



Synthesis

R&D Digest of Universiti Putra Malaysia

• Issue 4 • 1st Quarter • Mar. 2004

ISSN. 0127 - 9394

<http://rmc.upm.edu.my/synthesis/>

Contents

- 1 Great expectations—Research the key factor
- An Integrated Management for the Control of Bacterial Wilt of Tomato Caused by *Ralstonia solanacearum*
- 2 Editorial Spotlight
- 3 Genetic Variability of Four Sheep Breeds in Malaysia
- 4 Design and Evaluation of a Comfortable Motorcycle Helmet with Bio-composite Shell for Tropical Climates
- 5 Commercial Production of Economically Important Planting Materials Using Tissue Culture Technologies
- 6&7 Research Happenings
- 8 Development of Rice Bran Nutraceuticals with Cardioprotective Properties
- 9 Putranet -Virtual Office
- 10 Responses of Timber Concessionaires to Selected Policy Instruments
- 11 A Glance at Research Inventions & Innovations at UPM!
- 12 Reportage

What's Next

Highlights from the next issue -

- ▲ Report on 32nd International Exhibition of Inventions, New Techniques & Products, Geneva.
- ▲ Development of Standardised Functional Foods from Pegaga.
- ▲ Recovery of Vitamin E from Palm Fatty Acid Distillate using Neutralization-Adsorption Chromatography Method.

Great expectations – Research the key factor



Faces of Professor Muhammad Awang, Deputy Vice-Chancellor (Academic)—UPM, the nucleus for producing top quality research

As we traverse this journey of learning and discovery, we are also motivated and driven by a sense of mission and service. 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.

Knowledge has replaced natural resources and labour-intensive industries as a primary source of wealth creation and economic growth. Indeed, knowledge creation, dissemination and application are already developing into a global industry. Universities have a role in shaping this global industry as well as contributing to wealth creation.

The traditional role of the university is to provide quality campus learning and living experiences that include face-to-face interaction between students and faculty members. But knowledge- and technology-driven globalization offers

universities new and unexpected opportunities to complement its core learning experiences.

A leading university has to see through larger lenses and embrace a global perspective. To expand the intellectual horizons of its students, the university must promote a conducive research environment that would create opportunities for the rubbing of minds from different perspectives.

It is no longer common physical location that creates synergy between intellectual communities, but rather, common interests and a shared vision. I am confident UPM will provide a new model that will propel education and research to unprecedented heights of excellence and profoundly transform the mind of our scientists to strive for such a scientific excellence that may produce a Nobel Laureate by the year 2020. **rmc**

An Integrated Management for the Control of Bacterial Wilt of Tomato Caused by *Ralstonia solanacearum*



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

An evaluation on the effect of two tomato varieties, MT 11 and Pearl, treated with combination of two strains of *Pseudomonas putida*, Ca (NO₃)₂ and with/without Stonier's medium, on the incidence of bacterial wilt, was carried out 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 (NO₃)₂ were done at regular intervals before and after transplanting. Stonier's medium was applied 4 days before transplanting. For each variety, non-treated plants served as control. Results showed that the antagonist and Ca (NO₃)₂ treatments were not able to provide any resistance to the susceptible Pearl tomato variety which, recorded 100% infection.

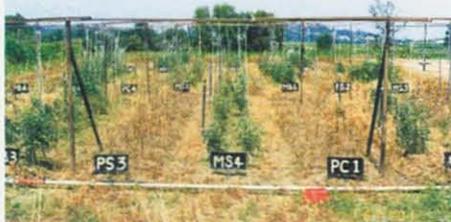
However, the two treatments with the MT 11, bio-primed with the combined strains of antagonist, treated with Ca Ca (NO₃)₂ and with or without Stonier's medium, could significantly reduce bacterial wilt incidence by 29 and 31% respectively, when compared to the MT 11 control. Their yields were also significantly higher by 114 and 121% for treatment without and with Stonier's medium, respectively. This study shows that the combination of antagonists and calcium nitrate could increase the resistance of the moderately susceptible variety. Thus, it could be used for the management of the disease in infested area. **rmc**

BRONZE – Malaysian Plant Protection Society (MPPS) Award – IPTA Research & Development Exposition 2003

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



An Integrated Management for the Control of Bacterial Wilt of Tomato

Serving community and country

Universiti Putra Malaysia (UPM) has made significant progress since it started as a agriculture school in 1930. Over the past decades, UPM has transformed itself into a premier institution embracing research as an integral part of its mission.

