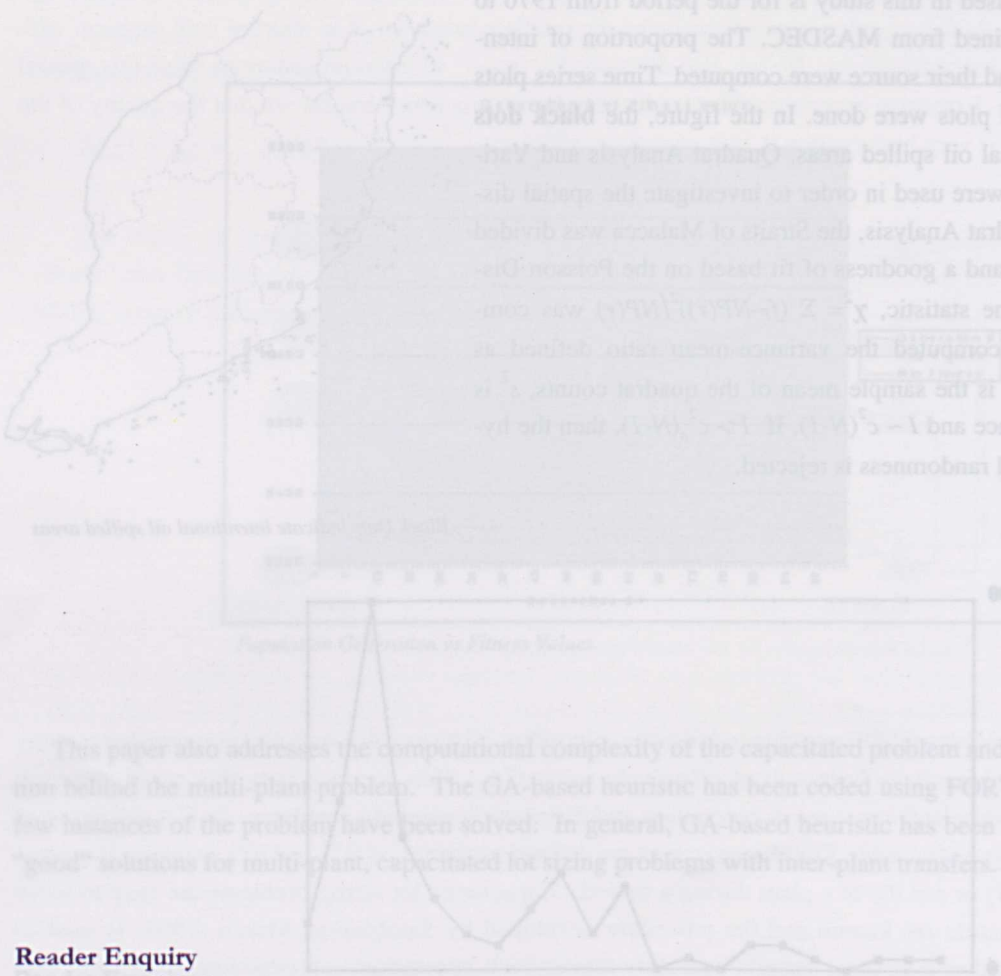


Black Dots indicate intentional oil spilled areas



Time Series plot of Intentional Oil Spills From 1976 to 1998

We found that almost 70% of the oil spills were intentional. A large amount, namely, 80% of the sources of intentional oil spills were due to foreign registered vessels. We also found that about 75% of the cases were in the southern part of the straits. There had also been a sharp increase in the number of intentional oil spills between the years 1994 to 1997. The quadrat analysis method and the variance-mean ratio indicated that the intentional oil spills occurred in clusters and these clusters were centered around the coastal waters of Malacca and Johor. This may imply that there are preferred areas of dumping due to convenience or otherwise.



Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6832
E-mail: mahen@fsas.upm.edu.my

Inter-Satellite Handover for Non-GEO Satellites Using Adaptive Steered Beams (ASB) Algorithms



Nor Kamariah Noordin, Borhanuddin Mohd Ali, Sabira Khatun,
Ratna Kalos Zakiah Sahbudin, Ng Chee Kyun and Aduwati Sali

This invention present the develop and implement an algorithm in which a dual beam pair will be generated for non-geostationary (non-GEO) satellites tracking which is called Adaptive Steered Beams (ASB) algorithm. The principle of this algorithm is based on the generation of two beams to track the two satellites located at opposite ends of the horizon for handover. This event occur at the moment when the outgoing satellite exceeds the well defined minimum critical elevation angle where at the same time the incoming satellite is located at the same minimum critical elevation angle at the other end. This algorithm is demonstrated through simulation of dual beams generated by using phased array antenna mathematical model where both high directivity beams are used to steer both satellites located at the same critical minimum angles at the opposite ends of the orbit.

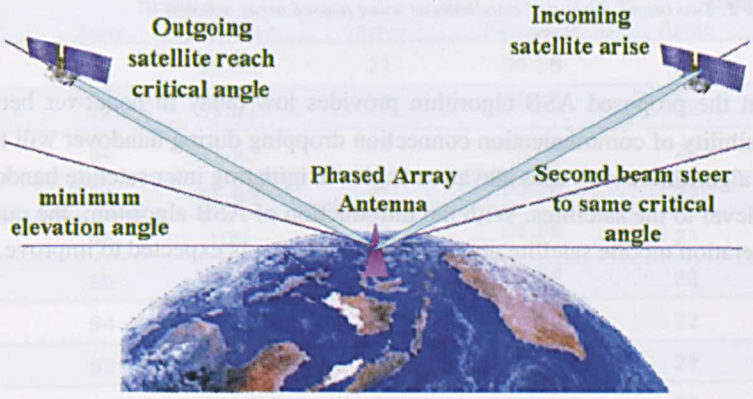


Figure 1: Overview of ASB algorithm

By assembling a number of antenna elements to form a phased array antenna, the direction of the main beam or its directivity, which contains the radiation, can be steered, controlled by phase shifter. This is accomplished through the adjustment of the signal amplitude and phase of each antenna element in the array. Accurate pointing of the beam in the desired direction minimizes radiation in the unwanted direction, and it improves the signal-to-noise ratio and the overall efficiency of the system. The ASB algorithm has been developed to provide a solution to handle the inter-satellite handover process. The ASB algorithm is based on two high directivity beams generated by phase array antenna steered to two ends of elevation angle for smooth handover.

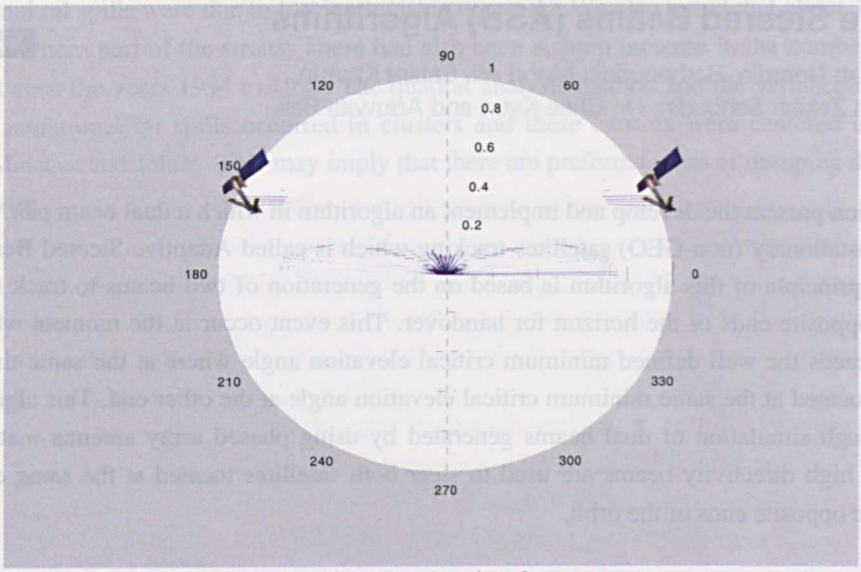


Figure 2: Two beams generated simultaneous using phased array antenna

It is concluded that the proposed ASB algorithm provides low delay in handover between satellites process. Thus, the possibility of communication connection dropping during handover will be significantly low. This is due to the algorithm which uses elevation angles in initiating inter satellite handover, instead of measuring signal link level to the satellites. With the introduction of ASB algorithm, the quality of service (QoS) for the next generation mobile satellite communication system is expected to improve.

Reader Enquiry
Department of Computer and Communication Systems
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6433
E-mail: nknordin@eng.upm.edu.my

A Study on User Satisfaction Towards Job Recruitment System (ICIS 2000) by Students' Stream at UPM



Noraini Che Pa, Haji Hasan Selamat, Azrina Kamaruddin and Fatimah Khalid

User satisfaction is one of the important elements in the development of any system. A study has been done to measure user satisfaction among UPM students towards Job Recruitment Information System (ICIS). Web-based system (ICIS 2000) has been developed for this purpose. Respondents were directly evaluating the prototype system, ICIS2000 using a set of questionnaire. The purpose of the study is to identify the relationship between users satisfaction level towards the design of the human-computer interface. As a conclusion, users feel that the web-based system (ICIS 2000) has a high satisfaction when using the system.

Factors towards the usage of ICIS 2000 system	Streams					
	Science		Art		Engineering	
	Agree	*Percentage*	*Agree*	*Percentage*	*Agree*	*Percentage*
Functional	92	95.83	31	96.88	21	95.45
Access time	92	95.83	31	96.88	22	100
Text	94	97.92	31	96.88	22	100
Colors	92	95.83	31	96.88	22	100
Information	96	100	31	96.88	21	95.45
Presentation	95	98.96	31	96.88	22	100
Commands	94	97.92	31	96.88	22	100
Menu	93	96.97	32	100	22	100
Graphic	95	98.96	32	100	22	100

Users satisfaction by stream towards ICIS 2000 system

Reader Enquiry
Department of Information System
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6522
E-mail: norainip@fsktm.upm.edu.my

Numerical Analysis Online Learning

Norazak Bin Senu, Bachok M. Taib, Azmi Jaafar and Ismail Abdullah

AwardWinner

Advances in computer technology and human-computer interface have created a wealth of new opportunities for the development of computer-based instruction and intelligent tutoring systems. Unfortunately, much of the material currently available on "electronic books" has learning still accomplished by reading text and viewing two-dimensional images.

This project produced the online Numerical Computational Laboratory (NCL), which features an interactive, and web based learning system. NCL system consists of numerical analysis calculators, notes, tutorials and a few links that students can get other useful information. Using NCL, students can review lecture notes 24 hours a day, solve the online tutorials to test their understanding, and at the same time they can use the calculator that includes equation solvers, animations, and graphics as a learning support and e-mail facility in order to receive feedback on course material.



Fig. 1. Numerical Computational Laboratory (NCL)

The numerical analysis calculators are developed using Tcl/Tk. Tcl/Tk is a scripting language that supports many features such as building powerful Graphical User Interface (GUI), cross-platform applications, flexible integrations, network applications and embedded applications. Tcl plug in is a facility that enables application to run on browser.

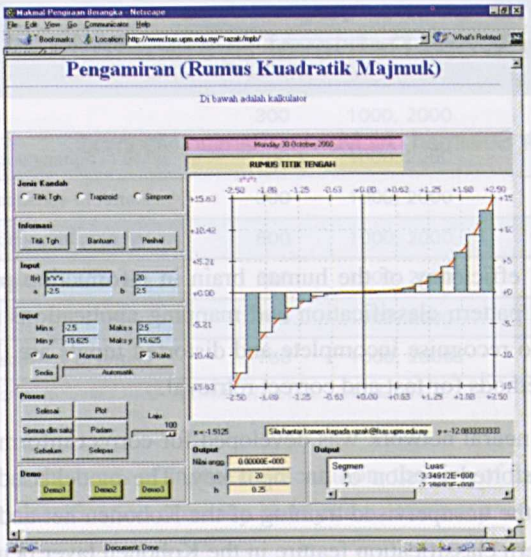


Fig. 2. An interactive and web based learning system

With these calculators, students can visualize and enhance understanding on the concept of numerical method such as solving Simultaneous Linear Equations, Numerical Differentiation and Integration, Interpolation, Nonlinear Equations, Function Approximation and Data Fitting and Ordinary Differential Equations. Numerical analysis notes and tutorial prepared using LaTeX are then converted to PDF file.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6848
E-mail: razak@fsas.upm.edu.my

Neural Network for a Word Retrieval System from a Database



Nur Izura binti Udzir, Md. Nasir Sulaiman, Ali Mamat, Ramlan Mahmod and Fatimah Ahmad

Inspired by the capability and efficiency of the human brain in information processing, artificial neural networks were widely used in pattern classification and mapping applications. Their robustness in noisy environment and their ability to recognise incomplete and distorted inputs are their main advantages over the conventional computing methods for fast and correct retrieval.

Associative retrieval using neural network was developed for correct information retrieval from a certain database when given a distorted version of an input key. The model used in this study is Counter-propagation, a combination of the unsupervised training of the Kohonen net and the supervised Grossberg net, with the unsupervised pattern classification feature in the Kohonen layer being the most important part of the system.

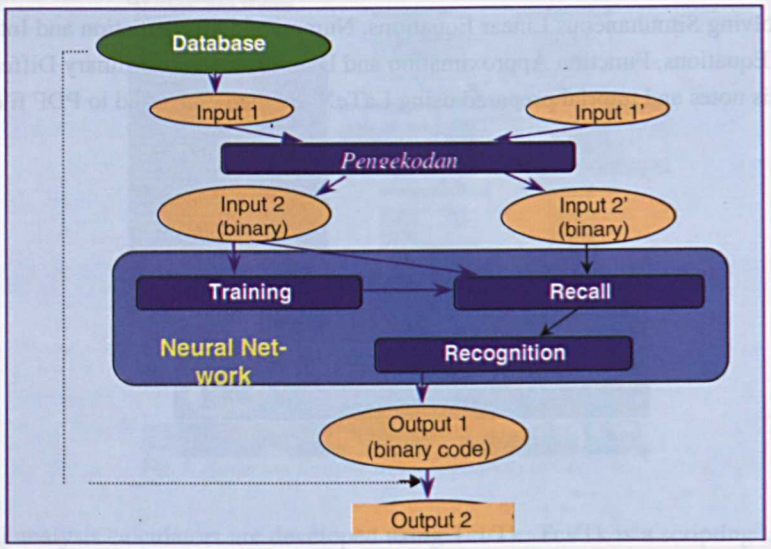


Fig.1: Database Word Retrieval System Developed

The focus of the study was the performance of the net specifically on the classification accuracy when different coding schemes were applied to represent the inputs. Seven coding schemes were used in the research, with different bit-size (i.e. number of bits) and encoding base. As test sets, we used error free sets, single error data sets, and double error sets.

Overall, all experiments have produced satisfying results. With every encoding scheme, the network has successfully recognised all test sets given with 100% recognition, though with different combination of number of competitive units, training cycle and time. However, the nets using coding schemes with a certain base showed better performances over schemes without any encoding base.

Scheme	Number of Bits	Base of Coding	Input Unit	Competitive Unit	Output Unit	Database Size
A	10	Nil	300	1000, 2000	100, 200	100, 200
B	10	Pronunciation in BM	300	1000, 2000	100, 200	100, 200
C	10	Frequency of letters	300	1000, 2000	100, 200	100, 200
D	20	Pronunciation in BM	600	1000, 2000	100, 200	100, 200
E	20	Frequency of letters	600	1000, 2000	100, 200	100, 200
F	26	Nil	780	1000, 2000	100, 200	100, 200
G	26	Frequency of letters	780	1000, 2000	100, 200	100, 200

Main characteristics of representation schemes used, network structures and database sizes

The study has proven that the types of input representation, the size of the competitive layer and the optimum training cycle affect classification accuracy and system efficiency.

Reader Enquiry
Department of Computer Science
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6512
E-mail: izura@fsktm.upm.edu.my

Chromatic Equivalence Classes of Certain Generalized Polygon Trees



Peng Yee Hock and Omoomi Behnaz

A λ - colouring of a graph G is an assignment

$$C: V(G) \to \{1, \ldots, \lambda\}$$
$$v \qquad \mapsto c(v)$$

such that if u and v are adjacent, then $c(u) \neq c(v)$. Two λ-colouring c_1 and c_2 of G are different if and only if $c_1(v) \neq c_2(v)$ for some $v \in V(G)$. The number of distinct λ-coluring of G is denoted by $P(G, \lambda)$. For any graph G, $P(G, \lambda)$ is in fact a polynomial in λ, called the chromatic polynomial of G.

Two graphs G and H are chromatically equivalent, denoted by $G \sim H$, if $P(G, \lambda) =$

$P(H, \lambda)$. A set of graphs S is a chromatic equivalence class if for any graph H that is chromatically equivalent with a graph G in S, then $H \in S$. To study the chromaticity of a class S of graphs means to study the problems of determining the chromatic equivalence classes of graphs in S.

Consider the generalized polygon tree $G_t^s(a,b;c,d)$ shown in Figure 1. The integers

a, b, c, d, s, and t represent the lengths of respective paths between the vertices of degree three, where $s \geq 0$ and $t \geq 0$. Let $r = s + t$. We now form a family $C_r(a, b; c, d)$ of the graphs $G_t^s(a,b;c,d)$ where the values of a, b, c, d and r are fixed but the values of s and t vary; that is

$$C_r(a, b; c, d) = \{ G_t^s(a,b;c,d) \mid r = s+t, s \geq 0, t \geq 0 \}.$$

The following problem was posted in "K.M. Koh and K.L.Teo, The search for chromatically unique graphs II, Discrete Mathematics, 172: 59 – 78, 1997."

Problem: Study the chromaticity of $G_t^s(a,b;c,d)$ in general.

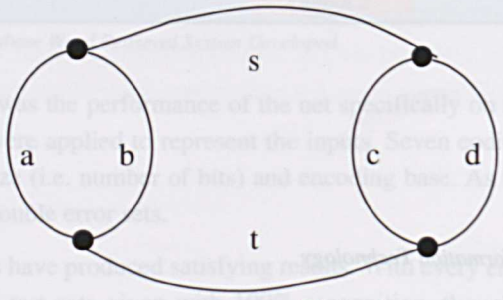


Figure 1: Generalized Polygon tree $G_t^s(a,b;c,d)$

The following theorem is a **complete solution** to this Problem.

Theorem: The family of graphs $C_r\ (a,b;c,d)$ is a chromatic equivalence class if and only if it is not one of the following families of graphs.

$C_r\ (1,b;c,d)$, for any $r \geq 0$, $c \neq r+1$, and $d \neq r+1$;

$C_0(2,b;b+1,b+2)$ for any b ≥ 2 ;

C_1 (2, 3 ; 3, 5) ;

C_1 (3, 5 ; 5, 8) ;

C_1 (3, b ; b + 1, b + 3), for any $b \geq 3$;

C_1 (3, c + 3 ; c, c + 1), for any $c \geq 3$;

C_1 (3, 3 ; c, c + 2), for any $c \geq 3$;

C_1 (3, b ; 3, b + 2), for any $b \geq 3$;

C_3 (2, 3 ; 2, 4) ;

C_5 (2, 6 ; 4, 5);

C_3 (2, c + 1 ; c, c + 2), for any $c \geq 3$;

C_3 (2, c + 2; c, c + 1), for any $c \geq 3$;

C_r (2, 4 ; 3, r + 2), for any $r \geq 2$;

C_r (2, r + 2); 3, 4), for any $r \geq 2$;

C_r (a, r + 2 ; a + 1, a + r + 2), for any $a \geq 2$ and $r \geq 2$;

C_r (a, a + 1 ; r + 2, a + r + 2), for any $a \geq 2$ and $r \geq 2$;

C_r (r – 1, c + 1; c, c + r – 1), for any $c \geq r \geq 2$;

C_r (r - 1, c + r – 1 ; c, c + 1), for any $c \geq r \geq 2$.

Reader Enquiry
Department of Mathematics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6852
E-mail: yhpeng@fsas.upm.edu.my

An Improved Public Key Cryptography Based on The Elliptic Curve

Ramlan Mahmod and Essam Faleh Al-Daoud

Elliptic curve cryptography offers two major benefits over RSA: more security per bit, and a suitable key size for hardware and modern communication. Thus, this results to smaller size of public key certificates, lower power requirements and smaller hardware processors.

Three major approaches are used in this report to enhance the elliptic curve cryptsytems: reducing the number of the elliptic curve arithmetic operations, speeding up the underlying finite field operations and reducing the size of the transited parameters. A new addition formula in the projective coordinate is introduced, where the analysis for this formula shows that the number of multiplications over the finite field is reduced to nine general field element multiplications. Thus this reduction will speed up the computation of adding two points on the elliptic curve by 11 percent. Moreover, the new formula can be used more efficiently when it is combined with the suggested sparse elements algorithms.

To speed up the underlying finite field operations, several new algorithms are introduced namely; selecting random sparse elements algorithms, finding sparse base points, sparse multiplication over polynomial basis, and sparse multiplication over normal basis. The complexity analysis shows that whenever the sparse techniques are used, the improvement rises to 33 percent compared to the standard projective coordinate formula and improvement of 38 percent compared to affine coordinate. A new algorithm to compress and decompress the sparse elements algorithms is introduced to reduce the size of the transited parameters.

The enhancements are applied on three protocols and two applications. The protocols are Diffie-Hellman, ELGamal and elliptic curve digital signature. In these protocols the speed of encrypting, decrypting and signing the message are increased by 23 to 38 percent. Meanwhile, the size of the public keys are reduced by 37 to 48 percent. The improved algorithms are applied to the on-line and off-line electronic payments, which lead to probably the best solution to reduce the objects size and enhance the performance.

Reader Enquiry
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6852
E-mail: ramlan@fsktm.upm.edu.my

Wireless File Transfer Using Bluetooth Technology

Ratna Kalos Zakiah, Goh Kean Jeet, Sabira Khatun and Ng Chee Kyun



The world of wireless technology has reached most of us in this rapidly developing IT days. Bluetooth, the latest wireless system technology which has gained the support from leading manufacturers had already deployed it's services few years ago are in it's way to conquer the wireless world. Bluetooth is a low power, low cost, short range RF technology that focuses on replacement of cables between electronic devices. It uses a fast frequency-hopping spread spectrum (FHSS) scheme and operates in the unlicensed Industrial Scientific Medical (ISM) band at 2.4 GHz. This project demonstrates the wireless file transfer from one PC to another PC using Ericsson Bluetooth Module (ROK101 008). In addition four main functions have been successfully implemented. They are Display, Save and Print the transferred file, and Chatting application.

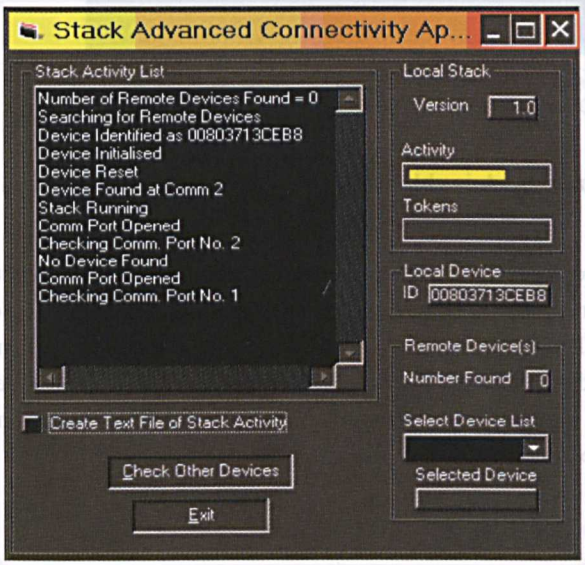


Figure 1: Shows information of activities performed by Stack including initialize and identify Local Device (which is personal computer A)

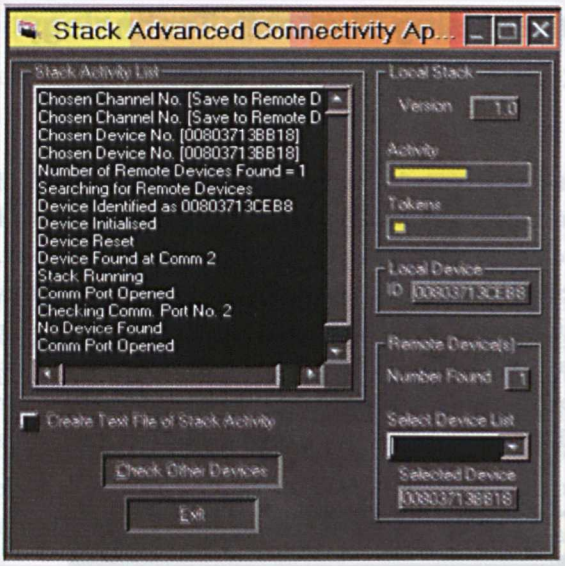


Figure 2: Information of activities performed by Stack including search and identify Remote Device (which is personal computer B)

These two figures show that once PC A is able to locate PC B then file transfer can take place between the two PCs.

The major advantage of this project is for a wireless office environment and home networking, which are in great demand today. The source code was written in Visual Basic 6.0 (VB) and used ActiveX component. It involved only two of the Bluetooth Protocol Stacks that is the Host Controller Interface (HCI) layer, and the Logical Link Control and Adaptation Protocol (L2CAP) layer. The HCI provides a command interface to the baseband controller and link manager, and access to hardware status and control registers. L2CAP is layered over the Baseband protocol and resides in the data link layer.

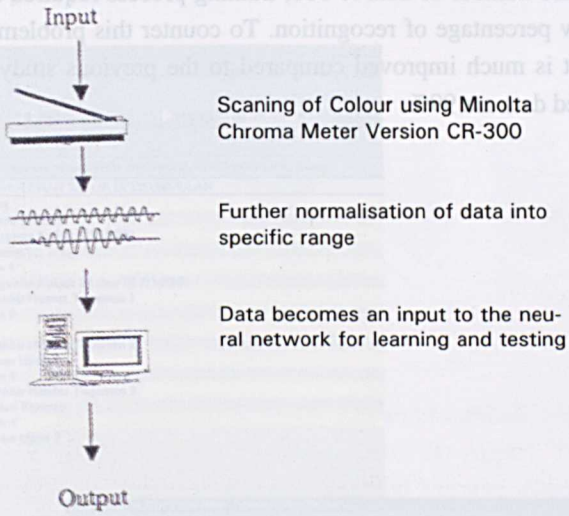
Reader Enquiry
Department of Computer and Communication Systems
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6431
E-mail: ratna@eng.upm.edu.my

Multi-layer Neural Network for Colour Recognition

Razali Yaakob, Md. Nasir Sulaiman, Ramlan Mahmod, Abd. Rahman Ramli and Mahmud Tengku Muda Mohamed



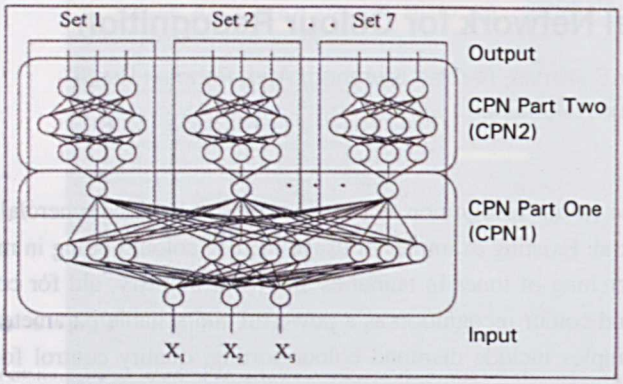
The need for an automatic colour recognition system for industrial and commercial applications as well as in agriculture is very crucial. Existing examples of usage include colour coding in manufacturing of electrical equipment, colour matching of tones in tanneries and paint industry, aid for colour recognition to the blind and colour-blind, and colour recognition as a powerful and reliable parameter for object recognition in robotics. Specific examples include diamond colour sorting, quality control for the manufacturing of coloured paper and grading of fruits based on colour.



Multi Layer Neural Network for Colour Recognition in General

Multi-layer neural network is sued to recognize the colours automatically. The data that represent the colours are scanned using Minolta Chroma Meter, which is capable to change colour into values. It offers five different colour systems for measuring absolute chromaticity, that is, CIE, Yxy, L*a*b*, L*C*H, Hunter Lab and XYZ. In this study, we use only L*a*b*. Two types of neural network were used in the early stage of study, i.e. Backpropagation (BP) and Counterpropagation network (CPN), where 100 data were used for testing.

The results show that CPN recognized 100% of trained data and untrained data however BP can only recognize 49% of trained data and 48% of untrained data.



Multi-CPN Network Architecture

With an increase in the number of data to 808, training process required a large size memory, learning time consuming and low percentage of recognition. To counter this problem, two-combined CPNs model are proposed. The result is much improved compared to the previous study, whereby the percentage for trained data and untrained data are 99%.

Reader Enquiry
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

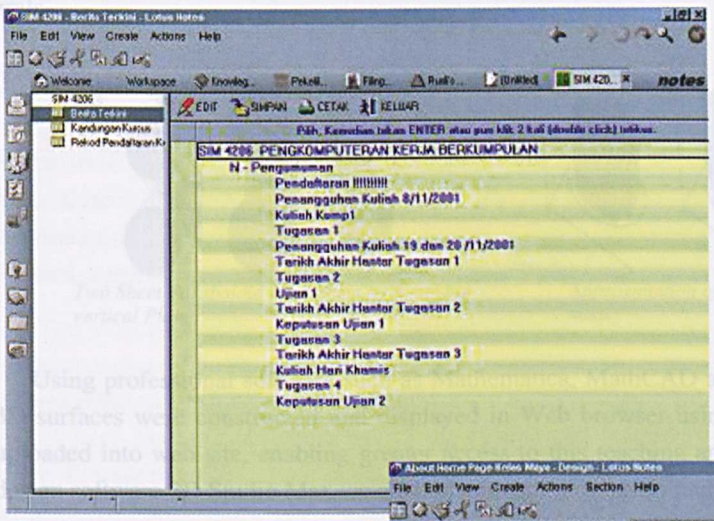
Tel: +603 8946 6585
E-mail: nasir@fsktm.upm.edu.my

The Development of Courseware for Virtual School

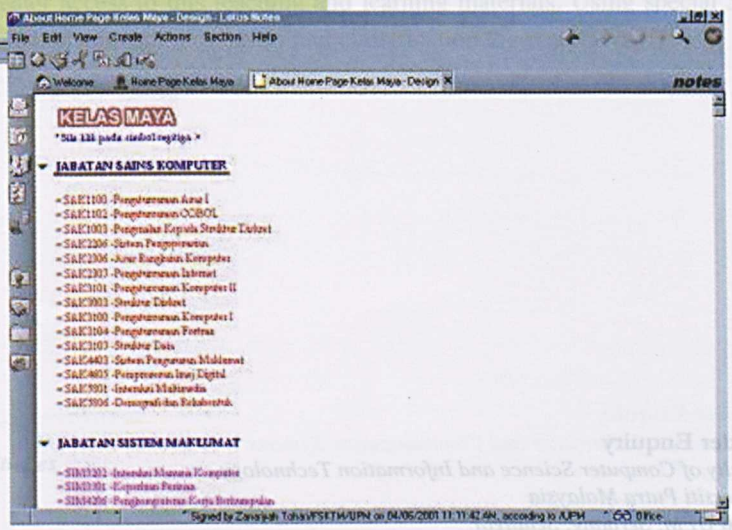
Rusli Hj. Abdullah



The current Information Technology (IT) capabilities have assisted users in their daily business without knowing what areas as well as professions they are involved. This includes the areas of teaching and learning where those who are in the borderless world could have a chance for long life learning and at any time using IT. Based on this learning system, a concept is introduced called Virtual School. In term of definition, this concept emphasis on learning that is based on software technology environment such as workgroup computing (groupware) and network computer or cyber technology where students, teachers, and school management as well as parents could closely monitor the process of learning and do the evaluation at any time as it could also be operated at any time regardless of any border and place.



IT based Virtual School



Courseware for Virtual School

Through this concept, students could plan the methodology of their study with their teacher's assistance and involvement. Besides that, students are also given the freedom to learn on their own as they could discuss and set a formal appointment or vice verse with their teacher at any time via online video conferencing or offline method that uses a compact disc. For school management and parents, this system will assist them in terms of monitoring and evaluating the quality of education at its school very easily as well as to allow them to do an interaction among others in virtual environment. Therefore, the environment of learning would be easier and has its advantage in terms of time, money and resources besides offering multi channel or resources with full time or part time selection.

Reader Enquiry
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6518
E-mail: rusli@fsktm.upm.edu.my

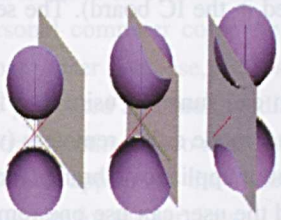
Animated Calculus

Rustem Suncheleev

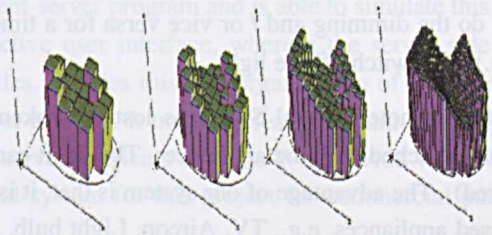
Award*Winner*

Computer based learning and teaching is fast growing sector in world economy. Recent review on e-learning shows that students become increasingly comfortable with computer and web based learning. In recent years many publications and web sites on modern technologies in teaching and learning have emerged. Some of them just online books and lecture notes, other provide more sophisticated and interactive learning. But still the problem of natural integration of modern technologies in teaching and learning mathematics is far from its final solution.

The aims of this research are to give some ideas how technology can be used in teaching and learning mathematics, to develop new interactive and visual software for mathematics education, to make visible and understandable the concept of multiple integral and methods for evaluating of double and triple integrals.



Two Sheet Paraboloid intersected by a moving vertical Plane



Approximation of the volume of the solid by Riemann sums

Using professional software such as Mathematica, MathCAD and MathLab, Flash-5 different types of 3D surfaces were constructed and displayed in Web browser using 3D Applet. This information can be uploaded into web site, enabling greater access to this teaching and learning materials. Using special 3D design software 3D Studio Max we created animation for study and classification these surfaces.

Reader Enquiry
Department of Mathematical
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6855
E-mail: rustem@inform.upm.edu.my

Remote Control Light Switch



Sabira Khatun, Nor Kamariah Noordin, Ratna Kalos ZakiahSahbudin,
M. Hasbullah Md. Marham, Fazirul Hisyam Hashim and Noor Asmawati Samsuri

Remote Control Switch is mainly a remote control handset, which can be used to switch on or switch off a set (maximum 64 units) of electrical and or mechanical appliances (switches) using either IR or RF signal. It uses only one frequency (very low) and coding – decoding technique to operate all the appliances (i.e. one code for one appliance). In the main unit (Remote Control Switch), there is one button for each appliance (i.e. 64 buttons for 64 appliances). The small receiver (just like a tag) attached with the appliances would receive the signal from the main unit, decode the command from it and apply on the appliance if the command is targeted to itself. For the case of electric bulb, side by side the switch on – off, the system has the dimming capability and or vice versa according to the user need. All the 64 appliances also can be turned on or off at a time using a single button if required. The first press (about 3 sec.) on the button of the main unit assigned for the indicates '1' (switch on the light). Then press and hold the same button will do the dimming and / or vice versa for a time cycle (fixed in the IC board). The second press (about 3 sec.) will switch off the light.

In case the Remote Control Switch is lost or broken, the system can function using the fixed wired switch buttons attached with the appliances. That is, it can work in dual mode either remotely (wireless) or directly (wired) . The advantage of our system is that, it is independent of appliance's brand (for household and office used appliances, e.g., TV, Aircon, Light bulb, PC etc.) and the user can use one remote instead of many.

Reader Enquiry
Department of Computer and Communication Systems
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6435
E-mail: sabira@eng.upm.edu.my

Network Independent Video on Demand System (VoD) Software



Sabira Khatun, Ong Kar Chun, Ng Chee Kyun, Aduwati Sali and Hasniza Hambali

This invention presents a complete interactive Video on Demand System (VoD) software to provide interactive VoD system in which the user has control over the session presentation through the high speed or any other network, including Asynchronous Transfer Mode (ATM) networking technology. The advantage of using the ATM or optical network as backbone network is its ability to support video, voice, and data simultaneously at the maximum high-speed rate of 155Mbps or higher. A client-server based software architecture id developed using Windows 2000 Server and Windows 98 operating system and installed in two PCs as server and client.

A typical VoD scenario consists of a local database and server-connected user via a communication network. Apart from watching movie, this implementation can also be applied for educational purpose. The VoD system is based on a two way interactive client-server program and is able to simulate this scenario on client's personal computer complete with interactive user interface, whereas the server side consists of video database, user database, videos and data files. Besides this, the organization of education materials will also be presented as a multimedia content over Internet. It involves designing and building a complete system for transmitting video and data files from server to clients over the World Wide Web (WWW). The billing system is applied to the Video on Demand system for this project for commercial purpose where client have to pay for the services.

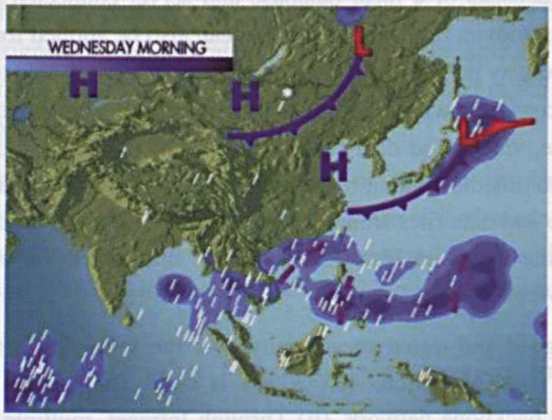
The VoD system is designed and tested successfully over the following networks: (i) Through ATM network, where ForeRunner™ ATM switch, *ASX-200BX* is used. There is no delay for the video to be downloaded over high-speed backbone network. (ii) Through Intranet, multiple PCs are connected within Local Area Network (LAN) to access the system and the video can be sent simultaneously without any delay to multiple users at the same time. (iii) Through World Wide Web (WWW), there is a delay for the video to be played at the client's browser. The buffering is needed for the video player to encode and play the videos through Internet.

Reader Enquiry
Department of Computer and Communication Systems
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6435
E-mail: sabira@eng.upm.edu.my

Parallel Computation on Weather Prediction using Two Levels Barotrophic Model

Susila Bahri, Bachok M. Taib, Rodzita Johari and Fudziah Ismail

Forecasting model for the short-range weather prediction that is used here is the two levels barotrophic model. This model is applied because it can give approximation for the air condition covering to higher isobar levels. By using the finite difference approximation, the quasigeostrophic vorticity equations that constitute the difference equation and the forecasting equations for each level are determined. The forecasting equation can them be solved by determining the suitable lateral conditions so that the geopotential heights are modified by using a formula. This can be achieved by using grids chosen from the meh scale. In effect, the system of equation is found. Then it is solved by using successive Over Relaxation method.



The data from British Atmospheric Data Centre (BDAC) is applied to the C program in UNIX operating system, which has been made. The program is then transformed into the parallel program.

Reader Enquiry
Department of Mathematical
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6821
E-mail: fudziah@fsas.upm.edu.my

Algorithm Synthesis for Modelling Cyclic Processes

Thomas S. Y. Choong



Depending on the problem and initial conditions, the simulation of cyclic processes may require hundred or thousands of cycles to reach cyclic steady state (CSS). It is therefore desirable to improve the computing efficiency of the simulation. Further, there is no satisfactory criterion for recognising CSS. Novel algorithm features that addressed these issues are developed.

The novel features of the algorithm are first studied using some simple algebraic equations. The algorithm features are then tested in the modelling and simulation of rapid pressure swing adsorption (RPSA), an effective process for air separation. The RPSA models are solved numerically using the method of lines. The governing partial differential equations are discretised spatially using the method of orthogonal collocation. This reduces the equations to a system of ordinary differential equations, which are then integrated over time using a standard numerical integration algorithm. Computer programs written in FORTRAN 90 are developed for the simulations.

Two novel algorithm features for processes that exhibit CSS are developed. We characterised the CSS, which involves spatial profiles at different instants during the cycle, by a single proxy variable, namely the oxygen product purity averaged over a complete cycle. The first novel feature of the algorithm is an *a priori* rational stopping criterion for transient simulation. The application of the rational stopping criterion bounds the CSS from above and below. This ensures that neither the progress towards CSS is truncated prematurely nor does simulating a needlessly large number of cycles waste computer time. The second feature of the algorithm is a reduction of the number of cycles required to reach the CSS while ensuring that the CSS is bracketed. The conditions where these two algorithm features are applicable have been identified. In the RPSA examples considered, a reduction in computing time by a factor of four is achieved.

Two novel algorithm features for the transient simulation of cyclic processes that exhibit CSS have been proposed. In principle, the algorithm could be used for any cyclic processes. Air separation using RPSA is used to demonstrate the algorithm features.

However, the application of the algorithm features is currently limited by rounding error occurring in the simulation. Therefore, the algorithm features may need further development before proving to be suitable for processes that converge very slowly towards CSS or for processes, which involve low concentrations of adsorbates.

Reader Enquiry
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6296
E-mail: tsyc2@eng.upm.edu.my

Development of Interactive Physics Multimedia Modules (Mechanics)



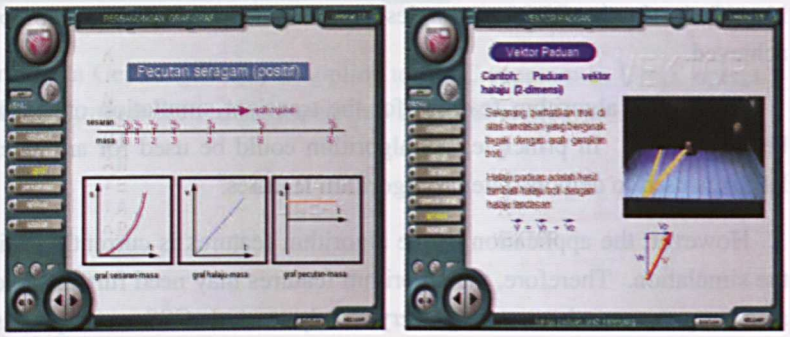
Zaidan Abdul Wahab and Zainal Abidin Sulaiman

Over the last decade computer technology has developed significantly to enable a personal computer (PC) to be used not only for scientific calculations and data analysis, but also an important and useful tool for use in the teaching and learning environment. A multimedia PC is able to combine text, audio, graphics video and animation, and presenting these elements in a meaningful way to the computer screen. Currently the interests of instructional designer and ecucators have shifted to the use of multimedia as another mode of information delivery.

In the research conducted, we explore, study and develop multimedia based teaching-learning modules in Physics for use by students at the upper secondary and first year university undergraduates. We have adopted that an appropriate and exciting learning module should contain relevant and accurate contents as well as well defined, focussed sequence of learning steps. Authoring software, graphics editors and audio/video capturing programs were used during the development stage. Simulations and animations included in the module can give students engaging, hands-on and active learning experiences. The exploratory nature of learning is also realised through the virtual experiment activities. The user interface and overall instructional design is studied and tested to give positive impact on the teaching and understanding of the concepts. The finished module is prepared in a CD-ROM version for easy installation on individual PCs. The focus of the module is on the effective use of multimedia approach to the learning of mechanics, which include topics on vector, forces, kinematics and rotational dynamics.



Main menu—Interactive Multimedia Modules



Multimedia based teaching learning—Physics modules

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6686
E-mail: zaidan@fsas.upm.edu.my

Development of Web Based Automation System for the Study of Superconducting Magnetic Levitation Phenomena



Zainal Abidin bin Sulaiman, Abdul Halim Shaari, Ionel Valeriu Grozescu, Zaidan Abdul Wahab and Teh Jia Yew

Computers can be utilized to control instruments, machines, motors, devices etc. Presently, an Automation System has been constructed and successfully used to measure the levitation force in the Bi-Sr-Ca-Cu-O (BSCCO) high T_C superconductor system.

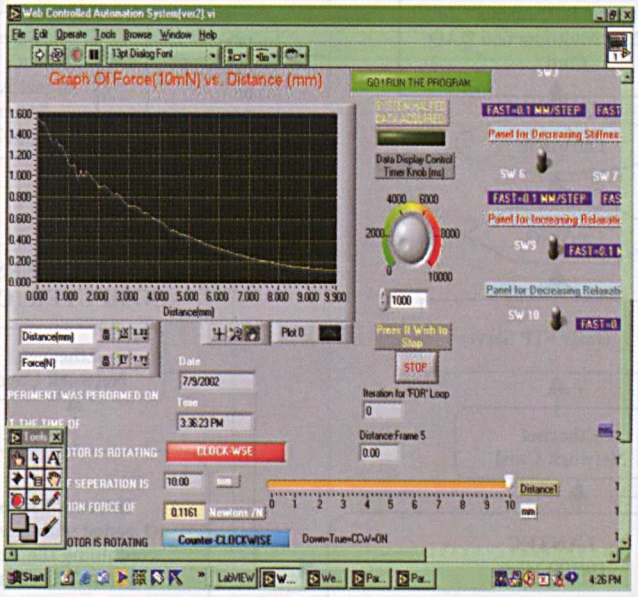


Figure 1: The User Interface for The Web Based Automation System

The major goal of this research is to vastly improve and enhance the existing Automation System to enable it to be controlled remotely via the Internet, through the use of a computer interfacing software called LabVIEW®. Apart from remote control, data acquisition is performed remotely through the Internet using LabVIEW. The existing Automation System comprises a PC with QBASIC software, stepper motor, stepper motor drive board and an opto-isolation circuit. Research is conducted to improve the existing Automation System via two major tasks: reprogramming the DOS-based QBASIC software into the Windows graphical based LabVIEW and perform electronic hardware improvements or enhancements on the existing Automation System. The improved and enhanced Automation System is utilized to conduct physics experiment of studying the superconducting magnetic levitation force, remotely through the Internet.

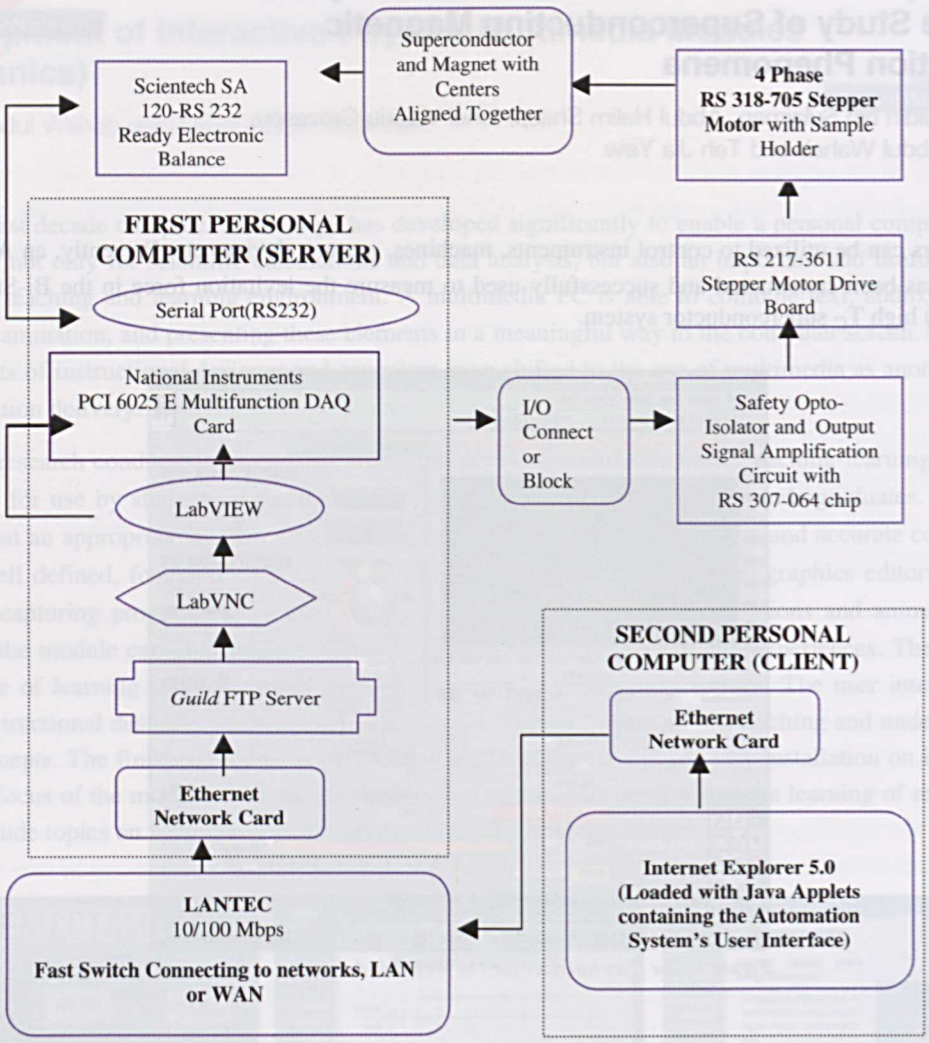


Figure 2: Schematic Illustration of The Web Based Automation System

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6687
E-mail: zainalas@fsas.upm.edu.my



Materials, Energy and Environment

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6687
E-mail: zulkafle@fsas.upm.edu.my

Contents

Materials, Energy and Environment

Determination of the Heating Values of Palm Oil Boiler Fuels 341

E. E. Supeni and M.Megat

CoastWatch 344

H. Assilzadeh, S. B. Mansor, A. R. Mohamd and H.M. Ibrahim

Turning Operation of Alloy Steel with Fuzzy Models 346

J.Y. Tan, S.V. Wong, A.M.S. Hamouda, Napsiah Ismail and M. R. Osman

Isolation and Characterization of EST's from Oil Palm Roots, Flowers and Meristems for the Development of a cDNA Chip 348

Lee Yang Ping, Ng Wai Har, Choi Mei Chooi, Meilina Ong Abdullah, Sharifah Shahrul Rabiah, Ho Chai Ling, Tan Siang Hee and K. Harikrishna

Preliminary Study on Steam Accumulator Sizing in Palm Oil Mill 350

Mohd.Halim Shah Ismail, Mustafa Kamal Abd. Aziz and Noor Azian Morad

Effect of Haze and Urban Atmospheric Pollutants on Agricultural Crops and Forest Species 352

Muhamad Awang, Wan Md Zin b Wan Yunus, Ahmad Makmom Abdullah and Zulkifly Kuang Abdullah

Pure Iron Oxide, Fe_2O_3 and Magnet $Ba/SrFe_{12}O_{19}$ from Steel-Mill Waste Product 354

Raba'ah Syahidah Azis, M.Hashim, A.Zakaria, J.Hassan, N.Yahya and N.M.Saiden

Tin (iv) Oxide Based Carbon Material Senses CO at Ordinary Temperature and Pressure above One Atmosphere 356

Sunny E Iyuke and Fakhru'l-Razi A.

High-Order Compact Finite-Difference Solution of Fluid Flow Problems 358

Waqar Asrar and Mahmood K. Mawlood

Impact of Gas and Particulate Matter from Biomass Burning on Respiratory System of Rat: Immune Biomarker (IgG) and Histological Analysis 360

Widiyanto S., H. Noor, M. Awang and Z. Othman

Contents

Materials, Energy and Environment

Determination of the Heating Values of Palm Oil 341
Boiler Fuels
E. E. Sayed and M.Moyet

Cancelled

A. Abdulkadir, S. A. Muazu, A. Z. Mohamed and
M.M. Ibrahim

Turning Operation of Alloy Steel with Rotary 356
Models
A.K. Das, S.K. Bhag, A.M.S. Ebenezer, Rajendra Prasad
and M. K. Dewan

Isolation and Characterization of EST's from Oil 348
Palm Roots, Flowers and Mesocarp for the
Development of a cDNA Chip

Lee Ching Ping, Aly Mat Rus, Cho Mei Chong,
Mariam Ong Abdullah, Sharifah Shahrul Ambok
Mr Chet Ching, Tan Siang Hee and E. Ravindran

Preliminary Study on Steam Accumulator Sizing 360
in Palm Oil Mill

Mohd.Afzan Shah Hanim, Mustaqim Zainal Abd. Aziz
and Noor Ayuza Mohamed

Table of Contents: Materials, Energy and Environment

Effect of Haze and Urban Atmospheric Pollutants on 382
Agricultural Crops and Forest Species

Mechanical Testing: Thin Mil Zn-Ni Alloy Plating
Ahmad Nazarene Abdullah and Zakiyah Ainley Abdullah

Pure Iron Oxide, Fe_2O_3 and Magnet $BaSrFe_{12}O_{19}$ 384
Iron Steel-Mill Waste Product

Study on Tensilon Aus, M.Rosdzin, A.Zaidana, A.Razman
N.Nafiz and A.M.Sukeen

Tin (Iv) Oxide Based Carbon Material Sensor CO at 386
Ordinary Temperature and Pressure above One
Atmosphere

Sany E. Dyab and Fadhiv T. Abd A.

High-Order Compact Finite-Difference Solution of 388
Fluid Flow Problems

Nayer Asrar and Mahmood K. Mandoof

Impact of Gas and Particulate Matter from Biomass 390
Burning on Respiratory System of Rat: Immune
Biomarker (IgG) and Histological Analysis

Wahyuni S., R. Noor, M. Anwar and Z. Dahlan

Determination of the Heating Values of Palm Oil Boiler Fuels

E. E. Supeni and M.Megat

For many years, steam generation using boiler for the process of heat involves the combustion of biomass solid fuels. Generally, the palm oil milling industry in Malaysia uses palm oil wastes (POW) such as fibre and shell to fire its boilers for thermal and power generation. In fact, in term of energy released, the heating value (HV) greatly plays an important role in determining the operational efficiency of the boiler. The quality of the POW is characterized by low fixed carbon and relatively high moisture contents, which affect the HV, which is also difficult for combustion to take place. With varies moisture contents (MC), the sample were being tested in the bomb calorimeter at the Thermodynamics Laboratory in the Department of Mechanical and Manufacturing Engineering, University Putra of Malaysia.

In this study, the higher heating values (HHV) of two solid fuel palm oil wastes (POW) which were fibre and shell obtained from specific location in the Guthrie Labu Mill, Negeri Sembilan, Malaysia were determined experimentally by using the 1341 bomb calorimeter as shown in Figure 1. The HHV in unit MJ/kg of the POW as a function of moisture contents (MC) in unit % were calculated from the following equations. HHV for fibre = =-0.1596 MC + 17.028 and HHV for shell =-0.2342 MC + 20.461. The correlation factors were 0.8251 and 0.8234 respectively. The test taken were also analysed with the analysis of variance (ANOVA) to see the difference between the samples. The HHV calculated from this experiment showed a mean difference of 0.6% and 1.3 % with the Dulong's Formula.

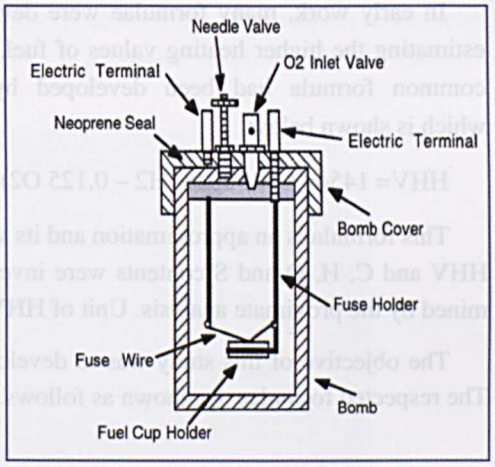


Figure 1: 1341 Bomb Calorimeter

The graph in Figure 2 shows the effect of moisture contents on the higher heating value for six samples of fibre. A total of six tests were carried out by drying the samples in the time (minutes) interval 5,10,15 and t_{max}. The ranges of HHV were from 11.32 MJ/kg at 30 % of MC to 17.52 MJ/kg at 100% of MC. From this study, the trend of HHV plotted was inversely proportional to MC and the correlation factor R2 is 0.8251,while the intercept factor is found to be 17.028. The correlation factor maybe lower as the data of samples results distribution deviated slightly. The slope of the equation is –0.1596. The abscissa shows the quantity of moisture in the fibre in percentage amount. The maximum and minimum HHV is recorded to be 17.52 MJ/kg and 10.9 MJ/kg respectively.

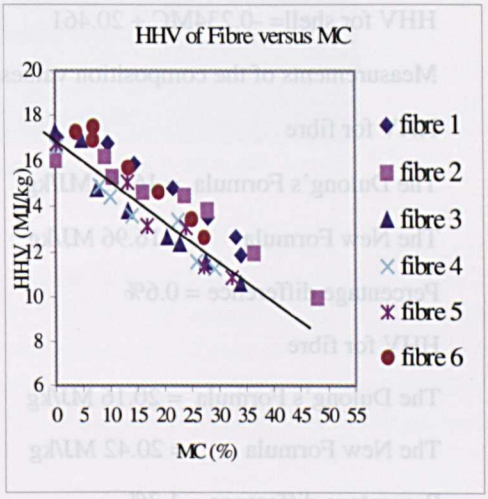


Figure 2: The Tabulated of HHV for Fibre at different moisture contents

In Figure 3, all of HHV for eight samples tend to decrease as the MC increases. By comparing both figures HHV of shell gives higher values. While the slope of HHV of shell is higher compared with that of fibre which is proved by the slope of shell accounted for –0.2342 whereas the slope of fibre is –0.1596. Similarly, parameters of data such as intercept, slope, maximum and minimum. Again here, as the moisture content increases the higher heating value decreases. The maximum value of HHV is 21.085 MJ/kg and the minimum HHV is 15.970 MJ/kg. By using correlation factor, it is noticed that the MC influences the HHV curves of the graph.

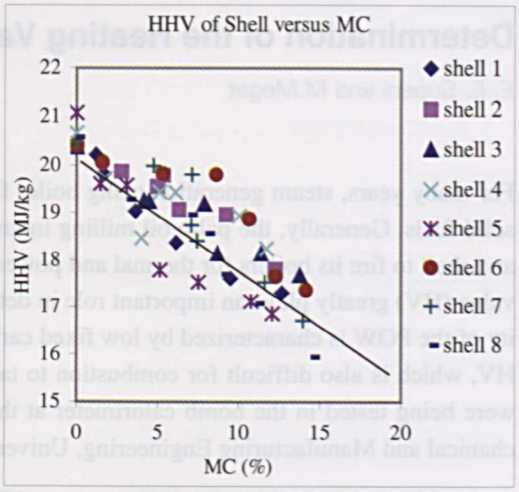


Figure 3: The Tabulated of HHV for shell at different moisture contents

In early work, many formulae were developed for estimating the higher heating values of fuel. The most common formula had been developed by Dulong, which is shown below.

HHV= 14544 C = 62028 (H2 – 0.125 O2) + 4050 S

This formula is an approximation and its validity is questionable. The relationship between the observed HHV and C, H, O and S contents were investigated in percentage values. All content values were determined by the proximate analysis. Unit of HHV is in Btu/lb.

The objective of this study was to develop new formulae for both samples, which are fibre and shell. The respected formulae are shown as follows.

HHV for fibre= -0.1596MC + 17.028

HHV for shell= -0.234MC + 20.461

Measurements of the composition values were obtained from Sirim by the ultimate analysis.

HHV for fibre

The Dulong's Formula = 16.86 MJ/kg

The New Formula = 16.96 MJ/kg

Percentage difference = 0.6%

HHV for fibre

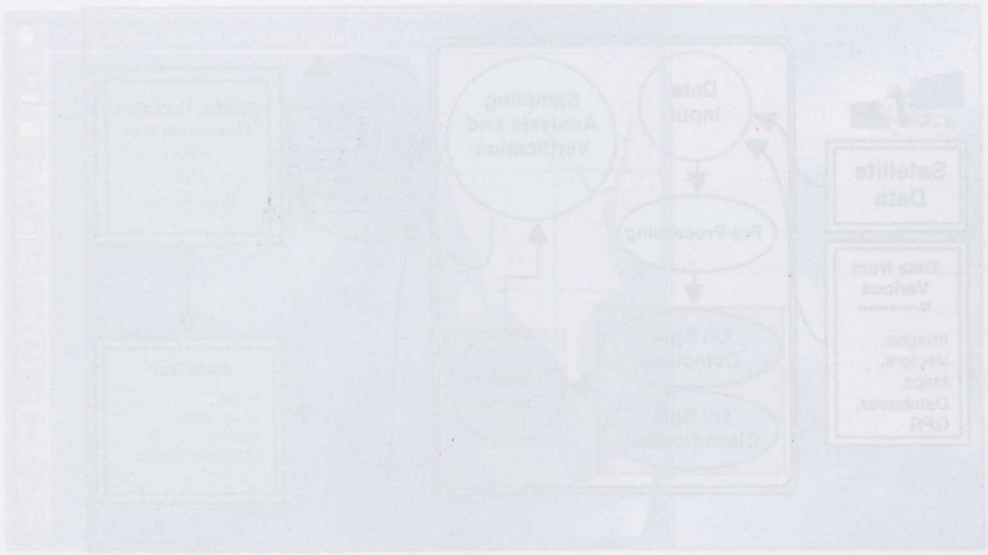
The Dulong's Formula = 20.16 MJ/kg

The New Formula = 20.42 MJ/kg

Percentage difference = 1.3%

By comparing the both formulae, the percentage difference for fibre and shell values were small accounted for 0.6% and 1.3% respectively.

In conclusion, the average higher heating value of combustion of fibre was found to be the range between 11.32 to 17.45 MJ/kg, while the average higher heating value of combustion of shell was found to be the range between 16.96 to 20.22 MJ/kg. To show its validity the Dulong's formula were used to verify the values. The formulae developed in this work prove good agreement with the experimental results for biomass samples.



Reader Enquiry
Department of Mechanical and Manufacturing Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6638
E-mail: mmegat@eng.upm.edu.my

CoastWatch



H. Assilzadeh, S. B. Mansor, A. R. Mohamd and H.M. Ibrahim

The use of modelling, spatial analysis, and near real-time systems can assist decision-makers to make better-informed judgments that will affect the governance and management of the sea environment.

CoastWatch based geomatic systems refers to the activities for better monitoring and assessment of sea phenomenon such as oil or other hazardous spills, sea wave spectra, ship detection and Environmental Sensitivity Index (ESI) maps for hazards in coastal area. The employing remote sensing, GIS and other geomatic systems are to mitigate the age-old problems of information availability and timeliness, data management, and synoptic inventory of natural resources when hazards caused by accident or human error. The proposed system can be used for detection, mapping, evaluation and modelling of sea phenomena such as oil spills in sea environments in order to reduce response time and qualify decision making process in contingency planning or other management issues.

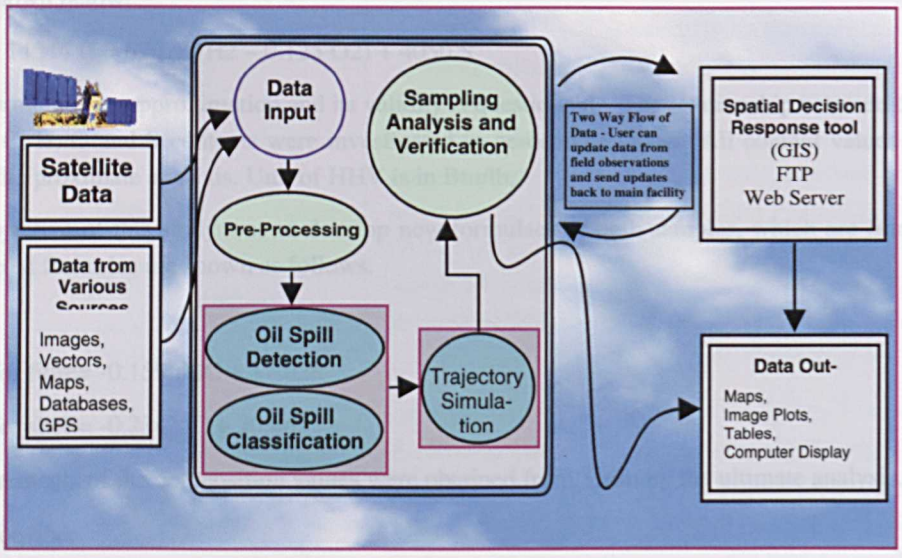


Figure 1: Schematic of oil spill contingency plan for the Straits of Malacca using remotely sensed data and GIS

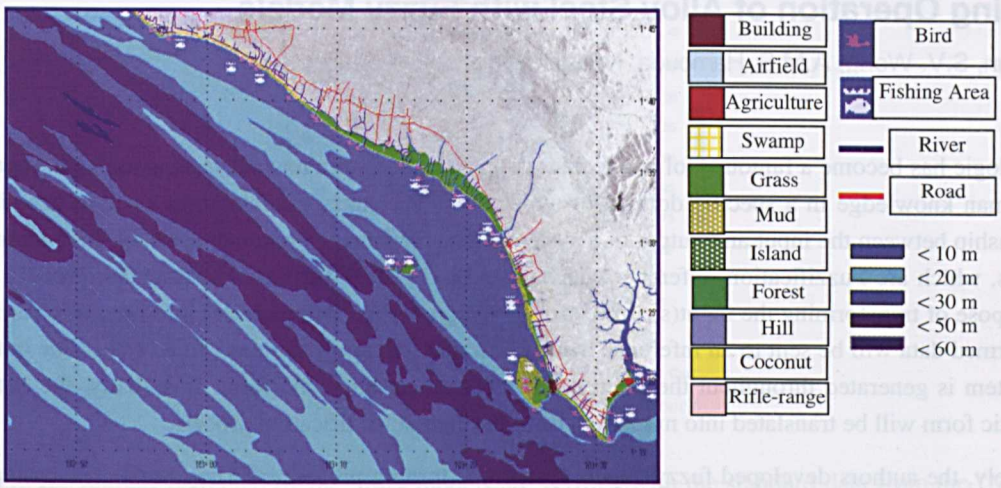


Figure 2. Documental bathymetric and ESI map prepared for the Straits of Malacca from the states of Johor up to Melaka

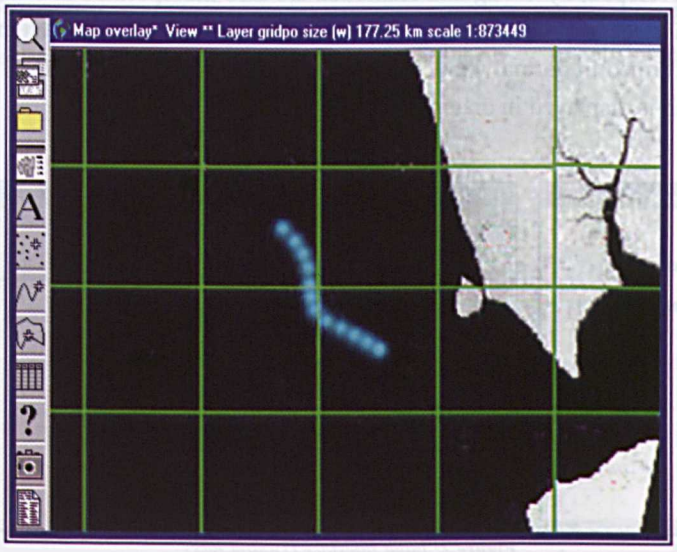


Figure 3: Hypothetical oil spill trajectory simulated for an appropriate point in the Straits of Malacca

Reader Enquiry
Institute of Advance Technology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7543
E-mail: shattri@putra.upm.edu.my

Turning Operation of Alloy Steel with Fuzzy Models

J.Y. Tan, S.V. Wong, A.M.S. Hamouda, Napsiah Ismail and M. R. Osman

Fuzzy logic has become a famous tool and technique in control system nowadays. It is useful in representing human knowledge in a specific domain of application. The fuzzy model can be used to describe the relationship between the input and output of a system. Generally, fuzzy system consists of three main components, which are Fuzzification, Inference Mechanism, and Defuzzification. Fuzzification process serves the purpose of transforming the input(s) (in the form of digital, precise/imprecise) into linguistic form. The transformed data will be sent to an inference mechanism that will apply the predefined rules. The output of the system is generated throughout the inference mechanism in linguistic form. Eventually, the output in linguistic form will be translated into numerical form through defuzzification process.

Lately, the authors developed fuzzy expert system for turning process of Alloy Steel. The system was based on two different types of fuzzy models, which are cutting speed and feed rate fuzzy models. With the integration of these fuzzy models, the developed fuzzy expert system has two inputs and two outputs. Further more, the fuzzy models, which developed, by Wong and Hamouda are also incorporated into the system. The present models cover Carbon Steel and Alloy Steel (Low Carbon, Medium Carbon and High Carbon). The Fuzzy Expert System is performed in normal window frame as shown in figure 1. Figure 2 illustrates the system inputs interface, which is displayed in dialog form.

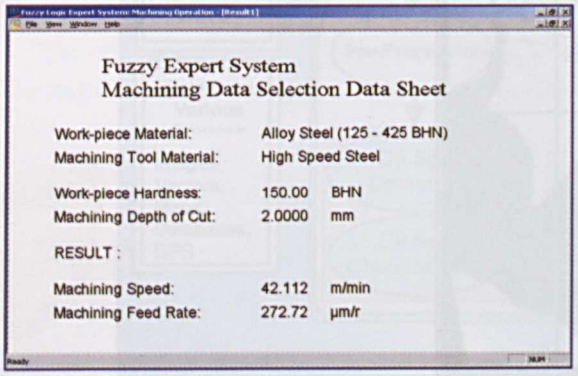


Figure 1: FES Main Screen Display

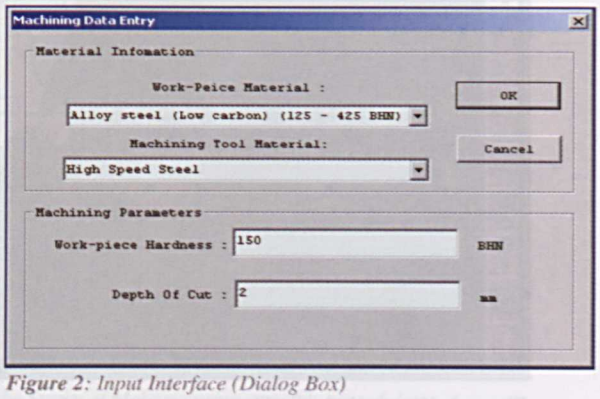


Figure 2: Input Interface (Dialog Box)

Both the previous fuzzy models, cutting speed and federate fuzzy models, possess two inputs and one output. The inputs of both models are material hardness and depth of cut. The output is cutting speed and feed rate for cutting speed and feed rate models, respectively. Lately, the authors has combined these two fuzzy models, and named it as cutting tool fuzzy model. The present fuzzy model consists of two inputs and two outputs. The fuzzy rules are further divided into two separate sets. The relationship between 2-inputs-and-1-output was represented in 3-D surface graph as shown in figure 3.

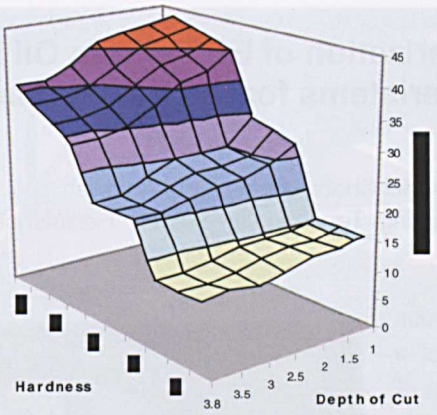


Figure 3: 3-D Surface Graph for High Speed Steel Cutting Speed Fuzzy Model

All of the outputs predicted by the fuzzy models are verified with the standard data from the "Machining Data Handbook" by Metcut Research Associates.

According to the results shown, present models show good correlation when compared to the standard data. The average absolute percentage error of cutting speed and feed rate is 2.68% and 2.87% respectively. These show the feasibility of applying the present fuzzy models in predicting machianability data.

Reader Enquiry
Department of Mechanical and Manufacturing
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6339
E-mail: wongsv@eng.upm.edu.my

Isolation and Characterization of EST's from Oil Palm Roots, Flowers and Meristems for the Development of a cDNA Chip



Lee Yang Ping, Ng Wai Har, Choi Mei Chooi, Meilina Ong Abdullah, Sharifah Shahrul Rabiah, Ho Chai Ling, Tan Siang Hee and K. Harikrishna

Every organ plays a specific role that contributes to the development of a plant. For example, the initiation of the floral developmental program which is essential for plant reproduction causes great changes in the physiology of the plant such as the translocation of photosynthate to the developing floral tissue, whereas the primary physiological role of the root system is to absorb water and nutrients from the soil, which is then conveyed to various parts of the plant. Nevertheless, the function as well as development of each of these organs is inter-related to each other.

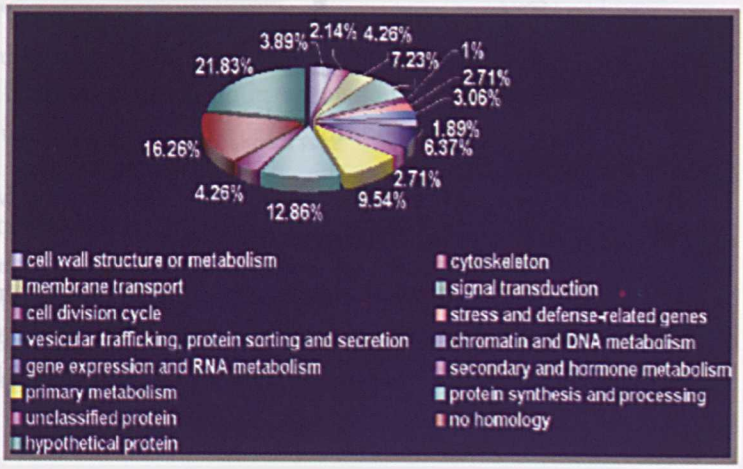


Figure 1: Functional Characterization of Putatively Identified Oil Palm Root Systems ESTs

To dissect the molecular mechanisms underlying these developmental processes, a vast amount of genetic resources are required as markers that would enable to obtain a complete picture of the complex floral and root developmental processes in oil palm. Therefore, expressed sequence tags (ESTs) were used as a genetic resource in this project to facilitate the isolation and identification of new gene markers on large-scale basis and also to provide information on gene expression patterns via cDNA microarrays. A total of 5,100 ESTs clones were generated from both cDNA libraries of oil palm flower and root systems. These included 1,600 clones from oil palm flower and another 3,500 clones from oil palm root systems. As we compared the ESTs clones generated from oil palm flowers and roots with known genes in the database, the majority of the ESTs encoded proteins involved in stress and defense, signal transduction and metabolic pathways. However, there were some genes, which were specifically expressed only in either the flower or the root systems. For example, *Agamous* and *Squa* promoter binding protein were flower specific genes that are only expressed in floral organs, whereas, root hair defective 3 gene and several root specific proteins were found only in the root systems.

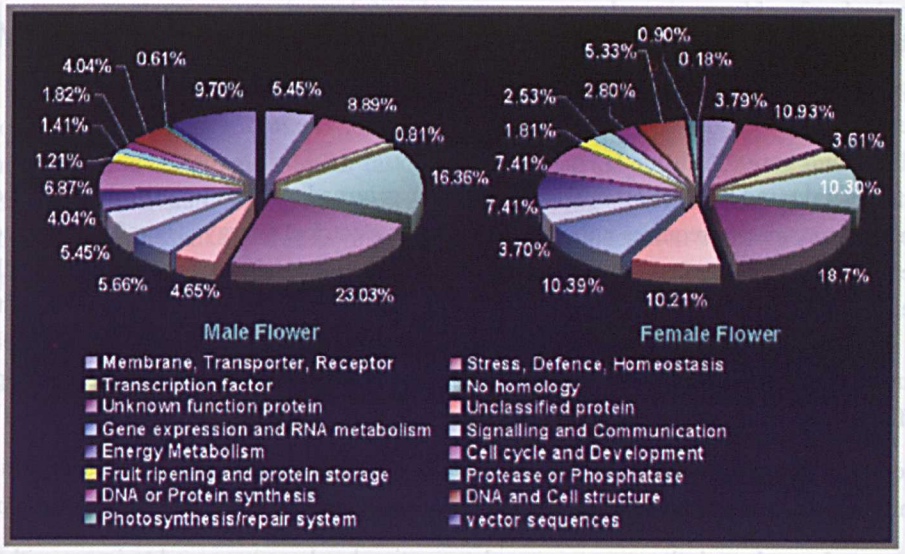


Figure 2: Functional Characterization of Putatively Identified Oil Palm Flower ESTs

The results indicated that the ESTs method employed was efficient at identifying and isolating oil palm genes that are either expressed specifically in floral or root systems or those that are shared between both organs. These ESTs have been used to construct an oil palm cDNA microarray to facilitate genome wide expression profiling.

Reader Enquiry
Faculty of Food Science and Biotechnology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8344
E-mail: hharikrishna@yahoo.com

Preliminary Study on Steam Accumulator Sizing in Palm Oil Mill

Mohd.Halim Shah Ismail, Mustafa Kamal Abd. Aziz and Noor Azian Morad

The present general trend of palm oil mills in Malaysia has turned towards large scale mill processing. This increase in milling capacity requires either more steam or electrical energy. Therefore, attention should be paid to the energy generation from the relatively cheap waste materials such as fibre and shell available in abundance, as well as the steam management in palm oil mills. This is to ensure better distribution and utilization of the energy system. The key word today in the energy management in the palm oil mill industry is to cut wastage through better energy system and equipment design, maintenance and operation control, for efficient utilization of available thermal energy.

It is therefore, the objective of this research work to study steam generation and distribution system in palm oil mill in order to provide better understanding for solving steam demand fluctuating problems.

In the research conducted, the steam accumulator option has been proposed to improve the steam management system in palm oil mill. Observation in an operating palm oil mill has been undertaken to investigate the pressure fluctuation and steam losses in the mill. Results from investigation have confirmed that the unsteady pattern of steam consumption during the sterilization process was the main contribution to the overall pressure fluctuation of the steam system in the mill. A mathematical model based on conservation of mass and energy principle was developed to study the dynamics of the backpressure vessel and the steam accumulator when subjected to different operating conditions. The mathematical model for the backpressure vessel and the steam accumulator in this work is the first one in the work. The model has the capability to predict effect of various mill conditions on the pressure fluctuations in the backpressure vessel.

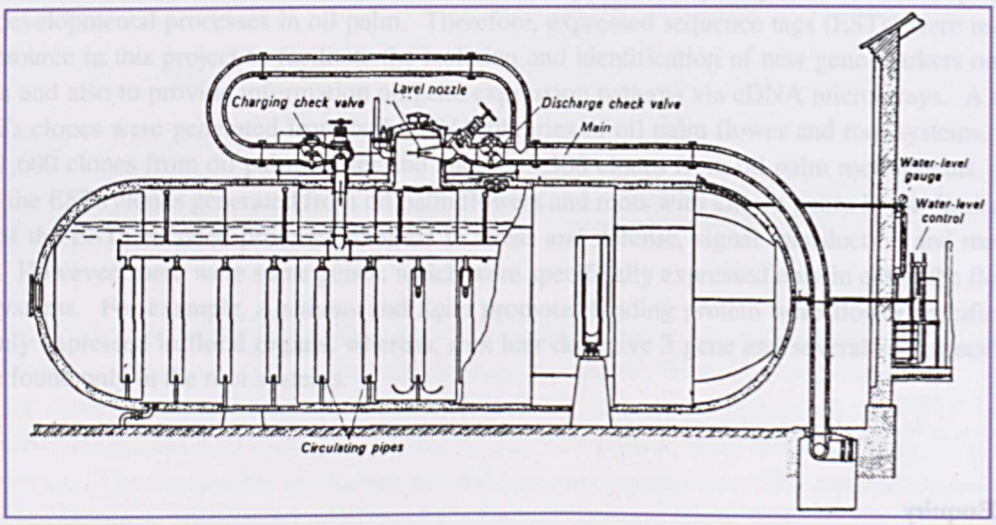


Figure 1: Varying pressure steam accumulator

The results from simulation work showed that the steam accumulator is capable of reducing the pressure fluctuation in the backpressure vessel. It is hoped results in this research work could be used as a starting point for studying the feasibility of installing steam accumulators in palm oil mills and can be used as a design tool to assist mill engineer to assess the best steam accumulator size to cope with the current mill steam demand fluctuation conditions. Similar task can also be carried out to different mills with different steam system capacities for studying the possibility of implementing steam accumulator system in palm oil mills. The study conducted shall serve as an important point of consideration in future design of steam system for new palm oil mills.

Reader Enquiry
Department of Chemical and Environment Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6287
E-mail: mshalim@eng.upm.edu.my

Effect of Haze and Urban Atmospheric Pollutants on Agricultural Crops and Forest Species



Muhamad Awang, Wan Md Zin b Wan Yunus, Ahmad Makmom Abdullah and Zulkifly Kuang Abdullah

During the haze episode, several reports have indicated that biomass burning was the dominating source of particulate matter. This particulate pollution such as PM10 is a real and serious problem with the potential to cause adverse effect on air quality, global climate, damaging human health and plants.

The objective of this study was to determine the effect of the biomass burning on growth and physiological performance of the plants. In this study, two tropical forest species (*Shorea ovalis* and *Shorea leprosula*), two pioneer species (*Mallotus paniculatus* and *Macaranga triloba*) and paddy were selected and exposed to the product of biomass burning inside the closed fumigation chamber six hours daily for 30 days. The microclimate condition and photon flux density inside and outside the chamber were observed. At the same time, growth parameter such as plant height, leaf area, dry weight, visible injury and net photosynthesis were measured.

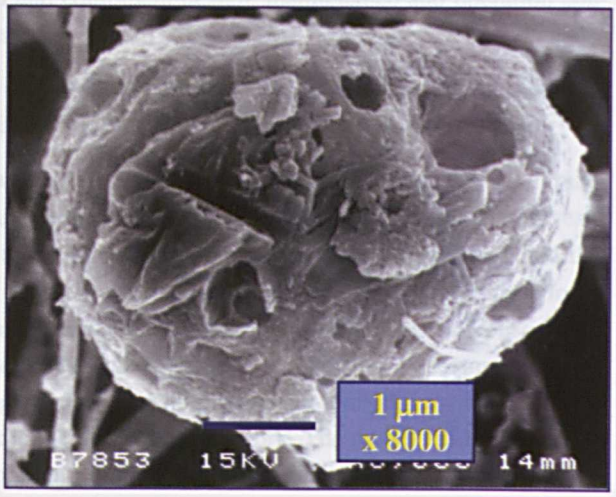


Figure 1: Photomicrograph of haze particle (at magnification of 500x). It was spherical shape and coarse-textured

The result of the experiment showed the effects on the tropical forest and pioneer species included leaf injuries, depression of net photosynthesis, and decline in relative growth rate in terms of height, leaf area and dry weight. The leaf injuries included interval bleaching for matured leaves and red-brown discoloration for young leaves. Scanning Electron Microscope (SEM) picture showed the trapped particles were attached to each other and had affected the closure of stomata on the leaves. Since particles carry many toxic substances bound to their surfaces, chemical pollution source to be impacted in a major way through physical obstruction by the particles themselves. Particulate pollution physically clogged the stomata opening and caused impeding normal gas exchange.

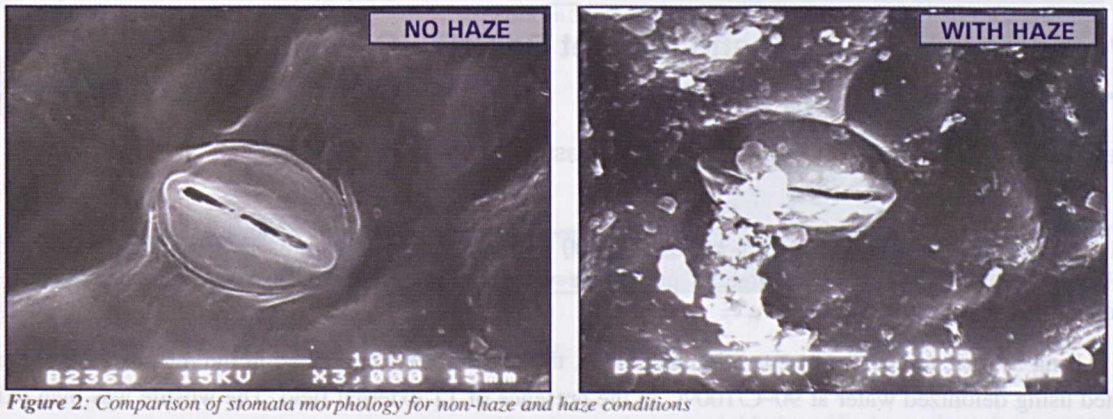


Figure 2: Comparison of stomata morphology for non-haze and haze conditions

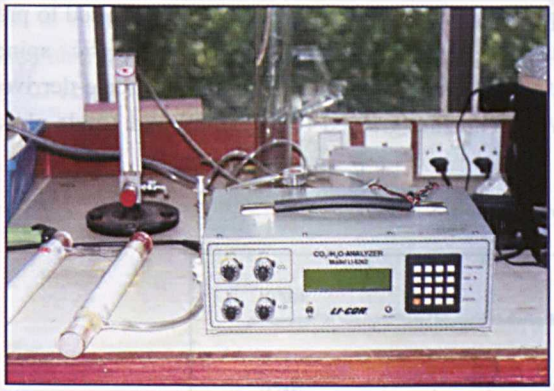


Figure 3: LI-6262 CO_2/H_2O Analyzer



Figure 4: Fumigation chamber with an air exchanger and cooling system

Moreover, it reduced the absorption of carbon dioxide form the atmosphere and the intensity of sunlight reaching the interior of the leaf, and thereby suppressing growth of the plants. Thus, the chronic injury appeared as a bleaching of the chlorophyll that revealed the presence of red, brown or black pigments or yellowing of the leaf in these species plants. Consequently, it caused the reduction of growth performance and yield.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6743, 8946 6024
E-mail: awang@admin.upm.edu.my

Pure Iron Oxide,Fe_2O_3 and Magnet Ba/$SrF_{12}O_{19}$ from Steel-Mill Waste Product



Raba'ah Syahidah Azis, M.Hashim, A.Zakaria, J.Hassan, N.Yahya and N.M.Saiden

Malaysian steel factories produce more than 30,000 tons millscale per month. This immense amount of millscale presents to us a challenge to purify the wustite, FeO, in the millscale for conversion to a stoichiometric hematite, Fe_2O_3.

Using a Curie temperature separation technique, the wustite, FeO contained in the millscale was separated using deionized water at 90°C/100°C in the presence of 1T external field. The wustite was then oxidized in air at 400°C/500°C/600°C for 10 hours in air. An XRD phase analysis showed that a very high percentage of Fe_2O_3 was present in the final powder preparation. A conventional method was used to prepare hexagonal $BaFe_{12}O_{19}$/$SrFe_{12}O_{19}$ pallet shape. The development of stoichiometric spinel $BaFe_{12}O_{19}$/$SrFe_{12}O_{19}$ was confirmed by XRD result. The elemental analysis of the millscale-derrived $BaFe_{12}O_{19}$/$SrF_{12}O_{19}$ pallet was carried out by EDAX. The fine-grained (0.3-0.5mm) and single-phase microstructure was confirmed by SEM surface scan.

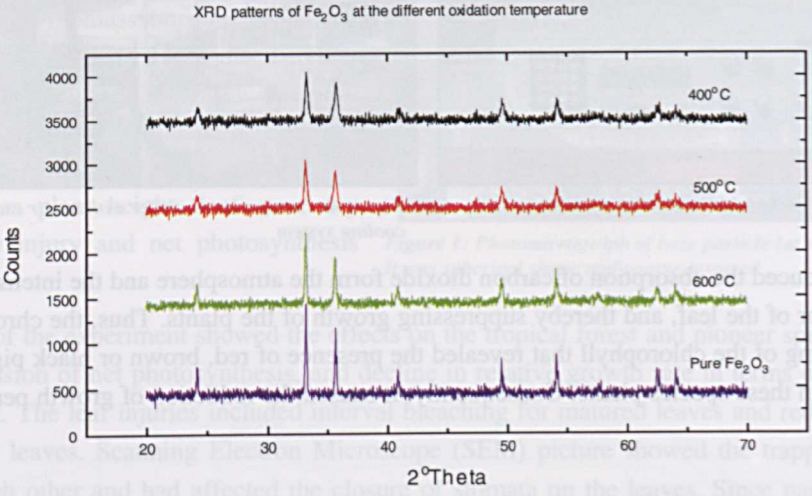
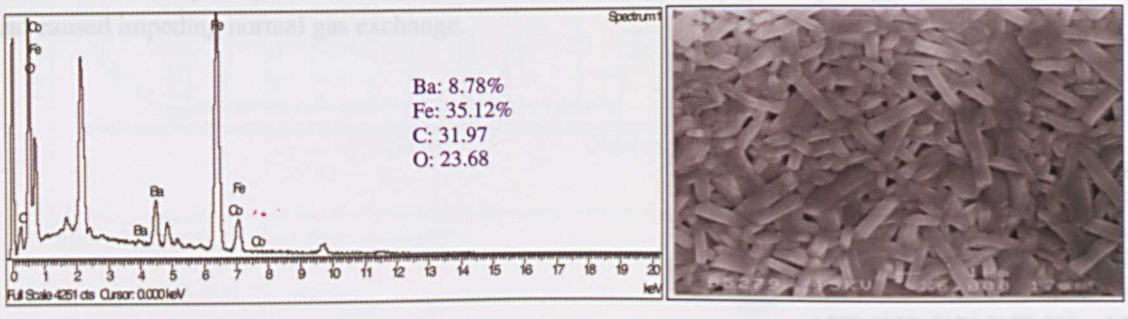


Figure 1. XRD pattern of Fe_2O_3 derived from millscale and pure iron



(a) (b)

Figure 2: EDAX and Microstructure of Millscale Derrived $BaFe_{12}O_{19}$

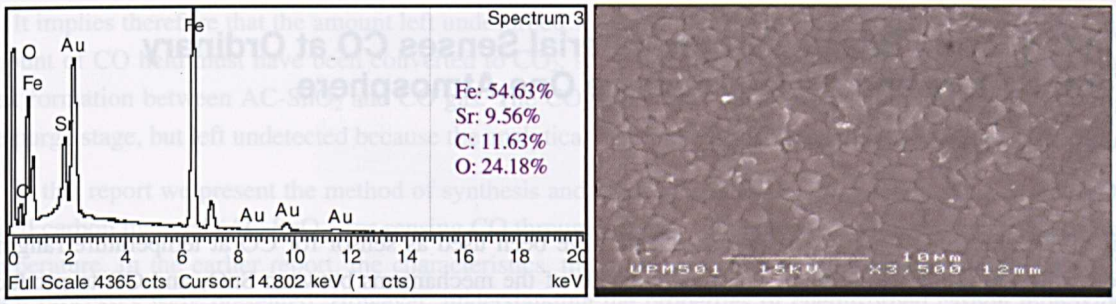


Figure 3: EDAX and Microstructure of Millscale Derived $SrFe_{12}O_{19}$

It could be concluded that the low-cost purification technique yielded purified wustite whose conversion to very pure hematite raw material was achieved as indicated by XRD, EDAX element analysis and SEM observation.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6666
E-mail: raabah@fsas.upm.edu.my

Tin (iv) Oxide Based Carbon Material Senses CO at Ordinary Temperature and Pressure above One Atmosphere

Sunny E Iyuke and Fakhru'l-Razi A.

Tin (iv) oxide (SnO_2) and its based adsorbents have been used as sensor for CO at temperature ranging from 250-350^{0}C for a long time. The fundamentals of the mechanisms between SnO_2 and CO to produce CO_2 at these temperatures have long been established. However, the high temperature requirements of these sensors had imposed limits to their applications. It has been reported that SnO_2 based materials show excellent potential as catalysts for the oxidation of CO, SO_2, saturated and unsaturated hydrocarbons. As well as other organic compounds, the ammoxidation and isomerisation of alkenes, and the dehydration of alcohol. SnO_2 in its pure composition is a mild oxidising agent. However, its unique catalytic properties can be significantly modified by the incorporation of other elements (group 5: P, Sb, Bi, V; 6: Cr, Mo, W; Mn and Cu) to give a wide range of activity and selectivity. Its adsorptive properties to CO at room temperature were also reported to increase when it was impregnated into activated carbon (AC-SnO_2). In these reports, it was claimed that the adsorption of CO seemed almost reversible. This means that all that was adsorbed on the AC-SnO_2 was not completely desorbed in the pressure swing adsorption system used.

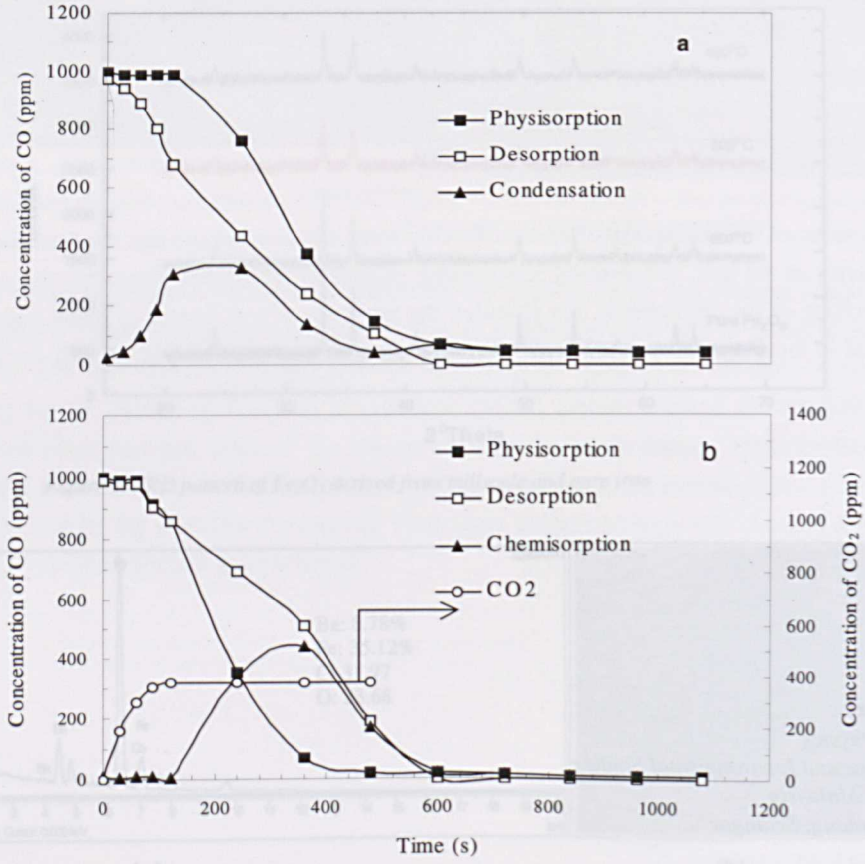


Figure 1: Physisorption and chemisorption occurring at temperature 301 K and pressure 5 atm. In a PSA system (a) between pure activated carbon and CO (b) between activated carbon impregnated with SnO_2 and CO to produce CO_2 from solid catalysed reaction

It implies therefore that the amount left undesorbed was held perhaps by chemisorption. Invariably, this amount of CO held must have been converted to CO_2, since it is the only by-product expected from complex formation between AC-SnO_2 and CO gas. The CO_2 produced is also expected to be desorbed during the purge stage, but left undetected because the analytical instrument was operated only to detect CO.

In this report we present the method of synthesis and mode of application of a newly synthesised SnO_2 based carbon material (AC-SnO_2) for sensing CO through catalytic oxidation of CO to produce CO_2 at low temperature. In the earlier report, the characteristics, the mode of action and the kinetics of the CO/AC-SnO_2 processes were presented. However, understanding the properties of chemisorbed carbon monoxide (CO) molecules on a newly synthesised AC-SnO_2 adsorbent/catalyst surfaces would provide insight into major factors controlling reactivity and thus its catalytic effectiveness in either CO sensing or combating CO pollution and control. Thus we report the use of pressure swing adsorption (PSA) system to adsorb CO from H_2/CO (75/25 volume percent) mixture by adsorption and catalytic oxidation of the adsorbed CO to gaseous CO_2. The feed mixture represents a typical H_2/CO ratio from steam reformer effluent. The H_2 acts as inert carrier to transport the CO to and through the beds packed with activated carbon impregnated with tin (iv) oxide (AC-SnO_2) novel adsorbent. An unimpregnated pure activated carbon and the one impregnated with -SnO_2 were used to evaluate the effect of -SnO_2 as impregnant on the same quality and quantity of activated carbon, and the results compared (Fig 1). The Langmuir-Hinshelwood kinetics was used to fit the experimental rate data. The rate constant is equal to 0.0217 s^{-1}, while the adsorption equilibrium constant is 1.0447.

Reader Enquiry
Department of Chemical and Environmental Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7099
E-mail: iyuke@yahoo.com

High-Order Compact Finite-Difference Solution of Fluid Flow Problems

Waqar Asrar and Mahmood K. Mawlood

It is well known that fluid flow problems, especially in transition and turbulent regimes, posses a wide range of temporal and spatial scales. Direct numerical simulation and large eddy simulation of such flows require numerical schemes that can accurately represent this range of scales. The range of scales that can be resolved by a numerical scheme is determined by resolution efficiency of the scheme. Researchers have shown that the error produced by finite-difference schemes can be quite high for the smaller scales. Higher order finite-difference schemes capture the smaller scale physics more efficiently than low-order schemes. In recent years a class of high-order schemes, known as high-order compact schemes, have attracted much attention due to their narrow grid stencil, enhanced accuracy and better resolution power over the conventional high-order schemes.