Our departments, faculties and research institutes have achieved high levels of competence in their fields. We instill in our students diligence and discipline, and we can take great pride that our graduates are pragmatic and proficient in their areas of specialization. Today, UPM degrees in the natural, biological, medical mathematical, computer and social sciences, and the professional disciplines are recognized in this region and the rest of the world as proof of strong academic achievement.

In addition to the teaching and research initiatives to become a global knowledge enterprise, a major thrust in the year was to raise the level of service provided by all staff. This gave impetus to staff training and development designed to bring out the best in every staff.

The importance of the UPM fraternity in providing the continuity that underpins the University was brought into sharper focus in the year with the forging of close ties between the main stakeholders—students, faculty and staff. This affirmation of ties will grow in importance as the University matures and renews itself with the passing of each cohort. Efforts are stepped up to include the active participation of all constituents in University-wide events. Infrastructure of many buildings, laboratories and equipment was upgraded and enhanced to facilitate learning in a conducive environment.

As a result of this, the year saw an increase in the number of staff promotions who benefited at large. The table below indicates a list of newly promoted professors:

Professors	Faculty
1. Dzolkhifli bin Omar	Agriculture
2. Ghizan bin Saleh	Agriculture
3. Mohd. Khanif bin Yusop	Agriculture
4. Muzafar Shah bin Habibullah	Economics & Management
5. Zainal Abidin bin Mohamed	Economics & Management
6. Turiman bin Suandi	Educational Studies
7. Zaidatul Akmaliah bt Lope Pihie	Educational Studies
8. Azni bin Hi. Idris	Engineering
9. Jamilah bt Bakar	Food Science & Biotechnology
10. Son Radu	Food Science & Biotechnology
11. Rozumah bt Baharudin	Human Ecology
12. Seow Heng Fang	Medicine & Health Sciences
13. Dzulkely Kuang Abdullah	Science & Environmental Studies
14. Malik bin Hi. Abu Hassan	Science & Environmental Studies
15. Norhani bt Abdullah	Science & Environmental Studies
16. Peng Yee Hock	Science & Environmental Studies
17. Abdul Aziz bin Saharee	Veterinary Medicine
18. Mohd. Azmi bin Mohd. Lila	Veterinary Medicine

* from 1/8/03 – 2/1/04



With our community of talented individuals and through synergistic partnerships with other universities and industry, we aim to build up new knowledge areas and promote commercial application of knowledge to create wealth for country.

Finally, the hard work and dedication of all UPM academia who have contributed to the University's successes is very much acknowledged. The University would also like to acknowledge the Government of Malaysia for their foresight in viewing education as a long-term investment and thank them for their strong and steadfast support.

Let us now embark on this journey towards our vision and continue to enjoy the performance together. 

Executive Editor
sidek@putra.upm.edu.my

EDITORIAL BOARD

Advisor	Professor Muhamad Awang
Co-Advisor	A.Prof. Mohd. Shahwahid Othman
Executive Editor	A.Prof. Sidek Hj. Ab. Aziz
Managing Editor	Nayan Deep S. Kanwal, Esq.
Reviewers	A.Prof. Zulkifli Idrus. A.Prof. Nor Aripin Shamaan
Secretary	Jamsari Tamsir
Circulation Manager	Mustapha Kamal Tahir
Reporter	Siti Nurulhuda Abu Seman
Online Webmaster	Ahmad Faisal Abdul Ghafar
Assistance	Nurhaznita Mahmood Saharia Mohd Jani Zaihan Yazid

Funding Opportunities

Contract Research

Contract research, undertaken by both public research institutions and universities, has shown an upward trend in recent years. Such a trend is encouraging as it helps to ensure that research activities undertaken by public research institutions and universities are aimed at addressing actual industry problems and need.

Through contract research activities, greater linkages between the public and private sectors will be further enhanced.

Several R&D grant schemes namely IRPA Research and Development Grant Scheme, Industry Research and Development Grant Scheme (IGS), Multimedia Super Corridor (MSC) Research and Development Grant Scheme (MGS) and Demonstrator Application Grant Scheme (DAGS) has been introduced to further enhance private sector participation in R&D. Currently, RM100 million has been allocated for IGS, RM100 million for MGS and RM50 million for DAGS.

Industry Research and Development Grant Scheme (IGS)

Introduction

The government has launched several incentive schemes to boost Research & Development (R&D) activities, particularly to encourage the private sector to undertake R&D. These schemes have been largely tax-based. Experience has, however, shown that while tax-based incentives have benefited some, they have not encouraged significant R&D ventures. Due to high risk inherent in R&D investments, the private sector has regularly requested the Government for more direct, up-front grant support based on the concept of risk-sharing. In response to this, the Government established the Industry R&D Grant Scheme (IGS) in 1997.

The purpose of IGS is to increase private sector R&D and promote closer cooperation between the private sector and PRIs as well as public sector universities through collaborative linkage. Malaysian majority-held joint-venture companies including those with MSC-status companies are eligible to apply. University collaboration with local PRIs are encouraged to apply for this type of grant. The approved R&D proposals must be undertaken in Malaysia. The amount approved under IGS will be determined on the merits of each application but not exceeding 70% of the approved project cost.

Objectives of IGS Scheme

- To encourage Malaysian companies to be more innovative in creating new technologies, products and processes which will benefit the national economy;
- To strengthen national competitiveness in the global markets;
- To promote closer cooperation through joint ventures and institutional linkages between the private sector and public sector universities and research institutes; and
- To encourage strategic global and regional linkages in R&D to enhance indigenous technology development.

Who Could Apply ?

Any systematic or intensive study carried out in the field of science and technology with the objective of using the results of the study for the promotion of the improvement of materials, devices, products, produce or processes, but does not include:

- quality control or routine testing of materials, devices, products or produce;
- research in the social sciences or the humanities;
- routine data collections;
- efficiency surveys or management studies; and
- market research or sales promotion.

Selection of projects will take into considerations the extent to which projects that meet the objectives and the conditions of the Scheme. The research must focus on key technology areas with prospects for early commercialisation. The selection criteria also include the potential to strengthen or extend existing areas of comparative advantage and to contribute to the development of high value added products, processes and services. The research also will contribute to training of Malaysians in new technology areas. The grant is usually for a maximum duration of 3 years. The amount approved under IGS will be determined upon the merits of each application but not exceeding 70% of the approved project cost.

The scheme will normally provide grants to meet direct project cost such as salary expenditure, plant expenditure, prototype expenditure, pilot plant, and materials consumed, administrative and travel cost related to the project. The grant applicant is expected to co-invest in the form of cash, personnel or equipment or a combination thereof. Funding is normally provided for three years to encourage early commercialisation.

Inquiries on the IGS should be directed to the IGS Secretariat. Applications for IGS grants must be made on prescribed IGS Applications forms accessed and downloaded through MOSTE website <http://www.moste.gov.my/s&t/> 

Managing Editor
ndeeps@admin.upm.edu.my

Genetic Variability of Four Sheep Breeds in Malaysia



J.M. Panandam, S.V. Kumar, K. Yusoff, S. Vengketeshwara Rao, S.M. Hon, C.C. Tan, M.N. Nummeran, and C.A. Azarudin



There are a number of sheep breeds and breed groups in Malaysia and little is known of their genetic makeup. The genetic variability of four of these, namely the Malin (M), Barbados Blackbelly (BB), Dorset-Malin (DM) and Santa Ines (SI), were evaluated using the techniques of randomly amplified polymorphic DNA (RAPD) and cellulose acetate electrophoresis (CAE). RAPD analysis of 30 samples from each breed

detected eight primers with good resolution; seven primers detected polymorphism with 38 polymorphic markers. Dice's genetic distance within the populations ranged between 0.0693 - 0.0930 and that between the breeds ranged 0.104 - 0.136. No marker that could be used as a unique identifier for the breeds was detected. CAE of 50 samples from each breed showed the RBC enzymes, G6PD, LDH, MDH, ME, PGDH,

SOD and PGM, to be monomorphic for all four breeds. M and DM showed higher frequencies of the low activity phenotype of NP (0.62 and 0.66, respectively) while BB and SI showed higher frequencies of the high activity phenotype (0.62 and 0.52, respectively). The frequencies of HBA in M, DM and SI were 0.23, 0.14 and 0.43, respectively, while BB was monomorphic and homozygous for the slower HB^B. 