In the present studies, two different approaches for high-order compact space discretization are tested for accuracy and ease of implementation. According to the results obtained, a class known as Hermitian, has been adopted for further studies. A number of flow problems with smooth solutions are then solved using a fourth-order accurate scheme. Results obtained on coarse computational grids have shown considerable improvement in accuracy as compared with results obtained by a standard second order scheme on very fine grids. For flows containing discontinuities, a third- and a fifth-order shock-capturing upwind method are developed. In these methods, flux vector splitting (FVS) and the idea of total variation diminishing (TVD) are used. The schemes are successfully applied to a number of test problems.

Some typical results are shown here. Fig. 1 shows the contour plots of vorticity in a driven cavity. Fig. 2 shows numerical results for a two-dimensional convection diffusion problem.

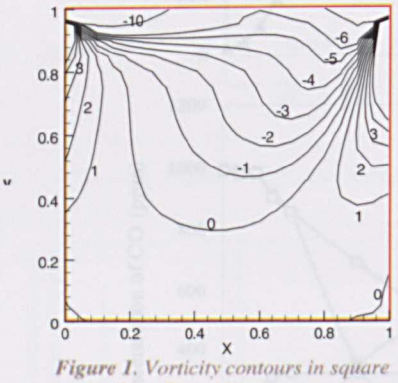


Figure 1. Vorticity contours in square cavity flow, Re = 100

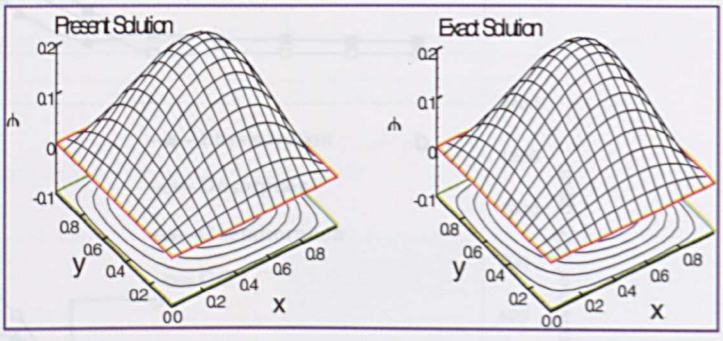


Figure 2. Results for a 2-D convection diffusion problem

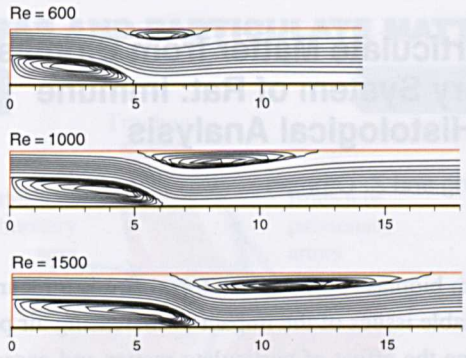


Figure 3. Flow past a backward facing step

Fig. 3 shows the contours of stream function and separation bubbles in flow past a backward facing step. All these results compare favourably with published data and other prediction methods.

Reader Enquiry
Department of Aerospace Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6402
E-mail: waqar@eng.upm.edu.my

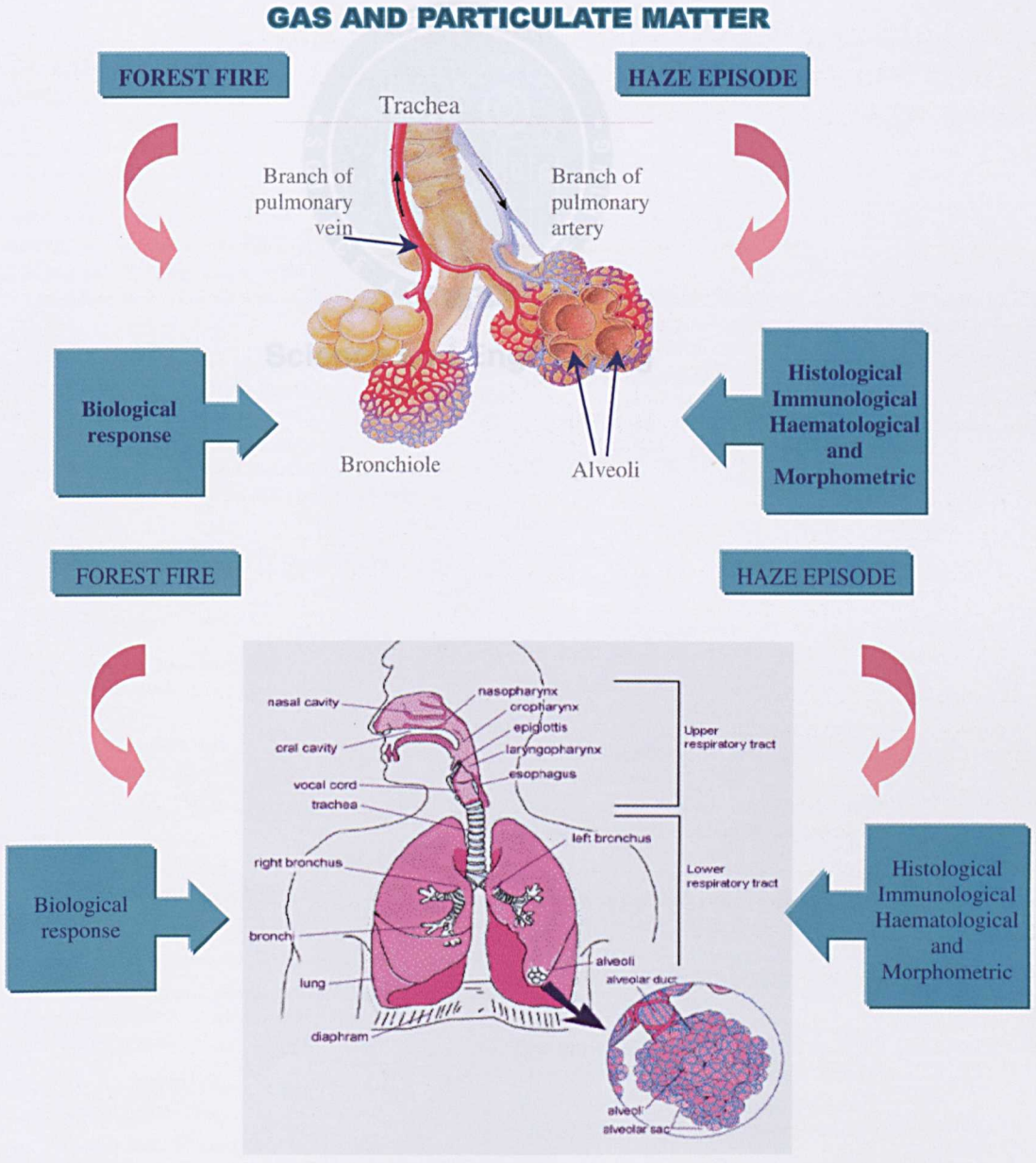
Impact of Gas and Particulate Matter from Biomass Burning on Respiratory System of Rat: Immune Biomarker (IgG) and Histological Analysis



Widiyanto S., H. Noor, M. Awang and Z. Othman

Trans-boundary air pollution from biomass burning like forest fire is a recurrent environmental problem in Southeast Asia. This raises inevitable issues of the impact of increasing air pollution on human health. This study was carried out to determine the effect of particulate matter and gases from biomass burning on the respiratory system using experimental animals in a laboratory simulation. ***Spraque-Dawley*** rats were used in this experiment. The experimental rats were divided into two groups: treatment and control. The treatment rats were exposed to the smoke from biomass burning for 2 hours per day for six days/week in a chamber and injected with 1 mg Keyhole Limpet hemocyanin (KLH) in 0.2 ml solution intravenously on day 0 and 8. Control animals were sham- injected with sterile deionised water and introduced into the chamber but not exposed to pollutants. Every 2 weeks 6 rats from each group were sacrificed and airway tissue, blood and serum were collected for haematological, histological, and immunological analysis. Histological parameters studied included number of goblet cells, mucus gland size and size of alveolus as examined under light microscope and by analysis of the mean average number and width of surface area.

Result of the air quality showed that the concentration of the Particulate matter (PM_{10}, $PM_{2.5}$ and PM_1) in the smoke was very high compared with the control. The average of PM_{10}, $PM_{2.5}$ and PM_1 in the smoke were 2414.45±190.63 $\mu g/m^3$, 379.46±20.01 $\mu g/m^3$, and 201.30±18.95 $\mu g/m^3$. The biomass burning also produce gas pollutant such as CO, NO_2, H_2S, O_3, NH_3, and SO_2. But only concentration of CO and NH_3 showed significant differences compared with the control. The histology study indicated that the number of goblet cells of treatment group increased during the study. The increase in size of mucus gland and alveolus size was in accordance with period of exposure. Likewise, the increase in concentration of mucus was parallel with exposure period. Level of Immunoglobulin G type from ELISA analysis showed significant difference between treatment and control group.



Gas and Particulate Matter

The results suggest that exposure to gas and particulate matters from biomass burning would badly affect the respiratory system

Reader Enquiry
Department of Biomedicine
Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8469
E-mail: hamdan@medic.upm.edu.my

Impact of Gas and Particulate Matter from Biomass Burning on Respiratory System of Rat: Immune Biomarker (IgG) and Histological Analysis

Widyanto S., H. Noor, M. [illegible] and Z. [illegible]

Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8469
E-mail: [illegible]@[illegible].upm.edu.my



Science and Engineering

Contents

Science and Engineering

Effect of Magnetic and Non-Magnetic Elements Doped in Manganite Perovskite 367

Abdul Halim Shaari, W. Mahmood Mat Yunus, Mohd. Maarof Mokhsin, Hishamuddin Zainuddin, Wan Daud Wan Yusoff, Abdullah Chik, Zohra Gebrel, Lim Kean Pah and Imad Hamadneh

Fabrication of Mono and Multifilament Tapes Prepared via Coprecipitation Method 368

Abdul Halim Shaari, Jamil Suradi, Sidek Hj A Aziz, Wan Daud Wan Yusoff, Roslan Shukor and Imad Hamadneh

Understanding How Enzyme Works: Homology Modelling of FI Protease from *Bacillus stearothermophilus* FI 369

Abu Bakar Salleh, Raja Noor Zaliha Raja Abdul Rahman, Mahiran Basri, Mohd Basyaruddin Hj. Abdul Rahman, Bimo Ario Tejo, Noor Azlina Ibrahim and Azira Mohd.

Visualisation on Reconstruction of Road Accident System 370

Ahmad Rodzi Mahmud

Metal Chalcogenide Thin Films by Electrochemical Method For Solar Energy Conversion 371

Anuar Kassim, Zulkarnain Zainal, Mohd. Zobir Hussein and Abdul Halim Abdullah

Conductive Polymer for Secondary Battery and Photovoltaic Applications 373

Anuar Kassim, Zulkarnain Zainal, Mohd. Zaki Abd. Rahman, Dzulkefly Kuang and Abdul Halim Abdullah

Development of Photopyroelectric Spectrometer 375

Azmi Zakaria, Mohd Maarof Moksin, Mansor Hashim, Ling Yoke Ting, Liaw Hock Sang and Sabarina Mohd. Shapee

The Chemistry of Betulinic Acid: Search for Anti HIV and Anti- Cancer Drug 376

Faujan H. Ahmad, Mahiran Basri and Manaf Ali

Cuneifolin, a new xanthone from *Garcinia cuneifolia* and mucigerin, a new coumarin from *Calophyllum mucigerum* 378

G. C. L. Ee, X. H. Mong, K. N. Ng, Y. H. Taufiq-Yap, M. Rahmani and A. M. Ali

The Studies of Elastic Properties and Heat Treatment of Superionic Glasses $(Ag_2O)_x(B_2O_3)_{1-x}$ 379

Halimah Mohamed Kamari, Hasnu Rizal, Sidek Hj. Abdul Aziz, Chow Sai Pew, Abdul Halim Shaari and Kamirul Amin Matori

Quantizing Punctured Worlds 381

Hishamuddin Zainuddin, Ahmed Bouketir and F.P. Zen

A portable Fiber Optic Based Lightning Detector System 382

Ishak Bin Aris

Robotoy II 383

Ishak Bin Aris

RF-based Car Pager System 384

Ishak Bin Aris

Two Alternating Pressure Swing Adsorption (PSA) Beds for Hydrogen Purification and CO Removal from the Workplace Using Tin in Activated Carbon 385

Iyuke Sunny Esayegbemu

Crashworthiness of Motorcycle Frontal Components 387

K.S. Tan, S.V. Wong, R.S. Radin Umar, M.M.H. Megat Ahmad and A.M.S. Hamouda

High Oxide Ion Conductivity in Bi_2MoO_6 Oxidation Catalyst 389

Lee Chnoong Kheng

Electrochemical oxidation of L-cysteine and Vitamin E using C_{60} Fullerene Modified Carbon Electrode 391

Lim Ei Bee, Tan Wee Tee, Goh Joo Kheng and Nur Rahizan Binti Ilaha

A Study of Magnetic Parameters of Iron-Deficient Ni-Zn Ferrites $(Ni_{0.3}Zn_{0.7}Fe_{2-X}O_4)$ 392

Mansor Hashim, Rosidah Alias,, Jumiah Hassan, Salleh Harun, Abd. Halim Shaari and Wan Daud Wan Yusof

Antifungal Therapy and Cytotoxicity of Bis-(Methylthiomethyl) Disulphide and Extract from *Scorodocarpus Borneensis* 393

Mawardi Rahmani, Christophe Wiart, Shar Mariam Muhamed, Abd Manaf Ali, Hazar B.M. Ismail and Mohd Aspollah Sukari

Characterization and Utilization of Bioactive Constituents from *Murraya koenigii* and Aegle marmelos 395

Mohd Aspollah Sukari, Mawardi Rahmani, Abdul Manaf Ali, Kartini Ahmad, Sugeng Riyanto, and Nakisah Mat Amin

Fiber Duplexer Module (FDM) 397

Mohd. Khazani Abdullah

Novel Surface Chemistry for Analyzing Polyanions by SELDI-TOF Mass Spectrometry 398

Mohd Puad Abdullah, Sambandan TG., Lessard P., Rha C. and Marziah M.

Woven Banana Fibre/Epoxy Composite Telephone Stand 400

Mohd Sapuan Salit

Design of a Sealed Off CO_2 Gas Laser 401

Nasrullah Khan, N. Mariun and S. Iqbal

Voltage Sag Mitigation System 402
N. Khan, N. Mariun and D. Rohi

The Effect of Cationic Substitution in Nonstoichiometric Strontium Hexaferrite 403
Norlaily Mohd Saiden, Mansor Hashim, Wan Mohd Daud Wan Yusoff, Mohd Maarof Moksin, Noorhana Yahya and Rabaah Syahida Azis

Characterization and Assessment of Failure Life of Materials Under Cyclic Loading Condition 404
Prithvi Raj Arora

Need for an Alternative Guardrail for Safer Motorcycling 406
R.S Radin Umar, A.B Ibitoye, S.V Wong, A.M.S Hamouda and T.H Law

Study on Crash Pattern and Injury Characteristics on Motorcycle Crashes, which is Roadside Furniture Related, along Exclusive Motorcycle Lane 408
S.H. Tung, S.V. Wong, T.H. Law and R.S. Radin Umar

Non-destructive Stress Measurement System 410
Samsul Bahari Mohd Noor, Mohd Saleh Jaafar and Waleed A. M. Thanoon

Electrical Resistively Investigation of a Polluted Ground at Bukit Kapar, Kelang, Selangor D.E. 412
Shaharin Ibrahim, Lau Kien Liong, Mohd Shah Ibrahim, Rahmat Kamid, Suhaimi Ibrahim and Rahman Arkimin

Application of Geophysical Logging for Groundwater Assessment within Tampin–Gemas–Malacca Area 416
Shaharin Ibrahim, Mohd Shah Ibrahim and Rahmat Kamid

Application of Geophysical Methods in Landslides and Slope Failures in Cameron Highlands, Pahang D.M. 418
Shaharin Ibrahim, Lau Kien Liong, Mohd Shah Ibrahim, Rahmat Kamid, Suhaimi Ibrahim, Rahman Arkimin, Amri Ab. Rahman, Norliana Mahussin and Marlia Jamail

Three-Component Balance for Low Speed Wind Tunnel 421
Shamsuddin Sulaiman and Hafizal Abu Bakar

Ultrasonic Properties of Oil Palm Trunk (*Elaeis Guineensis* Jacq.) 422
Sidek H.A.A., Rosmawati S., Kaida K. and Faridah A.

First Example of Triphenylene -Based Discotic Liquid Crystals Containing Azobenzene Moieties 423
Sidik bin Silong, MD. Lutfor Rahman, Mohamad Zaki Ab. Rahman, Mansor bin Ahmad, Wan Md. Zin Wan Yunus and Md Jelas Haron

The Classification Level of Damage and Estimation of Repair Cost for Crashed Vehicles 424
Stephen Yong C. V., S.V. Wong and M.M.H. Megat Ahmad

Electrochemical Studies of Some Charge-transfer Compounds in Solutions 426
Tan Wee Tee, Goh Joo Kheng, Tan Tjin Ling and Lim Ei Bee

Voltammetry of C_{60} Microcrystals in Non Aqueous Solution 427
Tan Wee Tee, Lim Ei Bee, Goh Joo Kheng, Abdul Halim Shaari and Zulkarnain Zainal

Surface Plasmon Resonance-Optical Sensor 429
W. Mahmood Mat Yunus, Zainal Abidin Talib, Mohd Maafor Moksin, Azmi Zakaria, Zaidan Abd Wahab and Ionel Valeriu Grozescu

Graft Copolymerization of Vinyl Monomers onto Sago Starch 430
Wan Md. Zin Wan Yunus, Mansor Ahmad, Mohamad Zaki Ab. Rahman, Wan Ahmad Badhi, Md. Jelas Haron and Sidik Silong

Cost Effective Low Temperature Fabrication of Barium Plumbate-Based Barrier Layer Capacitor Elements 431
Wan Mohamad Daud bin Wan Yusoff, Abdul Halim Shaari Zainul Abidin Hassan, Zainal Abidin Talib, Ari Sulistyo Rini, Iftetan Ahmad Taha and Azizah Ishaq

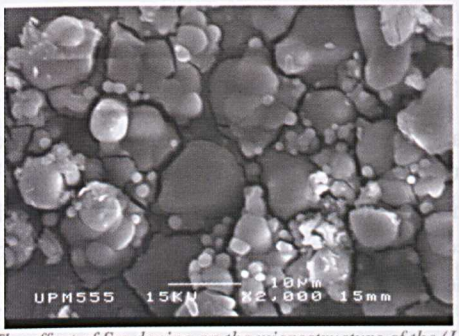
High Mobility Lattice Oxygen of Vanadyl Pyrophosphate Catalyst Prepared via $VOPO_4 2H_2O$ 433
Y.H. Taufiq-Yap, M.H. Looi and M.Z. Hussein

Effect of Magnetic and Non-Magnetic Elements Doped in Manganite Perovskite

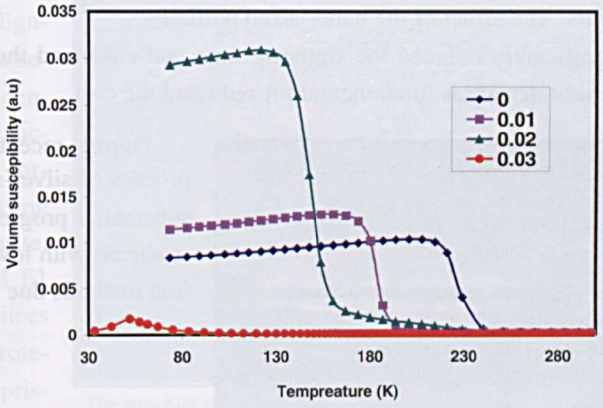
AwardWinner

Abdul Halim Shaari, W. Mahmood Mat Yunus, Mohd. Maarof Mokhsin, Hishamuddin Zainuddin, Wan Daud Wan Yusoff, Abdullah Chik, Zohra Gebrel, Lim Kean Pah and Imad Hamadneh

Structural, magnetic, and electrical properties of ABO_3 typed $(La_{1-x}A_x)_{2/3}Ca_{1/3}MnO_3$ (A = In, Sn) doped with nonmagnetic element(In) and magnetic element(Sn) were studied using AC susceptometer, DC four probe technique and Scanning Electron Microscope. Series of In and Sn doping in La site of La-Ca-Mn-O system were prepared using solid-state reaction method. The metal to insulator temperature T_p and the Curie temperature, T_c, decreases as the dopant content increases showing the decreasing ferromagnetic properties of the compound. For each substitution, there is an enhancement in susceptibility as the field intensity increases from 0.1 Oe to 10 Oe. For x = 0.4, the ac susceptibility shows a cusp around 53 K, suggesting a spin glass state. The system became disordered as the doping increases beyond x = 0.4, showing that the failure of the double exchange mechanism.



The effect of Sm doping on the microstructure of the $(La_{1-x}Sm_x)_{2/3}Ca_{1/3}MnO_3$ (x=0.02)



The temperature dependence of susceptibility of $(La_{1-x}Sm_x)_{2/3}Ca_{1/3}MnO_3$

The effect of doping decreases the porosity of the microstructure for the system.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

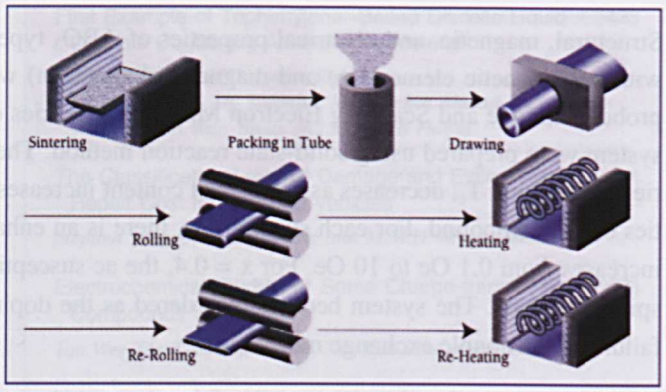
Tel: +603 8946 6648
E-mail: ahalim@fsas.upm.edu.my

Fabrication of Mono and Multifilament Tapes Prepared via Coprecipitation Method

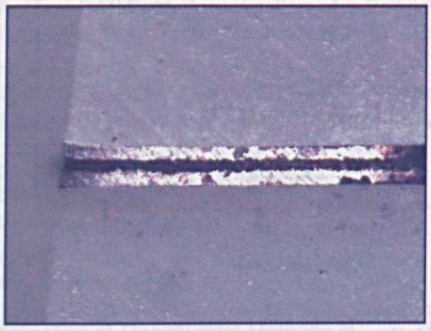


Abdul Halim Shaari, Jamil Suradi, Sidek Hj A Aziz, Wan Daud Wan Yusoff, Roslan Shukor and Imad Hamadneh

Bi-2223/Ag mono and multi filament tapes were fabricated by Powder In Tube (PIT) method. The superconducting powder Bi(Pb)-2223 has been prepared via coprecipitation technique using oxalate precursor and derived from metal oxides and carbonates as starting materials. An improvement in the critical current of the superconducting tapes was observed. The values for mono tape varied from 0.3 A to 1.5A as the sintering time increases from 24 hours to 100 hours. The effect of the nano- sized particles significantly reduced the sintering time and enhanced the volume fraction of Bi-2223. Increasing critical current density is fundamental for reducing the cost.



Powder In Tube (PIT) wire / coil making process



Cross sectional view of the mono tape

During recent years, the efforts to improve the preparation process of silver-sheated (Bi,Pb)2Sr2Ca2Cu3Ox tapes have led to substantial progress in the transport properties of these composite materials with lower cost as compared to the conventional preparation methods due to the reduction of the sintering time.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6648
E-mail: ahalim@fsas.upm.edu.my

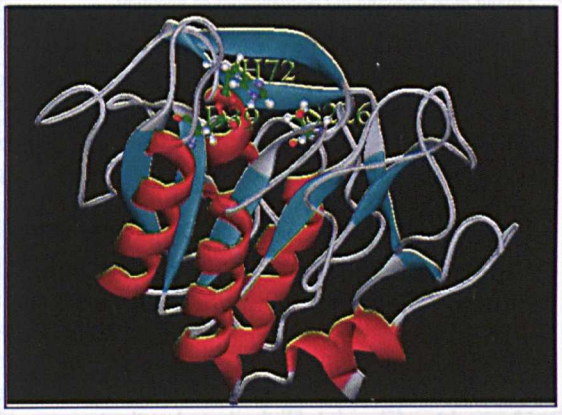
Understanding How Enzyme Works: Homology Modelling of F1 Protease from *Bacillus stearothermophilus* F1



Abu Bakar Salleh, Raja Noor Zaliha Raja Abdul Rahman, Mahiran Basri, Mohd Basyaruddin Hj. Abdul Rahman, Bimo Ario Tejo, Noor Azlina Ibrahim and Azira Mohd.

Serine proteases are produced by different of species of bacteria. These enzymes have been extensively studied on the specificity of enzyme catalysis and their considerable industrial importance. Since the three-dimensional structures of individual's protein yet to be predicted, the structure of these protein were determined experimentally by x-ray crystallography or NMR techniques. Knowledge on these experimental structure and development of computational for molecular biologist, provide all the necessary information to predict 3D structure. Homology modelling predicts the three dimensional structure of given protein sequence based primarily on its alignment to one or more proteins of known structure. The use of individual homology models in biology is already rewarding and increasingly widespread.

In the homology modelling, an optimal alignment leads to a more accurate model. The optimal alignment of the F1 protease sequence (target) to the sequence of thermitase (template) showed 61% identity. The three-dimensional of F1 protease was successfully predicted. The essential accuracy and correctness of the final structure were evaluated using the three independent methods from website: Procheck, Errat and Verify 3D. The predicted F1 protease comprises 9 beta strands and 6 alpha helices arranged in a single domain. As in all serine proteases, F1 protease contains a catalytic triad, comprising Asp 39, His 72 and Ser 226.



The structure of F1 protease

Reader Enquiry
Institute of Bioscience
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

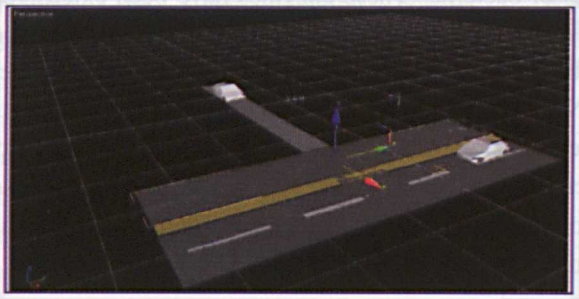
Tel: +603 8946 8090
E-mail: abubakar@ibs.upm.edu.my

Visualisation on Reconstruction of Road Accident System

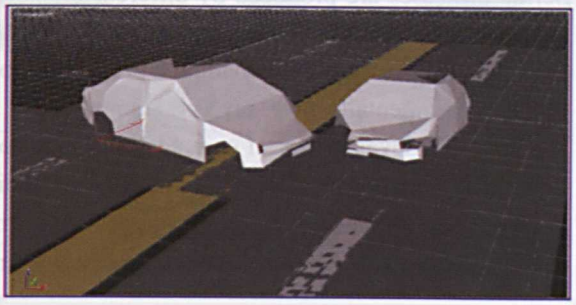
Award*Winner*

Ahmad Rodzi Mahmud

Road accident cases in Malaysia are increasing dramatically. Some road accident cases are now brought to courtroom. The handlings of the claims are getting larger and complicated. Hence evidences must be presented in a professional way.



Layout map showing the occurrences of accident



Reconstruction of an accident case to determine clear evidence

Technical analysis such as Time/Distance and speed calculation, tire mark interpretation and off-tracking analysis need to be presented. Apart from the geometrical aspect of the road, the layout map showing the occurrences of accident need to be presented in the court arguments. In addition the visibility and road condition need be shown as well. As such there is a need to reconstruct the accident cases to determine a clear evidences. The study undertaken was focused on developing modules for road accident re-construction. This effort will gain more evidences by integrating the current database gathered from the recorded form (POL27) by the police with the site investigation data. The data was formulated and animated to produce professional evidences for the courtroom.



Animated data to produce professional evidences of accidents for the courtroom

Reader Enquiry
Institute of Advance Technology (ITMA)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 2106
E-mail: arm@eng.upm.edu.my

Metal Chalcogenide Thin Films By Electrochemical Method For Solar Energy Conversion



Anuar Kassim, Zulkarnain Zainal, Mohd. Zobir Hussein and Abdul Halim Abdullah

Metal chalcogenides and their mixtures are attractive and useful systems for solar energy conversion studies by photoelectrochemical means. Electrodeposition could be a cost-effective technology for the production of terrestrial photoelectrochemical (PEC) cells. Thin-film photovoltaic technologies are being developed as a means of substantially reducing the cost of photovoltaic (PV) systems. The rationale for this is that thin-film modules are expected to be cheaper to manufacture owing to their reduced material costs, energy costs, handling costs and capital costs. Reduction of cost for the thin film cells is achieved by minimisation of the amount of material used, the possibility of inexpensive materials processing methods and the use of inexpensive mounting arrays. The main advantage of thin film solar cells is their promise of being low cost, due to low cost production and the use of the relatively low cost materials. The light generated electrons and holes in a thin film are produced close to the space charge region, so there is a high probability that they will be separated rather than recombined.

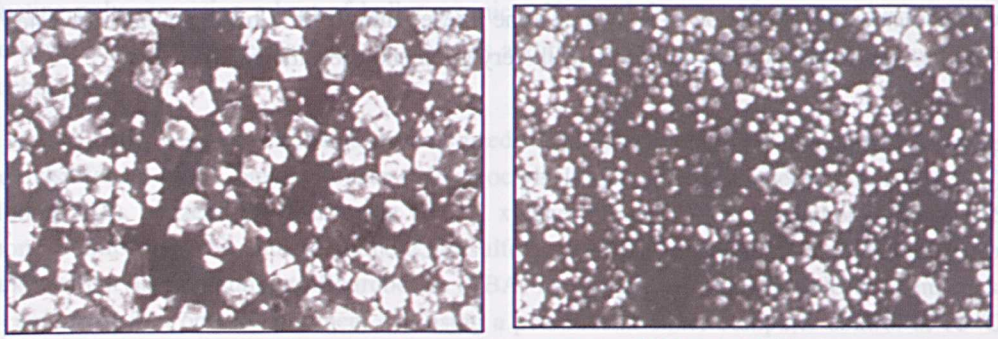


Figure 1. SEM micrographs of films prepared at various potential; (a) -0.500V (b) – 0.600 V

Various thin films such as SnSe, Cu_2S and Ni_3Se_2 were prepared and studied. The thin films showed interesting photoactivity behaviour and were in polycrystalline form. The films were prepared in the presence of chelating agent such as ethylenediaminetetraacetate (EDTA). The presence of EDTA in aqueous solution was found to improve the lifetime of the deposition bath as well as the adhesion of the deposited film on the substrate. The SnSe films formed exhibited *p*-type semiconductor behaviour with very good photosensitivity, optical absorbance in the visible light spectrum and band gap energy (E_g) of 1.0 eV. The Cu_2S films deposited at –0.40 V (*vs.* Ag/AgCl) showed better x-ray diffraction data and better morphology (Figure 1 & 2).

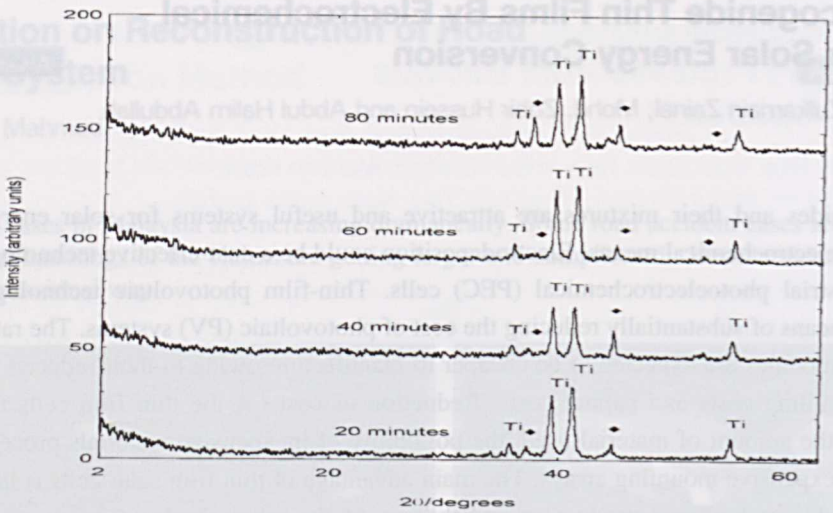


Figure 2. D patterns of the samples prepared at different deposition periods: 20, 40, 60 and 80 min. Cu_2S (♦)

The Cu_2S films also showed good photoactivity behaviour with a bandgap value of 1.5 eV. X-ray diffraction data indicates the formation of polycrystalline Ni_3Se_2 films with a bandgap value of 1.4eV. The film exhibited *p*-type semiconductor behaviour with very good photosensitivity.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6779, 8946 6776
E-mail: anuar@fsas.upm.edu.my

Conductive Polymer for Secondary Battery and Photovoltaic Applications

Award Winner

Anuar Kassim, Zulkarnain Zainal, Mohd. Zaki Abd. Rahman, Dzulkefly Kuang and Abdul Halim Abdullah

The interest in the development of conducting polymers such as polyaniline, polypyrrole, polythiophene, polyphenylene etc. has increased tremendously during the last decade because of their electronic properties in batteries, electronic devices, functional electrodes, electrochromic devices, optical switching devices and sensors. Conducting polymers can be prepared by chemical or electrochemical polymerization. The robust nature of the bulky anions such as dodecyl sulfate and p-phenol sulfonate has been observed to impart mechanical strength to the conducting polymer and the bulky anions have been found not to move easily out of / into the film. Hence, our effort has been focused on the preparation of conducting polymers using a host of bulky organic sulfonated dopant anions over pyrrole and aniline monomers by chemical and electrochemical methods and the characterization of the films by several analytical techniques.

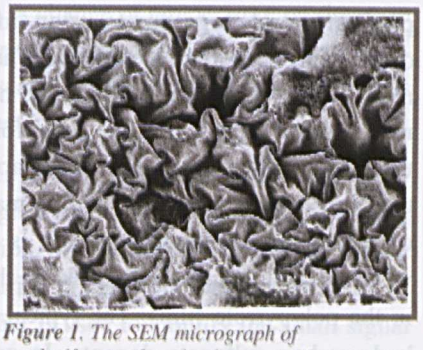


Figure 1. The SEM micrograph of octylsulfonate-doped polypyrrole film

The various bulky organic sulfonated dopants used for the electrochemical preparation of polypyrrole were methylsulfonate (MS), butylsulfonate (BSA), octylsulfonate (OSA), dodecylsulfonate (DSA), benzenesulfonate (BS), benzene-1,3-disulfonate (BDS), xylenesulfonate (SXS), camphorsulfonate (CS), anthraquinone-2-sulfonate (AS), anthraquinone-2,6-disulfonate (ADS), tetraethylammonium tetrafluoroborate (TEA) and tetrabutylammonium tetraflouroborate (TBA) in aqueous medium. The electrochemical synthesis was carried out in a one-compartment cell using a potentiostat under computer control at 18 ^{0}C for 5 hours. For the chemical synthesis of polypyrrole, various oxidizing agents, such as, potassium peroxydisulfate, ferric chloride and ferric nitrate were used. Our effort in chemical synthesis also involves the preparation of polyanniline using different sulfonic acids.The electrochemically prepared polypyrrole (ppy-) films were characterized by cyclic voltammetry (CV), FTIR spectroscopy, scanning electron microscopy (SEM), X-ray diffraction (XRD), elemental analysis and conductivity measurement. The conductivity of all the polypyrrole films was found between 0.11 to 5.52 Scm^{-1} at room temperature. For the series of various alkylsulfonated dopants, such as, methylsulfonate (MS), butylsulfonate (BSA), octylsulfonate (OSA) and dodecylsulfonate (DSA), the conductivity of the films was found to increase with the increase of carbon number of the dopants For the series of various aromatic based sulfonates, such as, benzenesulfonate (BS), benzene-1,3-disulfonate (BDS), anthraquinone-2- sulfonate (AS) and anthraquinone-2,6-disulfonate (ADS), the conductivity of the films was found to decrease with the increase of sulfonate group of the dopants. Apart from the above-mentioned dopants used, camphor sulfonate (CS) produced a much superior film compared to the rest in terms of its conductivity. The conductivity for polypyrrole film

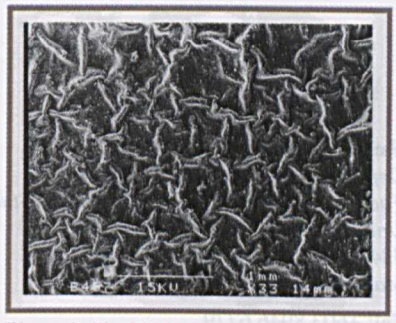


Figure 2. The SEM micrograph of camphor sulfonate -doped polypyrrole film

doped with CS was measured 5.52 Scm^{-1} at room temperature. The conductivity of the polypyrrole films prepared by chemical method was found to vary with the mole ratio of oxidant to pyrrole, and the type of the solvent used. The highest conductivity of ppy-$Fe(NO_3)_3$ prepared chemically in ethanol and aqueous medium was found to be $6.62x10^{-1}$ Scm^{-1} and $7.39x10^{-2}$ Scm^{-1}, respectively. The major peaks of all the IR-spectra of polypyrrole doped with various dopants confirmed their incorporation to the polypyrrole structure. From the elemental analysis, it has been found that the mole ratios of polypyrrole to dopant were between 1.97: 1 to 4.40: 1. The scanning electron micrographs of the polymer films showed the differences in polymer morphology due to using different dopant anions. The typical SEM micrograph of polypyrrole doped with octylsulfonate dopant. The cyclic voltammetry analysis shows that smaller dopants produced more current which reflects that the movement of the dopants in and out of the polymer surface is much more flexible than that of the cases for long chain dopants or bigger dopants. The X-ray scattering reveals that all the polypyrrole doped with various aliphatic and aromatic sulfonate dopants are amorphous since all the films exhibited broad scattering maxima in the high-angle 2θ ranges from 20-30°. There are three types of molecular arrangement, which is pyrrole-pyrrole, pyrrole-dopant and dopant-dopant scattering. The weakness of the high angle-peaks in the 2θ range of 20° to 30° indicates that there is far less order present in the polypyrrole films. The typical example of X-ray diffractograms of polypyrrole doped with linear hydrocarbon sulfonate dopants. In conclusion, it can be reported that various bulky organic sulfonate dopants were found suitable to incorporate into the polypyrrole chain by electrochemical method in aqueous medium. Efforts were also successful in preparing polyaniline films using various sulfonic acids by electrochemical method and polypyrrole films using some oxidizing agents by chemical method.

Further research on polypyrrole and polyaniline-based conducting polymer can be recommended to investigate the mechanical properties, such as, tensile strength, stability against heat and stress, of the conducting polymer

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6779
E-mail: anuar@fsas.upm.edu.my

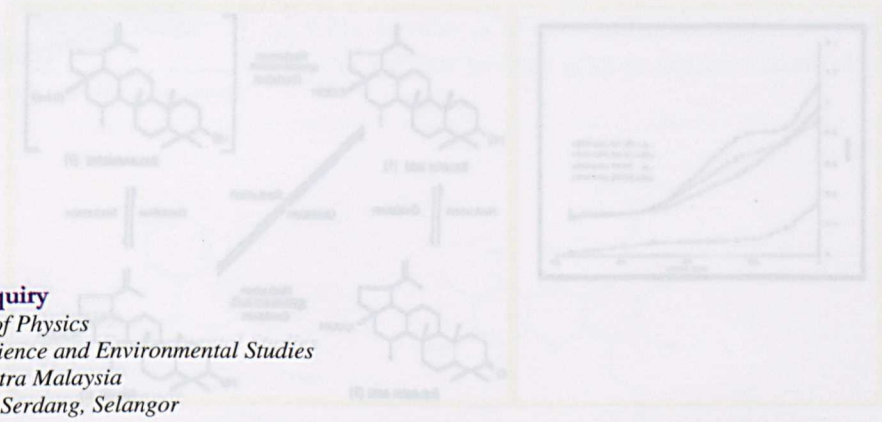
Development of Photopyroelectric Spectrometer

Azmi Zakaria, Mohd Maarof Moksin, Mansor Hashim, Ling Yoke Ting, Liaw Hock Sang and Sabarina Mohd. Shapee



A highly sensitive photopyroelectric spectrometer has been developed. Its detection is based on photothermal effect that is a photo-induced thermal state change of the sample. A change of temperature produces an electrical signal in a photopyroelectric sensor, which is in thermal contact with sample. Since sample heating is a direct consequence of absorption of light, the reflection and scattering loses do not produce serious problems in this technique as it does in conventional optical spectrometer.

The developed spectrometer system consists of a 1 kW high power Xenon light source, a computer controlled stepper motor to wavelength scan a monochromator and for signal processing, a mechanical chopper for light modulation, and a photopyroelectric cell for signal generation. The heat produced in the sample after absorption of the modulated light causes the polyvinyledine flouride (PVDF) photopyroelectric detector film detector to produce a voltage signal. A low-noise preamplifier is used to amplify the small signal before feeding the signal to a lock-in amplifier for analyzing. The signal is recorded as a function of the wavelength over the spectral range of interest by scanning the monochromator. The spectrum of the sample is obtained by dividing the sample raw spectrum to the carbon spectrum that represent light source spectrum. This normalization eliminates the spectral variation of the excitation source. The system was applied non-destructively to solid samples such as poly-methylmethacrylate doped with methyl red, coloured paper, plant leaves etc. Both the absorption and transmission spectra, which characterized the optical and thermal properties of the sample, were readily recorded by simply varying the chopping frequency.



Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6650
E-mail: azmizak@fsas.upm.edu.my

The Chemistry of Betulinic Acid: Search for Anti HIV and Anti- Cancer Drug



Faujan H. Ahmad, Mahiran Basri and Manaf Ali

Betulinic acid has been found to exhibit a wide range of biological activities; such as antitumor activity against human melanoma, against mouse skin two-stage carcinogenesis, leishmanicidal activity against amastigotes of Leishmania amazonesis, spasmogenic activity on isolated rat fundus, anti-inflammatory activity in mouse paw and ear edema test, antiplasmodial and antimalarial activity. Interestingly, betulinic acid is virtually nontoxic (IC_{50}>20µg/ml) to a wide ranges of cultured human cell line and only shows a selective cytotoxic activity towards human melanoma cells (IC50 1-5µg/ml. Betulinic acid: Isolation from *Triphyophyllum peltatum* and *Ancistroclaus heyneanus*, antimalarial activity, and crystal structure of the benzyl ester

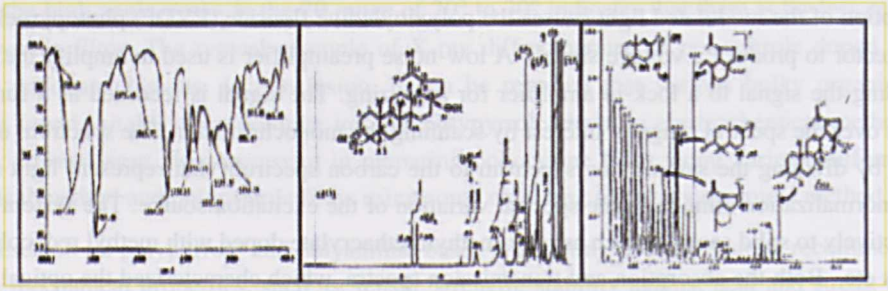


Figure 1. IR, NMR and Mass Spectra of Betulinic Acid

Up to date we managed in isolating, in gram scale, pure product of betulinic acid from selected local Malaysia plant. The structure of this compound was confirmed by spectroscopic data and is in full agreement with those reported in literature as well as obtained from the authentic material.

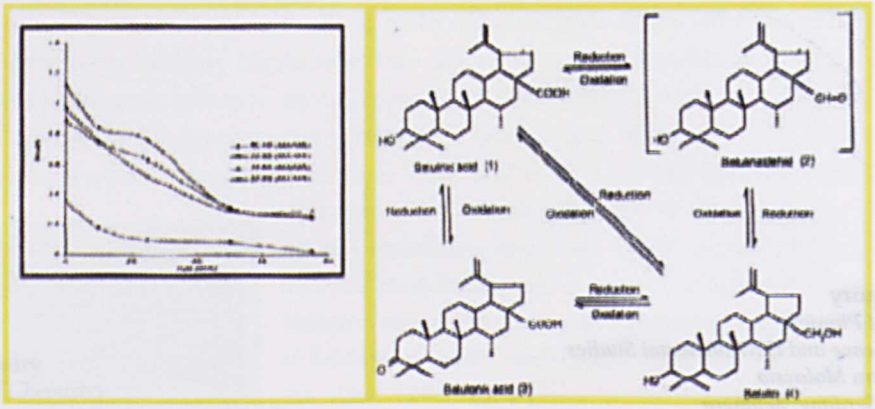


Figure 2. Solubility of betulinic acid in the MA/Tween 80:20 water system at different methyl acetate. MA and mixed surfactants, MS weight ratios as water weight percentage at 25.0±0.5 °C

Since this interesting compound is non-water soluble and only sparingly soluble in most organic solvents, its solubility in microemulsion was investigated. As expected its solubility decrease when the water content increase. Investigation on various microemulsion systems is still on progress, aiming for the development in drug delivery system.

We are now concentrated on the synthesis of its derivative, including its esters and amides using enzymatic reaction, since reaction-using enzyme is expected to give a clean product. It is hope that such derivatives will improve its solubility as well as bioactivities.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6784
E-mail: faujan@fsas.upm.edu.my

Cuneifolin, a new xanthone from *Garcinia cuneifolia* and mucigerin, a new coumarin from *Calophyllum mucigerum*



G. C. L. Ee, X. H. Mong, K. N. Ng, Y. H. Taufiq-Yap, M. Rahmani and A. M. Ali

Members of the Guttiferae are known to be rich source of xanthones. Prenylated xanthones have been reported to show antibacterial and antifungal activities. Extensive research has shown that *Garcinia* and *Calophyllum* species exhibited a wide range of biological and pharmacological activities such as cytotoxic, antimicrobial, antimalarial and anti-HIV-1 protease inhibitory activities. *Calophyllum mucigerum and Garcinia cuneifolia* have shown potential to be used as a natural larvicide.Detail chemical studies on the stem bark extracts of *Garcinia cuneifolia* have furnished a new xanthone **cuneifolin**. While studies on the stem bark of *Calophyllum mucigerum* have yielded a new coumarin **mucigerin**. Structures for both of the compounds were elucidated based on Nuclear Magnetic Resonance (NMR), Mass Spectrometry and Gas Chromatography- Mass Spectrometry data.



Leaves of Garcinia cuneifolia



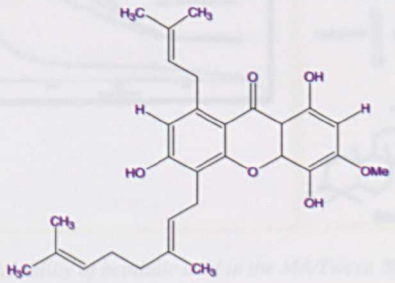
Bark of Garcinia cuneifolia

Larvicidal activity screening of the crude bark extracts using the larvae of *Aedes aegypti* indicated the larvae to be susceptible to these extracts. The larvae of *Aedes aegypti* are moderately susceptible to the three *Calophyllum mucigerum* crude extracts. The hexane extract gave an LC_{50} value of 87.9 µg ml^{-1}.

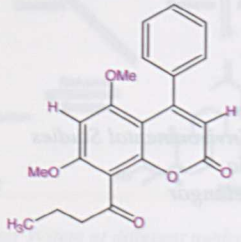


Leaves of Calophyllum mucigerum

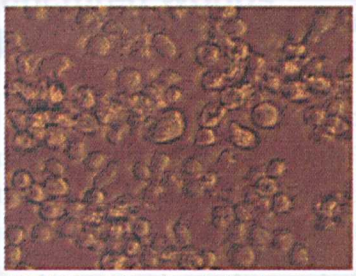
Bioassay testing on the crude hexane and ethanol extracts of *Garcinia cuneifolia* indicated the plant to be moderately toxic to the larvae of *Aedes aegypti*. The hexane extract gave an LC_{50} value of 119.9 µg ml^{-1}. While for the ethanol extract, an LC_{50} value of 105.2µg ml^{-1} was obtained.



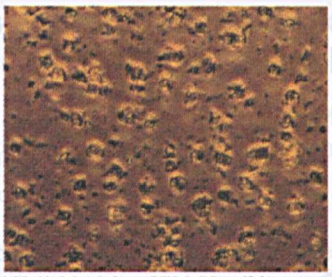
Cuneifolin



Mucigerin



CEM-SS cell line (Control set)



100 % Mortality CEM-SS cell line

For *Calophyllum mucigerum*, cytotoxic screening against CEM-SS cell line (T- Lymphoblastic leukemia) on the crude ethyl acetate and ethanol extracts indicated weak activity. However, the crude hexane extract shows moderate activity with and IC_{50} value of 16.2 $\mu g\ ml^{-1}$.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6785
E-mail: gwen@fsas.upm.edu.my

The Studies of Elastic Properties and Heat Treatment of Superionic Glasses $(Ag_2O)_x(B_2O_3)_{1-x}$



Halimah Mohamed Kamari, Hasnu Rizal, Sidek Hj. Abdul Aziz,. Chow Sai Pew, Abdul Halim Shaari and Kamirul Amin Matori

The elastic properties of superionic glasses, silver borate glasses $(Ag_2O)_x(B_2O_3)_{1-x}$ with different compositions of silver (x = 0.2 to x = 0.4) have been studied. The ultrasonic velocity has been made using a transducer having resonating frequency of 5 Mhz (both longitudinal and shear). The density and ultrasonic velocity show an interesting observation, which are used to explore the structural changes in the network. Elastic moduli and Debye temperature of the glasses have been determined using the experimental data.

Anomalies observed in the elastic properties and Debye temperature exhibit similar trend of the behaviour as that of density. The temperature dependence of the elastic properties explores useful information about the structural stability and physical properties of the silver borate glasses.



The sample was then annealed in a temperature controlled oven at temperature ranging between 300 – 360oC for 2-3 hours



Using conventional melt quenching technique. Mixing appropriate amount of oxides, chloride and borates made glasses



After melting, the crucible was removed from the furnace and the melt was poured onto a split stainless steel to form a cylindrical sample

The observed results through ultrasonic non-destructive evaluation explore the structural stability, structural changes and mechanical properties of the glasses.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6672
E-mail: halimah@fsas.upm.edu.my

Quantizing Punctured Worlds

Hishamuddin Zainuddin, Ahmed Bouketir and F.P. Zen



Quantization is a well-known but ad-hoc procedure for transforming a classical system into a quantum one. Being ad-hoc in nature, there are various quantization schemes being offered to build quantum theory beyond the standard one allowing the most general context possible.

Our current effort chooses a scheme that emphasizes the topology and geometry of the underlying system to be intertwined in the group-theoretic description of its symmetries. The systems to be quantized are those of a test particle moving on two-dimensional spaces with points removed i.e. punctured surfaces. The expectation is that the topological features arising from the punctures should be reflected in the canonical group needed for quantization. Such systems can find applications in areas like quantum Hall effect, integrable models, string theory and quantum gravity. We demonstrate some of these topological features and indicate how they can be incorporated in the ensuing quantum theory.

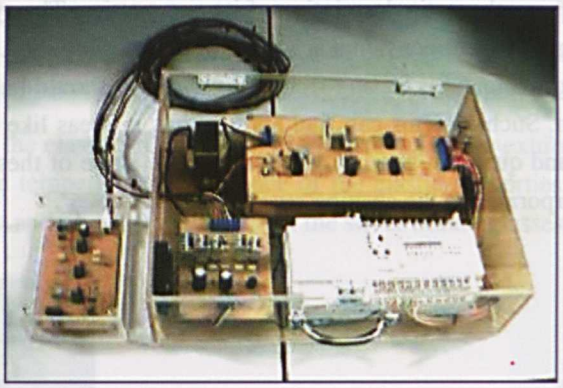
Reader Enquiry
Institute of Advance Technology (ITMA)
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7561
E-mail: hisham@fsas.upm.edu.my

A Portable Fiber Optic Based Lightning Detector System

Ishak Bin Aris

Award*Winner*

The portable fiber optic-based lightning detector system is used to provide a reliable system (affordable, accurate, less noise and less interference), which is capable of monitoring, detecting and storing automatically, the data of the lightning profile.



A Portable fibre optic based lighting detector system

A photo detector is applied to the front-end of the system as the sensing element for the lightning flash. The system uses fiber optic as its transmission system to transmit the data from the lightning detector to the analog receiver at the other end of the fiber optic. A Programmable Logic Controller (PLC) that is part of the system is used to collect and store the data with the time and the date of occurrences and this data can be viewed or retrieved through the personal computer (PC). The system can be operated in two modes namely off-line and on-line modes. In the off-line mode, the system is operating independently to record the data at designated and remote site. There is no computer connected to the system during its data recording activity. The system will record the lightning activities for a predetermined period. After this period, the user can come and collect it. The PC is then connected to the system to retrieve the data.In the on-line mode, the system is linked to the server database directly via an Internet. Many systems can be linked to the server database. The data is recorded and compiled automatically and continuously to the server database.

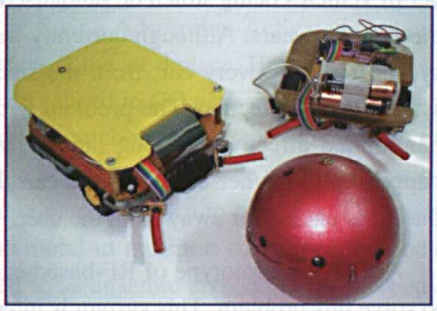
Reader Enquiry
Department of Electrical and Electronic Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6324
E-mail: ishak@eng.upm.edu.my

Robotoy II

Ishak Bin Aris

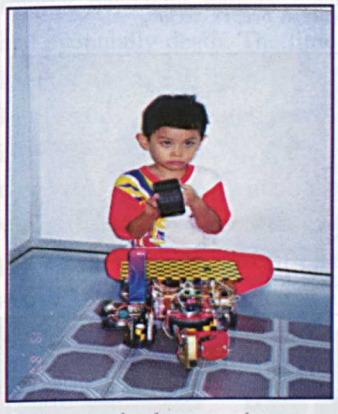
Award Winner

The Robotoy II consists of three programmable autonomous guided robots. Each robot has its own characteristics and features.



Robotoy II

The main purpose of this invention is to provide a teaching and learning tool for secondary school pupils and teachers and university students to study, learn and understand about basic topics of the robotic system such as basic movement of the robot, controller, feedback system, various sensors, programming, mechanical structure, electronics and artificial intelligence. The concept of "edutainment" is applied to the students during the process of learning. This concept combines both learning and entertainment together to generate interest and make difficult subject become easy to learn and understand. The first robot is capable of talking, moving around, dancing, picking and placing an object. It can also avoid an obstacle along its travelling path. It is controlled using a digital remote control. The second robot is capable of following a target and run from its enemy. Clapping the operator's hands can activate the second robot. The third robot is complementing the second robot. It has the same features as the second robot. The programming of the robots is implemented via a serial cable to the computer without taking the robots controller from its body. Batteries power the robots.



Robotory under demonstration

This product can be commercialized both locally and internationally.

Reader Enquiry
Department of Electrical and Electronic Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6324
E-mail: ishak@eng.upm.edu.my

RF-based Car Pager System

Ishak Bin Aris

According to the data provided by the Polis Diraja Malaysia, the number of vehicles being stolen or vandalised has been increased greatly for the last few years. Although currently there is a normal security alarm system fixed in every car, from the statistic figure, it shows that this system is not effective. The problem with this system is that the alarm has limited effective working range. The user will not know what is happening to his/her car when the car alarm is triggered, especially if the car is parked far away from the user.

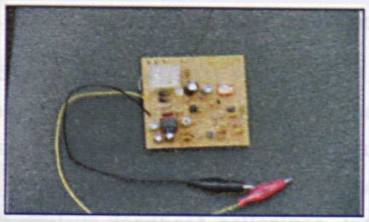


Figure 1. Receiver circuit

A low cost prototype of RF-based car pager system was developed to solve this problem. This system is interfaced with a standard security alarm system of the car. Basically, this system has three main sections namely a car security anti-theft alarm unit, an UHF transmitter-receiver set and a beeper circuits. This system is capable of informing the user through the car beeper attached to the car key chain, when the car security alarm is triggered. This is achieved by sending the signal from the security alarm system transmitter located inside the car to the user via air propagation or radio frequency (RF). The receiver, which is located in the car beeper, will process the signal and generate an audible sound to the user. This means that when the user works in his/her office and parks his car outside his/her office building, the car beeper will produce an audible sound to him if the car alarm is triggered.

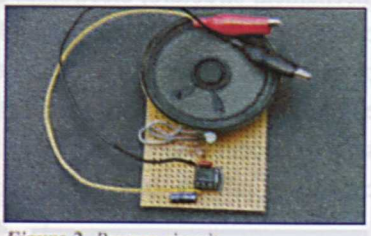


Figure 2. Beeper circuit

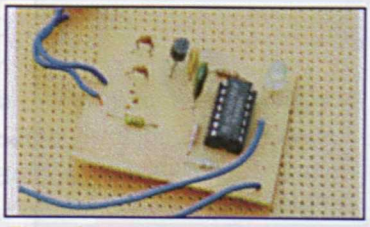


Figure 3. Transmitter circuit

This system also can be implemented to other vehicle types and other security systems. This system can be commercialised and it has a very big commercial value, especially to the vehicle manufacturers.



Figure 4. Central locking alarm unit

Reader Enquiry
Department of Electrical and Electronic Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6324
E-mail: ishak@eng.upm.edu.my

Two Alternating Pressure Swing Adsorption (PSA) Beds for Hydrogen Purification and CO Removal from the Workplace Using Tin in Activated Carbon

AwardWinner

Iyuke Sunny Esayegbemu

It has been clearly shown in the study that PSA-AC-SnO_2 (Pressure Swing Adsorption-Activated Carbon-Tin (IV) Oxide) system is a novelty tool for chemical (e.g. CO) safety at the workplace. However, the prevention and reduction of occupational accidents and diseases that are related to CO emission should attract serious concern. This is because, when CO is inhaled into the lungs, it combines with the haemoglobin of the blood and incapacitates the blood's ability to carry oxygen to the body tissues. This is why it is considered a dangerous asphyxiant. The absorption of CO into the blood stream is known to be about 200 times stronger than that of oxygen, which then lessens the ability of the blood to transport oxygen to the body organs, and eventually leads to asphyxia that is commonly referred to as anaemic anoxia. When the body thus senses the shortage of oxygen content in the blood stream, the heart beats increases to supply more blood to the oxygen-impoverished organs thereby resulting to a rising blood pressure. If the period of CO inhalation increases, the risk of breathing difficulty also increases. Other symptoms could be cardiac trauma, headache, nausea, weakness, dizziness, weariness, vomiting, loss of consciousness, brain damage and eventually death. The time of exposure to CO and its concentration are the determining factor for the level of damage to the health of humans and animals, which has been nicely presented in this study (Fig 1). In the study, a characteristic and a cheap AC-SnO_2 adsorbent have been synthesised by impregnating SnO_2 into activated carbon, and then effectively used to remove CO from H_2/CO (75/25 volume %) model mixture using pressure swing adsorption (PSA) separation processes (Fig 2) while the hydrogen component was purified. The activated carbon was initially impregnated with stannous chloride ($SnCl_2.2H_2O$) as Sn^{2+} precursor, which was oxidised to Sn^{4+} in the form of SnO_2 from H^+SnCl^{3-}(aq) during drying at temperature above 180^0C. It is shown that a considerable amount of CO at 1000 ppm was successfully reduced to 10.4 ppm.

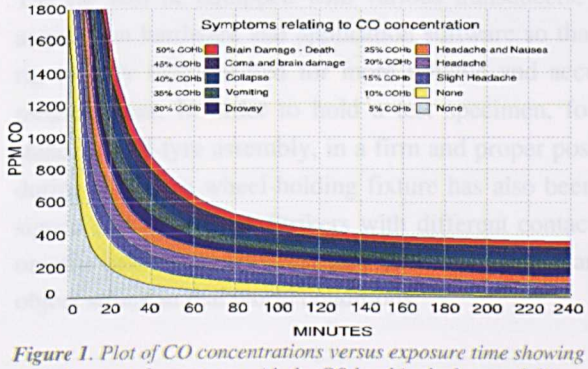


Figure 1. Plot of CO concentrations versus exposure time showing typical expected symptoms with the CO level in the haemoglobin [Source: Stephanie Trotter 1999. CO-Gas Safety, Registered Charity No. 1048370]

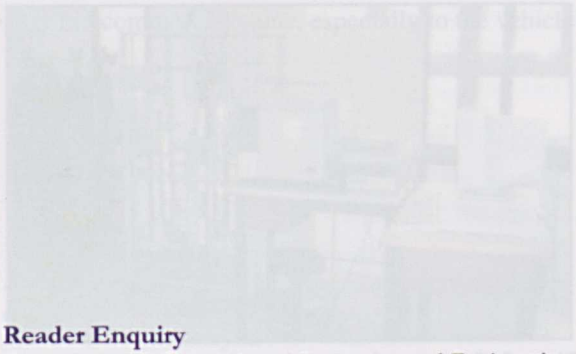


Figure 2. Experimental set-up of two alternating PSA beds separation processes for workplace chemical hazard and hydrogen purification

In comparison of PSA results of the pure and impregnated activated carbon, it was shown that adsorption of carbon monoxide was higher with the impregnated carbon than in the pure carbon. It was also observed that the concentration of carbon monoxide, which was 1000 ppm, was successfully reduced to 40.2 and 10.4 ppm by the pure and the impregnated activated carbons, respectively. These results were within limits of experimental errors perhaps due to the gas standards used in the gas chromatography analysis. Simulation results obtained at cyclic time of 600 seconds in the PSA operation at 10 atmospheres the product recovery and purity were 99.99 % and 57.48 %, respectively. While at 6 atmosphere the product recovery and purity were 92.17 % and 77.12 %, respectively.

The HAZOP study conducted had shown a little hazardous risk, meaning the project can enjoy a safe operation and the attendants a safe working environment. With these promising results the PSA Unit incorporating the newly developed AC-SnO_2 adsorbent has been hooked up to the 5kW fuel cell power plant, which was also designed, assembled and commissioned under my research conducted.

While the main objective of this article was to purify hydrogen for PEM fuel cell use, it has also introduced a new and innovative CO pollution control technique, which might open a new era not only in CO emission control and prevention but also a new market for tin minerals. However, every human must be reminded that life neither has replacement, alternative nor second chance, thus there should be no room for any lukewarm attitude or apathy to CO emission prevention. After all, prevention is not only better than cure, it is also cheaper than cure.



Reader Enquiry
Department of Chemical and Environmental Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6294
E-mail: sunny@eng.upm.edu.my

Crashworthiness of Motorcycle Frontal Components

K.S. Tan , S.V. Wong, R.S. Radin Umar, M.M.H. Megat Ahmad and A.M.S. Hamouda

A comprehensive database on crashworthiness of motorcycle is required for investigation of traffic collision involving motorcycle. Pang emphasized the need of such database in order to correlate the change of velocity to crash and injury severity. Although post-impact damage and deformation for vehicular components have long been used to assess the velocity change of vehicle or the severity of vehicular impact, but only very few research has been carried out on motorcycle components crashworthiness in terms of correlation between change of speed and components deformation, especially wheel-tyre assembly which represents the first and direct impact contact point in frontal collision. Through the experimental approach, this research is intended to lay out a route for the development of an expert system comprises of a complete crashworthiness database of all types of commercial available motorcycle, along with different feasible combinations, which applicable for predicting of the change of velocity during collision based on post-impact evidence and provide insights into such field for further researches to be carried out.

Motorcycles which involved in road crash and sustained damages or deformations on wheel and front fork structure have been studied to identify the typical modes of damage and deformation, from light to severe crash conditions. The damages and deflections sustained by the front fork structures are classified into (i) grazed, (ii) dented/smashed, (iii) distorted, and (iv) broken off. Bending and displacement from the axle axis are included in distorted category. Compared to other damage and deflection modes (except grazed), the front fork is more tended to be distorted due to its relatively slender structure. For wheel, the damage and deformation modes generally observed are (i) in-plane dented, (ii) buckled/collapsed, (iii) distorted, and (iv) rim broken off. The spokes mostly will be distorted rather than being broken off. In most cases, the tyres have been observed to be punctured and dislocated from the rim.

A pendulum impact tester has been designed and developed as a tool for experimental studies on the dynamic strength and crashworthiness of interested components. The rig will be equipped with various transducers, data acquisition hardware and application software so that the rig is fully instrumented for more reliable and accurate measurement. In order to hold a test specimen, for instance wheel-tyre assembly, in a firm and proper position during impact, a wheel-holding fixture has also been designed and developed. Strikers with different contact geometry have been designed in order to simulate various object struck in real world conditions.

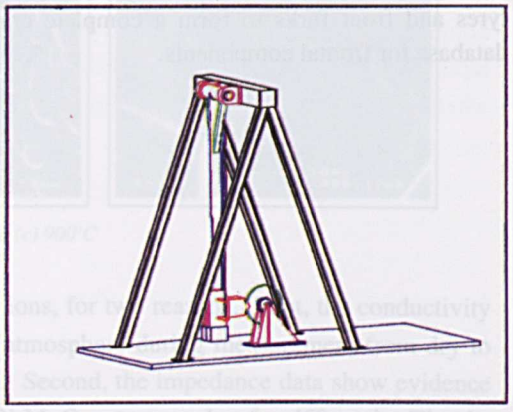


Figure 1. Pendulum impact tester with wheel holding fixture

In order to exactly reproduce the crucial and important characteristics of the real-world crash conditions, the following essential parameters have been identified: (a) wheel-tyre assembly, (b) tyre pressures, (c) speed of impact, (d) geometry and structure of the objects struck, (e) compliance of front suspension, (f) wheel rotation motion and speed, (g) location of the impact relative to the wheel-tyre assembly (radially or offset), and (h) impact angle. Examination on these parameters indicated that the first three could be duplicated relatively easy and may be independent of the vehicle or the crash conditions. The Rio Hondo testing did show that tyre pressure is one of the most significant variables affecting road hazard performance. The impact speed of the vehicles involved in any collision makes up one of the essential parameters for assessing the movement sequence of the vehicle and the crash severity. The nature of impact that is, the hitting object and target obstacle collision mode, stiff or deformable impact, has been pointed out to have influences on collision severity. The external geometry of the object struck, together with different impact location and impact angle would give specific deformation shape to the wheel. By not considering the compliance of suspension, rotation motion and speed of wheel, the other parameters of impact test could be reproduced considerably easy with the aid by proper wheel holding fixture and at lower cost compared to full-scale crash test.

It is expected that the research would give valuable contributions to the accident investigation and reconstruction as follows: (a) identification, definition and classification of typical deformation modes or patterns in frontal ±30° direct impact for motorcycle wheel-tyre assembly and front fork, (b) formulation of relationships between the speed/momentum change or impact energy and the deflection of wheel-tyre assembly and front fork structure, (c) development of standard models for crashworthiness of motorcycle wheel-tyre assembly and front fork structure, and (d) compilation of commercially available motorcycle wheels, tyres and front forks to form a complete crashworthiness database for frontal components.

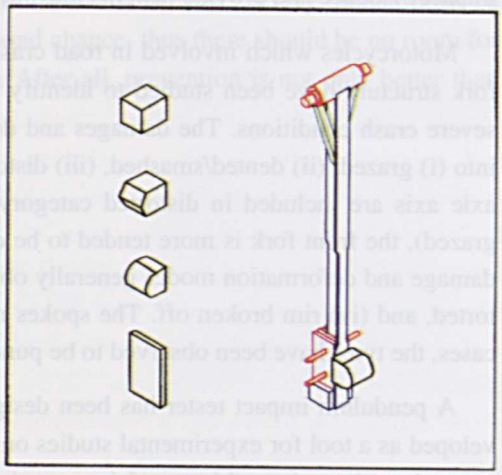


Figure 2. Pendulum arm and strikers with various contact geometry

Reader Enquiry
Department of Mechanical and Manufacturing Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6339
E-mail: wongsv@eng.upm.edu.my

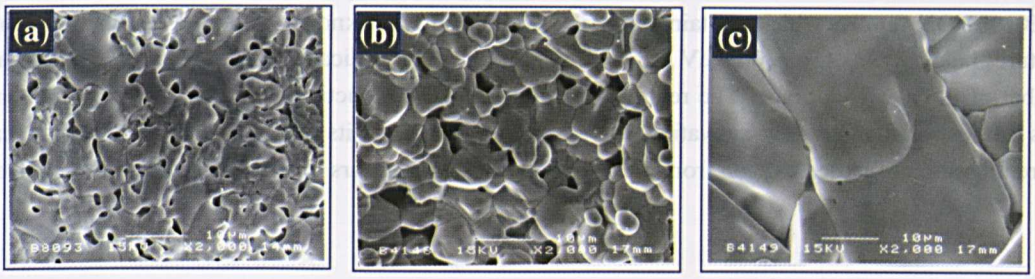
High Oxide Ion Conductivity in Bi_2MoO_6 Oxidation Catalyst

Lee Chnoong Kheng

Bismuth molybdates are useful oxidation catalysts in selective olefin oxidation and ammoxidation processes. Various studies using ^{18}O-labelled catalyst have shown that mechanisms involving lattice oxygen appear to operate when these materials are used as oxidation catalysts. There is, however, very little information on the anionic conductivity of these materials.

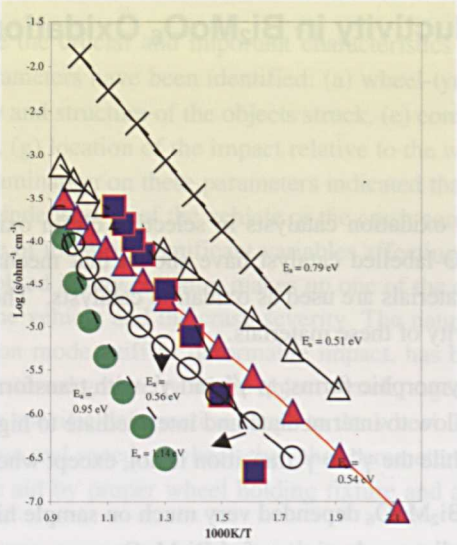
Bi_2MoO_6 exists in three polymorphic forms: γ, γ' and γ, with transformation temperatures of 604 and 640-670°C, respectively for the low to intermediate and intermediate to high temperature polymorphs. The γ to γ' transition is reversible while the γ' to γ transition is not, except when high pressures are applied.

The electrical properties of Bi_2MoO_6 depended very much on sample history and polymorph. Arrhenius conductivity plots of the total pellet conductivity of γ-Bi_2MoO_6 were very dependent on the sintering temperature with the highest conductivities observed after sintering at 928°C, a temperature close to melting. Linearity of the Arrhenius plots also appeared to increase with increasing sintering temperature or after repeated heat-cool cycles. These effects are attributed to an increase in grain size and increased area of contact between grains in well-sintered samples, giving rise to an overall increase in pellet conductivity and evidence was obtained from scanning electron micrographs (SEM) of pellets of γ-Bi_2MoO_6 sintered at 800°C, 850°C and 900°C, showing an increase in grain size, decreased porosity and increased contact between grains with increasing sintering temperature.



SEM micrographs of γ-Bi_2MoO_6 sintered at (a) 800°C, (b) 850°C and (c) 900°C

The conducting species in γ-Bi_2MoO_6 appear to be oxide ions, for two reasons. First, the conductivity data (Z* plots) were completely unaffected by changing the atmosphere during measurement from dry to wet air and so, there was no evidence of protonic conduction. Second, the impedance data show evidence at low frequencies of an inclined spike, seen clearly for γ-Bi_2MoO_6, at an angle of ~ 45° to the Z′ axis. Such a spike is characteristic of a diffusion-limited process represented by a Warburg impedance; in the present case, the origin is likely to be the diffusion of oxygen molecules towards/away from the electrode/sample contact and is a very strong indicator that the present materials are oxide ion conductors and not electronic semiconductors.



Arrehius plots of γ-Bi_2MoO_6 (,), γ'-Bi_2MoO_6 sintered at 800°C ( ),850°C ( ), 900°C ( ) and yttria-stabilized zirconia ( ).

Thus, a well-sintered sample of γ'-Bi_2MoO_6 is a better oxide ion conductor than the low temperature γ polymorph. It has activation energy of 0.51 eV and conductivity of 7.3 x 10^{-6} ohm^{-1} cm^{-1} at 300°C. Its conductivity at 300°C is comparable to that of yttria-stabilized zirconia (YSZ), while its activation energy is much less than that of YSZ, 0.79 eV. The activation energy of γ'-Bi_2MoO_6 is, in fact, less than that of the BIMEVOX family, which contains materials with the highest known oxide ion conductivity for temperatures below ~ 500°C e.g. 0.56 eV for $Bi_2V_{0.9}Cu_{0.1}O_{5.35}$. This indicates that γ'-Bi_2MoO_6 contains a small number of mobile oxide ions. The relatively high oxide ion conductivity of γ'-Bi_2MoO_6 at low temperatures and especially, the low activation energy, may account for its usefulness as an oxidation catalyst where migration of lattice oxygen from the bulk to the surface appears to be of paramount importance.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6789
E-mail: cklee@fsas.upm.edu.my

Electrochemical oxidation of L-cysteine and Vitamin E using C_{60} fullerene modified carbon electrode



Lim Ei Bee, Tan Wee Tee, Goh Joo Kheng and Nur Rahizan Binti Ilaha

Use of a glassy carbon electrode modified by adhered micro crystals of fullerene (C_{60}) mediates the oxidation of cysteine in the presence of aqueous electrolyte containing potassium ion. Under conditions of cyclic voltammetry, the potential for oxidation of cysteine is lowered by approx.100 mV and current is enhanced significantly relative to the situation prevailing when a bare glassy carbon electrode is used. Mediation also occurs when the potential range covered include that of C_{60}/C_{60}^{n-} redox couples. The sensitivity under condition of cyclic voltammetery is dependent largely on pH, temperature and C_{60} dosage.

Similar work was extended to include the electro-oxidation of vitamin E (α-Tocopherol) in a mixed solvent of low pH (pH 3.36). The oxidative currents of vitamin E obtained by using a C_{60} modified GC electrode were also found to increase significantly with increase in temperature, potential cycling and scan rate.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6807
E-mail: wttan@fsas.upm.edu.my

A Study of Magnetic Parameters of Iron-Deficient Ni-Zn Ferrites ($Ni_{0.3}Zn_{0.7}Fe_{2-X}O_4$)



Mansor Hashim, Rosidah Alias,, Jumiah Hassan, Salleh Harun, Abd. Halim Shaari and Wan Daud Wan Yusof

Ferrites having many advantageous over other magnetic materials such as metallic material have fulfilled a major need of the rapidly growing electronic industry such as electromagnetic interference suppressors, multi-layer chip components, inverter transformer, etc. Their usage in this field has been unabated for several decades since the first commercial ferrite products in about 1945. The most required properties for the use of these materials are high magnetic permeability and low core loses at high induction levels and at fairly high frequency. Higher saturation flux density is needed to minimize the number of coil turns and lower core loss is needed to allow maximum throughout power for a given temperature rise. The preparation of required properties of ferrite product is a complicated task because they are strongly dependent on the chemical composition, chemical homogeneity, powder purity, microstructure, stoichiometry, etc.

The present work is aimed mainly to investigated the effect of iron-oxide concentration on magnetic properties and microstructures of Ni-Zn ferrites in which x was varies from 0 to 0.01 in steps of 0.002.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6669
E-mail: rosidah_alias@yahoo.com

Antifungal Therapy and Cytotoxicity of *Bis*-(Methylthiomethyl)Disulphide and Extract from *Scorodocarpus Borneensis*



Mawardi Rahmani, Christophe Wiart, Shar Mariam Muhamed, Abd Manaf Ali, Hazar B.M. Ismail and Mohd Aspollah Sukari

The aim of this research is to discover single entity and multicomponent bioactive natural products that may serve as leads for the development of new pharmaceuticals that address therapeutic needs.



Figure 1. Skin irritancy test on rabbit; treated with (a) paraffin, (b) seeds extract of S. borneensis and (c) $AlCl_3$

Chemical constituents responsible for biological effects are identified and then either isolated and purified in the search for new single entity pharmaceutical ingredients or characterized and standardized in the search for new multicomponent botanical products. Amongst the large number of plant species screened for biological activity in our laboratory, the crude extract of the seeds of *Scorodocarpus borneensis*, locally known as *Pokok Kulim*, has been found to inhibit the growth of microbes including pathogenic fungi such as *Penicillium, Acremonium, Aspergillus, Fusarium, Microsporium, Alternaria, Curvalaria* and *Candida albicans*. In some cases the extract showed better test results compared to nystatin standard and the strongest inhibitions were obtained against *Acremonium* sp. and *Candida albicans*. The leaves and the bark were also tested for their bilogical activity, however both were not very active in comparison with the seeds extract. *S. borneensis* is a big timber tree from family Olacaceae with characteristic pungent garlic-like smell and produced large quantity of fruits. The plant is known to occur widely in the northern part of the Peninsular and in Indonesia. The Malays have used the seeds for food flavouring in place of garlic and traditional medicine preparation for application on dematomycoses. Only one previous work has been reported on the plant by a group of Japanese researchers on the leaves of the plant collected from Sumatra, Indonesia with the isolation and identification of flavonoids and megastigmanes. From the crude extract of the seeds of *S. borneensis*, a number of compounds have been isolated and the structures were spectroscopically identified as *bis*-(methylthiomethyl)disulphide (major component), scopotin, cadalene-ß-carboxylic acid and 13-docosenyl serotonine.

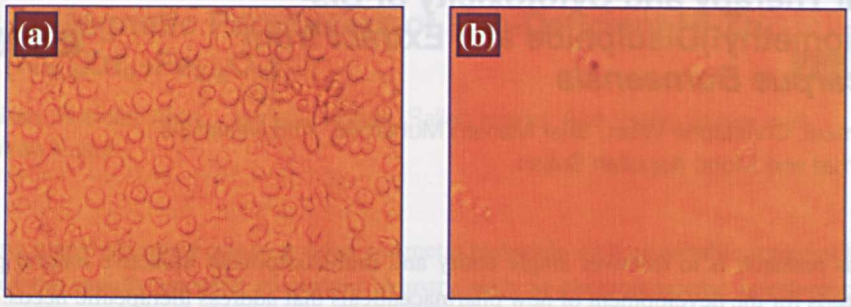


Figure 2. CEM-SS cells growth inhibition by seeds extract of S. borneensis invitro treated with (a) control and (b) extract at IC_{50} for 3 days

The characteristic pungent garlic smell of the fruits and seeds and the strong biological activity shown by the crude extract is due primarily on the presence of *bis*-(methylthiomethyl)disulphide. The compound acted significantly on methicillin resistant strain of *Staphylococcus aureus* and showed strong cytotoxic activity against CEM-SS leukemia and KU812F chronic myelogenous cancer cell lines. Both scopotin and 13-docosenyl serotonine exhibit moderate antimicrobial and cytotoxic activities against microbes and cancer cell-lines tested. The preparation made from the extract exhibited *in vivo* and *in vitro* drastic antifungal activities.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6794
E-mail: mawardi@fsas.upm.edu.my

Characterization and Utilization of Bioactive Constituents from *Murraya koenigii* and *Aegle marmelos*



Mohd Aspollah Sukari, Mawardi Rahmani, Abdul Manaf Ali, Kartini Ahmad, Sugeng Riyanto and Nakisah Mat Amin

Malaysia has about 1,500 species of plants that are known to possess medicinal properties. Tropical plants have been acknowledged to be the source of forest product substances such as pharmaceuticals, natural insecticides, flavours, oils, foods and other industrial goods. As part of our interest in the phytochemistry of Rutaceae plants, several medicinal plants including *Murraya koenigii and Aegle marmelos* were selected for investigation. *Murraya koenigii* (curry leaf) is usually searched for its aromatic leaves; used for natural flavouring in foods and sauces. Parts of the plant has been used as raw material for traditional medicine formulation, and also known to be the richest source of carbazole alkaloids. *Aegle marmelos* grows easily in Indian Subcontinent and also in Southesat Asia. This plant is used in traditional medicine treatments such as for intermittent fever, intestinal ailments, fertility control, treatment after childbirth and fish poison. Previous studies revealed thet the plant contained mostly coumarins and alkaloids. The structures of the compounds were elucidated based on their spectroscopic data and by comparison with the literatures.

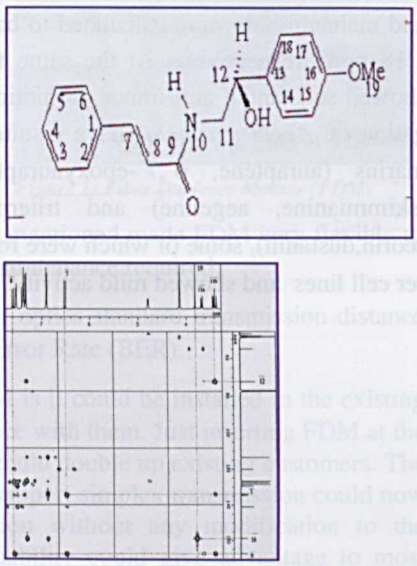


Figure 1: Structure and HMBC spectrum of Aegeline (alkaloid from A marmelos)

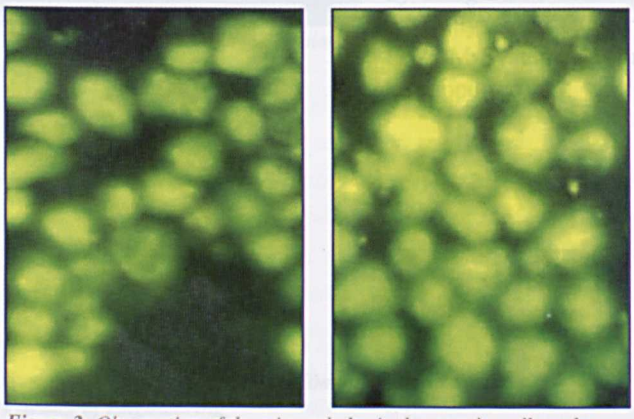
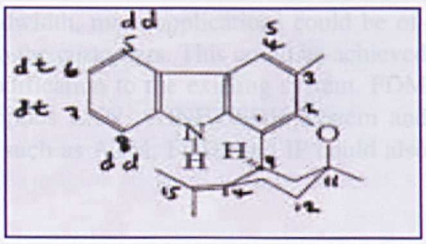


Figure 3: Observation of the microtubules in the amoeba cells under fluorescence microscopy



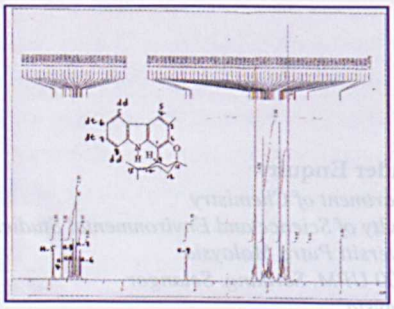


Figure 2: Structure and ^{1}H NMR of murrayazoline (alkaloid from M. koenigii)

From the petroleum ether, chloroform and methanol extracts of the leaves, stem bark and root of *M.koenigii,* several carbazole alkaloids, triterpenes and long chain compounds were isolated and characterized. Antimicrobial activity studies on the crude extracts and pure compounds have showed that the isolates possess mild activity. However, some of the carzazole alkaloids exhibited strong activity against amoeba, *Acanthamoeba castellani.* Girinimbine and mahanimbine were calculated to have IC_{50} values of 3.04 and 1.18 ppm, respectively. At the same time, girinimbine had also showed substantial anti-tumor promoting activity. Similar investigation on *Aegle marmelos* have resulted in the isolation of coumarins (auraptene, 6',7'-epoxyauraptene, marmin), alkaloids (skimmianine, aegeline) and triterpenes (lupeol, lupenone, zeorin,dustanin), some of which were found to be cytotoxic to cancer cell lines and showed mild activity against microbes.

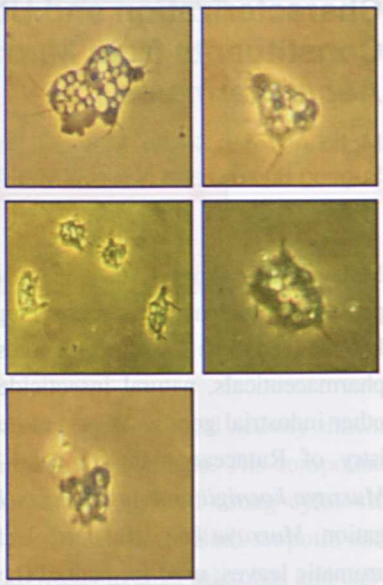


Figure 4: Light microscopy of Acanthamoeba cells after treatment with Girinimbine and Mahanimbine

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6797
E-mail: aspollah@fsas.upm.edu.my

Fiber Duplexer Module (FDM)

Mohd. Khazani Abdullah

Fiber Duplexer Module (FDM) is a totally passive optical device capable of doubling fiber utilization. It converts fiber optics simplex transmission mode (one fiber in each direction) into full duplex transmission (bi-directional transmission in a fiber). This is achieved without wavelength conversions, optical-electrical conversion and without power supplies.

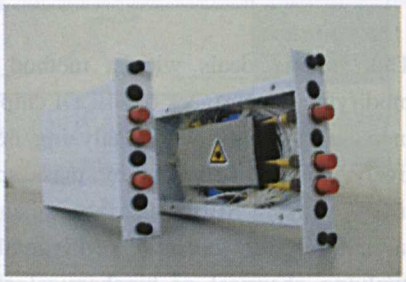


Figure 1: Fiber Duplexer Module (FDM)

This device comes with some special features. FDM could operate without power supply. The insert-and-operate concept introduced is another special feature of FDM. Totally passive components used to develop FDM made this device transparent of bit rate, transmission format and network architecture. All the features mentioned made FDM very flexible to support a single fiber bi-directional transmission beside minimum maintenance required.

FDM could support up to 70 km fiber distance. This is a fiber optics standard transmission distance without amplifier. The quality of the data is maintained at zero Bit Error Rate (BER).

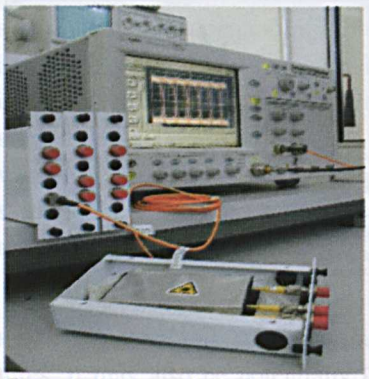


Figure 2: FDM installed in the existing networks

The main advantage of FDM is it could be installed in the existing networks without any interference with them. Just inserting FDM at the transmitters and receivers side could double up existing customers. The existing fibers that are used to support simplex transmission could now support full duplex transmission without any modification to the equipments involved. This capability could give advantage to most system users, especially lease line companies, where maximum fiber utilization has become their main objective.

By increasing the fiber bandwidth, more applications could be offered by the service providers to the customers. This could be achieved by using FDM without any modification to the existing system. FDM basically could support fiber optics LAN, SONET/SDH System and DWDM System. All protocols such as ATM, FDDI and IP could also be supported.

Reader Enquiry
Department of Computer and Communication Systems
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6446, 8946 6454
E-mail: khazani@eng.upm.edu.my

Novel Surface Chemistry for Analyzing Polyanions by SELDI-TOF Mass Spectrometry

AwardWinner

Mohd Puad Abdullah, Sambandan TG., Lessard P., Rha C. and Marziah M.

This finding deals with a method for modifying the surfaces of SELDI chips to increase their utility in analyzing negatively charged polymers by mass spectroscopy (MS). SELDI (surface enhanced laser desorption ionization) MS involves applying chemical or biochemical samples to the surface of a specialized chip, ionization of the sample via a laser pulse and then detection of the products via MS (Figure 1).

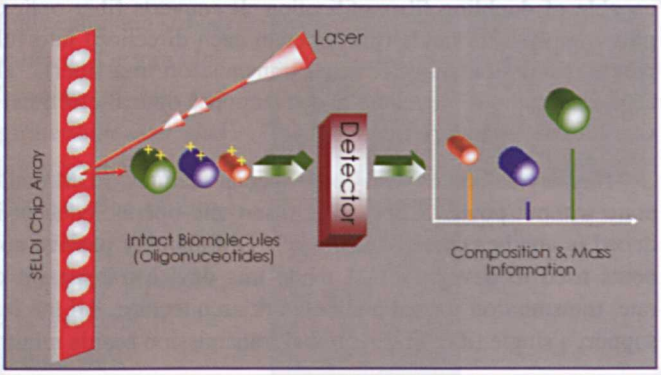


Fig. 1. Polyanions composition on SELDI chip is read by laser pulse initiates molecular desorption from the chip surface

SELDI chips with much different surface chemistry are commercially available. By changing the surface properties of the chip one can influence the types of molecules that can be selected for analysis via MS and/or the resolution and sensitivity of the analysis. We have developed a unique surface by modifying SELDI chips in a manner that makes detection of anionic polymers such as oligonucleotides and nucleic acids more sensitive and allowing extensive washing of samples after they have been applied to the chip surface.

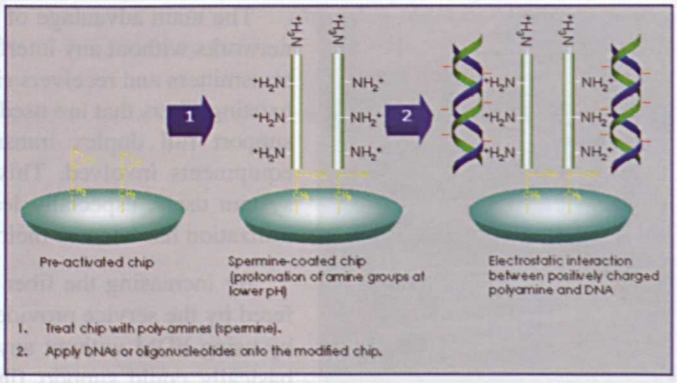


Fig. 2. Electrostatic and ionic interactions between positively charged polyamine and negatively charged phosphate backbone of oligonucleotide or DNA molecule

Oligonucleotide and DNA are usually difficult to determine by matrix-assisted laser desorption/ionization (MALDI) – TOF because of impurities such as metal ions and salts. As a result, the sensitivity and resolution of the MS spectra are severely affected if the samples are not cleaned-up prior to analysis. To overcome this problem we have developed a unique surface chemistry to maximize the capture of oligonucleotides from complex reaction mixtures. The process not only immobilizes the oligonucleotide but also allows extensive washing of the chip for removal of impurities. The chemistry that was modified was based on the maximization of the interaction between the negatively charged phosphodiester backbone of the oligonucleotide and the modified surface.

The PS chip surface was reacted with polyamines such as spermine, poly-lysine, hexamethylenediamine and others to produce a covalently linked polyamine surface (Figure 2). The surface due to its chemical property generates a positively charged chemistry, which ionically and electrostatically interacts and immobilizes negatively–charged oligonucleotides. Modifying the PS chips involves three simple steps; (1) activating the surface using PBS buffer, (2) immobilizing the polyamines of interest and (3) removing of the unreacted polyamines by washing.

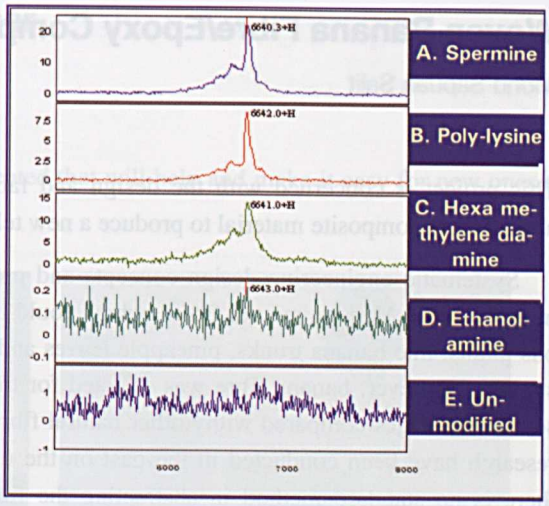


Fig. 3. The polyamine-coated surfaces (A, B and C) produced intense SELDI MS spectra compared with the non polyamine (D). The unmodified surface (E) produced no signal

Figure 3 shows that the polyamine-coated surfaces (A, B and C) produced intense SELDI-MS spectra compared with the non polyamine-coated surface (D and E). The modified PS chip with a non-polyamine such as ethanolamine produced a weak signal suggesting that the chemistry on the modified surface due to protonation of multiple amine groups at low pH (Figure 4) were responsible for immobilizing the oligonucleotide so that it remained on the surface even after the sample were repeatedly washed. On the unmodified or non polyamine-coated surface, the signals produced were either undetectable or very weak.

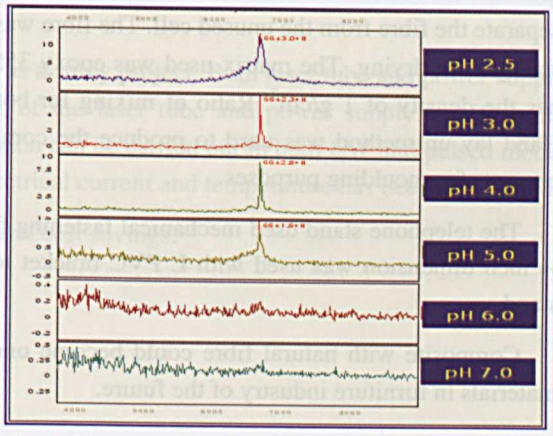


Fig. 4. Protonation of multiple amine groups of the polyamine molecules in acidic aqueous solutions (pH 2.5 – 5.0) was responsible for immobilizing the oligonucleotide produced no signal

The new SELDI chip can be used to detect and separate poly-anions from complex reaction mixtures. It may also be potentially used in identifying single nucleotide polymorphisms (SNP), a single nucleotide variation in a genome of closely related organisms for possible use as biological markers. Detection of SNP by MS is technically difficult due to salt adducts and this chip offers an alternative solution.

Reader Enquiry
Department of Biochemistry and Microbiology
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6706
E-mail: fuad@fsas.upm.edu.my

Woven Banana Fibre/Epoxy Composite Telephone Stand

Mohd Sapuan Salit

Award Winner

This project is concerned with the design and fabrication of woven natural fibre composite material to produce a new telephone stand.



Telephone stand made from composite material using banana fibrez

Systematic engineering design concepts and process were applied in this project. Various natural fibres, which could be found from various plants, like banana trunks, pineapple leaves and coconut coir were studied. However, banana fibre was selected for this project as it has some advantages compared withy other natural fibres. Since not much research have been conducted in the past on the use of banana fibre, there is no standard method in abstracting the fibres. Banana fibres were abstracted from matured banana trunks after the fruits were plucked. Then the banana trunk was placed under sunlight for drying process. Dried banana trunks were then soaked in water for 2 weeks to separate the fibre from the unused cell. The fibre was then placed under sunlight for drying. The matrix used was epoxy 3554A with the density of 1.15 g/cm^3 and hardener used has the density of 1 g/cm^3. Ratio of mixing for both materials (epoxy and hardener) was 4:1 by weight. Hand lay up method was used to produce the composite artefact. Various moulds were developed using cements for moulding purposes.

The telephone stand used mechanical fastening for joining process. The slotted countersunk screw with ¼ inch dimension was used with L PVC bracket to join the top plate and middle plate of the telephone stand.

Composite with natural fibre could become one of the alternative materials in furniture industry of the future.

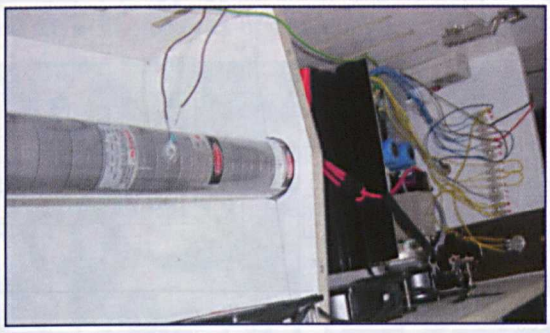
Reader Enquiry
Department of Mechanical and Manufacturing Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6318
E-mail: sapuan@eng.upm.edu.my

Design of a Sealed Off CO_2 Gas Laser

Nasrullah Khan, N. Mariun and S. Iqbal

A simple but quantitatively descriptive design is presented that will help and make it easy for new ones to understand and design a sealed CO_2 laser.