Fig 1. The four sheep breeds



Malin (M)



Barbados Blackbelly (BB)



Dorset Malin (DM)



Santa Ines (SI)

WINNER Malaysian Genetic Society Award (Animal Genetic category) – IPTA Research & Development Exposition 2003

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

Design and Evaluation of a Comfortable Motorcycle Helmet with Bio-composite Shell for Tropical Climates

Award Winner



R.S. Radin Umar, F.M. Shuaeib, S.V. Wong, A.M.S. Hamouda and Megat M. H. M. Ahmad

The research conducted is devoted to the design and evaluation of a new crashworthy motorcycle helmet taking into consideration the tropical climate of Malaysia.

Different shell materials made of hybrid natural fiber composite (NFC) have been designed and fabricated for the replacement of the present ABS helmet shell (Fig. 1). All the new NFC shells were fabricated and evaluated by the standard dynamic penetration test (Malaysian Standard 1: 1996, a type approval test for motorcycle helmet). Three additional test methods have been developed to further evaluate the new shell designs in a more quantified manner. These methods involved helmet crushing, helmet penetration and helmet rigidity tests. All these methods are at quasi-static strain rate and have been developed based on mechanics of materials principles.

Test results confirmed the superior performance of the new natural fiber shell helmets as compared to the market dominant ABS shell helmets. The present shell is more effective and environmental friendlier. In the terms of liner design, the use of EPP foam is recommended. A 3D finite element model for the helmet with EPP foam has been developed and simulated (Fig. 2a, b, and c). It has been simulated by using LS-DYNA-3D solver. Based on the simulation results, the impact resistance of the helmet with EPP foam liner was found to be satisfactory with reference to the related helmet standards. Design optimizations have been conducted and optimum design for the helmet has been obtained (Fig. 3). The helmet design has incorporated a new ventilation system and thermal analysis and design have been



Fig 1. The helmet with bio-composite shell



Fig 2a. The 3D finite element model

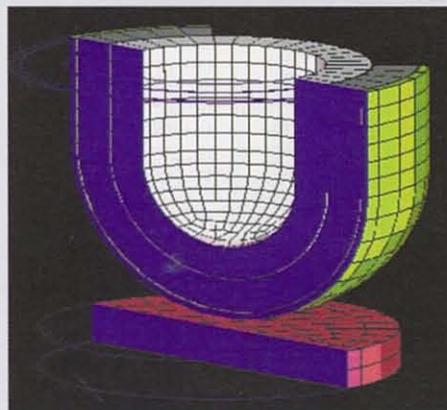


Fig 2b. Cross section of the finite element model

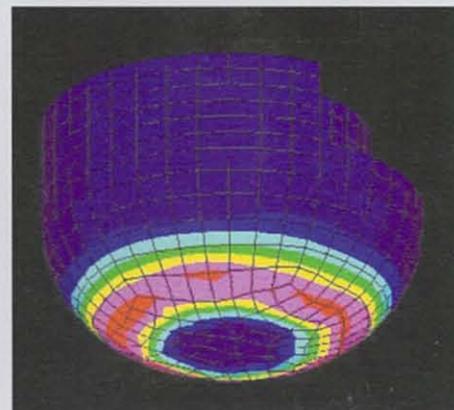


Fig 2c. Impact simulation contour

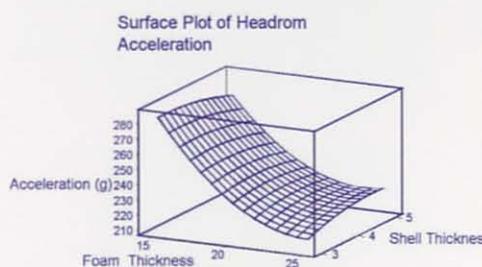


Fig 3. The RSM design optimization

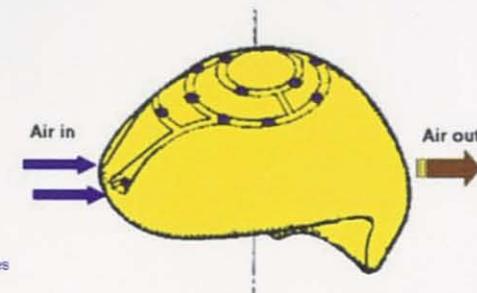


Fig 4. The new ventilation system

conducted (Fig. 4). Comparison between the helmet and the commercially available helmet without ventilation system has been carried out. The effect of adding the ventilation system to the helmet has been structurally investigated by the finite element simulation. It was found to have positively improved the energy absorption performance of the helmet.