Internal view of CO_2 Gas Laser



CO_2 gas Laser Unit

The design of a sealed CO_2 gas laser is undertaken as a study project. Both laser tube and power supply is housed in a specially designed container. Cooling of the laser tube and power supply is efficiently achieved by using four 30Watt fans. Sealed tube operation can be carried out in both CW and pulsed mode. The variation in the output power due to changes in electrical current and temperature has been considered.

Novel design approaches are used for expediency, and cost savings.

Reader Enquiry
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6308
E-mail: khan@eng.upm.edu.my

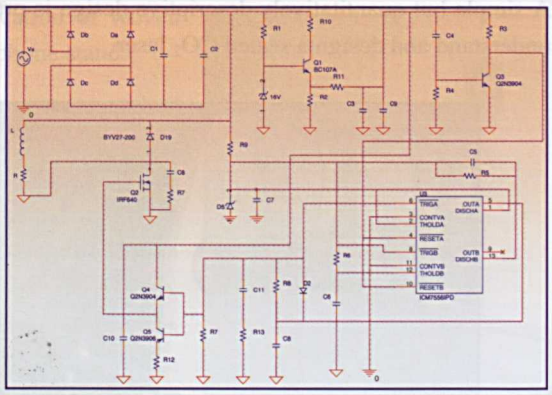
Voltage Sag Mitigation System

N. Khan, N. Mariun and D. Rohi

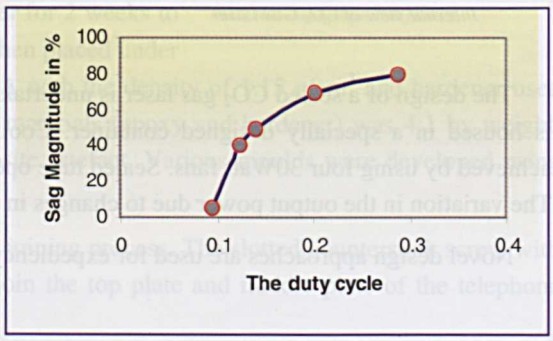
This product is based on the simulation design experience of a chopper based voltage sag corrector (VSC) for low level power supplies. This power quality instrument is suitable for protecting electromagnetic contactors, relays, PLCs and process controllers against voltage sags (or dips) of half to several cycle durations and 10-90% sag magnitudes.

The design of this simple instrument consists of dynamic chopper duty cycle adjustment according to the duration and magnitude of voltage sag. Simulation studies show that this voltage sag corrector can improve voltage sags within range of 90% to 10% values. Simulation design details and further suggestions to improve the design for real time applications in electric utilities and industries are have been investigated. Principle of our VSC is entirely different from other available devices.

The simulation studies have been carried out on the AC/DC contactors. GEC made (DYSC) is based on external voltage injection after inception of fault on transmission or distribution system whilst ours VSC is based on dynamic duty cycle regulation during voltage sag.



Voltage Sag Regulator Circuit



Sag magnitude as a function of the duty cycle for Experimental results

Reader Enquiry
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6308
E-mail: khan@eng.upm.edu.my

The Effect of Cationic Substitution in Nonstoichiometric Strontium Hexaferrite



Norlaily Mohd Saiden, Mansor Hashim, Wan Mohd Daud Wan Yusoff, Mohd Maarof Moksin, Noorhana Yahya and Rabaah Syahida Azis

An experiment was carried out to investigate the simultaneous effect of cationic substitution to the magnetic and physical properties of strontium ferrite magnet.

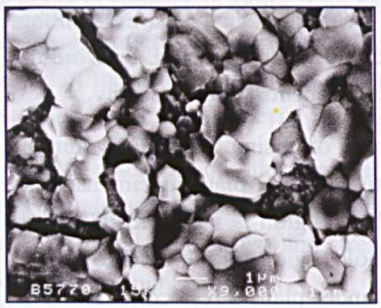


Figure 1. d1: Sr0.9Dy0.1Fe11.9Zn0.1O19 sintered at 1300°C for 10 hours

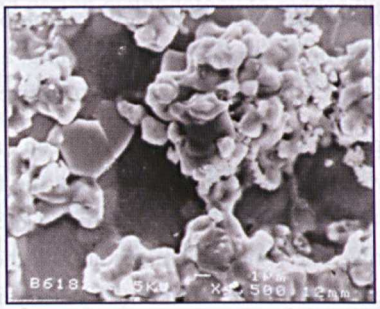


Figure 2. d9: Sr0.1Dy0.9Fe11.1Zn0.9O19 sintered at 1300°C for 10 hours

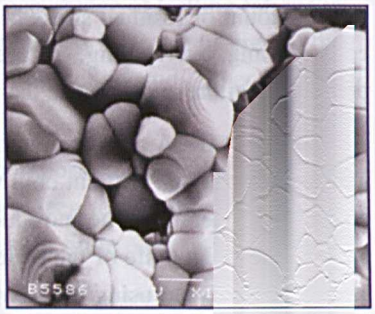


Figure 3. y3sint~1: Sr0.7Y0. 3Fe11.7Zn0. 3O19 sintered at 1300oC for 10 hours

Hard magnetic ferrite with composition $Sr_{1-x}M_xFe_{12-x}Zn_xO_{19}$ (x=0.1, 0.3, 0.5, 0.7, 0.9) (M=La, Nd, Yb, Dy) was studied in detail in order to get fine-grained microstructure, high density and high Curie temperature compared to non-substituted Sr- hexaferrite.

In this project, the conventional ceramic sintering technique was used as the preparation technique to produce a good performance material. Characterization of hysteresis parameters was also done which included Br, Hc and BH_{max}. Grain sizes <1μm were obtained for most of the samples.

Reader Enquiry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6683
E-mail: laily@fsas.upm.edu.my

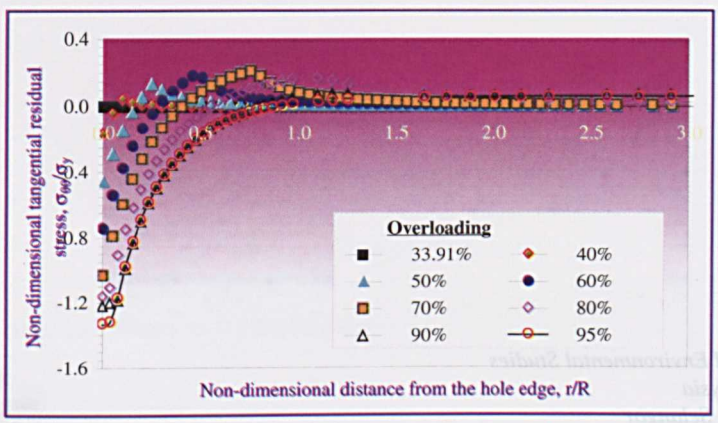
Characterization and Assessment of Failure Life of Materials Under Cyclic Loading Condition

Prithvi Raj Arora

In aircraft sub assemblies and other machines failure usually starts at the edge of the fastener holes. As the load between the mechanical components is transferred through the fastener joints it is imperative that the material resistance against plastic deformation should be adequate enough around the hole region. The requisite amount of residual stress is introduced around the hole region by techniques such as stress coining, cold working, overloading, surface rolling, low plasticity burnishing, and laser shock peening, to avoid the premature failure and enhance the fatigue life of structural and machine components simultaneously.

In present IRPA project investigation with overloading has been carried out using 2024-T351 aluminium alloys with and without cold work. It has been observed that the fatigue life of plate specimens is increased considerably. The introduction of residual stresses around the hole region is instrumental in improving the fatigue life of the material. The residual stresses around the hole region for the given overload have been analysed using two-dimensional finite element (FE) analysis under plane stress condition. The results (see Figure) indicate that large compressive tangential residual stresses are induced at the hole edge on unloading. Reverse yielding was also observed for an overloading $\sigma_{OL} > 75\%$ which is responsible for reducing the extent of compressive residual stresses around the hole edge. A model is also developed giving tangential residual stress at the hole edge for a given overload.

Under oscillating conditions, load transfer between contacting surfaces may induce differential strains that can result in small amplitude relative sliding giving rise to fretting fatigue. There is a poor understanding of the mechanics of fretting fatigue. This fretting fatigue process can bring about a reduction of fatigue strength of aerospace and machine components. It is essential to understand the mechanics of fretting fatigue and the key parameters influence the crack nucleation process. Occurrences of fretting fatigue failure in structural members such as bolted flange joints; riveted lap joints or even rocket propulsion fuel tanks have been well documented.



Non-dimensional tangential residual stress versus non-dimensional radial distance for the unloading phase

The research work is being carried out in the fatigue and fracture mechanics area to characterise the failure in general of industrial machines and aerospace structures. Fretting fatigue is one of the small areas in fatigue and fracture mechanics characterising failures. The research work in the fretting fatigue area has been underway using an IRPA grant awarded by Government of Malaysia. It is proposed to study the role of fretting contact on the formation of fatigue cracks in aircraft grade 7075-T6 aluminium alloy, Ti-6AL-4V, and BS L65 aluminium alloys. The mechanics of fretting fatigue is to be studied experimentally as well as using finite element analysis. Using the data of the experimental program a model is to be developed to predict the nucleation of fretting fatigue cracks based on mixed mode fracture behaviour. Efforts will also be made to suggest an application based design methodology to reduce the occurrence of fretting fatigue in aerospace structural components. It is proposed to develop a finite element based software to predict the failure of machine components under fretting fatigue conditions. Also it is proposed to study other fracture mechanics aspects of material behaviour.

Other research activities include the experimental characterisation of composite materials and nonferrous metals using acoustic emission technique, development of accelerated creep test methods for metals and non metals, and stress and strength analysis of machine components using finite element method and boundary element method.

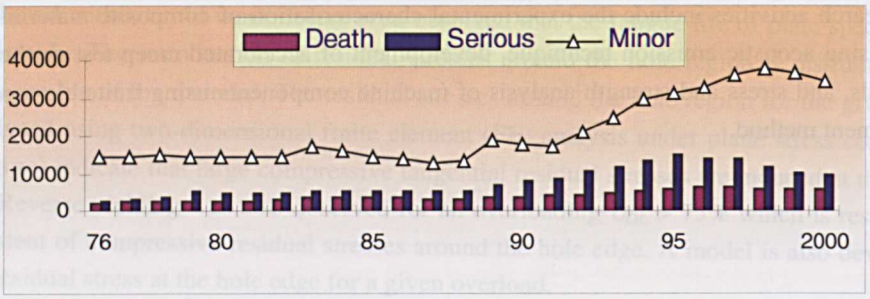
Reader Enquiry
Department of Aerospace Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6404
E-mail: prithvi@eng.upm.edu.my

Need for an Alternative Guardrail for Safer Motorcycling

R.S Radin Umar, A.B Ibitoye, S.V Wong A.M.S Hamouda and T.H Law

Motor vehicle accidents involving guardrails have been studied to a large extent but little consideration has been given to motorcycle accidents against guardrail. According to Gowan, (1996), motorcyclists have not been explicitly considered as test vehicles in the International testing standards for the evaluation of safety barriers. This may be due to low priority given to motorcycles since motorised vehicles dominate traffic in most developed countries. In contrast, motorcycles dominate traffic in Asian countries. For instance, 53% of vehicle registration in Malaysia is motorcycle (Pang et al., 2000). The tremendous increase in the number of motorcycle usage has been causing dramatic increase in the annual motorcycle fatalities in Malaysia (*see Figure*).



Motorcycle Accident and Casualty in Malaysia (source: PDRM, 2000)

The conventional W-Beam guardrail commonly installed on roads is not designed to absorb narrow impact of motorcycle. This impact can be compared to the impact of other motorised vehicles on guardrail ends. The narrow impact of motorcycle on guardrail will cause riders to be ejected, while impacts of vehicle on guardrail end will cause rollover of such vehicle. The existing guardrails with insufficient heights can pose a threat to riders as they can be catapulted over the top of the barrier system. This common guardrail type also leaves a space between the road surface and the bottom of the guardrail, which potentially allows fallen riders to slide under it into contact with roadside hazards. Therefore, hitting of guardrail by motorcycle will cause the rider to be ejected to slide under the guardrail, hit the posts or roll over the guardrail to hit more hazardous object.

The literature reviewed showed that guardrail geometry features constitute greater risk of injury to motorcyclists in any guardrail-related accident. The studies found out that collisions with exposed edge of guardrail were more severe than collision with other features of guardrail. The results from the survey carried out on the perception of riders also support the outcome from past researches. However these past researches were not based on the most harmful cause in a crash sequence. This is necessary because the goal is to make guardrail-related accidents less serious for motorcyclists. Therefore, there is need to modify the design of the existing guardrail so as to achieve a substantial reduction of injuries likely to be sustained by the motorcyclists

The following proposed measures could be valuable to increase motorcycle safety:

1. Adding components to the existing guardrail design to shield the exposed edge of posts.
2. Replacing guardrail face with a smooth, continuous surface, which allows riders to slide along the surface without the danger of impacting any sharp edges, or corners that can cause impact stress concentration.
3. Providing alternative guardrail material with high-energy absorbing properties, which has better energy dissipation to reduce the injury risk for fallen motorcyclists.



Reader Enquiry
Road Safety Research Centre
Department of Mechanical and Manufacturing
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6262
E-mail: radinumx@eng.upm.edu.my

Study on Crash Pattern and Injury Characteristics on Motorcycle Crashes, which is Roadside Furniture Related, along Exclusive Motorcycle Lane

S.H. Tung, S.V. Wong, T.H. Law and R.S. Radin Umar

The main objective of this study is to determine the suitability of the existing design and location of the roadside furniture along the exclusive motorcycle lane from safety point of view. The targeted roadside furniture included in this study are the street lightings, traffic signs, guardrails, and landscaping (included the vegetation). The objectives of the study are: (i) identifying the crash patterns along the exclusive motorcycle lane for motorcycle crashes related to roadside furniture, (ii) categorizing the injury characteristics and injury severity involved in the roadside furniture related motorcycle crashes along the exclusive motorcycle lane, (iii) determining the suitability of the existing location and design of the roadside furniture and landscaping from safety point of view, and (iv) formulating the risk factors for the motorcyclists on the design and the location of the targeted respective roadside furniture along the exclusive motorcycle lane.

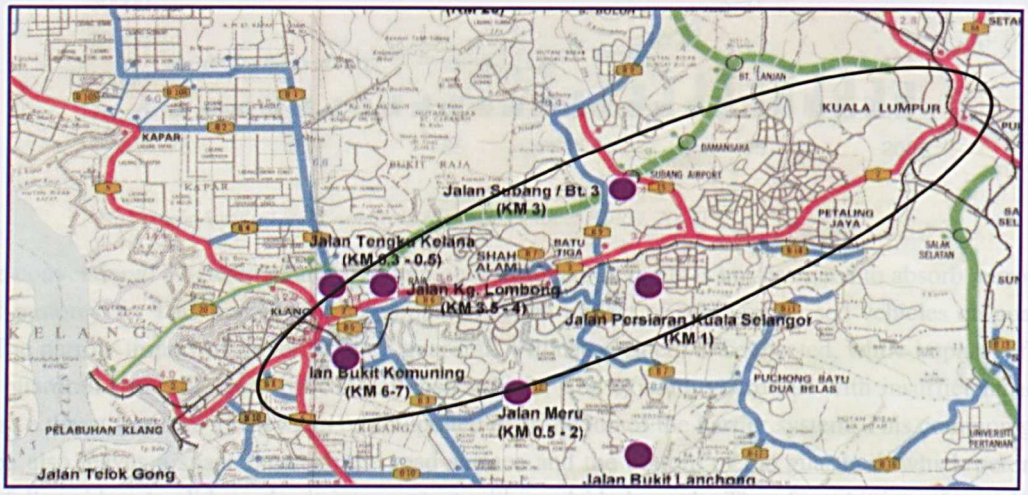


Figure 1. Location of Federal Route F0002 in Selangor state

Due to the high number of motorcyclist fatalities in our country, the government of Malaysia was constructing new exclusive motorcycle lanes and restructuring the existing exclusive motorcycle lanes. The major function of the exclusive motorcycle lane is to segregate the motorcycle away from other motor vehicle traffic. The separation reduces the exposure of the motorcyclists to any crashes occurred with other motor vehicles. Even though the motorcycles have been segregated from the main traffic, other modes of motorcycle crash are still unavoidable. Inadequate safety design of the roadside furniture may be the main factor of the crashes occurrence. The existing design of the exclusive motorcycle lane is the adoption from the highway or road design. Motorcyclists are more exposed to injury compared to other automobile occupants due to less protection from the vehicle. Therefore, the probability of the motorcyclists getting injured by the roadside furniture while travelling is higher compared to other automobile occupants. The existing roadside furniture design may not provide the best safety condition to the motorcyclist travelling along the exclusive motorcycle lane. Safer motorcycle lanes could be provided for the motorcyclists. At present, a proper exclusive motorcycle lane design standard is yet to be formulated. It is important to discover the causes of the motorcycle crashes and injury along the exclusive motorcycle lane, which is related to the roadside furniture and this, will contribute to the development of design standard for exclusive motorcycle lanes.

The catchments areas for this study are the exclusive motorcycle lane along Federal Route F0002 and the motorcycle track along Lebuhraya Shah Alam (KESAS). The target of the data are motorcycle crashes occurred along the exclusive motorcycle lane which are related to guardrails, street lighting poles, traffic sign poles, trees, and other roadside furniture / rigid object. Linkages will be formed between police and hospitals during the data collection session. The first information of a motorcycle crash will be collected from the police (or the hospital). From the police department, information about the location of the crashes, crash patterns, and the admitted hospital of the casualties may be collected. From the hospital, the injury data may be collected from the casualties' medical reports. The injury characteristics, injury severity and the casualties' information will be obtained. Later, personal interview may be carried out to the casualties o verify the collected data. From the police, the locations of the crashes will be determined. Then, site visit is needed to capture the parameters of the roadside furniture involved in the crashes for analysis. These parameters comprise of the height of the guardrails, the distance of the street lighting poles from road edge, the tree trunk's diameter, etc. All the data collected will be stored and managed by a proper database management system. Statistical analysis will be performed from the stored data.

The main aim of the study is to formulate a model to determine the risk factors of motorcyclists along the exclusive motorcyclist with respective deign of roadside furniture. This may served a guideline in designing roadside furniture along exclusive motorcycle lane.

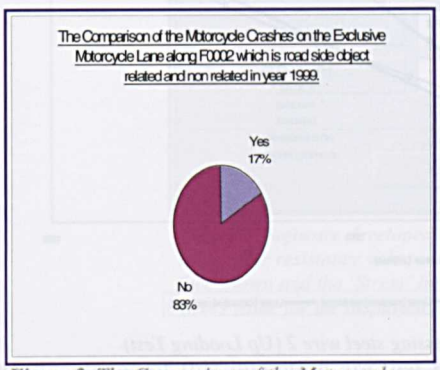


Figure 2. The Comparison of the Motorcycle Crashes on the Exclusive Motorcycle Lane along F0002, which is roadside object, related and non-related in year 1999

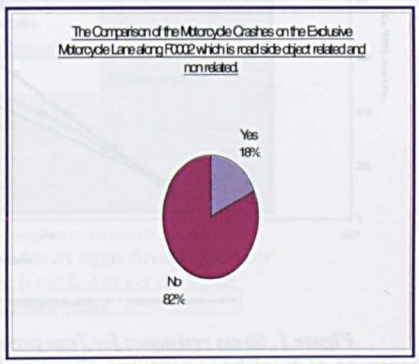


Figure 3. The Comparison of the Motorcycle Crashes on the Exclusive Motorcycle Lane along F0002, which is roadside object, related and non-related in year 2000

Figure 1 shows the location of Federal Route F0002 (more known as Federal Highway) in Selangor state. Figure 2 and 3 show the comparison of motorcycle crashes occurred on the exclusive motorcycle lane along Federal Route F0002 which is roadside furniture related and non-related occurred in year 1999 and 2000.

Reader Enquiry
Department of Mechanical and Manufacturing Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6262
E-mail: radinumx@eng.upm.edu.my

Non-destructive Stress Measurement System

Samsul Bahari Mohd Noor, Mohd Saleh Jaafar and Waleed A. M. Thanoon



In most industrial applications, the requirement of effective measurement method is very essential.

To date, the non-destructive stress measuring of pre-stressed steel or after the steel has been stressed has not yet been established. Therefore, this project is to develop the non-destructive residual stress measurement technique for pre-stressed steel by using resistance measurement as a tool for determining the stress value.

The research conducted introduces a new method in stress measuring since the electrical resistance of the pre-stressing steel bar can be measured directly without any necessity to install a sensor or measurement device.

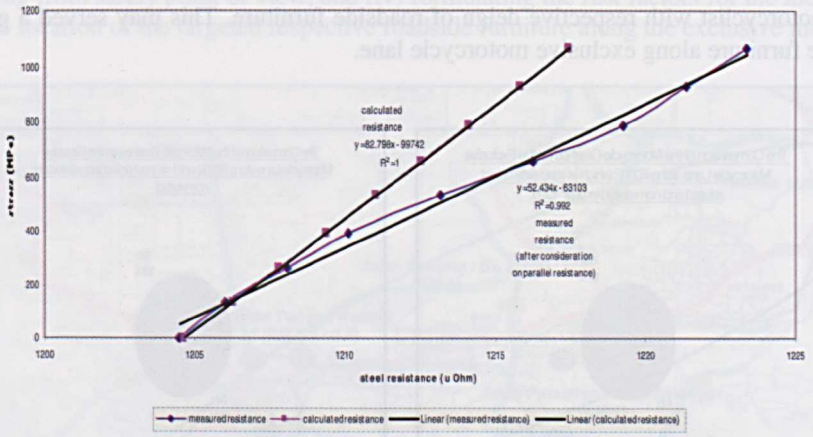


Figure 1. Stress resistance for 7mm pre-stressing steel wire 2 (Up Loading Test)

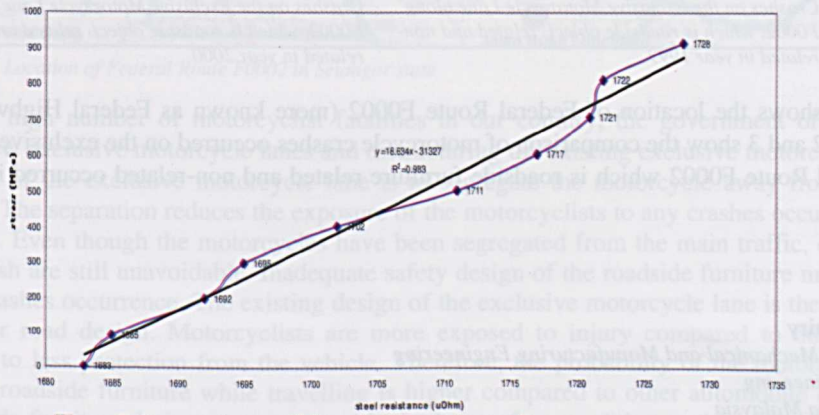


Figure 2. Stress resistance (7 Strand pre-stressing steel)

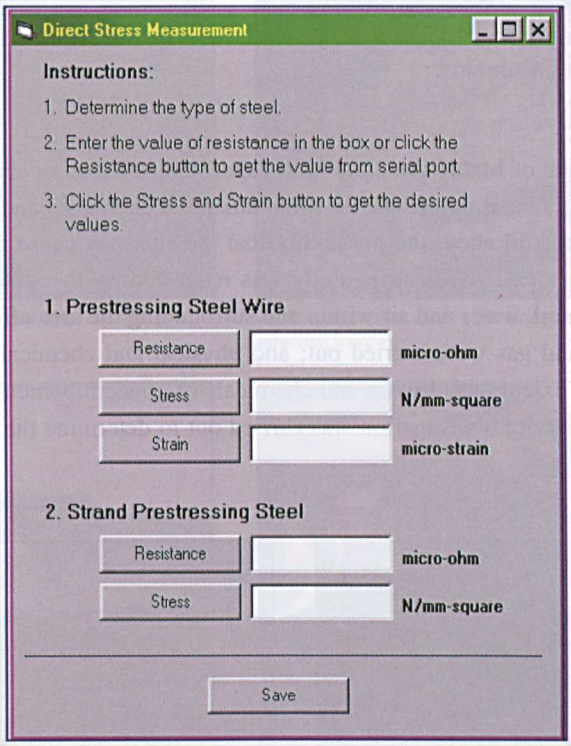


Figure 3. *Software developed to convert resistance value to stress. The resistance value is keyed in as input through the interface shown and the 'Stress' button is clicked to get the equal stress value for the displayed resistance value*

The major advantages of this invention are that it is non-destructive, and is able to measure existing stress in pre-stressed steel. A software has been developed to convert resistance value to stress. Direct measurement without using strain gauge can be made possible by having interfacing circuitry in place, which is currently under development.

Reader Enquiry
Department of Electrical and Electronic Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6320
E-mail: samsul@eng.upm.edu.my

Electrical Resistively Investigation of a Polluted Ground at Bukit Kapar, Kelang, Selangor D.E.



Shaharin Ibrahim, Lau Kien Liong, Mohd Shah Ibrahim, Rahmat Kamid, Suhaimi Ibrahim and Rahman Arkimin

Sometimes in late 1999 one of Malaysian daily newspaper reported that an abandoned quarry site in Bukit Kapar has been used as an illegal dump site for some unknown chemicals and industrial wastes. Residents around the site were distrustful about the possibility that the site may cause pollution to the environment affecting the surrounding areas. A scientific study was requested by the state authority to determine the extent of pollution of the soil, water and air within and surrounding the area affected. Bore hole drilling and sampling of soil, water and gas were carried out; and physical and chemical analyses were done on the samples to determine the extent of pollution and chemicals of concern, which could cause harmful effects to life. The electrical resistivity investigation was carried out to determine the location and the area extent of the polluted ground.



Highly fissured sandstone formed the base of the abandoned quarry



Horizontal fissures and joint planes of the sandstone on the northern part of the abandoned quarry



Dirty water high in oil and grease in the central part of the abandoned quarry



The northern half of part of the quarry floor lies a depression which collect rain water, an ideal place for mosquito breeding



A partially submerged drum probably contain industrial wastes



Some of the softer beds within the sandstone – shale equence were easily eroded



A general view in the southern part of the abandoned quarry



Water level measurement at bore hole No. 4, in the central part of the abandoned quarry

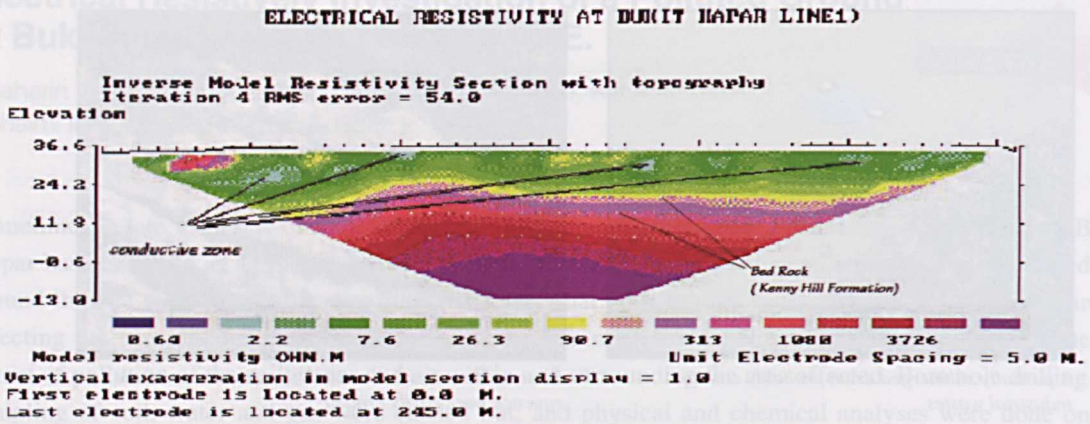


A cattle barn located on western side of the polluted ground

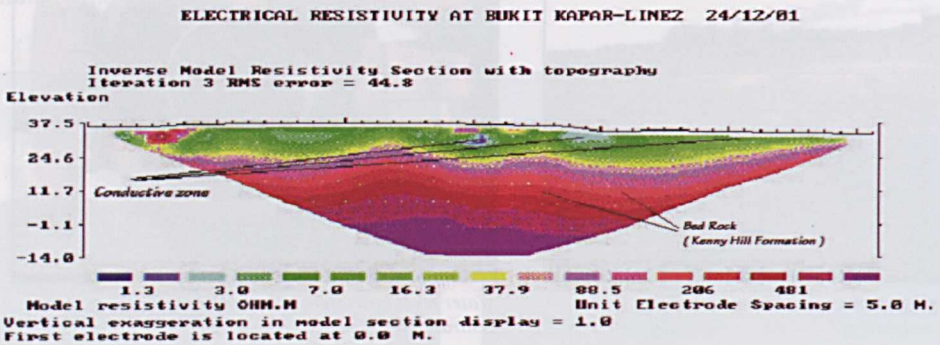


Water from this pond located near to the were used to "clean" the cattle barn

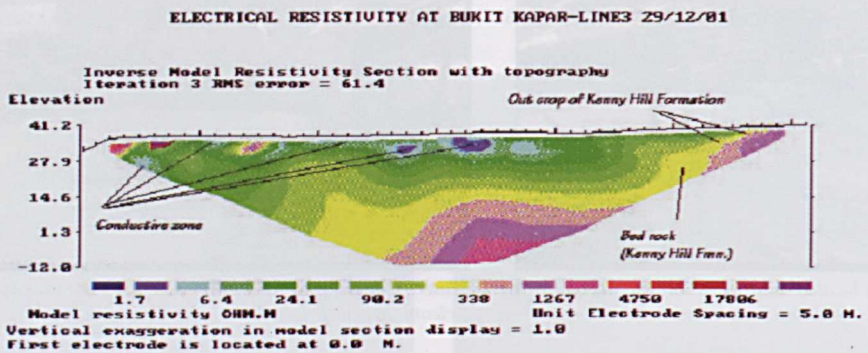
A total of 50 stainless steel electrodes were driven into the ground at 5-meter interval using Werner configuration. Low frequency commutated current were injected into the ground via two current electrodes and the resulting potential difference and the resistance were measured between two electrodes located on the inside of the current electrodes. The measuring instrument automatically recorded potential difference, amount of injected current and the resistance. The field data were interpreted using electrical resistivity interpretation software, which produces 2-dimensional resistivity images of the area.



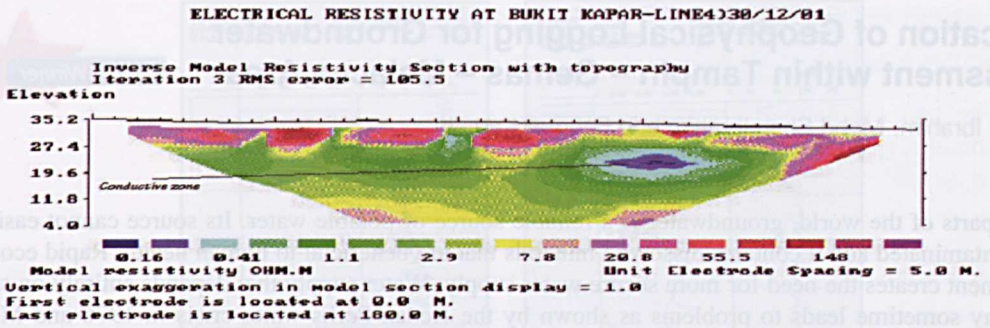
Electrical resistivity image of line I. Note the presence of highly conductive zones in certain part of the ground.



Electrical resistivity image of line 2. Note the presence of highly conductive zones



Electrical resistivity image of line 3. Note the presence of highly conductive zones. The ground is higher on the right. Note also the possible direction of groundwater flow as indicated by the pattern on the conductive zones



Electrical resistivity image of line 4. Note the presence of a large zone of conductive materials

The result of electrical resistivity investigation of the area indicated that the central part of the abandoned quarry polluted. The depth of the polluted ground varies between 0.5 and 15 meter below ground surface. Chemical analyses of the soil and water samples confirmed that the central part of the abandoned quarry is high in oil and grease and heavy metals. The state authority had subsequently closed the area to public to prevent possible harmful effect to human and animal life.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6681
E-mail: shaharin@fsas.upm.edu.my

Application of Geophysical Logging for Groundwater Assessment within Tampin – Gemas – Malacca Area



Shaharin Ibrahim, Mohd Shah Ibrahim and Rahmat Kamid

In most parts of the world, groundwater is a reliable source of potable water. Its source cannot easily become contaminated and it contains dissolved minerals that are beneficial to human health. Rapid economic development creates the need for more secure water supply. Water supply that depends entirely on surface water may sometime leads to problems as shown by the Kedah-Perlis water crisis in 1976 and Malacca water crisis in 1991. Hence the need to assess the availability of water supply from other sources, especially groundwater may not be over emphasized.

Assessment of groundwater reserves in Tampin – Gemas – Malacca region has been carried out due to availability of exploratory groundwater wells and due to logistic considerations. OYO GW Combination geologger has been used in this study. It measures and records the natural gamma radiation from rock formations penetrated by the wells, measure and records the 16" – 64" normal resistivity and the self potential of the rock formation surrounding the bore hole.



Geophysical logging at Bukit Apit, Masjid Tanah, Malacca



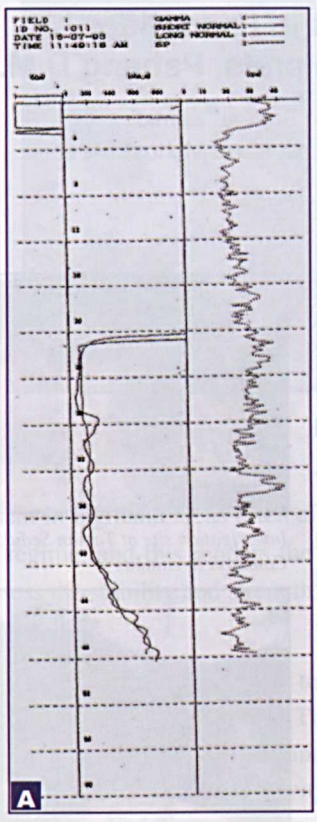
Geophysical logging at Pasir Besar Gemas, Johor



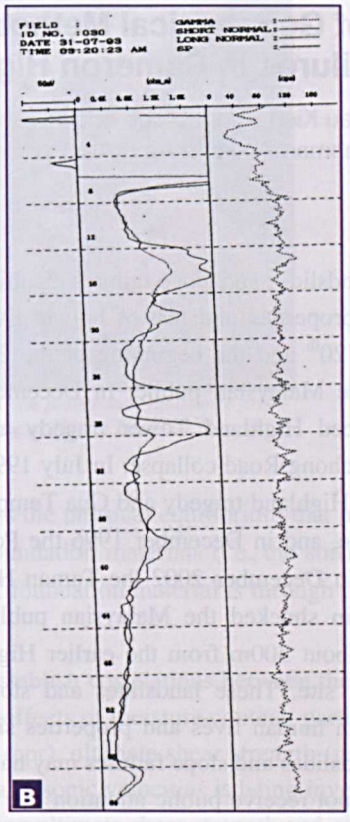
Geophysical logging at Kg. Ulu Yoh, Tampin, Negeri Sembilan



Geophysical logging at Bangka Hulu, Gemas, Johor



Geophysical log of tube well at Bangka Hulu, Gemas, Johor. D.T



Geophysical log of tube well at Kg. Ulu Yoh, Air Mawang, Johol, Negeri Sembilan

The results of geophysical logging of bore holes in Tampin – Gemas – Malacca area indicated that substantial amount of groundwater could be abstracted from sedimentary – meta-sedimentary rock formations. Groundwater may also be abstracted from Tampin Granite while granitic rock in Jasin does not yield enough water due to its massive structure.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6681
E-mail: shaharin@eng.upm.edu.my

Application of Geophysical Methods in Landslides and Slope Failures in Cameron Highlands, Pahang D.M.



Shaharin Ibrahim, Lau Kien Liong, Mohd Shah Ibrahim, Rahmat Kamid, Suhaimi Ibrahim, Rahman Arkimin, Amri Ab. Rahman, Norliana Mahussin and Marlia Jamail

Number of major landslides and slope failures resulting in lot of damaged properties and lost of human lives towards the end of 20th and the beginning of the 21st Century shocked the Malaysian public. In December 1993, we experienced Highland Tower tragedy and Kuala Lumpur – Puchong Road collapse. In July 1995, we had the Genting Highland tragedy and Gua Tempurung highway failure, and in December 1996 the Post Dipang mud slide. In December 2002 the Taman Hill View landslide again shocked the Malaysian public, which occurred at about 300m from the earlier Highland Tower tragedy site. These landslides and slope failures affected both human lives and properties significantly. Other landslides and slope failures may have taken place but did not receive public attention due to the gravity of the situation. Grik – Jeli East - West Highway experiences slope failures almost every year with more than a million ringgit budget for maintenance. The newly constructed Simpang Pulai – Gua Musang Highway experiences much slope instability problems.



Investigation site at Taman Sedia, Tanah Rata, Cameron Highlands



Investigation site at Taman Tringkap Puncak, Tringkap, Cameron Highlands



Investigation site at Taman Tringkap Puncak, Tringkap, Cameron Highlands

In Malaysia, all landslides and slope failures usually take place during heavy monsoon season. The triggering factor has been identified to be high pore water pressure associated with prolonged heavy rainfall. Other factors which are equally important are the slope and topography of the area, the type and thickness of residual soil, type of rock underlying the soil, structural elements within the underlying rock formation, especially the fracture and joints density; and its orientation.



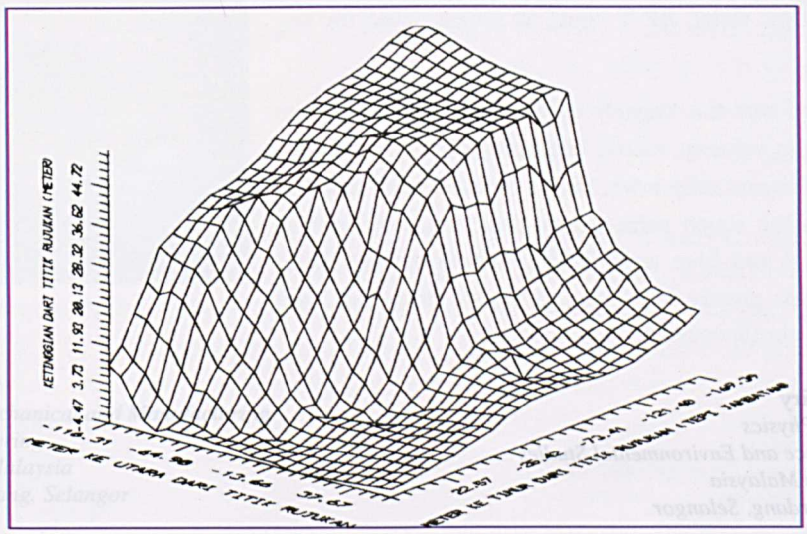
Ultimate shear strength probing at Taman Tringkap Puncak



Cone penetration resistance probing at Taman Tringkap Puncak

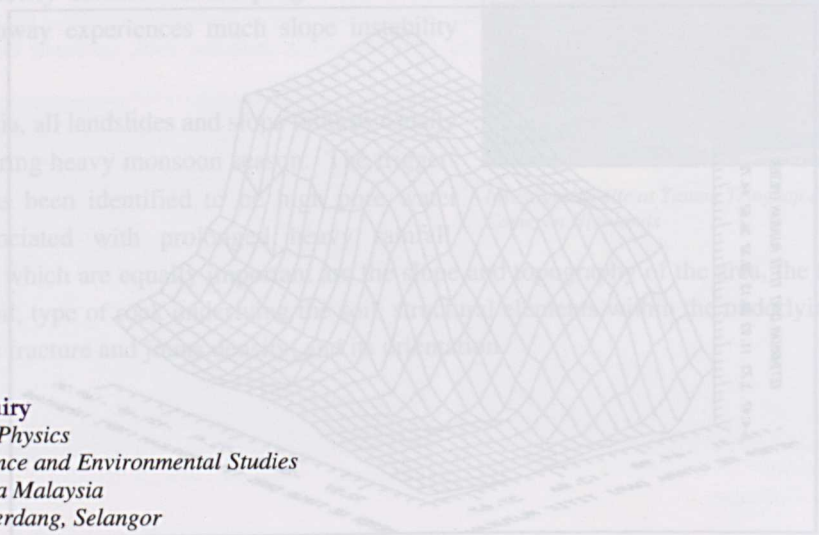
Physical development in highland areas often alters the physical equilibrium that has been achieved by the soil under natural regime; and this renders the foundation materials (i.e. the soil) unstable. The most common method to assess the stability and strength of foundation material is through the usage of geotechnical methods.

The research conducted under study attempts to establish correlations between the classical geotechnical parameters to that of geophysical parameters. The effects of moisture content, particle sizes, percentage of clay, silts and sand on cone penetration resistance (cpr), ultimate shear strength (uss), cohesion (c) and angle of internal friction (d) and electrical resistivity and sonic velocities is being investigated on carefully prepared samples in laboratory. Field investigation using ultimate shear strength and cone penetration resistance probing and 2-dimensional electrical resistivity imaging were carried out on failed and stable slopes within similar geologic setting.



3 dimensional view of the Taman Tringkap Puncak landslide

Initial results from laboratory investigation indicated that cone penetration resistance, ultimate shear strength and electrical resistivity are correlated. Field investigation indicated that; on a sloping face that had experienced slope failure; there exist three zones of soil, viz. the soil core (with u.s.s > 260 kPa) , soil mantle (with u.s.s between 50 and 200 kPa) and failed zone. The stable slope exhibits a sharp increase in u.s.s approaching the soil core. The thickness of the intact soil mantle varies between 0.5 to 1.0 meter at a slope angle of 60 ° to 90 ° and slope length between 5 to 7 meters. For a sloping face with slope angle between 60 ° to 90 ° and slope length between 5 to 7 meter (in most cases along Federal road) and up to 60 meter (in the case of Taman Tringkap Puncak), if the soil mantle is thicker than 1.0 to 1.5m, than the slope will be prone to slope failure; under the Malaysian wet monsoon season.

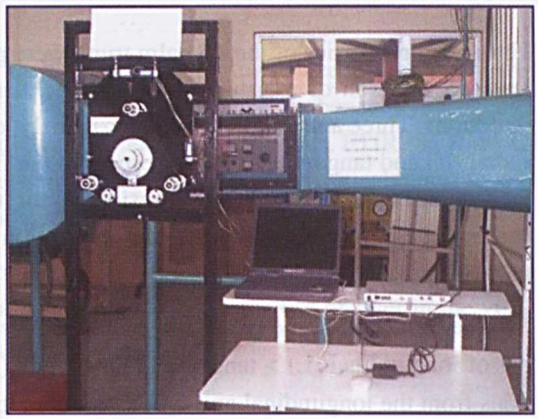


Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6681
E-mail: shaharin@eng.upm.edu.my

Three-Component Balance for Low Speed Wind Tunnel

Shamsuddin Sulaiman and Hafizal Abu Bakar



Low Speed Wind Tunnel

Wind tunnel has been used as a primary tool in aerodynamics research and development. It consists of a tunnel and instrumentation that includes speed/pressure measurements and drag and lift forces or called three-component balance device. The instrumentations are available in the market but most of them are imported and are therefore very expensively especially the three-component balance. Therefore, this project concentrates on the design and fabricates the three-component balance by using local materials and resources that are readily available.

The three-component balance, intended for mounting on the side wall of the working section of wind tunnel is constructed from a 6061 aluminium alloy and its main framework comprises a mounting and triangular plates. It is equipped with load cells that are capable to measure loads up to 50 lbs. The load signal is connected to a sensor interface and a data analyzer.

Our research group has successfully fabricated the three-component balance of low speed wind tunnel. The force acting on the arm was measured directly by strain gage load cell and then converted and displayed on the digital signals. With the computerized system, this instrument can be used and applied properly in the aerodynamic testing of wind tunnel.

Reader Enquiry
Department of Mechanical and Manufacturing
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6334
E-mail: suddin@eng.upm.edu.my

Ultrasonic Properties of Oil Palm Trunk *(Elaeis Guineensis Jacq.)*



Sidek H.A.A., Rosmawati S., Kaida K. and Faridah A.

Ultrasonic properties of the oil palm trunk were physically studied as a function of moisture content (MC), density and grain directions. Three anisotropic directions, namely longitudinal (L), radial (R) and tangential (T) with respect to the fibre and vascular bundle arrangements were considered for these measurements. These properties were determined with a commercial ultrasonic tester at 45kHz.

The ultrasonic velocity and elastic constant varied in the order of longitudinal (L) > tangential (T) > radial (R). Any deviations from the longitudinal axis will affect the ultrasonic properties and elastic constants for all moisture content measurements. The decreased pattern of velocity and elastic constants in the L, R and T directions differed from the LR, LT and RT directions.

Ultrasonic methods are also capable of detecting decay in the living oil palms. This was based on the ultrasonic waves traced from the transmitter to the receiver transducers that were placed around the trunk. The system was then tested by comparison of the tomogram with the cross-section of the cut trunk in the same plane after the measurements were conducted. Decay in trunks decreased the ultrasonic velocity and increased the transit time until the ultrasonic tester, BP-V could no longer detect the signals.

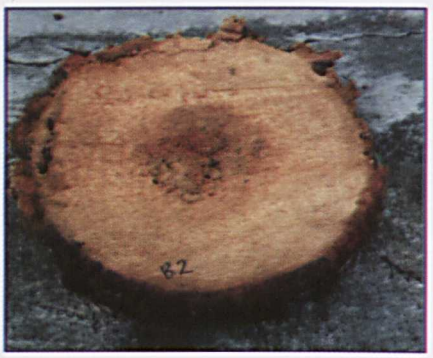
This method was also capable of detecting defects in palm wood. Ultrasonic velocity, elastic constants, density and moisture content were normally lower in the decayed palm wood as compared with the sound palm wood. Basic anatomy such as vascular bundles and fibre arrangements within the peripheral and middle zones greatly influenced ultrasonic properties such as velocity and elastic constant.



Oil palm plantation



Measurement of trunk circumference



Cross sectional view of the Oil Palm trunk

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6682
E-mail: sidek@putra.upm.edu.my

First Example of Triphenylene -Based Discotic Liquid Crystals Containing Azobenzene Moieties



Sidik bin Silong, MD. Lutfor Rahman, Mohamad Zaki Ab. Rahman, Mansor bin Ahmad, Wan Md. Zin Wan Yunus and Md Jelas Haron

Syntheses of a triphenylene-based discotic liquid crystal molecule containing azobenzene moieties were reported. The molecule consists of a triphenylene as central core and six rod-like azobenzene mesogenic groups as the peripheral core. The chemical structure was deduced by elemental analyses, FTIR, ^{1}H and ^{13}C NMR spectroscopy. The liquid crystal properties were determined by polarizing optical microscopy (POM) and differential scanning colorimetry (DSC) methods.

The result shows that the liquid crystal molecule exhibits a discotic (N_D) phase and a smectic-A phase. UV-Visible spectrum of the molecule indicates that the absorption would allow the use of laser in the visible range to photo-induced reorientation of the azo groups.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6801
E-mail: sidik@fsas.upm.edu.my

The Classification Level of Damage and Estimation of Repair Cost for Crashed Vehicles

Stephen Yong C. V., S.V. Wong and M.M.H. Megat Ahmad

The Collision Deformation Classification (CDC) form is a form that needs to be filled by the traffic collision investigator during a traffic investigation. The CDC code was developed as a mean of recording crash damage in a simple coddle form. It is a seven-digit alphanumeric coding system used to describe the direct contact damage sustained by automobiles involved in accidents as shown in *Figure 1*. Normally, a complete CDC form for traffic investigation consists of six categories. They are the details of the accident, general vehicle, exterior damage, interior damage, occupant assessment and occupant injury. At present, there is no standard CDC form in Malaysia.

This study is devoted to the design of a CDC form, which is able to quantify the damage of a crashed vehicle. The designed CDC form can be used for investigating the causes of the collision. It consists of the details of the accident, general vehicle and exterior damage. It can be considered as an investigation form for the appointed adjusters during their investigation on behalf of the insurance company. It also can be a documentary evidence for conducting law enforcement or insurance claims. This will also help reduce the conflict between the insurance company and the workshop.

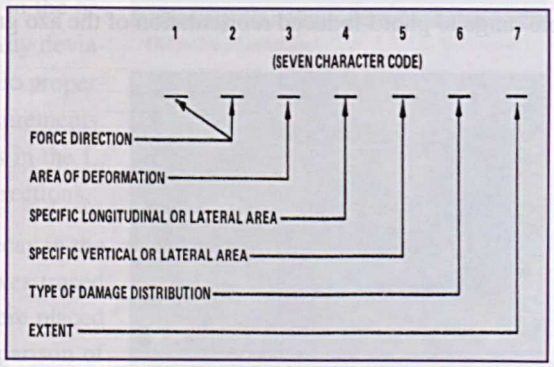


Figure 1. The Column Number for Identification

Ten case studies have been conducted and verified by using this CDC form, which involved 3 vans, 3 saloons and 4 hatchbacks. The causes of the deformation for each case are based on the information available and according to the information available with the authors. All the owners of respective crashed vehicle have been interviewed to obtain the actual cause of the deformation. As per the results, the causes of eight out of ten cases have been determined precisely and accurately. Therefore, the reliability of the outcome is up to 80% as compared to the actual facts.

The authors have developed a method to estimate the repair cost for the crashed vehicle. The repair cost includes both the prices for the spare parts and the labour cost. With this new method, the vehicle is divided into several zones accordingly and both horizontal and vertical axes are defined as shown in the *Figures 2 and 3*. The level of the damage can be classified by determining the area of the deformation. With proper analysis from the determination of deformation zone, the vehicle components that need to be changed or repaired can be identified. As a result, the range of the repair cost can then be estimated accurately. Since the prices for both spare parts and the labour cost vary from time to time and for different types of vehicle and workshop. The pricing database incorporated in the system needs to be updated from time to time accordingly.

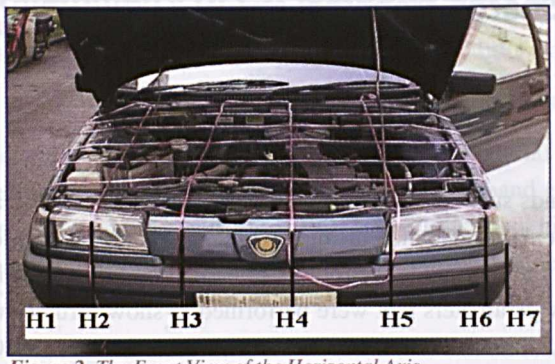


Figure 2. The Front View of the Horizontal Axis

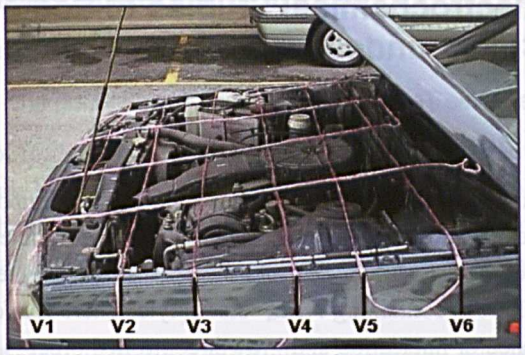


Figure 3. The Left View of the Vertical Axis

From the preliminary analysis carried out, it has been found that the total cost estimation has polynomial relationship with the area percentage of direct damage as shown in the *Figure 4*. The area percentage of direct damage is the percentage of direct damage area of the total area of the vehicle. Four-crashed Proton Iswara Aeroback have been investigated as pilot study and the repair cost has been estimated respectively with the present method. The Mean Absolute Deviation (MAD) between the total cost estimation and the total actual repair cost is RM144.50. Assuming that the forecast errors are normally distributed; the MAD will be 0.8 times the standard deviation of the forecast errors. About 58% of the error will be less than 1 times the MAD, 89% of the forecast errors will be less than 2 times the MAD and 98% percent will be less than 3 times the MAD. However, this relationship can be verified by increasing the volume of the case studies for this model of the vehicle.

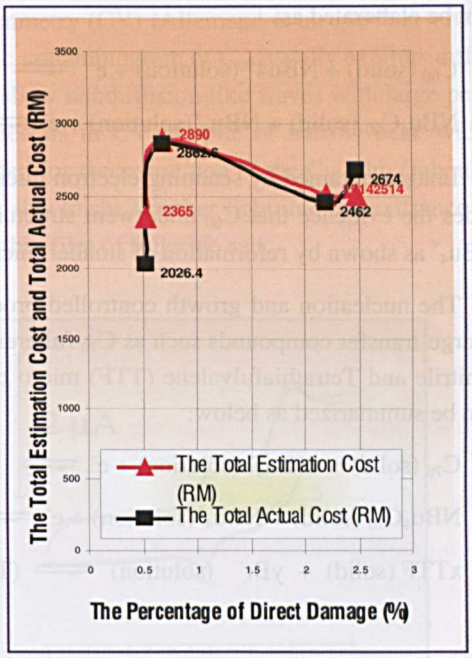


Figure 4. The Total Cost Estimation and the Total Actual Cost against the Percentage of Direct Damage

In conclusion, the designed CDC form is appropriate for investigating and quantifying the damage of the crashed passenger vehicle. In future, further customization of the CDC form can be applied to heavy vehicles as well. Besides that, the difference between the actual repair cost and the estimation repair cost is due to the overall labour cost. Generally, the repair work has been underestimated as the labour cost is based on the complexity of the repair work involved. However, increasing the volume of the cases under study and improving the standard of labour cost would help to reduce the gap between the estimation cost and actual repaired cost.

Reader Enquiry
Department of Mechanical and Manufacturing Engineering
Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6339
E-mail: wongsv@eng.upm.edu.my

Electrochemical Studies of Some Charge-transfer Compounds in Solutions



Tan Wee Tee, Goh Joo Kheng, Tan Tjin Ling and Lim Ei Bee

Voltametric studies of some charge-transfer compounds such as C_{60} fullerene micro crystals adhered to an electrode by solvent casting or mechanical transfer exhibit evidence of nucleation and growth controlled processes for the $C_{60}^{0/n-}$ and $C_{60}^{ns-/0}$ solid state when the modified electrode is in contact with acetonitrile solutions containing NBu_4^+ electrolyte. There are few parameters that were performed to show further evidence of nucleation and growth controlled process such has scan reversal studies, chronocoulometry (CC) and chronoamperometry (CA). The processes between the microcrystalline C_{60} and the NBu_4^+ electrolyte can be elaborated as:

$$C_{60}\,(\text{solid}) + NBu4^+\,(\text{solution}) + e^- \rightleftharpoons NBu_4C_{60}\,(\text{solid}) \text{ and}$$

$$NBu_4C_{60}\,(\text{solid}) + NBu_4^+(\text{solution}) + e^- \rightleftharpoons (NBu_4)_2C_{60}\,(\text{solid})$$

Images obtained by scanning electron microscopy reveal that the micro particle sizes decreased. It provides the evidence that C_{60} underwent structural rearrangement during reduction process to accommodate NBu_4^+ as shown by reformation of smaller microcrystalline product.

The nucleation and growth controlled processes observed above were also observed for other related charge-transfer compounds such as C_{70} fullerene micro crystals in the presence of NBu_4^+ electrolyte in acetonitrile and Tetrathiafulvalene (TTF) micro crystals in the presence of bromide solution. Their reactions can be summarized as below:

$$C_{70}\,(\text{solid}) + NBu_4^+\,(\text{solution}) + e^- \rightleftharpoons NBu_4C_{70}\,(\text{solid}) \text{ and}$$

$$NBu_4C_{70}\,(\text{solid}) + NBu_4^+(\text{solution}) + e^- \rightleftharpoons (NBu_4)_2C_{70}\,(\text{solid})$$

$$xTTF\,(\text{solid}) + yBr^-\,(\text{solution}) \rightleftharpoons (TTF^+)_y\,(TTF)_{x-y}(Br^-)_y\,(\text{solid}) + ye^-$$

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6807
E-mail: wttan@fsas.upm.edu.my

Voltammetry of C_{60} Microcrystals in Non Aqueous Solution

Tan Wee Tee, Lim Ei Bee, Goh Joo Kheng, Abdul Halim Shaari and Zulkarnain Zainal

Electrochemistry of C_{60} - fullerene, a starting material for fulleride synthesis has been widely studied and is well understood in solution voltammetry (Allemand et al. 1991; Curl, 1993) but less so in solid state voltammetry (Jahoulet and Bard, 1991). The fulleride which can be electrochemically generated may be semiconducting (eg. $(NBu_4)_xC_{60}$, x =1, 2, 3) (NBu_4 = tetrabutylammonium) or superconducting (eg.K_3C_{60}) (Curl,1993) .

C_{60} has a high affinity for electron and can be electrochemically reduced/oxidised in solution. Electrochemical analysis of C_{60} reveals the existence of at least six oxidation states of C_{60}^{n-} (n = 1,2,3,4,5,6). The six known reduction of C_{60} are all-reversible by cyclic voltammetry (CV) (Allemand et al. 1991) at -10°C in acetonitrile (ACN) / toluene solvent system. Solution cyclic voltammogram of C_{60} usually exhibits diffusion-like waves (Fig.1). However in solid state, the C_{60} film show nondiffusion-like waves with large peak separation indicating the presence of an inert zone or hysteresis in CV in spite of narrow peak width (Fig.1). This has been attributed to a large overpotential needed for reconstruction of the C_{60} film (Jahoulet and Bard, 1991; Compton et al. 1993). In our studies, we are able to shed further light into the existance of this inert zone and the factors that influence the stability of a thin film of fulleride salt.

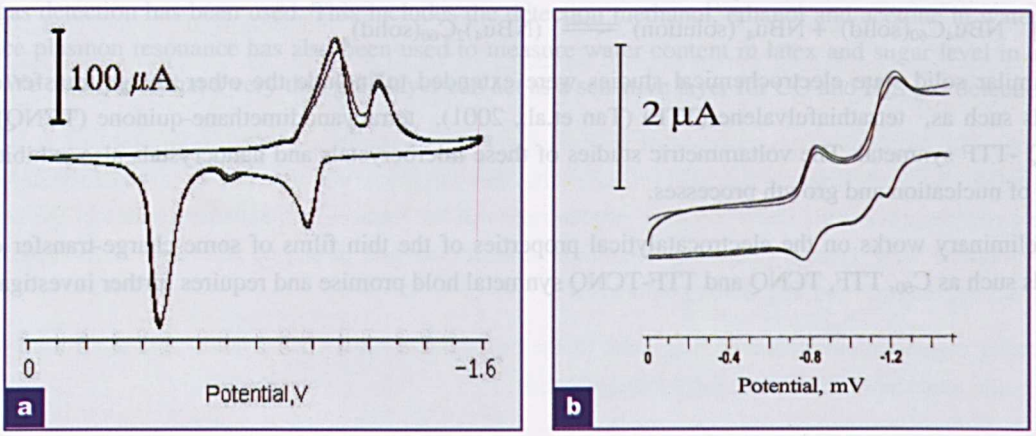


Fig.1.(a) Cyclic voltammogram obtained for the reduction of microcrystalline C_{60} mechanically attached to a 1 mm Au electrode and immersed in 0.1 M NBu_4PF_6/ACN at room temperature using a scan rate of 25 mV/s.(b) Cyclic voltammogram of a solution of C_{60} in 0.1M NBu_4PF_6/CH_2Cl_2 under similar experimental conditions as in (a)

In this study, solid state voltammetry using CV, was employed to study the reduction of microcrystals of C_{60} (1-30 μm sizes) mechanically attached at the electrode surface and immersed in a nonaqueous solvent system containing a supporting electrolyte whose cation can react with C_{60} to form a fulleride salt which appears as a thin film at the electrode surface.

Solid-state cyclic voltammetry of C_{60} -fullerene and fulleride formed electrochemically have been studied as a function of electrode materials, electrolytes, nonaqueous solvent system (including mixed solvents), temperature and solid deposition techniques. Chronocoulometry (CC) and chronoamperometry (CA) of C_{60} at various conditions were also selectively carried out in order to study its surface charge and current transient kinetics respectively.

Solvent casting technique, which allows several monolayers of C60 molecules to be formed at the electrode surface, was found to be a useful deposition technique as compared to the mechanical transfer technique where monolayers deposition cannot be readily controlled. Evidences of nucleation and growth (N & G) processes (Fletcher et al. 1983), associated with thin film formation of (NBu_4) C_{60} or $(NBu_4)_2$ C_{60} fulleride were again detected in the acetonitrile solvent using NBu_4^+ as cation at temperature ranging between O^0C and 75^0C during scan reversal and scan rate studies of CV,CA and CC. The N & G processes can be used to explain the presence of inert zone between peaks (Tan et.al. 2002). The results indicate the stability of the fulleride film over this temperature range. During the search for better nonaqueous solvent systems for the voltammetric studies of C_{60} fullerene and in situ generation of a more stable fulleride film at the electrode, dimetylsulfoxide (DMSO) and acetonitrile and mixed solvents of DMSO/ACN were found to be more superior than the other solvent systems. The overall electrochemical process of fullerene (C_{60}) occurring at the electrode-solid-electrolyte interface is as follow :

[1] $C_{60}(solid) + NBu_4^+(solution) + e^- \rightleftharpoons NBu_4C_{60}(solid)$, and

[2] $NBu_4C_{60}(solid) + NBu_4^+(solution) \rightleftharpoons (NBu_4)_2C_{60}(solid)$

Similar solid state electrochemical studies were extended to include the other charge-transfer compounds such as, tetrathiafulvalene (TTF) (Tan et.al., 2001), tetracyanodimethane-quinone (TCNQ) and TCNQ -TTF synmetal. The voltammetric studies of these microcrystals and nanocrystals also exhibit evidence of nucleation and growth processes.

Preliminary works on the electrocatalytical properties of the thin films of some charge-transfer compounds such as C_{60}, TTF, TCNQ and TTF-TCNQ synmetal hold promise and requires further investigation.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6807
E-mail: wttan@fsas.upm.edu.my

Surface Plasmon Resonance-Optical Sensor

W. Mahmood Mat Yunus, Zainal Abidin Talib, Mohd Maafor Moksin, Azmi Zakaria, Zaidan Abd Wahab and Ionel Valeriu Grozescu

AwardWinner



Surface Plasmon Resonance-Optical Sensor

A surface plasmon is an electromagnetic wave propagating along the surface of a thin metal film. Optical excitation of the plasmon can be observed if a p-polarized, collimated light beam undergoes total internal reflection at a glass/metal/dielectric. The effect is observed as a sharp minimum of the reflectance when the angle of incidence is varied. The resonance condition includes the following parameters: wavelength, angle of incidence, metal thickness and dielectric constants of metal and media on its both sides. Thus for monochromatic light and fixed metal layer, the angle at which the resonance observed depends critically on dielectric constants adjacent to the metal layer. By covering the metal layer with a chemically active thin layer, a very sensitive and selective sensor can be obtained.

In the research conducted, the surface plasmon resonance as highly sensitive optical sensor for chemical and gas detection has been used. This includes the detection methanol, ethanol and acetone in water. This surface plasmon resonance has also been used to measure water content in latex and sugar level in a solution. We also found that a very thin gold layer can act as a sensitive layer for CO and H_2S gas detection.

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6684
E-mail: mahmood@fsas.upm.edu.my

Graft Copolymerization of Vinyl Monomers onto Sago Starch



Wan Md. Zin Wan Yunus, Mansor Ahmad, Mohamad Zaki Ab. Rahman, Wan Ahmad Badhi, Md. Jelas Haron and Sidik Silong

Various vinyl monomers such as methyl methacrylate, methyl acrylate, acrylonitrile, styrene, acrylic acid and 2-hydroxyethyl methacrylate, were successfully grafted onto sago starch by free radical graft copolymerization. The optimum yield of grafting, grafting efficiency and rate of graft copolymerization are dependent upon the initiators and their concentrations and the amount of the monomer and sago starch in the reaction mixture as well as the reaction temperature and period.

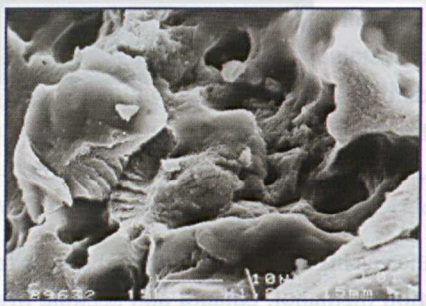


Figure 1. SEM photograph of synthetic polymer grafted sago starch

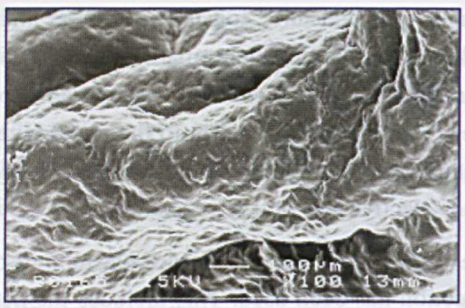


Figure 2. SEM photograph of gelatinized sago starch 100X

A new equation rate of polymerization was derived from the proposed reaction mechanism. A new kinetics model for graft fraction was also proposed and the validity of the model was satisfactory supported by the experimental results up to a certain concentration of the monomer. Characterizations of the copolymers produced were carried out using thermogravimetric analysis, scanning electron microscopy, FTIR spectroscopy and differential scanning calorimetry.

Further investigations indicated that some of the copolymers produced were suitable to be used as hydrogels and matrices for chelating ion exchange resins.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6601
E-mail: wanzin@fsas.upm.edu.my

Cost Effective Low Temperature Fabrication of Barium Plumbate-Based Barrier Layer Capacitor Elements



Wan Mohamad Daud bin Wan Yusoff, Abdul Halim Shaari Zainul Abidin Hassan, Zainal Abidin Talib, Ari Sulistyo Rini, Iftetan Ahmad Taha and Azizah Ishaq

The demand for small size capacitors with large capacitance value has increased tremendously as a result of rapid miniaturization of electronics circuit and devices. Barium and strontium titanate-based materials are widely used as multiplayer capacitors (MLC) and barrier layer capacitors (BLC). They have special features such as high permittivity, low loss factor, high insulating resistance and stable temperature coefficient of capacitance. Under the research conducted, Barium plumbate-based materials $Ba_xM_{1-x}PbO_3$ (M = Mg, and Sr) were chosen in order to study their BLC characteristics because of the similar perovskite structure to titanate and its high conductivity. It is hoped that these two characteristics will improve the properties of barrier layer capacitors.

$Ba_xM_{1-x}PbO_3$ (M=Mg, Sr) ceramics have been fabricated by solid state methods with low sintering temperature 850 C for 24 hours. Samples were shaped into pellets with ~0.2 cm of thickness and ~1.3 cm of diameter. Polished samples were characterized using HP 4912 Impedance Analyzer in frequency range of 5 Hz – 13 GHz.

$BaPbO_3$ exhibit relatively stable real part of permittivity in range 1Hz – 100kHz with value of 140 and has low loss factor. Substitutions of alkaline-earth ions Mg and Sr have affected dielectric properties of $BaPbO_3$. Addition of 10% mol Mg at Ba-site has increased the real part of permittivity to value of ~650. Relatively stable both real and imaginary parts of permittivities were found in small range of frequency (10kHz – 300kHz), and remain stable with increasing temperature *(Figure 1)*. Loss factors are still high until 50% mol Mg addition but permittivity is as high as 600. Further addition shows lower loss factor and lower permittivity as well *(Figure 2)*.

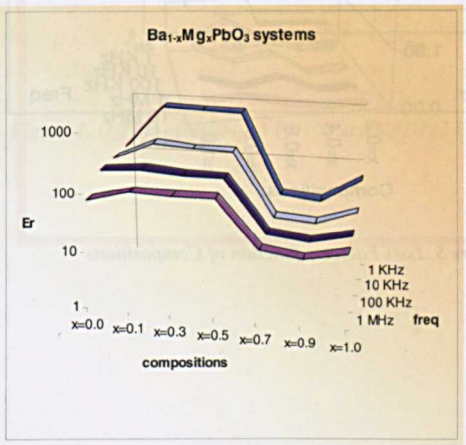


Figure 1. Composition and field dependence of real-part of permities

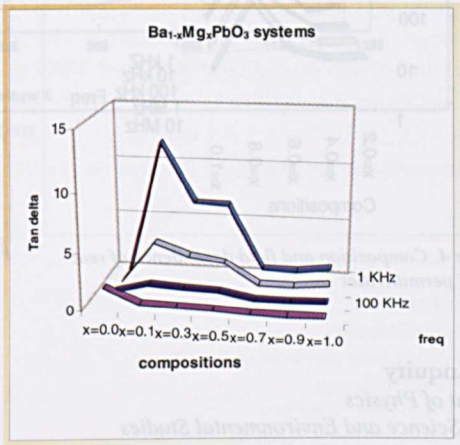


Figure 2. Loss Factor a function of Compositions

Temperature dependences of imaginary parts of permittivity were observed. Resistivities at 10 kHz were plotted versus measurement temperatures and show thermally effected of resistivity. There are two facts observed, negative temperature coefficient of resistance -for pure BaPbO3 and 10% mol Mg-doped- and positive temperature coefficient of resistance for higher Mg contents *(Figure 3)*.

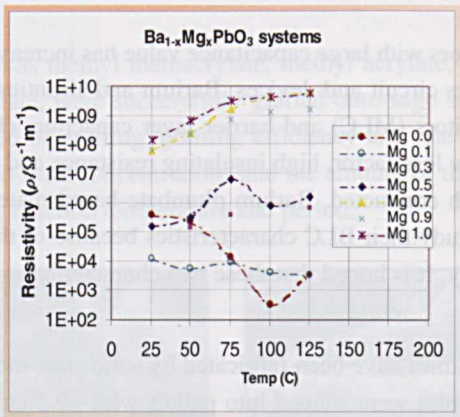


Figure 3. Temperature dependence of resistivity

20% mol Sr-substituted at Ba-site, real parts of permittivities have lower values of ~15, but stable in wider range of frequency *(Figure 4)*. The range stretches from 100kHz to 10MHz. Permittivity of $Ba_xSr_{1-x}PbO_3$ has maximum value at x=0.8 that reach value of 1400 at 1 KHz but also high loss factor. Relatively stable permittivity, and low loss were obtained at high frequency *(Figure 5)*.

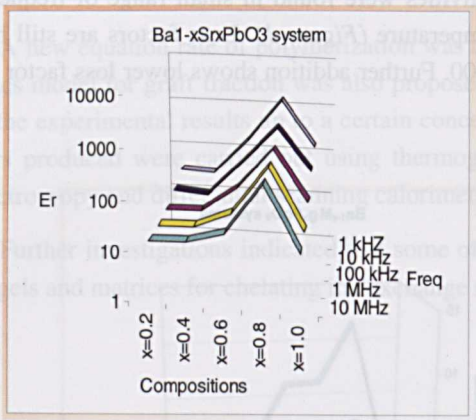


Figure 4. Composition and field dependence of real part of permittivities

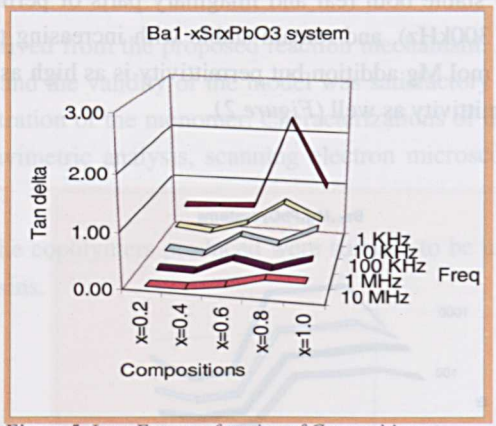


Figure 5. Loss Factor a function of Compositions

Reader Enquiry
Department of Physics
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6685
E-mail: wmdaud@fsas.upm.edu.my

High Mobility Lattice Oxygen of Vanadyl Pyrophosphate Catalyst Prepared via $VOPO_4{\cdot}2H_2O$

Y.H. Taufiq-Yap, M.H. Looi and M.Z. Hussein

Vanadyl pyrophosphate, $(VO)_2P_2O_7$ is currently the most effective catalyst which is used commercially for the selective oxidation of *n*-butane to maleic anhydride.

In this study, $(VO)_2P_2O_7$ was prepared in a two step procedure based on $VOPO_4{\cdot}2H_2O$. The final catalysts were obtained by calcining the precursor at 673 K for different periods (40, 100 and 132 h) in a mixture of *n*-butane/air (0.75 % *n*-butane in air) and are denoted VPD40, VPD100 and VPD132, respectively.

Crystal phase determination by XRD showed that the catalysts comprised of predominantly V^{4+} species of $(VO)_2P_2O_7$, together with traces of V^{5+} phase of $VOPO_4$, which diminished with increase calcination time leading to improvement of crystallinity, in agreement with results from SEM.

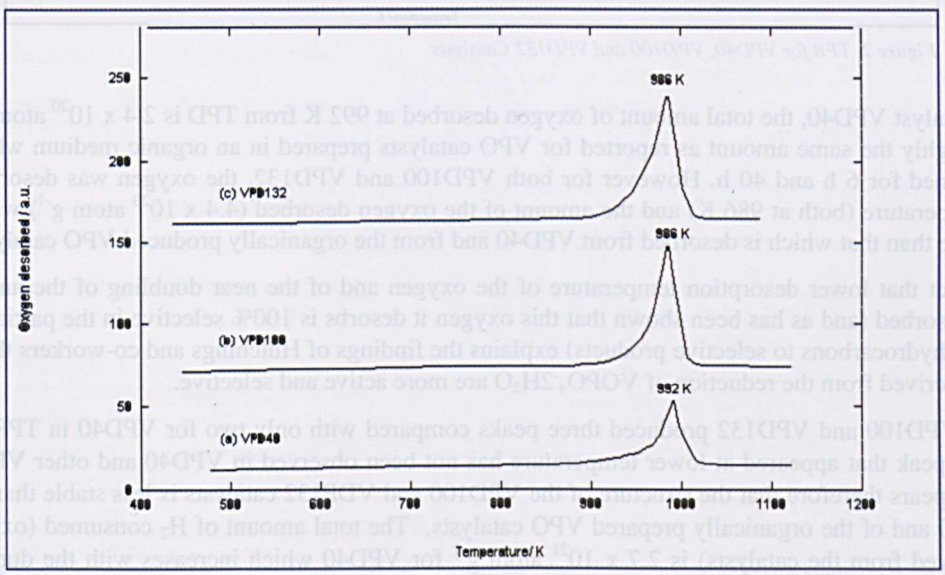


Figure 1. O_2TPD of VPD40, VPD100 and VPD132 Catalysts

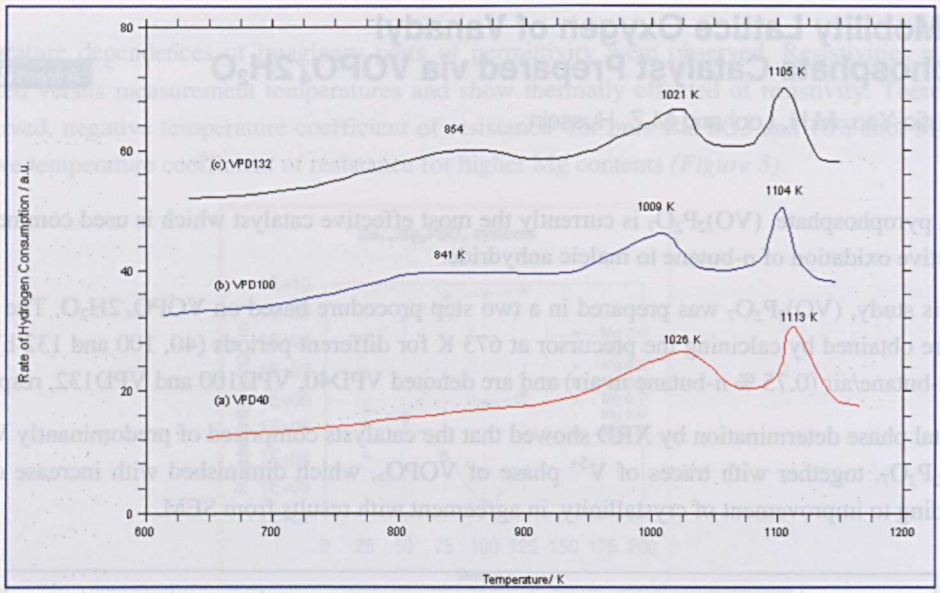


Figure 2. TPR for VPD40, VPD100 and VPD132 Catalysts

For catalyst VPD40, the total amount of oxygen desorbed at 992 K from TPD is 2.4 x 10^{20} atom g^{-1} and this is roughly the same amount as reported for VPO catalysts prepared in an organic medium which had been calcined for 6 h and 40 h. However for both VPD100 and VPD132, the oxygen was desorbed at a lower temperature (both at 986 K) and the amount of the oxygen desorbed (4.4 x 10^{20} atom g^{-1}) was virtually double than that which is desorbed from VPD40 and from the organically produced VPO catalyst.

The fact that lower desorption temperature of the oxygen and of the near doubling of the amount of oxygen desorbed (and as has been shown that this oxygen it desorbs is 100% selective in the partial oxidation of C_4 hydrocarbons to selective products) explains the findings of Hutchings and co-workers that VPO catalysts derived from the reduction of $VOPO_4{\cdot}2H_2O$ are more active and selective.

Both VPD100 and VPD132 produced three peaks compared with only two for VPD40 in TPR by H_2. The extra peak that appeared at lower temperature has not been observed in VPD40 and other VPO catalysts. It appears therefore that the structure of the VPD100 and VDP132 catalysts is less stable than that of the VDP40 and of the organically prepared VPO catalysts. The total amount of H_2 consumed (oxygen atoms removed from the catalysts) is 2.7 x 10^{21} atom g^{-1} for VPD40 which increases with the duration of calcination to 3.2 x 10^{21} and 3.3 x 10^{21} atom g^{-1} for VPD100 and VPD132 respectively, in rough agreement with the temperature programmed desorption results.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6809
E-mail: yap@fsas.upm.edu.my



Social Sciences and Humanities

Figure 2. TPR profiles of VPD40 and VPD132 catalysts

For catalyst VPD40, the total amount of oxygen desorbed at 992 K from TPD is 2.4×10^{20} atom g^{-1} and this is roughly the same amount as reported for VPO catalysts prepared in an organic medium which had been calcined for 6 h and 40 h. However for both VPD100 and VPD132, the oxygen was desorbed at a lower temperature (both at 986 K) and the amount of the oxygen desorbed (4.4×10^{20} atom g^{-1}) was virtually double than that which is desorbed from VPD40 and from the organically produced VPO catalyst.

The fact that lower desorption temperature of the oxygen and of the near doubling of the amount of oxygen desorbed (and as has been shown that this oxygen it desorbs is 100% selective in the partial oxidation of C_4 hydrocarbons to selective products) explains the findings of Hutchings and co-workers that VPO catalysts derived from the reduction of $VOPO_4.2H_2O$ are more active and selective.

Both VPD100 and VPD132 produced three peaks compared with only two for VPD40 in TPR by H_2. The extra peak that appeared at lower temperature has not been observed in VPD40 and other VPO catalysts. It appears therefore that the structure of the VPD100 and VDP132 catalysts is less stable than that of the VDP40 and of the organically prepared VPO catalysts. The total amount of H_2 consumed (oxygen atoms removed from the catalysts) is 2.7×10^{20} atom g^{-1} for VPD40 which increases with the duration of calcination to 3.2×10^{20} and 3.3×10^{20} atom g^{-1} for VPD100 and VPD132 respectively, in rough agreement with the temperature programmed desorption results.

Reader Enquiry
Department of Chemistry
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 6600
E-mail: yap@fsas.upm.edu.my

Contents

Social Sciences and Humanities

Misconduct Amongst Secondary and Primary School Students: Policy Implications 439

Abdullah Al-Hadi M., Rozumah, B., Rumaya, J., Asnarulkhadi, AS., Mansor, AT., Amna, M.N. and Tan, J.P.

Rural Women's Involvement in Micro Enterprise: A case study of MADA Women 441

Jariah Masud, Laily Paim, Mumtazah Othman, Aini Said, Husniyah A. Rahim, Mohd. Amim Othman

The New Philosophy and Rural Development Strategy and Gerakan Desa Wawasan: An Exploratory Study 443

Jariah Masud, Laily Hj. Paim, Tengku Aizan, Amini Amir Abdullah, Mumtazah Othman, Asnarul Khadi Abu Samah and Aishah Idris

Interactive and Animated Mathematics for Math Education 445

Kamel Ariffin Mohd Atan and Rustem Suncheleev

An Experiment on Violin Teaching to Groups of Pre-School Children 446

Liew Ai Lin

Family Functioning: Humanistic Perspective 447

Lily Mastura Hj. Harun

Socialization and Financial Behaviours of Youth 449

Mohamad Fazli Bin Sabri

Economic Valuation of Forest Catchments Conservation: Trade-Offs Between Water and Timber Production 451

Mohd Shahwahid H. O.,Awang Noor A. G, Abdul Rahim N, Zulkifli Y. and Razani U.

Competency of the Wood-Based Industry in the Face of Global Competition 452

Mohd Shahwahid H. O., Jalaluddin H., Khairul Zaman M.D., Basri H., Mohd Nor M.Y. and Zulkifli H.

Divisia Monetary Aggregates and Economic Activity 453

Muzafar Shah Habibullah

Competing Through Quality 455

Salleh Yahya

Relationships of Self-Regulated Learning and Self-Efficacy Beliefs with Academic Achievement in Higher Education Institutions 456

Samsilah Roslan, Abdul Majid Mohd. Isa, Othman Dato' Hj. Mohamed and Rohani Ahmad Tarmizi

The Patterns and Role Structure in Family Decision Making in Malaysia 457

Samsinar Md Sidin, Ruhana Busu, Alvin Yong Onn Soon, Wong Fong Yee

The Use of McCarthy Scales of Children's Abilities (MSCA) as an Instrument for Intelligence Quotient among Children in Malaysia 459

Shamsul B.S., Zailina H., Jamal H.H. and Rohani A.

Leg Strength Per Body Mass Ration among Malaysian Netball Players 460

Soh Kim Geok

The Behaviour of Malaysian Stock Prices and Economic Growth 461

Tan Hui Boon

Development and Validation of an Information Technology (IT) Based Instrument to Measure Teachers' IT Preparedness 463

Wong Su Luan, Kamariah Abu Bakar, Ramlah Hamzah, Rohani Ahmad Tarmizi

Private Capital Flows From Asean Four 465

Zulkornain Yusop

Contents

Social Sciences and Humanities

Misconduct Amongst Secondary and Primary School Students: Policy Implications
[illegible]

Rural Women's Involvement in Micro Enterprise: A case study of MADA Women
[illegible]

The New Philosophy and Rural Development Strategy and Iranian Dess Wawasan: An Exploratory Study
[illegible]

Interactive and Animated Mathematics for Math Education
[illegible]

An Experiment on Violin Teaching to Groups of Pre-School Children
[illegible]

Family Functioning: Humanistic Perspective
[illegible]

Socialization and Financial Behaviours of Youth
[illegible]

Economic Valuation of Forest Catchments Conservation: Trade-Offs Between Water and Timber Production
[illegible]

Competency of the Wood-Based Industry in the Face of Global Competition
[illegible]

Division Monetary Aggregates and Economic Activity
[illegible]

Competing Through Quality
[illegible]

Relationships of Self-Regulated Learning and Self-Efficacy Beliefs with Academic Achievement in Higher Education Institutions
[illegible]

The Patterns and Role Structure in Family Decision Making in Malaysia
[illegible]

The Use of McCarthy Scales of Children's Abilities (MSCA) as an Instrument for Intelligence Quotient among Children in Malaysia
[illegible]

Leg Strength Per Body Mass Ratio among Malaysian Netball Players
[illegible]

The Behaviour of Malaysian Stock Prices and Economic Growth
[illegible]

Development and Validation of an Information Technology (IT) Based Instrument to Measure Teachers' IT Preparedness
[illegible]

Private Capital Flows From Asean Four
[illegible]

Misconduct Amongst Secondary and Primary School Students: Policy Implications

Abdullah Al-Hadi M., Rozumah, B., Rumaya, J., Asnarulkhadi, AS., Mansor, AT., Amna, M.N. and Tan, J.P.

The study aims to analyze comprehensively the phenomenon of misconduct problems amongst secondary and primary school students according to their ecology (individual, family, school and community) and to provide input for policy and practice.

Two methods of data collection, namely survey and focus group discussions (FGD) were used in the study. The study was conducted at eight randomly chosen states (Kedah, Pulau Pinang, Melaka, Johor, Kelantan, Terengganu, Wilayah Persekutuan and Selangor), which were divided into four zones (North, South, East and West) in Peninsular Malaysia. A total of 2,511 students from urban and rural areas were surveyed, whereby 2,432 were students identified with disciplinary records (PDR) and 79 without disciplinary records (PTR). Fifty-three sessions of FGD were conducted with the students, parents and school administrators to gather additional information for the study. Questionnaire measures of different ecology (individual, family, peers, school, media and community) of students were designed for the study. Student's conduct problems were measured using a 31-item Likert scale comprising various misconduct activities probably committed by students.



Problems amongst school students—schoolgirls smoking



Misconduct amongst children—temptations for drug abuse (Heroin kit)

Generally, the study found that student's profile and ecology, family processes and school related factors correlate significantly with misconduct among the students. Multivariate analyses revealed that peer pressure was found to be the most important unique predictor for misconduct problem amongst students, followed by gender, party orientation, school climate, family happiness, student-school relationship and family functioning. Students in the urban area who have misconduct problems tend to be male students, experienced higher peer pressure, emphasize on party orientation, tend to dislike school, perceived family as less happy and less functional. While, those from rural areas who have higher tendency towards misconduct were boys, younger, low in academic orientation, high in party orientation and peer pressure, dislike school and reported lower level of satisfaction towards school climate. Five components in the student's ecosystem, namely school characteristics, support system, student characteristics, family

processes and external factors such as peer and media, have been identified to play a prominent role in dealing with misconduct behaviour among students.

This may imply that the micro, meso, as well as the exso-system of the students may have direct and indirect effect on misconduct. Prevention and intervention programs should therefore consider the contribution of these systems in their planning and implementation activities.

Reader Enquiry
Faculty of Human Ecology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 7082, 8946 6062
E-mail: abdhadi@putra.upm.edu.my

Rural Women's Involvement in Micro Enterprise: A case study of MADA Women

AwardWinner

Jariah Masud, Laily Paim, Mumtazah Othman, Aini Said, Husniyah A. Rahim and Mohd. Amim Othman



This study was conducted among 123 women who were involved in micro enterprise under the supervision of Muda Agriculture Development Authority (MADA). Data was collected using the interview technique among the women randomly selected from the list of women entrepreneurs provided by MADA. The data was collected in 2001 and was coded and analyzed using SPSS program. More than half of the women interviewed had only primary education with mean age of 46 years. Mean age of the husbands was 49. Husbands had slightly higher education compared with the respondents. On the overall, the educational attainment of the respondents was much lower compared with the urban counterpart. Though all respondents were involved in micro enterprises, only 37% reported their employment as entrepreneurs. There were 29% respondents who claimed to be full time housewives, and 24% indicated that they were farmers. Two thirds of the respondents started their enterprises in the early 90s producing "bahulu', chilly source, and traditional cookies. Mean capital invested in the projects was RM952; which is considered as very small. Products produced by the respondents include traditional cookies (26%), chilly sources (26%), 'Kuih Karas' (traditional snack) (11%), 'Bahulu" (13%), various chips (11%), and instant or frozen food (5%).

These women's involvement in the micro enterprise helped in increasing the family income. Income received from the enterprise ranged from below RM300 to maximum of more than RM1,000. There were 46% respondents who earned more than RM500-1000 per month followed by 34% who earned more than RM1,000 per month. Prior to their involvement in the enterprise, 58%of these women were earning less than RM500 per month and only 10% reported earning more than RM1,000 per month.



Micro enterprises activities



Women involved in the micro enterprises

The data clearly indicated that their involvement in the micro enterprise has helped increase their income as well as family income. Data from this study will be presented to MADA officials to enable them plan for the development of the women micro enterprise as one of the strategies to achieve "one village one product" goal.

Reader Enquiry
Department of Resource Management and Consumer Studies
Faculty of Human Ecology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7054
E-mail: jariah@putra.upm.edu.my

The New Philosophy and Rural Development Strategy and Gerakan Desa Wawasan: An Exploratory Study



Jariah Masud, Laily Hj. Paim, Tengku Aizan, Amini Amir Abdullah, Mumtazah Othman, Asnarul Khadi Abu Samah and Aishah Idris

The objective of the research conducted was to evaluate the role of the Village Security and Development Committee (JKKK) and development agents in achieving the goal of Gerakan Desa Wawasan Programs.

Qualitative and quantitative data was gathered to obtain information about the respondents' knowledge, understanding and commitment to rural development. A total of 158 officers and 288 JKKK personnel were involved in this research. The data revealed that the low level of knowledge among the officers from various governmental agencies and JKKK regarding GDW are closely related to the low level of education and the age factor. Officers from various governmental agencies and JKKK are among groups who have been involved in community development programs before the launching of GDW. This factor may influence their commitment to the Second Rural Development Transformation Program (*Transformasi Kedua Pembangunan Luar Bandar*), which focused more on human resource development instead of physical development. Workloads among KPLB officers especially those who involved in the implementation of the programs was one of the factors identified as affecting the efficient implementation of the GDW. The existing training modules reviewed did not include important elements of development activities such as participatory approach to development. There is a need to enhance the training module in order to ensure the effective implementation of GDW programs.



***Figure 1**. Rural and community developmental facilities*



Figure 2. Community activities

Data form the study indicated that the level of empowerment among the community members still could be improved. A proper monitoring mechanism should be established in order to monitor the implementation and to evaluate the implication of the programs. The GDW program as stated in the program blue print is a dynamic program and is comparable to rural development programs in other countries such as Korea, Indonesia and Japan. To date, the program have shown positive results and the impact can be enhanced through identification of setbacks and constraints in implementation. Planners need to identify appropriate actions and measures for effective implementation to ensure rural areas become developed parallel to the development in the urban areas.

Reader Enquiry
Department of Resource Management and Consumer Studies
Faculty of Human Ecology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7054
E-mail: jariah@putra.upm.edu.my

Interactive and Animated Mathematics for Math Education



Kamel Ariffin Mohd Atan and Rustem Suncheleev

It's no mystery that our education system, especially in mathematics, is in dire need of improving. Although today's online culture provides access to thousands of topics in a matter of seconds, the methods used to interact with and impart knowledge to the students are embarrassingly outdated. According to constructivism, school of thought, learning is a search for meaning. Each learner generates his own "mental models" to make sense of his experiences.

In order to teach well we must not only understand the mental models that students use but also help them to develop the models.

In our research " Interactive and animated mathematics for math education" we focus on primary concepts of mathematics but not on isolated facts. Using professional software "Matematica", "MathLab", "Flash" we create animation to help students to develop "mental models" of basic mathematics concepts, understand them, use these visual images to support abstract definitions and theorems. In this way students will avoid memorizing a lot of isolated facts and formulae but derive these facts and formulae from well-developed "mental model" of the particular mathematical concept.

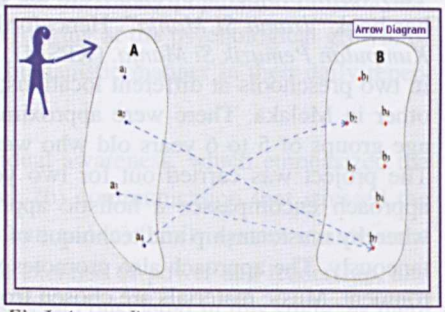


Fig.1. Arrow diagram

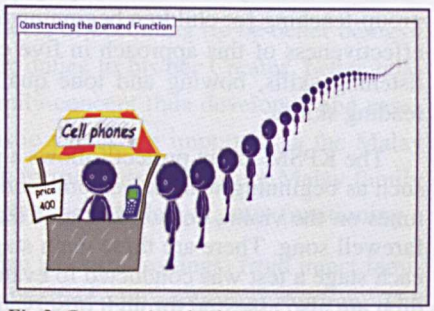


Fig.2. Constructing the demand function

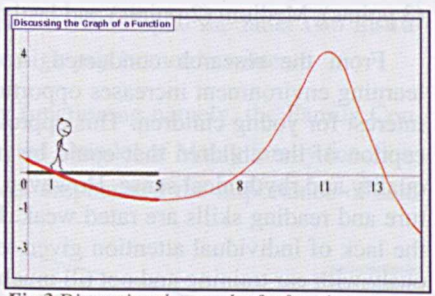


Fig.3.Discussing the graph of a function

Reader Enquiry
Institute of Mathematical Research
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6872, 8946 6855
E-mail: kamel@inform.upm.edu.my

An Experiment on Violin Teaching to Groups of Pre-School Children



Liew Ai Lin

This violin project is birthed from the researcher's ideas introduced in her book "*Irama Si Manja*". Henceforth, this violin project is named: *Kumpulan Pemuzik Si Manja*. (KPSM). Initially, this project was tested in two preschools at different locations; one in UPM, Serdang and another in Melaka. There were approximately ten children between the age groups of 5 to 6 years old who were started on a pint size violin. The project was carried out for two years. The characteristic of this approach encompasses a holistic approach of instrumental learning whereby musicianship and technique of violin playing are taught simultaneously. The approach also promotes violin teaching in a group environment. Music materials are chosen from the folksongs of Malaysia.



Effectiveness of group-teaching for children beginning to play violin

The main objectives of this project was to test the effectiveness of group-teaching for children beginning to play violin and to evaluate the effectiveness of this approach in five categories; posture, pitching and listening skills, bowing and tone quality, rhythmic pulse, and lastly, reading skills.



Children being assessed through observation

The KPSM violin project follows a progression for each lesson plan such as beginning with; a welcome song, games and exercises; playing tunes on the violin, consolidation of learning and finally ending with a farewell song. There are three main stages of the project. At the end of each stage a test was conducted to evaluate the students progress. Children are also assessed through observation. A checklist of the five categories as mentioned above is measured by three types of scoring Good (3 points), Medium (2 points) and lastly Weak (1 point).



Children between the age groups of 5 to 6 years playing violin

From the research conducted, it was found that violin group-learning environment increases opportunities to stimulate and maintain interest for young children. This approach also increases the aural perception of the children that could be measured in their pitching, tone quality and rhythmical sense. However, in other categories such as posture and reading skills are rated weak. It is mentioned that posture for violin playing was weak because of the lack of individual attention given to each child and the reading skills should be introduced simultaneously with ear training and not till much later.

This KPSM project is extended further to children in the primary school. Many more suitable teaching materials were developed for children at this age group.

Reader Enquiry
Department of Music
Faculty of Human Ecology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7126
E-mail: ailin_violin@yahoo.com

Family Functioning: Humanistic Perspective



Lily Mastura Hj. Harun

Family functioning has been the focus of treatment for families with psychological concerns. This study was conducted to develop a model of family functioning designed for the Malay population in Malaysia. The model of family functioning proposed in this study starts from looking at the psychological growth of individual family members, then the family hence interacting in a humanistic manner in their daily repertoire.

The humanistic model of family functioning focuses on individual awareness, which emphasized the importance of expression, self-fulfilment, and family cohesiveness; (b) communication that stressed the importance of individual growth, interaction, and conflict management; and (c) family system maintenance that can be achieved by performing appropriate tasks and roles, the exercise of power and leadership, and responsibilities in the family system. The humanistic approach has been considered in this study, as there is a common focus with the Islamic principles that emphasized the process of self-actualization or 'tazkiyah'. The process of actualization sees human as engaged in the process of becoming (to be better beings). Once an actualized self is achieved especially in performing his/her duties to his/her Creator, better relationships can be attained in their family relationship. A sound family-concept thus developed and eases family interaction in a manner that respects one another. Humanistic values are important in the Malay society, as Islam is a devout way of life. This study aims to develop instruments to measure Malay family functioning, develop a model of Malay family functioning and identify types of Malay family functioning.

This study was conducted on 1,137 Malay individuals (from urban and rural settings) from intact families who were in the sixth stage of their family life cycle. These are families with adolescent children. The research instruments used in this study were the adapted version of the Tennessee Self-Concept Scale, the Family Concept Scale, and the Family Interaction Scale. The researcher developed the latter two instruments based on the humanistic propositions. These instruments have high psychometric values.

The study established two instruments to measure Malay family functioning namely, the Family Concept Scale and the Family Interaction Scale. This study also constructed a model of Malay family functioning (see Figure 1) embedded with the humanistic values. The model emphasized the importance of self-actualization – having developed oneself and having a close relationship with one's Creator, maintaining a positive family concept with aspirations to better interact in the family environment, and respecting one another regardless of roles, age, or position in the family system. Based on the self-centered and family-centered dimension, three propositions were forwarded. There were family members who were just too self-centered at the expense of other family members. These self-centered individuals divulged themselves in self-absorption. This family type is similar to the self-focused family type (Fisher, 1977), unintended

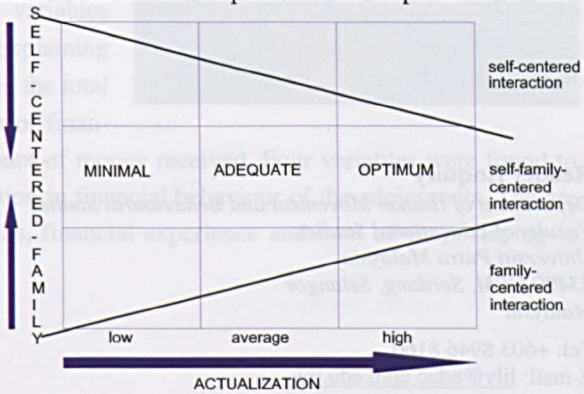


Figure 1. Humanistic Model of Malay Family Functioning

family type (Akerman & Behren, 1956; Ackerman, 1958), 'every man for himself' (Ford & Rarrick, 1974), and egocentric family (Voiland & Buell, 1961; Voiland, 1962). While on the other extreme continuum, individual family members try to become martyrs, to champion for the cause of others. This family type is similar to the 'internalized' family type (Fisher, 1977), 'externally isolated' (Akerman & Behren, 1956; Ackerman, 1958), 'suicidal family' (Gehrke & Kirschenbaum, 1967), and 'family character neurosis (Richter, 1974). These two extremes were considered dysfunctional. A humanistic family functioning would seek for a balance in self-development and family development. The self-family-centered interaction is seen as similar to the open family type as described by Kantor and Lehr (1975). Individuals in this family type are seen to be self-actualized and so is the whole family. It might be compatible with the definition of the family system as proposed by Wertheim (1973, 1975). It is stated that an ideal, adaptive family system can be conceptualized as one characterized by an optimal, socio-culturally appropriate balance between stability-promoting, self-corrective processes or 'morphostasis' and change-promoting self-directive processes or 'morphogenesis' (Wertheim, 1975). In this respect, a functional family system can be categorized as being optimal, adequate, and minimal. These are contingent on their levels of interpersonal interaction.

One distinctive feature of Islamic families is that the rights and responsibilities of one person or family is not a private affair but extends towards religious brotherhood. Islam lays emphasis on specific acts of kindness and defines the responsibilities and rights of various relationships. In a widening circle of relationship, our first obligation is to our immediate family-parents, husband or wife and children, then to other relatives, neighbours, friends and acquaintances, orphans and widows, the neediest of the community, our fellow Muslims, all our fellow human beings and animals. Family functioning is engaged in the sense of 'tawheed'. Man should realize that to survive, there is a need to revive the religious sentiments of its member. Religion creates virtues and morality, which is fundamental in interpersonal relationships. If self is perfected in its relationship to his or her Creator, then relationship with others will be a mere simple task. Human beings are always in the process of becoming, human beings are dynamic, not static. 'Going back to basics' is a saying by John Majors (former British Prime Minister), which can be interpreted, as going back to the traditional value system, religiously and socially oriented. The writer believes this is possible as we have the potentials and the faculty – the God-like knowledge.

Reader Enquiry
Department of Human Movement and Behavioural Studies
Faculty of Educational Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8160
E-mail: lily@educ.upm.edu.my

Socialization and Financial Behaviours of Youth

Mohamad Fazli Bin Sabri

The purpose of this study is to examine adolescents' financial behaviours and financial socialization. In addition, factors affecting their financial behaviour were identified. This study adopted the convenience sampling method.



Data were obtained using self-administered questionnaires, distributed to 3,500 first year students in 2001 at Universiti Putra Malaysia. A total of 2,219 sets of completed questionnaires were analyzed. Sixty seven point nine percent of the respondents were females and 32.1% were males. Respondents in both groups were in their late adolescent stage. The findings showed that the majority of respondents had financial problems, despite their claim that they were practising good financial management. This is because their financial behaviour is actually affected by their interaction with the socialization agents. Majority of them were found to interact with their peers, parents and media in terms of their consumption.





The Multiple Regression (Stepwise) analysis showed that the variables, which significantly explained variation in adolescents' interaction with peers, were media use, number of financial problems, interaction with parents, total interaction time with peers, number of siblings and number of financial sources. The variables that can significantly explain the variation in adolescents interaction with parents were total interaction time with parents, time using media, family's income, interaction with peers, number of siblings, total interaction time with peers and financial experience. On the other hand, seven variables were found to have significantly contributed in explaining variation in interaction with media. These variables are the total time and the extent of interaction with peers, number of financial problems, interaction with parents and total amount of money received. Four variables were found to have contributed significantly in explaining the variation in financial behaviour of the adolescents. The are interaction with parents, number of financial problems, financial experience and total of years staying in boarding school.





In conclusion of this study, financial behaviour of the adolescents was influenced by financial socialization. The adolescents learned about financial management from their interaction with peers, parents and media. The findings were consistent with the studies done by various researchers in the area of consumer socialization.

Reader Enquiry
Faculty of Human Ecology
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7113
E-mail: apr_13@yahoo.com

Economic Valuation of Forest Catchments Conservation: Trade-Offs Between Water and Timber Production



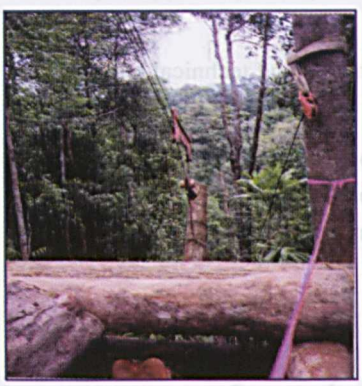
Mohd Shahwahid H. O.,Awang Noor A. G, Abdul Rahim N, Zulkifli Y. and Razani U.

This paper concerns costs and benefits of managing forested catchments in Malaysia.

Three land use options, catchments protection (CP), reduced impact logging (RIL) and conventional logging (CL), were simulated for four selected catchments in the Hulu Langat Forest Reserves (HLFR), Selangor, Malaysia. Sedimentation and its potential 'on-site' and 'off-site' impacts from each option on the dam and water intake ponds in the catchments were simulated. The net benefits derived from logging, hydroelectric power (HEP) generation and water regulatory dam for water treatment and the external costs emanating from the sedimentation were estimated.



Multiple use forestry: source of water supply for recreation, treated water and hydroelectric power generation



Timber production and its residual impact

Complementing water uses with logging in forested catchments was efficient in HEP catchments but not in water treatment catchments. Although, the RIL option was more beneficial than CL, but the sediment load released can impose substantial external costs on downstream water users. Findings of this study are important, as losses from environmental impacts have often been ignored. Policy and land administrators have to incorporate both direct and indirect (sometimes intangible) external impacts, when making appropriate land use decisions.

Reader Enquiry
Department of Hospitality and Recreation
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6028
E-mail: msho@econ.upm.edu.my

Competency of the Wood-Based Industry in the Face of Global Competition



Mohd Shahwahid H. O., Jalaluddin H., Khairul Zaman M.D., Basri H., Mohd Nor M.Y. and Zulkifli H.

The wood-based industry has contributed significantly to the Malaysian economy but is facing growing global competition. The objectives of this study are to identify and nurture the core competencies and capabilities of the wood-based industry and to assess the strength of international competitors.



Made in Malaysia competitively priced furniture

The study conducted covers six sectors: wood resources, sawn timber, solid and composite panel products, wood building and joinery products, furniture and fixtures, and pulp and paper. Through a nation-wide industry survey and international benchmarking exercises, various economic and management tools were used that integrated strength, weakness, opportunities and threat analysis (SWOT); scenario analysis; value chain analysis; competency matrices: product-market matrix, technology-product matrix, skill-product matrix; and assessing financial, economic and technical key performance indicators.

The outcome of these exercises resulted in the identification of core competencies existing in Malaysian wood-based industry. An action plan to spearhead Malaysia's wood-based industrial and international trade was formulated which would be beneficial to regulating Government agencies and the private sectors in its implementation more effectively.

Reader Enquiry
Department of Hospitality and Recreation
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6028
E-mail: msho@econ.upm.edu.my

Divisia Monetary Aggregates and Economic Activity

Muzafar Shah Habibullah

AwardWinner

In this study we investigate the long run relationships between alternative monetary aggregates and economic activity in ten Asian developing countries. We constructed Divisia monetary aggregates and compared its performance with the traditional Simple-sum monetary aggregates for the period 1980:1 to 1994:4. The long run relationships between these monetary aggregates and key macroeconomic variables were evaluated using several econometric procedures: – the Engle-Granger two-step; Kremers *et al.* error-correction; Johansen-Juselius techniques; seasonal unit root, cointegration and seasonal error-correction model approach; superexogeneity; Lucas critique and p-star modeling approach.

Our results suggest that there is a potential role for Divisia monetary aggregates as a useful guide for monetary policy purposes in the Asian countries.

Following Barnett (1980), a Divisia monetary aggregate is constructed in the following manner: Let q_{it} and p_{it} represent the quantities and user costs of each asset to be included in the aggregate at time t. The expenditure share on the services of monetary asset i in period t is: $s_{it} = p_{it}q_{it}/\Sigma_j p_{jt}q_{jt}$. The user cost of each asset is measured as: $p_{it} = (R_t - r_{i,j})/(1 + R_t)$ where R_t is the benchmark rate, the maximum $[r_j, r_i; i=1,2,...,n). j=1,2,..k. i \neq j]$. The growth rate of a Divisia aggregate then can be written as $G(Q_t) = \sum_{i=1}^{n} s_{it}^{*}G(q_{it})$ where $s_{it}^{*} = 0.5(s_{it}+s_{it-1})$ and n is the number of assets in the aggregate. Single period changes, beginning with a base period can be cumulated to determine the level of the Divisia aggregate in each succeeding period.

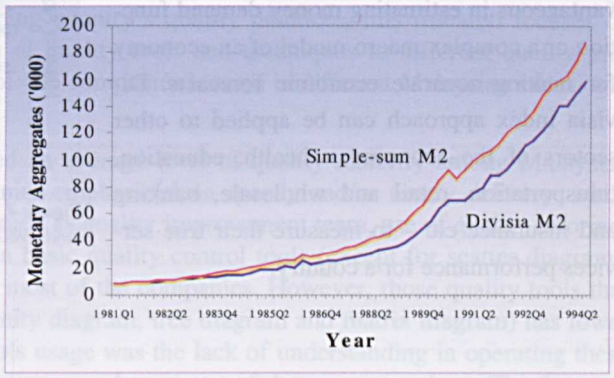


Figure 1. Simple-sum and Divisia Monetary Aggregates in Indonesia 1980:1-1994:4

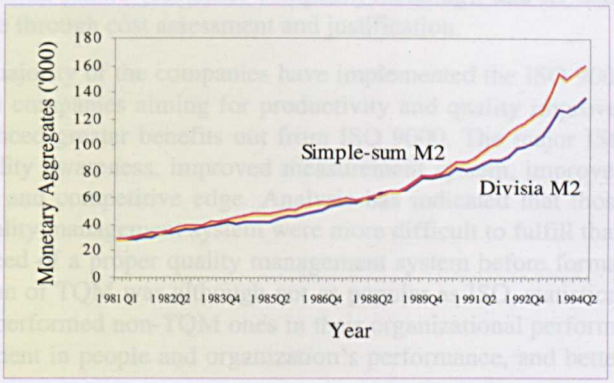


Figure 2. Simple-sum and Divisia Monetary Aggregates in Malaysia 1980:1-1994:4

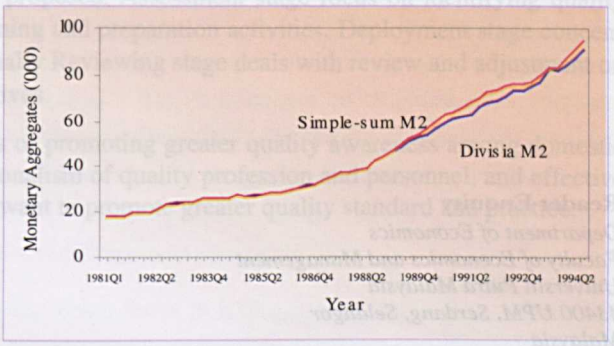


Figure 3. Simple-sum and Divisia Monetary Aggregates in Singapore 1980:1-1994:4

In conclusion, the need for such aggregates may arise in designing policies to curb inflation, influence economic growth and employment. The use of these aggregates can be advantageous in estimating money demand function or a complex macro model of an economy for making accurate economic forecasts. Divisia index approach can be applied to other sectors of the economy – health, education, transportation, retail and wholesale, banking and insurance etc – to measure their true services performance for a country.

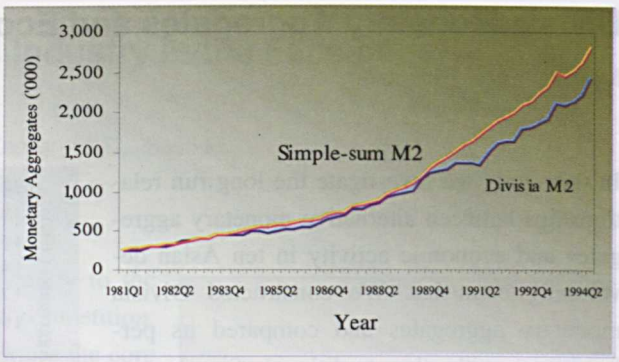


Figure 4. Simple-sum and Divisia Monetary Aggregates in Thailand 1980:1-1994:4

Reader Enquiry
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7635
E-mail: muzafar@putra.upm.edu.my

Competing Through Quality

Salleh Yahya

With the purpose of shedding light on developing country's quality practices, this research focuses on various quality issues ranging from application of quality tools and techniques to different quality programs. The data of this study, which comprised of 405 companies located in different Malaysian states, was collected through questionnaire survey.

Overall, the empirical findings have revealed an average level of quality maturity among Malaysian companies. About half of the surveyed companies emphasized on speedy and/or timely delivery, while others have been quite active in quality efforts such as quality improvement team, use of quality information, and follow-up of products sales. The seven basic quality control tools (except for scatter diagram), quality control circle and SPC were adopted by most of the companies. However, those quality tools that emphasis on management and planning (i.e. affinity diagram, tree diagram and matrix diagram) has lower adoption rate. The major difficulty of quality tools usage was the lack of understanding in operating these statistical techniques, and the availability, consistency, and accuracy of data, among others. The focus of quality costing exercise was found to be associated with appraisal cost (testing and inspection), cost of internal failure (scrap or rework), and cost of external failure (customer complaint handling), and its main purpose was to benchmark process's performance through cost assessment and justification.

In terms of quality programs implemented, majority of the companies have implemented the ISO 9000 quality assurance system. Analysis revealed that companies aiming for productivity and quality improvement, instead of market considerations, experienced greater benefits out from ISO 9000. The major ISO benefits were better documentation, greater quality awareness, improved measurement system, improved customer satisfaction, higher perceived quality, and competitive edge. Analysis has indicated that those ISO 9000 requirements that are related to the quality management system were more difficult to fulfill than those operational ones, suggesting the critical need of a proper quality management system before formal implementation of ISO 9000. The implementation of TQM was although not as popular as ISO, statistical analysis has suggested that TQM companies outperformed non-TQM ones in their organizational performance. The major benefits of TQM are: improvement in people and organization's performance, and better understanding of customer's needs.

Based on the empirical findings, a four-stage *Quality Development Model* (QDM) model – Assessment, Development, Deployment, and Reviewing – is proposed. Assessment stage focus on identifying quality gap, Development stage focus on the quality training and preparation activities, Deployment stage concentrates on quality program implementation, and finally Reviewing stage deals with review and adjustment on the progress and implementation of quality initiatives.

In addition, this study has indicated the needs of promoting greater quality awareness among domestic companies, improvement on the level of professionalism of quality profession and personnel, and effective R&D supporting policies, if Malaysian company want to promote greater quality standard and practice.

Reader Enquiry
Graduate School of Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7440
E-mail: salleh@putra.upm.edu.my

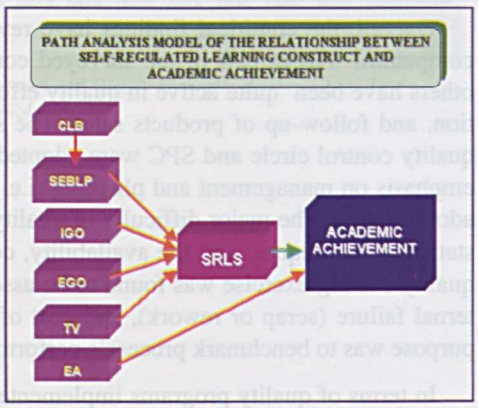
Relationships of Self-Regulated Learning and Self-Efficacy Beliefs with Academic Achievement in Higher Education Institutions



Samsilah Roslan, Abdul Majid Mohd. Isa, Othman Dato' Hj. Mohamed and Rohani Ahmad Tarmizi

The main purpose of this study is to explore the relationship between self-regulated learning and academic achievement in higher education institutions. This study also attempts to investigate the influence of self-efficacy beliefs on academic achievement through the use self-regulated learning strategies.

The measurement of self-regulated learning in this study is based on the self-regulated learning subscales proposed by Pintrich, Smith, Garcia and McKeachie (1991). Based on the general expectancy-value model of motivation, the relationships between the motivation components (self-efficacy beliefs for learning and performance, control of learning beliefs, intrinsic goal orientation, extrinsic goal orientation, task value and test anxiety) and self-regulated learning strategies are placed in a conceptual scheme of self-regulated learning.



CLB	-	Control of Learning Beliefs
SEBLP	-	Self-Efficacy Beliefs for Learning and Performance
IGO	-	Intrinsic Goal Orientation
EGO	-	Extrinsic Goal Orientation
TV	-	Task Value
EA	-	Exam Anxiety
SRLS	-	Self-Regulated Learning Strategies

Partial correlation was used to control for extraneous variables in investigating the relationship between self-regulated learning and academic achievement. The results show that self-regulated learning was positively and significantly related to academic achievement.

Path analysis revealed that self-regulated learning strategies mediated the influence of self-efficacy beliefs for learning and performance, intrinsic goal orientation, extrinsic goal orientation and task value on academic achievement. The influence of control of learning beliefs on the use of self-regulated learning strategies were found to be mediated by self-efficacy beliefs for learning and performance. Test anxiety was not a significant predictor of self-regulated learning strategies but was found to be a significant predictor of academic achievement.

Reader Enquiry
Faculty of Educational Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8194
E-mail: samsilah@educ.upm.edu.my

The Patterns and Role Structure in Family Decision Making in Malaysia



Samsinar Md Sidin, Ruhana Busu, Alvin Yong Onn Soon, Wong Fong Yee

This study focuses on the influences of family members in decision making with regards to purchases of products and services.

The objectives of the study are to investigate the patterns of family decision making, the roles played by family members in purchase decision making and the influence of these factors; culture, religiosity, sex role orientation, perception of modernism, spousal resources and demographic variables in family decision making in Malaysia.

Engel, Blackwell and Miniard (1990) proposed that decision making within the family unit and the relative influence each member has is determined by the roles the members assume. Roles played by husbands and wives vary across product characteristics and decision processes (Henthorne, 1997). Husbands tend to be more dominant in terms of where and when to purchase, whereas wives seem to be more dominant in selecting product features such as colour and style.

Previous research have shown that relative influence of family members are also influence by factors such as culture (Henthorne, 1997), sex role orientation and spousal resources (Lee and Beatty, 2002), perception of modernism (Al-Thakeb, 1985), demographic variables such as education, income and occupation (Hopper, 1995), family life cycle (Ruth & Commuri, 1998) and outside employment of the wife (Martinez & Polo, 1999).

As Malaysia goes through rapid industrialisation process, it is anticipated that modernization will bring about changes in cultural norms, creates more opportunities for women to work outside the house, delay marriages and shift societal standards (Qualls, 1987). These trends will consequently lead to some adjustments in the family in terms of the relative influence of the husbands and wives in family decision-making. While there is much research conducted in this area, literature on family decision-making in Malaysia remains scarce. Given the importance of the family as an important decision making unit (Assael, 1998), this study is both important and meaningful.

This study will investigate the role structure of husbands and wives in the decision making settings of purchasing furniture, electrical appliances, groceries and eating out. Both husband and wife will be interviewed to minimize any possible bias that any spouse may have in answering the survey questions. Husband and wife perceptions of their relative influence will be analysed separately.

The target population will be families in Malaysia, which focus in Klang Valley, Johor Bharu, Penang and Kuantan. A stratified sampling of 250 families by race, geographical location and income will be used. Personal interviews using a structured questionnaire will be used for data collection.

From this study, it is expected that a clear and comprehensive understanding of the patterns, the structure and the factors influencing family decision-making process in purchasing products and services are established. As different products and services will be investigated, the findings from this study will highlight the patterns of decision making in families in Malaysia.

This study will also emphasize not just the finality but also the decision making process. Project will benefit the government and policy makers in understanding family decision-making and other related issues.

Reader Enquiry
Department of Marketing and Management
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7674
E-mail: sms@putra.upm.edu.my

The Use of McCarthy Scales of Children's Abilities (MSCA) as an Instrument for Intelligence Quotient among Children in Malaysia

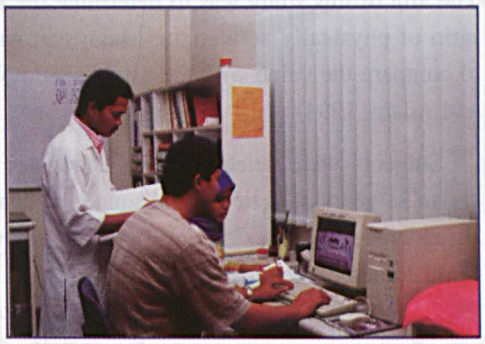


Shamsul B.S., Zailina H., Jamal H.H. and Rohani A.

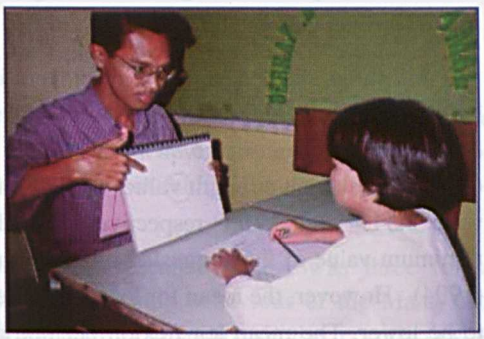
The objective of this study is to test the usage and the reliability of McCarthy Scales of Children's Abilities (MSCA) as a measuring tool for intelligence quotient (IQ) among Malay children in Malaysia.

A total of 212 children from four schools in Kuala Lumpur and Trengganu had been selected for this study by using stratified random sampling according to age and gender. The selected children underwent the IQ test using the MSCA. The test was divided into 6 scales namely, Verbal, Performance-perception, Quantitative, Memory, Motor and General Cognitive. The contents of the Verbal scale, Performance-perception and Quantitative did not overlap. When the three scales are added, it formed a General Cognitive scale, which indicated the general IQ of the children. The MSCA tests have been translated from English to Bahasa Malaysia and the examples in the question have been modified to suit the local condition.

The results on 18 tests from the 6 scales showed a good reliability because the alpha value exceeded 80% for all the children tested or when they are grouped according to school or the study area.



Translation process



MSCA memory test

Reader Enquiry
Faculty of Medicine and Health Science
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8532
E-mail: shambs@medic.upm.edu.my

Leg Strength Per Body Mass Ration among Malaysian Netball Players

Soh Kim Geok

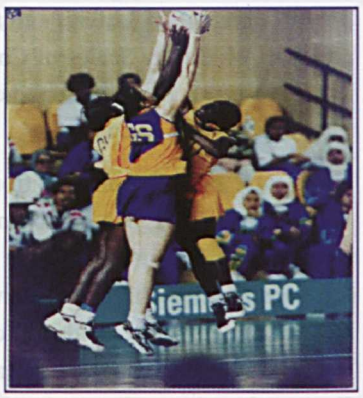
AwardWinner

The aim of this study was to determine the leg strength per body mass ratio of physically active elite Malaysian national netball players, and to compare the value with the established norms (Dintiman et al., 1998 and Adam, 1994).

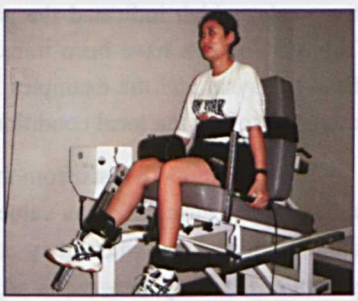
Subjects were selected from under 17, under 19, under 21, and above 21 years of age National squad. A concentric peak torque during leg extension and flexion at 60^0 per second was measured with a Lido Multi Joint Isokinetic Machine.

Significant differences in leg flexion per body mass were reported. The f values reported for right and left legs were 4.20 ($p<.01$) and 5.76 ($p<.01$) respectively.

This study showed that netball players in different age categories had better leg strength per body mass ratio value for leg extension as compared to the norm given by Dintiman et al. (1998) and Adam (1994). The mean strength values for left and right leg per body mass were 2.54% and 2.75% respectively. Both results were above the minimum value of 2.5 suggested by Dintiman et al. (1998) and Adam (1994). However, the mean for leg flexion per body mass was reported to be lower. The mean leg flexion per body mass value for both legs was 1.55% respectively.



Leg Strength Per Body Mass Ratio is a very Important Element in Netball Game as the game involves a Lot of Jumping



A Concentric Peak Torque During Leg Extension and Flexion at 60^0 per second was measured with a Lido Multi Joint Isokinetic machine

Reader Enquiry
Faculty of Educational Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8153
E-mail: kim@educ.upm.edu.my

The Behaviour of Malaysian Stock Prices and Economic Growth

Tan Hui Boon

Malaysia is a small and open economy, which had an impressive average economic growth of 8% for nine years prior to the 1997 Asian financial crisis. The stock market was also bullish at that time - the stock prices and thus the returns were up trending, the market capitalization and the number of listed companies were also increasing rapidly. The situation was totally turned around after the eruption of the financial crisis in the middle of 1997. The exchange rate depreciated in a great amount, the stock market crashed and the economic growth experienced a negative figure of -7.4% in 1998. These two extreme scenarios had indicated the importance of conducting studies related to stock market, macroeconomic fundamentals and economic growth.

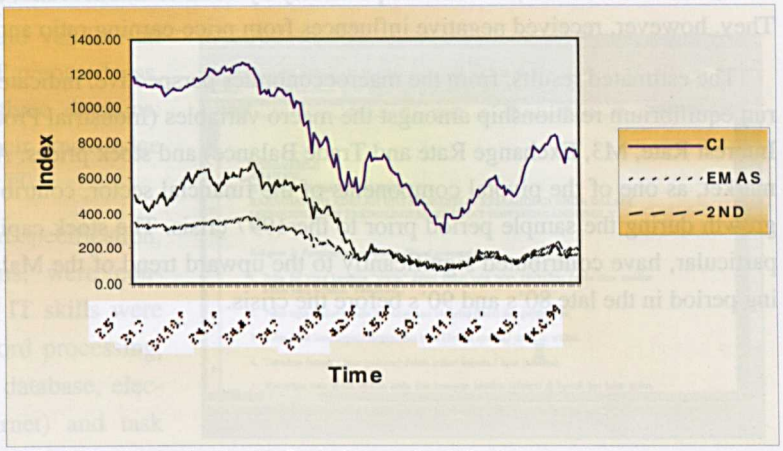


Fig. 1. Tracking volatilities in Kuala Lumpur Stock Exchange

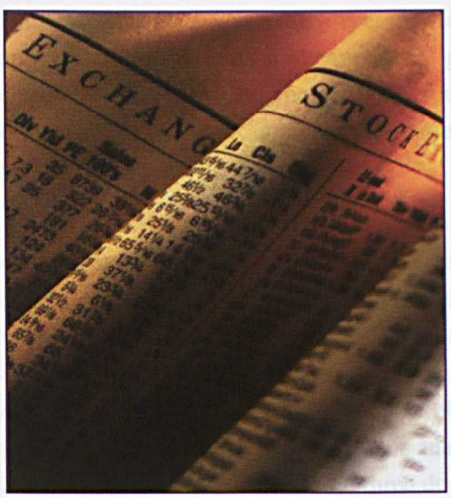


Fig. 2. Risks and returns in the stock market

The purpose of this research project was three folds. Firstly we studied the dynamic behaviour of the Malaysian stock prices and modeled its volatility via the recently developed Generalized Autoregressive Conditional Heteroskedasticity (GARCH) technique. Secondly we investigated the impact of fluctuations in stock volume traded, bid-ask spread, firm size and asset growth on the stock prices from the microeconomics perspective. Lastly we examined the causal relationships amongst the stock prices, economic growth, monetary aggregates and other important macroeconomic variables.

The methodology employed in the research include: (i)The Augmented Dickey-Fuller and Phillips-Perrons Unit Root tests to investigate the basic time-series properties the stationarity of each time series. (ii) The Johansen and Juselius Multivariate Cointegration Analysis was employed to examine the long-run equilibrium relationships amongst the variables. (iii)The volatility of variables were computed using the appropriate Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model. (iv) The influences from the macro variables to the stock market and vice-versa were investigated using the Granger-causality test under the framework of Vector Error Correction Model (VECM).

The estimated results of this project showed that there was Day-of-the-week Effect in the stock market during the sample period of 1985-1999 – Monday gave the lowest negative Returns, and Friday, followed by Wednesday, gave the highest average returns. There was also seasonality in the stock returns – the average returns for February and December were higher than the rest of the months. The excess stock returns were, at the micro level, determined positively by book-to-market ratio, trading volume and bid-ask spread. They, however, received negative influences from price-earning ratio and firm size.

The estimated results, from the macroeconomics perspective, indicated that there was a significant long-run equilibrium relationship amongst the macro variables (Industrial Product Index, Consumer Price Index, Interest Rate, M3, Exchange Rate and Trade Balance) and stock prices. According to the findings, the stock market, as one of the pivotal components of the financial sector, contributed substantially to the economic growth during the sample period prior to the 1997 crisis. The stock capitalization and trading activities, in particular, have contributed significantly to the upward trend of the Malaysian economy during the booming period in the late 80's and 90's before the crisis.

Reader Enquiry
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7640
E-mail: tanhb@putra.upm.edu.my

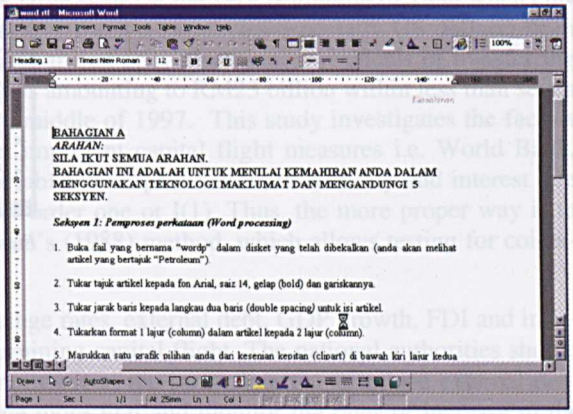
Development and Validation of an Information Technology (IT) Based Instrument to Measure Teachers' IT Preparedness



Wong Su Luan, Kamariah Abu Bakar, Ramlah Hamzah, Rohani Ahmad Tarmizi

This study attempts to develop and validate an instrument to measure teachers' IT preparedness. IT preparedness is measured in three domains: the teachers' actual IT skills, their knowledge about IT and their attitudes toward IT.

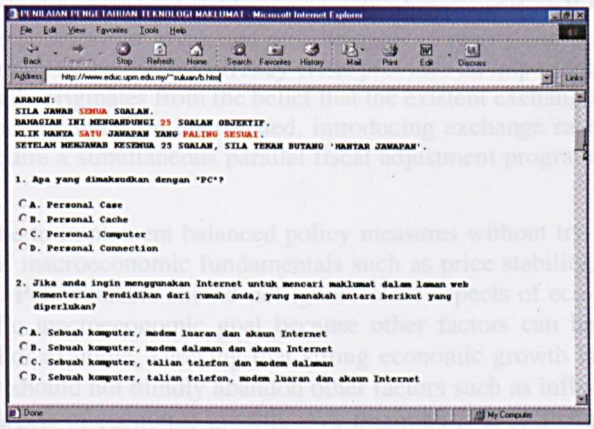
Initially, three tables of content specification, which comprised two dimensions, were constructed for each domain. Actual IT skills were measured in terms of content (word processing, electronic spreadsheet, electronic database, electronic presentation and the Internet) and task categories (basic operation, manipulation and design); knowledge about IT was measured in terms of content categories (system hardware, system software and the Internet) and Bloom's taxonomy (knowledge, comprehension and application); attitudes were measured in terms of content categories (the Internet, specific software applications, software applications in general, computer and IT in general) and four subdomains (usefulness, confidence, anxiety and aversion).


BAHAGIAN A
ARAHAN:
SILA IKUT SEMUA ARAHAN.
BAHAGIAN INI ADALAH UNTUK MENILAI KEMAHIRAN ANDA DALAM MENGGUNAKAN TEKNOLOGI MAKLUMAT DAN MENGANDUNGI 5 SEKSYEN.

Sekyen 1: Pemproses perkataan (Word processing)

1. Buka fail yang bernama "wordp" dalam disket yang telah dibekalkan (anda akan melihat artikel yang bertajuk "Petroleum").
2. Tukar tajuk artikel kepada fon Arial, saiz 14, gelap (bold) dan gariskannya.
3. Tukar jarak baris kepada langkau dua baris (double spacing) untuk isi artikel.
4. Tukarkan format 1 lajur (column) dalam artikel kepada 2 lajur (column).
5. Masukkan satu grafik pilihan anda dari koleksian keratan (clipart) di bawah kiri lajur kedua

Figure 1. Part of Section One in Part A


PENILAIAN PENGETAHUAN TEKNOLOGI MAKLUMAT - Microsoft Internet Explorer

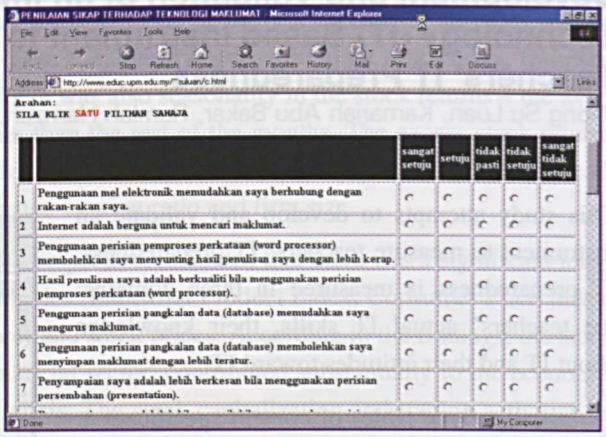
ARAHAN:
SILA JAWAB SEMUA SOALAN.
BAHAGIAN INI MENGANDUNGI 25 SOALAN OBJEKTIF.
KLIK HANYA SATU JAWAPAN YANG PALING SESUAI.
SETELAH MENJAWAB KESEMUA 25 SOALAN, SILA TEKAN BUTANG 'HANTAR JAWAPAN'.

1. Apa yang dimaksudkan dengan 'PC'?
   - A. Personal Case
   - B. Personal Cache
   - C. Personal Computer
   - D. Personal Connection
2. Jika anda ingin menggunakan Internet untuk mencari maklumat dalam laman web Kementerian Pendidikan dari rumah anda, yang manakah antara berikut yang diperlukan?
   - A. Sebuah komputer, modem luaran dan akaun Internet
   - B. Sebuah komputer, modem dalaman dan akaun Internet
   - C. Sebuah komputer, talian telefon dan modem dalaman
   - D. Sebuah komputer, talian telefon, modem luaran dan akaun Internet

Figure 2. Screen Shot of Part B's Multiple-Choice Questions

A panel of six expert judges who verified the content and task level of each item established content validity. Face validity was established when the participants claimed that the instrument seemed to measure their actual IT preparedness. Phases one and two of the study were used to analyse and revise the item pool. Items that met the difficulty, discriminant criteria (between 30% and 90%, above .30 respectively) and distractor analysis were administered in phases three and four. Factor analysis was accomplished with an option of four factors. The reliability of scores from each of the three domains (skills, knowledge and attitudes) was above .70. Two main and six minor hypotheses were tested to support construct validity. The items also showed convergent and divergent validity.

Based on the results of all tests carried out, the instrument was proven to be good. It also exhibited its ability to relate to relevant extraneous variables (gender and prior computer experience).


PENILAIAN SIKAP TERHADAP TEKNOLOGI MAKLUMAT - Microsoft Internet Explorer

Arahan:
SILA KLIK SATU PILIHAN SAHAJA

		sangat setuju	setuju	tidak pasti	tidak setuju	sangat tidak setuju
1	Penggunaan mel elektronik memudahkan saya berhubung dengan rakan-rakan saya.					
2	Internet adalah berguna untuk mencari maklumat.					
3	Penggunaan perisian pemproses perkataan (word processor) membolehkan saya menyunting hasil penulisan saya dengan lebih kerap.					
4	Hasil penulisan saya adalah berkualiti bila menggunakan perisian pemproses perkataan (word processor).					
5	Penggunaan perisian pangkalan data (database) memudahkan saya mengurus maklumat.					
6	Penggunaan perisian pangkalan data (database) membolehkan saya menyimpan maklumat dengan lebih teratur.					
7	Penyampaian saya adalah lebih berkesan bila menggunakan perisian persembahan (presentation).					

Figure 3. Screenshot of Part C's Likert Scale Items

Reader Enquiry
Department of Science and Technical Education
Faculty of Educational Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8175
E-mail: suluan@educ.upm.edu.my

Private Capital Flows from Asean Four

Zulkornain Yusop



Private capital outflows in the form of Capital flight had aggravated the intensity of the recent economic crisis as it drained the capital out of the country at the time when it was in the highest need of capital.

A classic example of capital flight took place (on a large scale) at the very beginning of 1998 when currency traders received a large volume of "buy" orders (for foreign currencies especially US dollars) from corporations in the Malaysia. The Malaysian authorities traced activities by local residents of transferring money out from the country to foreign accounts overseas amounting to RM23 billion within less than seven months since the currency crisis hit the country in the middle of 1997. This study investigates the factors affecting capital flight from Malaysia using the four important capital flight measures i.e. World Bank, Dooley, Private Claim and Cuddington. All of the variables (except inflation, uncertainty and interest rate differential) are found non-stationary i.e. integrated of order one or I(1). Thus, the more proper way is to proceed with cointegration tests by employing Johansen's (1988) method, which allows testing for cointegration in a system of equations.

Our empirical findings clearly conclude that exchange rates, external debt, GDP growth, FDI and inflation (short run estimation) are important factors determining capital flight. The national authorities should therefore ensure not only the stability of exchange rates but at the same time try to reduce external debt build-up, promote steady economic growth, encourage more FDI and monitor the rates of increase in the general price level. It is essential that the national authorities not only achieve currency stability but also strengthen the credibility of exchange rates. A seemingly strong and stable currency (perhaps superficially induced by certain macroeconomic or exchange rate policies) but weak and unsustainable in reality can be more harmful than a weak but non-manipulated currency. The recent currency crisis provides an important lesson on how the collapse of an exchange rate actually originates from the belief that the existent exchange rate is no longer sustainable. Since macroeconomic variables are interrelated, introducing exchange rate policies in order to stabilize the currency would require a simultaneous parallel fiscal adjustment program and settlement of external debt problem.

A more preferred and effective strategy would be to implement balanced policy measures without trying to concentrate only on one or certain aspects of macroeconomic fundamentals such as price stability, steady economic growth or exchange rate stability. Policymakers should not ignore other aspects of economic fundamentals in trying to achieve a specific macroeconomic goal because other factors can be equally important determinants of capital flight. For example, knowing that strong economic growth is associated with a decline in capital flight, a country should not blindly abandon other factors such as inflation and external debt in order to achieve certain targets of economic growth. We might be able to attain our targets in terms of economic growth, but if the growth is generated through heavy external financing and causing tremendous increase in the general price level, then the adverse effects of high foreign debt and inflation can result in an increase in capital flight. Overly expansionary monetary and fiscal policies in order to achieve an unrealistic growth target will only lead to widespread distortions and imbalances in the economy. Once the people see the loop-hole in the economy they start to react such that they are least exposed to any potential risk and loss.

Reader Enquiry
Department of Economics
Faculty of Economics and Management
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 7643
E-mail: zolyusop@econ.upm.edu.my

Private Capital Flows from Asean Four

Reader Enquiry
Department of Science and Technical Education
Faculty of Educational Studies
University Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia
Tel: +603 8946 8175
E-mail: salleh@educ.upm.edu.my

Appendices

Appendix 1
A glance at Research Inventions & Innovations at UPM —IRPA (RM-8) Ongoing Projects 469-527

Appendix 2
Commercialised Products, 1996-2004 529-532

Appendix 3
Products, Services and Processes Patented or Patent-pending —2003-04 533-541

Appendix 4
Awards and Prizes, 2003-04 543-561

Appendix 5
Exhibitions & Competitions, 2003-04 563-612

Appendix 6
Inaugural Lectures, 1989-2004 613-618

Appendix 7
Memoranda of Understanding (MOUs) & Memorandum of Agreement (MOAs), 1984-2004 619-626

Appendices

Appendix 1
A glance at Research Inventions & Innovations at UPM
—IRPA (RM-8) Ongoing Projects 469-527

Appendix 2
Commercialised Products, 1996-2004 529-532

Appendix 3
Products, Services and Processes Patented or Patent-pending
—2003-04 533-541

Appendix 4
Awards and Prizes, 2003-04 543-561

Appendix 5
Exhibitions & Competitions, 2003-04 563-612

Appendix 6
Inaugural Lectures, 1989-2004 613-618

Appendix 7
Memoranda of Understanding (MOUs)
& Memorandum of Agreement (MOAs), 1984-2004 619-626

A glance at Research Inventions & Innovations at UPM—IRPA (RM-8) Ongoing Projects[1]

Under RM-8, an allocation of about RM171 million for research has been approved for UPM.

Out of this, RM68.3 million for research under IRPA programme has been approved to support 416 Experimental Applied Research (EAR) projects, RM35 million for 34 Prioritised Research (PR) projects, RM57.6 million for seven Strategic Research (SR) projects, and RM9.9 million for eight Top Down National Biotechnology projects under National Biotechnology Directorate (NBD).

UPM also obtained a total of RM5.4m for 164 projects under the fundamental research between 2001 and 2004. In addition, UPM also garnered about RM24.3 million under International research grants for 21 projects, RM12.9million under other National research grants for 41 projects and RM12.7 million for 107 research projects under consultancies and contract research.

In nutshell, UPM received a total of almost RM225 million of research grants under various categories that are presented in tables 3-10 below. The figures in parenthesis quoted are the total number of projects and the amount allocated under each category.

Table 3.

Experimental Applied Research (EAR) Grants (IRPA RM-8)—2001-2004.

EAR *(416 Grants / RM68.3m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
1.	Agriculture	Abdul Ghani bin Yunus	Structural biology of the reproductive organs of some tropical fruits	AFF	01-02-04-0006 EA001	RM194,768
2.	Agriculture	Adam Bin Puteh	Inducing polyembrony through cytology and chemical techniques to increase planting material for nursery industry	SAE	01-02-04-0575-EA001	RM175,000
3.	Agriculture	Ahmad Husni bin Mohd.Hanif	Fertilization of sago palm (metroxylon sago) suckers in the nursery and production of advance planting material	AFF	01-02-04-0576-EA001	RM125,000
4.	Agriculture	Anuar Abd. Rahim	Site specific management (Precision Farming) for rice production	AFF	01-02-04-0014 EA001	RM194,000
5.	Agriculture	Azmi Abdul Rashid	In vitro culture and genetic transformation of cabbage	BAB	09-02-04-0265 EA001	RM193,820
6.	Agriculture	Che Roos Saad	The Biology and culture of horseshoe Crab Carcinoscorpius rotundicauda	AFF	01-02-04-0864 EA001	RM156,000

[1] *Data in chronological order sorted by Faculty and Name. (as of April 2004).*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
7.	Agriculture	Christopher Teh Boon Sung	Modelling the oil palm growth and its micro	AFF	01-02-04-0686-EA001	RM131,500
8.	Agriculture	Ghizan Bin Saleh	Breeding Of Grain Mize Hybrids For tolerence To Acid Soils	AFF	01-02-04-0491 EA001	RM197,000
9.	Agriculture	Ghizan Bin Saleh	Breeding of sweet corn hybrids for yields, quality and adaptation	AFF	01-02-04-0025 EA001	RM106,000
10.	Agriculture	Halimatun Yaakub	The utilisation of salts of saturated and unsaturated fatty acids as sources of energy in lactating goats	AFF	01-02-04-0713-EA001	RM198,760
11.	Agriculture	Halimi Bin Mohd. Saud	Development of effective microbial biofertilizers for yield improvement of high value vegetable crops grown on soilles, organic and conventional culture system	AFF	01-02-04-0028 EA001	RM237,800
12.	Agriculture	Hiryati binti Abdullah	Development of disease-suppressive compost for control of bacterial wilt of tomato	AFF	01-02-04-0031 EA001	RM206,000
13.	Agriculture	Hor Yue Luan	Cryopreservation of rattan (calamus spp.) seeds in liquid nitrogen for germplasm conservation	AFF	01-02-04-0035 EA001	RM74,000
14.	Agriculture	Hor Yue Luan	Conservation of genetic resources of oil palm (Elaeis guineensis Jacq.) in liquid nitrogen using the vitrification technique	BAB	01-02-04-0036 EA001	RM74,000
15.	Agriculture	Ismail Idris	Cytogenetic Evaluation of the Malaysian Gaur and the Gaur X Cattle Crossbreds	AFF	01-02-04-0861 EA001	RM149,000
16.	Agriculture	Ismail Idris	Crossbreeding of deer for commercialization	AFF	01-02-04-0038 EA001	RM247,000
17.	Agriculture	Jothi Malar Panandam	Genetic Characterization of Deer Species in Malaysia	AFF	01-02-04-0832-EA001	RM189,000
18.	Agriculture	Jugah Kadir	Development of Exserohilu. Sp. as Bioherbicide for Controlling Barnyard Grass (Echinocloa spp) Complex in Rice Field in Malaysia	AFF	01-02-04-0786-EA001	RM131,000
19.	Agriculture	Kamaruzaman Sijam	Development of Biopesticide for the Control of Seedborne Pathogen of Oil Palm	AFF	01-02-04-0860 EA001	RM123,000
20.	Agriculture	Kamaruzaman Sijam	Bacterial plant disease management through rapid detection and sustainable control measures	AFF	01-02-04-0394 EA001	RM150,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
21.	Agriculture	Liang Juan Boo	Anti-nutritive Factors in Common Tropical Legumes Forages	AFF	01-02-04-0055 EA001	RM176,000
22.	Agriculture	Loh Teck Chwen	Minimising nitrogen excretion in swine by dietary manipulation	BAB	01-02-04-0395 EA001	RM177,200
23.	Agriculture	Mad Nasir Shamsudin	Efficiency Analysis of Rice Production and Distribution system	EAM	05-02-04-0197 EA001	RM159,000
24.	Agriculture	Maheran Abd. Aziz	In Vitro propagation of Nymphaea spp. and other commercilly important aquatic plants	AFF	01-02-04-0060 EA001	RM235,000
25.	Agriculture	Maheran Abd. Aziz	Somatic embryogenesis and plant regeneration from immature male flowers of local banana cultivars	BAB	09-02-04-0430 EA001	RM170,000
26.	Agriculture	Mahmud bin Tengku Muda Mohamed	Development and production of locally produced Chitosan base postharvest treatments for extending storage life of fruits (Papaya and Banana) and cut flowers (Chrysanthemum and Orchids)	AFF	01-02-04-0061 EA001	RM170,000
27.	Agriculture	Mihdzar Abdul Kadir	In vitro mass propagation of pineapple varieties 'Josapine and Sarawak"	AFF	09-02-04-0442 EA001	RM148,000
28.	Agriculture	Mohamed Hanafi bin Musa	Identification and Evaluation of Upland Rice Variety for Cultivation on Selected Idle Land	AFF	01-02-04-0834-EA001	RM185,000
29.	Agriculture	Mohamed Hanafi bin Musa	Development of the fertigation technique for pineapple production on sandy soil	AFF	01-02-04-0067 EA001	RM199,500
30.	Agriculture	Mohd. Fauzi Ramlan	Evaluation of light harvesting mechanism of rice varieties and its implication on yield	AFF	01-02-04-0087 EA001	RM197,000
31.	Agriculture	Mohd. Ghazali Mohayidin	Knowledge Management and Business Intelligence Strategies in Malaysian Universities	EAM	07-02-04-0812-EA001	RM158,000
32.	Agriculture	Mohd. Khanif Yusop	Soil management for low water input rice culture	AFF	01-02-04-0078 EA001	RM217,000
33.	Agriculture	Mohd. Razi Ismail	Regulated irrigation and root pruning on flower and fruit development of mango, dokong and mangosteen plants	AFF	01-02-04-0518 EA001	RM185,000
34.	Agriculture	Mohd. Razi Ismail	Precise control of irrigation, nutrition and microclimate for high value vegetables in soilless culture using automation and computer control	AFF	01-02-04-0082 EA001	RM156,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
35.	Agriculture	Mohd. Ridzwan Abd. Halim	Commercial production of a complete rice straw -based feed for intensive ruminant production	AFF	01-02-04-0083 EA001	RM255,000
36.	Agriculture	Mohd. Yusof Hussein	Enhancing biological control of Asiatic corn borer through habitat and vegetative diversification	AFF	01-02-04-0400 EA001	RM142,000
37.	Agriculture	Radziah binti Othman	Enhancement of sweet potato quality through combined application of bacteria and arbuscular mycorrhiza on organically amended soil	AFF	01-02-04-0097 EA001	RM191,000
38.	Agriculture	Radziah binti Othman	Improved yield of onion (Allium ascolonium) through combined inoculation with rhizobacteria and arbuscular mycorrhiza	BAB	01-02-04-0098 EA001	RM126,000
39.	Agriculture	Rita Mohamad	Development of resistance in the cocoa mirid Helopeltis theivora	AFF	01-02-04-0101 EA001	RM150,400
40.	Agriculture	Rosenani binti Abu Bakar	Improvement of production system for organic leafy and fruit vegetables	AFF	01-02-04-0104 EA001	RM135,880
41.	Agriculture	Rosenani binti Abu Bakar	Low input fertilization management to enhance soil productivity and grain corn yields	AFF	01-02-04-0103 EA001	RM291,000
42.	Agriculture	Rosli Mohamad	The effect of herbicides on performance of vesicular arbuscular mycorrizhal fungi	AFF	01-02-04-0687-EA001	RM121,000
43.	Agriculture	Saleh bin Kadzimin	In Vitro propagation and conservation of indigenous orchid species	AFF	09-02-04-0448 EA001	RM127,000
44.	Agriculture	Sariah Meon	Development of an effective formulation technology and delivery of biocontrol agents for the control of soil-borne diseases	BAB	01-02-04-0109 EA001	RM199,000
45.	Agriculture	Shamshuddin bin Jusop	Alleviation of acid soil infertility in the Kemasin- Semarak IADP for rice cultivation	AFF	01-02-04-0111 EA001	RM147,000
46.	Agriculture	Shamshuddin bin Jusop	Ameloration of soil acidity using organic-based fertilizers and natural silicate for cocoa growth	AFF	01-02-04-0503 EA001	RM150,000
47.	Agriculture	Sharifah Kharidah Syed Muhammad	Development of Hydrolysed Vegetable Protein from Winged Bean	AFF	03-02-04-0416 EA001	RM65,240
48.	Agriculture	Siti Hajar Ahmad	Improvement of commercial ripening technology of Cavendish banana	AFF	01-02-04-0115 EA001	RM196,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
49.	Agriculture	Siti Zauyah Darus	Accumulation Of Heavy Metal Residues In Leafy And Root Vegetables Grown On Different Soil Types In Johor	AFF	01-02-04-0490 EA001	RM180,000
50.	Agriculture	Siti Zauyah Darus	Distribution of heavy metals and polyaromatic hydrocarbon in the estuarine ecosystem along the Larut-matang to Krian coastline, Perak	MEE	01-02-04-0118 EA001	RM185,000
51.	Agriculture	Syed Omar Syed Rastan	Control of "Padi Angin" (Weedy Rice) infestation using growth regulators and anaerobic direct seeding techniques	AFF	01-02-04-0402 EA001	RM199,000
52.	Agriculture	Thohirah Abdullah	Commercial environment-controlled production of indigenous ornamental zingibers for potted and cut-flower production	AFF	01-02-04-0517 EA001	RM166,000
53.	Agriculture	Zaharah Abdul Rahman	Sustainable grain maize production in agroferestry system	AFF	01-02-04-0126 EA001	RM175,620
54.	Agriculture	Zainal Abidin Mior Ahmad	Studies on Cladosporium-Phyllosticta foliar disease complex in banana of improved management	BAB	01-02-04-0127 EA001	RM101,000
55.	Agriculture	Zainal Aznam Mohd Jelan	Development of Foliage Protein Meal For Ration of Meal Goat	AFF	01-02-04-0862 EA001	RM172,000
56.	Agriculture	Zakaria bin Wahab	Selection and characterization of maize genotypes for water stress (drought) tolerance	AFF	01-02-04-0129 EA001	RM168,000
57.	Agriculture	Zulkifli Hj. Shamssuddin	Enhancement In Yield Of Oil Palm Inoculated With Plant Growth Promoting Rizobacteria (PGPR)	AFF	09-02-04-0497 EA001	RM270,000
58.	Agriculture	Zulkifli Idrus	Alleviation of heat stress related problems in broiler chickens through nutritional manipulation	AFF	01-02-04-0405 EA001	RM167,000
59.	Computer Science and Information Technology	Abdul Azim b. Abd Ghani	The Development of Web-Based Software Certification Model	ITM	04-02-04-0175 EA001	RM225,000
60.	Computer Science and Information Technology	Abu Bakar Md. Sultan	Hybrid Genetic Algorithm for University Class Timetabling	ITM	04-02-04-0802-EA001	RM109,000
61.	Computer Science and Information Technology	Hamidah Ibrahim	Semantic Intergrity Constraints Maintenance for Parallel Database Systems	ITM	04-02-04-0797-EA001	RM167,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
62.	Computer Science and Information Technology	Mohd. Hasan b. Selamat	Knowledge Management in Collaborative Environment	ITM	04-02-04-0182 EA001	RM231,000
63.	Economics & Management	Abu Sofian bin Yaacob	Study of the effectiveness and compliance on critical areas in self-assessment tax system	EAM	05-02-04-0189 EA001	RM77,040
64.	Economics & Management	Ahmad Zainuddin Abdullah	Sunk Cost, entry and exit barriers in selected manufacturing industry	EAM	05-02-04-0531 EA001	RM107,000
65.	Economics & Management	Ahmad Zubaidi Baharumshah	Trade, Current Account and the Exchange Rates in Asian 6 Economies (Singapore, Thailand, Malaysia, Philippines, Indonesia and Korea).	EAM	05-02-04-0532-EA001	RM150,260
66.	Economics & Management	Alias bin Radam	Performance of Malaysia food manufacturing industries	AFF	05-02-04-0420 EA001	RM129,397
67.	Economics & Management	Annuar Md Nasir	Business Failure Prediction Model In Malaysia : An Empirical Analysis	EAM	05-02-04-0191 EA001	RM71,840
68.	Economics & Management	Azali Mohamed	Asian Economic Integration	EAM	05-02-04-0192 EA001	RM198,850
69.	Economics & Management	Huson Joher Aliahmed	Choice of Quality Differentiated Audit Firms: Further Evidence on Analysis of Determinants and Wealth Effect	SSH	05-02-04-0421 EA001	RM42,000
70.	Economics & Management	Kenny Teoh Guan Cheng	To buy local; or to buy foreign. Application of Structured Equation Modelling and Neural Networks to the development of a Consumer Ethnocentrism Scale for Malaysia.	EAM	05-02-04-0195 EA001	RM92,900
71.	Economics & Management	Khalid Abdul Rahim	Trade-Related Application of Economic Instruments for Environmental Protection: The Case of Malaysian Small and Medium Scale Industries	EAM	05-02-04-0196 EA001	RM124,600
72.	Economics & Management	Mohammed bin Yusoff	Trade Balance and Exchange Rate: Evidence from ASEAN	EAM	05-02-04-0199 EA001	RM108,120
73.	Economics & Management	Mohd. Kamel Idris	The Mechanics of Employer-employee Relations Towards Sustainable productivity; A study in Malaysian Manufacturing Sector	EAM	05-02-04-0200 EA001	RM112,500
74.	Economics & Management	Murali Sambasivan	Algorithms/Solution Techniques for Solving Multi-Plant, Multi-Item, and Multi-Period Production Planning and Distribution Problems With Inter-Plant Transfers	AFF	09-02-04-0329 EA001	RM39,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
75.	Economics & Management	Muzafar Shah Habibullah	Monetary services index (MSI), monetary policy effectiveness and economic activity	EAM	05-02-04-0201 EA001	RM176,800
76.	Economics & Management	Salleh Yahya	Measuring Customer satisfaction in Banking, Manufacturing and retailing	EAM	05-02-04-0204 EA001	RM101,200
77.	Economics & Management	Samsinar Md Sidin	The Patterns and Role Structure in Family Decision Making	SSH	05-02-04-0205 EA001	RM98,040
78.	Economics & Management	Shamsher Mohamad	Risk-adjusted Performance of Unit Trust Funds in Malaysia	EAM	05-02-04-0206 EA001	RM57,840
79.	Economics & Management	Tan Hui Boon	Human Capital, Productivity, Innovation and Growth: A Transition to K-Economy	SSH	05-02-04-0207 EA001	RM93,800
80.	Economics & Management	Zakariah b. Abdul Rashid	Technological Obsolescence and Structural Change- the Role of Relative Prices in Affecting Technological Change in Malaysia	SSH	05-02-04-0208 EA001	RM143,792
81.	Economics & Management	Zulkornain Yusop	Private Capital Inflow into the Selected ASEAN countries	EAM	05-02-04-0209 EA001	RM96,300
82.	Educational Studies	Ab.Rahim Bakar	The role of vocational and technical education in workforce preparation: An assessment of the workplace skills desired by employers, acquired by students and taught by vocational and technical education institutions	SSH"	07-02-04-0726-EA001	RM159,440
83.	Educational Studies	Aida Suraya Md Yunus	Development of Indicators as compliment to current For University Entrance Requirement	SSH	07-02-04-0537 EA001	RM226,000
84.	Educational Studies	Aminah Ahmad	Consequences of Interrole Conflict among Employed Parents	SSH	07-02-04-0223 EA001	RM139,980
85.	Educational Studies	Aminuddin Hussin	Continous flow nutrient trunk intusion, efficient and environment friendly fertilizing procedure for oil palm (Elais guineensis Jacq)	AFF	01-02-04-0506 EA001	RM178,000
86.	Educational Studies	Azimi bin Hamzah	Religiosity and Personality Development Index: Application for Nation Building	SSH	07-02-04-0225 EA001	RM135,180
87.	Educational Studies	Habsah Ismail	Congruency of Teachers' Belief and Practices	SSH	07-02-04-0535 EA001	RM155,000
88.	Educational Studies	Kamariah Abu Bakar	Designing and Delivering Online Lifelong Learning Among the Working Adults in Selected Malaysian and Private Organizations	SSH	07-02-04-0536-EA001	RM193,587

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
89.	Educational Studies	Mohd. Majid Konting	Teacher's Beliefs and Craft Knowledge of Good Practises in The Primary School Classroom	SSH	07-02-04-0732-EA001	RM196,600
90.	Educational Studies	Mokhtar Nawawi	Enhancing Mathematics Learning for Lower Secondary School Student Using Multimedia Mathematics Courseware	SSH	07-02-04-0843-EA001	RM146,800
91.	Educational Studies	Rahil Hj. Mahyuddin	Diagnosis of Children's Basic Skills Acquisition	SSH	07-02-04-0844-EA001	RM133,000
92.	Educational Studies	Sharifah Md. Nor	An Examination of Teaching Practices, Learning Needs and Climate of At-Risk Students	SSH	07-02-04-0846-EA001	RM279,960
93.	Educational Studies	Soh Kim Geok	Somatotype and anthropometrik measurement comparison among Malaysia netball and basketball players	SSH	07-02-04-0810-EA001	RM56,280
94.	Educational Studies	Zaidatol Akmaliah Lope Pihie	Evaluation Teaching and Learning In Business Using Service Quality Factors	SSH	07-02-04-0538 EA001	RM197,290
95.	Engineering	Abdel Magid Hamouda	Design And Fabrication of A Bullet Proof Vest Using A Hybrid Composite Material System.	MEE	03-02-04-0494 EA001	RM245,000
96.	Engineering	Abdel Magid Hamouda	Damage Management of Sheet Metal Forming using Virtual Manufacturing	SAE	03-02-04-0407 EA001	RM168,640
97.	Engineering	Abdul Aziz Abdul Samad	Development of Embedded Smart Sensors using Fibre Bragg Gratings and their performance I Real-time Monitoring of Prototype Structures	SAE	03-02-04-0136 EA001	RM127,000
98.	Engineering	Abdul Aziz Abdul Samad	Development of Expert System for Distress	SAE	03-02-04-0137 EA001	RM201,000
99.	Engineering	Abdul Aziz Jaafar	Mathematical model and algorithm development for the flow and heat transfer on film-cooled turbine blades	MEE	09-02-04-0616-EA001	RM188,500
100.	Engineering	Abdul Ghani Liew Abdullah	Formulation and Evaluation of Polyelectroltyte from Moringa oleifera Seeds on Its Preservation and Effectiveness as Coagulant and Goagulant Aid	SAE	09-02-04-0848-EA001	RM149,000
101.	Engineering	Abdul Rahman Ramli	Development of Real-time Data Acquisition and Remote Monitoring System	SAE	09-02-04-0257 EA001	RM84,500
102.	Engineering	Abdul Rashid bin Mohamed Shariff	Image Analysis of Oil Palm Fruitslets	SAE	01-02-04-0513-EA001	RM157,160

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
103.	Engineering	Anvar A. Ashrabor	Development of High-Performance Concrete Using Local Materials Subjectived to Tropical Environment	MEE	03-02-04-0138 EA001	RM134,600
104.	Engineering	Ashraf Ali Omar	Mathematical Modeling of Fluid flow Through High Lift Devices	SAE	09-02-04-0433 EA001	RM185,000
105.	Engineering	Ashraf Gasim Eisid Abdalla/Borhanudd in Mohd. Ali	Development of Air Interface based Technologies on Reprogrammable hardware for Access Point in the next Generation Wireless Networks	ITM	04-02-04-0179 EA001	RM185,000
106.	Engineering	Azni Idris	Advanced oxidation using electro-chemical activation and uv radiation for the destruction of toxic and hazardous wastes	MEE	03-02-04-0139 EA001	RM218,000
107.	Engineering	Badronnisa Yusof	Modelling the effects of vegetation growth on the hydraulic performance and the water quality in a tropical river system.	SAE	08-02-04-0611-EA001	RM212,000
108.	Engineering	Budiatman Satiawihardja	Production of mono/di-acylglycerols by enzymatic esterification process in developed packed bed bioreactor from palm oil fatty acid distillate using lipase of rice bran and oil palm mesocarp	MEE	09-02-04-0906 EA001	RM112,000
109.	Engineering	Bujang Bin Kim Huat	Deformation and Shear Strenght Characteristics and Index Properties of Peat and Organic Soils with Variable Fiber and Organic Contant	SAE	09-02-04-0434 EA001	RM115,500
110.	Engineering	Bujang Kim Huat	Deep Stabilization Methods for Improvement of Peat Soils	MEE	09-02-04-0870 EA001	RM132,000
111.	Engineering	Chuah Teong Guan	Process simulation and modelling of rigid ceramic filter for high temperature gas cleaning industrial application	SAE	09-02-04-0702-EA001	RM142,000
112.	Engineering	Dadang Mohamad Masoem	The development of Malaysian Traffic Injury Surveillance Information System for Analyzing The Relative Road Accident	ITM	09-02-04-0750-EA001	RM153,640
113.	Engineering	Dayang Laila Abang Haji Abdul Majid	Structural Optimization of Aeroelastically Tailored Composite Wing	SAE	09-02-04-0899 EA001	RM129,000
114.	Engineering	Desa Ahmad	Development of Hybrid Photovoltaic System for Tropical Greenhouse Cooling	SAE	09-02-04-0873 EA001	RM189,400
115.	Engineering	Faizal Mustapha	A Knowledge based approach on troubleshooting aircraft engine and parts for Air Wing Unit (UUP-PDRM)	SAE	09-02-04-0543 EA001	RM144,620

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
116.	Engineering	Fakhru'l-Razi Ahmadun	Synthesis of high performance environmental friendly biodegradable lubricants from vegetable oils	AFF	03-02-04-0145 EA001	RM249,000
117.	Engineering	Husaini Omar	The strength measuring device for soils and pavement materials	SAE	03-02-04-0409 EA001	RM132,000
118.	Engineering	Iyuke Sunny Esayegbemu	Innovative environmental friendly and cyanide free cassava flour processing in bioreactor and adsorber systems	MEE	09-02-04-0437 EA001	RM152,100
119.	Engineering	Jamaloddin Noorzaei	Sructural Behavior of Hihg Concrete Faced Rockfill Darms	SAE	09-02-04-0751-EA001	RM172,000
120.	Engineering	Ling Tau Chuan	The development of rapid and selective technique for the direct recovery of intracellular proteins from bakers' yeast	SAE	09-02-04-0621-EA001	RM200,100
121.	Engineering	Md.Liakot Ali	Development of an FPGA-based SoC For Low Cost IC Testing	SAE	09-02-04-0829-EA001	RM178,000
122.	Engineering	Medyan Riza	Synthesis and Characterisation of and advance polymer for use as a barrier packaging	MEE	09-02-04-0703-EA001	RM154,500
123.	Engineering	Megat Johari Megat Mohd. Noor	Design and Development of Membrane Bioreactor for Treating High Strength Municipal Wastewater.	MEE	09-02-04-0441 EA001	RM172,160
124.	Engineering	Mohamad Khazani Abdullah	A Self-healing Dense Wavelength Division Multiplexing Transport Network.	SAE	04-02-04-0876 EA001	RM96,500
125.	Engineering	Mohamed Daud	Intelligent Spatial Knowladge-based System for Risk Assessment, Risk Management and Response to Crisis	EAM	08-02-04-0425 EA001	RM149,600
126.	Engineering	Mohammad Nizam Filipski Abdullah	Micro-Satelite Attitude Control System Design and Simulation	SAE	09-02-04-0443 EA001	RM105,626
127.	Engineering	Mohd. Amin Mohd. Soom	Modeling paddy soil and water parameters for precision farming of rice	AFF	01-02-04-0070 EA001	RM145,000
128.	Engineering	Mohd. Halim Shah Ismail	Design and development of novel heat penetration technique for sterilisation process in palm oil mills	SAE	09-02-04-0321 EA001	RM199,000
129.	Engineering	Mohd. Saleh Jaafar	Prediction of Durability Characteristic of Distressed Concrete Structures Through Mathematical Modelling using NDT Data	SAE	03-02-04-0152 EA001	RM171,600

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
130.	Engineering	Mohd. Sapuan Bin Salit @ Sinon	Concurrent engineering manufacturing system of polymeric based composite automative pedal box	MEE	09-02-04-0323 EA001	RM99,080
131.	Engineering	Napsiah Ismail	Development of Intelligent Process Planning System for Tool and Die Industry	SAE	09-02-04-0825-EA001	RM173,900
132.	Engineering	Nasrullah Khan	Design of InGaN based blue semiconductor laser	MEE	09-02-04-0704-EA001	RM170,760
133.	Engineering	Nasrullah Khan	Design of an intelligent interface for mechanical relays	SAE	09-02-04-0625-EA001	RM157,500
134.	Engineering	Prasetyo Edi	Aerodynamic Design and Technology Concepts for an Unmanned Aerial Vehicle (UAV)	SAE	09-02-04-0901 EA001	RM156,160
135.	Engineering	Prithvi Raj Arora	Fretting fatigue characterisation of 7075-T6, Ti-6Al-4V, and BS L65 aerospace aluminium alloys and its applications to aerospace industry	MEE	09-02-04-0446 EA001	RM175,000
136.	Engineering	Prithvi Raj Arora	Design, development and force analysis of six component external balance for aerospace wind tunnel applications	SAE	09-02-04-0635-EA001	RM161,500
137.	Engineering	Radin Umar Radin Sohadi	Design and Development of Motorcycle Barrier System	SAE	09-02-04-0830-EA001	RM158,200
138.	Engineering	Ratna Kalos Zakiah Sahbudin	Development and impementation of home using bluetooth technology	ITM	04-02-04-0689-EA001	RM133,000
139.	Engineering	Rimfiel Janius	Spectral Mapping For Quality Index Development For Stafruits	SAE	09-02-04-0902 EA001	RM195,000
140.	Engineering	Robiah Yunus	Formulation of Natural Systhetic Lubricant for Hydraulic Fluids	MEE	09-02-04-0856-EA001	RM112,000
141.	Engineering	Rosely Ab. Malik	Development of Automated Rapid Soil Moisture Content Determination Equiptment Using Pulse Infra Red Technology.	SAE	03-02-04-0412 EA001	RM198,100
142.	Engineering	Roslina Mohd. Sidek	Design of Floating-Gate MOSFET for Low Voltage Analog Integrated Circuits	SAE	09-02-04-0617-EA001	RM193,000
143.	Engineering	Rosnah Mohd Yusuff	Development of a Diagnostic tool to measure Manufacturing Best practices in the SMIs of Malaysia	ITM	04-02-04-0879 EA001	RM103,000
144.	Engineering	Sa'ari bin Mustapha	Development of a GIS Tool For Monitoring Risk Potential of Hazard Installations	SAE	09-02-04-0340 EA001	RM166,500

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
145.	Engineering	Sabira Khatun	Development Of A Software-Radio-Based Wireless Terminal Adapter For 3G/4G Systems	ITM	04-02-04-0186 EA001	RM248,000
146.	Engineering	Salihudin Hassim	Material Characterization for Road Construction in Malaysia	SAE	03-02-04-0413 EA001	RM187,000
147.	Engineering	Salim Said	Development of a decision support system and water management techniques for rice and maize	AFF	08-02-04-0251 EA001	RM85,000
148.	Engineering	Senan Mahmod Abdullah	Automatic Semiconductor Tap Changer for Power Transformers	MEE	09-02-04-0764-EA001	RM76,920
149.	Engineering	Shamsuddin Bin Sulaiman	Development and Analysis of Casting Product using Network Method of Flow and Solidification Process.	SAE	03-02-04-0415 EA001	RM168,000
150.	Engineering	Shattri Mansor	Development of an Integrated Monitoring System for Natural and Environmental Disaster Management	MEE	09-02-04-0346 EA001	RM183,000
151.	Engineering	Sudhanshu S. Jamuar	Design and development of flickemeter and calibration test system	SAE	09-02-04-0761-EA001	RM238,000
152.	Engineering	Syed Javaid Iqbal	Design and Construction of Eye Safe Laser Range Finder/Speed Detector Using 1550 mm Fiber Laser	SAE	03-02-02-0522-EA001	RM146,500
153.	Engineering	Tan Ka Kheng	Theory and Simulations of Fluidized beds	SAE	09-02-04-0453 EA001	RM126,000
154.	Engineering	Tan Ka Kheng	Development of aTheory and enhancement of liquid-expanded columns for process industries	SAE	09-02-04-0708-EA001	RM174,000
155.	Engineering	Tang Sai Hong	Characterisation, Optimisation and Simplification of Computer-Controlled Robotic Systems.	SAE	09-02-04-0545 EA001	RM142,500
156.	Engineering	Tey Beng Ti	Apoptosis (Programmed Cell Death) In Animal Cell Cultures Used for the Production of Biopharmaceuticals.	AFF	09-02-04-0454 EA001	RM201,000
157.	Engineering	Tey Beng Ti	Production and purification of recombinant Hepatitis B virus nucleocapsid	HAS	09-02-04-0766-EA001	RM199,000
158.	Engineering	Thamer Ahmed Mohammed	Development of Bio-composite interlocking block system for river revetment	SAE	09-02-04-0767-EA001	RM157,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
159.	Engineering	Thomas Choong Shean Yaw	Development of a comprehensive software for the design of pressure swing adsorption processes for chemical and process industries	SAE	09-02-04-0359 EA001	RM86,000
160.	Engineering	Thomas Choong Shean Yaw	Convergence acceleration for the calculation of cyclic steady state for the design of pressure swing adsorption for chemical and process industries.	SAE	09-02-04-0622-EA001	RM199,600
161.	Engineering	Waleed Abdul MalikThanoon	The Development of Ferrocement Brick Composite Floor Panel for Low Cost Housing	SAE	03-02-04-0417 EA001	RM185,600
162.	Engineering	Wan Ishak bin Wan Ismail	Design and development of on-line computer control bio-production robot for smart farming	MEE	09-02-04-0364 EA001	RM125,000
163.	Engineering	Wong Shaw Voon	Development of dynamic simulation solver with novel object-oriented approach for nonlinear metal forming	SAE	09-02-04-0623-EA001	RM172,000
164.	Engineering	Yousif A. Khalid	Experimental and Finite Element Analysis of the Pressure Carrying Capacity for Reinforced Composite Material Tubes.	MEE	09-02-04-0824-EA001	RM98,000
165.	Engineering	Zainuddin Md Yusoff	Design and Development of Device to measure weathering rate of granitic rocks	MEE	03-02-04-0174 EA001	RM181,080
166.	Engineering	Zairil Azhar Zaludin	Controlling a high trust automatic ariel vehicle for agriculture based activities-using a low cost autopilot system	SAE	09-02-04-0770-EA001	RM110,600
167.	Engineering	Zairil Azhar Zaludin	Ariel Reconnaisance Vehicle for Military Surveillance with 24 hour Operation Cycle	SAE	09-02-04-0618-EA001	RM150,500
168.	Food Science and Biotechnology	Azizah Osman	Establishment and Improvement of Post-harvest Physiological Disorders of Local Dessert Bananas	AFF	01-02-04-0015 EA001	RM223,000
169.	Food Science and Biotechnology	Badlishah Sham Baharin	Separation of Vitamin E from Palm Fatty Acid Distillate Using Adsorption Column Chromatography	BAB	03-02-04-0141 EA001	RM298,700
170.	Food Science and Biotechnology	Clemente Michael Wong Vui Ling	Cloning and characterisation of Novel Phytase Genes from Mitsuokella sp.	BAB	01-02-04-0390 EA001	RM128,000
171.	Food Science and Biotechnology	Clemente Michael Wong Vui Ling	Characterization of The 2u Plasmid of Saccharomyces cerevisiae and Construction of a High Copy Number Expression Plasmid	SAE	09-02-04-0271 EA001	RM84,920

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
172.	Food Science and Biotechnology	Foo Hooi Ling	Utilisation of lactic acid bacteria isolated from Local Foods	BAB	01-02-04-0584-EA001	RM123,600
173.	Food Science and Biotechnology	Hasanah Mohd. Ghazali	Production of High Amylose Starch Through Modification of the Properties of Sago and Other Local Starches Using Pullulanase	BAB	09-02-04-0436 EA001	RM170,000
174.	Food Science and Biotechnology	Jamilah Bakar	The development of shelf stable frozen fish-based convenient products	AFF	03-02-04-0688-EA001	RM186,400
175.	Food Science and Biotechnology	Jennifer Ann Harikrishna/Ho Chai Ling	Development of Expressed Sequence Tags from mangrove for future use in rice breeding	AFF	01-02-04-0042 EA001	RM93,256
176.	Food Science and Biotechnology	Jennifer Ann Harikrishna/Ho Chai Ling	Isolation of slinity tolerance genes from mangrove plants	BAB	09-02-04-0291 EA001	RM112,756
177.	Food Science and Biotechnology	Jinap Selamat	Development of Fat Bloom Resistance Chocolates Containing Processed Palm Oil	AFF	03-02-04-0410 EA001	RM170,000
178.	Food Science and Biotechnology	Kulaveerasingam Harikrishna	The transformation of oil palm with flowering genes	AFF	01-02-04-0044 EA001	RM115,256
179.	Food Science and Biotechnology	Lai Oi Ming	Enzymatic synthesis of Ferulyl-Substituted Acylglycerols for sunscreen formulation	BAB	01-02-04-0054 EA001	RM152,000
180.	Food Science and Biotechnology	Lai Oi Ming	The Development of Filter Aids and Enzyme Immobilization Carriers from Cheap Silica Sources	SAE	09-02-04-0301 EA001	RM107,000
181.	Food Science and Biotechnology	Mohd. Ali Hassan	Bioconversion of Food Wastes to Environmental Friendly Biodegradable Packaging Materials	MEE	08-02-04-0246 EA001	RM158,000
182.	Food Science and Biotechnology	Mohd. Ali Hassan	Bioremediation of selected lignocellulosic wastes with local beneficial fungi	MEE	08-02-04-0542 EA001	RM175,000
183.	Food Science and Biotechnology	Mohd. Yazid Abd. Manap	Bile Salt Hydrolase (BSH) from Bifidobacterium Pseudodatenulatum G4: Its Potential Uses as an Antihyper-Chcolesterolemia	BAB	09-02-04-0445 EA001	RM150,000
184.	Food Science and Biotechnology	Mohd. Yazid Abd. Manap	Suppressive Effect of Selected Prebiotic and Probiotic Bacteria on Generation of Volatile Methanethiol	BAB	09-02-04-0558 EA001	RM173,000
185.	Food Science and Biotechnology	Nazamid Saari	Production of Shelf-Stable Chilli Puree	AFF	01-02-04-0648-EA001	RM102,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
186.	Food Science and Biotechnology	Nazimah Sheikh Abdul Hamid	Production of Dried Tropical Fruit Powders Using Spray Drying and Agglomeration Technology	AFF	03-02-04-0156 EA001	RM241,690
187.	Food Science and Biotechnology	Nazimah Sheikh Abdul Hamid	Production of Shelf Stable Tropical Fruit Purees and Concentrates Through Physical and Enzymatic Modifications.	AFF	01-02-04-0789-EA001	RM205,000
188.	Food Science and Biotechnology	Norihan Mohd. Salleh	Induction of Calli and hairy roots for selected Malaysian herbs for secondary metabolites production	AFF	09-02-04-0552 EA001	RM270,000
189.	Food Science and Biotechnology	Quek Siew Young	Development of Novel Durian-based Products and Their Flavour Characterization During Processing and Storage	AFF	03-02-04-0159 EA001	RM196,000
190.	Food Science and Biotechnology	Raha Abdul Rahim	Development of Nisin Inducible Expression Vector in Lactococcus	BAB	09-02-04-0334 EA001	RM198,000
191.	Food Science and Biotechnology	Raha Abdul Rahim	Construction of Local Lactococcus Recombinant Vaccine Against Cholera	BAB	09-02-04-0335 EA001	RM229,000
192.	Food Science and Biotechnology	Roselina Karim	Development of Frozen Dough Based for Traditional Malaysian Cakes	AFF	03-02-04-0161 EA001	RM263,700
193.	Food Science and Biotechnology	Rosfarizan Mohamad	Utilisation of Fed-batch fermenter for high densitiy cell cultivation of beneficial bacterium (Bacillu subtilis) for aquaculture industry	AFF	09-02-04-0337 EA001	RM192,680
194.	Food Science and Biotechnology	Rosfarizan Mohamad	Development of fed batch fermentation process for improvement of phytase production by Aspergillus ficuum	MEE	09-02-04-0706-EA001	RM158,500
195.	Food Science and Biotechnology	Russly Abdul Rahman	Application of Vacuum Processiang and Cook-chilled Technology for the Production of Savoury-rice Meals	AFF	03-02-04-0163 EA001	RM231,952
196.	Food Science and Biotechnology	Salmah Yusof	Enchancement of Quality and Storageability of Clarified Banana and Sapodilla Juices	AFF	01-02-04-0106 EA001	RM188,952
197.	Food Science and Biotechnology	Son Radu	Microbial Prospecting for Bioactive and Useful Substances	BAB	09-02-04-0452 EA001	RM142,000
198.	Food Science and Biotechnology	Son Radu	Development of Diagnostic DNA Probe for Detection and Identification of Vibrio cholerae	HAS	06-02-04-0219 EA001	RM132,000
199.	Food Science and Biotechnology	Suhaimi Napis	Diversity Analysis of Local Durian Clones Using Intergenic Spacer and Microsatellite Markers	AFF	01-02-04-0119 EA001	RM198,500

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
200.	Food Science and Biotechnology	Suraini Abd. Aziz	Degradation of lignocellulosic agro-wastes using ligninase and laccase from locally isolated fungus (white-root basidomycetes)	BAB	09-02-04-0351 EA001	RM159,000
201.	Food Science and Biotechnology	Tan Chin Ping	Production of Nataural Flavoring and Coloring Powders from Local Edible Plants by Using Spray Drum and Freeze Drying Methods	AFF	03-02-04-0168 EA001	RM184,000
202.	Food Science and Biotechnology	Tan Chin Ping	Application Of High Processing In preservation Of Selected Local Fruit Products	AFF	03-02-04-0493 EA001	RM208,000
203.	Food Science and Biotechnology	Yaakob Che Man	Detection of Lard in Food Products By Advance Instrumental Techniques	AFF	03-02-04-0418 EA001	RM225,600
204.	Food Science and Biotechnology	Yaakob Che Man	Development and Application of Rapid Methods for Analysis of Fat and Oil Products Using Fourier Transform Infrared (FTIR) Spectroscopy	SAE	09-02-04-0457 EA001	RM180,000
205.	Forestry	Ahmad Said Sajap	Foraging dynamics and nutritional ecology of subterranean termites, Coptotermes spp. pest of structural timber in buildings and landscapes	MEE	01-02-04-0012 EA001	RM91,000
206.	Forestry	Faizah Abood	Insect - wood relations of powderpost beetles with emphasis on establishing standard methods for durability and preservative efficacy tests	AFF	03-02-04-0144 EA001	RM174,300
207.	Forestry	Faridah Hanum Ibrahim	Plant diversity and conservation in Perlis State Park	AFF	01-02-04-0021 EA001	RM163,760
208.	Forestry	Jalaluddin Harun	Properties of medium desnity fibreboard [MDF] manufactured from new Rubberwood species and clones	SAE	03-02-04-0406 EA001	RM92,600
209.	Forestry	Lim Meng Tsai	The ecology and productivity of Azadirchta excelsa (Sentang) plantations	AFF	01-02-04-0056 EA001	RM141,600
210.	Forestry	Mohamed Zakaria Hussin	Understorey birds species as health indicator of forest ecosystem	AFF	08-02-04-0242 EA001	RM191,796
211.	Forestry	Mohd. Ariff Jamaludin	Build-up beams in the manufacture of structural building components	SAE	03-02-04-0150 EA001	RM114,000
212.	Forestry	Mohd. Ariff Jamaludin	Enhanced molding compound in the design and manufacture of interior building components	SAE	03-02-04-0153 EA001	RM291,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
213.	Forestry	Nor Aini Ab Shukor	Provenence Variation Of Shorea Leprosula	AFF	01-02-04-0492 EA001	RM123,700
214.	Forestry	Nor Aini Ab Shukor	Variation in the multiple leader growth habit of known genotypes of four important Acacia species	AFF	01-02-04-0093 EA001	RM116,700
215.	Forestry	Zaidon Ashaari	Utilization of bamboo culms for structural bamboo plywood	SAE	03-02-04-0173 EA001	RM128,040
216.	Human Ecology	Ahmad Tarmizi Talib	Religious Tolerence : A Comparative Study Between Malaysia and Indonesia	SSH"	07-02-04-0727-EA001	RM143,000
217.	Human Ecology	Elias Saion	Development and characterizations of high performance radiosensitive polymer dosimeters	SAE	09-02-04-0275 EA001	RM188,200
218.	Human Ecology	Husniyah Abd. Rahim	Pengetahuan, Sikap dan Amalan Penggunaan Kredit di kalangan di Malaysia	SAE	07-02-04-0227 EA001	RM108,200
219.	Human Ecology	Jariah Masud	The development of rural micro and small famili enterprise	SSH"	07-02-04-0735-EA001	RM147,000
220.	Human Ecology	Jayum A. Jawan	Adaptation, Transformation and Aspiration of Urban Squatters in Sarawak	SSH	07-02-04-0229 EA001	RM162,800
221.	Human Ecology	Laily Paim	Penggunaan dan Gaya Hidup Lestari di Kalangan Pegawai di Sektor Awam	SSH	07-02-04-0736-EA001	RM144,200
222.	Human Ecology	Musa Bin Abu Hassan	Masyarakat luar bandar dan projek ICT luar bandar: Satu usaha pembentukan k-komuniti	SSH	07-02-04-0231 EA001	RM145,000
223.	Human Ecology	Nurizan Yahaya	Poverty Among Elderly Malaysians: Towads Productive Ageing	SSH	07-02-04-0733-EA001	RM180,700
224.	Human Ecology	Nurizan Yahaya	Sikap dan amalan golongan Melayu Bandar terhadap pencapaian Wawasan 2020	SSH	07-02-04-0737-EA001	RM92,000
225.	Human Ecology	Rohani Abdullah	Parental Involvement and Children's Computer Usage and Abilities	SSH	07-02-04-0738 EA001	RM128,000
226.	Human Ecology	Sharifah Norazizan Syed Abd. Rashid	Culture, Conservation, and Heritage in the Context of City Marketing-Towards Developing Sustainable Urban Development Strategies	SSH	07-02-04-0234 EA001	RM177,984
227.	Human Ecology	Zaid Ahmad	Perception and Understanding of Rural Malaysians Towards the Process of Globalisation	SSH	07-02-04-0235 EA001	RM241,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
228.	Institute for Mathematical Research (INSPEM)	Kamel Ariffin Mohd. Atan	Interactive and animated mathematics for math education	SSH	07-02-04-0424 EA001	RM185,000
229.	Institute for Mathematical Research (INSPEM)	Noor Akma Ibrahim	TREE - STRUCTURED REGRESSION MODEL FOR THE SUBDISTRIBUTION OF COMPETING RISK	ITM	09-02-04-0895 EA001	RM94,500
230.	Institute for Mathematical Research (INSPEM)	Wan Zah Wan Ali	A study of mathematical values among Malaysian mathematics secondary school teachers	ITM	07-02-04-0742-EA001	RM197,160
231.	Institute of Advanced Technology (ITMA)	Adam Kilicman	New sequence spaces and matrix transformations in (V, □)	SAE	09-02-04-0898 EA001	RM104,000
232.	Institute of Advanced Technology (ITMA)	Azizi Ali @ Ibrahim	Database management system for recreational resources in Peninsular Malaysia, analysis of demand, supply and participation	SSH	07-02-04-0663-EA001	RM175,640
233.	Institute of Advanced Technology (ITMA)	D.N. Trikha	Development of Optimal Flooring and Roofing Prefabricated Systems for Industrialised Construction	SAE	03-02-04-0142 EA001	RM195,000
234.	Institute of Advanced Technology (ITMA)	Napsiah Ismail	Development of Intelligent Vision-based Parts Recognition System for Flexible Manufacturing Cell	SAE	09-02-04-0823-EA001	RM115,400
235.	Institute of Advanced Technology (ITMA)	Paridah Md.Tahir	Development of dimensionally stable wood composite through surface enhancement of wood particles/fibres (Synthesis and evaluation of low molecular weight phenol formaldehyde resin for the production high dimensionally stable oriented strand board)	SAE	03-02-04-0411 EA001	RM147,560
236.	Institute of Advanced Technology (ITMA)	Rahmita Wirza	Computer Aided Orthopedic Surgery	HAS	04-02-04-0496 EA001	RM204,560
237.	Institute of Advanced Technology (ITMA)	Rahmita Wirza	Surface design of total knee replacement using virtual manufacturing	SAE	04-02-04-0592-EA001	RM156,360
238.	Institute of Advanced Technology (ITMA)	Wong Shaw Voon	Development of Artificial Intelligence (AI) based Expert System for Optimum Turning Process	SAE	03-02-04-0171 EA001	RM164,140

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
239.	Institute of Bioscience (IBS)	Ab.Rani Bahaman	Development of a multivalent leptosspiral sub unit vaccine against leplospirisis in livestock and pet animal	AFF	01-02-04-0001 EA001	RM178,256
240.	Institute of Bioscience (IBS)	Ab.Rani Bahaman	Development of a rapid nucleic acid based diagnostic kit for human rotavirus	BAB	01-02-04-0002 EA001	RM106,000
241.	Institute of Bioscience (IBS)	Faridah Qamaruz Zaman	Identification of AFLP fragments linked to fruit skin colour in oil palm (Elaeis guineensis Jacq)	AFF	01-02-04-0022 EA001	RM129,000
242.	Institute of Bioscience (IBS)	Ho Yin Wan	Studies on the mass production and storage of lactobacillus probiotics for chickens	AFF	01-02-04-0034 EA001	RM189,000
243.	Institute of Bioscience (IBS)	Johnson Stanslas	Synthesis of novel andrographolide derivatives and evaluation of their antitumour potential	HAS	06-02-04-0603-EA001	RM189,500
244.	Institute of Bioscience (IBS)	Khozirah Shaari	Identification and quantification of chemical markers nd bioactive constituants of gynura procumbens (lure) merr	BAB	09-02-04-0619-EA001	RM157,000
245.	Institute of Bioscience (IBS)	Khozirah Shaari	Inhibitors of leukotriene biosynthesis from natural products as anti-asthmatic agents	HAS	06-02-04-0214 EA001	RM191,320
246.	Institute of Bioscience (IBS)	Mohd. Said Saad	Genetic diversity and conservation of phyllanthus spp.genetic resources for development of variety for anti cancer	BAB	01-02-04-0088 EA001	RM163,000
247.	Institute of Bioscience (IBS)	Muhammad Nazrul Hakim Abdullah	Anti-inflammatory and anti-microbial properties of Channa spp. extracts.	BAB	06-02-04-0605-EA001	RM232,000
248.	Institute of Bioscience (IBS)	Sieo Chin Chin	The effects of b-glucanase produced by lactobacillus-probiotics on the growth performance of broilers	AFF	01-02-04-0113 EA001	RM178,000
249.	Institute of Bioscience (IBS)	Sieo Chin Chin	Rapid Identification of Several Lactobacillus-Probiotic Strains for Poultry Using Molecular Biology Techniques	BAB	09-02-04-0765-EA001	RM172,256
250.	Institute of Bioscience (IBS)	Tan Wen Siang	Detection of hepatitis B core antigen with a recombinant bacteriophage	BAB	06-02-04-0608-EA001	RM100,000
251.	Institute of Community Development and Youth Studies (PEKKA)	Azimi bin Hamzah	Youth as a foundation for unity and solidarity: A study of inter ethnic tolertence	SSH"	07-02-04-0740-EA001	RM190,250

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
252.	Institute of Community Development and Youth Studies (PEKKA)	Jamilah Othman	Conflict Resolution for Sexual Harassment in Government Agencies in Peninsular Malaysia	SSH	07-02-04-0729-EA001	RM153,000
253.	Institute of Community Development and Youth Studies (PEKKA)	Rahim Md. Sail	Inculcation of Japanese Farmers' Work Cultures among Malaysian Youth Agro-Entreprenurs Using Transformational Learning Model	SSH	07-02-04-0232 EA001	RM155,000
254.	Institute of Community Development and Youth Studies (PEKKA)	Rahim Md. Sail	Volunteerism among retiress: A potential resource for community development	SSH	07-02-04-0540-EA001	RM171,400
255.	Institute of Community Development and Youth Studies (PEKKA)	Rumaya Juhari	Divorce Families in Malaysia: Children and Adults Wellbeing	SSH	07-02-04-0731-EA001	RM145,000
256.	Institute of Gerontology (IG)	Asnarulkhadi Abu Samah	Sokongan sosial ke atas warga tua: Satu kajian rol famili	SSH"	07-02-04-0728-EA001	RM197,800
257.	Institute of Multimedia and Software (IMP)	Borhanuddin Ali	Development of a Smart Multi-tier Stack for Pervasive Computing Enviromement	ITM	04-02-04-0795-EA001	RM156,300
258.	Institute of Multimedia and Software (IMP)	Sidek Hj. Ab. Aziz	Design of Interactive Web-Based Instructional System	ITM	04-02-04-0791-EA001	RM169,000
259.	Institute of Multimedia and Software (IMP)	Zakaria Kasa	Effectiveness of Webcast Lectures in Higher Education	ITM	07-02-04-0744-EA001	RM186,000
260.	Malaysian Graduate School of Management	Mohd. Azhar Abd Karim	General Equilibrium Modelling of Trade Induced Adjustment	EAM	05-02-04-0690-EA001	RM170,000
261.	Medicine and Health Sciences	Ahmad Bustamam Abdul	The Anti-tumourgenic Properties of Local Plant Products Cardaminin from Alpina zerumbetand zerombine from Zinzibar zerumbeton Cervical and Ovarian Candera Repectively in Cell Cukture and Female Nude Mice	HAS	06-02-04-0720-EA001	RM205,000
262.	Medicine and Health Sciences	Ahmad Bustamam bin Abdul	The anti-tumourgenic effects of a local plant extract, Flavokawin B, species Alpinia zerumbet on breast cancer of female nude mice and breast cancer cell lines.	HAS	06-02-04-0210 EA001	RM244,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
263.	Medicine and Health Sciences	Amin Bin Ismail	Functional Components from Roselle (Hibiscuc Sabriffa L) Seeds	HAS	06-02-04-0804-EA001	RM129,000
264.	Medicine and Health Sciences	Amin Bin Ismail	Studies on the Health Benefits of Procyanidins Extracted from Malaysian Cocoa Liquor and Cocoa Shells, and the Development of New Functional Food Products	HAS	01-02-04-0013 EA001	RM149,000
265.	Medicine and Health Sciences	Asmah Rahmat	Study on the mechanism of anticancer properties of the components isolated from the local plant extracts	HAS	06-02-04-0211 EA001	RM211,000
266.	Medicine and Health Sciences	Chong Pei Pei	Development DNA based dignostic test For detecting azole drug-resistant fungal pathogens of Candida species	HAS	06-02-04-0598-EA001	RM217,440
267.	Medicine and Health Sciences	Daud Ahmad Israf Ali	Induction of tumouricidal marcophage activity by natural products	AFF	01-02-04-0391 EA001	RM200,000
268.	Medicine and Health Sciences	Daud Ahmad Israf Ali	Use of proteomics in enhancing natural product drug discovery	SAE	09-02-04-0274 EA001	RM204,000
269.	Medicine and Health Sciences	Fauziah Othman	New castle disease virus (NDV)as anticancer agent in breast cancer cell	HAS	09-02-04-0277 EA001	RM214,000
270.	Medicine and Health Sciences	Fauziah Othman	A Study on neem leaf (Azadiracta indica) as an anti cancer agent in breast cancer	HAS	06-02-04-0597-EA001	RM155,000
271.	Medicine and Health Sciences	Mariana Nor Shamsuddin	Development of genomic probes for rapid identification of local bacterial pathogens	HAS	06-02-04-0215 EA001	RM187,500
272.	Medicine and Health Sciences	Maznah bt. Ismail	Nutraceutical products from Malaysian rice bran and their potential health benefits	HAS	06-02-04-0216 EA001	RM205,000
273.	Medicine and Health Sciences	Maznah Ismail	Development of Nutraceuticals from Strobilantens crispus Extract with Cardioprotective Propersties	HAS	06-02-04-0692-EA001	RM191,500
274.	Medicine and Health Sciences	Md Zuki Bin Abu Bakar @ Zakaria	Investigation on the use of modified external skeletal fixator (ESF) on bone healing quality, the cost and management in orthopedic fracture treatment.	HAS	01-02-04-0397 EA001	RM185,080
275.	Medicine and Health Sciences	Mirnalini Kandiah	Diet and exercise intervention among colorectal cancer survivors : A randomised controlled trial.	HAS	06-02-04-0682-EA001	RM140,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
276.	Medicine and Health Sciences	Mohamed Zain Mohamed/Wong Foong Yee	Creativity and Innovativeness in Malaysian Organizations	EAM	05-02-04-0203 EA001	RM153,360
277.	Medicine and Health Sciences	Mohd. Roslan Sulaiman	Mexperimental electrophysiological studies of vestibular compensation following unilateral deaffferentation	HAS	06-02-04-0694-EA001	RM170,500
278.	Medicine and Health Sciences	Rozita Rosli	Elucidation of the mechanisms whereby Falvokawin B inhibitis the growth of human breast cancer cell lines	HAS	06-02-04-0658-EA001	RM194,000
279.	Medicine and Health Sciences	Rozita Rosli	Profiling changes in gene expression of brain cancer cells in response to tamoxifen and tamoxifen-like synthetic compunds using both cDNA microarray and proteomics	HAS	09-02-04-0339 EA001	RM156,000
280.	Medicine and Health Sciences	Sabariah Abdul Rahman	The frequency od altered expression of oncogenes and tumor suppressor genes and their relationship to chemokines and angiogenic factors in cellular proliferative activities of gynaecological cancers in the Malaysian population	HAS	06-02-04-0218 EA001	RM193,500
281.	Medicine and Health Sciences	Sabrina Sukardi	A novel immunocontraceptive immunization of male paddy rats with a recombinant calcium-binding protein gene (cbp) construct.	AFF	09-02-04-0447 EA001	RM119,000
282.	Medicine and Health Sciences	Seow Heng Fong	Comparison of possible tumours markers in blood,biological fluids or tissue	HAS	09-02-04-0449 EA001	RM157,000
283.	Medicine and Health Sciences	Sharida Fakurazi	The effect of zerumbone treatment against hepatotoxicity following carbon tetrachloride administration	HAS	06-02-04-0806-EA001	RM117,500
284.	Medicine and Health Sciences	Wan Omar Abdullah	Development of nucleic acid vaccine against Brugia malayi infected Meriones ungiculatus	HAS	06-02-04-0221 EA001	RM146,216
285.	Medicine and Health Sciences	Zalilah Mohd. Shariff	Health and nutrition intervention for Orang Asli households - A focus on intrahousehold factors	HAS	06-02-04-0595-EA001	RM103,000
286.	Modern Languages Studies and Communication	Rosli Talif	Representation of Malays and Malay Culture in Malaysian-Singaporean Literature in English	SSH	07-02-04-0539-EA001	RM182,000
287.	Science and Environmental Studies	Abdul Halim Abdullah	Metal Oxide supported on modified activated carbon as catalysts for the oxidation of organic compounds	SAE	09-02-04-0747-EA001	RM189,500