*An update of the article published in Issue 2, 3rd Quarter (Sept. 2003).

WINNER Malaysian Solid State Science & Technology Society (MASS) Award – IPTA Research & Development Exposition 2003

Reader Enquiry

Faculty of Engineering
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6263
E-mail: radinumx@eng.upm.edu.my

Commercial Production of Economically Important Planting Materials Using Tissue Culture Technologies

Award Winner



Maziah M., Janna O. A., Abdullah M. P., Tee C.S., Sobri H., Anna L.P.K., Sreeramanan, S., Rosli, N., Chew Y.C., Ng C.Y., and Norazihan A.

The use of tissue culture techniques to mass propagate quality planting materials is a novel approach in accelerating commercial production for the plantation sectors. These protocols ensure unlimited multiplication of a single quality mother plant which will be true to type. They are useful in producing plants that are difficult to propagate by conventional methods that may be due to low seed set, sterility, infrequent flowering or limited supply of mother plants. In addition, plants obtained through these techniques will be disease-free and genetically stable. However, each plant species generally requires specific tissue culture conditions to produce desirable results. Protocols suitable for commercial production of quality planting materials for several important plant species such as medicinal plants [Tongkat Ali (*Eurycoma*

longifolia), Kacip Fatimah (*Labisia pumila*), Hempedu Bumi (*Andrographis paniculata*), Misai Kucing (*Orthosiphon staminea*), Pegaga (*Centella asiatica*), Jarum Mas (*Striga asiatica*), Sambung Nyawa (*Gynura procumbens*), Mengkudu (*Morinda citrifolia*) and Leletup (*Physalis minima*)], fruit crops (*Banana and Pineapples*) and ornamental plants (*Orchids, Senduduk, Chrysanthemum and Hibiscus*) were optimised and developed. The technologies are available for transfer to the commercial partners and they can also be satisfactorily applied to a wider scope of horticulture, agriculture, floriculture, forestry and plant genetic conservation. Other related technologies ready to be transferred are training, contract micropropagation and set up of low cost tissue culture laboratories. 



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: maziah@fsas.upm.edu.my

Research

R&D Commercialization Luncheon (13 January 2004)



From Left: Prof. Dr. Azni Idris, Assoc. Prof. Dr. Shabuwahid and Mr. Ong Hock Kheeng at the R&D Commercialization Luncheon held on 13 January 2004.



Welcome address by Deputy Vice Chancellor (Academic), Professor Muhamad Aitang.



Remarks by Dr. Roslidalab from the Malaysian Vaccine & Pharmaceuticals Sdn. Bhd.

Work Quality Enhancement Course (16-18 January 2004)



Prof. Dato' Sbeikh Omar talks on Leadership and Quality Management at the 3-day course on "Work Quality Enhancement" organized by Research Management Centre (RMC), UPM from 16-18 January 2004 at Port Dickson.



From Right: Dr. Nor Arpin, Professor Muhamad Aitang, Dr. Shabuwahid and Dr. Zulkifli.



Showing their experience are from right—Dr. Shabuwahid and Dr. Zulkifli.



Good Response—Dr. Nor Arpin at the team building session with all cheers!



Active participation in their game spirit for development.



RMC staff—expressing their game spirit for development.

Science Motivation Dialogue with National Young Scientist Award Winners (2 March 2004)



World famous Nobel Laureate in Physics, Professor Gerardus 't Hooft during his inspirational talk on creativity at the Science Motivation Dialogue session on 2nd March 2004.



From Left: Dr. Sidek with Professor Hamdan Subatmi (formerly from UPM) of KUSTEM at the dialogue session.



From Left: Dr. Husaini, Dr. Zulkarnaini and Dr. Sidek—at their creative thinking!



Inspired at the talk are from left: Dr. Taufiq Yip (UPM, Serlang) and Prof. Dr. Roslan Slnkor (UKM, Bangi)—Young Scientist Award winners.

Down the Memory Lane (past events)



Professor Muhamad Aitang welcoming the Eminent Scientist and Nobel Laureate, Professor Ahmed H. Zewail's to UPM.



Professor Muhamad Aitang during the Publicity of Universiti Putra Malaysia.



Deputy Vice Chancellor (Academic), Professor Muhamad Aitang sharing his thoughts with Prof. Zulkifli while Dr. Shabuwahid and Dr. Sidek look on.