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
288.	Science and Environmental Studies	Abdul Halim Abdullah	Photoassisted regeneration of activated carbon using semiconductor photocatalyst	SAE	09-02-04-0255 EA001	RM231,000
289.	Science and Environmental Studies	Abu Bakar Salleh	Enhanced production of organic solvent tolerant protease through genetic manipulation	BAB	09-02-04-0258 EA001	RM100,300
290.	Science and Environmental Studies	Adem Kilicman	Neutrix modelling for distributional differential equations and convulation product	ITM	09-02-04-0259 EA001	RM168,000
291.	Science and Environmental Studies	Ahmad Ismail	Pollution impacts on bioresources in the straits of Malacca	MEE	08-02-04-0237 EA001	RM179,400
292.	Science and Environmental Studies	Ahmad Makmom Hj. Abdullah	Evaluation of Industrial air pollution from Prai Industrial Zone and its impacts on Paddy Plantation in MADA(Muda Agricultural Development Authority) Area.	MEE	08-02-04-0613-EA001	RM237,240
293.	Science and Environmental Studies	Anuar Kassim	Synthesis and characterization of new composite conducting polymers to microelectrodes, microsensors and ion-exchange membranes.	MEE	09-02-04-0261 EA001	RM220,000
294.	Science and Environmental Studies	Anuar Kassim	Association behaviour and physicochemical properties of dihydroxystearic acid (DHSA) and their derivatives in osmetic application	SAE	09-02-04-0748-EA001	RM158,500
295.	Science and Environmental Studies	Aziz Arshad	Soft bottom communicaties of the Littoral and Sublittoral enviroments	EAM	08-02-04-0239 EA001	RM152,700
296.	Science and Environmental Studies	Azizi Muda	Environmental education planning in Malaysia	SSH	07-02-04-0423 EA001	RM187,160
297.	Science and Environmental Studies	Azmi Zakaria	Photothermal spectroscopic analysis of transition metal materials	MEE	02-02-04-0132 EA001	RM249,600
298.	Science and Environmental Studies	Chong Fai Kait/Abdul Halim Abdullah	Preparation, characterization and reaction studies on supported trimetallic Pt-Re-Sn catalysts	SAE	09-02-04-0269 EA001	RM101,000
299.	Science and Environmental Studies	Chow Sai Pew	Synthesis and characterization of tellurium borate and borophosphate glasses	SAE	09-02-04-0270 EA001	RM216,500
300.	Science and Environmental Studies	Dzulkefly Kuang Abdullah	Chemical modification of sago starch by using palm oil based oleochemicals for production of active compounds	BAB	01-02-04-0019 EA001	RM217,080

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
301.	Science and Environmental Studies	Elias Saion	Development and characterization of high perfomance reusable ion exchange polymeric metal composites (IPMCs) as biomimetic sensors, actuators and artificial muscles	MEE	09-02-04-0814-EA001	RM86,000
302.	Science and Environmental Studies	Faridah Abdullah	Early detection and biological treatment as strategies in integrated disease management of management of Ganoderma Boninenese	AFF	01-02-04-0020 EA001	RM180,000
303.	Science and Environmental Studies	Faridah Abdullah	Immunodiagnostics of ganoderma boninense	AFF	09-02-04-0629-EA001	RM193,120
304.	Science and Environmental Studies	Fatimah Md.Yusoff	Culture of Indigenous microalgae and zooplankton for the production of high quality live-feed for Penaeus Monodon larvae	AFF	01-02-04-0392 EA001	RM203,400
305.	Science and Environmental Studies	Faujan Hj. Ahmad	Synthesis of some Betulinic Acid Derivatives using enzymes	BAB	09-02-04-0276 EA001	RM200,000
306.	Science and Environmental Studies	Fudziah Ismail	Sequential and paralel solution of delay and algebraic differential equations and its application to the population growth modeling problem	ITM	09-02-04-0435 EA001	RM150,000
307.	Science and Environmental Studies	Gwendoline Ee Cheng Lian	Bioactive Acetogenins From Sarawak Annona, Disepalum and Goniothalamus secies.	SAE	09-02-04-0279 EA001	RM214,000
308.	Science and Environmental Studies	Habshah Midi	Robust regression with both continous and categorical variables with heteroiscedastic non-normal errors	SAE	09-02-04-0749-EA001	RM139,680
309.	Science and Environmental Studies	Hishamuddin Zainuddin	Quantum theory on punctured surfaces and related problems in many-body theory, quantum gravity and cosmology	SAE	09-02-04-0284 EA001	RM185,800
310.	Science and Environmental Studies	Idris Abd. Ghani	Aquaculture of green mussel: Improving productivity through transplanting method and multiple spat collecting techniques	AFF	01-02-04-0645-EA001	RM164,000
311.	Science and Environmental Studies	Ionel Valeriu Grozescu	Fototermal Deflection Analizer For Study Of Electrochemical Processes In Bateries And Fuel Cells During their Operations	BAB	09-02-04-0498 EA001	RM164,000
312.	Science and Environmental Studies	Irmawati Ramli	Characteisation and Catalytic Behaviour of Mixed Metal Oxides Catalysts for Partial Oxidation of Propane	MEE	09-02-04-0286 EA001	RM216,800

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
313.	Science and Environmental Studies	Isa Daud	Statistical modelling of environmental time series	SAE	09-02-04-0287 EA001	RM180,680
314.	Science and Environmental Studies	Ismail Omar	Protein expression in freshwater fish liver by 2-dimensional electrophoresis2-dimensional electrophoresis	BAB	09-02-04-0288 EA001	RM93,500
315.	Science and Environmental Studies	Jambari Hj. Ali	The optimization of rice field productivity by integrating blue green algae, fishers and duck as biocontrol agent for weeds and pests	AFF	01-02-04-0040 EA001	RM136,000
316.	Science and Environmental Studies	Janna Ong Abdullah	Development of transgenic technology using antisense gene construct for flower colour in Melastome sp.	BAB	09-02-04-0548 EA001	RM204,000
317.	Science and Environmental Studies	Japar Sidik Bujang	Seagrass taxonomy,biology and habitat characteristics	AFF	09-02-04-0290 EA001	RM199,900
318.	Science and Environmental Studies	Johari Ramli	Metabolic effects of pesticides in Malaysia fresh water fish in relation to meat quality	AFF	09-02-04-0293 EA001	RM100,000
319.	Science and Environmental Studies	Juzu Hayati Arshad	Availability and Activity of CoenzymeQ1ß in Malaysian Fresh Water Fish	AFF	09-02-04-0850-EA001	RM73,560
320.	Science and Environmental Studies	Juzu Hayati Arshad	Determination and extraction of essential fatty acids (omega fatty acids) and vitamin E from water fish	AFF	09-02-04-0294 EA001	RM95,000
321.	Science and Environmental Studies	Kaida Khalid	Development of Microwave - Assisted Processing (MAP) for Science, Industry and Technology Applications	SAE	09-02-04-0438 EA001	RM166,000
322.	Science and Environment al Studies	Karen Ann Crouse	Halogenation of Fatty Acids	SAE	09-02-04-0752-EA001	RM197,540
323.	Science and Environmental Studies	Karen Ann Crouse	Synthesis and Bioactivity studies of nitrogen-sulfur, nutrogen-oxygen-sulfur donor ligands and their complexes with transition and non-transition metals	SAE	09-02-04-0296 EA001	RM233,000
324.	Science and Environmental Studies	Khatijah Yusoff	Determination of the L gene sequence and intergenic regions of Newcastle disease virus strain AF2240	AFF	01-02-04-0053 EA001	RM97,000
325.	Science and Environmental Studies	Khatijah Yusoff	Macromolecular interactions between different proteins of NDV	SAE	09-02-04-0753-EA001	RM197,680

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
326.	Science and Environmental Studies	Lee Chnoong Kheng	Utilization of waste materials for the removal of pollutants in aqueous environment	MEE	08-02-04-0665-EA001	RM138,400
327.	Science and Environmental Studies	Lee Chnoong Kheng	Preparation and characterization of bismuth-based oxide ion conductors as new sensor materials	MEE	09-02-04-0302 EA001	RM110,800
328.	Science and Environmental Studies	Mahiran Basri	Enzyme Catalyzed synthesis of palm-based wax esters	BAB	09-02-04-0306 EA001	RM211,000
329.	Science and Environmental Studies	Mawardi Rahmani	Development and structural modification of antimicrobial and anticancer coumarins and sulphones from Micromelum and Glycosmic Sp. (Rutacaea)	BAB	09-02-04-0431 EA001	RM158,680
330.	Science and Environmental Studies	Maziah Mahmood	Development of rapid in vitro mass propagation techniques for commercially important fragrant orchid hybrids	AFF	01-02-04-0062 EA001	RM163,000
331.	Science and Environmental Studies	Md.Jelas Haron	Removal of heavy metal oxyanions from aqeous systems by modified chelating exchanges	SAE	09-02-04-0439 EA001	RM121,000
332.	Science and Environmental Studies	Md.Nordin Hj.Lajis	Investigation on the Cytotoxity and Antimicrobial compounds of Garcinia penangiana and G.nigrolineate	BAB	09-02-04-0313 EA001	RM163,884
333.	Science and Environmental Studies	Md.Nordin Hj.Lajis	The evaluation,production and derivatisation of the citric acid in Garcinia antroviridis	BAB	09-02-04-0440 EA001	RM181,884
334.	Science and Environmental Studies	Misri Kusnan	Ecobiological aspects of tiger shrimp culture pond with the emphasis on the role of micronutrients in shrimp pond productivity	AFF	01-02-04-0520 EA001	RM123,600
335.	Science and Environmental Studies	Mohamed Ibrahim Mohamed Tahir	Relationship between molecular structure and bioactivity of nitrogen-sulfur, nitrogen-oxygen-sulfur donor ligand and their complexes with transition and non-transition metals	SAE	09-02-04-0755-EA001	RM206,540
336.	Science and Environmental Studies	Mohd. Arif Syed	Isolation and characterization of particide degrading microorganism from Malaysia soils	AFF	08-02-04-0243 EA001	RM111,560
337.	Science and Environmental Studies	Mohd. Aspollah Hj. Sukari	Characterization and Utilization of bioactive constituents from Curcuma heyneana, Curcuma mangga and related species	BAB	09-02-04-0444 EA001	RM140,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
338.	Science and Environmental Studies	Mohd. Basyaruddin Abd. Rahman	Studies and Characterisation of Enzyme Immobilised onto Layered Double Hydroxides	MEE	09-02-04-0816-EA001	RM95,000
339.	Science and Environmental Studies	Mohd. Basyaruddin Abd. Rahman	A Semisynthetic Metallaoenzymes: Novel Catalysts for Petrochemicals and Esterification	SAE	09-02-04-0320 EA001	RM230,000
340.	Science and Environmental Studies	Mohd. Maarof H.A Moksin	Thermal wave investigation of phonon-phonon and phonon-electron interactions in high temperature superconductors at temperatures around Tc	SAE	02-02-04-0133 EA001	RM229,720
341.	Science and Environmental Studies	Mohd. Nasir Hassan	Development of a knowledge-based life cycle assessment (LCA) of municiple solid waste management and recycling systems in Malaysia	MEE	08-02-04-0244 EA001	RM169,000
342.	Science and Environmental Studies	Mohd. Noor Abd. Wahab	B-1.3 glucan level of Ganoderma lucidum, Ganoderma tsugae and Ganoderma tropicum	BAB	09-02-04-0322 EA001	RM120,500
343.	Science and Environmental Studies	Mohd. Pauzi Zakaria	Polycyclic Hydrocarbons (PAHs) in Urban and Remote Areas of Peninsular Malaysia: Identification of their transport pathway using molecular marker approach	SAE	08-02-04-0745-EA001	RM103,680
344.	Science and Environmental Studies	Mohd. Puad Abdullah	Enhancement of photosynthetic activity in rice using biochemical techniques and somaclonal variation	BAB	01-02-04-0074 EA001	RM154,000
345.	Science and Environmental Studies	Mohd. Puad Abdullah	Cloning of plant resistance gene family and fungal Avr genes	BAB	09-02-04-0756-EA001	RM180,680
346.	Science and Environmental Studies	Mohd. Yunus Abd. Shukor	Screening of microbes with the ability to degrade acrylamide	BAB	09-02-04-0758-EA001	RM181,000
347.	Science and Environmental Studies	Mohd. Yunus Abd. Shukor	Enzymatic Methods for the Determination of Heavy Metals in the Environment	MEE	09-02-04-0854-EA001	RM160,000
348.	Science and Environmental Studies	Mohd. Yusof Sulaiman	Realization of sensorless brushless dc motor for application in renewable energy industry	SAE	02-02-04-0134 EA001	RM197,302
349.	Science and Environmental Studies	Mohd. Zaizi Desa	Study of dye-sensitized photoelectrochemical solar cell	SAE	09-02-04-0324 EA001	RM194,000
350.	Science and Environmental Studies	Mohd. Zobir Bin Hussein	The Chemistry Of New Organic-Inorganic Hybrid Materials	SAE	09-02-04-0500 EA001	RM190,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
351.	Science and Environmental Studies	Muhajir Hamid	Study of insulin secreation by antidiabetic agent of Malaysian traditional plants	HAS	09-02-04-0328 EA001	RM192,000
352.	Science and Environmental Studies	Muhamad Awang	Effects of acid deposition on nutrient availability of natural tropical forest system	MEE	08-02-04-0248 EA001	RM139,500
353.	Science and Environmental Studies	Muskhazli Mustafa	Purification and characterization of non-volatile antifungal compound produced by bacillus subtilis	BAB	09-02-04-0667-EA001	RM147,884
354.	Science and Environmental Studies	Noor Akma Ibrahim	Data mining for economic evaluation of air pollution impacts and controls	EAM	05-02-04-0422 EA001	RM182,180
355.	Science and Environmental Studies	Nor Aripin Shamaan	Purification of glutathione S-transferases in the Kedah-Kelantan cattle (Bos indicus) and the water buffalo (Bos bubalus bubalis)	BAB	09-02-04-0330 EA001	RM97,000
356.	Science and Environmental Studies	Nor Azah Yusof	Simultaneous detection of heavy metal employing an optical fibre sensor and artificial neural network	MEE	09-02-04-0818-EA001	RM96,080
357.	Science and Environmental Studies	Nor'Aini Mohd. Fadzillah	Oxidative defense responses of various banana cultivars to Fusarium wilt	BAB	09-02-04-0331 EA001	RM183,400
358.	Science and Environmental Studies	Norani Abdul Samad	In vitro mass propagation of virus-free orchid hybrids and cultivars by conventional methods and bioreactors	BAB	01-02-04-0094 EA001	RM189,120
359.	Science and Environmental Studies	Norhani bt. Abdullah	The production of avian egg yolk antibody (IgY) against E. coli and Salmonella bacteria	AFF	01-02-04-0095 EA001	RM216,000
360.	Science and Environmental Studies	Radzali Muse	Production of flavonoids and essential oils from the rutaceae plants by using tissue and cell culture technique	BAB	09-02-04-0333 EA001	RM92,560
361.	Science and Environmental Studies	Radzali Muse	Production of carotenoids from the pummelo (Citrus grandis L. Osbek) plants (retaceace family) and their antioxidant activities by using biotechnology techniques	SAE	09-02-04-0762-EA001	RM125,840
362.	Science and Environmental Studies	Raja Noor Zaliha Raja Abdul Rahman	Enhancement of enzymatic activity and thermostability of lipase	BAB	09-02-04-0336 EA001	RM265,800
363.	Science and Environmental Studies	Raja Noor Zaliha Raja Abdul Rahman	Expression and characterization of organic solvent tolerant lipase from bacillus sphaericus 205y	MEE	09-02-04-0763-EA001	RM194,500

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
364.	Science and Environmental Studies	Rosta Harun	Identification of environmental ethics components suitable for educating Orang Asli-The Suku Temuan Subethnic group	SSH	07-02-04-0741-EA001	RM87,580
365.	Science and Environmental Studies	Rusea Go	Conservation and diversity of limestone orchids in Peninsular Malaysia and Sarawak	MEE	08-02-04-0249 EA001	RM187,732
366.	Science and Environmental Studies	Shaharin Ibrahim	Development of integrated quantitative groundwater assessment system for engineering and environmental application	MEE	03-02-04-0414 EA001	RM171,580
367.	Science and Environmental Studies	Sidek Hj. Ab. Aziz	Glass formation and themo-acoustic properties of bismuth oxide system	SAE	09-02-04-0550 EA001	RM217,000
368.	Science and Environmental Studies	Sidik Silong	Rational synthesis of novel side-group liquid crystal polymers for optical data storage materials	MEE	09-02-04-0450 EA001	RM136,000
369.	Science and Environmental Studies	Siti Khalijah Daud	Varietal identification and genome mapping in Malaysia banana (Musa sp)	AFF	09-02-04-0451 EA001	RM172,000
370.	Science and Environmental Studies	Suhaimi Mustafa	Recombinant inulinase for the production of high fructose syrups from sago starch	AFF	09-02-04-0892 EA001	RM220,200
371.	Science and Environmental Studies	Suhaimi Mustafa	Rapid Detection and Enumeration of Bifidobacterium longum by Real-Time PCR Targeting the Bile Salt Hydrolase (bsh) gene	SAE	09-02-04-0857-EA001	RM157,000
372.	Science and Environmental Studies	Syed Tajuddin Syed Hassan	Conservation ecology of predation and parasitism in agroecosystems	MEE	08-02-04-0426 EA001	RM186,000
373.	Science and Environmental Studies	Tan Soon Guan	Development and application of DNA microsatellite markers for the biodiversity characterization of the green-lipped mussel, Perna viridis	BAB	09-02-04-0353 EA001	RM223,000
374.	Science and Environmental Studies	Tan Wee Tee	Electrochemical studies at chemically modified electrodes	SAE	09-02-04-0354 EA001	RM185,000
375.	Science and Environmental Studies	Tan Wen Siang	Display of hepatitis B surface antigens on bacteriophages:a new approach for designing therapeutic proteins	BAB	09-02-04-0355 EA001	RM100,000
376.	Science and Environmental Studies	Tan Wen Siang	Identification of the Binding Site of Viral Hepatitis B Inhibitors	HAS	09-02-04-0893 EA001	RM86,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
377.	Science and Environmental Studies	Taufiq Yap Yun Hin	Modification, Characterization and Catalytic Activity of Vanadium Phosphorus Oxide (VPO) Catalysts for the Synthesis of Meleic Anhydride from Partial Oxidation of n-Butane	SAE	09-02-04-0356 EA001	RM182,800
378.	Science and Environmental Studies	Tengku Hanidza Tengku Ismail	To develop an exposure model to determine the extent of organophosphate pesticide (glyphosphate and fenthion) exposure among paddy farmers	AFF	06-02-04-0723 EA001	RM151,000
379.	Science and Environmental Studies	Umi Kalsom Yusuf	Flavonoid extracted from some selected medicinal plants and their antioxidant properties	HAS	09-02-04-0360 EA001	RM180,000
380.	Science and Environmental Studies	Umi Salamah Hassan	Genetic Variability of Seagrasses in Malaysian waters	AFF	09-02-04-0361 EA001	RM196,000
381.	Science and Environmental Studies	Wan Mahmood Mat Yunus	Development of real-time photoacoustic instrument for gas analysis using a single wavelength laser for gas analysis using a single wavelength laser excitation	SAE	09-02-04-0455 EA001	RM194,440
382.	Science and Environmental Studies	Wan Md Zin Wan Yunus	Preparation and characterization of clay-natural rubber nanocomposites	MEE	09-02-04-0365 EA001	RM123,000
383.	Science and Environmental Studies	Wan Mohamad Daud Wan Yusuf	Correlation of dielectric properties with processing and microstructure in stannates and plumbate systems	SAE	09-02-04-0456 EA001	RM231,700
384.	Science and Environmental Studies	Wan Nor Azmin Sulaiman	Determination of the variation between the design flood and the actual flood in selected small urban-rural catchments	SAE	09-02-04-0768-EA001	RM155,348
385.	Science and Environmental Studies	Zaidan Abdul Wahab	Determination of the thermal diffusivity and conductivity of selected solid ceramic and polymer materials at elevated temperatures	MEE	09-02-04-0769-EA001	RM248,800
386.	Science and Environmental Studies	Zainal Abidin Sulaiman	Development and assessment of student centred multimedia interactive physics teaching learning modules	ITM	07-02-04-0743-EA001	RM155,800
387.	Science and Environmental Studies	Zainal Abidin Talib	Cu-doped CaO-P205 glasses for lasers	SAE	09-02-04-0815-EA001	RM78,000
388.	Science and Environmental Studies	Zainal Abidin Talib	Development of Piezoelctric-based Gas Sensor Devices Formed from Plasma Polymerized Films	SAE	09-02-04-0458 EA001	RM159,400

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
389.	Science and Environmental Studies	Zelina Zaiton Ibrahim	Development of a methodology for rapid assessment of the impact of water resource management options on saline intrusions in Malaysian Estuaries: Application to the Langat River	MEE	08-02-04-0615-EA001	RM94,560
390.	Science and Environmental Studies	Zolkepli Othman	Evaluation of plant extracts and concoctions for medicinal values	HAS	09-02-04-0368 EA001	RM179,000
391.	Science and Environmental Studies	Zulkarnain Zainal	Preparation and characterisation of cadmium chalgogenides thin films by pulse reversal technique for opto-electronicdevices	MEE	09-02-04-0771-EA001	RM252,000
392.	Science and Environmental Studies	Zulkarnain Zainal	Chemical and Electrochemical Synthesis of Binary and Ternary Metal Chalcogenides Film For Solar Cell Applications	SAE	09-02-04-0369 EA001	RM228,500
393.	Science and Environmental Studies	Zulkifly Abbas	Development of a propagation prediction tool for indoor wireless local area networks (WLANs)	SAE	09-02-04-0547 EA001	RM225,000
394.	Science and Environmental Studies	Zulkifly Abbas	PC-based Microwave reflectometer for dielectric measurements	SAE	09-02-04-0460 EA001	RM205,200
395.	UPM Bintulu Sarawak (Food & Agricultural Science)	Muta Harah bt. Zakaria@Ya	Distribution, diversity and use of aquatic macrophytes	AFF	09-02-04-0679-EA001	RM212,000
396.	UPM Bintulu, Sarawak	Yiu Pang Hung	Clean Production of Commodity-chemicals from Sago Biomass Using Electro synthesis Method	MEE	09-02-04-0821-EA001	RM154,500
397.	Veterinary Medicine	Abd. Wahid Haron	Cryopreservation of immature bovine oocytes	AFF	01-02-04-0005 EA001	RM194,976
398.	Veterinary Medicine	Abdul Rahman Omar	Development of an effective dagnostic tool and novel vaccine against infectious bursal disease virus infection	AFF	01-02-04-0007 EA001	RM162,000
399.	Veterinary Medicine	Abdul Rahman Omar	Identification of chicken anemia virus genetic determinant (s) associated with virus attenuation and pathogenicity	AFF	09-02-04-0700-EA001	RM98,000
400.	Veterinary Medicine	Bashir Ahmad Fateh Mohamed	Disease resistant throughbred-Kuda padi cross : Development and performance	AFF	01-02-04-0571-EA001	RM174,752
401.	Veterinary Medicine	Ganapathy a/l Kannan	Characterization of local isolate of Mycoplasma synoviae	AFF	01-02-04-0043 EA001	RM172,600
402.	Veterinary Medicine	Habibah Binti Arshad	Isolation, Identification and Characterization of Local Isolates of Sporothrix schenckii	AFF	01-02-04-0393 EA001	RM173,856

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
403.	Veterinary Medicine	Hassan Bin Mohd. Daud	Development of polymerase chain reaction -based rapid diagnositc tool for Herpesvirus cyprini	AFF	01-02-04-0029 EA001	RM134,200
404.	Veterinary Medicine	Loqman Mohamad Yusof	Development of Biomaterials from locally available ruminant offal in reconstructive surgery	BAB	01-02-04-0396 EA001	RM198,000
405.	Veterinary Medicine	Mohamed Shariff bin Mohamed Din	Investigation on the use of freeze dried reagents in the Fast TargetÔ White Spot Virus Detection Kit.	AFF	01-02-04-0069 EA001	RM147,580
406.	Veterinary Medicine	Mohd. Azmi bin Mohd. Lila	A Novel Genetically Engineered Virus-Vectored Immunocontraceptive Agent for the Control of Rat Pest Population and Transmission of Rat-to-human Zoonotic Diseases	AFF	01-02-04-0071 EA001	RM194,000
407.	Veterinary Medicine	Mohd. Hair Bejo	Holistic Approach on Molecular Characterization and Cellular Response to Infectious Bursal Disease Virus by Bioinformatics and nanotechniques	AFF	09-02-04-0822-EA001	RM172,000
408.	Veterinary Medicine	Mohd. Hair bin Bejo	Development of Vaccine and Diagnostic Kits for Infectious Bursal Disease in Poultry	AFF	01-02-04-0073 EA001	RM119,000
409.	Veterinary Medicine	Mohd. Hamami Sahri	Development of microwave density meter for wood products quality assessment.	SAE	03-02-04-0154 EA001	RM199,560
410.	Veterinary Medicine	Mohd. Shahar @ Mohd. Shah bin Abdul Majid	Occurrence of Vancomycin Resistant Enterococcus (VRE) in chickens and its Molecular characterisation	AFF	01-02-04-0398 EA001	RM157,600
411.	Veterinary Medicine	Mohd. Zamri bin Saad	Equine herpesvirus infection and its effect on performance of ponies and horses in Malaysia	AFF	01-02-04-0399 EA001	RM131,000
412.	Veterinary Medicine	Noordin bin Mohamed Mustapha	Nutritional and immunoregulatory approaches in abating bovine mastitis	AFF	01-02-04-0091 EA001	RM197,000
413.	Veterinary Medicine	Rasedee @ Mat Bin Abdullah	Pathophysiological changes leading to equine tendinitis	AFF	01-02-04-0401 EA001	RM185,000
414.	Veterinary Medicine	Sheikh Omar Abdul Rahman	Development of a new recombinant vaccine for footrot infection	AFF	01-02-04-0112 EA001	RM140,000
415.	Veterinary Medicine	Siti Khairani Bejo	Development of protein-base dinostic kit for brucellosis in ruminant	AFF	01-02-04-0507 EA001	RM191,000
416.	Veterinary Medicine	Siti Suri binti Arshad	Molecular characterisation of infectious bronchitis virus	AFF	01-02-04-0117 EA001	RM196,000

Table 4.

Prioritised Research (PR) Grants (IRPA RM-8)—2001-2004.

PR *(34 Grants / RM35m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
1.	Agriculture	Maheran Abd Aziz	Establishment of an alternative transformation and regeneration protocol by direct bombardment of chilli shoot tips.	BAB	01-02-04-0711-PR0049/04-03	RM367,500
2.	Agriculture	Sariah Meon	Development Biological and Agronomic Strategies for Management of Fusarium of Banana	AFF	01-02-04-0380 PR0010/05-03	RM562,000
3.	Agriculture	Mohd Fauzi Ramlan	Improvements in the utilization and management of production resources (particularly water and nutrients) for production system of selected vegetables especially under carbon dioxide enrichment	AFF	01-02-04-0683-PR0063/03-02	RM648,000
4.	Agriculture	Abdul Shukor Juraimi	Weed Management in Sustainable Production of High Yielding Irrigated Rice Under Minimal Water Input.	AFF	01-02-04-0778-PR0068/05-05	RM590,000
5.	Agriculture	Mohd Razi Ismail	Improved Water Use Efficiency of Rice For Water - Limited Environments.	AFF	01-02-04-0776-PR0068/05-01	RM600,000
6.	Educational Studies	Zaidatol Akmaliah Lope Pihie	Human Resource Development For At Risk Children	SSH	07-02-04-0487 PR0039/07-05	RM509,424
7.	Engineering	Hishamuddin bin Jamaludin	Ohmic Heated Pasteuriser/Steriliser	SAE	03-02-04-0379 PR0012/01-01	RM219,800
8.	Engineering	Robiah Yunus	Formulation of Carbon-Carbon Composite and Fibre Reinforced Plastics for Engineering Applications	SAE	03-02-04-0907-PR0072/08-07	RM2,755,600
9.	Engineering	Hishamuddin bin Jamaludin	Adaption and refinement of variable rate chemical applicators control systems in precision farming technology for mechanized rice production	SAE	01-02-04-0568-PR0052/11-08	RM420,152
10.	Food Science and Biotechnology	Salmah Yusof	Improvement of Existing Postharvest Handling Technology and Development of Standard Operating Procedures for Postharvest Handling of Roselle	AFF	01-02-04-0000 PR0029/05-04	RM300,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
11.	Food Science and Biotechnology	Kulaveerasingam Harikrishna/Faridah Qamaruz Zaman	The examination of agronomically important traits in crops plants through the use of genomicsand proteomics	BAB	01-02-04-0386 PR0015/07-01	RM953,000
12.	Food Science and Biotechnology	Tan Siang Hee	Development of functional genomics of Oil Palm (Elaies guineesis Jacq.): large scale cDNA insertion in Arabidopsis thaliana as a model system	AFF	01-02-04-0387 PR0015/07-02	RM370,000
13.	Institute Bioscience	Abu Bakar salleh	Scale Up Production : Enzymatic Synthesis of Palm-based Wax Esters	BAB	01-02-04-0383 PR0013/01-01	RM518,000
14.	Institute Gerontology	Jariah Masud	Economic and Financial Aspects of Aging	SSH"	06-02-04-0637-PR0056/05-01	RM391,000
15.	Institute Gerontology	Latiffah A Latif	Health Related Quality of Life	HAS	06-02-04-0638-PR0056/05-02	RM268,200
16.	Institute Gerontology	Sharifah Norazizan Syed Abd. Rashid	An Elderly Friendly Housing Environment for Older Malaysians	SSH	06-02-04-0639-PR0056/05-04	RM149,500
17.	Institute Gerontology	Tengku Aizan Hamid	Mental Health and Quality of life	HAS	06-02-04-0461 PR0031/05-02	RM1,227,800
18.	Institute of Advanced Technology (ITMA)	Ishak Aris	Development of An Electronic Control Unit (ECU) and its Diagnostic Kit for CNG Engine	SAE	03-02-04-0561 PR0030/10-06	RM2,935,648
19.	Institute of Advanced Technology (ITMA)	Fakhru'l-Razi Ahmadun	Natural Gas Storage for Direct Fuel NGV Engine Injection	SAE	03-02-04-0560 PR0030/10-01	RM4,490,760
20.	Institute of Advanced Technology (ITMA)	Barkawi Sahari	Vehicle Architecture and Integration	SAE	03-02-04-0562 PR0030/10-08	RM2,682,500
21.	Institute of Advanced Technology (ITMA)	Barkawi Sahari	NGV Refuelling Facilities and Equipment	SAE	03-02-04-0000 PR0030/10-10	RM4,182,000
22.	Institute of Advanced Technology (ITMA)	Jalaluddin Harun	Development Of Medium Density Fibreboad Using New Rubberwood Species And Clones And Oil Palm Fibre Blends	AFF	03-02-04-0779-PR0067/05-01	RM309,560
23.	Institute of Advanced Technology (ITMA)	Paridah Md Tahir	Development of particleboard from rubberwood and oil palm fibre blends	SAE	03-02-04-0780-PR0067/05-02	RM274,560

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
24.	Institute of Advanced Technology (ITMA)	Wan Ishak Wan Ismail	Design and Development of Vision System for oil Palm Plantation Operation	AFF	01-02-04-0471-PR0038/05-01	RM429,000
25.	Institute of Bioscience (IBS)	Abdul Manaf bin Ali	Effect of local natural products such as goniothalamin on cellular proliferation and apoptosis induction pertaining to coronary artery restenosis post-angioplasty	HAS	06-02-04-0374 PR0014/06-05	RM376,000
26.	Medicine and Health Sciences	Seow Heng Fong	Identification of novel therapeutic targets for treatment of breast cancer	HAS	06-02-04-0373 PR0002/07-07	RM429,400
27.	Medicine and Health Sciences	Hejar Abdul Rahman/Lekhraj Rampal	Development of Epidemiological Intelligence Surveillance System for HIV/AIDS and Cardiovascular	HAS	06-02-04-0483 PR0041/05-04	RM792,000
28.	Medicine and Health Sciences	Nasharuddin Abdul Aziz	Evaluation and prevention of occupational injuries among commercial vehicle drivers	HAS	06-02-04-0462-PR0061/09-06	RM1,053,500
29.	Medicine and Health Sciences	Seow Heng Fong	Identification of Nasopharyngeal Carcinoma Specific Epstein-Barr Virus Antigens towards the Development of Cytotoxic T Lymphocyte-based Immunotherapy	HAS	06-02-04-0636-PR0054/05-03	RM836,000
30.	Medicine and Health Sciences	Nor Amalina Emran	Characterization of genes in pathogenicity island (cagE, cagM in cagI region; cagT, cag6, cag5-cag10, cag 13 in cagII region and presence of IS605) in helicobacter pylori isolate	HAS	06-02-04-0907 PR0073/05-02	RM431,520
31.	Medicine and Health Sciences	Lekhraj Rampall	Novel Methods of Risk Identification, Stratification and Behavioral Interventions for HIV/AIDS Prevention(PR40203)	HAS	06-02-04-0482 PR0041/05-03	RM3,759,000
32.	Science and Environmental Studies	Janna Ong Abdullah	Profiling of gene(s) associated with fragrance in orchids	BAB	01-02-04-0474 PR0035/04-01	RM538,000
33.	Science and Environmental Studies	Maziah Mahmood	Biochemical and in Vitro Selection for Pigment and Fragrance Enhancement in Commercial Scented Orchids.	BAB	01-02-04-0475 PR0035/04-02	RM265,000
34.	Science and Environmental Studies	Nor'aini Mohd Fadzillah	Utilization of Biomolecular Markers for Fusarium Tolerance in Banana Cultivars	BAB	01-02-04-0382 PR0010/05-01	RM366,000

Table 5.

Strategic Research (SR) Grants (IRPA RM-8)—2001-2004.

SR *(7 Grants / RM57.6m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
1.	Institute of Bioscience (IBS)	Abdul Manaf bin Ali	Development and Production of genaticaally Recombinant Humanized Anti-Cancer Monoclonal Antibodies	HAS	03--02-04-0564-SR0008/05-05	RM12,101,160
2.	Science and Environmental Studies	Abdul Halim Shaari	Fabrication of Magnetic Sensor Head Based on Magnetoresistive and Magnetostrictive Thin Films Circuits for Device Applications	SAE	03-02-02-0015 SR0003/07-07	RM1,868,400
3.	Science and Environmental Studies	Taufiq Yap Yun Hin	Synthesis, Characterisation and Application of Multicomponent BiMoOx Catalysts for Propane Activation and Functionalisation to Acrylic Acids	MEE	03-02-02-3010 SR0002/05-05	RM4,018,550
4.	Veterinary Medicine	Arbakariya bin Ariff	Development and Production of Recombinaant Human Alpha-2b Interferon	SAE	03-02-04-0560-SR0008/05-01	RM12,417,160
5.	Veterinary Medicine	Mohd. Azmi bin Mohd. Lila	Development and Production of Anti Hepatitis B Recombiinant Vaccine	SAE	03--02-04-0561-SR0008/05-02	RM7,749,160
6.	Veterinary Medicine	Rasedee @ Mat Bin Abdullah	Development and Production of Combinant Human Erythropoietin	SAE	03--02-04-0563-SR0008/05-04	RM10,454,160
7.	Veterinary Medicine	Zarida binti Hambali	Development and Production of Therapeutic Epidermal Growth Factor (EGF Wound Healing Cream)	HAS	03--02-04-0562-SR0008/05-03	RM9,034,160

Table 6.

Top Down National Biotechnology Projects under National Biotechnology Directorate (NBD) (IRPA RM-8)—2001-2004.

NBD *(8 Grants / RM9.9m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
1.	Food Science and Biotechnology	Hasanah Mohd. Ghazali	Improving the functionality and nutritional qualities of fats and oils using biotechnological processes	BAB	09-02-04-004 BTK/ER/008	RM1,019,837

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
2.	Food Science and Biotechnology	Raha Abdul Rahim	Development of Recombinant Bacteria for Delivery of Functional Proteins	BAB	09-02-04-006 BTK/ER/024	RM1,089,600
3.	Medicine and Health Sciences	Seow Heng Fong	Molecular Approaches to the Diagnosis and Management of Systemic Fungal Infections	AFF	06-02-04-005 BTK/ER/023	RM1,493,100
4.	Science and Environmental Studies	Abu Bakar Salleh	The Effect of Conformation on Protein Function	BAB	09-02-04-001 BTK/ER/004	RM1,910,560
5.	Science and Environmental Studies	Khatijah Yusoff	Development of Novel Therapeutic and Diagnostic Reagent from Newcastle Disease Virus (NDV)	AFF	01-02-04-003 BTK/ER/006	RM1,769,400
6.	Science and Environmental Studies	Siti Shapor Siraj	Genome mapping in Malaysian freshwater catfish	BAB	01-02-04-008 BTK/ER/33	RM340,813
7.	Veterinary Medicine	Mohamed Shariff bin Mohamed Din	Improvement of shrimp health through biomediation and natural health food	AFF	01-02-04-002 BTK/ER/004	RM1,244,784
8.	Veterinary Medicine	Mohd. Zamri bin Saad	Alternative Control of Haemorrhagic Septicaemia in Cattle	AFF	01-02-04-007 BTK/ER/025	RM1,086,500

Table 7.

Fundamental Research (Short-term) Grants—2001-2004.

Fundamental *(164 Grants / RM5.4m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
1.	Agriculture	Abd. Razak Alimon	Enhancing The Nutritive Value of Palm Kernel Cake Through Fungal Treatment For Poultry Feed	03-07-02-0040S	RM15,000
2.	Agriculture	Ahmad Husni bin Mohd.Hanif	Sodium (Na)-for-Potassium (K) Substitution in Pineapple Plant	03-07-02-0039S	RM15,000
3.	Agriculture	Azizah @ Aminah Hashim	To Evaluate the Role of Arbursar mycorrhiza (AM) as the Decomposer Agent on Several Agricultural Residues either Single or in Combination with Other Beneficial Micro-organism (Rhizobacteria)	03-07-02-0027F	RM33,000
4.	Agriculture	Che Fauziah Ishak	Mechanism of Heavy Metals Retention in The Soil	03-07-02-0028F	RM30,000
5.	Agriculture	Dzolkhifli Omar	Spray Application and Formulation For Efficient and safe Control of Insect Pest	03-07-02-0029F	RM28,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
6.	Agriculture	Inon Sulaiman	Characterization of A Viral Pathogen With A 'Ringspot-like' Symptom On Papaya in Perak	03-07-02-0031F	RM33,000
7.	Agriculture	Loh Teck Chwen	Changes in the gut microflora of layers fed lactic acid bacteria fermented fish products.	03-07-03-021S	RM18,500
8.	Agriculture	Mohamad Idris Zainal Abidin	Induction of flowering in Japanes pear	03-07-02-0114F	RM30,000
9.	Agriculture	Mohd. Mokhtaruddin Ab. Manan	Water Retention Characteristics of Major Oil Palm Growing Soils In Malaysia.	03-07-02-0033F	RM37,500
10.	Agriculture	Mohd. Yusof Husin	Extraxtion, Identification and Bioassay of Plant Semiochemicals For Enhancing The Activities of Corn-borer Egg Pasitoid.	03-07-02-0041S	RM15,000
11.	Agriculture	Noorma Osman	Studies on the Effect of Heat Treatment, Botanical Insecticides and Pheromone on the Khapra Beetle Trogoderma granarium Everts	03-07-02-0032F	RM33,000
12.	Agriculture	Samsuri bin Abd. Wahid	Sorption of Hydrophobic Organic Compounds (HOCs) By Humic Substances	03-07-02-0034F	RM40,500
13.	Agriculture	Siti Aishah Hassan	Nutrient Uptake of Lowland Potted Chrysanthemums During Different Stages of Physiological Development	03-07-02-0030F	RM32,800
14.	Agriculture	Siti Hajar Ahmad	Biochemical changes during degreening process in banana.	03-07-03-020J	RM18,000
15.	Agriculture	Zaharah Abdul Rahman	Development and Use of Bioindicators in Assessing the Quality of Subsoil Materials Remediated with Farmyard Manure (FYM)	03-07-02-0043S	RM20,000
16.	Agriculture	Zakaria Sidek	Epidemialogical Studies of Cucurbit Viruses	03-07-02-0035F	RM31,000
17.	Agriculture	Zulkifli Idrus	Microbiological changes and immunocompetence of broiler chickens fed diets supplemented with herbs, antibiotics and organic acids.	03-07-03-022S	RM18,500
18.	Design and Architecture	Badrul Azmi Abdul Holed	A Study on Ergonomics of Soil Mixers Towards Increased Nursery Production of Ornamental and Landscape Plants	06-10-02-0096F	RM32,800
19.	Design and Architecture	Nordin Abd. Rahman	Planning and Designing of Open Spaces in Tropical Cities : How City Residents and Planners View The Outdoor Environment	06-10-02-0097F	RM40,500
20.	Economics and Management	Ahmad Zubaidi Baharumshah	Regional and multilateral trade liberalization : An econometric analysis of the ASEAN-5 countries.	06-02-03-004J	RM27,500
21.	Economics and Management	Ahmad Zubaidi Baharumshah	The ASEAN Currency Markets	06-02-02-0098S	RM15,000
22.	Economics and Management	Azman Hassan	Market Power in Malaysia Manufacturing Industries	06-02-02-0099S	RM15,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
23.	Economics and Management	Bany Ariffin Amin Noordin	Global Diversification and Firm's Value : An Investigation Based on Malaysia Multinational Corporations	06-02-02-0068F	RM10,725
24.	Economics and Management	Fatimah Mohd Arshad	The prospect of E-commerce for flowers in Malaysia : Distibutors' and consumers' perpectives.	06-02-03-005J	RM49,992
25.	Economics and Management	Kusairi bin Mohamed Noh	Analisis Konjoin Ekopelancongan di Kuala Selangor	06-02-02-0102S	RM11,000
26.	Economics and Management	Mohammed Yusoff / P.M.Azali Mohamed	Monetary Approach to Exchange Rate Detemination : A Case of ASEAN	06-02-02-0104S	RM15,000
27.	Economics and Management	Mohd. Shahwahid Hj. Othman	Principle of competitiveness of prioritized Malaysian wood-based products all along the value chain.	06-02-03-010K	RM47,200
28.	Economics and Management	Mohd. Shahwahid Hj. Othman	Theoritical basis of benchmarking manufacturing business.	06-02-03-011S	RM20,000
29.	Economics and Management	Muzafar Shah Habibullah	Asian economic and monetary union : Testing the theory of optimal currency area.	06-02-03-006J	RM46,214
30.	Economics and Management	Muzafar Shah Habibullah	Asymmetric Adjustment of Commercial Banck Interest Rates	06-02-02-0103S	RM15,000
31.	Economics and Management	Norashidah Mohamed Noor	Survivality Model for Small and Medium Scale Firms in Malaysia	06-02-02-0069F	RM19,080
32.	Economics and Management	Samsinar Md Sidin	Developing export marketing frame work for Malaysian wood-based furniture industry.	06-02-03-007J	RM49,353
33.	Economics and Management	Suhaila Abd. Jalil @ Mohd.Jalil	Concentration Model For Industries ; in the Emergence of ASEAN Free Trade Area (AFTA)	06-02-02-0105S	RM6,000
34.	Economics and Management	Tan Hui Boon	Index Arbitage Opportunities in the Malaysian Stock and Futures Markets	06-02-02-0100S	RM12,000
35.	Economics and Management	Tan Hui Boon	Trade Integration, Foreign Direct Investment and Technology Transfer in The ASEAN Region	06-02-02-0101S	RM15,000
36.	Economics and Management	Wan Azman Saini Wan Ngah	Asian monetary union : A quantitative assessment of generalized purchasing power parity theory.	06-02-03-003J	RM44,874
37.	Economics and Management	Wan Azman Saini Wan Ngah	Financial Liberalization and Votality Transmision of Equity Markets	06-02-02-0070F	RM32,520
38.	Economics and Management	Wong Foong Yee	Consumer's Purchasing Behavior Towards Imported Dairy Products	06-02-02-0071F	RM20,770
39.	Economics and Management	Zainal Abidin Mohamed	How information system and technology can help Malaysian food sector enter global market.	06-02-03-008J	RM50,000
40.	Economics and Management	Zulkarnanin Mohamad Sori	A Study of Corporate Distress and Financial Fragility in Selected Asian Country	06-02-02-0072F	RM18,052

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
41.	Economics and Management	Zulkornain Yusop	ASEAN economic integration : A theoritical assessment.	06-02-03-009K	RM92,000
42.	Educational Studies	Abdul Rahman Md. Aroff	Penelitian dan pemahaman tentang kesediaan pembelajaran untuk adab dan akhlak Islam KBSM.	06-05-03-019S	RM16,500
43.	Educational Studies	Asma Ahmad	Rekabentuk Program Latihan Pengurusan Perladangan Smallholders Plantation Sdn. Bhd. (RSPSB) Malaysia	06-05-02-0079F	RM13,000
44.	Educational Studies	Fauziah Hassan	For the Love of Reading : The Effects Extensive Reading on Language and Literary Skills	06-05-02-0078F	RM20,000
45.	Educational Studies	Habibah Elias	Effects of Combined Strategy Instruction and Attribution Retraining on Causal Atribution, Learning Strategies and Achievement of Lower Secondary Students	06-05-02-0107S	RM9,000
46.	Educational Studies	Habibah Elias	The relationship between the perception of success and achievement motivation among secondary school students in Selangor	06-05-02-0121F	RM27,000
47.	Educational Studies	Haziyah Hussin	Tahap Pengetahuan Asas Pelajar UPM : Perkaitan Spesis Tumbuhan Dengan Rekabentuk Motif Tekstil	06-05-02-0080F	RM30,000
48.	Educational Studies	Jamaliah Bt. Abdul Hamid	Knowledge management practices and school development.	06-05-03-018J	RM43,490
49.	Educational Studies	Jamilah Othman	Conflict Management in Malaysian Organizations	06-05-02-0081F	RM18,000
50.	Educational Studies	Kamariah Abu Bakar	Motivational Theory Underlying Students; Learning and Performance	06-05-02-0091F	RM31,300
51.	Educational Studies	Kamariah Abu Bakar	Acquisition of Sciences Process Skills in a Web-based Learning Environment	06-05-02-0108S	RM15,000
52.	Educational Studies	Khairuddin Idris	Theories Formulation on Learning Organisation in Malaysia	06-05-02-0082F	RM28,000
53.	Educational Studies	Mizan Adiliah Ahmad Ibrahim	An Evaluation Instrument for Individual Counselling Skills and the Aplication of Counselling Theories	06-05-02-0092F	RM20,400
54.	Educational Studies	Mohamed Fadzil Che Din	Profil Strategi Pembelajaran Pelajar-pelajar Sekolah di Malaysia	06-05-02-0083F	RM33,150
55.	Educational Studies	Mohd. Khairi Zawi	Determining gross Motor Development and Motor Profiency Lvel of Down Syndrome and Hearing-impaired Children Enrolled in Malaysian Schools	06-05-02-0089F	RM37,968
56.	Educational Studies	Mohd. Sofian Omar Fauzee	Hubungan Antara Keagraifan Dengan Prestasi Pemain : Aplikasi 'reserval frustration - aggression theory'	06-05-02-0084F	RM19,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
57.	Educational Studies	Noreen Nordin	Comparison of Visual Imagery Strategy and Conventional Strategy in the teaching of English For Science and Technology (EST)	06-05-02-0090F	RM3,824
58.	Educational Studies	Rohani Ahmad Tarmizi	Training Strategies for Transfer of Problem Solving Skills in Mathematics : A Cognitive Approach	06-05-02-0085F	RM16,000
59.	Educational Studies	Roxana Dev Omar Dev	Effects of Selected Local Herbs (Pegaga, jintan hitam, daun sadri, madu) and Omega Three on Cognitive and Physical Performance in Male Adolescent	06-05-02-0094F	RM15,000
60.	Educational Studies	Rusnani Abdul Kadir	Worldview and Counselling Preferrence : An Analouge Study	06-05-02-0086F	RM17,000
61.	Educational Studies	Saidon Amri	Assessment of Motor Skill Development Stages Among Standard One School Children in Malaysia and it's Relationship with Body Composition	06-05-02-0095F	RM30,000
62.	Educational Studies	Samsilah Roslan	A Theory in Teaching and Learning of Gifted Students	06-05-02-0087F	RM49,990
63.	Educational Studies	Shamsuddin Ahmad	Workplace Learning and Expertise Development by Malaysians Professional	06-05-02-0088F	RM30,000
64.	Educational Studies	Zaidatol Akmaliah Lope Pihie	The Practice of Transformational Leadership Among School Implication For School Effectiveness	06-05-02-0093F	RM31,000
65.	Engineering	Abdul Rashid bin Mohamed Shariff	Development of Precision Farming Technologies For Oil Palm Plantations	02-03-02-0016S	RM20,000
66.	Engineering	Ashraf Ali Omar	A Gas Kinetic Scheme For The Compressible Euler Equations	02-03-02-0017S	RM15,000
67.	Engineering	Badronnisa Yusof	Modelling the Effect of Vegetations on the Hydraulic Performance and the Roughness of a Tropical River / Chanel System	02-03-02-0012F	RM50,000
68.	Engineering	Ishak Aris	Development of Fuzzy Logic Based Position Estimation in Three-phase Brushless Permanent Magnet Motors	02-03-02-0013F	RM50,000
69.	Engineering	Ishak Aris	Development of e-Diabetes Monitoring System	02-03-02-0018S	RM15,000
70.	Engineering	Lee Teang Shui	Knowledge Based Reservior Inflow Forecasting	02-03-02-0113S	RM20,000
71.	Engineering	Mohamad Amran bin Mohd Salleh	Study of the characteristic time for sintering of glass/polymeric materials in a gas-solid fluidized bed.	02-03-03-015K	RM76,000
72.	Engineering	Mohammad Nizam Filipski Abdullah	Micro-Satellite Attitude Control System Design and Simulations	02-03-02-0019S	RM15,000
73.	Engineering	Mohibullah	Software development for the prediction of future of electrical energy demand in Malaysia.	02-03-03-014K	RM40,500

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
74.	Engineering	Napsiah Ismail	Reverse engineering technique for modeling and machining of free form surfaces.	02-03-03-016S	RM20,000
75.	Engineering	Nasrullah Khan	Design of a neural natwork based Harmanes filter	02-03-02-0112F	RM30,000
76.	Engineering	Nor Kamariah Noordin	Design and Development of Communication Adapter and its Applications Using Bluetooth Technology for 3rd and 4th Generation Mobile System	02-03-02-0020S	RM15,000
77.	Engineering	Nor Mariah Adam	Development of internet based expert system for solar system.	02-03-03-017S	RM20,000
78.	Engineering	Nor Mariah Adam	Expert System For Predicting and managing Thermal Cimfort For Building	02-03-02-0021S	RM20,000
79.	Engineering	Norhisam Misron	Development of new type of linear motor for large motor constant, high thrust and high speed.	02-03-03-012J	RM50,000
80.	Engineering	Norman Mariun	Custom Power Device for Power Quality Enhancement	02-03-02-0022S	RM15,000
81.	Engineering	Rimfiel Janius	Detachment of Oil Palm Fruitlets From the Fresh Fruit Bunch	02-03-02-0025S	RM15,000
82.	Engineering	Roslina Mohd. Sidek	Modelling of Submicron and Deep Submicron CMOS	02-03-02-0014F	RM39,500
83.	Engineering	Shamsuddin Bin Sulaiman	Fabrication of Three-Component Balance For Low Speed Wind Tunnel	02-03-02-0024S	RM15,000
84.	Engineering	Shamsudin Sulaiman	Study of lift and drag forces of aerodynamic shapes in the low speed wind tunnel.	02-03-03-013J	RM50,000
85.	Engineering	Yousif A. Khalid	Composite I Beams Behavior Under Crusing and Bending Loading Modes	02-03-02-0023S	RM15,000
86.	Engineering	Zairil Azhar Zaludin	Automatic Flight Control System Design For An Unmanned Aerial Vehicle	02-03-02-0015F	RM20,000
87.	Food Science and Biotechnology	Foo Hooi Ling	Screening and Characterization of Lipase Produced by Benefiacial Latic Acid Bacteria Isolated from Malaysia Fermented Foods	05-13-02-0061F	RM32,500
88.	Food Science and Biotechnology	Gulam Rusul Rahmat Ali	The Use of Mixture of Organic Acids to Enhance the Shelf-life of Poultry in Malaysia	03-13-02-0045S	RM16,000
89.	Food Science and Biotechnology	Ho Chai Ling	Molecular Cloning of Mannuronan C-5-epimerase from Brown Alga, Sargassum binderii	05-13-02-0062F	RM15,000
90.	Food Science and Biotechnology	Noorjahan Banu Mohamed Alitheen	The development of in vitro model representative of lymphoid organs for the study of organogenesis and host-pathogen interaction.	05-13-03-040J	RM50,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
91.	Food Science and Biotechnology	Norihan Mohd. Salleh	Molecular Studied on Bacteriocin Gene from Lactobacillus plantarum	05-13-02-0065S	RM15,000
92.	Human Ecology	Laily Paim	Penggunaan Lestari: Pembentukan indeks keprihatinan persekitaran	06-01-02-0119F	RM30,000
93.	Human Ecology	Mohammad Shatar Sabran	Keberkesanan Projek Ladang Merdeka Membasmi Kemiskinan	06-01-02-0066F	RM11,819
94.	Human Ecology	Mohd. Sharani Ahmad	Identification of Children's Conductive Hearing Loss in An Educational Computer Environment.	06-01-02-0067F	RM42,740
95.	Institute of Advanced Technology (ITMA)	Nik Mohd. Asri Nik Long	Solving Punch Problems in Elastic Half-space	01-20-02-0008F	RM23,000
96.	Institute of Bioscience (IBS)	Asmah Bt. Rahmat	Antioxidant activity of essential oil from Murraya koenigii and Polygonum minus and their effect on cancer cells proliferation.	05-14-03-043K	RM100,000
97.	Institute of Bioscience (IBS)	Daud Ahmad Israf Ali	Elucidation of the mechanism of inflammatory mediator suppression by the phytochemical, AR3.	05-14-03-045K	RM87,100
98.	Institute of Bioscience (IBS)	Fauziah Othman	Elemental analysis and enzime activity during hepatocarcinogenesis treated with strobilanthes crispus.	05-14-03-044K	RM32,000
99.	Institute of Bioscience (IBS)	Mohd. Roslan Bin Sulaiman	Evaluation of the antinociceptive and anti-inflamatory activities of pegaga (Centella asiatica) and lengkuas kecil (Alpina conchigera) extracts in mice, in vivo.	05-14-03-041K	RM80,000
100.	Institute of Bioscience (IBS)	Sharida Bt. Fakurazi	A liver ultrastructural study following diclofenac and ibuprofen treatment.	05-14-03-042K	RM100,000
101.	Institute of Bioscience (IBS)	Zarida binti Hambali	To Determine the Level of High Sensitive C-Reactive Protein (CRP) and Further Eavaluate its Usefulness in Asymptomatic Adults Population with Risk Factors of Developing Coronary Heart Disease	04-09-02-0054F	RM33,000
102.	Institute of Community Development and Youth Studies (PEKKA)	Jamilah Othman	Understanding Cooperation In Organization	06-17-02-0109S	RM15,000
103.	Malaysian Graduate School of Managemen	Mohd. Azhar Abdul Karim	Disentangling horizontal and vertical intra industry trade : A marginal approach.	06-21-03-047K	RM50,216

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
104.	Malaysian Graduate School of Management	Raduan Hj. Che Rose	Developing a competemcy-based research frame work for analyzing the strategic interrelationship between globalization and human resource management.	06-21-03-046J	RM38,590
105.	Malaysian Graduate School of Management	Zainal Abidin Kidam	An agent based model of stock market.	06-21-03-048K	RM66,968
106.	Medicine and Health Sciences	Ahmad Farouk Musa	Investigation on the effectiveness of endoscopic saphenous vein harvesting.	04-08-03-024K	RM100,000
107.	Medicine and Health Sciences	Chan Hooi Har	The Angiogenic Role of Endothelins in Hepatocellular Carcinoma	04-08-02-0046F	RM46,737
108.	Medicine and Health Sciences	Chong Pei Pei	Molecular Characterization of the Virulence Factors of Candida krusei	04-08-02-0047F	RM39,600
109.	Medicine and Health Sciences	Elizabeth George	Real-time Quantitative PCR Analysis For [alpha]-thala semia-1 of Southeast Asian Type Deletion in Malaysia	04-08-02-0048F	RM50,000
110.	Medicine and Health Sciences	Hejar Abdul Rahman	Behavorial lifestyles among upper six students in Selangor. (Tajuk lama : Road Traffic Safety Among Secondary School Students in Sepang District)	04-08-02-0049F	RM22,000
111.	Medicine and Health Sciences	Latiffah A. Latif	An In-Vivo study on effect the nigella sativa (Habatussauda) on neurotransmitter activities in Parkinson's induced rats.	04-08-03-023K	RM100,000
112.	Medicine and Health Sciences	Latiffah A. Latif	Prevalance of Neisseria meningtidis in a Throat and asopharyngeal Swab Survey of Returning Malaysian Haj Pilgrims 2002	04-08-02-0055F	RM49,374
113.	Medicine and Health Sciences	Norhaizan Mohd. Esa	A comparative study on the profile of lipoprotein classes in young and healthy subject from different races.	04-08-02-0115F	RM30,000
114.	Medicine and Health Sciences	Zaiton Ahmad	Geriatric Assessement Among the Elderly Inmates in the Rumah Kenangan homes	04-08-02-0050F	RM24,000
115.	Medicine and Health Sciences	Zalilah Mohd. Shariff	Nutrition and Academic Achievement Among Primary School Children	04-08-02-0051F	RM38,800
116.	Modern Languages Studies and Communication	Chan Swee Heng	ESL Academic Writing Skills : Establishing Knowledge Bases, Attitudes and Processes	06-02-02-0104S	RM5,075
117.	Modern Languages Studies and Communication	Lee Geok Imm	Cognitive Approach : A Study of Communication Strategies in Second Language Use	06-04-02-0076F	RM5,350

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
118.	Modern Languages Studies and Communication	Md.Salleh Hj. Hassan	Perlaksanaan Komunikasi Kepimpinan dalam Organisasi di Kalangan Pengamal - pengamal Pengurusan Kualiti di Malaysia	06-04-02-0106S	RM12,000
119.	Modern Languages Studies and Communication	Noor Aina Dani	Realiti Perubahan Bahasa : Daripada Bahasa Ibunda kepada Bahasa Melayu	06-04-02-0073F	RM15,000
120.	Modern Languages Studies and Communication	Rosli Talif	Cultural hybridity in Ahdaf Soueif's English fiction.	06-04-03-001S	RM4,470
121.	Modern Languages Studies and Communication	Shameem bt Mohd. Rafik Khan	The development of students' argumentative writing ability.	06-04-03-002S	RM8,080
122.	Modern Languages Studies and Communication	Shameem Rafik Khan	Vocabulary Acquisition and Learning Strategies in a Foreign Language	06-04-02-0074F	RM14,900
123.	Modern Languages Studies and Communication	Wong Bee Eng	The Effects of Vocabulary Development on Text Comprehension	06-04-02-0075F	RM6,534
124.	Science and Environmental Studies	Abdul Halim Shaari	Fabrication and Characterization of Superconducting Materials Via Coprecipitation Technique	01-11-02-0010S	RM15,000
125.	Science and Environmental Studies	Abdullah Sipat	Sub-cloning of The Xylanase Gene of Fibrobacter Succinogenes S85 From The Recombinant Xylanolytic Plasmid pBX6 using PCR	05-11-02- 0057F	RM45,000
126.	Science and Environmental Studies	Fudziah Ismail	Solving Ordinary and Delay Differential Equations Using Block Runge-kutta Method	01-11-02-0009S	RM15,000
127.	Science and Environmental Studies	Habshah binti Midi	An interior point algorithm for non-linear regression estimation.	01-11-03-029K	RM67,000
128.	Science and Environmental Studies	Halimah Mohamed Kamari	Elastic and Electrical Properties of Quaternary Glasses From System AgI-AgI2O-Te02.B203	01-11-02-0005F	RM29,000
129.	Science and Environmental Studies	Hamdan Noor	Fundamental Understanding of Biological Concepts Via Development of Multimedia Skills in School Children	03-11-02-0037F	RM25,000
130.	Science and Environmental Studies	Idris Abd. Ghani	Ecology and Growth of Green Mussel (Perna viridis)	03-11-02-0036F	RM33,100

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
131.	Science and Environmental Studies	Ionel Valeriu Grozescu	Heat conduction modeling for laser and microwave heating using finite difference method.	01-11-03-028K	RM77,600
132.	Science and Environmental Studies	Jumiah Hassan	The investigation of the dielectric properties of rubber wood and its composites at low frequencies with respect to the equivalent circuit modelling.	01-11-03-026J	RM50,000
133.	Science and Environmental Studies	Jumiah Hassan	Dielectric properties of nickel-zinc ferrites at frequencies 10-2 to 106Hz and temparatures 30-3500C	01-11-02-0111F	RM30,000
134.	Science and Environmental Studies	Karen A. Crouse	Nitrogen-sulfur donor ligands and their metal complexes : Coordination chemistry and electrical properties.	01-11-03-035S	RM20,000
135.	Science and Environmental Studies	Karen Badri	X-ray crystal structures of nitrogen-sulfur, nitrogen-oxygen-sulfur donor ligands and their complexes.	01-11-03-036S	RM20,000
136.	Science and Environmental Studies	Mahendran Shitan	Regrassion Models With Second-order Spatially Correlated Errors	01-11-02-0002F	RM10,000
137.	Science and Environmental Studies	Malik bin Hj. Abu Hassan	A mathematical model for optimal controlling of river water pollution.	01-11-03-031K	RM80,100
138.	Science and Environmental Studies	Mohammad Firuz Ramli	Landslide Hazard Mapping For Cameron Highlands	01-11-02-0003F	RM30,000
139.	Science and Environmental Studies	Mohd. Kamil Yusoff	The Study of Nutrient (N&P) removal by Two Wetland Plants (Phragmites karka and Lepironia articulata) in Pilot Tank Systems and Fields Study at Putrajaya Wetlands (UN 4-6)	03-11-02-0038F	RM32,000
140.	Science and Environmental Studies	Mohd. Yunus Abd. Shukor	Screening of Bacteria With Pesticide Degrading Ability	05-11-02- 0058F	RM43,000
141.	Science and Environmental Studies	Mohd. Zobir Bin Hussein	Kinetic Studies of Organic Ions Adsorption From Aqueous Systems	05-11-02- 0059F	RM30,000
142.	Science and Environmental Studies	Muhammad Awang	Indirect florescence technique for study of stress induced changes in plants.	03-11-03-039K	RM100,000
143.	Science and Environmental Studies	Muskhazli Mustafa	The Production of Volatile Antifungal by Bacillus subtilus	05-11-02-0060F	RM35,000
144.	Science and Environmental Studies	Noorhana Yahya	Synthesis and Characterisations of Carbon Nanotubes (Single wall nanotubes and multi wall nantubes) Prepared By Pulse Laser Ablasion Deposition Technique.	01-11-02-0004F	RM35,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
145.	Science and Environmental Studies	Rustem Suncheleev	Interactive and Animated Mathematics For Math Education	01-11-02-0006F	RM30,000
146.	Science and Environmental Studies	Saberi Othman / Dr.Misri Kusnan	Copper, Zink, Aluminium and Manganese in Mangrove Ecosystem and Their Effect To Manrove Productivity	03-11-02-0044S	RM15,000
147.	Science and Environmental Studies	Sidek Hj. Ab. Aziz	Determination of thermal and ultrasonic properties of bismate glasses.	01-11-03-027J	RM50,000
148.	Science and Environmental Studies	Sidek Hj. Ab. Aziz	Determination of Ultrasonic Properties of Borate and Phospate Glasses	01-11-02-0011S	RM20,000
149.	Science and Environmental Studies	Tan Soon Guan	Isolation, Characterization and Aplication of Microsatellite Markers For The Genetic Evaluation of Mungbean (Vigna radiata)	05-11-02-0064S	RM10,000
150.	Science and Environmental Studies	Wan Daud Wan Yusoff	Microstructure-dielectric properties relationship of giant dielectric constant materials based on AxCa1-xCuTi4O12.	01-11-03-030K	RM92,500
151.	Science and Environmental Studies	Wan Mahmood bin Mat Yunus	Investigation of electro-photon interaction in (CdTe)1-xTex composites system.	01-11-03-032K	RM100,000
152.	Science and Environmental Studies	Wan Md. Zin Wan Yunus	Effect of metal ions on the formation of fatty hydroxamic acids complexes.	01-11-03-037S	RM19,000
153.	Science and Environmental Studies	Wan Nor Azmin Sulaiman	Low Flow Analysis of Selected River Catchments During Inter-monsoon Season	01-11-02-0007F	RM32,000
154.	Science and Environmental Studies	Zaidan Abdul Wahab	Thermal Expansion Study of Epoxidised Natural Rubber	01-11-02-0001F	RM45,500
155.	Science and Environmental Studies	Zainal Abidin Talib	Investigation of ionic conductivity, relaxation and band transistions in fast ion conducting glass.	01-11-03-033K	RM100,000
156.	Science and Environmental Studies	Zainal Abidin Talib	To determine the influence of transition metal ion density in phosphate glass.	01-11-03-038S	RM20,000
157.	Science and Environmental Studies	Zulkarnain bin Zainal	Photooxidation of organic compounds using oxide semiconductor thin films photocatalyst.	01-11-03-034K	RM50,000
158.	Veterinary Medicine	Abdullah Sipat	Development of A Quantitative Assay For Deoxyribonuclease From The Latex of Hevea brasiliensis	05-11-02-0063S	RM15,000
159.	Veterinary Medicine	Arifah Abdul Kadir	Anti-imflammatory Effect of Yam (Dioscorea spp.) in Mice	04-09-02- 0056S	RM20,000

No.	Faculty/ Institute	Researcher	Innovation	Project Number	Allocation
160.	Veterinary Medicine	Latiffah Hassan	Antimicrobial Resistance Pattern of Salmonella and Enterococcus faecium from Farm Animals	04-09-02-0117F	RM30,000
161.	Veterinary Medicine	Mohamed Ali Rajion	Dietary manipulation to increase essential polyunsaturated fatty acids in local freshwater fishes	04-09-02-0116S	RM20,000
162.	Veterinary Medicine	Shanti Ganabadi	MHCII+cells in Experimentally Induced Osteoarthritis and Rheumatoid Arthritis	04-09-02-0053F	RM30,500
163.	Veterinary Medicine	Siti Zubaidah Ramanoon	Efficacy of pre and post milking tead dipping and dry cow therapy in bovine mastitis	04-09-02-0118S	RM20,000
164.	Veterinary Medicine	Zunita Zakaria	Investigation of antibiotic resistance in Stapyloccocus aureus of animal origin.	04-09-03-025J	RM50,000

Table 8.

International Research Grants—2001-2004.

International Research Grants *(21 Grants / RM24.3m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Allocation
1.	Agriculture	Mohd. Razi Ismail	Environmental Stress Impact	MEE	RM45,000
2.	Agriculture	Said Saad	Rationalization of Sweet Potato Germplasm	AFF	RM30,780
3.	Agriculture	Siti Zauyah Darus	Assessment of Heavy Metals in Vegetables and Soils in Southern Peninsular Malaysia	AFF	RM10,174
4.	Agriculture	Zaharah Abdul Rahman	Integrated Nutrient and Water Management in Agroforestry System for Sustained Food Crop	AFF	RM184,240
5.	Agriculture	Zaharah Abdul Rahman	Oil Palm Project	AFF	RM1,436,400
6.	Economics and Management	Mohd. Shahwahid Hj. Othman	Role of Economic Valuation in Environmental Planning and Policy	EAM	RM80,000
7.	Economics and Management	Mohd. Shahwahid Hj. Othman	Behavior of Timber Concessional in Response to Select Policy Instruments: Case of Peninsular Malaysia	EAM	RM15,000
8.	Engineering	Shahnor Basri	Boundary Element Analysis in Elastohydrodynamic Lubrication	SAE	RM350,000
9.	Food Science and Biotechnology	Son Radu	Evaluation of the Possible Risk of Cookies Contamination by Vibrio parahaemolyticus	BAB	RM5,000,000

10.	Food Science and Biotechnology	Son Radu	Diversity of endophytes of Malaysian Plants and Their Ecological and Taxanomic Characteristics	BAB	RM30,000
11.	Food Science and Biotechnology	Son Radu	The Dynamics of Flows and Movement in Southeast Asia	BAB	RM250,000
12.	Food Science and Biotechnology	Son Radu	Risk Assessment of Vibrio parahaemolyticus in Shrimp	HAS	RM3,000,000
13.	Forestry	Faridah Hanum Ibrahim	Rehabilitation Technology for Tropical Woodland Forest	AFF	RM350,000
14.	Forestry	Nik Muhamad Abd. Majid	Rehabilitation of Degraded Forest Land	AFF	RM80,618
15.	Science and Environmental Studies	Fatimah Md.Yusoff	Marine Biodiversity	AFF	RM50,000
16.	Science and Environmental Studies	Mohd. Basyaruddin Abd. Rahman	Kinetics of Enzymes	BAB	RM32,300
17.	Science and Environmental Studies	Mohd. Ibrahim Mohamed	Aquatic Resources and Environment Studies of the Straits of Malacca	MEE	RM13,000,000
18.	Veterinary Medicine	Abd. Wahid Haron	Fecal Analysis for Reproductive Hormones in Sumatra Rhinos	BAB	RM56,850
19.	Veterinary Medicine	Latiffah Hassan	Risk Assessment of P.multocida B-2 in Peninsular Malaysia	BAB	RM45,600
20.	Veterinary Medicine	Mohamed Shariff bin Mohamed Din	Hazard Analysis of Antimicrobial Resistance Associated with Asian Aquacultural Environmental	MEE	RM230,000
21.	Veterinary Medicine	Rehana Abdullah Sani	Development and Testing of an Integrated Approach to the Control of Gastro-intestinal Parasites of Small Ruminants in South and South East Asia	HAS	RM11,300

Table 9.

National Research Grants—2001-2004.

National Research Grants *(41 Grants / RM12.9m as of April 2004)*

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Allocation
1.	Agriculture	Abdul Shukor Juraimi	Penghasilan Bioherbisid untuk Pengawalan Rumpai Secara Biologi	AFF	RM218,000

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Allocation
2.	Agriculture	Christopher Teh Boon Sung	Bagaimana Kelapa Sawit (Elaeis guineesis) Menangkap Sinaran Sria dan Cara Mengoptimumkan Penangkapannya untuk Meningkatkan Kadar Tumbesaran dan Hasil Tanaman	AFF	RM100,000
3.	Agriculture	Hafidzi Mohd.Noor	Pemindahan Burung Pungguk ke Projek Padi Gedung	AFF	RM10,000
4.	Agriculture	Hafidzi Mohd.Noor	Kawalan Tikus di Petaling Jaya	HAS	RM79,000
5.	Agriculture	Mohd. Fauzi Ramlan	Effects of Slow Release Fertiliser on MAB Plantation	AFF	RM15,000
6.	Agriculture	Mohd. Fauzi Ramlan	Eradication of Bamboo Under HVTL	AFF	RM198,000
7.	Agriculture	Mohd. Fauzi Ramlan	The Effects of MTF Formulation on Three Soil Series for Oil Palm Production in TSK Hulu Kinta	AFF	RM15,000
8.	Agriculture	Mohd. Khanif Yusop	Penyelidikan Urea	AFF	RM590,116
9.	Agriculture	Mohd. Mokhtaruddin Ab. Manan	Use of Sewage Sludge as Oil Amendent	MEE	RM180,000
10.	Agriculture	Zaharah Abdul Rahman	Labelled Nutrient Uptake by Sago Palm	AFF	RM165,000
11.	Educational Studies	Petri Zabariah Megat A. Rahman	Kemahiran Komunikasi Keilmuan Ibubapa Melalui Pakej Perangsang Komunikasi, Pendidikan Awal Kanak-Kanak	SSH	RM70,000
12.	Educational Studies	Sharifah Mad Nor	K-Family	SSH	RM60,000
13.	Engineering	Abang Abdullah Abang Ali	Malaysian Engineering Education Model	SAE	RM29,500
14.	Engineering	Abang Abdullah Abang Ali	Penyelidikan Rumah Kos rendah	SAE	RM1,580,000
15.	Engineering	Abang Abdullah Abang Ali	Krusi Selangor Darul Ehsan	SAE	RM600,000
16.	Engineering	Azmi Yahya	Mesin Membancuh Campuran Tanah dan Menyedia Anak Benih Sawit dalam Polibag	SAE	RM70,000
17.	Engineering	Azni Idris	High rate Anaerobic Digestion Systems	HAS	RM120,000
18.	Engineering	Azni Idris	Sewage Treatement Project	MEE	RM42,000
19.	Engineering	Barkawi Sahari	Water Pipe Project	SAE	RM40,000
20.	Engineering	Fakhru'l-Razi Ahmadun	Colour Removal by Membrane Filtraion	SAE	RM60,000
21.	Engineering	Mohd. Amin Mohd. Soom	Centre of Tides	MEE	RM48,240

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Allocation
22.	Engineering	Radin Umar Radin Sohadi	Road Safety Research Centre	SAE	RM1,200,000
23.	Engineering	Shamsuddin Bin Sulaiman	MLVK-Metal Machining	SAE	RM208,449
24.	Engineering	Shattri Mansor	Wave-Spectra	SAE	RM204,545
25.	Food Science and Biotechnology	Ali Hassan	Development of a Novel Process to Produce Bio-Acid, Bio-plastic and Compost From Organic Waste	BAB	RM3,092,040
26.	Food Science and Biotechnology	Hirzun Mohd.Yusof	Development of Genetically Engineered S.cerevisease for Sago Starch Hydrolysis	BAB	RM35,000
27.	Food Science and Biotechnology	Ho Chai Ling	Genetic Engineering of Seaweed for better properties of Alginate: Molecular cloning of Mannuronan C-5 Epimerase from Brown Alga, Sargassum Binderii	BAB	RM30,000
28.	Food Science and Biotechnology	Son Radu	Prevalance and Molecular Characterization of Enterohaemorrhagic Escherichia coli 0157:H7	BAB	RM30,000
29.	Forestry	Jalaluddin Harun	Kenaf Fibre Utilization	AFF	RM350,000
30.	Institute of Bioscience (IBS)/FSMB	Arbakariya Ariff	Utilization of Microorganisms And Enzymes For The Production And Improvement Of Starch - Based Foods And Food Ingredients	BAB	RM240,000
31.	Medicine and Health Science	Maznah bt. Ismail	Studies on the Health Benefits of Rice and Rice Bran	HAS	RM120,000
32.	Medicine and Health Sciences	Muhammad Nazrul Hakim Abdullah	Toxicity and Anti-cancer Properties of NSAID Piroxicam and Mafenamic Acid	HAS	RM25,000
33.	Medicine and Health Sciences	Sharida Fakurazi	Mitochondria Ultrastructural Study Following Diclofenac and Ibuprofen Treatment	HAS	RM30,000
34.	Science and Environmental Studies	Aziz Arshad	Breeding characteristic and genetic manipulation of locally reared freshwater crayfish red claw (characquad ricarinapus)	SAE	RM20,000
35.	Science and Environmental Studies	Mohd. Nasir Hassan	Intrusive Site Investigation of an Illegal Dumping Site a "Program Perumahan Rakyat di Lot 24776, Kg. Batu Muda, Mukim Batu, K.L"	MEE	RM212,999
36.	Science and Environmental Studies	Mohd. Nasir Hassan	EIA on the Proposal Resourced Recovery Center-Waste to Energy at Lot 304 and Lot 3042, Mukim Ulu Semenyih, Ulu Langat District, Selangor	MEE	RM314,910

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Allocation
37.	Science and Environmental Studies	Nakisah Mat Amin	The mechanism of action of some medicinal plants extracts on amoebae	SAE	RM40,000
38.	Science and Environmental Studies	Siti Shapor Siraj	Breeding and Culture of the Malaysian Masheer (Ikan Kelah)	BAB	RM74,000
39.	Science and Environmental Studies	Siti Shapor Siraj	Genome mapping in Malaysian freshwater catfish	BAB	RM670,000
40.	Science and Environmental Studies	Siti Shapor Siraj	Reproductive biology and breeding trials of Malaysian mahseer	BAB	RM74,000
41.	Veterinary Medicine	Aini Ideris	Development of Effective Broad Spectrum Cancer Vaccine	AFF	RM1,620,000

Table 10.

Consultancies & Contract Research/IGS Grants—2001-2004.

Consultancies *(101 Grants / RM11.4m as of April 2004)*

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
1.	Agriculture	Ahmad Husni B. Mohd. Hanif	Soil Survey	Pelbagai Agency	RM7,000
2.	Agriculture	Ismail Latif	Projek perundingan ikan Tuna	Jabatan Perikanan	RM23,000
3.	Agriculture	Mad Nasir B. Hj Shamsuddin	Study to reinvent the federal agricultural marketing authority's (FAMA) market intelligence division into a world class agricultural information provider for the nation	Deloitte Kassim Chan Management Consultants Sdn.Bhd.	RM28,750
4.	Agriculture	Mahmud Tengku Muda Mohamed	Agricultural Rehabilitative Facilities Consultancy Services	TH Universal Builders Sdn.Bhd.	RM10,000
5.	Agriculture	Syed Omar Syed Rastan	Projek perundingan untuk Diversatech Sdn. Bhd	Diversatech Sdn.Bhd.	RM10,000
6.	Economics and Management	Ahmad Shuib	Penyediaan Pelan Pengurusan Rizab Hidupan Liar Pulau Tioman, Pahang	Jabatan PERHILITAN	RM204,000
7.	Economics and Management	Ahmad Shuib	Cost Reveniew Forecast & Financial Option Zoo Negara Baru	Jabatan PERHILITAN	RM190,000
8.	Economics and Management	Iskandar Abdullah	Projek kajian kepuasan pengguna	Perbadanan Pembekalan Letrik Sarawak (SECSO)	RM55,075
9.	Educational Studies	Abu Daud Silong	Kajian Lifelong Learning	Pelbagai Agency termasuk UNESCO	RM111,000

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
10.	Educational Studies	Abu Daud Silong	Kajian Persepsi Pelajar terhadap perpaduan negara	Jabatan Perpaduan Negara	RM45,000
11.	Educational Studies	Abu Daud Silong	Perkhidmatan Perundingan Pengkalan Data Pusat Rujukan Sosial	Jabatan Perpaduan Negara	RM45,000
12.	Educational Studies	Azimi B. Hamzah	Kerjasama PEKKA dan Charles Stuart University	Kementerian Pendidikan	RM36,000
13.	Educational Studies	Maimunah	Projek Perundingan	UNESCO	RM35,000
14.	Educational Studies	Maimunah	Projek Perundingan	UNESCO	RM35,000
15.	Educational Studies	Mazanah Bt. Muhamad	Emerging Paradigm in Program Planning	Pelbagai Agency	RM6,000
16.	Educational Studies	Mazanah Bt. Muhamad	Emerging Paradigm in Program Planning	Pelbagai Agency	RM6,000
17.	Educational Studies	Petri Zabariah Bt. Megat Abd. Rahman	Kajian Bahan Pengajaran dan Pembelajaran Pra Sekolah	EDU World Services	RM38,000
18.	Educational Studies	Petri Zabariah Bt. Megat Abd. Rahman	Kajian Bahan Pengajaran dan Pembelajaran Pra Sekolah	EDU World Services	RM38,000
19.	Educational Studies	Shamsuddin Ahmad	Kajian Pembangunan Sumber Manusia	Bahagian Kemahiran MARA	RM49,970
20.	Engineering	Azhar Mohamed Nasir	Strategic information system plan	MTDC	RM440,000
21.	Engineering	Azni Bin Hj. Idris	Sewage at Rubber Plantation works (IWK)	IWK Sdn.Bhd.	RM89,000
22.	Engineering	Azni Bin Hj. Idris	Sewage at Rubber Plantation works (IWK)	IWK Sdn.Bhd.	RM50,976
23.	Engineering	Azni Bin Hj. Idris	Penyelidikan Kontrak UPM & IFA Asia Sdn. Bhd	IFA Asia Pacific Sdn.Bhd.	RM365,000
24.	Engineering	Borhanuddin Mohd. Ali	Penyelidikan Kontrak UPM & Innodium Sdn. Bhd	Innodium Sdn.Bhd.	RM150,000
25.	Engineering	Husaini Omar	Projek IKS Pekan Banting	PKNS Engineering & Construction Bhd.	RM11,000
26.	Engineering	Ir. Radin Umar Radin Sohardi	Peningkatan Sistem Keutamaan Dan Dapat Kembali Pangkalan Data Kemalangan	Kementerian Kerjaraya	RM1,197,030
27.	Engineering	Ir.Radin Umar Radin Sohardi	Peningkatan Sistem Keutamaan Dan Dapat Kembali Pangkalan Data Kemalangan-Abendum 2	Jabatan Kerja Raya (JKR)	RM760,000
28.	Engineering	Lau Teik Hwa	Geographical Information system (GIS) for Cars Project (KDN/ POL/PT/54/2002)	D.G Kom	RM 450,00.00

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
29.	Engineering	Mohamad Khazani Abdullah	Fibner Characterization for time fiber network	TTdot Com.	RM99,000
30.	Engineering	Mohamad Khazani Abdullah	Penyelidikan Kontrak UPM & Significant Technology Sdn.Bhd	Significant Technology Sdn.Bhd.	RM220,917
31.	Engineering	Mohamed B. Daud	Projek Rambutan	Unit Perancang Ekonomi (EPU)	RM 1,492,000
32.	Engineering	Nor Mariah Adam	Study on effects of ventilating fan in kitchen and toilet area	Matsushita	RM70,000
33.	Engineering	Norman Mariun	Penyelidikan Kontrak UPM & Measers Sdn. Bhd	Measers Sdn.Bhd.	No Fixed Rate
34.	Engineering	Sa'ari Mustafa	Preparing Cimah Safety Report	LAKU Management Sdn.Bhd.	RM67,000
35.	Engineering	Saari Mustafa	preparing Cimah Safety Report	LAKU Management Sdn. Bhd.	RM67,000
36.	Engineering	Shatri Mansor	Projek cadangan peningkatan Sistem DPDS-GIS	Jabatan Perancang Bandar & Desa Perak	RM36,000
37.	Food Science and Biotechnology	Sharifuddin	Kajian Risk Assessment of Vibrio parahaemolyticus	Kementerian Kesihatan	No Fixed Rate
38.	Forestry	Awang Noor Abd. Ghani	Timber Harvesting System	Jabatan Perhutanan Sabah	RM49,798
39.	Forestry	Awang Noor Abd. Ghani	Development of Local volume table for mangrove forest in Pahang Darul Makmur	Pahang State Forestry Department	RM37,200
40.	Forestry	Awang Noor Abd. Ghani	Analisis Data Hutan Simpan Rompin Pahang	Jabatan Perhutanan Pahang	RM49,998
41.	Forestry	Awang Noor Abd.Ghani	Sistem Penuaian Hutan	Jabatan Perhutanan Sabah	RM31,200
42.	Forestry	Azani Alias	Forest Tree Survey	In-Site Design	RM68,000
43.	Forestry	Azlizam B. Aziz	Pelan Pembangunan Kemudahan Aktiviti Rekreasi Kuala Jarun, Pahang	Jabatan PERHILITAN	RM49,500
44.	Forestry	Faridah Anom	The development of Perlis State Park	WWF	RM49,000
45.	Forestry	Kamarudin Md Nor	Kajian tahan penerimaan perubahan di taman negara Pahang	PERHILITAN	RM71,532
46.	Forestry	Kamarudin Md Nor	Taman negara inter pretive center planning	Jabatan PERHILITAN	RM46,400
47.	Forestry	Kamaruzaman Jusoff	Airbone Remote Sensing Sdn. Bhd	Netniaga Sdn.Bhd. Aeroscan Precision Sdn.Bhd.	RM15,000

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
48.	Forestry	Kamaruzaman Jusoff	Projek perundingan antara UPM dengan Netniaga	Netniaga Sdn.Bhd.	RM120,000
49.	Forestry	Lim Meng Tsai	Development of Lanjak Entimau Wildlife sanctuary as a totally protect area. Phase II	ITTO	RM12,000
50.	Forestry	Manohar Mariapan	Projek perancangan interpretasi Taman Negara, Kuala Tahan, Pahang	Jabatan PERHILITAN	RM48,000
51.	Forestry	Mohd Ariff Jamaluddin	Pelan Pengurusan taman negara Kelantan dan Terengganu	Jabatan PERHILITAN	RM90,468
52.	Forestry	Mohd Zin Jusoh	Penyediaan rancangan pengurusan hutan 2001-2010	Kompleks Perkayuan Kelantan	RM167,150
53.	Forestry	Syed Omar Syed Rastan	Technical Advisor and consultant to Pertanian Farmix	Pertanian Farmix Sdn.Bhd.	RM10,000
54.	Forestry	Wan Sabri Wan Masud	Kajian ekopelancongan taman negara	Jabatan PERHILITAN	RM109,178
55.	Human Ecology	Jariah Masud	Benchmarking for rural information centre	INFRA	RM38,000
56.	Human Ecology	Jariah Masud	Modul Latihan Bidget Kebajikan	Kementerian Perpaduan	RM75,000
57.	Human Ecology	Jariah Masud	Kajian Falsafah dan strategi baru pembangunan luar bandar	INFRA	RM180,317
58.	Human Ecology	JayaLetchumi	Program management and development for children with special needs	Future Minds Centre	RM3,000
59.	Human Ecology	Rozumah Baharudin	Tingkah laku pra sosial dan kecemerlangan pelajar	Kementerian Pendidikan	RM204,840
60.	Human Ecology	Sharifah Norazizan	Urban design and architectural design for parcel Z for presint 1, PutraJaya	Putrajaya Holdings	RM13,000
61.	Research Management Centre	Mohd Shahwahid Hj. Othman	A model project for cost Analysis to achieve sustainable forest management	FRIM	RM210,000
62.	Science & Environmental Studies	Mohd Kamil Yusuf	Operasi Hutan di Kawasan Konsesi	Kompleks Perkayuan Kelantan	RM103,675
63.	Science & Environmental Studies	Mohd Kamil Yusuf	Penilaian kesan alam sekitar (EIA), projek pembangunan tanah tinggi di loging Kelantan	Perbadanan Kemajuan Iktisas Negeri Kelantan	RM80,000
64.	Science & Environmental Studies	Mohd Kamil Yusuf	EIA Sabah	Rakyat Berjaya Sdn.Bhd.	RM200,000

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
65.	Science & Environmental Studies	Mohd Kamil Yusuf	EIA di Bentong, Pahang	Sri Alam Sdn.Bhd.	RM18,000
66.	Science and Environmental Studies	Fatimah Yusoff	Island monitoring projek	Alam Sekitar Malaysia (ASMA)	RM10,000
67.	Science and Environmental Studies	Mohd Kamil Yusof	EIA bekalan air bawah tanah kawasan Olak Lempit, Selangor	JBA Selangor	RM85,000
68.	Science and Environmental Studies	Mohd Kamil Yusof	EIA for Genting Sanyen Brown Paper Mill Expansion Project	ASMA (M) Sdn.Bhd.	RM15,000
69.	Science and Environmental Studies	Mohd Kamil Yusof	EIA Projek pembangunan ladang rakyat mukim Relai Gua Musang	Darul Naim Agro Management	RM50,380
70.	Science and Environmental Studies	Mohd Kamil Yusof	Perundingan untuk Syarikat Probio Reseach Sdn. Bhd	Probio Research Sdn.Bhd.	RM10,000
71.	Science and Environmental Studies	Mohd Puad Abdullah	Development of Biomolecular markers of oil palm tissue culture using seldi protein chip array technology	Sime Darby	RM68,740
72.	Science and Environmental Studies	Mohd. Ibrahim Hj. Mohamed	Kajian mengenai penggubalan dasar pengurusan pesisiran pantai (Integrated Coastal Zone Management (ICZM) Policy	Unit Perancang Ekonomi (EPU)	RM198,000
73.	Science and Environmental Studies	Mohd. Ibrahim Hj. Mohamed	Consultancy Services for the study on national coastal zone management	Unit Perancang Ekonomi (EPU)	RM668,000
74.	Science and Environmental Studies	Mohd.Kamil Yusuf	Perlis State Park Development Management Plan	Perlis Forestry Department DANCED WWF	RM49,000
75.	Science and Environmental Studies	Mohd.Kamil Yusuf	Environmental Monitoring of Serdang Hospital Complex	Ranhill Engineers and Constructors Sdn.Bhd.	RM85,000
76.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed fruit plantation in Kelantan	DAMAI Sdn.Bhd.	RM50,000
77.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of forest operations in Tawau, Sabah	Rakyat Berjaya Sdn.Bhd.	RM200,000
78.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed highland development in Lojing, Kelantan	KPA Development Sdn.Bhd.	RM90,000

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
79.	Science and Environmental Studies	Mohd.Kamil Yusuf	Conceptual design on sediment desludging from Ringlet Lake, Cameron Highlands, Pahang.	Tenaga Nasional Research and Development Sdn.Bhd.	RM35,700
80.	Science and Environmental Studies	Mohd.Kamil Yusuf	Survey and Inventory for the proposed Bukit Kiara Arboretum	TropBio Forest Sdn.Bhd.	RM31,625
81.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed Maktab Kerjasama Malaysia's campus in Behrang, Perak	Maktab Kerjasama Malaysia	RM179,000
82.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed oil palm plantation in Kemaman, Terengganu	Atmostech Management and Services Consultancy Ladang Rakyat terengganu Sdn. Bhd.	RM48,000
83.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed disposal of sediment, Ringlet, Cameron Highlands. Pahang Additional Project	Tenaga Nasional Research Sdn.Bhd.	RM119,000
84.	Science and Environmental Studies	Mohd.Kamil Yusuf	Environmental monitoring in Brunei	Duaodua Apt.Waste Management,Brunei	RM30,000
85.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed disposal of sediment, Ringlet, Cameron Highlands. Pahang	Tenaga Nasional Research Sdn.Bhd.	RM99,000
86.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed KADA's training center in Lojing, Kelantan	Kemubu Agricultural Development Authority	RM80,000
87.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed forest operations in Kuala Balah Forest Reserve	Kompleks Perkayuan Kelantan Sdn.Bhd.	RM103,000
88.	Science and Environmental Studies	Mohd.Kamil Yusuf	Water quality monitoring for Gamuda-Hicom development Project in Kota Seri Kemuning, Shah Alam	Gamuda-Hicom Sdn.Bhd.	RM4,000
89.	Science and Environmental Studies	Mohd.Kamil Yusuf	Water quality monitoring along Simpang Pulai – Kuala Berang Highway: Package 3/1A	MTD Construction Sdn.Bhd.	No Fixed Rate
90.	Science and Environmental Studies	Mohd.Kamil Yusuf	Environmental monitoring within KUIM complex, Nilai, Negeri Sembilan	Environmental Planning Group Sdn.Bhd.	RM63,000
91.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed mixed development in Bentong, Pahang	Sri Alam Sdn.Bhd.	RM75,000

No	Faculty/ Institute	Researcher	Innovation	Industrial Collaboration	Allocation
92.	Science and Environmental Studies	Mohd.Kamil Yusuf	Wildlife Reserve Development Plan, Sg. Dusun, Selangor	Department of Wildlife, Selangor	RM242,000
93.	Science and Environmental Studies	Mohd.Kamil Yusuf	EIA of the proposed oil recycling of solvent in West Port, Klang, Selangor	Nature Recycling Sdn.bhd.	RM124,000
94.	Science and Environmental Studies	Mohd.Kamil Yusuf	Technical specialist for environmental auditing ISO14000	Underwriters Laboratory Private Incorporation India	RM4,000
95.	Science and Environmental Studies	Mohd.Kamil Yusuf	Water quality monitoring along East Coast Highway	MTD Construction Sdn.Bhd.	RM300,000
96.	Veterinary Medicine	Heng Hock Gan	Radiology Consultancy Programme II	Segar Pets Centre & Veterinary Services	RM1,200
97.	Veterinary Medicine	Heng Hock Gan	Radiology Consultancy to Harvard Animal Clinic	Harvard Animal Clinic	RM2,100
98.	Veterinary Medicine	Heng Hock Gan	Radiology Consultant	Animal Policlinic & Kennels	RM2,200
99.	Veterinary Medicine	Mohamed Shariff Bin Mohd Din	Science & government Liaison Advisor to director General of ICLARM	International Centre For Living Aquatic Resources Management (ICLARM)	RM16,000
100.	Veterinary Medicine	Mohamed Shariff Mohamed Din	Projek Perundingan ICLARM	ICLARM	RM29,000
101.	Veterinary Medicine	Mohd Hair Bejo	Penasihat Unit Berkuda DBKL	DBKL	RM18,000

Contract / IGS Research *(6 Grants / RM1.3m as of April 2004)*

No	Faculty/ Institute	Researcher	Innovation	Industrial Linkage	Allocation
1.	Engineering	Azni Idris (Prof. Dr.)	Fuel oil blending with edible oil waste	IFA Technology Sdn. Bhd.	RM364,550
2.	Engineering	Ishak Aris (Assoc. Prof. Dr.)	The development of a paper system to be interfaced with an immobilized system for motorcycles and heavy vehicles	Advanced Interconnection Technologies Sdn. Bhd.	RM209,236
3.	Engineering	Mohamad Khazani Abdullah (Assoc. Prof. Dr.)	Fiber break monitoring system	Significant Technologies Sdn. Bhd.	RM220,917
4.	Food Science and Biotechnology	Mohd. Ali Hassan (Prof. Dr.)	Compost, Bio-acids & Bio-plastic From Solid Wastes	Kasa Ganda Sdn. Bhd.	RM201,242

No	Faculty/ Institute	Researcher	Innovation	Industrial Linkage	Allocation
5.	Institute of Bioscience (IBS)	Ho Yin Wan (Prof. Dr.) & Arbakariya Ariff (Assoc. Prof. Dr.)	The upscaling Of Mixed Lactobacillus Culture Used As A Probiotic For Chicken	Stella Gen Sdn. Bhd.	RM275,680
6.	Institute of Advanced Technology (ITMA)	Abdul Rahman Ramli (Dr.)	Underwater Unmanned Vehicle for Maritime Intelligent / Surveillance / Reconnaissance - Remote Environmental Monitoring Units, Codename: 'Peralatan Khas Laut dan Perikanan (PARI-Z)'	Hitech Macro Sdn. Bhd.	Under negotiation

/Source: Research Grant Unit, RMC/ University Business Centre.

Commercialised Products, (1996-2004)

The year 2004 saw the emergence of several commercialised products. For example, there was a significant increase from 7 products between 1996 and 2000 to 26 between 2001 and 2004 that were commercialised. In addition, there are almost 250 products that have commercial potential. Achievements in terms of breakthroughs, new discoveries and innovations in R&D at UPM available for commercialization are contained in a book; "R&D at UPM: Creating New Frontiers of Innovative Research—2003 Edition, Editor: Nayan Deep S. Kanwal".

A total of 33 products commercialised from 1996 to 2004 are presented in table 11 below. The figures in parenthesis quoted are the total number of products commercialised.

Table 11.

Products Commercialised *(as of 2004)*[1].

Commercialised Products *(33)*

No.	Commercialised Product	Innovator	Industrial Collaboration	Contact Information
1.	Agar from local seaweed	Sharifah Kharidah Assoc Prof. Dr.) & En. Dzulkifly Hashim	Agartech (M) Sdn. Bhd. (Commercialized-Licencing-2001)	Faculty of Food Science and Biotechnology kharidah@fsb.upm.edu.my 603 8946 8420
2.	An Improved Method for The Detection of White Spot Syndrome Virus (WSSV) by Single-tube Nested Deoxyribonucleic Acid Amplification and a Detection Kit Utilizing the Method	Mohamed Shariff Mohamed Din (Prof. Dato' Dr.)	Genesis Biotechnology Sdn. Bhd. (Commercialized-2004)	Faculty of Veterinary Medicine Shariff@vet.upm.edu.my 603 89488246
3.	Aujeszky's Vaccine	Azmi Lila (Prof. Dr.)	Malaysian Vaccine and Pharmaceutical Sdn. Bhd. (Commercialized-2000)	Faculty of Veterinary Medicine azmi@vet.upm.edu.my 603 89468305
4.	Bacillus sphaericus 205y & Bacillus stearothermophilus F1 strains	Abu Bakar Salleh (Prof. Dr.)	Sime Darby Technology Centre Sdn. Bhd. (Commercialized-2004)	Faculty of Science and Environment abubakar@fsas.upm.edu.my 603 8946 8090
5.	Bacteriocin	Foo Hooi Ling (Assoc. Prof. Dr.), Loh Teck Chwen (Assoc. Prof. Dr.) & Ghulam Rusul Rahmat Ali (Prof. Dr.)	Nineteen O One Sdn. Bhd. (Commercialized-2004)	Faculty of Food Science and Biotechnology hlfoo@fsb.upm.edu.my 603 8946 8343
6.	Baja Mycorrhiza (VAM)	Azizah Hashim (Prof. Dr.)	Malaysian Agric. High Tech Sdn. Bhd. (Commercialized Joint Venture-1999)	Faculty of Agriculture azizah@agri.upm.edu.my 603 8946 6965

[1] Data sorted by product.

No.	Commercialised Product	Innovator	Industrial Collaboration	Contact Information
7.	Biofilter Technology	Azni Idris (Prof. Dr.)	Pakar Management Technology Sdn. Bhd. (Commercialized-2000)	Faculty of Engineering azni@eng.upm.edu.my 603 89486302
8.	Chicken probiotic technology	Ho Yin Wan (Prof. Dr.)	Janaf Sdn. Bhd. (Fully Commercialized - Sell of IP –2003)	Institute of Bioscience (IBS) ywho@ibs.upm.edu.my 603 8946 8067
9.	Collaboration works in relation to the biodiversity resources of the medicinal plants extraction in Malaysia	UPM	Nimura Genetic Solution Sdn. Bhd. (Commercialized-2003)	
10.	Compost from Sewage Sludge	Azni Idris (Prof. Dr.)	Evergreen Court Sdn. Bhd. (Commercialized with IWK-2004)	Faculty of Engineering azni@eng.upm.edu.my 603 89486302
11.	Compost, Bio-acids & Bio-plastic from Solid Wastes	Mohd. Ali Hassan (Prof. Dr.)	Kasa Ganda Sdn. Bhd. (Commercialized through IGS funding-2004)	Faculty of Food Science and Biotechnology alihas@putra.upm.edu.my 603 8946 8352
12.	Development of Technologies For The Sustainable Commercial Culture of Mud Crab With Special Reference To Mass Propagation Of Juvenile Crabs, Feed Formulation and Grow out System	Mohd Salleh Kamaruddin (Dr.)	Muhandis Sdn. Bhd. (Commercialized-2002)	Faculty of Agriculture msalleh@agri.upm.edu.my 603 8946 4103
13.	Fiber break monitoring system	Mohamad Khazani Abdullah (Assoc. Prof. Dr.)	Significant Technologies Sdn. Bhd. (Commercialized through IGS funding-2003)	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
14.	Fiber Reinforce Plastic Component for Interior Automotive Component	Jalaludin Harun (Dr.)	Polycomposite Sdn. Bhd. (Commercialized-2004)	Institute of Advanced Technology jalal@forr.upm.edu.my 603 8946 7173
15.	Fuel oil blending with edible oil waste	Azni Idris (Prof. Dr.)	IFA Technology Sdn. Bhd. (Commercialized through IGS funding-2003)	Faculty of Engineering azni@eng.upm.edu.my 603 89486302
16.	HO-meter-Small pressure meter	Husaini Omar (Assoc. Prof. Dr.)	MTD Bhd. (Commercialized-2001)	Faculty of Engineering husaini@eng.upm.edu.my 603 89486390
17.	Interactive Courseware Research & Development Laboratory (ICL) projects	Arfah Salleh (Assoc. Prof. Dr.)	AccTrak21 Sdn. Bhd. (Fully commercialized –2001)	Graduate School of Management (GSM) arfah@putra.upm.edu.my 603 8946 7440/1
18.	Latexometer	Kaida Khalid (Prof. Dr.)	Ever Flow River Trading Company Private Ltd. (Commercialized-2004)	Faculty of Science and Environment kaida@fsas.upm.edu.my 603 8946 6606

No.	Commercialised Product	Innovator	Industrial Collaboration	Contact Information
19.	Microwave in Palm Industry	Kaida Khalid (Prof. Dr.) & Azni Idris (Prof. Dr.)	Sawipac Sdn. Bhd. (Commercialized-2003)	Faculty of Science and Environment kaida@fsas.upm.edu.my 603 8946 6606
20.	Nutriceuticals health products	Suhaila Mohamed (Prof. Dr.)	Golden Health Sdn. Bhd. (Commercialized-2004)	Faculty of Food Science and Biotechnology suhaila@fsb.upm.edu.my 603 8946 8391
21.	Newcastle Disease (V4 Vaccine)	Latif (Prof. Dr.) & Aini Ideris (Prof. Dr.)	Malaysian Vaccine and Pharmaceutical Sdn. Bhd. (Fully Commercialized-1996)	Faculty of Veterinary Medicine aiini@vet.upm.edu.my 603 8946 8256
22.	Remote monitoring street lighting intelligent distribution management system	Norman Maruin (Assoc. Prof. Dr.)	Manser Digital Sdn. Bhd. (On going R&D project-2003)	Faculty of Engineering norman@eng.upm.edu.my 603 8948 6321
23.	Research and development of a world class 'off-the-shelf' system management software	Borhanuddin Mohd. Ali (Prof. Dr.)	Innodium Sdn. Bhd. (Commercialized through MOA-2003)	Faculty of Engineering borhan@eng.upm.edu.my 603 894 86443
24.	Rice Bran	Maznah Ismail (Assoc. Prof. Dr.)	Oriental Group (Commercialized-2004)	Faculty of Medicine and Health Science maznah@medic.upm.edu.my 603 8946 8483
25.	Soft Magnetic Ferite	Mansor Hashim (Dr.)	JOAssociates Sdn. Bhd. (Commercialized-2000)	Faculty of Science and Environment mansor@fsas.upm.edu.my 603 8946 6669/7554
26.	The development of a paper system to be interfaced with an immobilized system for motorcycles and heavy vehicles	Ishak Aris (Assoc. Prof. Dr.)	Advanced Interconnection Technologies Sdn. Bhd. (Commercialized through IGS funding-2002)	Faculty of Engineering ishak@eng.upm.edu.my 603 89486313
27.	The upscaling Of Mixed Lactobacillus Culture Used As A Probiotic For Chicken	Ho Yin Wan (Prof. Dr.) & Arbakariya Ariff (Assoc. Prof. Dr.)	Stella Gen Sdn. Bhd. (Commercialized through IGS funding-2004)	Institute of Bioscience (IBS) ywho@ibs.upm.edu.my 603 8946 8067
28.	The use of biotechnology and other relevant technologies to improve products and processes which will lead to new and innovative functional food products	Suhaimi Napis (Dr.)	Functional Food Creation Research Institute Co., Ltd. (Commercialized-MOU signed-2002)	Faculty of Food Science and Biotechnology suhaimi@fsb.upm.edu.my 603 8946 8362
29.	Underwater Unmanned Vehicle for Maritime Intelligent / Surveillance / Reconnaissance - Remote Environmental Monitoring Units, Codename: 'Peralatan Khas Laut dan Perikanan (PARI-Z)'	Abdul Rahman Ramli (Dr.)	Hitech Macro Sdn. Bhd. (Commercialized through IGS funding-2004)	Institute of Advanced Technology (ITMA) arr@eng.upm.edu.my 603 8946 6445
30.	UPM 93273 Infectious Bursal Disease (IBD) vaccine for chicken	Mohd. Hair Bejo (Prof. Dr.)	Malaysian Vaccine & Pharmaceutical Sdn. Bhd. (Commercialized-2004)	Faculty of Veterinary Medicine mdhair@vet.upm.edu.my 603 8946 8279

No.	Commercialised Product	Innovator	Industrial Collaboration	Contact Information
31.	Utilization Of Biogas And Biomass For New Bioproducts	Mohd. Ali Hassan (Prof. Dr.)	UPM-Kyushu Institute & FELDA Palm Industries (Commercialized-2004)	Faculty of Food Science and Biotechnology alihas@putra.upm.edu.my 603 8946 8352
32.	VitaGrow-foliar fertilizer	Syed Omar Syed Rastan (Assoc. Prof. Dr.)	Diversetech Sdn. Bhd. (Commercialized Licensing-2000)	Faculty of Agriculture syedomar@agri.upm.edu.my 603 8946 6988
33.	White Spot Virus Kit	Mohamed Shariff Mohamed Din (Prof. Dato'. Dr.)	Aquagen Sdn. Bhd. (2000)	Faculty of Veterinary Medicine Shariff@vet.upm.edu.my 603 8948 8246

†Source: University Business Centre (UBC). *Data as of April 2004.*

Products, Services and Processes Patented or Patent-pending (2003-04)

The year 2003 saw the emergence of various research outputs. For example, research products to be patented soared from 65 last year to about 102 (including two Trademarks) this year indicative of further enhancing the position of UPM as a centre of R&D in line with it's 6 outlined objectives; to enhance excellence in research and take research effort to new heights.

A total of 102 products and processes for the year 2003-04 are presented in table 12 below. The figures in parenthesis quoted are the total number of products and processes patented or patent-pending.

Table 12.

Patents / Patent-pending / Trade Marks—2003-04.

Patents *(04)*

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
1.	Husaini Omar (Assoc. Prof. Dr.)	Strength Measuring Device for Hard Soil, Weak Rock and Concrete; HO-meter - Small pressure meter	Patented USA US6650550B2	Faculty of Engineering husaini@eng.upm.edu.my 603 89486390
2.	Kaida Khalid (Prof Dr.)	Latexometer	Patented MY MY106441A	Faculty of Science and Environmental Studies kaida@fsas.upm.edu.my 603 89483651/ 6606
3.	Mohd. Razali Abdul Kadir (Assoc. Prof. IR. Dr.)	Interlocking Mortar less Load Bearing Building Block Systems	Patented UK GB2361254B Patented MY MY115629A	Faculty of Engineering razali@eng.upm.edu.my 603 89486374
4.	Ratnasamy Muniandy (Dr.)	Stone Mastic Asphalt with Cellulose Oil Palm Fibre (Paving Composition)	Patented USA USA 09/883,638	Faculty of Engineering ratnas@eng.upm.edu.my 603 8656 6373

Patent-pending *(48)*

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
1.	Abdul Manan Mat Jais (Prof Dr.)	Haruan Biomedical	Patent-pending PI 9501562	Faculty of Medicine and Health Science manan@ibs.upm.edu.my 603 89468492
2.	Ahmad Husni Mohd. Hanif (Assoc. Prof Dr.)	Production of Humic Acid and Humates	Patent-pending PI 20033264	Faculty of Agriculture husni@agri.upm.edu.my (603) 8946-6961

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
3.	Azni Idris (Prof. Dr.)	New Anaerobic Bioreactor-Biofil Process	Patent-pending PI 9502143	Faculty of Engineering azni@eng.upm.edu.my 603 89486302
4.	Badlishah Sham Bahari (Assoc Prof. Dr.)	Process for Producing Phytonutrient-enriched deacylglycerols	Patent-pending PI 20014817	Faculty of Food Science and Biotechnology badli@fsb.upm.edu.my 603 89468394
5.	Badlishah Sham Baharin (Assoc Prof. Dr.)	Carotene Recovery from Crude Palm Oil	Patent-pending PI 9501562	Faculty of Food Science and Biotechnology badli@fsb.upm.edu.my 603 89468394
6.	Badlishah Sham Baharin (Assoc Prof. Dr.)	Degumming of Crude Palm Oil by Membrane Technology	Patent-pending PI 20003946	Faculty of Food Science and Biotechnology badli@fsb.upm.edu.my 603 89468394
7.	Daud Ahmad Israf Ali (Assoc. Prof. Dr.)	Inhibition of Inflammatory Mediator Production by Cardamonin	Patent-pending PI 20032765	Institute of Bioscience daud@ibs.upm.edu.my 603 89468063
8.	Fakhru'l Razi (Assoc. Prof. Dr.)	Liquid State Bioconversion of Sewage Treatment Plant Sludge	Patent-pending PI20030941	Faculty of Engineering fakhrul@eng.upm.edu.my 603 89482047
9.	Fakhru'l Razi (Assoc. Prof. Dr.)	Solid State Bioconversion of Domestic Wastewater treatment Plant Sludge Into Compost,	Patent-pending PI20030942	Faculty of Engineering fakhrul@eng.upm.edu.my 603 89482047
10.	Fakhru'l Razi (Assoc. Prof. Dr.)	Palm Oil Based Trimethylolropane Esters	Patent-pending PI20030943	Faculty of Engineering fakhrul@eng.upm.edu.my 603 89482047
11.	Fakhru'l Razi (Assoc. Prof. Dr.)	Method of Producing Carbon Nanofiber/ Nanotube using catalyst CVD	Patent Pending	Faculty of Engineering fakhrul@eng.upm.edu.my 603 89482047
12.	Fakhru'l Razi (Assoc. Prof. Dr.)	An Improve Continuous Sterilization Process for Palm Oil Milling Process	Patent-pending PI20032588	Faculty of Engineering fakhrul@eng.upm.edu.my 603 89482047
13.	Harikrisna K. (Assoc. Prof. Dr.)	Method for the production of transgenic plants.	Patent-pending	Faculty of Food Science and Biotechnology krisna@fsb.upm.edu.my 603 89468344
14.	Husaini Omar (Assoc. Prof. Dr.)	Device and Method for Indirect Measurement of Physical Property of Rock and Soil.	Patent-Pending PI2001081	Faculty of Engineering husaini@eng.upm.edu.my 603 89486390
15.	Ishak Aris (Assoc. Prof. Dr.)	An Apparatus for Rating Building Surface and The Like	Patent-pending PI 20024902	Faculty of Engineering ishak@eng.upm.edu.my 603 89486313

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
16.	Ishak Aris (Assoc. Prof. Dr.)	A Robotic for Handling Hazardous Chemical	Patent-pending PI 20011552	Faculty of Engineering ishak@eng.upm.edu.my 603 89486313
17.	Ishak Aris (Assoc. Prof. Dr.)	A Portable Network Fibre Optic Base Lighting Detection System	Patent-pending PI 20020851	Faculty of Engineering ishak@eng.upm.edu.my 603 89486313
18.	Khatijah Yusoff (Prof. Datin Dr.)	Diagnostic Kit for PCR Elisa Newcastle Disease	Patent-pending PI 20005526	Faculty of Science and Environmental Studies khatijah@fsas.upm.edu.my 603 8946 6692
19.	Khatijah Yusoff (Prof. Datin Dr.)	Neuclotype - HIV kit; Nucleotide Sequences of the Nucleocapsid (NP)	Patent-pending PI 20004837	Faculty of Science and Environmental Studies khatijah@fsas.upm.edu.my 603 8946 6692
20.	Khatijah Yusoff (Prof. Datin Dr.)	Nucleocapsid Protein of Newcastle Disease Virus As a Carrier For Immunogens	Patent-pending PI 20021709	Faculty of Science and Environmental Studies khatijah@fsas.upm.edu.my 603 8946 6692
21.	Khatijah Yusoff (Prof. Datin Dr.)	Peptides That Inhibit The Propagation of Newcastle Disease Virus	Patent-pending PI 20013687	Faculty of Science and Environmental Studies khatijah@fsas.upm.edu.my 603 8946 6692
22.	Khatijah Yusoff (Prof. Datin Dr.)	Recombinant Nucleoapsid Protein and G Glycoprotein of Nipah Virus.	Patent-pending PI20032473	Faculty of Science and Environmental Studies wstan@fsas.upm.edu.my 603 89466715
23.	Lai Oi Ming (Assoc. Prof. Dr.)	Process for Producing Triacyglycerols containing Arachidonic and Docosahexaenoic Acids foe Use in Infant Formulations.	Patent-pending PI 20022504	Faculty of Food Science and Biotechnology omlai@putra.upm.edu.my 603 8946 8347
24.	Lai Oi Ming (Assoc. Prof. Dr.)	Process for Producing Ferulyl-sustituted Acylglycerols for Use as Novel Sunscreen Agents.	Patent-pending PI 20022503	Faculty of Food Science and Biotechnology omlai@putra.upm.edu.my 603 89468347
25.	Mahiran Basri (Prof. Dr.)	Production of wax esters.	Patent-pending PI 20033660	Faculty of Food Science and Environmental mahiran@fsas.upm.edu.my (603) 8946 6603
26.	Mohamed Shariff Mohamed Din (Prof. Dato' Dr.)	White Sport Syndrome (WSS) Detection Kit for Shrimp	Patent-pending PI 9904454	Faculty of Veterinary Medicine Shariff@vet.upm.edu.my 603 8946 8288
27.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Double Pass Optical Amplifier	Patent-pending PI 20033040	Faculty of Engineering khazani@eng.upm.edu.my 603 89486357

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
28.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Modulation of Signals in Optical systems	Patent-pending PI 20013510	Faculty of Engineering khazani@eng.upm.edu.my 603 89486357
29.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Optical Fibre Duplex Module	Patent-pending PI 20030426	Faculty of Engineering khazani@eng.upm.edu.my 603 89486357
30.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Telecommunication System and Automatic Optical Protection Switch System for Use Therein	Patent-pending PI20032218	Faculty of Engineering khazani@eng.upm.edu.my 603 89486357
31.	Mohd. Adzir Mahdi (Assoc. Prof. Dr.)	Application of Titl Variable Optical Attenuator in Optical Amplifiers to correct Stimulated Raman Scattering	Patent-pending PI20031185	Faculty of Engineering mdadzir@eng.upm.edu.my 603 89468347
32.	Mohd. Ali Hassan (Prof. Dr.)	A method for Producing Bacterial Bioplastics Coupled with Wastewater Treatment of Palm Oil Mill Effluent.	Patent-pending PI 9601322	Faculty of Food Science and Biotechnology alihas@putra.upm.edu.my 603 89468352
33.	Mohd. Azmi Mohd. Lila (Prof. Dr.)	Immuno-logical Enhancement System by Genetic Vaccines	Patent-pending PI 2002-3353	Faculty of Veterinary Medicine azmi@vet.upm.edu.my 603 89468305
34.	Mohd. Azmi Mohd. Lila (Prof. Dr.)	Non- infectious Immuno-contraceptive ZP3 Vaccine for population Control	Patent-pending PI20020030	Faculty of Veterinary Medicine azmi@vet.upm.edu.my 603 89468305
35.	Mohd. Hanafi Musa (Dr.)	Protein Enrichment of Palm Kernel Cake	Patent-pending PI 20012925	Faculty of Agriculture mmhanafi@agri.upm.edu.my 603 8946 6974
36.	Mohd. Yunus Abd. Shukor (Dr.)	Assay for heavy metals.	Patent-pending PI20033505	Faculty of Science and Environment yunus@fsas.upm.edu.my (603)8946-6722
37.	Mohd. Zobir Hussein (Prof. Dr.)	Method to Produce Controlled Release Formulation of 1-Naphthaleneacete, A Plant Growth Regulator	Patent-pending PI 20031954	Faculty of Science and Environmental Studies anuar@fsas.upm.edu.my 603 89466801
38.	Raja Noor Zaliha Raja Abd. Rahman (Assoc. Prof. Dr.)	Pseudomonas Aeruginosa Starin in K and Production of Ptotease Therefrom	Patent-pending PI20034117	Faculty of Science and Environment rnzaliha@fsas.upm.edu.my 603 8946 6713
39.	Ratnasamy Muniandy (Dr.)	Evaluation Stone Mastic Asphalt Technology; Stonemastic Asphalt for Road Surface (SMA)	Patent-pending PI 20004199	Faculty of Engineering ratnas@eng.upm.edu.my 603 8656 6377
40.	Ratnasamy Muniandy (Dr.)	Formulation of Stone Mastic Asphalt for High Risk Accident Areas	Patent-pending	Faculty of Engineering ratnas@eng.upm.edu.my 603 8656 6377

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
41.	Ratnasamy Muniandy (Dr.)	Rapid Mixer for Asphalt (RMA)	Patent-pending	Faculty of Engineering ratnas@eng.upm.edu.my 603 8656 6377
42.	Syed Abd. Rahman Al-Haddad (Dr.)	Remote Database Uploading Using Fax	Patent-pending	Faculty of Engineering sar@eng.upm.edu.my 603 89467563
43.	Syed Omar Syed Rastan (Assoc. Prof. Dr.)	ZAPPA™ Seed Treatment Reagent for Direct Seeding Paddy Rice	Patent-pending PI 20034182	Faculty of Agriculture syedomar@agri.upm.edu.my 603 8946 6988
44.	Tan Wen Siang (Assoc. Prof. Dr.)	Peptides that inhibit the association of the surface and core antigens of hepatitis B virus	Patent-pending PI20014538	Faculty of Science and Environmental Studies wstan@fsas.upm.edu.my 603 89466715
45.	Wong Shaw Voon (Dr.)	Artificial Intelligence Device and Corresponding Method for Selecting Machinability Data.	Patent-pending PI20024308	Faculty of Engineering wongsv@eng.upm.edu.my 603 89466339
46.	Wong Shaw Voon (Dr.)	Motorcycle Safety Helmet for Children	Patent-pending PI20031295	Faculty of Engineering wongsv@eng.upm.edu.my 603 89466339
47.	Wong Shaw Voon (Dr.)	Pendulum Impact Rest Rig	Patent-pending PI20024307	Faculty of Engineering wongsv@eng.upm.edu.my 603 89466339
48.	Zulkarnain Zainal (Assoc. Prof. Dr.)	Metal Chalcogenide Thin Films	Patent-pending PI20035041	Faculty of Science and Environment zulkar@fsas.upm.edu.my 603 8946 6810

Provisional Patent Applications *(49)*

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
1.	Abd. Rahman Ramli (Dr.)	System and Method of Motion Detection.	Under Process for Patenting	Institute of Advanced Technology (ITMA) arr@eng.upm.edu.my 603 89466445
2.	Abu Bakar Salleh (Prof. Dr.)	Heat-stable alkaline protease from thermophilic bacterium, Bacillus strearothermophilus F1 and secretory expression in Escherichia coli.	Under Process for Patenting	Faculty of Science and Environment abubakar@fsas.upm.edu.my 603 8946 8090
3.	Abu Bakar Salleh (Prof. Dr.)	A novel organic solvent tolerant lipase form a newly isolated Pseudomonas sp 55.	Under Process for Patenting	Faculty of Science and Environment abubakar@fsas.upm.edu.my 603 8946 8090

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
4.	Azmi Yahya (Assoc. Prof. Dr.)	3-Axis Automated Soil Profile Mapper	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
5.	Azmi Yahya (Assoc. Prof. Dr.)	3-Point Auto Hitch Tractor Dynamometer	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
6.	Azmi Yahya (Assoc. Prof. Dr.)	FFB Collector-Transporter	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
7.	Azmi Yahya (Assoc. Prof. Dr.)	Soil Cone Index and Shear Strength Mapper	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
8.	Azmi Yahya (Assoc. Prof. Dr.)	Tractor-implement Performance Mapping System	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
9.	Azmi Yahya (Assoc. Prof. Dr.)	Tree Crop Seedling Trasplanter	Under Process for Patenting	Faculty of Engineering azmiy@eng.upm.edu.my 603 8946 6266
10.	Badlishah Sham Baharin (Assoc Prof. Dr.)	Method of Vitamin E Recovery	Under Process for Patenting	Faculty of Food Science and Biotechnology badli@fsb.upm.edu.my 603 8946 8394
11.	Borhanuddin Mohd. Ali (Prof Dr.)	CHEK Proxy Framework (CPF) A client/Server Architecture with Dynamic and Transparent Middle Tier.	Under Process for Patenting	Faculty of Engineering borhan@eng.upm.edu.my 603 894 86443
12.	Chen Soon Der (Dr.)	Recursive Mean-Separate Histogram Equalization	Under Process for Patenting	Institute of Advance Technology Not available
13.	Fakhru'l Razi (Assoc. Prof. Dr.)	Synthesized Tin-Activated Carbon Adsorbent and the Application in Pressure Swing Adsorption For Purification of Hydrogen	Under Process for Patenting	Faculty of Engineering fakhrul@eng.upm.edu.my 603 8948 2047
14.	Foo Hooi Ling (Assoc. Prof. Dr.)	Bacteriocin of *Lactobacillus plantarum* I-UL4 Isolated Fermented Tapioca, Manihot esculanta	Under Process for Patenting	Faculty of Food Science and Biotechnology hlfoo@fsb.upm.edu.my 603 8946 8343
15.	Foo Hooi Ling (Assoc. Prof. Dr.)	Bacteriocin of *Lactococcus lactis* subsp. Lactis RW 18 Isolated from Malaysia Steamed Fish (*Rastrelliger Sp*)	Under Process for Patenting	Faculty of Food Science and Biotechnology hlfoo@fsb.upm.edu.my 603 8946 8343
16.	Foo Hooi Ling (Assoc. Prof. Dr.)	The Usage of Metabolites Produced by *Lactobacillus plantarum* I-UL4 as Feed Additive	Under Process for Patenting	Faculty of Food Science and Biotechnology hlfoo@fsb.upm.edu.my 603 8946 8343

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
17.	Foo Hooi Ling (Assoc. Prof. Dr.)	The Usage of Metabolites Produced by *Lactococcus. Lactis* subsp. Lactis RW as Feed Additive	Under Process for Patenting	Faculty of Food Science and Biotechnology hlfoo@fsb.upm.edu.my 603 8946 8343
18.	Jalaluddin Harun (Dr.)	Electron Beam Irradiated Oil Palm. Fibre: Polypropylene composite for Automotive and the other Industrial Application.	Under Process for Patenting	Institute of Advance Technology jalal@forr.upm.edu.my 603 8946 7173
19.	Jalaluddin Harun (Dr.)	High Performance Security Paper From Kenaf (*Hibiscus Cannabinus*) Fibre	Under Process for Patenting	Institute of Advance Technology jalal@forr.upm.edu.my 603 8946 7173
20.	Khairul Zaman Hj. Mohd Dahlan (Dr.)	Electron Beam Processing Oil Palm Empty	Under Process for Patenting	Institute of Advance Technology (ITMA) khairul@mint.gov.my 603 8925 0510 x 1612
21.	Khairul Zaman Hj. Mohd Dahlan (Dr.)	Fruit Branch Fibre Polypropylene composites for Automotive and Industrial Applications.	Under Process for Patenting	Institute of Advance Technology (ITMA) khairul@mint.gov.my 603 8925 0510 x 1612
22.	Mahiran Basri (Prof. Dr.)	Immobilization of lipase for effective synthesis of optically active compounds.	Under Process for Patenting	Faculty of Science and Environment mahiran@fsas.upm.edu.my 603 8946 6603
23.	Maznah Ismail (Assoc. Prof. Dr.)	Therapeutic Oil	Under Process for Patenting	Faculty of Medicine and Health Science maznah@medic.upm.edu.my 603 8946 8483
24.	Maznah Ismail (Assoc. Prof. Dr.)	Rice Bran Oil and The Process of Producing The Same	Under Process for Patenting	Faculty of Medicine and Health Science maznah@medic.upm.edu.my 603 8946 8483
25.	Megat Mohamad (Dr.)	Gas intake and Exhaust Valve Arrangement of Internal Combustion Engine	Under Process for Patenting	Faculty of Engineering 603 8946 6336
26.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Automatic Protection Switch for Fibre Network	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
27.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	DW code OSCDMA	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
28.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Erbium Doped Fiber Laser/Amplifier	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
29.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Hybrid FTTH-ADSL Technology	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
30.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Optical Fibre Switching System	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
31.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Spectral Encoding Optical CDMA System	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
32.	Mohammad Khazani Abdullah (Assoc. Prof. Dr.)	Wavelength Meter	Under Process for Patenting	Faculty of Engineering khazani@eng.upm.edu.my 603 8948 6357
33.	Mohd. Azmi Mohd. Lila (Prof. Dr.)	Gene Deleted Pseudirabies Vaccine with a Genetic Marker	Under Process for Patenting	Faculty of Veterinary Medicine azmi@vet.upm.edu.my 603 8946 8305
34.	Mohd. Azmi Mohd. Lila (Prof. Dr.)	Non- Abortogenic Genetifically Engineered Virus for Preparering Safe Pseudorabies Vaccines.	Under Process for Patenting	Faculty of Veterinary Medicine azmi@vet.upm.edu.my 603 8946 8305
35.	Mohd. Sapuan Salit (Assoc. Prof. Dr.)	Wind Power Station	Under Process for Patenting	Faculty of Engineering sapuan@eng.upm.edu.my 603 8946-6318
36.	Mohd. Yusof Sulaiman (Prof Dr.)	Solar Powered Air-Conditioner	Under Process for Patenting	Institute of Advance Technology myusofsul@putra.upm.edu.my 603 8948 7550
37.	Mohd. Zobir Hussein (Prof. Dr.)	Controlled and Released of A Plant Growth Regulator A-NAA From The Lamella of ZN-AL-LDH Nanocomposite.	Under Process for Patenting	Faculty of Science and Environmental Studies anuar@fsas.upm.edu.my 603 8946 6801
38.	Rahmita Wiza O.K Rahmat (Dr.)	Ultra Sound as a Guide for Intrapedicular Screw Placement	Under Process for Patenting	Institute of Advanced Technology (ITMA) anuar@fsas.upm.edu.my 603 8946 6513
39.	Raja Noor Zaliha Raja Abd. Rahman (Assoc. Prof. Dr.)	A new species for geobacillus producing a thermostable alkaline lipase.	Under Process for Patenting	Faculty of Science and Environment rnzaliha@fsas.upm.edu.my 603 8946 6713
40.	Raja Noor Zaliha Raja Abd. Rahman (Assoc. Prof. Dr.)	A novel organic solvent tolerant lipase from a newly isolated Bacillus sphaericus 205y	Under Process for Patenting	Faculty of Science and Environment rnzaliha@fsas.upm.edu.my 603 8946 6713
41.	Raja Noor Zaliha Raja Abd. Rahman (Assoc. Prof. Dr.)	Organic solvent tolerant protease from Pseudomonas aeruginosa strain K	Under Process for Patenting	Faculty of Science and Environment rnzaliha@fsas.upm.edu.my 603 8946 6713
42.	Ratnasamy Muniandy (Dr.)	Hydroplaning Testing Equipment (HTE)-TURAMESIN	Under Process for Patenting	Faculty of Engineering ratnas@eng.upm.edu.my 603 8656 6373

No.	Researcher	Product/ Research Title	Patent ID	Contact Information
43.	Shattri Mansor (Assoc. Prof. Dr.)	Fish Forecasting System	Under Process for Patenting	Institute of Advanced Technology (ITMA) shattri@eng.upm.edu.my 603 8656 6377
44.	Shattri Mansor (Assoc. Prof. Dr.)	Oil Spill Contingency Planner	Under Process for Patenting	Institute of Advanced Technology (ITMA) shattri@eng.upm.edu.my 603 8656 6377
45.	Syed Abd. Rahman Al-Hadad (Dr.)	Low Cost Motion Detection	Under Process for Patenting	Faculty of Engineering sar@eng.upm.edu.my 603 8946 7563
46.	Syed Abd. Rahman Al-Hadad (Dr.)	System and Method For Data File Upload Over A Communication Network.	Under Process for Patenting	Faculty of Engineering sar@eng.upm.edu.my 603 89467563
47.	Syed Omar Syed Rastan (Assoc. Prof. Dr.)	Seed Treatment Reagent for Direct Seeding Paddy Rice	Under Process for Patenting	Faculty of Agriculture syedomar@agri.upm.edu.my 603 8946 6988
48.	Wan Md. Zin Wan Yunus (Prof. Dr.)	Preparation of polyhydroxamic acid from palm oil.	Under Process for Patenting	Faculty of Science and Environment wanzin@fsas.upm.edu.my 603 8946 6646
49.	Wong Shaw Voon (Dr.)	Design of Cost Effective and Comfortable Motorcycle Helmet with Bio-composite Material for Tropical Climates	Under Process for Patenting	Faculty of Engineering wongsv@eng.upm.edu.my 603 8946 6339

Trademarks *(02)*

No.	Researcher	Product/ Research Title	Trademark ID	Contact Information
1.	Syed Omar Syed Rastan (Assoc. Prof. Dr.)	Vita Grow™, The Plant Grow and Yield Enhancer	Trademark No. 99006919	Faculty of Agriculture syedomar@agri.upm.edu.my 603 8946 6988
2.	Mohamed Shariff Mohamed Din (Prof. Dato' Dr.)	FastTrack™—White Sport Syndrome (WSS) Detection Kit for Shrimp	Trademark FastTrack™	Faculty of Veterinary Medicine Shariff@vet.upm.edu.my 603 8946 8288

*f*Source: Policy Planning and Finance Unit, RMC. *Data as of April 2004.*

Awards and Prizes, 2003-04[i]

UPM research achievements in the year reflected the versatility of the University 's research portfolio. Our contributions to scientific research and development have received worldwide recognition. Several UPM scientists have won prestigious prizes and received international accolades, indicative of our excellence in research.

A total of 338 awards and prizes in different categories won by UPM's scientists between 2003 and 2004 are given below in Table 13. The list is categorised by type of award/prize received. The figures in parenthesis quoted are total number of awards won in a category.

Table 13.

Awards and Prizes won by UPM Academia by Category—2003-04[1].

International Exhibitions Award *(10)*

32nd International Exhibition of Inventions, New Techniques and Products, Geneva *(10)*

Year	Prize / Award	Recipient
2004	Silver Medal—Carbon nanotubes and carbon nanofibers synthesis for nanotechnology applications	Fakhru'l-Razi Ahmadun [Assoc. Prof. Dr.] Faculty of Engineering
2004	GOLD Medal—E-ORY—Natural antioxidant rich nutraceutical formulation	Maznah Ismail [Assoc. Prof. Dr.] Faculty of Medicine and Health Sciences
2004	GOLD Medal—Nucleoceptin™—a novel vaccine for fertility control in animals	Mohd. Azmi Mohd. Lila [Professor Dr.] Faculty of Veterinary Medicine
2004	Silver Medal—Imuron™—a total solution for maximizing antibody responses	Mohd. Azmi Mohd. Lila [Professor Dr.] Faculty of Veterinary Medicine
2004	Silver Medal—CRFNanopath—a novel nanocomposite based controlled release formulation	Mohd Zobir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies
2004	Bronze Medal—Optical layer automatic protection switch	Mohd. Hanif Yaacob (Mr.) Faculty of Engineering
2004	Bronze Medal—Biocomposite helmet for tropical countries	Radin Umar Radin Sohadi (Professor Dr. Ir.) Faculty of Engineering
2004	Silver Medal—Palm oil based synthetic bio lubricant	Robiah Yunus [Mrs.] Faculty of Engineering
2004	Silver Medal—ZAPPA—the rice seeds germination enhancer	Syed Omar Syed Rastan [Assoc. Prof. Dr.] Faculty of Agriculture
2004	Silver Medal—Heavy duty pendulum impact test ring for crashworthiness studies	Wong Shaw Voon [Dr.] Faculty of Engineering

[1] Data presented as of April 2004.

National Exhibitions Award *(53)*

Awards won by Universiti Putra Malaysia *(01)*

Year	Prize / Award	Recipient
2003	FIRST Prize–Best Booth in the Special Category at the Expo S&T-Invention and Innovation Awards Exhibition held from 7-9 August 2003.	Universiti Putra Malaysia

IPTA Research & Development Exposition 2003 *(12)*

Year	Prize / Award	Recipient
2003	MASS Award—Low Field Magnettoresistance of Manganites Perovskites Bulks and Film For Sensing Devices	Abdul Halim Shaari [Prof. Dr.] Faculty of Science and Environmental Studies
2003	PIKOM Award—SMS Gateway Interface	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology
2003	GOLD Medal—Malaysian Plant Protection Society Award - Development of Biopesticide for Managing Cruciferous Vegetable Pest	Ahmad Said Sajap [Prof. Dr.] Faculty of Forestry
2003	MASS Award—Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications	Fakhru'l-Razi Ahmadun [Assoc. Prof. Dr.] Faculty of Engineering
2003	Bronze Medal—Malaysian Plant Protection Society Award - An Integrated Management For The Control of Bacterial Wilt of Tomato Caused By *Ralstonia Solanacearum*	Hiryati Abdullah [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Winner—Malaysian Genetic Society Award - Genetic Variability of Four Sheep Breeds in Malaysia	Jothi Malar Panandam [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Winner—Malaysian Genetic Society Award - Genetic Engineering of Bananas for Tolerance to *Fusarium* Wilt Disease	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Merit Winner—Malaysian Society of Plant Physiology Award - Commercial Production of Economically Important Planting Materials Using Culture Technologies	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Merit Winner—Malaysian Society of Plant Physiology Award - Genetic Engineering of Bananas for Tolerance to *Fusarium* Wilt Disease	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Winner—MASS Award - Design of Cost Effective and Comfortable Motorcycle Helmet with Bio-Composite Material for Tropical Climates	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering
2003	Winner—Malaysian Genetic Society Award - Cholera DNA Vaccine	Rozita Rosli [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	BEST Winner—Malaysian Society of Plant Physiology Award - Production of Bacterial Inoculants as Biofertilizer and Bioenhancer	Zulkifli Hj. Shamsuddin [Prof. Dr.] Faculty of Agriculture

EXPO S&T 2003—Invention and Innovation Awards 2003 *(30)*

Year	Prize / Award	Recipient
2003	GOLD Medal—The Generating Financial Reports Simulation (GenerReS) Software	Arfah Salleh [Assoc. Prof. Dr.] Graduate School of Management

Year	Prize / Award	Recipient
2003	GOLD Medal—The Study of Novel Biopreservative Produced by *Lactobacillus plantarum* I-UL4 isolated from Fermented Tapioca, Manihot Esculanta	Foo Hooi Ling [Assoc. Prof. Dr.] Faculty of Food Science and Biotechnology
2003	GOLD Medal—UPM-GS 2002: Improved Sweet Corn (*Zea mays* L.) Genotype Developed by Introgression of Exotic Germplasm	Ghizan Bin Saleh [Prof. Dr.] Faculty of Agriculture
2003	GOLD Medal—Gelatin from 3 Cultured Freshwater Fish Skins Obtained by Limiting Process	Jamilah Bakar [Prof. Dr.] Faculty of Food Science and Biotechnology
2003	GOLD Medal—BioCarrier™: A Novel Molecular Carrier from Newcastle Disease Virus	Khatijah Yusoff [Prof. Dr.] Institute of Bioscience
2003	GOLD Medal—IMURON™ A Total Solution for Polynucleotide Vaccines	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	GOLD Medal—Novel Polynucelotide Vaccine, NUCLEOCEPTIN™ For An Effective Fertility Control In Animals	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	GOLD Medal—Cost Benefit Analysis Simulation for Development Project Evaluation	Mohd. Shahwahid Hj. Othman [Assoc. Prof. Dr.] Faculty of Economics and Management
2003	GOLD Medal—Environmental Friendly Synthetic Lubricant	Robiah Yunus [Mrs.] Faculty of Engineering
2003	GOLD Medal—NDPath™: A Simple Solution to Newcastle Disease Virus Pathotyping	Tan Wen Siang [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	SILVER Medal—Data Hiding Techniques in Digital Images	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology
2003	SILVER Medal—Smart Remote Access Distributed System	Borhanuddin Mohd. Ali [Prof. Dr.] Faculty of Engineering
2003	SILVER and Bronze Medal—Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications	Fakhru'l-Razi Ahmadun [Assoc.Prof. Dr.] Faculty of Engineering
2003	SILVER Medal—SterllacTM : A Multi-strain Probiotic for Poultry	Ho Yin Wan [Prof. Dr.] Institute of Bioscience
2003	SILVER Medal—Enhancement of Lipase Enantioselectivity Through Immobilization	Mahiran Basri [Prof. Dr.] Faculty of Science and Environmental Studies
2003	SILVER Medal—Improved Enhanced Protection Against Fusarium Wilt by Constitutive Co-expression of Chitinase and Glucanase Genes in Transgenic Banana	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environment Studies
2003	SILVER Medal—E-ORYTM: Antioxidant Rich Nutraceutical Oil from Local Agricultural by-Products	Maznah Ismail [Assoc. Prof. Dr.] Faculty of Medicine and Health Sciences
2003	SILVER Medal—Alternative Methods for the Recovery of Intracellular Bioplastics from Various Waste Resources	Mohd Ali Hassan [Prof. Dr.] Faculty of Food Science and Biotechnology
2003	SILVER Medal—Design of Cost Effective and Comfortable Motorcycle Helmet with Bio-Composite Material for Tropical Climates (Two Medals)	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering
2003	SILVER Medal—Oil Spill Contingency Planner	Shattri Mansor [Assoc.Prof. Dr.] Institute of Advanced Technology

Year	Prize / Award	Recipient
2003	SILVER Medal—Growth of Aspergillus Niger in Solid Substrate Fermentation Using Palm Kernel Cake (PKC) as Substrate	Suraini Abd. Aziz [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	SILVER Medal—Detection of Lard in Chocolates by Fourier Transform Infrared (FTIR) Spectroscopy for 'Halal Authentication	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Bronze Medal—Nutrient Flow Stem Infusion Technique of Fertilizer Application in Oil Palm Seedlings.	Aminuddin bin Hussin [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Bronze Medal—Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications	Fakhru'l-Razi Ahmadun [Assoc. Prof. Dr.] Faculty of Engineering
2003	Bronze Medal—Composite Conversion Coating using Organic-Inorganic Nanolayered Hybrid Materials	Mohd. Zobir Hussein [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Bronze Medal—Modification of Oil Palm Empty Fruit Bunch Fiber by Graft Copolymerization	Nor Azowa Ibrahim [Mrs.] Faculty of Science and Environmental Studies
2003	Bronze Medal—Design and Development of Heavy Duty Pendulum Impact Test Rig (Two Medals)	Wong Shaw Voon [Dr.] Faculty of Engineering
2003	Bronze Medal—Electrochemical Assisted Photodegradation of Dye Pollutants using TiO2 Thin Film Electrodes	Zulkarnain Zainal [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies

International Invention, Innovation, Industrial Design and Technology Exhibition (ITEX 2003) *(10)*

Year	Prize / Award	Recipient
2003	GOLD Medal – Probiotic for Poultry	Ho Yin Wan [Prof. Dr.] Institute of Bioscience
2003	GOLD Medal —Novel Molecular Carrier	Khatijah Yusoff [Prof. Dr.] Faculty of Science & Environmental Studies
2003	SILVER Medal – Newcastle disease virus (NDV): A Killer in Chicken but a Potential Life Saver in Human	Fauziah Othman [Assoc. Prof Dr.] Institute of Bioscience
2003	SILVER Medal—Fibre Reinforced Plastic Composite (FRPC) for Interior Automotive and Other Application	Jalaluddin Harun [Dr.] Institute of Advanced Technology
2003	Bronze Medal—GMR & CMR Magnetic Thin Film for Sensor Applications	Abdul Halim Shaari [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Bronze Medal – Bioremediation of Petroleum Pollutants by Microbial Consortium	Farinazleen Mohamed Ghazali [Mrs.] Faculty of Science & Environmental Studies
2003	Bronze Medal – Development of Activated Carbon-Tin (IV) Oxide (SnO2) for Hydrogen Purification in Pressure Swing Adsorption (PSA) for (PEM) Fuel Cell.	Iyuke Sunny Esayegbemu [Assoc. Prof. Dr.] Faculty of Engineering
2003	Bronze Medal—SASSAR Kit (*Staphylococcus aureus* Species Specific Antibiotic resistant) Identification Kit.	Mariana Nor Shamsudin [Assoc. Prof. Dr.] Faculty of Medicine & Health Sciences

2003	Bronze Medal—Network Independent Video on Demand (VoD) System	Sabira Katun [Dr.] Faculty of Engineering
2003	Bronze Medal—Novel Peptide to Distinguishing Vaccinated Birds from those Infected with Virulent Newcastle disease virus	Tan Wen Siang [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies

UPM Invention & Research Exhibition and Awards *(266)*

GOLD Medal Winners *(37)*

Year	Prize / Award	Recipient
2003	Data Hiding Techniques in Digital Images	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology
2003	Nutrient Flow Stem Infusion Technique of Fertilizer Application in Oil Palm Seedlings.	Aminuddin bin Hussin [Assoc. Prof. Dr.] Faculty of Agriculture
2003	The Generating Financial Reports Simulation (GenerReS) Software	Arfah Salleh [Assoc. Prof. Dr.] Graduate School of Management
2003	Smart Remote Access Distribute System	Borhanuddin Mohd. Ali [Prof. Dr.] Faculty of Engineering
2003	Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications	Fakhru'l-Razi Ahmadun [Assoc.Prof. Dr.] Faculty of Engineering
2003	Natural Booster for Production of Pure and High Quality Microalgae	Fatimah Md Yusoff [Prof. Dr.] Faculty of Science and Environmental Studies
2003	The Study of Novel Biopreservative Produced by *Lactobacillus plantarum* I-UL4 isolated from Fermented Jatropha manihot	Foo Hooi Ling [Dr.] Faculty of Food Science & Biotechnology
2003	UPM-GS 200: Superior and Highly Stable Grain Maize Synthetic	Ghizan Bin Saleh [Prof. Dr.] Faculty of Agriculture
2003	Improved Sweet Corn (*Zea mays* L.) Populations Developed Through Hybridization and Selection for Desirable	Ghizan Bin Saleh [Prof. Dr.] Faculty of Agriculture
2003	A Novel Multi-strain Probiotic Supplement for Laying Hens	Ho Yin Wan [Prof. Dr.] Institute of Bioscience
2003	Gelatin from 3 cultured Freshwater Fish Skins Obtained by Limiting Process	Jamilah Bakar [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Collagen and Gelatin from Red Talapia (*Oreochromis nilotica*) Skins	Jamilah Bakar [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	BioCarrierTM: A Novel Molecular Carrier from Newcastle Disease Virus	Khatijah Yusoff [Prof. Dr.] Institute of Bioscience
2003	Enhancement of Lipase Enantioselectivity Through Immobilization	Mahiran Basri [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Improved Enhanced Protection Against Fusarium Wilt by Constitutive Co-expression of Chitinase and Glucanase Genes in Transgenic Banana	Marziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Improving the Nutracceutical Value of Rice Bran by Supercritical Fluid Extraction	Maznah Ismail [Assoc. Prof. Dr.] Faculty of Medicine and Health Sciences

Year	Prize / Award	Recipient
2003	Parallel Modified Explicit Group Iterative Algorithm on SMP Parallel Computer	Mohamed Othman [Assoc. Prof. Dr.] Institute of Mathematical Research
2003	Alternative Methods for the Recovery of Intracellular Bioplastics from Various Waste Resources	Mohd Ali Hassan [Prof. Dr.] Faculty of Food Science and Biotechnology
2003	IMURON™ A Total Solution for Polynucleotide Vaccines	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	Aujeszky's Disease Vaccine with Genetic Markets that Facilitates Disease Eradication in Endemic Territories	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	Novel Polynucelotide Vaccine, NUCLEOCEPTIN™ For An Effective Fertility Control In Animals	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	Responses of Timber Concessionaires to Selected Policy Instruments: The Case of Peninsular Malaysia	Mohd. Shahwahid Hj. Othman [Assoc. Prof. Dr.] Faculty of Economics and Management
2003	Organic Dye-interleaved Nanocomposites: Alizarin-3-Sulfonate in the Lamella host of Zn/A-layered Double Hydroxide	Mohd. Zobir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Modification of Oil Palm Empty Fruit Bunch Fiber by Graft Copolymerization	Nor Azowa Ibrahim [Mrs.] Faculty of Science and Environmental Studies
2003	Numerical Computations Laboratory	Norazak Senu [Mr.] Faculty of Science and Environmental Studies
2003	Structural Laminated Veneer Lumber (LVL) Produced from Topical Harwoods As New Building Material in Malaysia	Paridah Md. Tahir [Assoc. Prof. Dr.] Faculty of Forestry
2003	Design of Cost Effective and Comfortable Motorcycle Helmet with Bio-Composite Material for Tropical Climates	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering
2003	Environmental Friendly Synthetic Lubricant	Robiah Yunus [Mrs.] Faculty of Engineering
2003	Oil Spill Contingency Planner	Shattri Mansor [Assoc. Prof. Dr.] Institute of Advanced Technology
2003	Aerobic and Strength Training: Impact on VO2 max and Body Fat	Soh Kim Geok Faculty of Educational Studies
2003	Growth of *Aspergillus Niger* in Solid Substrate Fermentation Using Palm Kernel Cake (PKC) as Substrate	Suraini Abd. Aziz [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	NDPath™: A Simple Solution to Newcastle Disease Virus Pathotyping	Tan Wen Siang [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Synthesis and Characterization of Vanadyl Pyrophosphate Catalysts via Vanadyl Hydrogen Phosphate Sesquihydrate Precursor	Taufiq Yap Yun Hin [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Design and Development of Heavy Duty Pendulum Impact Test Rig	Wong Shaw Voon [Dr.] Faculty of Engineering
2003	Fourier Transform Infrared Spectroscopy as Tools in Palm Oil Analysis	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Detection of Lard in Chocolates by Fourier Transform Infrared (FTIR) Spectroscopy for 'Halal Authentication	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology

Year	Prize / Award	Recipient
2003	Electrochemical Assisted Photodegradation of Dye Pollutants using TiO2 Thin Film Electrodes	Zulkarnain Zainal [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies

Silver Medal Winners *(81)*

Year	Prize / Award	Recipient
2003	Transforming Spatio-Temporal Yield Maps to Classified Managements Zone Maps for Efficient Management of Oil Palm	A.R. Anuar [Assoc. Prof. Dr.] Faculty of Agriculture
2003	The Development of Web-Based Software Certification Model	Abdul Azim Abd Ghani [Assoc. Prof. Dr.] Faculty of Computer Science & Information
2003	Superconducting Properties of Bulk and Tapes of Bi(Pb)-Sr-Ca-Cu-) System Prepared via Conventional Solid State and Coprecipitation Methods	Abdul Halim Shaari [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Low Field Magnetoresistance of Manganites Perovskite Bulks and Films for Sensing Devices	Abdul Halim Shaari [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Fast DNA Detection Kit- LEPTOSCAN™ Detects Individuals with Leptospira Infection	Abdul Rani Bahaman [Prof. Dr.] Faculty of Veterinary Medicine
2003	Cell Phone Signal Strength Predictor	Abdul Rashid Mohamed Shariff [Dr.] Faculty of Engineering
2003	Structural Properties of Modified *Candida rugosa* Lipase in Water and Organic Solvent	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Sodium from Seawater for Potassium Substitution in Pineapple Plant	Ahmad Husni Mohd. Hanif [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Detection of Newcastle Disease Virus (NVD) with SYBR Green I Based Real Time Polymerase Chain Reaction (PCR)	Aini Ideris [Prof. Dr.] Faculty of Veterinary Medicines
2003	Forest Pricing Policy in Malaysia	Awang Noor Abd. Ghani [Assoc. Prof. Dr.] Faculty of Forestry
2003	Religiosity and Personality Development Index: Application for Nation Building	Azimi Hamzah [Prof.Dr.Hj.] Institute of Community Development & Youth Studies
2003	Preparation of Fatty Amides from Metal Soaps under Microwave Irradiation	Badri Muhamad [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Application of New Advanced Nanomaterials for Enzyme Immobilization	Basyaruddin Abdul Rahman [Dr.] Faculty of Science and Environmental Studies
2003	Characterization and Cloning of Novel Phytase Genes from Rumen Bacteria *Mitsuokella jalaludinii*	Clemente Michael Vui Ling [Dr.] Institute of Bioscience
2003	Trichoderma harzianum—The Effective, Eco-Friendly and Beneficial Microfungus	Faridah Abdullah [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	e-Commerce for Flowers: Is the Malaysian Public Ready for it?	Fatimah Mohd. Arshard [Prof. Dr.] Faculty of Economics and Management

Year	Prize / Award	Recipient
2003	Microsatelliting of Antioxidant Elements During Hepatocarcinogenesis Treated with *Strobilanthes crispus*	Fauziah Othman [Assoc. Prof. Dr.] Institute of Bioscience
2003	Parallel Two Point Fully Imlicit Block Method For Solving Large Systems of Ordinary Differential Equations	Fudziah Ismail [Dr.] Faculty of Science and Environmental Studies
2003	Synthesis and Characterization of Nanocrystalline of Copper Oxide	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies
2003	Synthesize and Characterization of Highly Crystalline Antimony Oxide Catalysts	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies
2003	Automatic House Painting Machine	Ishak Aris [Assoc. Prof. Dr.] Faculty of Engineering
2003	Simulasi Peluru Berpandu Darat Berasaskan iMAC	Ismail Abdullah [Dr.] Institute of Mathematical Research
2003	The Development of Courseware (Unit 20: Lets Do Something fun!) for Form 1 English, Ministry of Education Malaysia	Jayakaran Mukundan [Dr.] Faculty of Educational Studies
2003	Potential of Exserohilum longirostratum as Bioherbicide For Itchgrass	Jugah Kadir [Dr.] Faculty of Agriculture
2003	An Explicit Estimate of Exponential Sums Associated With Cubicx and Quartic Forms	Kamel Ariffin Mohd Atan [Prof. Dr.] Institute of Mathematical Research
2003	Characterization and Structure Elucidation of Synthesized Nitrogen-sulfur Donor Ligands with Potential Biological Activity	Karen A Crouse [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	The Impacts of Trade Liberalization on the Malaysian Oil Palm Oil Industry: the Case of Export Duty	Mad Nasir Bin Shamsudin [Prof.] Faculty of Agriculture
2003	Bootstrap Simulation Study of ARMA (p,q) of Order p+q=3	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies
2003	ARAR and Long Memory Modeling of Tourist Arrivals to Malaysia	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies
2003	Quasi-cauchy Diagonal Preconditioned Steepest Descent Method for Large-scale Optimization	Malik Hj. Abu Hassan [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Nonstoichiometry and its Effects on the Magnetic Properties of Mg0.5 Zn0.5 Fe2+x O4	Mansor Hashim [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Development of Membrane Based Assay for the Rapid Identification of Multiple Resistant Staphyloccus aureus	Mariana Nor Shamsuddin [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	High Sensitivity Erbium Doped Optical Fiber Amplifier	Mohamad Khazani Abdullah [Assoc. Prof. Dr.] Faculty of Engineering
2003	Bioconversion of Sago Hampas by Local Beneficial Fungi for the Production of Bioplastics	Mohd Ali Hassan [Prof. Dr.] Faculty of Food Science and Biotechnology
2003	The Use of Different Growing Media Amended with Rice Straw Compost and Partial Rootzone Drying for Improvement of Yield, Quality and Water use Efficiency Tomatoes from under Protected Environment	Mohd Razi Ismail [Assoc. Prof. Dr.] Faculty of Agriculture

Year	Prize / Award	Recipient
2003	A Novel Liner Alkane Sulfate Determination Method	Mohd Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	Site-Specific Fertilizer Management for Rice Based on Soil Electrical Conductivity	Mohd. Amin Mohd. Soom [Prof. Dr.] Faculty of Engineering
2003	DIMIS: A GIS-Based Water Management Tool for Precision Farming of Rice	Mohd. Amin Mohd. Soom [Prof. Dr.] Faculty of Engineering
2003	Trade-Induced Adjustment with Price Setting Agents	Mohd. Azhar Abdul Karim [Assoc. Prof. Dr.] Graduate School of Management
2003	HAVAX™ : A Recombinant Human Adenovirus Vaccine That Protects Young Chicks From Severe Bursa Disease	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	ELLUCIN™—A Recombinant Yeast for Contraception	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	Reverse-Transcriptase Nested Polymerase Chain Reaction Enzyme Linked Immunosorbent Assay for Detection of Infectious Bursal Disease Virus	Mohd. Hair Bejo [Assoc. Prof. Dr.] Faculty of Veterinary Medicine
2003	Indirect Enzyme Linked Immunosorbent Assay for Detection of Infectious Bursal Disease	Mohd. Hair Bejo [Assoc. Prof. Dr.] Faculty of Veterinary Medicine
2003	Conference Secretariat Web Application	Mohd. Shafree Ahmad [Mr.] Institute of Multimedia and Software
2003	Bioindicator for Heavy Metals using the Molybdenum-reducing Activity System	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	A Novel Iron Determination Method	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	Microbial Bioremediation of the Heavy Metal Molybdenum	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	Marine Macrohytes of The Unexplored Punang-Sari Beach Front of Lawas, Sarawak (Under the IRPA-8 Project: Distribution, Diversity and uses of Aquativ macrophytes)	Muta Harah Zakaria [Dr.] Bintulu Campus
2003	Browning-associated Enzymes I Metroxylon Sagu	Nazamid Saari [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Thermostable T1 Lipase from Locally Isolated *geobacillus sp.* Strain T1: Manipulation of Gene Expression in Prokaryotic Systems	Raja Noor Zaliha Raja Abdul Rahman [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	A Novel Organic Solvent Tolerant Lipase from *Bacillus sphaericus* 205y: Optimization and molecular Cloning	Raja Noor Zaliha Raja Abdul Rahman [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Use Sewage Sludge and Coconut Coir Mix as a Peat Dubstiotute for Potted Chrysanthemum	Rosenani Abu Bakar [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Direct Fermentation of Sago Starch to Kojic Acid by Aspergillus flavus	Rosfarizan Mohamad [Dr.] Faculty of Food Science and Biotechnology
2003	High Throughput Sequencing of Chromosome One of *Eimeria tenella* for Gene Discoveries	Rozita Rosli [Dr.] Faculty of Medicine and Health Science

Year	Prize / Award	Recipient
2003	Workgroup Computing Model: A Case of Implementation in Higher Learning Institution	Rusli Hj Abdullah [Mr.] Faculty of Computer Science & Information
2003	Adaptive Remote Control Using RF Device	Sabira Khatun [Dr.] Faculty of Engineering
2003	The Patterns and Role Structure in Family Decision Making	Samsinar Md Sidin [Assoc. Prof. Dr.] Faculty of Economics and Management
2003	Quantification and Characterization of *Trichoderma spp* from Different Ecosystemns	Sariah Meon [Prof. Dr.] Faculty of Agriculture
2003	The Use of Suppressive soil for the Control of Fusarium Wilt of Banana Seedlings	Sariah Meon [Prof. Dr.] Faculty of Agriculture
2003	Development of Integrated Quantitative Groundwater Assessment System for Engineering and Environmental Application	Shahari Ibrahim [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Vocabulary Acquisition and Learning Strategies in Foreign Language	Shameem Bt Mohd. Rafik Khan [Assoc. Prof. Dr.] Faculty of Modern Language & Communication
2003	Hydrolysed Vegetable Protein (HVP) from Winged Bean	Sharifah Kharidah Syed Muhammad [Dr.] Faculty of Food Science & Biotechnology
2003	Development and Implementation of ePWA Integrated System	Sidek Hj. Aziz [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Morphological Differences and Phylogenetic Relationships among Selected Malaysian Gobies	Siti Khalijah Daud [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Phage Display of the Immunodominant Regions of Hepatitis B Virus on Bacteriophage T7	Tan Geok Hun [Dr.] Institute of Bioscience
2003	Temperature Programmed Techniques Study on the Nature of the Oxidant in/on V205 Catalyst	Taufiq Yap Yun Hin [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Physicochemical Study of γ-Al2O3 Supported Vanadium Phosphorus Oxide Catalysts	Taufiq Yap Yun Hin [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Determinants of Depression Among The Malaysian Elderly	Tengku Aizan Hamid [Assoc. Prof. Dr.] Institute of Gerontology
2003	Modulation of Apoptosis for Enhancement of Antibody Productivity in Intensive Cell Culture of NS0 Cells	Tey Beng Ti [Dr.] Faculty of Engineering
2003	Design and Development of Automated Tractor for Mobile Harvesting Robot	Wan Ishak Wan Ismail [Prof. Dr.] Institute of Advanced Technology
2003	Lipase Catalysed Synthesis of Fatty Hydroxamic Acids from Palm Oil	Wan Zin Wan Yunus [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Epoxidized Natural rubber/organoclay Nanocomposites	Wan Zin Wan Yunus [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Creativity and Innovativeness of Malaysian Organizations	Wong Foong Yee [Mrs.] Faculty of Economics and Management
2003	Artificial Intelligent Based Expert System for Machining Process	Wong Shaw Voon [Dr.]

Year	Prize / Award	Recipient
		Faculty of Engineering
2003	Electronic Nose Based on Surface Acoustic Wave Sensor for Characterization of Vegetable Oil	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	The Response Surface Methodology: Optimization of Pandan (*Pandaus amaryllifolius*) Powder by Using Spray Drying Method	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Combined Solar Heater and Ice Maker	Yusof Sulaiman [Prof. Dr.] Institute of Advanced Technology
2003	Structural Plywood Manufactured from Bamboo Culms (*Gigantochloa scortechinii*)	Zaidon Ashaari [Assoc. Prof. Dr.] Faculty of Forestry
2003	Development of Biomaker for *Bacillus saphaericus*, UPMB 10, Plant Growth Promoting rhizpcbacteria on Oil Palm and Banana	Zulkifli Hj. Shamsuddin [Prof.] Faculty of Agriculture
2003	Application of Vegetable Soyabean as and Intercrop with Paddy	Zulkifli Hj. Shamsuddin [Prof.] Faculty of Agriculture

Bronze Medal Winners *(148)*

Year	Prize / Award	Recipient
2003	Flower and Fruit Development in Chempedak	Abdul Ghani Yunus [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Monoclonal Antibody Production by *Phytohemagglutinin-L*-Aggregated Hybridoma Cells	Abdul Manaf Ali [Prof. Dr.] Institute of Bioscience
2003	Development of Single Nucleotide Polymorphism (SNP) Detection Method Using SYBR Green I Based Real Time Polymerase Chain Reaction	Abdul Rahman Omar [Assoc. Prof. Dr.] Faculty of Veterinary Medicines
2003	Assessment of Health of Palm Oil Plantation from Space Using Rule Based Classification	Abdul Rashid Mohamed Shariff [Dr.] Institute of Advanced Technology
2003	GIS Based Management System for Durian Plantation	Abdul Rashid Mohamed Shariff [Dr.] Faculty of Engineering
2003	GIS for Vector Borne Diseases	Abdul Rashid Mohamed Shariff [Dr.] Institute of Gerontology
2003	Biosurfactants Production by *Pseudomonas aeruginosa* 181	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Bioremediaton of Petroleum Hydrocarbon Contamination by Immobilized Bacterial Cells	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Kajang Crime Mapping GIS	Ahmad Rodzi Mahmud [Prof. Dr.] Institute of Gerontology
2003	Current Account and Budget Deficit in Asian: A Vicious Cycle Phenomenon	Ahmad Zubaidi Baharumshah [Prof. Dr.] Faculty of Economics and Management
2003	What Happen To Savings During The Crisis- A Dynamic Panel Analysis of the ASEAN-5 Countries	Ahmad Zubaidi Baharumshah [Prof. Dr.] Faculty of Economics and Management
2003	Environmental Concern, Knowledge and Practices Gap among Teachers	Aini Mat Said [Mrs.] Faculty of Human Ecology
2003	Potential Health Benefits of Extracts Prepared from Cocoa Products of Low Quality Malaysian Beans	Amin Ismail [Dr.] Faculty of Medicine and Health Science

2003	Paddy Transportation and Distribution Systems: The Case of MADA Granary Area	Amin Mahir Abdullah [Dr.] Faculty of Agriculture
2003	Synthesis and Characterization of New Composite Conducting Polymers for Microelectrodes Microsensors and Ion-exchange Membranes	Anuar Kassim [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Study on The Effects of Various Parameters On The Preparation of Fiber-reinforced Adhesive	Anuar Kassim [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Possible Anticancer Effect of Red Spinach	Asmah Rahmat [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	Fish Asemblages of the Seagrass Habitat: Species Composition, Feeding Habits and Recruitment	Aziz Arshad [Dr.] Faculty of Science and Environmental Studies
2003	Functional Ingredients Derived from Rice Bran	Azizah Abdul Hamid [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Identification of Areas with Peel/pulp Splitting Disorder Pisang Mas (*Musa Sapientum cv Mas*) and Its Physico-chemical Characteristics	Azizah Osman [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Automated, 2-Axis Laser Soil Surface Profile Digitizer	Azmi Yahya [Assoc. Prof. Dr.] Faculty of Engineering
2003	Photo thermal Characterizations on Ceramic Varistor	Azmi Zakaria [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Design of Horizontal Drum SSC Bioreactor and its Performance Test for Pectinase Production	Budiatman Satiawihardja [Dr.] Faculty of Engineering
2003	Halal or Non-Halal Meats? A Molecular Detection Method	Clemente Michael Vui Ling [Dr.] Institute of Bioscience
2003	The Relationship Between Work Values, Organizational Commitment and Job Performance amongst Executives	Dahlia bt Zawawi [Mrs.] Faculty of Economics and Management
2003	Drug-Like Anti-Inflammatory Activity of Natural Product Isolated from *Alpinia Rafflesiana* in a Cellular Model of Inflammation	Daud Ahmad Israf Ali [Assoc. Prof. Dr.] Institute of Bioscience
2003	Dose and Temperature Dependence on the Conductivity of Ionic Polymer	Elias Saion [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Polymer-zeolite Composite Membranes for Potential Fuel Cell Applications	Elias Saion [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Development of Biocontaminant-free Detection Kit for Screening Seaweed DNA	Faizah Bt. Jaafar [Dr.] Faculty of Medicine and Health Science
2003	Indigenous Knowledge for Potential Drug Screening and Commercialized Products	Faridah Hanum Ibrahim [Assoc. Prof. Dr.] Faculty of Forestry
2003	AFTA and Its Implications on the Indonesian Palm Oil Industry	Fatimah Mohd. Arshard Faculty of Economics and Management
2003	Synthesis and Characterization Betulinic Acid Derivatives Produced using Lipase as Catalyst and their Biological Activity	Faujan Hj. Ahmad [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Evaluation of Apoptosis Inducing Ability of Neem (*Azadirachta indica*) Leaf Extract on MCF-7 Breast Cancer Cell Lines.	Fauziah Othman [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	Paralleziation of Trapezoidal Rule	Fudziah Ismail [Dr.] Institute of Mathematical Research

2003	Detection of Apoptotic Cells in Moribund Black Tiger Shrimp Penaeus monodon Infected with White Spot Syndrome Disease	Hassan Hj. Mohd Daud [Dr] Faculty of Veterinary Medicines
2003	Isolation of Salinity Tolerance Genes from the Mangrove Plants, *Bruguiera cylindrical*	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology
2003	Isolation of Salinity Tolerance Genes The Mangrove Plant, *Acanthus ilicifolius*	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology
2003	Functional genomic Studies of a Malaysian Red Seaweed, Gracilaria Changii (Gracilariales, Rhodophyta): An Expressed Sequence Tag (EST) Approach	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology
2003	Bile salt hydrolase and cholesterol-reducing activity of *Lactobacillus* strains from chickens	Ho Yin Wan [Prof Dr.] Institute of Bioscience
2003	Characterization of Bismuth Oxide Catalysts Prepared via Precipitation Method	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies
2003	Reliability Analysis for Failure Crushing Time Data using Competing Risks Model with Subdistribution Functions	Isa Daud [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Mathematics Integrated Virtual Education Systems (Discreet)	Ismail Abdullah [Dr.] Institute of Mathematical Research
2003	High Performance Security Paper from Kenaf (*hibiscus cannabinus*) Fibre	Jalaluddin Harun [Dr.] Institute of Advanced Technology
2003	Alkaline Washings and Their Effects on The Quality Attributes of Black Tilapia Fillets	Jamilah Bakar [Dr.] Faculty of Food Science & Biotechnology
2003	Glasshouse Acclimatization of Tissue Cultured *senduduk* Plantlets	Janna Ong Abdullah [Dr.] Faculty of Science & Environmental Studies
2003	Life and Adaptation in Seagrass Ecosystem	Japar Sidik Bujang [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Financial Behaviour of University Students: Policy Implication	Jariah Masud [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	The use of Concordance Software in Determining Vocabulary Load Distribution and Efficiency (VLDE) in Textbooks	Jayakaran Mukundan Faculty of Educational Studies
2003	Production of Polyphenols from Cocoa Beans: A Two in One Technology	Jinap Selamat [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Expression of 1-Aminocycopropane-1 Carboxylic Acid Oxidase Gene, OPSC10, in Oil Palm Suspension Culture	K. Harikrishna [Assoc. Prof. Dr.] Faculty of Food Science and Biotechnology
2003	On The Solutions of a Semi Quadratic Pair of Diophantine Equations and Its Applications	Kamel Ariffin Mohd Atan [Prof. Dr.] Institute of Mathematical Research
2003	Intervation Model Forecasting Automobile Sales in Malaysia	Kassim Haron [Dr.] Faculty of Science and Environmental Studies
2003	Potential of the NP Protein of NDV as an Antigenic Carrier for IBDV	Khatijah Yusoff [Prof. Dr.] Faculty of Science and Environmental Studies

2003	Potential of NP of NDV as an Antigenic Carrier for Truncated VP1 of Enterovirus 71	Khatijah Yusoff [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Perkhidmatan Produk Kewangan di Sumatera Barat, Indonesia: Perbandingan antara Etnik Minangkabau Cina	Laily Paim [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	Nasopharyngeal Carriage of Neisseria Meningitidis among Returning Malaysian Hajj Pilgrims 1422H	Latifah A. Latiff [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	Does PPP Hold between Asian and Japanese Economies	M. Azali [Assoc.Prof.] Faculty of Economics and Management
2003	Time Series Modeling of the Malaysian Automobile Sales	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies
2003	A Resistant Line Fit between Zn and Co Found in Estuary and Coastal Sediment Samples from Tanjung Karang and Pulau Langkawi	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies
2003	Some Explicit Stationary Conditions for the Unilateral Second Order Spatial ARMA Model	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies
2003	Senior Engineering: Factors Contributing to Career Growth	Maimunah Ismail [Prof. Dr.] Faculty of Educational Studies
2003	Technical versus Managerial Line: Career Route Preference of Senior Men and Women Engineers	Maimunah Ismail [Prof. Dr.] Faculty of Educational Studies
2003	Application of Membranes Array for Gene Expression Detection: Drug Target and Toxigenic Genes	Mariana Nor Shamsuddin [Assoc. Prof. Dr.] Faculty of Medicine and Health Science
2003	Cell Culture Technologies to Produce Important Bioactive Compounds	Marziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies
2003	Chemical Diversity and New Bioactive Coumarins from *Micromelum Minutum* (*Rutacaea*)	Mawardi Rahmani [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Development of Biomaterial from Ruminant Offal for Reconstructive Abdominal Wall Surgery	Md Zuki Abu Bakar @ Zakaria [Dr.] Faculty of Veterinary Medicines
2003	Removal of Arsenic from a Aqueous Solution using Tin (IV) Loaded-chelating Resin	Md. Jelas Haron [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Media Converter	Mohamad Khazani Abdullah [Assoc. Prof. Dr.] Faculty of Engineering
2003	Antimicrobial and Cytotoxic Products from Murraya Species	Mohd Aspollah Sukari [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Hybrid Nanocomposite of 2,4-dichlorophenoxyacetate, a Latex Stimulant	Mohd Zobir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies
2003	An Agent-Based Model of Choice, Complexity and Learning	Mohd. Azhar Abdul Karim Graduate School of Management
2003	The Role of Heterogeniety in Price-Formation and Market Equilibrium: An Analytical Model	Mohd. Azhar Abdul Karim Graduate School of Management
2003	JeskiTek™: A Hassle- Free Diagnostic Kit For Aujeszky's Disease	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine

2003	Development of Diagnostic Kits for Effective Detection of Human Rotaviruses	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	A Novel Rat Model Facilitates Vaccine Development and Intervention Studies for the Prevention of Congenital Cytomegalovirus Infection in Human	Mohd. Azmi Mohd. Lila [Prof. Dr.] Faculty of Veterinary Medicine
2003	Penggunaan Media Massa dan Pengaruh terhadap Remaja	Mohd. Fazli Sabri Faculty of Human Ecology
2003	Image Processing Technique of Quality Control of Oil Palm Fruitlets During Sterilization	Mohd. Halim Shah Ismail [Mr.] Faculty of Engineering
2003	Knowledge Management System in Collaborative Environment for Higher Learning Institutions	Mohd. Hasan Selamat [Assoc. Prof. Dr.] Faculty of Computer Science & Information Technology
2003	Assessment Software For Strategic Information System Planning	Mohd. Hasan Selamat [Assoc. Prof. Dr.] Faculty of Computer Science & Information Technology
2003	Comparative Advantage of the Food Processing Industry	Mohd. Mansor Ismail [Dr.] Faculty of Agriculture
2003	A Novel Enzymatic Assay of Heavy Metals	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	Microbial Bioremediation of the Heavy Metal Molybdenum	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies
2003	Anti-inflammatory Properties of three Local spp.	Muhd. Nazrul Hakim [Dr.] Institute of Bioscience
2003	Antifungal and Anti-bacterial Agents from Three Local *Cassia spp*.herbs	Muhd. Nazrul Hakim [Dr.] Institute of Bioscience
2003	Potential of Three Local *Euphorbiacea* Plants as Antimicrobial Agents	Muhd. Nazrul Hakim [Dr.] Faculty of Medicine and Health Science
2003	Penggunaan Komputer di kalangan Pelajar Berpendapatan Rendah	Mumtazah Othman [Dr.] Faculty of Human Ecology
2003	Testing Ling-run Neutrality of Money in Malaysia	Muzafar Shah Habibullah [Assoc. Prof. Dr.] Faculty of Economics and Management
2003	Comparison of Jackfruit (*Artocarpus heterophyllus*) Powders Produced By Using Drum-Drying and Spray-Drying Technologies	Nazimah Sheik Abd Hamid [Dr.] Faculty of Food Science & Biotechnology
2003	Interval Estimation for Survivor Function of Exponential Distribution under Double Type II	Noor Akma Ibrahim [Assoc. Prof. Dr.] Institute of Mathematical Research
2003	Variation in Multiple Leader Incidence of Four *Acacia* Species	Nor Aini Ab Shukor [Assoc. Prof. Dr.] Faculty of Forestry
2003	Propagation Protocols of Multi Purpose Tree Species	Nor Aini Ab Shukor [Assoc. Prof. Dr.] Faculty of Forestry
2003	Modification of Conjugate Gradient Method for Unconstrained Optimization	Norfifah Bachok [Mrs.] Faculty of Science and Environmental Studies
2003	Effects of *Mitsuokella Jalaludinii* and *Lactobacillus* Cultures Supplementation on the Performance and Nutrient Utilization of Broiler Chickens	Norhani Abdullah [Assoc. Prof. Dr.] Institute of Bioscience

2003	Kajian Kepuasan Tempat Tinggal dan Pencapaian Akademik Pelajar Lelaki Melayu Luar Kampus Universiti Putra Malaysia	Nurizan Yahaya [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	Chromaticity of Two-connected (n, n+4)-Graphs	Peng Yee Hock [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Effects of Processing Parameters on Physico-Chemical Properties of Drum-Dried Durian Powder	Quek Siew Young [Dr.] Faculty of Food Science & Biotechnology
2003	Flavonoids and Antioxidant Activities of Different Solvent Extract of Clausena excavate ("cerek hitam") Leaves	Radzali Muse [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Inculcation Farmers' Work Culture Among Malaysia Youth Agro-Entrepreneur using Transformative Learning Model	Rahim Md Sail [Prof. Dr.] Institute of Community Development & Youth Studies
2003	Cobb Angle Determination in x-ray Images	Rahmita Wirza [Dr.] Institute of Advanced Technology
2003	Acquisition of Computer Literacy among 5 and 6 Year Olds in a Laboratory Preschool	Rohani Abdullah [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	Availability of Home Computers and Preschooler's Computer Knowledge and Skills	Rohani Abdullah [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	The Effect of Modified Atmosphere Packaging (MAP) on The Microbiological and Sensory Qualities Of Chinese Wet noodles During Chilled Storage	Roselina Karim [Dr.] Faculty of Food Science & Biotechnology
2003	Development of Procedure for Packaging Perishable Sample for Long Distance Courier Services	Roselina Karim [Dr.] Faculty of Food Science & Biotechnology
2003	An *in Vitro* Study of the Antihistaminic and Anticholinergic Effects of Compounds from the Leaves of *Alseodaphne perakensis*	Rozita Rosli [Dr.] Faculty of Medicine and Health Science
2003	Anticancer, Genotoxicity Assessments and Purification of Acanthus Ilicifoliuo Seed Extract	Rozita Rosli [Dr.] Faculty of Medicine and Health Science
2003	A Multidisciplinary Application of DNA Vaccines	Rozita Rosli [Dr.] Faculty of Medicine and Health Science
2003	Investigation on the effects of SMDB-CD on Glioblastoma Cell Lines	Rozita Rosli [Dr.] Faculty of Medicine and Health Science
2003	Gender Roles and Marital Quality among Dual-Career Couples	Rumaya Juhari [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	Economic Hardship, Family Functioning and Marital Quality amongst Malay Poor Families in Selangor	Rumaya Juhari [Assoc. Prof. Dr.] Faculty of Human Ecology
2003	Paphiopedillum stonei: Treasures from Padawan Limestone Hills, Sarawak	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Hymenophyllaceae: The Unseen Between Primitive and Modern Fern	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Perlis Limestone Orchids: Beauty, Conversation and Future	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	*Selaginalleceae*: The Untapped Natural	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies

2003	Freezing Characteristics and Storage Behaviour of Precooked Frozen Nasi Lemak	Russly Abd. Rahman [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Sous Vide Processing of Rendang	Russly Abd. Rahman [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Development of chicken Rice by Using Sous Vide Cook-Chill Technology	Russly Abd. Rahman [Assoc. Prof. Dr.] Faculty of Food Science & Biotechnology
2003	The Inoculation Effects of azospirillum and mycorrhiza on the Canopy Architecture of maize (*Zea mays* L.)	S.H.M. Chin [Dr.] Faculty of Agriculture
2003	Optimization of Enzymatic Clarification from Banana (*Musa sapientum*) and Sapodilla (*Achras sapota*) Juice Extract using Responese Surface	Salmah Binti Yusof [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Knowledge and Accessibility to the Law of Fasakh	Sa'odah Ahmad [Mrs.] Faculty of Human Ecology
2003	Development of Biological and Agronomic Strategies for the Management of Fusarium Wilt of Banana	Sariah Meon [Prof.] Faculty of Agriculture
2003	The Effect of *Zingiber zerumbet* on Liver of Male Sprague-Dawley Rats	Sharida Fakurazi [Dr.] Faculty of Medicine and Health Science
2003	Advance Early Warning System for Flood Forecasting	Shattri Mansor [Assoc. Prof. Dr.] Institute of Advanced Technology
2003	Flash Technology Application in Courseware Development for the Internet Environment	Sidek Hj. Aziz [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Anomaly in Acousto-thermal Characteristics of Bismate and Plumbate Glasses	Sidek Hj. Aziz [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	A Rapid Technique for The Detection of Fecal Pollution in Water	Siti Khairani Bejo [Dr.] Faculty of Veterinary Medicine
2003	Assessment of the Population Genetic Structure of the Green-lipped Mussel, Perna viridis L using Random Amplified Polymorphgic DNA (RAPD) and Random Amplified Microsatellites (RAMs) Markers	Tan Soon Guan [Prof. Dr.] Faculty of Science & Environmental Studies
2003	Larvicidal and antimicrobial Activities from *Clausena excavata* (Jasin, Melaka)	Taufiq Yap Yun Hin [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Perception of Needs and Problems of the Elderly: Implications on Policies and Programmes	Tengku Aizan Hamid [Assoc. Prof. Dr.] Institute of Gerontology
2003	Non-Formal Learning and Older Malaysian	Tengku Aizan Hamid [Assoc. Prof. Dr.] Institute of Gerontology
2003	Aktiviti Senggang Pesara Malaysia	Tengku Aizan Hamid [Assoc. Prof. Dr.] Institute of Gerontology
2003	Preliminary Studies on Sterilization, Germoination and Propagation of *Curcuma aeruginosa*	Thohirah Lee Abdullah [Assoc. Prof. Dr.] Faculty of Agriculture
2003	The Effect of Lime and an Organic-based Fertilizer Application on Rice Production on an Acid Sulfate Soil	Totok Suswanto Faculty of Agriculture
2003	Sustainability of Successful Youth Organizations in Molding the Future Generation	Turiman Suandi [Prof.Dr. Hj.] Faculty of Educational Studies
2003	Competitive Strategies for a Palm Oil Exporting Company in Peninsular Malaysia: The Case of Selangor Palm Oil Sdn. Bhd (SPOSB)	Wan Mohd Marzuki Wan Bakar Faculty of Agriculture

2003	Development of A Genetically Engineered Vaccine to curb Zoonotic Transmission of *Brugian Filariasis*	Wan Omar Abdullah [Prof. Dr.] Faculty of Medicine and Health Science
2003	The Effect of Vocabulary on Text Comprehension	Wong Bee Eng [Dr.] Faculty of Modern Language & Communication
2003	Consumers' Purchasing Behavior toward Imported Dairy Products	Wong Foong Yee [Mrs.] Faculty of Economics and Management
2003	Rapid Methods for Determining Minor Components in RBD Palm Olein using Fourier Transform Infrared Spectroscopy	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology
2003	Fertilizer Nutrient Mobility in Peat and Uptake by Sago Palm	Zaharah A. Rahman [Prof.] Faculty of Agriculture
2003	A System Model for Beef Production Strategies	Zainal Abidin Bin Mohamed [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Optical Characterization of Phosphate Glasses	Zainal Abidin Talib [Assoc. Prof. Dr.] Faculty of Science & Environmental Studies
2003	Dietary Calcium Intake and Bone Mineral Density among Malay Postmenopausal Women	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science
2003	Effect of Calcium Supplementation on Serum Lipid Profile of Postmenopausal Chinese Women	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science
2003	Effectiveness of Calcium Supplementation and Weight-bearing Exercise in Reducing the rate of Bone Loss in Postmenapausal Chinese Women- a Two-Year Randomized Controoled Trial	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science
2003	Preparation of Tin Chalcogenide Thin Films by Electrochemical Method	Zulkarnain Zainal [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies
2003	Feeding of Palm-based Diets as a Practical Strategy to Alleviate Heat Stress in Broiler Chickens	Zulkifli Idrus [Assoc. Prof. Dr.] Faculty of Agriculture
2003	Development of Microwave Sensors for the Determination of Dielectric Properties of Oil Palm Fruits	Zulkifly Abbas [Dr.] Institute of Mathematical Research
2003	Mobile Communication Path Loss Studies in UPM Campus	Zulkifly Abbas [Dr.] Institute of Mathematical Research

Vice Chancellor Fellowship Awards *(03)*

Year	Prize / Award	Recipient
2003	Award for Excellence in Research	Husaini Omar [Assoc. Prof. Dr.] Faculty of Engineering
2003	Award for Excellence in Research	Mohd. Azmi Mohd. Lila [Assoc. Prof. Dr.] Faculty of Veterinary Medicine
2003	Award for Excellence in Teaching	Salihan Siais [Assoc. Prof. Dr.] Institute of Distance Education & Learning

International Postgraduate Students Awards *(02)*

Year	Prize / Award	Recipient
2003	French Government Scholarship Award for Training in Simulation and Visualisation of Landscapes, CIRAD, Montpellier, France.	Nayan Deep S. Kanwal (Mr.) Faculty of Forestry
2003	Paper Presentation Award at International Forum for Urban Landscape Technologies, Lullier, Switzerland.	Nayan Deep S. Kanwal (Mr.) Faculty of Forestry

Other Awards *(04)*

Year	Prize / Award	Recipient
2003	Vice Chancellor's Fellowship Award—Excellence in Professional Services	Abdul Karim Shah Bin Noh Shah (Tuan. Haji.)
2003	Vice Chancellor's Fellowship Award—Excellence in Professional Services	Rosmi Othman (Mr.)
2003	Vice Chancellor's Fellowship Award—Excellence in Supporting Services	Siti Aminah Datuk Sani (Miss)
2003	Vice Chancellor's Fellowship Award—Excellence in Supporting Services	Tajuddin Abdul Manap (Mr.)
Total Awards for the university (2003-04)		**338**

*f*Source: Faculties/Institutes.

These achievements listed above provide convincing proof that academic staff of Universiti Putra Malaysia continue to contribute to the advancement of knowledge resulting in technological inventions, training skilled human resources for nation building and forging partnerships with the industry.

[i] *Data in chronological order, sorted by award type and author.*

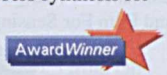
Exhibitions & Competitions 2003-04[i]

To promote the R&D products UPM exhibited its products at the following national and international Exhibitions and Competitions between 2003 and 2004. *Values in *parenthesis* indicate number of products exhibited.

Table 14.

Exhibitions and Competitions 2003-04[1].

1. 32nd International Exhibition of Inventions, New Techniques and Products *(10)*

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
31 Mar – 4 Apr 2004 Geneva, Switzerland	Carbon nanotubes and carbon nanofibers synthesis for nanotechnology applications 	Fakhru'l-Razi Ahmadun [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8656 7120 Email: fakhrul@eng.upm.edu.my
	E-ORY—Natural antioxidant rich nutraceutical formulation 	Maznah Ismail [Assoc.Prof.Dr.] Faculty of Medicine and Health Sciences Tel: +603-8946 8483 Email: maznah@medic.upm.edu.my
	Nucleoceptin™—a novel vaccine for fertility control in animals 	Mohd. Azmi Mohd. Lila [Professor Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Imuron™—a total solution for maximizing antibody responses 	Mohd. Azmi Mohd. Lila [Professor Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	CRFNanopath—a novel nanocomposite based controlled release formulation 	Mohd Zobir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466801 Email: mzobir@fsas.upm.edu.my
	Optical layer automatic protection switch 	Mohd. Hanif Yaacob (Mr.) Faculty of Engineering Tel: +603-8946 6454 Email: hanif@eng.upm.edu.my
	Biocomposite helmet for tropical countries 	Radin Umar Radin Sohadi (Professor Dr. Ir.) Faculty of Engineering Tel: +603-8656 7101 Email: radinumx@eng.upm.edu.my
	Palm oil based synthetic bio lubricant 	Robiah Yunus [Dr.] Faculty of Engineering Tel: +603-8946 6291 Email: robiah@eng.upm.edu.my

[1] Data presented as of April 2004.

Date / Venue	Product/ Process / Research Title	Exhibitor (Name & Full address with Tel/Fax/email)
	ZAPPA—the rice seeds germination enhancer 	Syed Omar Syed Rastan [Assoc. Prof. Dr.] Faculty of Agriculture Tel: +603-8946 6988 Email: syedomar@agri.upm.edu.my
	Heavy duty pendulum impact test ring for crashworthiness studies 	Wong Shaw Voon [Dr.] Faculty of Engineering Tel: +603-8946 6339 Email: wongsv@eng.upm.edu.my

2. IPTA Research and Development Exposition 2003 *(45)*

Date / Venue	Product/ Process / Research Title	Exhibitor (Name & Full address with Tel/Fax/email)
9 – 12 Oct 2003 **PWTC, Kuala Lumpur**	Low Field Magnettoresistance of Manganites Perovskites Bulks and Film For Sensing Device 	Abdul Halim Shaari [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6648 Email: ahalim@fsas.upm.edu.my
	Low Cost Motion Detection Using PC Camera	Abdul Rahman Ramli [Dr.] Faculty of Engineering Tel: +603-8946 7532 Email: arr@eng.upm.edu.my
	SMS Gateway Interface 	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology Tel: +603-8946 6445/ 6446 Email: arr@eng.upm.edu.my / arr@putra.upm.edu.my
	Value Addition to Pineapple Leaves From Zero Burning Practice	Ahmad Husni Mohd. Hanif [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6961 Email: husni@agri.upm.edu.my
	Development of Biopesticide for Managing Cruciferous Vegetable Pest 	Ahmad Said Sajap [Prof. Dr.] Faculty of Forestry Tel: +603-8946 7161 Email: ahsaid@putra.upm.edu.my
	Willingness Of Local Tourist To Pay For Conservation wof Tourism Spots in The Damai District, Sarawak	Alias Radam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7461 Email: -
	Monetary Policy Transmission Mechanism	Azali Mohamed [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603-8946 7626 Email: azali@putra.upm.edu.my
	Smart Remote Access Distributed Systems	Borhanuddin Mohd. Ali [Prof. Dr.] Faculty of Engineering Tel: +6012-351 3072 Email: borhan@eng.upm.edu.my
	Carbon Nanotubes and Vcarbon Nanofibers Synthesis for Nanotechnology Applications 	Fakhru'l-Razi Ahmadun [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8656 7120 Email: fakhrul@eng.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Breeding for Superior Sweet Corn Synthetics Through Mass Selection and Backcrossing	Ghizan Salleh [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6993 Email: ghizan@agri.upm.edu.my
	An Integrated Management For The Control of Bacterial Wilt of Tomato Caused By Ralstonia Solanacearum Award Winner	Hiryati Abdullah [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7231 Email: hiryati@agri.upm.edu.my
	Genetic Variability of Four Sheep Breeds in Malaysia Award Winner	J.M Panandam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6897 Email: jothi@agri.upm.edu.my
	Sheep Farm - A User-Friendly Database Management System for a Small Farm	J.M Panandam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6896 Email: jothi@agri.upm.edu.my
	Fibre Reinforced Plactic Composite (FRPC) from Oil Palm (Elaeis guineendid, jacq.) Fibre Blended in Termoplastic Matrix for Automotive and Other Applications	Jalaluddin Harun [Dr.] Institute of Advanced Technology Tel: +603-8946 7538 Email: jalal@putra.upm.edu.my
	Seagrasses: What Do We Know of The Resources in Malaysia?	Japar Sidik Bujang [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6602 Email: japar@fsas.upm.edu.my
	Blood Lipids and Fat Deposition in Commercial Broiler and Crossbred Village Chisken	Loh Teck Chwen [Dr.] Faculty of Agriculture Tel: +603-8946 6899 Email: mghazalee@putra.upm.edu.my
	Scale Up Production of Liquid Wax Ester Enzymatic Esterification Using Batch Mode Bioreactor	Mahiran Basri [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6603 Email: mahiran@fsas.upm.edu.my
	SASSAR Kit (Staphylococcus aureus Species Specific Antibiotic resistant) Identification Kit.	Mariana Nor Shamsuddin [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8497 Email: Mariana@medic.upm.edu.my
	Commercial Production of Economically Important Planting Materials Using Culture Technologies Award Winner	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	Genetic Engineering of Bananas for Tolerance to Fusarium Wilt Disease Award Winner	Maziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	Distribution and Sources of Polycylic Aromatic Hydrocarbons (PAHs) in Persian Gulf: 10 Years after the Gulf War	Mohamad Pauzi Zakaria [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6738 Email: mpauzi@fsas.upm.edu.my

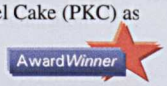
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Fiber Optics: Automatic Protection Switch (APS)	Mohamed Khazani Abdullah [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6454 Email: khazani@eng.upm.edu.my
	Trade Box and the Trade Adjustment Space	Mohd. Azhar Abdul Karim [Dr.] Graduate School of Management Tel: +603-8946 7435 Email: akmar@putra.upm.edu.my
	Novel Polynucelotide Vaccine, NUCLEOCEPTIN™ For An Effective Fertility Control In Animals	Mohd. Azmi Mohd. Lila [Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Measuring Cost Efficiency Malaysian Oil and Fat Industry: A Data Envelopment Analysis (DEA) Evidence	Mohd. Ghazali Mohayidin [Prof. Dr.] Faculty of Agriculture Tel: +603-8946 6175 Email: mghazalee@putra.upm.edu.my
	Reverse-Transcriptase Nested Polymerase Chain Reaction Enzyme Linked Immunosorbent Assay for Detection of Infectious Bursal Disease Virus	Mohd. Hair Bejo [Assoc.Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8287 Email: mdhair@vet.upm.edu.my
	The Impacts of Spatio-temporal Oceanographic Phenommenon on the Small Pelagic Fishery in the Straits of Malacca	Mohd. Ibrahim Hj. Mohamed [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6739 Email: mibrahim@fsas.upm.edu.my
	The Development of Copper-Coated Urea for Rice Production	Mohd. Khanif Yusop [Prof.Dr.] Faculty of Agriculture Tel: +603-8943 3097 Email: khanif@agri.upm.edu.my
	PUTRANET - virtual office	Mohd. Safree Ahmad [Mr.] Institute of Multimedia and Software Tel: +603-8946 8423 Email: mshafree@imedia.upm.edu.my
	The Mellin Differential Equations	Muhammed Rezal Kamel Ariffin [Mr.] Institute of Mathematical Research Tel: +603-8946 6838/ 6814 Email: rezal@fsas.upm.edu.my / akilic@fsas.upm.edu.my
	Design of Cost Effective and Comfortable Motocyle Helmet with Bio-Composite Material for Tropical Climates Award Winner	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering Tel: +603-8656 7101 Email: radinumx@eng.upm.edu.my
	Termostable Lipase L2: Optimization of Lipase Production and Gene Isolation	Raja Noor Zaliha Raja Abdul Rahman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6713 Email: mzaliha@fsas.upm.edu.my
	Environmental Friendly Synthetic Lubricant from Palm Oil	Robiah Yunus [Dr.] Faculty of Engineering Tel: +603-8946 6291 Email: robiah@eng.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Recycling of Crop Residues for Sustainable Crop Production in a Maize-groundnut Rotation System	Rosenani Abu Bakar [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6981 rosenani@agri.upm.edu.my
	Cholera DNA Vaccine Award Winner	Rozita Rosli [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603 – 8946 8480 Email: rozita@medic.upm.edu.my
	The Development of e-SPRINT: An Online Lecture Notes Management System	Sidek Hj. Abd. Aziz [Assoc.Prof.Dr.] Institute of Multimedia and Software Tel: +603-8946 7808 Email: sidek@putra.upm.edu.my
	ZAPPATM - The Rice Seed Germination Enchancer & Control of "Padi Angin" Infestation.	Syed Omar Syed Rastan [Assoc. Prof. Dr.] Faculty of Agriculture Tel: +603-8946 6988 Email: syedomar@agri.upm.edu.my
	Biotechnology For Cost-Efficient Production of The Shiitake Mushroom on Sawdust Waste	Tan Yee How [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7248 Email: alvinyht@agri.upm.edu.my
	Antifungal and Genotoxic Activities of Flavonoid Isolated from Some Selected Medicinal Plants	Umi Kalsom Yusuf [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6642 Email: umikay@fsas.upm.edu.my
	Lipase Cataysed Synthesis of Fatty Hyroxamic Acids from Palm Oil	Wan Md. Zin Wan Yunus [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6601 Email: wanzin@fsas.upm.edu.my
	Design and Development of Heavy Duty Pendulum Impact Test Ring	Wong Shaw Voon [Dr.] Faculty of Engineering Tel: +603-8946 6339 Email: wongsv@eng.upm.edu.my
	Avaiable P Dynamics in a Tropical Soil Amended with Natural Organic and Inorganic Fertilizer	Zaharah A. Rahman [Dr.] Faculty of Agriculture Tel: +603-8946 6933 Email: zaharah@agri.upm.edu.my
	Production of Bacterial Inoculants as Biofertilizer and Bioenhancer Award Winner	Zulkifli Hj. Shamsuddin [Prof. Dr.] Faculty of Agriculture Tel: +603-8946 6028 Email: zulsham@agri.upm.edu.my
	Enhancing Tolerance to Heat Stress, Resistance to Infectious Bursal Disease and Expression of Heat Shock Protein 70 in Broiler Chickens by Early Feed Restriction	Zulkifli Idrus [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6908 Email: zulkifli@agri.upm.edu.my
	Private Capital Flows from Asean Four	Zulkornain Yusop [Dr.] Faculty of Economics and Management Tel: +603-8946 7643 Email: zolyusop@econ.upm.edu.my

3. Expo S&T Invention & Innovation Awards *(30)*

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
7–9 August 2003 PWTC, Kuala Lumpur	Data Hiding Techniques in Digital Images 	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology Tel: +603-8946 7532 Email: arr@eng.upm.edu.my
	Nutrient Flow Stem Infusion Technique of Fertilizer Application in Oil Palm Seedlings. 	Aminuddin bin Hussin [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6962 Email: amin@agri.upm.edu.my
	The Generating Financial Reports Simulation (GenerReS) Software 	Arfah Salleh [Assoc.Prof.Dr.] Graduate School of Management Tel: +603-8946 7432 Email: arfah@putra.upm.edu.my
	Smart Remote Access Distributed System 	Borhanuddin Mohd. Ali [Prof. Dr.] Faculty of Engineering Tel: +603-8656 7120 Email: {borhan, mpnck}@eng.upm.edu.my
	Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications 	Fakhru'l-Razi Ahmadun [Assoc.Prof. Dr.] Faculty of Engineering Tel: +603-8656 7120 Email: fakhrul@eng.upm.edu.my
	The Study of Novel Biopreservative Produced by Lactobacillus plantarum I-UL4 isolated from Fermented Tapioca, Manihot Esculanta 	Foo Hooi Ling [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8343 Email: hlfoo@fsb.upm.edu.my
	UPM-GS 2002: Improved Sweet Corn (Zea mays L.) Genotype Developed by Introgression of Exotic Germplasm 	Ghizan Bin Saleh [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6993 Email: ghizan@agri.upm.edu.my
	SterllacTM : A Multi-strain Probiotic for Poultry 	Ho Yin Wan [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8067 Email: ywho@ibs.upm.edu.my
	Gelatin from 3 Cultured Freshwater Fish Skins Obtained by Limiting Process 	Jamilah Bakar [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8396 Email: jamilah@putra.upm.edu.my
	BioCarrierTM: A Novel Molecular Carrier from Newcastle Disease Virus 	Khatijah Yusoff [Prof.Dr.] Institute of Bioscience Tel: +6603-89466692 Email: khatijah@fsas.upm.edu.my
	Enhancement of Lipase Enantioselectivity Through Immopbilization 	Mahiran Basri [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6603 Email: mahiran@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Improved Enhanced Protection Against Fusarium Wilt by Constitutive Co-expression of Chitinase and Glucanase Genes in Transgenic Banana 	Maziah Mahmood [Prof.Dr.] Faculty of Science and Environment Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	E-ORYTM: Antioxidant Rich Nutraceutical Oil from Local Agricultural by-Products 	Maznah Ismail [Assoc.Prof.Dr.] Faculty of Medicine and Health Sciences Tel: +603-8946 8483 Email: maznah@medic.upm.edu.my
	Parellel Modified Explicit Group Iterative Algorithm on SMP Parellel Computer	Mohamed Othman [Assoc.Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 6565 Email: mothman@fstm.upm.edu.my
	Alternative Methods for the Recovery of Intracellular Bioplastics from Various Waste Resources 	Mohd Ali Hassan [Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8368 Email: alihas@putra.upm.edu.my
	IMURONTM A Total Solution for Polynucleotide Vaccines 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8945 8305 Email: azmi@vet.upm.edu.my
	Novel Polynucelotide Vaccine, NUCLEOCEPTINTM For An Effective Fertility Control In Animals 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8945 8305 Email: azmi@vet.upm.edu.my
	Cost Benefit Analysis Simulation for Development Project Evaluation 	Mohd. Shahwahid Hj. Othman [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603- 8946 6185 Email: msho@econ.upm.edu.my
	Composite Conversion Coating using Organic-Inorganic Nanolayered Hybrid Materials 	Mohd. Zobir Hussein [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6801 Email: mzobir@fsas.upm.edu.my
	Modification of Oil Palm Empty Fruit Bunch Fiber by Graft Copolymerization 	Nor Azowa Ibrahim [Mrs.] Faculty of Science and Environmental Studies Tel: +603-8946 6802 Email: azowaib@fsas.upm.edu.my
	Structural Laminated Veneer Lumber (LVL) Produced from Topical Harwoods As New Building Material in Malaysia	Paridah Md. Tahir [Dr.] Faculty of Forestry Tel: +603-8946 7187 Email: parida@putra.upm.edu.my
	Design of Cost Effective and Comfortable Motocycle Helmet with Bio-Composite Material for Tropical Climates 	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering Tel: +603-8946 7101 Email: radinumx@eng.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Environmental Friendly Synthetic Lubricant 	Robiah Yunus [Dr.] Faculty of Engineering Tel: +603-8946 6291 Email: robiah@eng.upm.edu.my
	Oil Spill Contigency Planner 	Shattri Mansor [Assoc.Prof. Dr.] Institute of Advanced Technology Tel: +603-8946 7543 Email: shattri@eng.upm.edu.my
	Growth of Aspergillus Niger in Solid Substrate Fermentation Using Palm Kernel Cake (PKC) as Substrate 	Suraini Abd. Aziz [Assoc.Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8363 Email: suraini@putra.upm.edu.my
	NDPathTM: A Simple Solution to Newcastle Disease Virus Pathotyping 	Tan Wen Siang [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6715 Email: wstan@fsas.upm.edu.my
	Vanadyl Pyrophosphate Catalysts via Sesquihydrate Precursor: Selective Oxidation of C4 to Maleic Anhydride	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	Design and Development of Heavy Duty Pendulum Impact Test Rig 	Wong Shaw Voon [Dr.] Faculty of Engineering Tel: +603-8946 6339 Email: wongsv@eng.upm.edu.my
	Detection of Lard in Chocolates by Fourier Transform Infrared (FTIR) Spectroscopy for 'Halal Authentication 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: ycm@putra.upm.edu.my
	Electrochemical Assisted Photodegradation of Dye Pollutants using TiO2 Thin Film Electrodes 	Zulkarnain Zainal [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6810 Email: zulkar@fsas.upm.edu.my

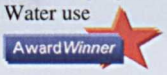
4. UPM Invention & Research Exhibition and Awards 2003 *(470)*

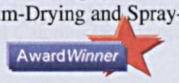
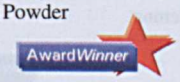
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
8–10 July 2003 UPM, Serdang.	Recycling of Oil Palm Wastes: Ten Year Application of Empty Fruit Bunches in an Oil Palm Plantation	A.B. Rosenani [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6981 Email: rosenani@agri.upm.edu.my
	Recycling of Crop Residues for Sustainable Crop Production in a Maize-groundnut Rotation System	A.B. Rosenani [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6981 Email: rosenani@agri.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Optimization of Whole Blood Assay for Screening of Anti-Inflammatory Activities of Natural Products	A.K. Arifah [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 6829 Email: arifah@vet.upm.edu.my
	Transforming Spatio-Temporal Yield Mnaps to Classifield Managements Zone Maps for Efficient Management of Oil Palm Award Winner	A.R. Anuar [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6963 Email: anuar@agri.upm.edu.my
	Ultrastructural Alterations in Frozen-Thawed Immature Bovine Oocytes	Abd. Wahid Haron [Assoc.Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8283 Email: wahid@vet.upm.edu.my
	Flower and Fruit Development in Chempedak Award Winner	Abdul Ghani Yunus [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7260 Email: agy@agri.upm.edu.my
	Anatomy of Oil Palm Seed and Seedling	Abdul Ghani Yunus [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7260 Email: agy@agri.upm.edu.my
	Application of Real-Time Quantitative PCR for The Measureremento f Viral Load in Chikens Infected with Infectious Bursal Disease Virus	Abdul Rahman Omar [Assoc.Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8268 Email: aro@vet.upm.edu.my
	GIS Based Management System for Durian Plantation Award Winner	Abdul Rashid Mohamed Shariff [Dr.] Faculty of Engineering Tel: +603-8946 6414 Email: rashid@eng.upm.edu.my
	Sodium from Seawater for Potassium Sustitution in Pineapple Plant Award Winner	Ahmad Husni Mohd. Hanif [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6961 Email: husni@agri.upm.edu.my
	Detection of Newcastle Disease Virus (NVD) with SYBR Green I Based Real Time Polymerase Chain Reaction (PCR) Award Winner	Aini Ideris [Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8943 2509 Email: aiini@admin.upm.edu.my
	Paddy Transportation and Distribution Systems: The Case of MADA Granary Area Award Winner	Amin Mahir Abdullah [Dr.] Faculty of Agriculture Tel: +603-8946 7452 Email:-
	Nutrient Flow Stem Infusion Technique of Fertilizer Application in Oil Palm Seedlings. Award Winner	Aminuddin bin Hussin [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6962 Email: amin@agri.upm.edu.my
	Fish Asemblages of the Seagrass Habitat: Species Composition, Feeding Habits and Recruitment Award Winner	Aziz Arshad [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6644 Email: azizar@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Identification of Areas with Peel/pulp Splitting Disorder Pisang Mas (Musa Sapientum cv Mas) and Its Physico-chemical Characteristics 	Azizah Osman [Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8373 Email: azosman@putra.upm.edu.my
	Performance of Selected Resins on Adsorption of Vitamin E	Badlishah Sham Baharin [Assoc.Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8394 Email: badli@fsb.upm.edu.my
	Heavy Metals Content in Soils of Peninsula Malaysia Grown with Cocoa Beans	Che Fauziah Ishak [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6966 Email: fauziah@agri.upm.edu.my
	Trichoderma harzianum - The Effective, Eco-Friendly and Beneficial Microfungus 	Faridah Abdullah [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6620 Email: fidah@fsas.upm.edu.my
	Indegenous Knowledge for Potential Drug Screening and Commercialized Products 	Faridah Hanum Ibrahim [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603-8946 7178 Email: faridah@forr.upm.edu.my
	Natural Booster for Production of Pure and High Quality Microalgae 	Fatimah Md Yusoff [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6621 Email: fatimamy@fsas.upm.edu.my
	The Study of Novel Biopreservative Produced by Lactobacillus plantarum I-UL4 isolated from Fermented Jatropha manihot. 	Foo Hooi Ling [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8343 Email: hlfoo@fsb.upm.edu.my
	UPM-GS 200: Superior and Highly Stable Grain Maize Synthetic 	Ghizan Bin Saleh [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6993 Email: ghizan@agri.upm.edu.my
	Improved Sweet Corn (Zea mays L.) Populations Developed Through Hybridization and Selection for Desirable 	Ghizan Bin Saleh [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6993 Email: ghizan@agri.upm.edu.my
	Indigenous Metabolism Manipulation Techniques to Reduce The Satured Fat Content in Mutton	Goh Yong Meng [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8338 Email: ymgoh@vet.upm.edu.my
	The Economic Benefits of the Barn Owl Tyoto Alba in Ricefield	Hafidzi Mohd. Noor [Dr.] Faculty of Agriculture Tel: +603-8946 6983 Email: hafidzi@agri.upm.edu.my
	PGPR (Plant Groth-Promoting Rhizobacteria) Inoculants for High Value Vegetable Crops	Halimi Mohd. Saud [Dr.] Faculty of Agriculture Tel: +603-8946 6967 Email: halimi@agri.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Enzymatic Production of High Amylose from Sago Starch	Hasanah M. Ghazali [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8345 Email: hasanah@fsb.upm.edu.my
	Moringa oleifera seed, a Potential New Source of Edible Oleic Acid-type Oil in Malaysia: properties and Extraction of the Oil	Hasanah M. Ghazali [Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8345 Email: hasanah@fsb.upm.edu.my
	Ultrastructure and Sequencial Development of White Spots and Their Chemecal Composition in Experimentally WSSV-Infected Shrimp	Hassan Hj. Mohd Daud [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8286 Email: hassan@vet.upm.edu.my
	Detection of Apoptotic Cells in Moribund Black Tiger Shrimp Penaeus monodon Infected with White Spot Syndrome Disease Award Winner	Hassan Hj. Mohd Daud [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8286 Email: hassan@vet.upm.edu.my
	Effect of Microbes on Bacterial Wilt of Tomato caused by Ralstonia solanacearum	Hiryati Abdullah [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-89467231 Email: hiryati@agri.upm.edu.my
	A Novel Multi-strain Probiotic Supplement for Laying Hens Award Winner	Ho Yin Wan [Prof. Dr.] Institute of Bioscience Tel: +603-8946 8067 Email: ywho@ibs.upm.edu.my
	Characterization of Viral Disease of Sweet Potato in Malaysia	Inon, S., A [Dr.] Faculty of Agriculture Tel: +603-8946 7232 Email: inon@agri.upm.edu.my
	Influence of Management Characteristics on Technical Efficiency of Rice Farmers in MADA	Ismail Abd. Latif [Dr.] Faculty of Agriculture Tel: +603-8946 7453 Email: ismaill@econ.upm.edu.my
	Modelling the Potential Productivity of Banana and Pineapple Intercropped with Immature Rubber	Jamal Talib [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6972 Email: jamal@agri.upm.edu.my
	Alkaline Washings and Their Effects on The Quality Attributes of Black Tilapia Fillets Award Winner	Jamilah Bakar [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8396 Email: jamilah@putra.edu.my
	Gelatin from 3 cultured Freshwater Fish Skins Obtained by Limiting Process Award Winner	Jamilah Bakar [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8396 Email: jamilah@putra.edu.my
	Collagen and Gelatin from Red Talapia (Oreochromis nilotica) Skins Award Winner	Jamilah Bakar [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8396 Email: jamilah@putra.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Production of Polyphenols from Cocoa Beans: A Two in One Technology 	Jinap Selamat [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 6314 Email: jinap@putra.upm.edu.my
	Potential of Exserohilum longirostratum as Bioherbicide For Itchgrass 	Jugah Kadir [Dr.] Faculty of Agriculture Tel: +603-8946 7233 Email: kaju@agri.upm.edu.my
	Microsatellite Polymorphism in Mafriwal Dairy Cattle of Malaysia	Kalaiselvi Palani [Mrs.] Faculty of Agriculture Tel: +603-8946 7933/ 6896 Email: pkselvi56@hotmail.com
	Biological Control of Sxhisophyllum commune, the Causal Agent of Brown Germ and Seed Rot Diseaes of Oil Palm	Kamaruzaman Sijam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6986 Email: kama@agri.upm.edu.my
	Incorporation of I-PKc to Aquafeed	M.M. Hanafi [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6974 Email: mmhanafi@agri.upm.edu.my
	The Impacts of Trade Liberalization on the Malaysian Oil Palm Oil Industry: the Case of Export Duty 	Mad Nasir Bin Shamsudin [Prof.] Faculty of Agriculture Tel: +603-8946 7254 Email: nasir@econ.upm.edu.my
	Potential Use Coral as Biomaterial in Reconstructive Bone Surgery	Md Zuki Abu Bakar @ Zakaria [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8301 Email: zuki@vet.upm.edu.my
	Development of Biomaterial from Ruminant Offal for Reconstructive Abdominal Wall Surgery 	Md Zuki Abu Bakar @ Zakaria [Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8301 Email: zuki@vet.upm.edu.my
	Quantitative Determination of Essential Fatty Acid Concentrations in Local Freshwater Fishes 	Mohamed Ali Rajion [Prof. Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8299 Email: mohdali@vet.upm.edu.my
	New Single Tube Single Loading Nested Polymerase Chain Reaction (PCR) Kit for Detection of Hepatopancreatic Parvovirus in Panaeid Shrimp 	Mohamed Shariff Mohamed Din [Prof. Dato' Dr.] Faculty of Veterinary Medicines Tel: +6012 283 9845 Email: shariff@vet.upm.edu.my
	Improvement of Soiless Culture Tomatoes Grown in High Temperature under Protection Environment	Mohd, Razi Ismail [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6935 Email: razi@agri.upm.edu.my
	The Use of Different Ggrowing Media Amended with Rice Straw Compost and Partial Rootzone Drying for Improvement of Yield, Quality and Water use Eefficiency Tomatoes from under Protected Environment 	Mohd, Razi Ismail [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-89466935 Email: razi@agri.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Site-Specific Fertilizer Management for Rice Based on Soil Electrical Conductivity 	Mohd. Amin Mohd. Soom [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6642/ 012-293 5853 Email: amin@eng.upm.edu.my
	DIMIS: A GIS-Based Water Management Tool for Precision Farming of Rice 	Mohd. Amin Mohd. Soom [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6642/ 012-293 5853 Email: amin@eng.upm.edu.my
	Enhancing Biological Control of Asiatic Corn Borer Through Habitat and Vegetative Diversification	Mohd. Yusof Hussein [Prof.] Faculty of Agriculture Tel: +603-8946 7239 Email: yusof@agri.upm.edu.my
	Equine Herpesvirus Detection Kit	Mohd. Zamri Saad [Prof. Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8282 Email: zamri@vet.upm.edu.my
	Comparison of Jackfruit (Artocarpus heterophyllus) Powders Produced By Using Drum-Drying and Spray-Drying Technologies 	Nazimah Sheik Abd Hamid [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8386 Email: nazimah@putra.upm.edu.my
	Browning-associated Enzymes I Metroxylon Sagu 	Nazamid Saari [Assoc.Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8375 Email: nazamid@putra.upm.edu.my
	Variation in Multiple Leader Incidence of Four Acacia Species 	Nor Aini Ab Shukor [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603-8946 7186 Email: dnoraini@putra.upm.edu.my
	Propagation Protocols of Multi Purpose Tree Species 	Nor Aini Ab Shukor [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603-8946 7186 Email: dnoraini@putra.upm.edu.my
	Effects of Mitsuokella Jalaludinii and Lactobacillus Cultures Supplementation on the Performance and Nutrient Utilization of Broiler Chickens. 	Norhani Abdullah [Assoc.Prof.Dr.] Institut of Bioscience Tel: +603-8946 6710 Email: norhani@fsas.upm.edu.my
	Study on the Development of Malaysian Paddy Farming Management-An Evaluation of Technology Reform and Group Farming 	Norsida Man [Dr.] Faculty of Agriculture Tel: +603-8946 7254 Email: norupi@agri.upm.edu.my
	Structural Laminated Veneer Lumber (LVL) Produced from Topical Harwoods As New Building Material in Malaysia 	Paridah Md. Tahir [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603-8946 7187 Email: parida@putra.upm.edu.my
	Effects of Processing Parameters on Physico-Chemical Properties of Drum-Dried Durian Powder 	Quek Siew Young [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8388 Email: syquek@putra.upm.edu.my

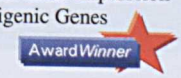
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Growth Enhancement of onion (Allium ascalonicum) Through PGPR Inoculation	Raziah Othman [Dr.] Faculty of Agriculture Tel: +603-8946 6980 Email: radziah@agri.upm.edu.my
	Molecular Polymorphism of the Oil Palm Beetles, Orycetes rhinoceros AwardWinner	Rita Muhamad [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7244 Email: rita@agri.upm.edu.my
	The Effect of Modified Atmosphere Packaging (MAP) on The Microbiological and Sensory Qualities Of Chinese Wetnoodles During Chilled Storage AwardWinner	Roselina Karim [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8372 Email: rosaz@putra.upm.edu.my
	Development of Procedure for Packaging Perishable Sample for Long Distance Courier Services AwardWinner	Roselina Karim [Dr.] Faculty of Food Science & Biotechnology Tel: +603-89468372 Email: rosaz@putra.upm.edu.my
	The Effect of Four Major Rrice Cultivars of Indonesia on CH4 (methane) Emission from Rice Field	Rosenani Abu Bakar [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6981 Email: rosenani@agri.upm.edu.my
	Use Sewage Sludge and Coconut Coir Mix as a Peat Dubstiotute for Potted Chrysanthemum AwardWinner	Rosenani Abu Bakar [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6981 Email: rosenani@agri.upm.edu.my
	Freezing Characteristics and Storage Behaviour of Precooked Frozen Nasi Lemak AwardWinner	Russly Abd. Rahman [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8408 Email: russly@putra.upm.edu.my
	Sous Vide Processing of Rendang AwardWinner	Russly Abd. Rahman [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8408 Email: russly@putra.upm.edu.my
	Development of chicken Rice by Using Sous Vide Cook-Chill Technology AwardWinner	Russly Abd. Rahman [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8408 Email: russly@putra.upm.edu.my
	The Innoculation Effects of azospirillum and mycorrhiza on the Canopy Architecture of maize (Zea mays L.) AwardWinner	S.H.M. Chin [Dr.] Faculty of Agriculture Tel: +603-8946 6964 Email: chris@agri.upm.edu.my
	Optimisation of EnzymaticClarification from Banana (Musa sapientum) and Sapodilla (Achras sapota) Juice Extract using Responese Surface AwardWinner	Salmah Binti Yusof [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8410 Email: salmahy@putra.upm.edu.my
	Quantification and Characterization of Trichoderma spp from Different Ecosystemns AwardWinner	Sariah M. [Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7247 Email: sariahm@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Development of Biological and Agronomic Strategies for the Management of Fusarium Wilt of Banana AwardWinner	Sariah M. [Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7247 Email: sariahm@putra.edu.my
	The Use of Suppressive soil for the Control of Fusarium Wilt of Banana Seedlings AwardWinner	Sariah M. [Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7247 Email: sariahm@putra.edu.my
	Hydrolysed Vegetable Protein (HVP) from Winged Bean AwardWinner	Sharifah Kharidah Syed Muhammad [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8389 Email: kharidah@fsb.upmedu.my
	In Vivo Study on the Performance of B-glucanase-Producing Lactobacillus strains as Feed Addtive for Poultry	Sieo Chin Chin [Mrs.] Institute of Bioscience Tel: +603-8946 6702 Email: ccsieo@fsas.upm.edu.my
	Growth and Flower Quality of Lowland Potted Chrysanthemums (Dendranthema grandiflora cv 'Time Fire') as Affected by Nitrogen and Calcium Fertilization	Siti Aishah Hassan [Dr.] Faculty of Agriculture Tel: +603-8946 6946 Email: aishah@agri.upm.edu.my
	An Efficient Method of Developing DNA Microsatellites Markers for Mystus nemurus	Siti Shapor Siraj [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466639 Email: shapor@fsas.upm.edu.my
	Assessment of Heavy Metals in Soils and Vegetables in Johore	Siti Zauyah [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6987 Email: zauyah@agri.upm.edu.my
	Growth of Aspergillus Niger in Solid Substrate Fermentation Using Palm Kernel Cake (PKC) as Substrate AwardWinner	Suraini Abd. Aziz [Assoc.Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8363 Email: suraini@fsb.upm.edu.my
	Feeding Lactobacillus plantarum I-UL4 isolated from Malaysian Tempeh on Growth Performance Faecal Flora and Lactic Acid Bacteria and Plasma Cholesterol Concentration in Postweaning Rats	T.C. Loh [Dr.] Faculty of Agriculture Tel: +603-8946 6899 Email: tcloh@agri.upm.edu.my
	Preliminary Studies on Sterilization, Germoination and Propagation of Curcuma aeruginosa AwardWinner	Thohirah Lee Abdullah [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6947 Email: thohirah@agri.upm.edu.my
	The Effect of Lime and an Organic-based Fertilizer Application on Rice Production on an Acid Sulfate Soil AwardWinner	Totok Suswanto [Mr.] Faculty of Agriculture Tel: +6012-275 8041 Email: samsudin@agri.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Design and Development of Automated Tractor for Mibile Harvesting Robot 	Wan Ishak Wan Ismail [Prof. Dr.] Institute of Advanced Technology Tel: +603-8946 7533 Email: wiwi@putra.upm.edu.my
	Competitive Strategies for a Palm Oil Exporting Company in Penensular Malaysia: The Case of Selangor Palm Oil Sdn. Bhd (SPOSB) 	Wan Mohd Marzuki Wan Bakar [Mr.] Faculty of Agriculture Tel: +603-8946 7457 Email: marzuki@agri.upm.edu.my
	Development of Cu Coated Urea	Y.M.Khanif [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6991 Email: khanif@agri.upm.edu.my
	Fourier Trasform Infrared Spectroscopy as Tools in Palm Oil Analysis 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: yaakub@upm.edu.my
	Detection of Lard in Chocolates by Fourier Transform Infrared (FTIR) Spectroscopy for 'Halal Authentication 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: yaakub@upm.edu.my
	Rapid Methods for Determining Minor Components in RBD Palm Olein using Fourier Transform Infrared Spectroscopy 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: yaakub@upm.edu.my
	Electronic Nose Based on Surface Acoustic Wave Sensor for Characterization of Vegetable Oil 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: yaakub@upm.edu.my
	The Response Surface Methodology: Optimization of Pandan (Pandaus amaryllifolius) Powder by Using Spray Drying Method 	Yaakob Che Man [Prof. Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8371 Email: yaakub@upm.edu.my
	Fertilizer Nutrient Mobility in Peat and Uptake by Sago Palm 	Zaharah A. Rahman [Prof.] Faculty of Agriculture Tel: +603-8946 6932 Email: zaharah@agri.upm.edu.my
	Structural Plywood Manufactured from Bamboo Culms (Gigantochloa scortechinii) 	Zaidon Ashaari [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603- 8946 7170 Email: zaidon@putra.upm.edu.my
	A System Model for Beef Production Strategies 	Zainal Abidin Bin Mohamed [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7464/ 7254 Email: zam@agri.upm.edu.my
	Diagnosis of Banana Leaf Speckle Disease	Zainal Abidin Mior Ahmad [Dr.] Faculty of Agriculture Tel: +603-8946 7250 Email: -

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Prevalence and Molecular Characterization of Listeria monocytogenes and Listeria innocua Isolated from Shrimp (Peneaus indicus) in Wet Markets	Zaitun Hassan [Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8392 Email: zaihas@fsb.upm.edu.my
	Application of Vegetable Soyabean as and Intercrop with Paddy AwardWinner	Zulkifli Hj. Shamsuddin [Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6990 Email: zulsham@agri.upm.edu.my
	Development of Biomaker for Bacillus saphaericus, UPMB 10, Plant Growth Promoting rhizpcbacteria on Oil Palm and Banana AwardWinner	Zulkifli Hj. Shamsuddin [Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6990 Email: zulsham@agri.upm.edu.my
	Feeding of Palm-based Diets as a Practical Strategy to Alleviate Heat Stress in Broiler Chickens AwardWinner	Zulkifli Idrus [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6908 Email: zulkifli@agri.upm.edu.my
	Keetch-Byram Drought Index Calculator (KBDIC) - A Windows-based Software for Forest Fire Risk Assessment	Ahmad Ainuddin Nuruddin [Dr.] Faculty of Forestry Tel: +603-8926 9279 Email: ainuddin@forr.upm.edu.my
	Functional Ingredients Derived from Rice Bran AwardWinner	Azizah Abdul Hamid [Assoc.Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8374 Email: azizah@fsb.upm.edu.my
	Roselle and Its Properties	Salmah Binti Yusof [Prof.Dr.] Faculty of Food Science & Biotechnology Tel: +603-8946 8410 Email: salmahy@putra.upm.edu.my
	Effects of Local Natural Product Compounds On Vascular Smooth Muscle Cells AwardWinner	Abdul Manaf Ali [Prof. Dr.] Institute of Bioscience Tel: +603-8946 8098 Email: manaf@putra.upm.edu.my
	Monoclonal Antibody Production by Phytohemagglutinin-L-Aggregated Hybridoma Cells AwardWinner	Abdul Manaf Ali [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8098 Email: manaf@putra.upm.edu.my
	Development of Single Nucleotide Polymorphism (SNP) Detection Method Using SYBR Green I Based Real Time Polymerase Chain Reaction AwardWinner	Abdul Rahman Omar [Assoc.Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8268 Email: aro@vet.upm.edu.my
	Development of Nucleoprotien (NP) of Newcastle Disease Virus (NVD) as a Carrier for VP3 Antigenic Polypeptide of Chicken Anemia Virus (CAV)	Abdul Rahman Omar [Assoc.Prof.Dr.] Faculty of Veterinary Medicines Tel: +603-8946 8268 Email: aro@vet.upm.edu.my
	Structural Properties of Modified Candida rugosa Lipase in Water and Organic Solvent	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 8090 Email: abubakar@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Bioremediaton of Petroleum Hydrocarbon Contamination by Immobilized Bacterial Cells Award Winner	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 8090 Email: abubakar@fsas.upm.edu.my
	Biosurfactants Production by Pseudomonas aeruginosa 181 Award Winner	Abu Bakar Salleh [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 8090 Email: abubakar@fsas.upm.edu.my
	Structural Properties of Modified Candida rugosa Lipase in Water and Organic Solvent Award Winner	Abu Bakar Salleh [Prof. Dr.] Institute of Bioscience Tel: +603-8946 8090 Email: abubakar@fsas.upm.edu.my
	Application of New Advanced Nanomaterials for Enzyme Immobilization Award Winner	Basyaruddin Abdul Rahman [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6603 Email: basya@fsas.upm.edu.my
	Design of Horizontal Drum SSC Bioreactor and its Performance Test for Pectinase Production Award Winner	Budiatman Satiawihardja [Dr.] Faculty of Engineering Tel: +603-8946 6359 Email: budsat@eng.upm.edu.my
	Characterization and Cloning of Novel Phytase Genes from Rumen Bacteria Mitsuokella jalaludinii Award Winner	Clemente Michael Vui Ling [Dr.] Institute of Bioscience Tel: +603-8946 8356 Email: wongvl@fsb.upm.edu.my
	Halal or Non-Halal Meats? A Molecular Detection Method Award Winner	Clemente Michael Vui Ling [Dr.] Institute of Bioscience Tel: +603-8946 8356 Email: wongvl@fsb.upm.edu.my
	Drug-Like Anti-Inflammatory Activity of Natural Poduct Isolated from Alpinia Rafflesiana in a Celullar Model of Inflammation Award Winner	Daud Ahmad Israf Ali [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8063 Email: daud@ibs.upm.edu.my
	Development of Biocontaminant-free Detection Kit for Screening Seaweed DNA Award Winner	Faizah Bt. Jaafar [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8496 Email: faeezaaa78@yahoo.com
	Antibodies for the Detection of Ganoderma Boninense	Faridah Abdullah [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6620 Email: fidah@fsas.upm.edu.my
	Double Extraction Procedure for Higher Quality DNA of Mucilaginous Plants	Ghizan B. Saleh [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 6993 Email: ghizan@agri.upm.edu.my
	Isolation of Salinity Tolerance Genes from the Mangrove Plants, Bruguiera cylindrical Award Winner	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8362 Email: clho@fsb.upm.edu.my

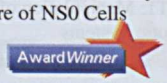
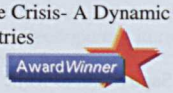
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Isolation of Salinity Tolerance Genes The Mangrove Plant, Acanthus ilicifolius 	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8362 Email: clho@fsb.upm.edu.my
	Functional genomic Studies of a Malaysian Red Seaweed, Gracilaria Changii (Gracilariales, Rhodophyta) : An Expressed Sequence Tag (EST) Approach 	Ho Chai Ling [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8362 Email: clho@fsb.upm.edu.my
	Bile salt hydrolase and cholesterol-reducing activity of Lactobacillus strains from chickens 	Ho Yin Wan [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8067 Email: ywho@ibs.upm.edu.my
	The Development Of Molecular Tolos That Facilitate Analysis of Grain Filing in Rice	K. Harikrishna [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8362 Email: clho@fsb.upm.edu.my
	Expression of 1-Aminocyclopropane-1 Carboxylic Acid Oxidase Gene, OPSC10, in Oil Palm Suspension Culture 	K. Harikrishna [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8362 Email: clho@fsb.upm.edu.my
	Potential of the NP Protein of NDV as an Antigenic Carrier for IBDV 	Khatijah Yusoff [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +6013-392 3776 (Rafidah) Email: khatijah@fsas.upm.edu.my , azfieda@yahoo.com
	Potential of NP of NDV as an Antigenic Carrier for Truncated VP1 of Enterovirus 71 	Khatijah Yusoff [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6715/ 6692 Email: khatijah@fsas.upm.edu.my lalitus_26@hotmail.com
	BioCarrierTM: A Novel Molecular Carrier from Newcastle Disease Virus 	Khatijah Yusoff [Prof.Dr.] Institute of Bioscience Tel: +603-8946 6692 Email: khatijah@fsas.upm.edu.my
	Inhibition of 5-Lipoxygenase by Plants used in Traditioanl Remedies for Asthma	Khozirah Shaari [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8064 Email: khozirah@hotmail.com
	In Vitro Evaluation of Anti-inflammatory Activity of Vitex Negundo Extracts	Khozirah Shaari [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8064 Email: khozirah@hotmail.com
	Scale up Production of Liquid Wax Ester by Enzymatic Esterification using Batch Mode Bioreactor	Mahiran Basri [Prof.Dr.] Institute of Bioscience Tel: +603-8946 6603 Email: mahiran@fsas.upm.edu.my
	Application of Membrans Array for Gene Expression Detection: Drug Target and Toxigenic Genes 	Mariana Nor Shamsuddin [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8497 Email: Mariana@medic.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Green Fluorescent Protein: A Powerful Tool for Monitoring Transgenic Orchids	Marziah Mahmood [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	Improved Enhanced Protection Against Fusarium Wilt by Constitutive Co-expression of Chitinase and Glucanase Genes in Transgenic Banana AwardWinner	Marziah Mahmood [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	Cell Culture Technologies to Produce Important Bioactive Compounds AwardWinner	Marziah Mahmood [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	In Vitro Microcloning of Commerically Important Fragrant Orchid Species - Phalaenopsis violacea	Marziah Mahmood [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6703 Email: marziah@fsas.upm.edu.my
	Micropropagation of Labisia pumila (Kacip Fatimah)	Marziah Mahmood [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8084 Email: marziah@fsas.upm.edu.my
	Synthesis of Anthraquinones Using Friedel-Craft Condensation	Md. Nordin Hj. Lajis [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8082 Email: nhlajis@ibs.upm.edu.my
	A New Anthraquinone From Hedyotis Capitellata	Md. Nordin Hj. Lajis [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8082 Email: nhlajis@ibs.upm.edu.my
	Bioactivity and Chemical Studies of Selected Malay Ulam's; Cosmos Caudatus Kunth	Md. Nordin Hj. Lajis [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8082 Email: nhlajis@ibs.upm.edu.my
	Bioactivity and Chemical Studies of Selected Malay Ulam's; Curcuma Mangga Val	Md. Nordin Hj. Lajis [Prof.Dr.] Institute of Bioscience Tel: +603-8946 8082 Email: nhlajis@ibs.upm.edu.my
	Alternative Methods for the Recovery of Intracellular Bioplastics from Various Waste Resources AwardWinner	Mohd Ali Hassan [Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8368 Email: alihas@fsb.upm.edu.my
	Bioconversion of Sago Hampas by Local Beneficial Fungi for the Production of Bioplastics AwardWinner	Mohd Ali Hassan [Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8368 Email: alihas@fsb.upm.edu.my
	Development of Growth Medium for Centella asiatica cell culture by Response Surface	Mohd Azmuddin B. Abdullah [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8448 Email: azmuddin@fsb.upm.edu.mu

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Gene Expression Profiling of P53+/- Hemizygous Knockout Mice and Wild-type Mice After Administration of Diethlstilbestrol by cDNA Array analysis	Mohd Nazil Salleh [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8570 Email: alif@medic.upm.edu.my
	Metabonomic Investigations into Diethlstilbestrol Toxicity in Female Wild-type Mice	Mohd Nazil Salleh [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8575 Email: mns30@putra.upm.edu.my
	The Use of Proteinchip and SELDI-TOF Mass Spectrometry to Identify the Naturally 0occurring Secretion Protein Machinery in Plant Cell Suspension Cultures	Mohd Puad Abdullah [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6706 Email: fuad@fsas.upm.edu.my
	Jasmonic Acid Elicitation, Hyrogen Peroxide Level and Antioxidant Vitamins in Morinda elliptica	Mohd. Azimuddin [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8348 Email: azmuddin@fsb.upm.edu.my
	IMURONTM: A Total Solution for Polynucleotide Vaccines Award Winner	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	HAVAXTM: A Recombinant Human Adenovirus Vaccine That Protects Young Chicks From Severe Bursa Disease Award Winner	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Aujeszky's Disease Vaccine with Genetic Markets that Facilitates Disease Eradication in Endemic Territories Award Winner	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Novel Polynucelotide Vaccine, NUCLEOCEPTIN™ For An Effective Fertility Control In Animals Award Winner	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Reverse-Transcriptase Nested Polymerase Chain Reaction Enzyme Linked Immunosorbent Assay for Detection of Infectious Bursal Disease Virus Award Winner	Mohd. Hair Bejo [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8287 Email: mdhair@vet.upm.edu.my
	Indirect Enzyme Linked Immunosorbent Assay for Detection of Infectious Bursal Disease Award Winner	Mohd. Hair Bejo [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8287 Email: mdhair@vet.upm.edu.my
	Comparison and conventional and PCR-based methods for the identification of Bifidobacterium spp. Isolated from infant faeces	Mohd. Yazid Manap [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8402 Email: myazid@fsb.upm.edu.my
	Isolation and Screening of Ligninolytic Fungi for the Biodegradation of Textile Dyes	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my

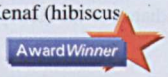
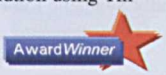
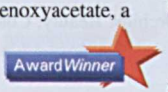
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Diesel Bioremediation by Antarctic Microbes	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Alternative Assay for Monitoring Herbicides Bioremediation by Microbes	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Isolation and Characterization of Atrazine-degrading Bacteria from Malaysian Soil	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Isolation and Characterization of Carbofuran-degrading Bacteria from Malaysian Soil	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Microbial Biomediatation of The Heavy Metal Molybdenum	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Isolation and Characterization of Diuron-degrading Bacteris from Malaysian soil	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6722 Email: yunus@fsas.upm.edu.my
	Anti-inflammatory Properties of three Local spp. Award Winner	Muhd. Nazrul Hakim [Dr.] Institute of Bioscience Tel: +603-8946 8518 Email: nazrulh@putra.upm.edu.my
	Application of Chemiluminesscent Assay for Detection Escherichia Coli isolates from Differentsources	Nagi Ahmed Alhaj [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8497 Email: Nagi_2001@yahoo.co.uk
	Idenfitication and Characterization of Nucleopolyhedrovirus and Granulovirus as potential Biological Control Agents for Spodoptera litura, a Serious Pest of Vegetable Crops	Norani Abdul Samad [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6709 Email: noraini@fsas.upm.edu.my
	In Vivo Production of Spodoptera Litura Nucleopolyhedrovirus (SpltNPV) and Spodoptera Liture Granulovirus (SPltGV) for Commercial Production	Norani Abdul Samad [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6709 Email: noraini@fsas.upm.edu.my
	Establishment of Bio Prospecting Primer in Detecting	Norfarrah Mohd. Alipiah [Mrs.] Faculty of Medicine and Health Science Tel: +603-8946 8497 Email: farrah_alipiah@yahoo.com
	In Vitro Propagation and Calli Induction of Selected Medicinal Plants	Norihan Mohd. Salleh [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8353 Email: norihanms@putra.upm.edu.my

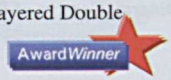
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Genetic Differentiation Among Orang Asli Population using Uniparental Marker	Patimah Ismail [Assoc.Prof.Dr.] Faculty of Medicine and Health Sciences Tel: +603-8946 8462 Email: patimah@putra.upm.edu.my
	Proliferation of Callus Induction and Development for Monoterpenes Composition of Michelia alba D.C	Radzali Muse [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6712 Email: radzali@fsas.upm.edu.my
	Flavonoids and Antioxidant Activities of Different Solvent Extract of Clausena excavate ("cerek hitam") Leaves AwardWinner	Radzali Muse [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6712 Email: radzali@fsas.upm.edu.my
	Production of Polyunsaturated of Fatty Acids (PUFAs); y-linolenic acid (GLA) from absidia spp.	Radzali Muse [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6712 Email: radzali@fsas.upm.edu.my
	Construction of a Recombinant E.coli Expressing an Antioxidant Gene of Lactococcus lactis M4	Raha Abdul Rahim [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8359 Email: raha@fsb.upm.edu.my
	Discovery of an Anti-staphylococcus Producing Microorganism from Soil Around the Roots of Lemon Grass.	Raha Abdul Rahim [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8343 Email: raha@fsb.upm.edu.my
	Thermostable T1 Lipase from Locally Isolated geobacillus sp. Strain T1: Manipulation of Gene Expression in Prokaryotic Systems AwardWinner	Raja Noor Zaliha Raja Abdul Rahman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6713 Email: mzaliha@fsas.upm.edu.my
	A Novel Organic Solvent Tolerant Lipase from Bacillus sphaericus 205y: Optimization and molecular Cloning AwardWinner	Raja Noor Zaliha Raja Abdul Rahman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6713 Email: mzaliha@fsas.upm.edu.my
	Thermostable Organic Solvent Tolerant Lipase from Thermophilic bacterium	Raja Noor Zaliha Raja Abdul Rahman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6713 Email: mzaliha@fsas.upm.edu.my
	Direct Fermentationof Sago Starct to Kojic Acid by Aspergillus flavus AwardWinner	Rosfarizan Mohamad [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8419 Email: farizan@putra.upm.edu.my
	High-density Cell Cultivation of Benificial Microorganisms for Agriculture Industry	Rosfarizan Mohamad [Dr.] Faculty of Food Science and Biotechnology Tel: +603-8656 6426/ ext 8419 Email: farizan@putra.upm.edu.my
	An in Vitro Study of the Antihistaminic and Anticholinergic Effects of Compounds from the Leaves of Alseodaphne perakensis AwardWinner	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	High Throughput Sequencing of Chromosome One of Eimeria tenella for Gene Discoveries 	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my
	Screening of Laccase Enzyme Producer from Locally Isolated White-Rot Fungus for The Biodegradation	Suraini Abd. Aziz [Assoc.Prof.Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8363 Email: suraini@fsb.upm.edu.my
	Phage Display of the Immunodominant Regions of Hepatitis B Virus on Bacteriophage T7 	Tan Geok Hun [Dr.] Institute of Bioscience Tel: +603-8946 6715 Email: geokhun@hotmail.com
	NDPathTM: A Simple Solution to Newcastle Disease Virus Pathotyping 	Tan Wen Siang [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6715 Email: wstan@fsas.upm.edu.my
	Production of the Nucleocapsid Protein of a Swine Nipah Virus Isolate in Escherichia coli	Tan Wen Siang [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 6715 Email: wstan@fsas.upm.edu.my
	Larvicidal and antimicrobial Activities from Clausena excavata (Jasin, Melaka) 	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	Modulation of Apoptosis for Enhancement of Antibody Productivity in Intensive Cell Culture of NS0 Cells 	Tey Beng Ti [Dr.] Faculty of Engineering Tel: +603-8946 6289 Email: btey@eng.upm.edu.my
	Lipase Catalysed Synthesis of Fatty Hydroxamic Acids from Palm Oil 	Wan Zin Wan Yunus [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6601 Email: wanzin@fsas.upm.edu.my
	Current Accountand Budget Deficit in Asian: A Vicious Cycle Phenomenon 	Ahmad Zubaidi Baharumshah [Assoc.Prof] Faculty of Economics and Management Tel: +603-8946 7622 Email: zubaidi@putra.upm.edu.my
	What Happen To Savings During The Crisis- A Dynamic Panel Analysis of the Asian-5 Countries 	Ahmad Zubaidi Baharumshah [Assoc.Prof] Faculty of Economics and Management Tel: +603-8946 7625 Email: zubaidi@putra.upm.edu.my
	Profitability, Economy Efficciency and Production Behaviour of Paddy Farming in Malaysia	Alias Radam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7461 Email: alias@putra.upm.edu.my
	An Analysis of Technical Progress and Efficiency in Malaysia Food Industries	Alias Radam [Assoc.Prof.Dr.] Faculty of Agriculture Tel: +603-8946 7461 Email: alias@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Forest Pricing Policy in Malaysia 	Awang Noor Abd. Ghani [Assoc.Prof.Dr.] Faculty of Forestry Tel: +603-89467167 Email: awangoor@putra.upm.edu.my
	The Relationship Betweeen Work Values, Organizational Commitment dan Job Performance amongst Executives 	Dahlia bt Zawawi [Mrs.] Faculty of Economics and Management Tel: +603-8946 7673 Email: dahlia@econ.upm.edu.my
	Does PPP Hold between Asian and Japanese Economies 	M. Azali [Assoc.Prof] Faculty of Economics and Management Tel: +603-8946 7626 Email: azali@putra.upm.edu.my
	Time Series Modelling of the Malaysian Automobile Sales 	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6832 Email: mahen@fsas.upm.edu.my
	Comparative Advantage of the Food Processing Industry 	Mohd. Mansor Ismail [Dr.] Faculty of Agriculture Tel: +603-8946 7455 Email: -
	Responses of Timber Concessionaires to Selected Policy Intruments: The Case of Peninsular Malaysia 	Mohd. Shahwahid Hj. Othman [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603-8946 6185 Email: msho@econ.upm.edu.my
	Testing Ling-run Neutrality of Money in Malaysia 	Muzafar Shah Habibullah [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603-8946 7635 Email: muzafar@putra.upm.edu.my
	Executive and Management Attitudes towards Corporate Social Responsibility in Malaysia	Saadiatul Ibrahim [Mrs.] Faculty of Economics and Management Tel: +603-8946 7705 Email: saida@putra.upm.edu.my
	Perceptions of Business Ethics in Selected Industries in Malaysia	Saadiatul Ibrahim [Mrs.] Faculty of Economics and Management Tel: +603-8946 7705 Email: saida@putra.upm.edu.my
	The Influence of Work Variables on Quality of Work Life of Working Individuals in Malaysia	Samsinar Md Sidin [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603-8946 7673 Email: sms@putra.upm.edu.my
	International Portfolio Diversification : A Malaysian Perspective	Sazali Zainal Abidin [Prof. Dr.] Faculty of Economics and Management Tel: +603- 8946 7631 Email: sazali@maa.com.my
	Stock Price and EXCHANGE Rate Interactions: An Empirical Investigation	W.N.W Azman-Saini [Mr.] Faculty of Economics and Management Tel: +603-8946 7768 Email: wazman@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Portfolio Diversification and Equity Merket Integration	W.N.W Azman-Saini [Mr.] Faculty of Economics and Management Tel: +603-8946 7768 Email: wazman@putra.upm.edu.my
	Evaluating theEconomics Impact of Genetically Modified Food (GMF)`	Wong Foong Yee [Mrs.] Faculty of Economics and Management Tel: +603-8946 7714 Email: fywong@econ.upm.edu.my
	Foreign Direct Investment, Economic Growth and Financial Development: A Comparative Analysis	Zulkornain Yusop [Dr.] Faculty of Economics and Management Tel: +603-8946 7643 Email: zolyusop@econ.upm.edu.my
	Accounting Simulation Specially for Education and Training (ASSET) 	Arfah Salleh [Assoc.Prof.Dr.] Graduate School of Management Tel: +603-89467432 Email: arfah@putra.upm.edu.my
	AFTA and Its Implications on the Indonesian Palm Oil Industry 	Fatimah Mohd. Arshard [Prof.Dr.] Faculty of Economics and Management Tel: +603-89467650 Email: fatimah@econ.upm.edu.my
	e-Commerce for Flowers: Is the Malaysian Public Ready fot it? 	Fatimah Mohd. Arshard [Prof.Dr.] Faculty of Economics and Management Tel: +603-89467650 Email: fatimah@econ.upm.edu.my
	An Agent-Based Model of Choice, Complexity and Learning 	Mohd. Azhar Abdul Karim [Mr.] Graduate School of Management Tel: +603-89467435 Email: akmazhar@putra.upm.edu.my
	The Role of Heterogeniety in Price-Formation and Market Equilibrium: An Analytical Model 	Mohd. Azhar Abdul Karim [Mr.] Graduate School of Management Tel: +603-89467435 Email: akmazhar@putra.upm.edu.my
	Trade-Induced Adjustment with Price Setting Agents 	Mohd. Azhar Abdul Karim [Mr.] Graduate School of Management Tel: +603-89467435 Email: akmazhar@putra.upm.edu.my
	Low Field Magnetoresistance of Manganites Perovskite Bulks and Films for Sensing Devices 	Abdul Halim Shaari [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466648 Email: ahalim@fsas.upm.edu.my
	Synthesis and Characterization of New Composite Conducting Polymers for Microelectrodes Microsensors and Ion-exchange Membranes 	Anuar Kassim [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466779 Email: anuar@fsas.upm.edu.my
	Formation of Organo-Mineral Nanocomposite Materials: Surfactant Encapsulated in Zn-Al-Layered Double Hydroxide	Asmah Hj. Yahaya [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466780 Email: asmah@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Photothermal Characterisations on Ceramic Varistor 	Azmi Zakaria [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466650 Email: azmizak@fsas.upm.edu.my
	Studies of Adsorption of Reactive Dyes Using Activated Carbon	Chuah Teong Guan [Dr.] Faculty of Engineering Tel: +603-89466288 Email: chuah@eng.upm.edu.my
	High Performance Security Paper from Kenaf (hibiscus cannabinus) Fibre 	Jalaluddin Harun [Dr.] Institute of Advanced Technology Tel: +603-89467538 Email: jalal@putra.upm.edu.my
	The Relation Between Household Municipal Solid Waste Composition and Energy Content of Refuse Derived Fuel 	Mahendran Shitan [Dr.] Institute of Mathematical Research 03-8946 6832 Email: mahen@fsas.upm.edu.my
	Nonstoichiometry and its Effects on the Magnetic Properties of Mg0.5 Zn0.5 Fe2+x O4 	Mansor Hashim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +6013-3224205 Email: mansor@fsas.upm.edu.my
	Removal of Arsenic from a Aqueous Solution using Tin (IV) Loaded-chelating Resin 	Md. Jelas Haron [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466775 Email: mdjelas@fsas.upm.edu.my
	A Novel Liner Alkane Sulfate Determination Method 	Mohd Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722/ 013-3594419 Email: yunus@fsas.upm.edu.my
	Study of Dye-sensitized Photoelectrochemical Solar Cell	Mohd Zaizi Desa [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466676 Email: mzaizi@fsas.upm.edu.my
	Hybrid Nanocomposite of 2,4-dichlorophenoxyacetate, a Latex Stimulant 	Mohd Zobir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466801 Email: mzobir@fsas.upm.edu.my
	Nutrient Removal Of Two Wetland Plants In An Experimental Scale Surface-Flow Wetland System	Mohd. Kamil Yusoff [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466741 Email: mkamil@fsas.upm.edu.my
	Bioindicator for Heavy Metals using the Molybdenum-reducing Activity System 	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722 Email: yunus@fsas.upm.edu.my
	A Novel Iron Determination Method 	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722 Email: yunus@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	A Noval Enxymatic Assay of Heavy Metals 	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722 Email: yunus@fsas.upm.edu.my
	Microbial Bioindicator of Heavy Metals 	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722 Email: yunus@fsas.upm.edu.my
	Microbial Bioremediaton of the Heavy Metal Molybdenum 	Mohd. Yunus Shukor [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466722 Email: yunus@fsas.upm.edu.my
	Organic Dye-interleaved Nanocomposites: Alizarin-3-Sulfonate in the Lamella host of Zn/A-layered Double Hydroxide 	Mohd. Zobir Hussein [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466801 Email: mzobir@fsas.upm.edu.my
	Modification of Oil Palm Empty Fruit Bunch Fiber by Graft Copolymerization 	Nor Azowa Ibrahim [Mrs.] Faculty of Science and Environmental Studies Tel: +603-89466802 Email: azowaib@fsas.upm.edu.my
	Environmental Friendly Synthetic Lubricant 	Robiah Yunus [Dr.] Faculty of Engineering Tel: +603-89466291 Email: robiah@eng.upm.edu.my
	Paphiopedillum stonei: Treasures from Padawan Limestone Hills, Sarawak 	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466634 Email: rusea@fsas.upm.edu.my
	Hymenophyllaceae: The Unseen Between Primitive and Modern Fern 	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies 03-89466634 Email: rusea@fsas.upm.edu.my
	Perlis Limestone Orchids: Beauty, Conversation and Future 	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466634 Email: rusea@fsas.upm.edu.my
	Selaginalleceae: The Untapped Natural 	Rusea Go [Assoc. Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-89466634 Email: rusea@fsas.upm.edu.my
	Exhaust Flow Concentration by Vortex and Vortex Suction Device	Sergei Sportar [Dr.] Faculty of Engineering Tel: +603-89466361 Email: ergei@eng.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Development of Integrated Quantitative Groundwater Assessment System for Engineering and Environmental Application 	Shaharin Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466681 Email: shaharin@fsas.upm.edu.my
	Anomaly in Acousto-thermal Characteristics of Bismate and Plumbate Glasses 	Sidek Hj. Aziz [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466682 Email: sidek@fsas.upm.edu.my
	A Rapid Technique for The Detection of Fecal Pollution in Water 	Siti Khairani Bejo [Dr.] Faculty of Veterinary Medicine Tel: +603-89468278 Email: khairani@vet.upm.edu.my
	Combined Solar Heater and Ice Maker 	Yusof Sulaiman [Prof. Dr.] Institute of Advanced Technology Tel: +603- 8946 7531 Email: myusof@fsas.upm.edu.my
	Preparation of Tin Chalcogenide Thin Films by Electrochemical Method 	Zulkarnain Zainal [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466810 Email: zulkar@fsas.upm.edu.my
	Electrochemical Assisted Photodegradation of Dye Pollutants using TiO2 Thin Film Electrodes 	Zulkarnain Zainal [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466810 Email: zulkar@fsas.upm.edu.my
	Study on The Effects of Various Parametres On The Preparation of Fiber-reinforced Adhesive 	Anuar Kassim [Prof.Dr.] Faculty of Science and Environmental Studies Tel: +6012-2648089 Email: cheesiong10@hotmail.com
	The Development of Web-Based Software Certification Model 	Abdul Azim Abd Ghani [Assoc.Prof.Dr.] Faculty of Computer Science & Information Technology Tel: +603-8946 6501 Email: azim@fsktm.upm.edu.my
	Data Hiding Techniques in Digital Images 	Abdul Rahman Ramli [Dr.] Institute of Advanced Technology Tel: +603-8946 7532 Email: arr@eng.upm.edu.my
	Cell Phone Signal Strength Predictor 	Abdul Rashid Mohamed Shariff [Dr.] Faculty of Engineering Tel: +603-89466414 Email: rashid@eng.upm.edu.my
	Generalized Functions and Current Mathematical Problems in Industry	Adem Kilicman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466813 Email: akilic@fsas.upm.edu.my
	Differential Equations and Distributional Solutions	Adem Kilicman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466813 Email: akilic@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Fresnel Integrals and the Convolution	Adem Kilicman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466813 Email: akilic@fsas.upm.edu.my
	Semiregular Property on Some Generalizations of Lindelof Spaces	Adem Kilicman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466813 Email: yakilic@fsas.upm.edu.my
	Convolution and Generalized Functions	Adem Kilicman [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466813 Email: akilic@fsas.upm.edu.my
	Are Asian Real Exchange Rates Stationary	Ahmad Zubaidi Baharumshah [Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 7625 Email: zubaidi@putra.upm.edu.my
	Money, Output and Stock Proces: Testing for Market Efficiency of the Kuala Lumpur Stock Exchange	Ahmad Zubaidi Baharumshah [Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 7625 Email: zubaidi@putra.upm.edu.my
	An Algebraic Approach to the Invariants of Surfaces	Bekbaev Ural [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466818 Email: bekbaev@fsas.upm.edu.my
	On Variants of Curves	Bekbaev Ural [Assoc.Prof.Dr.] Institute of Mathematical Research Tel: +603-89466818 Email: bekbaev@fsas.upm.edu.my
	Smart Remote Access Distribute System AwardWinner	Borhanuddin Mohd. Ali [Prof. Dr.] Faculty of Engineering Tel: +6012-3513072 Email: borhan@eng.upm.edu.my
	LUC Polyfunctional Transformation in Cryptographic System	Faridah Yunos [Miss] Institute of Mathematical Research Tel: +603-89466868 Email: mrushdan@inform.upm.edu.my
	Parallel Two Point Fully Imlicit Block Method For Solving Large Systems of Ordinary Differential Equations AwardWinner	Fudziah Ismail [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466821 Email: Fudziah@fsas.upm.edu.my
	Poisson and Negative Binomial Regression Models for the Number of Digital Communication Line Failures	Fauziah Maarof [Mrs.] Faculty of Science and Environmental Studies Tel: +603-89466820 Email: fauziah@fsas.upm.edu.my
	Block Embedded Diagonally Implicit Runge-kutta Method for Solving Ordinary Differential Equations	Fudziah Ismail [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466821 Email: Fudziah@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Numerical Solution of Delay Differential Equations (DDE) using Continuous Extension Eexplicit Runge-kutta Method	Fudziah Ismail [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466821 Email: Fudziah@fsas.upm.edu.my
	Paralleziation of Trapezoidal Rule 	Fudziah Ismail [Dr.] Institute of Mathematical Research Tel: +603-89466821 Email: Fudziah@fsas.upm.edu.my
	The Performance of Robust M-based Generalized Linear Model (GLM) Procedures for Designed Experiments with Non-normal Responses	Habshah Midi [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466822 Email: habshah@fsas.upm.edu.my
	The Performance of a Robust Ridge Regression Estimator Based on MM Estimator (RMM) in the Presence of Outliers and Muticollinearity	Habshah Midi [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466822 Email: habshah@fsas.upm.edu.my
	Enforcement of Integrity Constraints Against Transactions in a Distributed Database	Hamidah Ibrahim [Dr.] Faculty of Computer Science & Information Technology Tel: +603-89466510 Email: hamidah@fsktm.upm.edu.my
	Animated Song: The Recreation of Movie Song	Harun@ Eyong Jantrik [Mr.] Institute of Multimedia and Software Tel: +603-89467803 Email: harun@imedia.upm.edu.my
	Reliability Analysis for Failure Crushing Time Data using Competing Risks Model with Subdistribution Functions 	Isa Daud [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466826 Email: isa@fsas.upm.edu.my
	Mathematics Integrated Virtual Education Systems (Discreet) 	Ismail Abdullah [Dr.] Institute of Mathematical Research Tel: +603-8946 6874 Email: isbah@inform.upm.edu.my
	Data Acquisition System using Biometric Technology	Ismail Abdullah [Dr.] Institute of Mathematical Research Tel: +603-8946 6874 Email: isbah@inform.upm.edu.my
	Simulasi Peluru Berpandu Darat Berasaskan iMAC 	Ismail Abdullah [Dr.] Institute of Mathematical Research Tel: +603-8946 6874 Email: isbah@inform.upm.edu.my
	An Explicit Estimate of Exponential Sums Associated With Cubicx and Quartic Forms 	Kamel Ariffin Mohd Atan [Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 6872 Email: kamel@inform.upm.edu.my
	On The Solutions of A Seni Quadratic Pair of Diophantine Equations and Its Applications 	Kamel Ariffin Mohd Atan [Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 6872 Email: kamel@inform.upm.edu.my

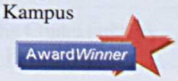
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Application of Non-linear GARCH Model with T-error Distribution on the KLCI Daily Return	Kassim Haron [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466830 Email: kassim@fsas.upm.edu.my
	A Resistant Line Fit between Zn and Co Found in Estuary and Coastal Sediment Samples from Tanjung Karang and Pulau Langkawi Award Winner	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466832 Email: mahen@fsas.upm.edu.my
	Bootstrap Simulation Study of ARMA (p,q) of Order p+q=3 Award Winner	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466832 Email: mahen@fsas.upm.edu.my
	Some Explicit Stationary Conditions for the Unilateral Second Order Spatial ARMA Model Award Winner	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466832 Email: mahen@fsas.upm.edu.my
	ARAR and Long Memory Modelling of Tourist Arrivals to Malaysia Award Winner	Mahendran Shitan [Dr.] Faculty of Science and Environmental Studies Tel: +603-89466832 Email: mahen@fsas.upm.edu.my
	Quasi-cauchy Diagonal Preconditioned Steepest Descent Method for Large-scale Optimization Award Winner	Malik Hj. Abu Hassan [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466811 Email: malik@fsas.upm.edu.my
	Etnomatematik	Mat Rofa Ismail [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466836 Email: mrofa@fsas.upm.edu.my
	A Cryptosystem Analogous To LUCELG	Mohamad Rushdan Md. Said [Dr.] Institute of Mathematical Research Tel: +603-8946 6841 Email: mrushdan@inform.upm.edu.my
	Parellel Modified Explicit Group Iterative Algorithm on SMP Parellel Computer Award Winner	Mohamed Othman [Assoc.Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 6565 Email: mothman@fstm.upm.edu.my
	Knowledge Management System in Collaborative Environment for Higher Learning Institutions Award Winner	Mohd. Hasan Selamat [Assoc.Prof.Dr.] Faculty of Computer Science & Information Technology Tel: +6v03-89466575 Email: hasan@fsktm.upm.edu.my
	Assessment Software For Strategic Information System Planning Award Winner	Mohd. Hasan Selamat [Assoc.Prof.Dr.] Faculty of Computer Science & Information Technology Tel: +603-89466575 Email: hasan@fsktm.upm.edu.my
	Lips Reading Learning Aided Using 3D Facial Movement	Mohd. Rizal Mohd. Khanafie [Mr.] Institute of Multimedia and Software Tel: +603-89468424 Email: rizal@imedia.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Conference Secretariat Web Application 	Mohd. Shafree Ahmad [Mr.] Institute of Multimedia and Software Tel: +603-89468423 Email: mshafree@imedia.upm.edu.my
	Streaming Lectures for Mobile Device (PDA)	Mohd. Zul Mohd. Yusoff [Mr.] Institute of Multimedia and Software Tel: +603-89468431 Email: mohdzul@imedia.upm.my
	Generalized Conditions for F(s) To Be The Mellin Transform of A Generalized Function in E p,q	Muhammad Rezal Kamel Ariffin [Mr.] Institute of Mathematical Research Tel: +603-8946 6838 Email: rezal@fsas.upm.edu.my
	The Mellin Differential Equations	Muhammad Rezal Kamel Ariffin[Mr.] Institute of Mathematical Research Tel: +603-8946 6838 Email: rezal@fsas.upm.edu.my
	Maximum Likelihood Estimation of the Three Parameters Extreme Value Distribution	Noor Akma Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466847 nakma@fsas.upm.edu.my
	Mathematical Analysis for Primal Dual Linear Programming using Barrier Function Method	Noor Akma Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466847 Email: nakma@fsas.upm.edu.my
	Data Mining for Risks Assessment of Air Pollution	Noor Akma Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466847 Email: nakma@fsas.upm.edu.my
	Time Computation within Fuzzy Networks	Noor Akma Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466847 Email: nakma@fsas.upm.edu.my
	Interval Estimation for Survivor Function of Exponential Distribution under Double Type II 	Noor Akma Ibrahim [Assoc.Prof.Dr.] Institute of Mathematical Research Tel: +603-89466847 Email: nakma@fsas.upm.edu.my
	Soft Computing in Competing Risks	Noor Akma Ibrahim [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466847 Email: nakma@fsas.upm.edu.my
	Numerical Computations Laboratory 	Norazak Senu [Mr.] Faculty of Science and Environmental Studies Tel: +603-89466848 Email: razak@fsas.upm.edu.my
	Modification of Conjugate Gradient Method for Unconstrained Optimization 	Norfifah Bachok [Mrs.] Faculty of Science and Environmental Studies Tel: +603-89466849 Email: norfifah@fsas.upm.edu.my

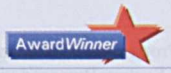
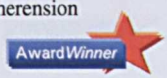
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Oscillatory Marangoni Convection in a Conducting Fluid Layer with a Deformable Free Surface in the Presence of a Vertical Magnetic Field	Norihan Md. Arifin [Mrs.] Faculty of Science and Environmental Studies Tel: +603-89466850 Email: norihan@fsas.upm.edu.my
	Chromaticity of Two-connected (n, n+4)-Graphs 	Peng Yee Hock [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466852 Email: yhpeng@fsas.upm.edu.my
	Cobb Angle Determination in x-ray Images 	Rahmita Wirza [Dr.] Institute of Advanced Technology Tel: +603-8946 7541 Email: rahmita@fsktm.upm.edu.my
	Workgroup Computing Model: A Case of Implementation in Higher Learning Institution 	Rusli Hj Abdullah [Mr.] Faculty of Computer Science & Information Technology Tel: +603-8946 6518 Email: rusli@fsktm.upm.edu.my
	Adaptive Remote Control Using RF Device 	Sabira Khatun [Dr.] Faculty of Engineering Tel: +603-89466435 Email: sabira@eng.upm.edu.my
	Web-based ECG	Sabira Khatun [Dr.] Faculty of Engineering Tel: +603-89466435 Email: sabira@eng.upm.edu.my
	On the Estimate Cardinality of the Set of Solutions to Congruence Equation by Transformation Methods	Sharifah Kartini Binti Said Husain [Mrs.] Institute of Mathematical Research Tel: +603-8946 6857 Email: skartini@fsas.upm.eu.my
	Oil Spill Contigency Planner 	Shattri Mansor [Assoc.Prof.Dr.] Institute of Advanced Technology Tel: +603-8946 7543 Email: Shattri@eng.upm.edu.my
	Development and Implementation of ePWA Integrated System 	Sidek Hj. Aziz [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466682 Email: sidekaa@fsas.upm.edu.my
	Flash Technology Application in Courseware Development for internet environment 	Sidek Hj. Aziz [Assoc.Prof.Dr.] Faculty of Science and Environmental Studies Tel: +603-89466682 Email: sidekaa@fsas.upm.edu.my
	On the Cardinality of the Set of Solutions to Congruence Equation	Siti Hasana Sapar [Mrs.] Institute of Mathematical Research Tel: +603-8946 6849 Email: sitihas@fsas.upm.edu.my
	An Estimation of Exponential Sums Associated with a Quadratic Form	Siti Hasana Sapar [Mrs.] Institute of Mathematical Research Tel: +603-8946 6849 Email: sitihas@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Teknik Ganda Dua Terkecil: Lawatan Kedua	Zainul Abidin Hassan [Dr.] Institute of Mathematical Research Tel: +603-8946 6689 Email: zainul@fsas.upm.edu.my
	Parallel Two Point Fully Imlicit Block Method For Solving Large Systems of Ordinary Differential Equations	Zanariah Abdul Majid [Mrs.] Institute of Mathematical Research Tel: +6019-3604900 Email: zanzamajid@hotmail.com
	GIS for Vector Borne Diseases AwardWinner	Abdul Rashid Mohamed Shariff [Dr.] Institute of Gerontology Tel: +603-8946 6414 Email: rashid@eng.upm.edu.my
	Tahap Pengetahuan, Sikap dan Amalan Pembelian Perumahan di kalangan Pengguna di Sabah	Ahmad Hariza Hashim [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-8946705 Email: ahariza@putra.upm.edu.my
	Kajang Crime Mapping GIS AwardWinner	Ahmad Rodzi Mahmud [Prof.Dr.] Institute of Gerontology Tel: +603- 8946 6383 Email: arm@eng.upm.edu.my
	Sustainable Consumption: Knowledge and Practices among Secondary School Students	Aini Mat Said [Mrs.] Faculty of Human Ecology Tel: +603-89467095 Email: ainimatsaid@hotmail.com
	Environmental Concern, Knowledge and Practices Gap among Teachers AwardWinner	Aini Mat Said [Mrs.] Faculty of Human Ecology Tel: +603-89467095 Email: ainimatsaid@hotmail.com
	Culture, Conservation and Heritage in the Context of City Marketing-Towards Developing Sustainable Urban Development Strategies	Aishah Edris [Mrs.] Faculty of Human Ecology Tel: +603-89467074 Email: aishahed@putra.upm.edu.my
	Noticing Grammatical structure in oral input	Arshad Samad [Dr.] Faculty of Educational Studies Tel: +603-8946 7906 Email: arshad@educ.upm.edu.my
	Ciri-ciri Keusahawanan di kalangan Usahawan Wanita Luar Bandar yang terlibat dalam Perusahaan Mikro	Askiah Jamaluddin [Mrs.] Faculty of Human Ecology Tel: +6013-3610475 Email: askiah02@yahoo.com
	ESL Academic Writing Skills: Establishing Knowledge Bases, Attituteds and Processes	Chan Swee Heng [Assoc.Prof.Dr.] Faculty of Modern Language & Communication Tel: +603-8946 8707 Email: shchan@fbm.upm.edu.my
	Tahap Pengetahuan Asas Pelajar UPM Tentang Spesis Tumnbuhan Dan Motif Tumbuhan Dalam Tekstile Tempatan	Haiyah Hussin [Dr.] Faculty of Educational Studies Tel: +603-8946 8127 Email: haziayh@educ.upm.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Sustainability of Successful Youth Organizations in Molding the Future Generation 	Turiman Suandi [Assoc.Prof.Dr. Hj.] Faculty of Educational Studies Tel: +603–8946 8247 Email: tj@ace.upm.edu.my
	Tahap Pengetahuan dan Sikap Penggunaan Kredit di kalangan Pengguna di Sabah	Husniyah Abdul Rahim [Mrs.] Faculty of Human Ecology Tel: +603-89467101 Email: husniyah2@hotmail.com
	Financial Behaviour of University Students: Policy Implication 	Jariah Masud [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467054 Email: jariah@putra.upm.edu.my
	Women in Micro Enterprise: Mechanization and Technology Adoption	Jariah Masud [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467054 Email: jariah@putra.upm.edu.my
	Kajian Falsafah dan Strategi Baru Pembangunan Luar Bandar dan Gerakan Desa Wawasan: Satu Tinjauan	Jariah Masud [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467054 Email: jariah@putra.upm.edu.my
	The Development of Courseware (Unit 20: Lets Do Something fun!) for Form 1 English, Ministry of Education Malaysia 	Jayakaran Mukundan [Mr.] Faculty of Educational Studies Tel: +603-8946 8182 Email: jaya@edu.upm.edu.my
	An Evaluation of the Certificate in the English Language Course for Jobless Graduates in the Graduate Training Scheme (GTS)	Jayakaran Mukundan [Mr.] Faculty of Educational Studies Tel: +603-8946 8182 Email: jaya@edu.upm.edu.my
	The use of Concordance Software in Determining Vocabulary Load Distrubition and Efficiency (VLDE) in Textbooks 	Jayakaran Mukundan [Mr.] Faculty of Educational Studies Tel: +603-8946 8182 Email: jaya@edu.upm.edu.my
	Parental Assessment of Early Intervention Programs for Children with Intellectual Disabilities	Jayaletchumi Mottan [Mrs.] Faculty of Human Ecology Tel: +603-89467083 Email: jayam@putra.upm.edu.my
	Perkhidmatan Produk Kewangan di Sumatera Barat, Indonesia: Perbandingan antara Etnik Minangkabau Cina 	Laily Paim [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467053 Email: laily@putra.upm.edu.my
	Penggunaan Lestari: Pembentukan Indeks Keperihatinan Persekitaran	Laily Paim [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467053 Email: laily@putra.upm.edu.my
	A Study of Communication Strategies in Second Language Use	Lee Geok Imm [Mrs.] Faculty of Modern Language and Communication Tel: +603-8946 8716 Email: gilee@fbm.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Senior Engineering: Factors Contributing to Career Growth 	Maimunah Ismail [Prof. Dr.] Faculty of Educational Studies Tel: +603-8946 8226 Email: mismail@eace.upm.edu.my
	Technical versus Managerial Line: Career Route Preference of Senior Men and Women Engineers 	Maimunah Ismail [Prof. Dr.] Faculty of Educational Studies Tel: +603-8946 8226 Email: mismail@eace.upm.edu.my
	Unsur Kualitatif dalam Pendidikan Matematik	Mat Rofa Ismail [Assoc.Prof.Dr.] Institute of Mathematical Research Tel: +603-8946 6836 Email: mrofa@fsas.upm.edu.my
	Contemporary Nature of Adult Learning	Mazanah Muhamad [Assoc.Prof.Dr.] Faculty of Educational Studies Tel: +603-8946 7091 Email: mazanah@ace.upm.edu.my
	Malaysian Literature in English: An Evolving Tradition	Mohamad A Qayum [Prof.Dr.] Faculty of Modern Language and Communication Tel: +603-8946 8720 Email: qayum@fbm.upm.edu.my
	Penggunaan Media Massa dan Pengaruh terhadap Remaja 	Mohd. Fazli Sabri [Mr.] Faculty of Human Ecology Tel: +603-89467113 Email: apr_13@yahoo.com
	Identification of Conductive Hearing Loss in a Computer Learning Environment	Mohd. Sharani Ahmad [Mr.] Faculty of Human Ecology Tel: +603-89467086 Email: msharani@eco1.upm.edu.my
	Young Children's Collaborative Interactions in an Educational Computer Environment	Mohd. Sharani Ahmad [Mr.] Faculty of Human Ecology Tel: +603-89467086 Email: msharani@eco1.upm.edu.my
	Penggunaan Komputer di kalangan Pelajar Berpendapatan Rendah 	Mumtazah Othman [Dr.] Faculty of Human Ecology Tel: +603-89467104 Email: mumtazah@putra.upm.edu.my
	Masyarakat Luar Bandar dan Projek ICT: Satu Usaha Pembentukan K-Masyarakat	Musa Abu Hassan [Assoc.Prof.Dr.] Institute of Peace and Community Learning Tel: +603-8946 8580 Email: zamre@peka.upm.edu.my
	The Social and Spatial Impact of Settlement Policies in Kuala Lumpur, Malaysia	Nobaya Ahmad [Dr.] Faculty of Human Ecology Tel: +603-89467069 Email: nobaya@putra.upm.edu.my .
	Kajian Kepuasan Tempat Tinggal dan Pencapaian Akademik Pelajar Lelaki Melayu Luar Kampus Universiti Putra Malaysia 	Nurizan Yahaya [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467107 Email: nurizan@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Inculcation Farmers' Work Culture Among Malaysia Youth Agro-Entreprenuer using Transformative Learning Model Award Winner	Rahim Md Sail [Prof. Dr.] Institute of Peace and Community Learning Tel: +603-8946 8571 Email: rahim@peka.upm.edu.my
	Voluntreerism Among Retirees: A Potential Resource for Community Development	Rahim Md Sail [Prof. Dr.] Institute of Peace and Community Learning Tel: +603-8946 8571 Email: rahim@peka.upm.edu.my
	High-flyer Women Scientists: What Makes Them to the Top	Rahima Abdul Hamid [Prof.Dr.] Faculty of Educational Studies Tel: +6019- 3003216 Email: kzr333@yahoo.com
	Acquisition of Computer Literacy among 5 and 6 Year Olds in a Laboratory Preschool Award Winner	Rohani Abdullah [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467150 Email: rohani_safri@yahoo.com
	Availibility of Home Computers and Preschooler's Computer Knowledge and Skills Award Winner	Rohani Abdullah [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467150 Email: rohani_safri@yahoo.com
	Conduct Problems amongst School-Going Adolescent	Rozumah Baharudin [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467051 Email: rozumah@putra.upm.edu.my
	Parenting and Marital Quality in Intercultural Marriage Family	Rumaya Juhari [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467051 Email: rumaya@putra.upm.edu.my
	Predictors of Fathering Quality amongst Father in Dual-Career Family	Rumaya Juhari [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467089 Email: rumaya@putra.upm.edu.my
	Gender Roles and Marital Quality among Dual-Career Couples Award Winner	Rumaya Juhari [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89467088 Email: rumaya@putra.upm.edu.my
	Economic Hardship, Family Functioning and Marital Quality amongst Malay Poor Families in Selangor Award Winner	Rumaya Juhari [Assoc.Prof.Dr.] Faculty of Human Ecology Tel: +603-89468575 Email: rumaya@putra.upm.edu.my
	The Patterns and Role Structure in Family Decision Making Award Winner	Samsinar Md Sidin [Assoc.Prof.Dr.] Faculty of Economics and Management Tel: +603-8946 7673 Email: sms@putra.upm.edu.my
	Knowledge and Accessibility to the Law of Fasakh Award Winner	Sa'odah Ahmad [Mrs.] Faculty of Human Ecology Tel: +603-89467090 Email: saodahahmad@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Vocabulary Acquisition and Learning Strategies in Foreign Language 	Shameem Bt Mohd. Rafik Khan [Assoc.Prof.Dr.] Faculty of Modern Language and Communication Tel: +603-8946 8666 Email: shameem@fbm.upm.edu.my
	Aerobic and Strength Training: Impact on VO2 max and Body Fat 	Soh Kim Geok Faculty of Educational Studies Tel: +603-8946 8153 Email: kim@educ.upm.edu.my
	Mental Health and Quality of Life of Older Malaysians	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-8946 7091 Email: aizan@putra.upm.edu.my
	Determinants of Depression Among The Malaysian Elderly 	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-8946 7091 Email: aizan@putra.upm.edu.my
	Perception of Needs and Problems of the Elderly: Implications on Policies and Programmes 	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-8946 7091 Email: aizan@putra.upm.edu.my
	Kajian Persepsi Masalah dan Keperluan Warga Tua Johor	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-8946 7091 Email: aizan@putra.upm.edu.my
	Non-Formal Learning and Older Malaysian 	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-89467091 Email: aizan@putra.upm.edu.my
	Aktiviti Senggang Pesara Malaysia 	Tengku Aizan Hamid [Assoc.Prof.Dr.] Institute of Gerontology Tel: +603-89467091 Email: aizan@putra.upm.edu.my
	The Effect of Vocabulary on Text Compherension 	Wong Bee Eng [Dr.] Faculty of Modern Language and Communication Tel: +603-89468677 Email: bee@fbm.upm.edu.my
	Consumers' Pechasing Behavior toward Imported Dairy Products 	Wong Foong Yee [Mrs.] Faculty of Economics and Management Tel: +603-89467714 Email: fywong@econ.upm.edu.my
	Creativity and Innovativeness of Malaysian Organizations 	Wong Foong Yee [Mrs.] Faculty of Economics and Management Tel: +603-89467714 Email: fywong@econ.upm.edu.my
	Culture, Conservation and Heritage in the Context of City Marketing: The Cases of Georgetown, Pulai Pinang	Zahid Emby [Dr.] Faculty of Human Ecology Tel: +603-89467065 Email: zahid@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Colossal Magnetoresistance (CMR) in Rae Earth Doped La-Ca-Mn-O (LCMO) Ceramic	Abdul Halim Shaari [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466648 Email: ahalim@fsas.upm.edu.my
	Dielectric Properties of Stannate and Vanadate Ceramics for Capacitance Application	Abdul Halim Shaari [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466644 Email: ahalim@fsas.upm.edu.my
	Superconductiong Properties of Bulk and Tapes of Bi(Pb)-Sr-Ca-Cu-) System Prepared via Conventional Solid State and Coprecipitation Methods Award Winner	Abdul Halim Shaari [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466873 Email: ahalim@fsas.upm.edu.my
	Intergranular Properties of Bi-based Temperature Superconductors	Abdul Halim Shaari [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466644 Email: ahalim@fsas.upm.edu.my
	Correlation Between FFA in Oil Palm and the Color of the Oil Palm Fruit	Abdul Rashid Mohamed Shariff [Dr.] Institute of Advanced Technology Tel: +603- 89466414 Email: rashid@eng.upm.edu.my
	Assessment of Health of Palm Oil Plantation from Space Using Rule Based Classification Award Winner	Abdul Rashid Mohamed Shariff [Dr.] Institute of Advanced Technology Tel: +603- 8946 6414 Email: rashid@eng.upm.edu.my
	Fire Risk Modeling and Mapping Using GIS and Remotely Sensed Data	Ahmad Rodzi Mahmud [Dr.] Faculty of Engineering Tel: +603-89466383 Email: arm@eng.upm.edu.my
	Automated, 2-Axis Laser Soil Surface Profile Digitizer Award Winner	Azmi Yahya [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-89466267/ 6421/ 6465 Email: azmiy@eng.upm.edu.my
	Automated Soil Penetrometer-Shearometer Unit for Measuring Soil Penetration Resistance and Shear Stress	Azmi Yahya [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-89466267/ 6421/ 6465 Email: azmiy@eng.upm.edu.my
	A Tractor with Built-in Data Acquisition and Differential Global Positioning System for Mapping Power and Energy Demand of Agricultural Field Operations	Azmi Yahya [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-89466267/ 6421/ 6465 Email: azmiy@eng.upm.edu.my
	Preparation of Fatty Amides from Metal Soaps under Microwave Irradiation Award Winner	Badri Muhamad [Prof. Dr.] Faculty of Science & Environmental Studies Tel: +603-89467491 Email: karen@fsas.upm.edu.my
	Dose and Temperature Dependence on the Conductivity of Ionic Polymer Award Winner	Elias Saion [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466654 Email: elias@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Radiation Induced Relaxation Processes in Ionic Polymer	Elias Saion [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466654 Email: elias@fsas.upm.edu.my
	Polymethacrylamide Gel (PMAG) Polymer Dosimeters	Elias Saion [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-89466654 Email: elias@fsas.upm.edu.my
	A New Dosimeter Incorporating Chloral Hydrate and Raman Scattering Technique	Elias Saion [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6654 Email: elias@fsas.upm.edu.my
	Polymer-zeolite Composite Membranes for Potential Fuel Cell Applications Award Winner	Elias Saion [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6654 Email: elias@fsas.upm.edu.my
	Carbon Nanotubes and Carbon Nanofibers Synthesis for Nanotechnology Applications Award Winner	Fakhru'l-Razi Ahmadun [Assoc.Prof. Dr.] Faculty of Engineering Tel: +603-8656 7120 Email: fakhrul@eng.upm.edu.my
	Computer Simulation of Food Sterilization Process	Ibrahim Omer Mohamed [Dr.] Faculty of Engineering Tel: +603-8946 5796 Email: iom@eng.upm.edu.my
	Synthesis and Characterisation of Nanocrystalline of Copper Oxcide Award Winner	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6786 Email: irmawati@fsas.upm.edu.my
	Characterisation of Bismuth Oxcide Cataysts Prepared from Bismuth trinitrate Pentahydrate	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6786 Email: irmawati@fsas.upm.edu.my
	Characterisation of Bismuth Oxide Catalysts Prepared via Precipatition Method Award Winner	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6786 Email: irmawati@fsas.upm.edu.my
	Synthesize and Characterisation of Highly Crystalline Antimony Oxide Catalysts Award Winner	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6786 Email: irmawati@fsas.upm.edu.my
	Effect of Calcinations Temperature on The Morphology of Vanadium-antimony Mixed Oxcide Catalysts	Irmawati Ramli [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6786 Email: irmawati@fsas.upm.edu.my
	Automatic House Painting Maching Award Winner	Ishak Aris [Dr.] Faculty of Engineering Tel: +603-8946 6324/ 013-388 8577 Email: ishak@eng.upm.edu.my

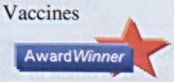
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Glasshouse Acclimatization of Tissue Cultured *senduduk* Plantlets 	Janna Ong Abdullah [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6697 Email: jong@fsas.upm.edu.my
	Life and Adaption in Seagrass Ecosystem 	Japar Sidik Bujang [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6602 Email: japar@fsas.upm.edu.my
	Dielectric Properties of Hevea Rubber Latex	Jumiah Hassan [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6656 Email: jumiah@fsas.upm.edu.my
	Dual Frequency Multi-pupose Moisture and Density Sensor System Based on Microstrip patch antenna	Kaida Khalid [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6659 Email: kaida@fsas.upm.edu.my
	Characterization and Structure Elucidation of Synthesized Nitrogen-sulfur Donor Ligands with Potential Biological Activity 	Karen A Crouse [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 7491 Email: karen@fsas.upm.edu.my
	Identification and Evaluation of Accident Black Spots on Roads Using Road Accident View (RAV) Geographical Information Systems (GIS) 	Law Teik Hua [Mr.] Faculty of Engineering Tel: +603-8946 7852 Email: lawteik@eng.upm.edu.my
	Enhancement of Lipase Enantioselectivity Through Immopbilization 	Mahiran Basri [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6603 Email: mahiran@fsas.upm.edu.my
	Chemical Diversity and New Bioactive Coumarins from Micromelum Minutum (Rutacaea) 	Mawardi Rahmani [Prof. Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6794 Email: mawardi@fsas.upm.edu.my
	Meja Makan Automatik (Automated Dining Table)	Megat Mohamad Hamdan Megat Ahmad [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6336 Email: mmegat@eng.upm.edu.my
	High Sensivity Erbium Doped Optical Fiber Amplifier 	Mohamad Khazani Abdullah [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6454 Email: khazani@eng.upm.edu.my
	Media Converter 	Mohamad Khazani Abdullah [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6454 Email: khazani@eng.upm.edu.my
	Transport Pathway of Polycyclic Hydrocarbons in Langat River Basin	Mohamad Pauzi Zakaria [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6738 Email: mpauzi@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Polycyclic Aromatic Hydrocarbons (PAHs) Analysis from Water and Sediments (SPE/GC/MS)	Mohamad Pauzi Zakaria [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6738 Email: mpauzi@fsas.upm.edu.my
	Antimicrobial and Cytotoxic Products from Murraya Species Award Winner	Mohd Aspollah Sukari [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6797 Email: aspollah@fsas.upm.edu.my
	Cheap and Simple Technique for Wide Range Thermal Diffusivity Measurement at Low Temperature	Mohd Maarof Mokhsin [Prof. Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6674 Email: maarof@fsas.upm.edu.my
	Pharmaceutically Important Constituents of Zingiberaceous Species	Mohd Aspollah Sukari [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6797 Email: aspollah@fsas.upm.edu.my
	Image Processing Technique of Quality Control of Oil Palm Fruitlets During Sterilisation Award Winner	Mohd. Halim Shah Ismail [Mr.] Faculty of Engineering Tel: +6013-303 7207 Email: saadamir9@hotmail.com
	Marine Macrohytes of The Uexplored Punang-Sari Beach Front of Lawas, Sarawak (Under the IRPA-8 Project: Distribution, Diversity and uses of Aquativ macrophytes) Award Winner	Muta Harah Zakaria [Dr.] Bintulu Campus Tel: +6086-855363 Email: drmuta@btu.upm.edu.my
	Design of Cost Effective and Comfortable Motocycle Helmet with Bio-Composite Material for Tropical Climates Award Winner	Radin Umar Radin Sohadi [Prof.Ir.Dr.] Faculty of Engineering Tel: +603-8656 7101 Email: radinumx@eng.upm.edu.my
	LD (Lift and Drag) Analyser	Shamsuddin bin Sulaiman [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6334/ 019-330 6124 Email: suddin@eng.upm.edu.my
	Integrated Design and Fabrication of Plastic Injection Mould	Shamsuddin bin Sulaiman [Assoc.Prof.Dr.] Faculty of Engineering Tel: +603-8946 6334/ 019-330 6124 Email: suddin@eng.upm.edu.my
	Advance Early Warning System for Flood Forecasting Award Winner	Shattri Mansor [Assoc.Prof.Dr.] Institute of Advanced Technology Tel: +603-8946 7543 Email: Shattri@eng.upm.edu.my
	Morphological Differences and Phylogenetic Relationships among Selected Malaysian Gobies Award Winner	Siti Khalijah Daud [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6638 Email: sitikd@fsas.upm.edu.my
	Assessment of the Population Genetic Structure of the Green-lipped Mussel, Perna viridis L using Random Aplified Polymorphgic DNA (RAPD) and Random Aplified Microsatellites (RAMs) Markers. Award Winner	Tan Soon Guan [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6640 Email: sgtan@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Solid Phase Voltammetry of Microcrystalline C60 Fullerene in Aqueous Electrolyte	Tan Wee Tee [Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6807 Email: wttan@fsas.upm.edu.my
	Temperature Programmed Techniques Study on the Nature of the Oxidant in/on V205 Catalyst AwardWinner	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	Physicochemical Study of γ-Al2O3 Supported Vanadium Phosphorus Oxide Catalysts AwardWinner	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	Synthesis and Characterisation of Vanadyl Pyrophosphate Catalysts via Vanadyl Hydrogen Phosphate Sesquihydrate Precursor AwardWinner	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	Bismuth-modified Vanadyl Phrophosphate Catalysts	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	The Role of K Dopont on the Nature of Oxidants in/on Vanadyl Pyrophosphate Catalysts	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	High Mobility Lattice Oxygen of Fe-doped Vanadium Phosphorus Oxide Catalysts	Taufiq Yap Yun Hin [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6809 Email: yap@fsas.upm.edu.my
	A Simulator for Cyclic Adsorption Process	Thomas Choong Shean Yaw [Dr.] Faculty of Engineering Tel: +603-8946 6293 Email: tsyc2@eng.upm.edu.my
	To Stop or Not To Stop? A Novel Rational Stopping Criterion for the Simulation of Cyclic Processes	Thomas Choong Shean Yaw [Dr.] Faculty of Engineering Tel: +603-8946 6293 Email: tsyc2@eng.upm.edu.my
	Antifungal and Genotoxic Activities of Favonoid Isolated from Selected Medicinal Plants	Umi Kalsom Yusuf [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6642 Email: umikay@fsas.upm.edu.my
	Optical and Thermal Characterization of Porous Silicon using Photoacoustic (PA) Spectroscopic Technique	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my
	Surface Plasmon Resonance Optical Sensor for the Detection of Chlorine ion/molecule and Disaccharide in Water	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Carrier Transport Properties of Au/Si silicide using Open Photoacoustic Technique	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my
	Thermal Diffusivity and Electrical Conductivity Measurement on Polyaniline (Emeraldine base and emeraldine salt)	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my
	Thermal Characterization of Malaysian Wood and Medium Density Fiberboard (MdF) by Photoacoustics and Photothermal Techniques	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my
	I-V Characteristic of puse Sn02 and Sn02-CuO Ceramic Gas Sensors	W. Mahmood Mat Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6684 Email: mahmood@fsas.upm.edu.my
	Epoxidized Natural rubber/organoclay Nanocomposites AwardWinner	Wan Zin Wan Yunus [Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6601 Email: wanzin@fsas.upm.edu.my
	Artificial Intelligent Based Expert System for Machining Process AwardWinner	Wong Shaw Voon [Dr.] Faculty of Engineering Tel: +603-8946 6339 Email: wongsv@eng.upm.edu.my
	Design and Development of Heavy Duty Pendulum Impact Test Ring AwardWinner	Wong Shaw Voon [Dr.] Faculty of Engineering Tel: +603-8946 6339 Email: wongsv@eng.upm.edu.my
	Optical Characterization of Phosphate Glasses AwardWinner	Zainal Abidin Talib [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6646 Email: zainalat@fsas.upm.edu.my
	Development of Microwave Sonsors for the Determination of Dielectric Properties of Oil Plam Fruits AwardWinner	Zulkifly Abbas [Dr.] Institute of Mathematical Research Tel: +603-8946 6690 Email: za@fsas.upm.edu.my
	Mobile Communication Path Loss Studies in UPM Campus AwardWinner	Zulkifly Abbas [Dr.] Institute of Mathematical Research Tel: +603-8946 6690 Email: za@fsas.upm.edu.my
	Experimental Investigation into the Filtration and Reverse Flow Cleaning Modes on Cylindrical and Tapered Rigid Ceramic Filters	Chuah Teong Guan [Dr.] Faculty of Engineering Tel: +603-8946 6288 Email: chuah@eng.upm.edu.my
	Numerical Simulation of NOx Abatement in Three Way Catalytic Converter (TWCC)	Chuah Teong Guan [Dr.] Faculty of Engineering Tel: +603-8946 6288 Email: chuah@eng.upm.edu.my

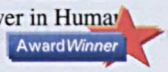
Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Fast DNA Detection Kit- LEPTOSCANTM Detects Inviduals with Leptospira Infection Award Winner	Abdul Rani Bahaman [Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8061 Email: rani@vet.upm.edu.my
	Potential Health Benefits of Extracts Prepared from Cocoa Products of Low Quality Malaysian Beans Award Winner	Amin Ismail [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8557 Email: amin@medic.upm.edu.my
	The Effect of Supplementation of Water Extract of Fresh Garlic (Allium Sativum Linn.) on Liver Cancer Cell	Asmah Rahmat [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8443 Email: asmah@medic.upm.edu.my
	Possible Anticancer Effect of Red Spinach Award Winner	Asmah Rahmat [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8443 Email: asmah@medic.upm.edu.my
	Comparison of CDR1 and MDR1 Gene Expression and Gene Sequences of Azole-drug Resistant Candida albicans and Candida glabrata Clinical Isolates	Chong Pei Pei [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8520 Email: cpp@medic.upm.edu.my
	Synthesis and Characterization Betulinic Acid Derivatives Produced using Lipase as Catalyst and their Biological Activity Award Winner	Faujan Hj. Ahmad [Assoc.Prof.Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6603 Email: faujan@fsas.upm.edu.my
	Microsatelliting of Antioxidant Elements During Hepatocarcinogenesis Treated with Strobilanthes crispus Award Winner	Fauziah Othman [Assoc.Prof.Dr.] Institute of Bioscience Tel: +603-8946 8439 Email: fauziah@putra.upm.edu.my
	Evaluation of Apoptosis Inducing Ability of Neem (Azadirachta indica) Leaf Extract on MCF-7 Breast Cancer Cell Lines. Award Winner	Fauziah Othman [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8439 Email: fauziah@putra.upm.edu.my
	Nasopharyngeal Carriage of Neisseria Meningitidis among Returning Malaysian Hajj Pilgrims 1422H Award Winner	Latifah A. Latiff [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603- 8946 8446 Email: Latiffah@medic.upm.edu.my
	Extraction and Characterization of Fish Oil From Local Freshwater Fish	Mahiran Basri [Prof. Dr.] Faculty of Science & Environmental Studies Tel: +603-8946 6603 Email: mahiran@fsas.upm.edu.my
	Development of Membrance Based Assay for the Rapid Identification of Multiple Resistant Staphyloccus aureus Award Winner	Mariana Nor Shamsuddin [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8497 Email: Mariana@medic.upm.edu.my
	Improving the Nutracceutical Value of Rice Bran by Supercritical Fluid Extraction Award Winner	Maznah Ismail [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8483 Email: nurzillah@yahoo.com

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	JeskiTekTM: A Hassle- Free Diagnostic Kit For Aujeszky's Disease 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-89468305 Email: azmi@vet.upm.edu.my
	Development of Diagnostic Kits for Effective Detection of Human Rotaviruses 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	A Novel Rat Model Facilitates Vaccine Development and Intervention Studies for the Prevention of Congenital Cytomegalovirus Infection in Human 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	ELLUCIN™ - A Recombinant Yeast for Contraception 	Mohd. Azmi Mohd. Lila [Assoc.Prof.Dr.] Faculty of Veterinary Medicine Tel: +603-8946 8305 Email: azmi@vet.upm.edu.my
	Antifungal and Anti-bacterial Agents from Three Local Cassia spp.herbs. 	Muhd. Nazrul Hakim [Dr.] Institute of Bioscience Tel: +603-8946 8518 Email: nazrulh@putra.upm.edu.my
	Potential of Three Local Euphorbiacea Plants as Antimicrobial Agents 	Muhd. Nazrul Hakim [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8518 Email: nazrulh@putra.upm.edu.my
	Mechanism of Liver Toxity of Azole Antifungal Drugs: Involvement of Cytochrome P 450	Muhd. Nazrul Hakim [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8518 Email: nazrulh@putra.upm.edu.my
	Ploymorphism on Exon 4 of p53 Gene among Cancer Patient	Patimah Ismail [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8462 Email: patimah@putra.upm.edu.my
	Anticancer, Genotoxicity Assessments and Purification of Acanthus Ilicifoliuo Seed Extract 	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my
	Detection of a Novel Intronic Point Mutation in the Cystathione-b Snthase Gene of Down's Syndrome	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my
	A Multidiciplinary Application of DNA Vaccines 	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my
	Investigation on the effects of SMDB-cd on Glioblastoma Cell Lines 	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Molecular Characterisation of Rotavirus G and P Types from Children with Diarrhoea Admitted to Hospital Kuala Lumpur and Hospital Kuching	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603–8946 8480 Email: rozita@medic.upm.edu.my
	Novel Calcium-binding Proteins of the Outer Acrosomal Membrances of Ram Spermatozoa-potential for Immunocontraception	Sabrina Sukardi [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8461 Email: sabrina@medic.upm.edu.my
	Effects of L-arginie on Sperm Quality of Rabbits	Sabrina Sukardi [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8461 Email: sabrina@medic.upm.edu.my
	The Effect of Zingiber zerumbet on Liver of Male Sprague-Dawley Rats Award Winner	Sharida Fakurazi [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8570 Email: Sharida@medic.upm.edu.my
	Development of A Genetically Engineered Vaccine to curb Zoonotic Transmission of Brugian Filariasis Award Winner	Wan Omar Abdullah [Prof.Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8544 Email: wanomar@medic.upm.edu.my
	Appropriate Antibiotic Administration in Elective Surgical Procedures-Still Missing the Message	Yunus Gul [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603–2050 1013 Email: yunus@medic.upm.edu.my
	Venous Thromboembolism Prophylaxis Amongst General Surgeons in Malaysia Award Winner	Yunus Gul [Assoc.Prof.Dr.] Faculty of Medicine and Health Science Tel: +603–2050 1013 Email: yunus@medic.upm.edu.my
	Dietary Calsium Intake and Bone Mineral Density among Malay Postmenopausal Women	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 9369 Email: zaitun@medic.upm.edu.my
	Effect of Calcium Supplementation on Serum Lipid Profile of Postmenopausal Chinese Women Award Winner	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 9369 Email: zaitun@medic.upm.edu.my
	Effectiveness of Calcium Supplementation and Weight-bearing Exercise in Reducing therate of Bone Loss in Postmenapausal Chinese Women- a Two-Year Randomized Controoled Trial Award Winner	Zaitun Yassin [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 9369 Email: zaitun@medic.upm.edu.my
	Indicators and Nutritional Outcomes of Household Food Insecurity Among Rural Women in Sabak Bernam, Selangor	Zalilah Mohd Shariff [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8551 Email: zalilah@medic.upm.edu.my
	Religiosity and Personality Development Index: Application for Nation Building Award Winner	Hj. Azimi Hamzah [Prof.Dr.Hj.] Institute of Peace and Community Learning (PEKKA) Tel: +603-8946 8572 Email: -

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	The Generating Financial Reports Simulation (GenerReS) Software 	Arfah Salleh [Assoc.Prof.Dr.] Graduate School of Management Tel: +603-8946 7432 Email: arfah@putra.upm.edu.my
	Intervation Model Forecasting Automobile Sales in Malaysia 	Kassim Haron [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6830 Email: kassim@fsas.upm.edu.my

5. 14th International Invention, Innovation, Industrial Design & Technology (I-TEX) *(20)**

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
16-18 May 2003 Sunway Convention Centre, Malaysia.	GMR & CMR Magnetic Thin Film for Sensor Applications 	Abdul Halim Shaari [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603-8956 6648 Email: ahalim@fsas.upm.edu.my
	SMS Gateway Interface	Abdul Rahman Ramli [Dr.] Faculty of Engineering Tel: +603-8656 7127 Email: arr@eng.upm.edu.my
	Nanotechnology	Fakhru'l Ahmadun [Assoc. Prof. Dr.] Faculty of Engineering Tel: +603-8656 7099 Email: fakhrul@eng.upm.edu.my
	Bioremediation of Petroleum Pollutants by Microbial Consortium 	Farinazleen Mohamad Ghazali [Mrs.] Faculty of Science and Environmental Studies Tel: +603-8946 8090 Email: nazghazali@putra.upm.edu.my
	Newcastle Disease Virus (NDV): A killer in Chicken but a Potential Life Saver in Huma 	Fauziah Ohman [Assoc. Prof. Dr] Institute of Bioscience Tel: +603-8946 8439 Email: fauziah@putra.upm.edu.my
	Probiotic for Poultry 	Ho Yin Wan [Prof. Dr.] Institute of Bioscience Tel: +603-8946 8067 Email: ywho@ibs.upm.edu.my
	Development of Activated Carbon Tin (IV) Oxide (Sn02) for Hydrogen Purification in Pressure Swing Adsorption (PSA) for (PEM) Fuel Cell 	Iyuke Sunny Esayegbemu [Assoc. Prof. Dr.] Faculty of Engineering Tel: +603-8946 6294 Email: sunny@eng.upm.edu.my
	Fibre Reinforced Plastic Composite (FRPC) for Interior Automotive and Other Applicants 	Jalauddin Harun [Dr.] Institute of Advance Technology Tel: +603-8946 7538 Email: jalal@putra.upm.edu.my
	New Concept in "Keropok Lekor" Production, Handling and Utilization	Jamilah Bakar [Assoc. Prof. Dr.] Faculty of Food Science and Biotechnology Tel: +603-8946 8396 Email: jamilah@putra.upm.edu.my

Date / Venue	Product/ Process / Research Title	Exhibitor *(Name & Full address with Tel/Fax/email)*
	Novel Molecular Carrier 	Khatijah Yusoff [Prof. Dr.] Faculty of Science a Environmental Studies Tel: +603-8946 6692 Email: khatijah@fsas.upm.edu.my
	SASSAR Kit (Staphylococcus aureus Species Specific Antibiotic resistant) Identification Kit 	Mariana Nor Shamsudin [Assoc. Prof. Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8496 Email: mariana@medic.upm.edu.my
	Development and Commercialization of New Orchid Varieties Using Biotehnology Techniques	Marziah Mahmood [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603 8946 6703 Email: marziah@fsas.upm.edu.my
	Rice Bran Malaysia (RBM): From Wasteful Resource to Useful Health Products	Maznah Iamail [Assoc.Prof. Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8483 Email: maznah@medic.edu.my
	Hybrid Organic-inorganic Nanocomposite as a Controlled Release Formulation of Napthalene3 Acetate	Mohd Zabir Hussein [Prof. Dr.] Faculty of Science and Environmental Studies Tel: +603 8946 6801 Email: mzobir@fsas.upm.edu.my
	Career Champion ™ Matrix Jobs Games ™	Othman B. Dato' Haji Mohamed [Prof.Dr.] Faculty of Educational Studies Tel: +603-8946 8164 Email: othman@educ.upm.edu.my
	Wireless File Transfer Using Bluetooth Technology	Ratna Kalos Zakiah Sahbudin [Mrs.] Faculty of Engineering Tel: +603-8946 6431 Email: ratna@eng.upm.edu.my
	Cholera DNA Vaccine	Rozita Rosli [Dr.] Faculty of Medicine and Health Science Tel: +603-8946 8480 Email: rozita@medic.upm.edu.my
	Network Independent Video on Demand (VoD) System 	Sabira Khatun Aduwati Sali [Dr.] Faculty of Engineering Tel: +603-8946 6460 Email: sabira@eng.upm.edu.my
	Novel Peptide to Distinguish Vaccinated Birds from Those Infected with Virulent Newcastle Disease Virus 	Tan Wen Siang [Dr.] Faculty of Science and Environmental Studies Tel: +603-8946 6715 Email: wstan@fsas.upm.edu.my
	An Innovative and High-yield Production Technology or the Shiitake Mushroom Using Special Techniques and Enzyme Markers	Tan Yee-How [Assoc. Prof] Faculty of Agriculture Tel: +603-8946 7248 Email: alvinyht@agri.upm.edu.my

[i] *Data in chronological order, sorted by author.*

Inaugural Lectures, 1989-2004[i]

Traditionally, on promotion to the rank of professor, an academic is expected to present a public lecture on his/her contributions to science. The inaugural lectures of UPM's professors are given in *Table 15* below. *Values in parenthesis indicate total number of Inaugural lectures presented.

Table 15.

Inaugural Lectures of UPM's Professors by Faculty—1989-2004, ***(74)***[1]

	Faculty	Inaugural Lectures
1.	*Faculty of Agriculture*	10
2.	*Faculty of Economics and Management*	12
3.	*Faculty of Educational Studies*	01
4.	*Faculty of Engineering*	04
5.	*Faculty of Fisheries (UPMT)*	01
6.	*Faculty of Food Science and Biotechnology*	07
7.	*Faculty of Forestry*	01
8.	*Faculty of Human Ecology*	01
9.	*Faculty of Marine and Environmental Sciences (UPMT)*	01
10.	*Faculty of Medicine and Health Science*	03
11.	*Faculty of Modern Language and Communication*	02
12.	*Faculty of Science & Environmental Studies*	21
13.	*Faculty of Veterinary Medicine*	08
14.	*Graduate School of Management*	01
15.	*Institute of Bioscience*	01
	Total	**74**

1. Faculty of Agriculture (10)

No.	Name	Title	Date
1.	Abdul Rahman Abdul Razak (Professor Dr.)	*Plant Parasitic Nematodes, Lesser Known Pests of Agricultural Crops*	1993, Jan 30
2.	Azizah Hashim (Professor Dr.)	*The Endomycorrhiza: A Futile Investment?*	1999, Oct 23
3.	Mohd. Yusof Hussein (Professor Dr.)	*Pest Control: A Challenge in Applied Ecology*	1994, Jul 9

[1] Data presented as of April 2004.

No.	Name	Title	Date
4.	Rosli Mohamad (Professor Dr.)	*Pesticide Usage: Concern and Options*	1996, Feb 10
5.	Sariah Meon (Professor Dr.)	*Biological Control of Plant Pathogens: Harnessing the Richness of Microbial Diversity*	1999, Aug 14
6.	Shamsuddin Jusop (Professor Dr.)	*Rock, Mineral and Soil*	1994, Jun 18
7.	Sharifuddin Haji Abdul Hamid (Professor Dr.)	*Management of Highly Weathered Acid Soils for Sustainable Crop Production*	1999, Oct 28
8.	Wan Sulaiman Wan Harun (Professor Dr.)	*Soil Physics: From Glass Beads To Precision Agriculture*	1996, Mar 16
9.	Wong Kai Choo (Professor Dr.)	*Advancing the Fruit Industry in Malaysia: A Need to Shift Research Emphasis*	1999, May 15
10.	Zaharah A. Rahman (Professor Dr.)	*Nutrient Management Strategies for Sustainable Crop Production in Acid Soils: The Role of Research using Isotopes*	2002, Apr 13

2. Faculty of Economics and Management (12)

No.	Name	Title	Date
1.	Abdul Aziz Abdul Rahman (Professor Dr.)	*Sustained Growth And Sustainable Development: Is there A Trade-Off 1~'or Malaysia*	1996, Apr 13
2.	Ahmad Zubaidi Baharumshah (Professor Dr.)	*The Economics of Exchange Rates In the East Asian Countries*	2002, Oct 26
3.	Chew Tek Ann (Professor Dr.)	*Sharecropping in Perfectly Competitive Markets . A Contradiction in Terms*	1996, Apr 27
4.	Fatimah Mohd. Arshad (Professor Dr.)	*Analysis of Agriculture Marketing in Malaysia: The requirement of Renewal Agenda.*	2002, Jan 26
5.	Ishak Hj. Omar (Professor Dr.)	*Market Relationships in The Malaysian Fish Trade: Theory and Application*	1997, Mar 22
6.	Maisom Bte. Abdullah (Professor Dr.)	*Productivity Driven Growth: Problems & Possibilities*	2002, Apr 27
7.	Mohd. Ariff Hussein (Professor Dr.)	*Changing Roles of Agricultural Economics*	1994, Mar 5
8.	Mohd. Ghazali Mohayiddin (Professor Dr.)	*Managing Change in the Agriculture Sector: The Need for Innovation Educational Initiatives*	2002, Jan 12
9.	Mohd. Ismail Ahmad (Professor Dr.)	*Marketing Management: Prospects and Challenges for Agriculture*	1994, Apr 6
10.	Nik Mustapha R. Abdullah (Professor Dr.)	*Fisheries Co-Management: An Institutional Innovation Towards Sustainable Fisheries Industry*	2002, Feb 28
11.	Shaik Md. Noor Alam S.M. Hussain (Professor Dr.)	*Contractual Justice In Asean: A Comparative View Of Coercion*	2002, Oct 31

No.	Name	Title	Date
12.	Shamsher Mohamed Ramadili (Professor Dr.)	*The New Issues Market: Regulatory Intervention, Forecast Errors and Challenges*	2003, Apr 26

3. Faculty of Educational Studies (01)

No.	Name	Title	Date
1.	Rahim Md. Sail (Professor Dr.)	*Extension Education for Industrialising Malaysia: Trends, Priorities and Emerging Issues*	1995, Jul 22

4. Faculty of Engineering (04)

No.	Name	Title	Date
1.	Abang Abdullah Abang Ali (Professor Ir.)	*Indigenous Materials and Technology for Low Cost Housing*	1990, Aug 30
2.	Malay Raj Mukerjee (Professor Dr.)	*A Distributed Collaborative Environment for Distance Learning Applications*	1998, Jun 17
3.	Radin Umar Radin Sohadi (Professor Ir. Dr.)	*Road Safety Interventions in Malaysia: How Effective are they?*	2003, Feb 21
4.	Zohadie Bardaie (Professor Ir. Dr.)	*Engineering Technological Developments Propelling Agriculture into the 21st Century*	1994, May 28

5. Faculty of Fisheries (UPMT) (01)

No.	Name	Title	Date
1.	Ang Kok Jee (Professor Dr.)	*The Evolution of an Environmentally Friendly Hatchery Technology for Udang Galah, the King of Freshwater Prawns and a Glimpse into the Future of Aquaculture in the 21st Century*	1995,Oct 14

6. Faculty of Food Science and Biotechnology (07)

No.	Name	Title	Date
1.	Gulam Rusul Rahmat Ali (Professor Dr.)	*Food Safety: Perspectives and Challenges*	2002, Mar 23
2.	Hasanah Mohd. Ghazali (Professor Dr.)	*Tapping the Power of Enzymes—Greening the Food Industry*	2004, May 11
3.	Jinap Selamat (Professor Dr.)	*Cocoa: Wonders for Chocolate Lovers*	2004, Feb 14
4.	Mohamed Ismail Abdul Karim (Professor Dr.)	*Microbial Fermentation and Utilization of Agricultural Bioresources and Wastes in Malaysia*	1996, Mar 2
5.	Suhaila Mohamad (Professor Dr.)	*Food and its Healing Power*	1997, Apr 12

6.	Yaakob Che Man (Professor Dr.)	*Oils and Fats Analysis—Recent Advances and Future Prospects*	2004, Mar 27
7.	Yu Swee Yean (Professor Dr.)	*Fish Processing and Preservation. Recent Advances and Future Directions*	1995, Dec 9

7. Faculty of Forestry (01)

No.	Name	Title	Date
1.	Nik Muhammad Nik Abd. Majid (Professor Dr. Dato')	*The Diminishing Tropical Rain Forest: Causes, Symptoms and Cure*	1995, Aug 19

8. Faculty of Human Ecology (01)

No.	Name	Title	Date
1.	Nazaruddin Mohd. Jali (Professor Dr.)	*Will Rural Sociology Remain Relevant In The 21st Century*	1996,Sept 21

9. Faculty of Marine and Environmental Sciences (UPMT) (01)

No.	Name	Title	Date
1.	Law Ah Theem (Professor Dr.)	*Oil Pollution in the Malaysian Seas*	1994, Sept 24

10. Faculty of Medicine and Health Science (03)

No.	Name	Title	Date
1.	Abdul Salam Abdullah (Professor Dr.)	*Natural Toxicants Affecting Animal Health and Production*	1994, Jun 29
2.	Azhar Md. Zain (Professor Dr.)	*Psychotherapy for Rural Malays—Does it Work?*	2003 Sept 13
3.	Wan Omar Abdullah (Professor Dr.)	*Immunodiagnosis and Vaccination for Brugian Filariasis: Direct Rewards from Research Investments*	2002, Jun 6

11. Faculty of Modern Language and Communication (02)

No.	Name	Title	Date
1.	Abdul Hamid Mahmood (Professor Dr.)	*Bahasa Melayu as a Knowledge language – Challenges and Hope.*	1995, Jun l0
2.	Amat Juhari Moain (Professor Dr.)	*The History of Bahasa Melayu*	1994, Aug 6

12. Faculty of Science & Environmental Studies (21)

No.	Name	Title	Date
1.	Abdul Halim Bin Shaari (Professor Dr.)	*High Temperature Superconductivity: Puzzles and Promises*	2004, Mar 13
2.	Abu Bakar Salleh (Professor Dr.)	*Enzyme technology: The Basis for Biotechnological Development*	1996, Jun 8
3.	Annuar Md. Nassir (Professor Dr.)	*Is the KLSE Efficient? Efficient Market Hypothesis Vs Behavioural Finance*	2002, Nov 23
4.	Fatimah Md. Yusoff (Professor Dr.)	*An Ecological Approach: A Viable Option for Aquaculture Industry in Malaysia*	2003 August 9
5.	Ho Yin Wan (Professor Dr.)	*Fungi. Friends or Foes*	1996, Jul 27
6.	Kaida Khalid (Professor Dr.)	*Microwave Aquametry: A Growing Technology*	2004, Apr 24
7.	Kamel Ariffin Mohd. Atan (Professor Dr.)	*The Fascinating Numbers*	1996, Jun 29
8.	Lee Chnoong Kheng (Professor Dr.)	*Green Environment, Clean Power*	2000, Jun 24
9.	Mawardi Rahmani (Professor Dr.)	*Chemical Diversity of Malaysian Flora: Potential Source of Rich Therapeutic Chemicals*	2003 July 26
10.	Maziah Mahmood (Professor Dr.)	*Plant Biotechnology - Strategies for Commercialisation*	1996, Dec 21
11.	Md. Nordin Hj. Lajis (Professor Dr.)	*Fine Chemicals from Biological Resources: The Wealth from Nature*	1995, Jan 21
12.	Mohamed Suleiman (Professor Dr.)	*Numerical Solution of Ordinary Differential Equations. A Historical Perspective*	1993, Dec 11
13.	Mohd. Ibrahim Haji Mohamed (Professor Dr. Capt.)	*Managing Challenges in Fisheries Development through Science and Technology*	1994, Jul 23
14.	Mohd. Yusuf Sulaiman (Professor Dr.)	*Back to The Future with The Sun*	1996, May 18
15.	Muhamad Awang (Professor Dr.)	*Do We have Enough Clean Air to Breathe?*	2000, Apr 7
16.	Noraini Abd. Samad (Professor Dr.)	*Molecular Plant Virology: The Way Forward*	2000, Feb 2
17.	Ruth Kiew (Professor Dr.)	*Plant Taxonomy, Biodiversity and Conservation*	1994, May 11
18.	Sulaiman M. Yassin (Professor Dr.)	*The Challenge to Communication Research in Extension*	1989, Jul 22
19.	Syed Tajuddin Syed Hassan (Professor Dr.)	*Agro-ento Bioinformation: Towards the Edge of Reality*	2002, Jun 22
20.	Tan Soon Guan (Professor Dr.)	*Genetic Diversity of Some Southeast Asian Animals: of Buffaloes and Goats and Fishes Too*	1996, Aug 10

21.	Wan Md. Zin Wan Yunus (Professor Dr.)	*Chemical Modification Of Polymers: Current and Future Routes for Synthesizing New Polymeric Compounds*	2002, Nov 9

13. Faculty of Veterinary Medicine (08)

No.	Name	Title	Date
1.	Aini Ideris (Professor Dr.)	*Avian Respiratory and Immunosuppressive Diseases - A Fatal Attraction*	1999, Jul 10
2.	Dahlan Ismail (Professor Dr.)	*Sustainability of Tropical Animal- Agricultural Production Systems: Integration of Dynamic Complex Systems*	2002, Jun 27
3.	Mohamed Ali Rajion (Professor Dr.)	*The Essential Fatty Acids—Revisited*	2003 Aug 23
4.	Mohamed Mahyuddin Mohd. Dahan (Professor Dr.)	*The Changing Demand for Livestock Products*	1994, Apr 20
5.	Mohamed Shariff Mohamed Din (Professor Dr.)	*Fish Health: An Odyssey through the Asia – Pacific Region*	1995, Mar 25
6.	Mohd Zamri Saad (Professor Dr.)	*Respiratory Tract Infection: Establishment and Control*	2003 Sept. 27
7.	Sheikh Omar Abdul Rahman (Professor Dr.)	*Health, Disease and Death in Creatures Great and Small*	1995, Feb 25
8.	Tengku Azmi Tengku Ibrahim (Professor Dr.)	*Chromosome Distribution and Production Performance of Water Buffaloes*	1995, May 6

14. Graduate School of Management (01)

No.	Name	Title	Date
1.	Han Chun Kwong (Professor Dr.)	*Blueprint for Transformation or Business as Usual? A Structurational Perspective of the Knowledge-based Economy in Malaysia*	2003, May 31

15. Institute of Bioscience (01)

No.	Name	Title	Date
1.	Abdul Rani Bahaman (Professor Dr.)	*Leptospirosis - A Mode/ for Epidemiology, Diagnosis and Control of Infectious Diseases*	1996 Nov 16

Memoranda of Understanding (MOUs) & Memorandum of Agreement (MOAs), 1984-2004

Propelled by the University's increasing internationalisation, UPM stepped up its ties with members of international academe. UPM signed several Memorandum of Understanding (MOUs) with international universities and agencies that will intensify its academic and research collaboration with its peers abroad. At the same time, the university also signed Memorandum of Agreement (MOAs) with a number of agencies. An impressive list of about 292 MOUs and MOAs signed between UPM and international / national agencies for the period 1984-2004 is presented in Tables 16a and 16b. Figure in parenthesis indicate total number of MOUs signed.

Table 16a.

MOU with international universities and agencies, 1984-2004[i]—*(133)*[1]

Year	International Institution / Agency	Date
2004	Tokyo University of Agriculture, Tokyo, Japan	March 16, 2004
2003	King Saud University, Saudi Arabia	December 9, 2003
2003	Cornell University, Ithaca, New York, USA	September 22, 2003
2003	Thamar University, Yemen	August 27, 2003
2003	South Dakota University, USA	July 10, 2003
2003	University of Massachusetts, Amherst, USA	June 13, 2003
2003	University of Joensuu, Finland	January 31, 2003
2002	Universitas Sriwijaya Inderalaya, Indonesia	May 24, 2002
2002	Kyushu Institute of Technology, Japan	February 4, 2002
2001	Oklahoma State University, USA	October 1, 2001
2001	Regional Program Director, PEMSEA	July 18, 2001
2001	Jamia Millia Islamia, India	March 29, 2001
2001	SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Philippines	February 8, 2001
2000	Royal Agricultural College, UK	October 12, 2000
2000	University of Yanggon, Myanmar	September 7, 2000
2000	Urawa Junior College Japan	August 18, 2000
2000	National Pingtung University of Science & Technology, Taiwan	July 24, 2000
2000	University of Bergen, Norway	June 16, 2000
2000	Wood Research Institute Kyoto University, Japan	March 15, 2000
1999	Kokugakuin University, Japan	December 1, 1999
1999	Netlink Ranve International, India & GKV	November 11, 1999
1999	University of Mauritius, Mauritius	August 4, 1999
1999	Nanyang Technology University, Singapore	July 20, 1999

[1] Data presented as of April 2004.

Year	International Institution / Agency	Date
1999	Mauritius Research Council, Mauritius	May 14, 1999
1999	IEC Softwares LTD, India & GKV – IT SDN.BHD.	May 5, 1999
1999	Kyushu University, Japan	April 19, 1999
1999	Mauritius Sugar Industry Research Institute, Mauritius	April 9, 1999
1998	Universitas Jayabaya, Indonesia	November 25, 1998
1998	Alif Society, Mauritius	November 19, 1998
1998	CAMTECH (SA), Australia	August 26, 1998
1998	Ministry of Agriculture / Universities In The Hashemite Kingdom of Jordan, Jordan	July 23, 1998
1998	University of Science & Technology Sana'a, Republic of Yemen	July 14, 1998
1998	Commonwealth Scientific & Industrial, Australia	June 22, 1998
1998	Latona Biotechnology Ventures, USA	May 22, 1998
1998	The University of The Witwaterrand, Johannesburg South Africa	May 7, 1998
1998	The University of Texas at San Antonio, USA	May 4, 1998
1998	Can Tho Uninersity, Vietnam	January 2, 1998
1997	San Diego State University, USA	October 27, 1997
1997	Universidad Nacional Agraria La Molina, Peru	October 15, 1997
1997	University of Adelaide, Australia	October 14, 1997
1997	Pusat Penelitian Kopi dan Kakao Jember, Indonesia	September 29, 1997
1997	Prince Songkla University, Thailand	September 17, 1997
1997	Tashkent State Agrarian University, Uzbekistan	September 15, 1997
1997	University of Roorkee, India	August 5, 1997
1997	Future School Educational Product	June 6, 1997
1997	Queen's International Corporation, USA	June 6, 1997
1997	Universitas Muhammadiyah Yogyakarta, Indonesia	June 3, 1997
1997	University of Nottingham, UK	March 15, 1997
1997	Vista University, South Africa	February 3, 1997
1997	Universitas Tanjungpura Kalimantan, Indonesia	January 9, 1997
1996	Macquarie University, Australia	December 23, 1996
1996	The University of Waikato, New Zealand	November 28, 1996
1996	University of Natal, South Africa	November 6, 1996
1996	University of Newcastle upon Tyne, England	November 4, 1996
1996	The University of Sydney, Australia	November 1, 1996
1996	Tashkent State Technical University, Uzbekistan	October 31, 1996
1996	University of Pretoria, South Africa	October 25, 1996
1996	University of Cape Town, South Africa	October 22, 1996
1996	University of Stellenbosch, South Africa	October 22, 1996
1996	University of The Western Cape, South Africa	October 21, 1996
1996	University Consortium, USA	October 16, 1996
1996	Murdoch University, Australia	October 8, 1996
1996	The University of Western Australia	October 7, 1996
1996	Curtin University of Technology, Australia	October 7, 1996
1996	Faculty of Science, The Australia National University, Australia	September 26, 1996

Year	International Institution / Agency	Date
1996	The University of New England, UK	September 23, 1996
1996	University of Gezira, Sudan	September 11, 1996
1996	Universitas Padjadjaran Bandung, Indonesia	September 2, 1996
1996	The Faculty of Medicine University of British Columbia, Canada	August 28, 1996
1996	Lincoln University, New Zealand	August 27, 1996
1996	The University of Applied Engineering Aaachen, Germany	August 8, 1996
1996	Chulalongkorn University, Thailand	June 21, 1996
1996	University of New England, Australia	June 6, 1996
1996	Institut Teknologi Bandung, Indonesia	April 30, 1996
1996	Universitas Padjadjaran, Indonesia	April 30, 1996
1996	Universitas Gadjah Madah, Yogyakarta, Indonesia	April 19, 1996
1996	University of Victoria, Australia	March 8, 1996
1996	Kyobashi 1- Chome, Japan	March 1, 1996
1996	University of Southhampton, UK	January 23, 1996
1996	The Ministry of Construction Jihad, Iran	January 5, 1996
1995	University of Gezira, Sudan	November 25, 1995
1995	International Potato Cente (CIP), Lima, Peru	November 17, 1995
1995	The University of Queensland, Australia	November 16, 1995
1995	The University of Georgia, USA	October 30, 1995
1995	Dublin City University (DCU), Ireland	August 4, 1995
1995	Universitas Andalas, Indonesia	July 25, 1995
1995	Charles Sturt University, NSW, Australia	June 26, 1995
1995	Worldview International Foundation, Bangladesh	June 19, 1995
1995	The University of Birmingham (UOB), UK	March 30, 1995
1995	University of Khartoum, Sudan	February 13, 1995
1994	Kagoshima University, Japan	October 28, 1994
1994	Japan International Cooperation Agency (JICA), Japan	October 17, 1994
1994	University of Western Sydney, TQM Sdn. Bhd., Australia	August 9, 1994
1994	Universitas Riau, Indonesia	June 7, 1994
1994	University of Newcastle, Australia	June 3, 1994
1994	Kyushu University, Japan	April 8, 1994
1993	University of Guelph, Canada	December 23, 1993
1993	The University of Gent, Belgium	December 3, 1993
1993	International Food Information Service, UK	November 3, 1993
1993	Japan International Cooperation Agency, Japan	August 17, 1993
1993	Ohio University, Athens	January 26, 1993
1992	The Japanese Technical Cooperation, Japan	September 11, 1992
1992	The International Food Institute of Queensland / Department of Primary Industries, Australia	June 12, 1992
1991	Winrock International, Bangkok, Thailand	August 29, 1991
1991	Winrock International Institute for Agricultural Development, USA	July 22,1991
1991	National Institute for Environmental Studies, Japan	June 10, 1991
1991	University College of North Wales, Bangor, UK	April 1, 1991

Year	International Institution / Agency	Date
1990	Yokohama National University, Japan	December 27, 1990
1990	Institute of Environmental Science and Technology (Yokohama National University), Japan	December 27, 1990
1990	The University of Brunei Darulssalam, Brunei	December 10, 1990
1990	The University of Hohenheim, Germany	May 29, 1990
1990	Japan International Cooperation, Japan	April 19, 1990
1989	Institut Pertanian Bogor (Indonesia), Kasetsart University (Thailand), Universitas Gajah Madah (Indonesia), University of The Philippines at Los Banos (Philippines)	September 19, 1989
1989	Kagoshima University, Japan	May 2, 1989
1989	Kasetsart University, Thailand & University of The Philippines at Los Banos, Philippines	April 28, 1989
1989	SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Philippines	April 17, 1989
1989	The Canberra College of Advanced Education, Australia	April 7, 1989
1989	Michigan State University, USA	February 24, 1989
1989	The University of Hull, UK	January 10, 1989
1988	University of Reading, UK	October 1, 1988
1988	University of Newcastle Upon Tyne, United Kingdom	April 24, 1988
1988	Canadian High Commission in Malaysia	February 25, 1988
1988	Stephen F. Austin State University, USA	January 29, 1988
1988	University of Southampton, UK	January 22, 1988
1987	Kagoshima University, Japan	June 6, 1987
1987	Winrock International Institute for Agricultural Development, USA	May 6, 1987
1987	University of Aberdeen, Scotland, UK.	March 19, 1987
1986	International Rice Research Institute, Philippines	August 18, 1986
1986	Louisiana State University & Louisiana State University Agricultural Centre, USA	August 8, 1986
1985	Australian Centre for International Agricultural Research, Australia	October 28, 1985
1985	University of Southampton, UK	October 10, 1985
1985	University College of North Wales, UK	September 4, 1985
1984	Implementation Survey Team Japan International Cooperation, Japan	August 29, 1984

Table 16b.

Memorandum of Understanding / Agreement (MOUs/MOAs) with national agencies, 1983-2004—***(159)***[2]

Year	National Institution / Agency	Date
2004	Institut Penyelidikan Teknologi Nuklear Malaysia (MINT)	March 1, 2004
2004	Institut Pengajian Tinggi Swasta (IPTS) / Francias UPM **(MoA)**	February 11, 2004
2004	Radio Television Malaysia (RTM)	January 26, 2004

[2] Figure in parenthesis indicate total number of MOUs/ MOAs signed.

Year	National Institution / Agency	Date
2003	The National Cancer Society of Malaysia	September 22, 2003
2003	Persatuan Penterjemahan Malaysia	September 22, 2003
2003	Pusat Zakat Malaysia	June 9, 2003
2003	Forest Research Institute Malaysia (FRIM)	May 20, 2003
2003	Majlis Paralimpik Malaysia	April 23, 2003
2003	Dewan Bandaraya Kuala Lumpur and FRIM	April 14, 2003
2003	AIROD Sdn. Bhd.	February 7, 2003
2002	Construction Industry Development Board (CIDB)	September 9, 2002
2002	Lembaga Pemasaran Pertanian Persekutuan	May 7, 2002
2002	Majlis Paralimpik Malaysia	April 23, 2002
2002	Lembaga Getah Malaysia	February 18, 2002
2001	Majlis Sukan Negara	November 5, 2001
2001	Diversatech (M) Sdn. Bhd.	October 25, 2001
2001	Pakar Management Technology (M) Sdn. Bhd.	October 25, 2001
2001	Pusat Remote Sensing Negara	October 25, 2001
2001	Monash University Malaysia Bandar Sunway, Selangor	September 19, 2001
2001	IEC College of Engineering and Technology and Meteor Sdn. Bhd.	April 11, 2001
2001	Metro Kajang Holdings Berhad	April 11, 2001
2001	Yayasan Alumni Universiti Putra Malaysia (YAUPM)	February 15, 2001
2000	GeniurSoft Sdn. Bhd	October 12, 2000
2000	Lembaga Pemasaran Pertanian Persekutuan (FAMA)	October 5, 2000
2000	Research Institute of Investment Analysts Malaysia	June 23, 2000
1999	ELS International Language Centers and Unisoft Sdn. Bhd.	September 6, 1999
1999	Nanyang Technology University, Singapore	July 20, 1999
1999	KFC Holdings (Malaysia) Bhd.	June 30, 1999
1999	Mahirnet Sdn. Bhd.	June 4, 1999
1999	Bernas Dominals Sdn. Bhd.	May 6, 1999
1999	IEC Softwares Ltd. and Glogal Knowledge Vision-IT Sdn. Bhd.	May 5, 1999
1999	Indah Water Konsortium Sdn. Bhd.	April 29, 1999
1999	Optical Media Sdn. Bhd.	February 5, 1999
1998	Info-house I.T Sdn. Bhd.	November 25, 1998
1998	Lembaga Kemajuan Perhutanan Negeri Sabah (SAFODA)	November 13, 1998
1998	Inter Sea Fishery (M) Sdn. Bhd.	October 27, 1998
1998	Lakescape Integration	October 27, 1998
1998	Institut Penyelidikan Teknologi Nuklear Malaysia (MINT)	October 20, 1998
1998	Sabutek (M) Sdn. Bhd., Kuala Lumpur	October 20, 1998
1998	Konsortium KPMM Sdn. Bhd.	October 8, 1998
1998	Gabungan Pengusaha Makanan Bumiputera Malaysia	October 8, 1998
1998	Global Definition Sdn. Bhd.	September 25, 1998
1998	PNB Information Technologies Sdn. Bhd.	August 12, 1998
1998	AccTrak21 Sdn. Bhd.	August 4, 1998
1998	Sun Microsystems (M) Sdn. Bhd	August 4, 1998
1998	Lotus Sales and Services Sdn. Bhd.	August 4, 1998

Year	National Institution / Agency	Date
1998	Metraplas Industries Sdn. Bhd.	July 13, 1998
1998	National Foundation for Management Education	June 25, 1998
1998	Tenaga Nasional Research & Development Sdn. Bhd.	June 9, 1998
1998	Jabatan Perhutanan Sabah	May 16, 1998
1998	Aero Precision Resources Sdn. Bhd.	April 29, 1998
1998	BSN Commercial Bank (Malaysia) Bhd.	April 22, 1998
1998	Garden International School Sdn. Bhd. and CF BT Education Services Sdn. Bhd.	April 17, 1998
1998	SUKOM Ninety Eight Berhad	April 1, 1998
1998	COSMOSPECT Information Technology Institute	March 4, 1998
1998	Yayasan Saad	February 17, 1998
1998	Jabatan Bomba & Penyelamat Malaysia	January 26, 1998
1998	Institut Sains dan Teknologi Darul Takzim	January 15, 1998
1998	Institut Pengajian Ilmu – Ilmu Islam	January 5, 1998
1997	Kolej UNITEK Malaysia	December 26, 1997
1997	Japanese Implementation Study Team and The Authorities Concern of the Government Malaysia	December 1, 1997
1997	Kerajaan Negeri Selangor Darul Ehsan	November 26, 1997
1997	Tropbio Research Sdn. Bhd.	November 17, 1997
1997	Kumpulan Syarikat MTD	September 16, 1997
1997	MOFAZ (M) Sdn. Bhd.	September 10, 1997
1997	Maxisegar Education Sdn. Bhd.	June 18, 1997
1997	UNITI Sdn. Bhd.	June 9, 1997
1997	Mindtel LLC, Barn Technology Sdn. Bhd. and Canary Infoport Sdn. Bhd.	May 30, 1997
1997	The Incorporated Society of Planters	May 21, 1997
1997	Institut Pembangunan Sumber Manusia	May 14, 1997
1997	Pusat Matrikulasi Chermai Jaya	May 7, 1997
1997	Prime College, Kuala Lumpur	May 2, 1997
1997	Kolej Yayasan Melaka	April 22, 1997
1997	Konsortium Pakatan Didik	February 21, 1997
1997	Pusat Teknologi dan Pengurusan Lanjutan Ampang, Selangor	January 4, 1997
1997	Institut Penyelidikan Perubatan	1997
1996	The Board of The Standards and Industrial Research Institute of Malaysia (SIRIM)	August 28, 1996
1996	Cybernetics Training Centre Sdn. Bhd.	August 5, 1996
1996	Kumpulan 3P Pelegong	August 4, 1996
1996	Malaysian Resources Corporation Berhad	July 16, 1996
1996	Hume Cemboard Sdn. Bhd.	June 6, 1996
1996	Kolej Pendidikan Perdana	May 24, 1996
1996	Tidalmont Recources Sdn. Bhd.	May 15, 1996
1996	Majlis Agama Islam Wilayah Persekutuan	May 7, 1996
1996	Toeic Centre Malaysia Business Exclusive Sdn. Bhd.	April 17, 1996
1996	IKIP Education Sdn. Bhd.	March 8, 1996

Year	National Institution / Agency	Date
1996	Pusat Matrikulasi Chermai Jaya	February 13, 1996
1996	Sal Group of Colleges Malaysia	February 9, 1996
1996	Sun Microsystems Pte. Ltd. and Accurate Information System Consultant Sdn. Bhd.	January 30, 1996
1996	Lang Education Sdn. Bhd.	January 24, 1996
1996	Majlis Sukan Negara Malaysia	January 22, 1996
1996	Kerajaan Negeri Johor Darul Ta'zim dan Yayasan Pelajaran Johor	January 18, 1996
1996	Innovative Fometa Fresh Feed Sdn. Bhd.	January 6, 1996
1996	K.L.International Airport Berhad (KLIAB)	January 4, 1996
1996	Southern Bank Berhad	1996
1995	International Potato Center (CIP)	November 17, 1995
1995	Center for Continuing Education Sdn. Bhd.	October 24, 1995
1995	Cellular Communications Networks (Malaysia) Sdn. Bhd. (CELCOM)	October 20, 1995
1995	Institute of Technology Petronas sdn. Bhd.	October 19, 1995
1995	Asia Pacific Smelt Sdn. Bhd.	October 7, 1995
1995	Hume Fibreboard Sdn. Bhd.	September 25, 1995
1995	TIME TELEKOM : Time Telecommunications Sdn. Bhd	September 15, 1995
1995	Yayasan Sabah	September 7, 1995
1995	Bahagian Penyelidikan dan Pembangunan Telekom Malaysia Berhad	September 6, 1995
1995	Telekom Malaysia Berhad	September 6, 1995
1995	Tenaga Nasional Berhad	August 29, 1995
1995	Frank Small Management Centre Sdn. Bhd.	August 29, 1995
1995	Malaysian Technology Development Corporation	August 26, 1995
1995	Sesama Medical College Management Sdn. Bhd.	August 3, 1995
1995	Yayasan Pelajaran MARA	July 28, 1995
1995	Tenaga Nasional Berhad	June 26, 1995
1995	Universiti Kebangsaan Malaysia	June 5, 1995
1995	Emile Woolf College Of Malaysia	May 19, 1995
1995	Yayasan Pelajaran MARA	May 18, 1995
1995	Institut Teknologi MARA	May 18, 1995
1994	IBM World Trade Corporation	October 31, 1994
1994	Pollution Engineering Sdn. Bhd.	October 10, 1994
1994	Malaysian Timber Industry Development Council	August 4, 1994
1994	Motorola Semiconductor Sdn. Bhd.	June 24, 1994
1994	Taliworks Consortium Sdn. Bhd.	June 8, 1994
1994	Bahagian Perancangan dan Penyelidikan Pendidikan Kementerian Pendidikan Malaysia	April 25, 1994
1994	Majlis Perbandaran Petaling Jaya	April 18, 1994
1993	Jabatan Penjara Malaysia	November 5, 1993
1993	PETRONAS (Petronas Research & Scientific Services Sdn. Bhd.)	September 14, 1993
1993	Bahagian Hal Ehwal Wanita Kementerian Perpaduan Negara Dan Pembangunan Masyarakat	September 7, 1993

Year	National Institution / Agency	Date
1993	Remee Holdings Sdn. Bhd.	August 24, 1993
1993	Majlis Penyelidikan Dan Kemajuan Sains Negara (MPKSN)	July 19, 1993
1993	Kuala Lumpur City Centre Berhad (KLCCB)	April 15, 1993
1993	Remee Holdings Sdn. Bhd.	April 2, 1993
1993	Applied Physics & Process Technologies Sdn. Bhd.	April 1, 1993
1993	Institut Penyelidikan Minyak Kelapa Sawit Malaysia (PORIM)	March 9, 1993
1993	Institut Penyelidikan Getah Malaysia (RRIM)	March 9, 1993
1993	Institut Penyelidikan Dan Kemajuan Pertanian Malaysia (MARDI)	March 9, 1993
1993	Yayasan Gerakbakti Kebangsaan	February 22, 1993
1993	Institut Penyelidikan Pehutanan Malaysia (FRIM)	February 9, 1993
1992	The State Government of Pahang	October, 15 1992
1992	Petroliam Nasinal Berhad (PETRONAS)	October 1, 1992
1992	Lembaga Penduduk Dan Pembangunan Keluarga Negara	June 20, 1992
1992	Institut Penyelidikan Getah Malaysia	May 15, 1992
1992	The International Development Research Centre	April 14, 1992
1991	Ibu Pejabat Perhutanan Semenanjung Malaysia	December, 17 1991
1991	Environmental Studies, Japan (NIES)	June 10, 1991
1991	Forest Research Institute Malaysia (FRIM) and National Institute for University College of North Wales, Bangor, UK	June 7, 1991
1991	Ministry of Industrial Development Sarawak	January 12, 1991
1990	Institut Sistem Mikroelektronik Malaysia	December 27, 1990
1990	ICI Fertilizers (Malaysia) Sdn. Bhd	September 17, 1990
1990	The Rijksuniversiteit Gent (State University of Gent)	June 20, 1990
1990	Agrofresh (Malaysia) Sdn. Bhd.	June 1, 1990
1990	International Development Research Centre	February 1990
1990	Kementerian Perumahan Dan Kerajaan Tempatan	January 2, 1990
1989	Kementerian Pertanian	April 20, 1989
1988	Institut Kajian Strategik Dan Antarabangsa	September 29, 1988
1988	Majlis Amanah Rakyat	March 17, 1988
1988	The International Development Research Centre	January 27, 1988
1987	Perusahaan Otomobil Nasional Sdn. Bhd.	July 11, 1987
1985	Amanah Saham Pahang Berhad	November 7, 1985
1984	Lembaga Kemajuan Pertanian Kemubu	September 20, 1984
1984	Unit Tenaga Nuklear (UTN), Jabatan Perdana Menteri	September 14,1984
1983	Institut Penyelidikan dan Kemajuan Pertanian Malaysia	September 1, 1983

[i] *Sorted by date in descending order.*

Indices

Subject Index 629

Author Index 635

Year	National Institute/Agency	Date
1993	Remee Holdings Sdn. Bhd.	August 24, 1993
1993	Majlis Penyelidikan Dan Kemajuan Sains Negara (MPKSN)	July 19, 1993
1993	Kuala Lumpur City Centre Berhad (KLCCB)	April 15, 1993
1993	Remee Holdings Sdn. Bhd.	April 2, 1993
1993	Applied Physics & Process Technologies Sdn. Bhd.	April 1, 1993
1993	Institut Penyelidikan Minyak Kelapa Sawit Malaysia (PORIM)	March 9, 1993
1993	Institut Penyelidikan Getah Malaysia (RRIM)	March 9, 1993
1993	Institut Penyelidikan Dan Kemajuan Pertanian Malaysia (MARDI)	March 9, 1993
1993	Yayasan Gerakhakti Kebangsaan	February 22, 1993
1993	Institut Penyelidikan Pehutanan Malaysia (FRIM)	February 9, 1993
1992	The State Government of Pahang	October, 15 1992
1992	Petroliam Nasional Berhad (PETRONAS)	October 1, 1992
1992	Lembaga Penduduk Dan Pembangunan Keluarga Negara	June 20, 1992
1992	Institut Penyelidikan Getah Malaysia	May 15, 1992
1992	The International Development Research Centre	April 14, 1992
1991	Ibu Pejabat Pertanian Semenanjung Malaysia	December, 17 1991
1991	Environmental Studies, Japan (NIES)	June 10, 1991
1991	Forest Research Institute Malaysia (FRIM) and National Institute for University College of North Wales, Bangor, UK	June 7, 1991
1991	Ministry of Industrial Development Sarawak	January 12, 1991
1990	Institut Sistem Mikroelektronik Malaysia	December 27, 1990
1990	ICI Fertilisers (Malaysia) Sdn. Bhd	September 17, 1990
1990	The Rijksuniversiteit Gent (State University of Gent)	June 20, 1990
1990	Agrofresh (Malaysia) Sdn. Bhd.	June 1, 1990
1990	International Development Research Centre	February 1990
1990	Kementerian Perumahan Dan Kerajaan Tempatan	January 2, 1990
1989	Kementerian Pertanian	April 20, 1989
1988	Institut Kajian Strategik Dan Antarabangsa	September 29, 1988
1988	Majlis Amanah Rakyat	March 17, 1988
1988	The International Development Research Centre	January 27, 1988
1987	Perusahaan Otomobil Nasional Sdn. Bhd.	July 11, 1987
1985	Amanah Saham Pahang Berhad	November 7, 1985
1984	Lembaga Kemajuan Pertanian Kemubu	September 20, 1984
1984	Unit Tenaga Nuklear (UTN), Jabatan Perdana Menteri	September 14,1984
1983	Institut Penyelidikan dan Kemajuan Pertanian Malaysia	September 1, 1983

[1] *Sorted by date in descending order.*

INDEX

Subject Index

A

Acacia mangium, 73
Academic
  achievement, 456
  performance, 236, 269
Accidents, 255
Acoustic, 51
Acrosomal membranes, 257
Activated carbon, 385
Adaptive steered beams
  ASB, 313
Adipose tissue, 93
Adolescents, 449
Adrinal, 92
Adulterants, 177
Aerodynamics, 421
Aeroponic System, 94
Aerospace structures, 405
Agglomeration, 71
Air pollution, 360
Alachlor, 38
Algorithm, 313
  synthesis, 333
Allergen immunotherapy, 189
Allergic diseases, 189
Alloy steel, 346
Aluminium toxicity, 152
Amelioration, 45
Amino Acid, 117
Ammoxidation, 389
Ananas comosus L. Merr
  pineapple, 64
Anemia, 234
Angiosperms, 50
Animated
  calculus, 329
  mathematics, 445
Anthocyanin, 71, 83
Anthracnose disease, 63
Anti- cancer, 376
Anti HIV, 376
Anti nutritional factors
  ANFs, 188
Antibiotic, 261
  resistance, 105
Antifungal therapy, 393
Antigen, 273
  purification, 144
Antiinfective, 91
Anti-inflammatory, 154, 205
  therapeutic agents, 272
Antineoplastic agent., 251
Antioxidant, 71, 90, 166, 201
Anti-streptococcal vaccines, 216
Anti-tumor compound, 159
Apoptosis, 250
Aquaculture, 123-124, 183
Aquatic plants, 50
Aroma precursors, 55
Articular cartilage, 240
Ascorbic acid, 83
Aspergillus flavus, 120, 185
Asthmatic, 189
Asynchronous Transfer Mode
  ATM, 331
Authenticity, 200
Automated guided vehicle
  AGV, 98
Automation system, 335
Azobenzene moieties, 423

B

Babblers, 65
Bacillus Sp Strain T1, 179
Bacillus subtilis, 183
Bacteria, 369
Bacterial, 229
  inoculants, 106
  wilt, 43
Bacteriocin, 133
Bacteriophage M13, 273
Banana, 60, 74-75, 89, 92, 106, 152
  cultivars, 89
  fibre, 400Barium plumbate, 431
Barn owl,
  Tyto alba, 42
Barotrophic, 332
Basal Stem Rot Disease
  control and prevention, 129
Beneficial
  bacteria, 40
  microorganism, 183
Benoxaprofen, 270
Betulinic acid, 376
Beverages, 71
BFGS method, 302
Bioactive
  compounds, 272
  constituents, 395
Biochemical indicators, 152
Biodegradable, 117, 128, 138, 163-164, 190
Biodiversity, 35
Bioenhancer, 106
Biofertiliser, 106
Bioindicator, 242
Biological control agent, 42
Biological oxygen demand
  BOD, 164
Biomarkers, 242
Biomass burning, 352, 360-361
Biopesticide, 84
Biopreservative, 168
Bioreactor, 162
Bioremediation product, 41
Biosensor, 39
Biotransformation, 185
Bird species, 65
Blood pressure, 173
Bluetooth, 323
Body mass ratio, 460
Boiler fuels, 341
Bone mineral density
  BMD, 277
Bone
  mineral, 277
  modelling, 267
Bovine mastitis, 58
Brain cancer, 249
Breast cancer, 215, 249
Broadbills, 65
Broiler, 188, 197
  chickens, 176
Buffalo, 260

C

Calcium, 235
Callus, 64
Calophyllum, 379-380
Cancer, 166, 254
  therapy, 266
Candida species, 219
Candidal virulence factors, 219
Candidiasis, 219
Capital flows, 465
Car pager, 384
Carbon material, 356
Carbon Nanofiber
  CNF, 297
Carbon Nanotube
  CNT, 297
Carbon sources, 120, 148, 185
Carboxypeptidases, 55
Cardiovascular diseases, 166
Cardiovasular disease
  CVD, 236
Catchment protection
  CP, 451
Cationic substitution, 403
Cattle, 260
cDNA
  chip, 348
  clones, 174
Cell- bound enzymes, 185
Cell culture system, 234
Cell lines, 249
Cell structures, 74, 76
Cellulase, 122
Cempedak
  Artocarpus integer Merr, 25
CEMSS, 217
Cervical inflammatory changes, 258
Cervical spine, 255
CGTase
  Cyclodextrin
    Glycosyltransferase, 195
Chaetomium globosum, 122
Channa striatus
  Haruan fish, 240
Charge-transfer, 426
Chelating, 430
Chemotherapeutic, 264
Chest injury, 255
Chickens, 261
Childbirth, 234
Children, 459
Chitosan, 63
Chlorella, 239
Cholera, 229, 252
Cholestatic jaundice, 270
Cholesterol, 83, 138

Chromatic, 320
Chronic disorder, 240
Chrysanthemum, 63, 88
Citrus tristeza virus
CTV, 144
Clinical diagnosis, 227
CO
emission, 386
pollution, 386
Coastal environment, 242
Coastwatch, 344
Coaxial probefor, 209
Cocoa, 53, 55, 207
Cocoa mirid, 79
Collision Deformation
Classification
CDC, 424
Collision, 387
Colour recognition, 325
Commercial crop, 83
Composting, 69
Confectionery products, 71
Confocal microscopy, 226
Conservation, 32
Contigent Valuation Method
CVM, 32
Control weeds, 80
Controlled release formulations
CRF, 38
Convolution, 288
Copolymerization, 430
Copper coated, 99
Coprecipitation, 368
Coptotermes curvignathus
isoptera
rhinotermitidae, 28
Coral reef mapping, 51
Cosmetic, 117, 128
Coumarin, 378
Courseware, 327
Cows, 58
Crash pattern, 408
Crashed vehicles, 424
Crashworthiness, 387
Creatine, 270
Crop
management, 81
product, 80
Cross-language, 307
Cryptography, 322
Cryptosystem, 305
Cuneifolin, 378
Cyclic loading condition, 404
Cymodoceaceae, 50
Cysteine, 391
Cytokines, 265
Cytolytic, 217
effects, 217
Cytotoxic, 396
effects, 249
Cytotoxicity, 250, 393
LUC
RSA

D

Damai district
Sarawak, 32
Data Envelopment Analysis
DEA, 165
Database management system, 46
DBMS
Decision making, 457
Degraded land, 70
Diagnostic methods, 219
Dietary calcium, 277
Dietary fat, 93
Differential equations, 299
Differential scanning calorimetry
DSC, 177, 201, 423, 430

Diploid, 89
Discotic liquid crystals, 423
Disease
control, 84
resistance, 207
Distance learning system, 291
Distributional equations, 288
Diuron, 38
Divisia monetary aggregates, 453
DN
values, 182
DNA, 29-30, 89, 227
fingerprinting, 192
microsatellite loci, 186
microsatellite markers, 203
sequences, 186
sequencing, 254
vaccine, 252
Document holder, 246
Dried fruit concentrates, 71
Drought, 152
Drug
development, 272
resistance, 264
Dry mixes, 71
Ductal breast carcinoma, 254

E

Ecological roles, 35
Economic
activity, 453
growth, 461
Ecosystem, 242, 311
Edible
oils, 201
plants, 90
Elastic properties, 380
e-learning, 329
Electrical resistivity, 412
Electrochemical, 371, 391
studies, 426
Electromagnetic Forces
EMF, 61
Electron microscopy, 82
EM
Elliptic curve, 322
Emergency upper gastrointestinal
endoscopy
EUGIE, 274
Emodin · 137
Endoscopy, 274
Entomopathogenic, 100
Environmental sensitivity index maps
ESI, 344
Enzymatic
interesterification, 138
synthesis, 115, 117
Enzyme, 245, 369
carriers, 245
Epidemiological, 244
investigation, 194
Epidemiology, 82
Erythromycin resistance plasmid, 178
Escherichia coli, 173, 178, 261
ESTs
expressed sequence tags, 146-147, 189, 348
Etiologic agents, 231
Eurycoma longifolia
Tongkat Ali, 159-161
Exfoliative vaginal cytology, 37
Export categories, 67

F

Fabrication, 431
Family functioning, 447
Fat deposition, 93
Fats, 138, 201
Feed efficiency, 188
Fermentation, 148, 173
Fertilizers, 99
Fiber Duplexer Module
FDM, 397
Fiber optic, 382, 397
Filter aids, 245
Financial behavior, 449
youth, 449
Financial socialization, 449
Fingerprinting, 229
methods, 194
Finite-difference, 358
Flash, 445
Flavokawin, 250
Flavonoid, 205
Flooded rice, 81
Floor sheathings, 72
Floral development, 146
Flow cytometry, 227
Flower development, 25
Fluid flow, 358
Flycatchers, 65
Foam, 190
Food
adulteration, 177
industry, 131, 138, 200
poisoning, 229
preservation, 168
processing, 67
Forest catchment conservation, 451
Forest fire, 360
Forested catchments, 451
Fracture mechanics, 405

Fragile X syndrome, 247
Freeze drying, 123
Freshwater prawn, 124
Fretting fatigue, 404
Front fork structure, 387
Fruit colour, 166
FTIR spectroscopy, 373, 430
Functional food, 239
Fungal formulations, 100
Furniture industry, 400
Fuzzy
  logic, 346
  models, 346

G

Gamma function, 284
Garbage disposal, 190
Gas detection, 429
Gas laser, 401
Gastrointestinal, 78, 217, 274
Gateway, 283
Gelatinized sago starch, 148
Gene
  expression, 126, 146-147, 151
  therapy, 265
  mapping, 204
Generalised function, 288
Generalized Autoregressive
  Conditional Heteroskedasticity
  GARCH, 461
Genetic algorithms, 295, 309
  GA
Genomics, 229
Genotoxic, 205
Genotypes, 64
Geomatic systems, 344
Geophysical
  logging, 416
  methods, 418
Gerakan Desa Wawasan, 443
GIS, 56, 344
  modeling, 86
Glucanase, 175, 188
  See Lactobacillus
Glucose fatty ester, 128
Glucosidase, 122
  See Cellulase
Goblet cells, 360
Green banana, 74
Green way, 138
Groundwater, 416
Group A *Streptococci*, 216
  GAS
Growth performance, 188
Guardrail design, 406-407
Guttiferae, 379

H

Haemoglobin, 234, 239
Haemorrhagic, 275
Hazardous spills, 344
Haze, 352
HBV
  Hepatitis B virus, 263
Head injury, 255
Health
  benefits, 71, 83, 90, 238
  problém, 263, 273
Healthcare, 274
Heat treatment, 380
Heating values, 341
Heavy metal, 61, 69
Helic study, 236
Helminthosis, 78
Hepatitis B, 263, 273
Hepatocellular carcinoma, 263
Hepatotoxic biomarkers, 270
Herbal medicine, 225
Herbal tea, 238
herbicide, 38
Heuristic approach, 309
High level expression, 179
High pathogen, 69
High voltage lines
  HVL, 61-62
Hinshelwood kinetics, 357
Hip implants, 267
Home networking, 324
Homology modelling, 369
Hormone, 173
Human
  health, 84, 360
  infection, 104
Humanistic perspective, 447
Humic acid, 44
Hybridisation, 357
Hybridoma clone, 215
Hydrocharitaceae, 50
Hydrocolloids, 48
Hydro-electric power
  HEP, 451
Hydrogen purification, 385
Hydrolytic enzymes, 133
Hydroseeding, 70
Hygrothermal-viscoelastic, 72

I

Ikan rebus, 131
Immobilization, 245
Immobilized lipase, 150
Immune system, 104, 265
Immunoglobulin G
  IgG, 360
Immunoregulatory approaches, 58
Impregnation, 72
In Vitro, 63-64, 130, 151-154, 156, 160, 192, 207-208, 239, 249, 394
In Vivo, 394
Industrial
  fermentation, 119
  goods, 395
Infections, 78
Information retrieval system, 307
Inhibitors, 272
Injury, 255
  characteristics, 408
Inorganic fertilizers, 103
Insectivorous, 65
Intelligence quotient
  IQ, 459
Interactive physics, 334
Intercropping, 92
Interface, 283
Internet technology, 301
Internodes, 97
Inter-plant, 309
Inter-satellite, 313
Intronic point mutations, 254
Ion conductivity, 389
Iron
  deficiency, 234
ISO 9000
  quality assurance system, 455
Isolates, 221
IT: Information technology, 463
  preparedness, 463
  skills, 463

J

Jackfruit, 25
Java servlets, 291
JavaScript, 291
JKKK
  Village security and development
  committee, 443
Job recruitment system, 315

K

Kenaf fibre
  Habiscus cannabinus, 143
Keropok lekor, 48
Kidney, 173, 187
Kinetics, 120
Kitchen garbage, 163
Kojic acid, 120-121, 185

L

Lactic acid, 123, 131, 163
  bacteria, 133
  probiotic, 123, 131
Lactobacillus, 131, 141, 188
  probiotic, 142
  probiotic strains, 175
Lambs, 78
Land use, 32
Landfill, 163
Landscaping, 70
Landslides, 418
Lard, 177
Larval growth, 36
Larvicide · 137
Latent semantic indexing method, 307
Latex, 429
Lattice oxygen, 433
Lecture timetabling, 295
Leg strength, 460
Legume, 68
Leukemia, 264
Leukemic cell line, 217
Levitation, 335
Light switch, 330
Lightning detector, 382

Lindelof spaces, 287
Lipoprotein metabolism, 193, 197
Listerial gastroenteritis, 104
Listeriosis, 104
Liver cancer rats, 226
Liver disease, 263
Livestock, 188
  manure, 56
Lodging, 96
Logging, 65

M

Macrobrachium rosenbergii, 29-30
  De Mann, 29, 124
Macroorchidism, 247
Magnetic, 335, 367
  materials, 392
  parameters, 392
Main air, 303
  wood, 303
Maize-groundnut rotation system, 80
Malay
  malay women, 277
Malaysian economy, 462
Malignancy, 264
Malignant glioma, 249
Manganite perovskite, 367
Manufacturing
  industry, 67
Mappings, 287
Marine, 242
  fish, 221
Mass
  cultivation, 239
  spectrometry, 398
Matematica: Mathematica, 329, 445
MathCAD, 329
Mathematics education, 329
MathLab, 329, 445
McCarthy Scales of Children's Abilities
  MSCA, 269, 459
McCarthy scales, 459
McCarthy scores, 269
Mechanics, 334
Medical plants, 225
Medicinal plants, 205, 395
Mellin sense, 308
Mental retardation, 247
Meristems, 348
Metabolic enzymes, 79
Metal chalcogenide, 371
Metarhizium anisopliae
  Deuteromycetes, 28
Methane emission, 81
Micro enterprise, 441
Microalgae, 239
Microbes, 195
Microbial, 229
Micropropagation, 161
Misconduct, 439
Mitigation strategies, 81
Modelling Kojic acid fermentation, 120
Modelling, 333, 344
Molasses, 68
Molecular
  epidemiology, 192
  markers, 89
Molecular typing
  Escherichia coli, 194
Monoclonal antibody, 215
Monocotyledonous plants, 50
Monospecific polyclonal antiserum,
  144
Motorcycle, 255, 387
  crashes, 408
  lane, 408
Mucus gland, 360
Multifilament tapes, 368
Multimedia, 334
Multi-plant, 309
Multi-supplement, 235
Mungbean, 186
Murraya koenigii
  curry leaf, 395
Muscle
  fatigue, 246
  strain, 246
Mycoinsecticides, 100
Mystus nemurus
  Ikan baung, 203

N

Nanotechnology, 297
Natural insecticides, 395
Neck and shoulder pain, 246
Neck injury, 255
Neem
  Azadirachta indica, 222
Nematode, 78
Netball players, 460
Neural network, 318, 325
Neutrix modeling, 288
Newcastle Disease Virus
  NDV, 217
Newton, 293
Nitrogen fertilization, 88
Nitrogen fertilizer application., 77
NMR spectroscopy, 423
Non-Isotopic RNase Cleavage Assay
  NIRCA, 254
Non-radioactive diagnostic, 247
Novel biopreservative, 131
Nuclear Magnetic Resonance
  NMR, 378
Numerical analysis, 316
Nutraceutical products, 71, 166
Nutrient utilisation, 176
Nutrition, 236

O

Oil palm empty fruit bunch
  OPEFB, 119, 122
Oil palm, 61, 102, 106-107
  fruits, 209
  roots, 348
  seedlings, 102, 106
  shells, 245
  trunk, 422
Oil, 138
  content, 182
  pollution, 242
  spill, 242, 311
Oncogenes, 249
Online learning, 316
Open Reading Frames
  ORF, 140
Orchid hybrids, 151
Organic
  acids, 163-164
  materials, 45
Oriented stand board
  OSB, 72
Orthopaedic implants, 267
Oryza Sativa L
  rice, 96
Osteoporosis, 278
Outer Acrosomal Membrane
  OAM, 257
Outer Membrane Protein
  OMP, 260
Ovine footrot, 82
Oxidation, 391
  catalyst, 389

P

P dynamics, 103
  phosphate
p53 Gene, 254
Paclobutrazol, 96-97
Paddy rat spermatozoa, 257
Paediatric wards, 244
Palm kernel olein
  PKL, 115
Palm oil mill effluent
  POME, 119, 162, 164
Palm oil, 117, 119, 128-129, 138, 162,
  164-165, 174, 177, 179, 201
  affluent, 239
  mill, 350
Palm, 341
Papaya, 63
Paper industry, 143
Papermaking, 143
Papilloma virus, 258
Particleboard, 72
Particulate matter, 360
Pasteurella multocida, 260
Pathogenesis, 82, 263
Pathogenic
  bacterium, 221
  fungi, 393
Pathogens, 229
PCR finger, 106
Pennisetum purpureum
  elephant grass, 68
Peptone, 122, 180, 192
Pest, 80
  management, 79
PGPR , 77
Pharmaceutical industries, 123, 128,
  159
Pharmaceuticals, 393, 395
Pharmacotherapy, 275

Photopyroelectric, 375
Photovoltaic, 373
Physiological stages, 88
Phytochemicals, 71, 153, 166
Phytonutrients, 71
Pig
production, 56
waste, 56
See pork
Pineapple, 92
leaves, 44
Plant based protein, 124
Plant growth promoting rhizobacteria
Plant pathogens, 84
Plantaricin, 168
Plantation species, 72
Planting materials, 64
Plasmid profiling, 105
Platensis, 234
Ploiarium alternifolium · 137
Plywood, 72
Policy implications, 439
Pollutants, 352
Pollution, 80, 352, 357
Polyanions, 398
Polygon trees, 320
Polyhedron, 293
Polymer, 373
Polyphenols, 91
Polyploid bananas, 89
Polyvinyledine flouride
PVDF, 375
Pork, 177
See pig
Posidoniaceae, 50
Postmenopausal women, 377
Poultry, 188, 217
Pregnancy, 234
Pre-school children, 446
Pressure swing adsorption
PSA, 385
Printing paper, 106
Printing, 143
Probiotic, 141
Proctitis, 275
Productivity growth, 67
Prognostic markers, 264
Programmable logic controller
PLC, 382
Proliferation, 25
Protease, 118, 180
Protein expression, 227
Pseudomonas aeruginosa
strain K, 118
Psychological growth, 447
Public health, 234
Pummelo
Citrus grandis L. *Osbek*, 166

Q

Quality development model
QDM, 455
Quantizing, 381
Quantum theory., 381

R

Precursor renin gene
REN, 173
Radio frequency
RF, 384
Rainforests, 65
Rancidity, 200
Randomised lard, 177
RAPD, 221, 229
See RAPD-PCR, 29
Rapid enzymatic methods, 39
Rat, 42, 222
Raw food, 104
Real-time systems, 344
Recombinant
allergens, 189
human protein, 173
mite allergens, 189
Recycling
crop residues, 80
Reduced impact logging
RIL, 451
Reef mapping, 51
Refined-bleached-deodorised
RBD, 177, 201
See Palm oil
Refined-bleached-deodorized palm oil,
177, 201
See Palm Oil
Regeneration system, 64
Remote control switch, 330
Renin, 173
angiotensin system, 173
Repair cost, 424
Reproductive system, 222
Resin, 72
Resistance, 96
Respiratory system, 361
Retardant, 96
Rheumatic fever, 216
Rhinitic, 189
Rhinoceros, 37
Rhizobacteria, 77
Rice
cultivars, 81
field, 41
production, 99
soils, 99
River catfish, 203
Road
accident, 370
crash, 387
Robotic, 98
automation, 98
Robotoy, 383
Role structure, 457
Rootzone temperature, 94
Roselle, 83
Hibiscus sabdariffa, 83
Rubberwood, 73
Runge-Kutta, 299
Ruppiaceae, 50

S

Safer motorcycling, 406
Sago palm
metroxylon sagu, 171
Sago starch, 190, 430
Salinity, 152
Santa Ines, 78
Sawntimber, 452
Scanning electron microscope
SEM, 352
School
children, 236, 269
students, 439
Sea
environment, 344
wave spectra, 344
Seafood, 192
products, 39
Seagrass, 50
fauna, 35
Self-efficacy, 456
Self-regulated learning, 456
Serine proteases, 369
Sewage sludge, 69
Sheep
farm, 46
resistant, 78
Ship detection, 344
Shipping lanes, 311
Short-message-service
SMS, 283
Shrimp, 221
production, 40
Silages, 68
Silica, 245
Silver barb
Bardodes gonionotus, 36
Single tube molecular system, 231
Singly Diagonally Implicit Runge-Kutta
SDIRK, 299
Slope failures, 418
Slope stabilization., 70
Sloping land, 92
Sludges, 162
SMS gateway, 283
Soil
acidity, 45
amendment, 69
erosion, 92
structure, 92
sustainability, 92
Soil-borne disease, 84
Soilless culture, 88
Solar energy, 371
Solvent
acetone-butanol-ethanol, 117-119,
123, 148-149
Somatic embryogenesis, 60, 161
Spatial analysis, 344
Spatial distribution, 311
Spectrometer, 375
Spectrophotometer, 160
Sperm motility, 222
Spermatozoa, 222
Spirulina, 234, 239

Sprague-Dawley rats, 270
See Rats
Spraque-Dawley, 360
See Rats
Spray drying, 71
Staphylococcus aureus, 231
Starch, 118-120, 148, 171, 190, 195
Stathmokinetic agent, 205
Statistical models, 200
Steam accumulator, 350
Steel-mill
waste product, 354
Sterile triploid, 89
Stock prices, 461
Stomatal density, 74
Streptococcal, 229
Stress
measurement system, 410
tolerant, 152
Strobilanthes cripus
SCE, 238
Strobilanthus crispus, 226
Strontium ferrite magnet, 403
Substrate, 117, 119-120, 150
Sumatran rhinoceros
Dicerorhinussumatrensis, 37
Superconducting, 335
Superionic glasses, 480
Surface enhanced laser desorption ionization
SELDI, 398
Surface plasmon, 429
Sweetpotato, 77
System data repository, 292

T

Taurine, 270
Teachers, 463
Telephone stand, 400
Testosterone level, 222
Theory
distributions, 288
Therapeutic
needs, 393
properties, 239
Thermostable
serine protease, 180
T1 Lipase, 179
Thin films, 371
metal film, 429
Tin, 385
oxide, 356
Tissue culture, 153, 159, 161
Tixic shock syndrome
TSS, 230
Tomato, 43, 84, 126
Topical bioassays, 79
Total Hip Arthroplasty
THA, 267
Tourism spots, 32
Tourists, 32
Toxic shock syndrome, 216
Traffic, 387
Transcriptional control, 126
Transgenic orchids, 151
Trapezius muscle, 246
Triacylglycerol
TAG, 197
Triphenylene, 423
Tropical
feeds, 175
fish, 86
fruit, 71
herbs, 90
soil, 103
Tropical fish forecasting
TroFFS, 86-87
Tulip, 94
Tumour, 250
Tumour-marker, 226
Turmeric
Curcuma longa, 240
Typhoid, 229, 244
Tyto alba, 42
See Barn Owl

U

Udder macrophage, 58
Ultrasonic, 422
Ultrasound, 241
Understorey, 65
Urban atmospheric, 352
Urea, 68, 99
fertilizer, 102
User satisfaction, 315

V

Vaccination, 260
Vaccine, 260, 265
Vase life, 63
Vegetable oil products, 200
Vehicle accidents, 406
Very low density lipoprotein
VLDL, 93, 197, 199
Vibrato, 303
Vibrio cholerae, 252
Vibrio parahaemolyticus, 221
Vibriosis, 221
Video data, 51
Video display terminal
VDT, 246
Video on demand System
VoD, 331
Village chicken, 197
Vinyl monomers, 430
Violin
teaching, 446
timbral, 303
Viral hepatitis, 229
Virtual school, 327
Visual software, 329
Vitamin A, 83
Vitamin E, 391
Voltage sag corrector
VSC, 402
Voltage sag mitigation system, 402
Voltammetry, 427

W

Waste
disposal, 245
distribution, 56
Water
content, 429
shrimp, 36
Weather prediction, 332
Webcasting, 301
lectures, 301
WebEd, 291
White blood cells, 264
White spot syndrome virus
WSSV, 41
See Shrimp
Wildlife
ecosystems, 32, 65
Wind
pollination, 25
tunnel, 421
Wireless file transfer, 323
Wood-based industry, 452
Word retrieval system, 318
Writing, 143

X

Xanthone, 137, 378

Y

Yeast
biodiversity, 202
strain, 202

Z

Zannichelliaceae, 50
Zeolite, 36
Zero discharge, 164
zNose™
electronic nose, 200
Zosteraceae, 50

Author Index

A

Abas Said, 32
Abd. Wahid Haron, 37
Abdul Aziz Saharee, 260
Abdul Ghani Liew Abdullah, 297
Abdul Ghani Yunus, 25
Abdul Halim Abdullah, 371, 373
Abdul Halim Shaari, 335, 367-368, 380, 392, 427, 431
Abdul Hamed Belal Danna, 297
Abdul Magid Salem Hamouda, 346, 388, 407
See Hamouda, AMS
Abdul Majid Mohd. Isa, 456
Abdul Manaf Ali, 205, 215-217, 258, 377, 393, 395
See Manaf Ali
Abdul Rahim Abdul Mutalib, 82
Abdul Rahim N, 451
Abdul Rahman Abdul Razak, 74
Abdul Rahman Bah, 102-103
Abdul Rahman Bin Ramli, 283, 325
Abdul Rahman Omar, 217
Abdul Rahman Razak, 25
Abdul Rashid Mohd. Shariff, 86
Abdul Razak Alimon, 36
Abdul Reezal Abdul Latif, 104
Abdul Salam Abdullah, 238-239
Abdul Wahab Jantan, 236
Abdullah Al-Hadi Hj. Muhamed, 439
Abdullah Chik, 367
Abu Bakar Salleh, 39, 115, 117-118, 150, 179-180, 369
Adem Kilicman, 284, 287-288, 308
Aduwati Sali, 313, 331
Afizah Merican, 32
Ahmad Husni Mohd Haniff, 44-45
Ahmad Makmom Abdullah, 352
Ahmad Rodzi Mahmud, 370
Ahmad Said Sajap, 28
Ahmed Bouketir, 381
Ahmed Kamel B Abdul Ghani, 86
Ahmed Rodzi, 86
Ahmed, OH, 44
Aini Ideris, 217
Aini Said, 441
Aishah Idris, 443
Aizam Zainal Abidin, 29, 124
Ali Mamat, 318
Ali, AM, 378
Alias Radam, 32, 67
Al-Jashamy, K, 82
Alvin Yong Onn Soon, 457
Amghalia, 231
Amini Amir Abdullah, 443
Amna, MN, 439
Amri Ab Rahman, 418
Anna, LPK
Anna Ling Pick Kiong, 153, 157
Anuar Kassim, 371, 373
Anwar Jabor Fawakhreh, 284-287
Arbaah Mohd Salleh, 272
Arbakariya Ariff, 119-120, 122-123, 148, 162, 164, 183
Ari Sulistyo Rini, 431
Ariffin, O, 269
Asgar Ali
Asghar Ali Warsi, 63
Asgari, L, 36
Asiah Abdul Malik, 88
Asmah Rahmat, 225-226
Asmah Yahaya, 238
Asnarulkhadi Abu Samah, 439, 443
Assilzadeh H, 344
Awang Noor AG, 451
Azhar, AA, 255
Azimahtol Hawariah Lope Pihie, 159
Azira Mohd., 369
Aziz Arshad, 35, 50
Azizah Hamid, 90
Azizah Hashim, 43
Azizah Ishaq, 431
Azlina Mohd Danial, 238
Azmi Abdul Rashid, 60, 64
Azmi Jaafar, 316
Azmi Lila, 82, 90, 221, 242
See Mohd. Azmi Mohd. Lila
Azmi Zakaria, 354, 375, 429
Azni Idris, 162
Azrina Kamaruddin, 315

B

Bachok M Taib, 316, 332
Bala, I, 153, 157
Banerjee, Sanjoy, 40
Basri, H, 452
Basyaruddin Abd. Rahman, 150
Beckwith-Hall, B, 270
Beh Kok Siang, 283
Benchamaporn Wongsuban, 190
Bimo Ario Tejo, 369
Borhanuddin Mohd Ali, 291, 313

C

Caldwell, J, 270
Chan Kit Lam, 159
Chan Pick Kuen, 126
Chan Siew Pheng, 277
Chan Soon Choy, 203
Chan Yoke Mun, 277
Che Fauziah Ishak, 81
Che Man, YB
Yaakob Bin Che Man, 138, 177, 201
Che Nyonya Abdul Razak, 39, 180
Che Roos Saad, 36, 124
Che Teh Fatimah Nachiar Iskandar, 260
Cheah Pike See, 249
Cheang, PS, 219
Chee Siew Swee, 277
Cheong Soon Kheng, 227
Chew, ES, 56
Chew, FT, 189
Chia Chok Seng, 265
Choi Mei Chooi, 348
Chong Pei Pei, 219
Choong Chieh Wean, 126
Choong Siew Shean, 37
Chow Sai Pew, 380
Christophe Wiart, 393
Chu Boon Seang, 138
Clemente Michael Wong Viu Ling, 140
Corcoran, C, 270

D

Daud Israf, 272
Devaraja, TN, 40
Dzolkhifli Omar, 79
Dzulkefly Kuang Abdullah, 38, 128, 352, 373
Dzulkifly Mat Hashim, 71, 138

E

Eddy Azian, 63
Ee, GCL
Gwendoline Ee Cheng Lian, 137, 378
Elezabeth Manickam, 238
Emily Christine D'Silva, 219
Emizul Ezani Binti Zulkifli, 293
Endang Purwati, 104
Essam Faleh Al-Daoud, 322

F

Fahrul Hakim bin Ayob@Huyop, 295
Faizah Mohd Yasin, 297
Fakhru'l-Razi Ahmadun, 297, 356
Faridah Abas, 272
Faridah Abdullah, 129, 205, 422
Faridah Jamal, 216
Fatimah Abu Bakar, 39
Fatimah Ahmad, 307, 318
Fatimah Khalid, 315
Fatimah Md.Yusoff, 40
Faujan H Ahmad, 376
Fauziah Ishak, 45
Fauziah Othman, 225-226
Fazirul Hisyam Hashim, 330
Fazrul Edlin Saleh, 69
Fennie Fong Kah Ling, 242
Flora Chin Lee Sa, 94
Foo Hooi Ling, 131, 133, 197
Fudziah Ismail, 299-300, 332

G

Galila Hassan Onsa, 171
Ganapathy, KK, 261
Ganesan S/O Vadamalai, 205
Goh Joo Kheng, 391, 426-427
Goh Kean Jeet, 323
Goldin, RD, 270
Gulam Rusul Rahmat Ali, 48, 71, 104, 131, 133, 168
Gwendoline Ee Cheng Lian, 137, 378
See Ee, GCL

H

Habsah Mohammed, 250
Hafidzi Mohd Noor, 42

Hafizal Abu Bakar, 421
Hairuszah Ithnin, 365
Halimah Hussin, 28
Halimah Mohamed Kamari, 380
Halimah Saimi, 64
Halimi Mohd. Saud, 69
Hamdan Noor, 360
Hamdan Suhaimi, 128
Hamouda, AMS, 346, 387, 406
See Abdul Magid Salem Hamouda
Hanapi, UK, 166
Harikrishna Kulaveerasingam, 189
Harikrishna, K, 174
Harikrishna Veerakulasingam, 126, 146, 348
Harjit Singh, 265
Harwant Singh, 255
Hasan Selamat, 315
Hasanah Mohd Ghazali, 138, 177, 245
Hashim, M, 166
Hasniza Hambali, 331
Hasnu Rizal, 380
Hassan Mohd. Daud, 221
Hazar B M.Ismail, 393
Hazel Matias, 40
Hazlina Ahamed Zakeri, 138
Hazlinda Binti Abdul Razak, 222
Hiryati binti Abdullah, 43
Hirzun Mohd Yusof, 123, 140, 173, 183
Hishamuddin Omar, 234, 239
Hishamuddin Zainuddin, 367, 381
Ho Chai Ling, 146, 173, 348
Ho Yin Wan, 141, 175-176, 188
Hoh Boon Peng, 203
Hon Sook Kit, 252
Husniyah A Rahim, 441
Hussein, MZ, 245

I

Ibitoye, AB, 406
Ibrahim, HM, 51, 344
Ideris, I, 178
Idrus, Z
Zulkifli Idrus, 197, 261
Iftetan Ahmad Taha, 431
Imad Hamadneh, 367-368
Inon Sulaiman, 144
Ionel Valeriu Grozescu, 335, 429
Iqbal, S, 401
Irine Runnie, 90
Ishak Bin Aris, 382-384
Ismail Abdullah, 316
Iyuke Sunny Esayegbemu, 297, 356, 385

J

Jabar, MF, 274
Jalaluddin Harun, 143, 452
Jalaludin, S
Syed Jalaludin Bin Syed Salim, 141
Jamal Talib, 92
Jamal, HH, 269, 459
Jamil Suradi, 368
Jamilah Bakar, 48, 55, 171
Janna Ong Abdullah, 151
Japar Sidik Bujang, 35, 50-51
Jariah Masud, 441, 443
Jasni Sabri, 82
Jefferelli Shamsul Bahrin, 246
Jefri, MS, 51
Jelan, ZA, 56
Jinap Selamat, 53, 55, 171
Johari Endan, 94
Joseph, MR, 29, 124
Josephine, Y, 269
Jothi Malar Panandam, 46, 78
Jothi Panandam
Julia Ibrahim, 173
Jumiah Hassan, 354, 392

K

Kaida Khalid, 422
Kalavathy Ramasamy, 141
Kamariah Abu Bakar, 463
Kamariah Long, 138
Kamaruddin Hashim, 190
Kamarul Azahar Mohd Rozali, 244
Kamaruzaman Sijam, 63, 144
Kamel Ariffin Mohd Atan, 445
Kamirul Amin Matori, 380
Karen Crouse, 249
Karim, MIA, 119-120, 122, 148, 162-164, 183
Mohamed Ismail Abdul Karim
Kartini Ahmad, 395
Kechen Ban, 265
Ker Yee Ping, 138
Khairuddin Itam, 205
Khairul Zaman, MD, 452
Khanif Jusop, 81
Khatijah Mohd Yusoff, 203, 215-217, 258
Khatijah MY
Khozirah Shaari, 272
Kok, WL, 273
Ku Day Chyi, 291
Kumar, SV, 186
Kwan, YY, 146
Kyaw Zay-Ya, 48

L

Lai Oi Ming, 138, 177, 245
Laily Paim, 236, 441, 443
Lama Hamadneh, 252
Lan Ganqui, 176
Lau Kien Liong, 412, 418
Law, TH, 406, 408, 470
Lawal Billa, 86
Lee Cheng Yee., 94
Lee Chnoong Kheng, 389
Lee Kam Loong, 43
Lee Poh Geok, 118
Lee Yang Ping, 348
Lee Yock Ann, 131
Lee, YP, 146
Leong Wah June, 302
Leong, CF, 227
Leow Thean Chor, 179
Leslie Charles Lai, 250
Lessard, P, 398
Liang Juan Boo, 56
Liaw Hock Sang, 375
Liew Ai Lin, 446
Lily Mastura Hj. Harun, 447
Lim Ei Bee, 391, 426-427
Lim Kean Pah, 367
Ling Yoke Ting, 375
Loganathan, P, 56
Loh Su Peng, 234, 239
Loh Teck Chwen, 56, 93, 197
Long, K, 245
Looi, MH, 433
Lutfor Rahman, MD, 423

M

Maan Fahmi Alkatib, 297
Madihah Zawawi, 217
Madihah, MS, 119, 148
Maha Abdullah, 227, 264
Mahendran Shitan, 311
Maheran Abdul Aziz, 60, 64, 144
Mahinda Abeywardena, 90
Mahiran Basri, 39, 115, 117-118, 150, 179-180, 369, 376
Mahmood K. Mawlood, 358
Mahmud Tengku Muda Mohamed, 61, 63, 88, 325
Majid Eshaghi, 216
Makhdzir bin Mardan, 301
Malik Hj. Abu Hassan, 302
Manaf Ali
See Abdul Manaf Ali, 205, 215-217, 258, 376, 393, 395
Manap, MY, 178
Mansor Ahmad, 423, 430
Mansor Hashim, 354, 375, 392, 403
Mansor Monsi, 302
Mansor, AT, 439
Mansor, SB, 344
Margaret Liew Yoon Bing, 138
Mariam Mohd Ismail, 138
Mariana Nor Shamsudin, 219, 229, 231, 252
Marikkar, JMN, 177
Marlia Jamail, 418
Mawardi Rahmani, 379, 393, 395
See Rahmani M.
Maziah Mahmood, 151-153, 155, 157, 159, 161, 398
Maznah Ismail, 234, 236, 238-239
Md. Humayun Kabir, 60
Md. Jelas Haron, 423, 430
Md. Nasir Sulaiman, 295, 318, 325
Megat Mohamad Hamdan Megat Ahmad, 255, 341, 387, 424
Megat Ahmad, MMH
Meilina Ong Abdullah, 174, 348
Michele Law Soo Ling, 303
Michelle, NYT, 240
Mihdzar Abdul Kadir, 60, 64
Mirnalini Kandiah, 277
Misnawi, 53
Mitsuaki Nishibuchi, 192, 194

Mohamad Fazli Bin Sabri, 449
Mohamad Rushdan Md Said, 305
Mohamad Zaki Ab. Rahman, 423, 430
Mohamd, AR, 344
Mohamed Ismail Abdul Karim, 119-120, 122, 148, 162-164, 183
See Karim, MIA
Mohamed Osman Ahmed Bushara, 165
Mohamed Othman, 295
Mohamed Saifulaman Mohamed-Said, 250
Mohamed Shariff
Mohamed Shariff Mohamed Din, 40, 221, 242
Mohamed Suleiman, 299
Mohamed Zakaria Hussin, 65
Mohd. Ali Hassan, 120, 162-164, 190
Mohd. Amim Othman, 441
Mohd. Aspollah Sukari, 205, 393, 395
Mohd. Azmi Mohd Lila, 82, 90, 221, 242
Mohd. Basyaruddin Abdul Rahman., 180, 369
Mohd. Fauzi Ramlan, 88, 92
Mohd. Ghazali Mohayidin, 43, 165
Mohd. Halim Shah Ismail, 350
Mohd. Hasbullah Md Marham, 330
Mohd. Hudzari Bin Razali, 98
Mohd. Ibrahim Hj. Mohd, 86
Mohd. Khanif Yusof, 96, 99
Mohd. Khazani Abdullah, 397
Mohd. Maarof Moksin, 367, 375, 403, 429
Mohd. Mansor Ismail, 67
Mohd. Nizam Lani, 104
Mohd. Nor, MY, 452
Mohd. Puad Abdullah, 151, 398
Mohd. Rasid Osman, 346
Mohd. Ridzwan Abd Halim, 68
Mohd. Rizal Kapri, 123
Mohd. Said Saad, 64
Mohd. Saleh Jaafar, 410
Mohd. Sapuan bin Salit, 400
Mohd. Shah Ibrahim, 412, 416, 418
Mohd. Shahwahid Hj Othman, 451, 452
Mohd. Sham Mohd Kassim, 236
Mohd. Yazid Abd. Manaf, 138
Mohd. Zaki Abdul Rahman, 63, 373
Mohd. Zamri Saad, 260
Mohd. Zobir Hussein, 371, 433
Mohd. Zul bin Mohd Yusoff, 301
Mokhtaruddin Abd. Manan, 69
Mong, XH, 378
Muataz Ali Atieh, 297
Mubarak, AR, 80
Muhajir Hamid, 215
Muhamad Awang, 352, 360
Muhamad Saufi Mohd Kassim, 98
Muhamad Taufik Abdullah, 307
Muhammad Rezal Kamel Ariffin, 308
Muhrizal, S, 45
Mumtazah Othman, 441, 443
Muniandy, N, 260
Murali Sambasivan, 309
Murugeson Kallianna, 311
Mustafa Kamal Abd. Aziz, 350
Muta Harah Zakaria, 35, 50
Muzafar Shah Habibullah, 453

N

Najiah Musa, 221
Nakisah Mat Amin, 395
Napsiah Ismail, 346
Nasaruddin Abdul Aziz., 246
Nasir Umar-Tsafe, 250
Nasrullah Khan, 401-402
Nathan, S, 273
Nazamid Saari, 55, 171
Nazimah Sheikh Abdul Hamid, 71
Neela, V, 231
Nelli Yohana Mohd Said, 244
Ng Chee Kyun, 313, 323, 331
Ng Chyan Leong, 173
Ng Kee Seong, 254
Ng, KN
Ng Kim Nee · 137, 378
Ng, WH
Ng Wai Har, 174, 348
Noor Aini Umar, 90
Noor Asmawati Samsuri, 330
Noor Azian Morad, 350
Noor Azlina Ibrahim, 369
Noordin Mohamed Mustapha, 58, 90
Noorhana Yahya, 354, 403
Nor 'Aini Mohd. Fadzillah, 89, 152
Nor 'Aini, MF
Nor Aizam Adnan, 182
Nor Kamariah Noordin, 313, 330
Nor Rizan, K, 258
Nor Salina, MZ, 89
Noraihan Nordin, 222
Noraini Abdul Rahman, 164
Noraini Che Pa, 315
Norazak Bin Senu, 316
Norazlin Sapuan, 28
Nordin Hj Lajis, 250, 272
Norhani Abdullah, 141, 175-176, 188, 197
Norhasnizah Ahmad, 246
Norihan Mohd Saleh, 133, 166, 168
See Saleh, NM
Norlaily Mohd. Saiden, 354, 403
Norliana Mahussin, 418
Norlijah Othman, 236, 244
Normah Hashim, 236
Norman Mariun, 401-402
Norshariza Nordin, 249, 254
Nur Izura binti Udzir, 318
Nur Rahizan Binti Ilaha, 391
Nurhadi, 144
Nurmawati Syakroni, 249

O

Obaje, OJ, 128
Omoomi Behnaz, 320
Ong Boo Kean, 215
Ong Kar Chun, 331
Ong, ST, 273
Ooi, S.S., 255
Othman Dato' Hj. Mohamed, 456

P

Paridah Md. Tahir, 72
Patimah Ismail, 29, 225-226
Patimah, I,
Paul Roach, 90
Pauline Chew Xui Sim, 138
Peng Yee Hock, 320
Peter Pook, 249
Phan Chin Lee, 219
Phang Lai Yee, 164
Phebe Ding, 74
Prakash, V, 291
Prasanna, S, 274-275
Premalatha Pakirisamy, 106
Prihasto Setyanto, 81
Prithvi Raj Arora, 404

Q

Quah, SC, 186
Quek Siew Young, 71

R

Raba'ah Syahidah Azis, 354, 403
Radin Umar Radin Sohadi, 255, 387, 406, 408
Radin Umar, RS
Radzali Mispan, 182
Radziah Othman, 77
Raed Ali Al-Khasawneh, 300
Raha Abdul Rahim, 123, 131, 140, 168, 173, 178, 183, 231
Raha Binti Abdul Rahman, 242
Rahim, RA, 123, 131, 140, 168, 173, 178, 183, 231
See Raha Abdul Rahim
Rahman Arkimin, 412, 418
Rahmani, M, 378, 393, 395
See Mawardi Rahmani
Rahmat Kamid, 412, 416, 418
Raja Noor Zaliha Abdul Rahman, 115, 117-118, 150, 179-180, 369
Rajan Amarthalingam, 96
Ramlah Hamid, 197
Ramlah Hamzah, 463
Ramlan Mahmod, 260, 307, 318, 322, 325
Rani Sarmugam, 277
Rashid Shariff, 182
Rashidah Abdul Rahim, 115
Ratna Kalos Zakiah Sahbudin, 313, 323, 330
Razali Muse, 90
Razali Yaakob, 325
Razani, U, 451
Rehana Abdullah Sani, 78
Rehir Dahalan, 239
Rha, C, 398
Richard Head, 90
Rita Muhamad Awang, 79
Rizaldi Boer, 81

Rodzita Johari, 332
Rofina Yasmin Othman, 126
Rohani Abdullah, 459
Rohani Ahmad Tarmizi, 456, 463
Rohaya Halim, 182
Rohi, D, 402
Rokiah Pendek, 277
Roop Goyal, 182
Rosenani Abu Bakar, 80-81
Rosfarizan Mohamad, 120, 123, 183, 185
Rosidah Alias, 392
Roslan Shukor, 368
Rosli Noormi, 159
Rosmawati, S, 422
Rosnan Hamzah, 246
Rosnina Hj Yusoff, 37
Ross, E, 178
Rozihan Mohamad, 29, 124
Rozita Abdul Talib, 236
Rozita Rosli, 219, 231, 247, 249, 250, 252, 254
Rozumah Baharudin, 439
Ruhana Busu, 457
Rumaya, J, 439
Rusli Hj. Abdullah, 327
Russly Abdul Rahman, 48, 71
Rustem Suncheleev, 329, 445

S

Sabariah Abdul Rahman, 254, 258
Sabariah, AR.
Sabarina Mohd. Shapee, 375
Sabira Khatun, 313, 323, 330-331
Sabrina Bt Sukardi, 222
Sahar Usmani, 203
Saleh, NM, 133, 166, 168
See Norihan Mohd Saleh
Saleha Abdul Aziz, 261
Salleh Harun, 392
Salleh Yahya, 309, 455
Salmah Yusof, 83, 138
Sambandan, TG, 398
Samsilah Roslan, 456
Samsinar Md Sidin, 457
Samsul Bahari Mohd Noor, 410
Samuel Lihan, 104
Sariah Meon, 84
Seow Heng Fong, 219, 227, 263-265
Sew, YS, 189
Seyed Alireza Asgari, 267
Shaban Awidat, 249
Shaharin Ibrahim, 412, 416, 418
Shahrul, SHR, 146
Shaker, ARH, 275
Shamshuddin Jusop, 45
Shamsuddin Sulaiman, 421
Shamsul, BS, 269, 459
Shanthi, G.
Shanti Ganabadi, 240
Shanthi, M, 245
Shar Mariam Muhamed, 393
Sharida Fakurazi, 270
Sharifah Kharidah Muhammad, 190
Sharifah Shahrul Rabiah, 348
Sharizah Alimat, 247
Shattri Mansor, 51, 86, 182
Shazali Abu Mansor, 32
Sheikh-Omar Abd. Rahman, 82
Sidek Hj. Abd. Aziz, 368, 380, 422
Sidik Silong, 423, 430
Sieo Chin Chin, 175, 188
Siti Aishah Hassan, 88
Siti Aishah Mohd Ali, 215, 258
Siti Aishah MA.
Siti Hajar Ahmad, 63, 74
Siti Khalijah Daud, 89
Siti Sabariah Buhari, 236
Siti Salhah Othman, 150
Siti Shapor Siraj, 203
Siti Suhaila bt Abdul Rahman, 126
Siti Zauyah Darus, 80
Siti Zubaidah Ramanoon, 82
Siti Zulaiha Hanapi, 104
Sobri, H, 161
Soh Kim Geok, 460
Somarny, WMZ, 231
Son Radu, 104, 131, 133, 192, 194, 231
Soo Ee Lin, 117
Sreeramanan Subramaniam, 155
Sri Wahyuni, 96
Stephen Yong Chi Vui, 424
Sugeng Riyanto, 398
Suhaila Mohamed, 83, 90
Suhaimi Ibrahim, 412, 418
Suherman, J, 225-226
Sukardi, S, 257
Supeni, EE, 341
Suppramaniam, CV, 168
Suraini Abd. Aziz, 119, 148, 195
Suraini, AA.
Suriah Abdul Rahman, 277
Susila Bahri, 332
Suzita, S., 152
Syahida Ahmad, 272
Syahrilnizam Abdullah, 252
Syed Omar Syed Rastan, 69

T

Tai, KL, 99
Tan Boon Chong, 219
Tan Chin Ping, 200-201
Tan Chon Seng, 151
Tan Chun Knee, 86
Tan Hui Boon, 461
Tan Siang Hee, 146, 189, 348
Tan Soon Guan, 76, 186, 203
Tan Tjin Ling, 426
Tan Wee Tee, 391, 426-427
Tan Wen Siang, 273
Tan, BK, 197
Tan, JP, 439
Tan, JY, 346
Tan, KS, 387
Tan, SH, 174
Taufiq-Yap YH, 378, 433
See Yap Hun Hin@Md Taufiq
Tee Chong Siang, 151
Tee Pau Ling, 83
Tee Seok Bee, 138
Tee, TP, 56
Teh Jia Yew, 335
Tengku Aizan, 443
Tengku Mohammed Tengku Sembok, 307
Thohirah Lee Abdullah, 94
Thomas Choong Shean Yaw, 333
Tin-Tin Myaing, 261
Tong Chow Chin, 90
Tung, SH, 408

U

Uma Rani Sinniah, 96
Umi Kalsom Yusuf, 205
Umi Salamah Hassan, 205

W

Waleed Thanoon, AM, 410
Wan Ahmad Badhi, 430
Wan Ishak Wan Ismail, 98
Wan Mahmood Mat Yunus, 367, 429
Wan Md. Zin Wan Yunus, 352, 423, 430
Wan Mohd Daud Wan Yusoff, 367-368, 392, 403, 431
Wan Sulaiman, WH, 92
Wang, MS, 257
Waqar Asrar, 358
Wee Chien Yeong, 151
Widiyanto, S, 360
Wong Fong Yee, 457
Wong Shaw Voon, 255, 346, 387, 406, 408, 424
Wong, SV
Wong Soon Fen, 219
Wong Su Luan, 463

Y

Yaacob Abd.Wahab, 28
Yaakob Che Man, 138, 177, 201
See Che Man YB
Yap Yun Hin @ Md Taufiq
See Taufiq-Yap YH, 378, 433
Yeap, JS, 255
Yem Poh Cheang, 291
Yip, KM, 51
Yoshihito Shirai, 163-164
You Kok Yeow, 209
Yousr Abdullah Noaman, 104
Yunus Gul, 274-275
Yusep Ikrawan, 55
Yusof Bin Ibrahim, 100
Yusoff, K, 178, 186, 273

Z

Zabidi Azhar Mohd Hussin, 236
Zaharah Abd Rahman, 102-103
Zaidan Abdul Wahab, 334-335, 429
Zailina, H, 269, 459
Zainal Abidin bin Sulaiman, 334-335
Zainal Abidin Mior Ahmad, 270
Zainal Abidin Talib, 429, 431

Zainal Zahari, Z, 37
Zainul Abidin Hassan, 431
Zaiton Hassan, 104
Zaitun Yassin, 277
Zakaria Wahab, 25
Zalilah Mohd Shariff, 236
Zamirah, ZA, 260
Zen, FP, 381
Zohra Gebrel, 367
Zolkepli Othman, 360
Zulkafli Ghazali, 190
Zulkarnain Zainal, 371, 373, 427
Zulkifli Hj. Shamsuddin, 77, 106
Zulkifli Idrus, 197, 261
See Idrus, Z.
Zulkifli, H, 452
Zulkifli, S., 152
Zulkifli, Y, 451
Zulkifly Abbas, 209
Zulkornain Yusop, 465
Zunita Zakaria, 82



Research Management Centre (RMC)
Universiti Putra Malaysia
Chancellory
Administration Building
43400 UPM Serdang
Selangor Darul Ehsan
Malaysia

Tel: **+603 8946 6028 • 8946 6192 • 8946 6183**
Fax: **+ 603 8942 6539**
URL: **http://www.admin.upm.edu.my/~research**
http://rmc.upm.edu.my
E-mail: rschinfo@admin.upm.edu.my

ISSN 1675-1248