Dr. Shabuwahid (centre) with Prof. Zulkifli and Prof. Zulkifli deputy director, RMC.

Happenings



Professor Dr. Mohd. Hair Bejo presenting his research findings



Dr. Rusbidah from the Malaysian Vaccine & Pharmaceuticals Sdn. Bhd. receives a token of appreciation from Professor Mubamad Awang



Guests at the RCD Commercialization Luncheon

Signing of MoU between UPM and MINT (1 March 2004)



RMC staff in team building



Vice Chancellor, UPM, Dato' Zohaitie at the MoU ceremony in UPM on 1st March 2004



Director-General, MINT, Dato' Dr. Ahmad Sobri expresses his commitment



True to the spirit of globalization, a Memorandum of Understanding between UPM & MINT



From Left: Dr. Shaharudin, Dato' Zohaitie, Dato' Dr. Ahmad Sobri and Dr. Nabruil Khair, Deputy DG, MINT at the official signing of the MoU ceremony

g their views on city



g with Professor Ahmed
ecture held at
m 14 October 2002



Dr. Shaharudin thanking Mr. Jerry Day from AIPEL Consultants for his stimulating talk on patenting in 2002



Overseas Collaboration—Discussions with (from left) David Allen, Registrar, University of Birmingham, Dr. Tom Craig, Director, British Council, Kuala Lumpur, Dr. Shaharudin and Prof. Dr. Zulkifli



UPM Vice Chancellor, Dato' Zohaitie Bardak congratulating the outgoing RMC director, Prof. Zulkifli in June last year whilst the incoming director, Dr. Shaharudin smiles



ing ahead with
ab (the then)



From Right: Mr. Nayati, Mr. Chee, Ibe (late) Un. Ezzam and Assoc. Professor Dr. Idris Abdul at the official farewell of the outgoing RMC director in June 2003



En. Mustajiba, Mr. Nayati, Mr. Chee (mid) (late) En. Ezzam—Officers at a regular RMC management meeting



Professor Emeritus Jabuladeen (facing camera) one of the founding members of University Research Unit, now known as RMC at the UPM R&D Exhibition 2002



Development of Rice Bran Nutraceuticals with Cardioprotective Properties



Maznah Ismail, Azrina Azlan,
Abdul Salam Abdullah



Award Winner

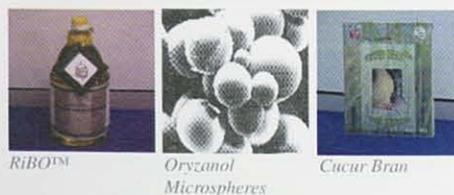
Interest in rice bran.....

Rice is the most consumed food in the world with a trading volume reaching as much as 18.2 million tonnes (Bernas Annual Report, 1997). In Malaysia alone consumption is estimated to be higher than 1.7 million tonnes of paddy per year. During processing of paddy into white rice at least 10% of its weight is lost and discarded as rice bran. In Malaysia, rice bran is underutilized and only used as animal feedstuff. However in the global scene, there has been a growing interest in the utilization of rice bran due to its excellent chemical composition. Making use of discarded materials is not only smart-economics but it is in fact a form of entrepreneurial recycling.

The most notable feature of rice bran is its high content of several components with antioxidant properties such as gamma-oryzanol. In addition, its content of tocotrienol is higher than most other vegetable oils. With additional research these compounds can be upgraded from low value status to high revenue stream of raw materials for nutraceuticals. We postulate that if enough scientific evidence can be generated locally to show the health benefits of these nutraceuticals, the demand for rice bran will increase similar to other parts of the world. Although synthetic antioxidants are commonly used to prevent oxidative reactions, the increased demand for "natural products" as an important current consumer trend, may motivate the use of rice bran nutraceuticals even more.

The overall research programme is to develop rice bran nutraceuticals with cardioprotective properties. Currently the specific objectives leading to the development of these nutraceuticals take three folds namely, stabilization procedures for production of stabilized rice bran, cardioprotective effects of rice bran nutraceuticals by means of *in vitro*, animal studies and human feeding intervention trial and lastly bioavailability and pharmacokinetics of rice bran nutraceuticals for improved utilization using Caco-2 cell culture system and animal model.

A number of nutraceutical products have been developed from this research programme which include stabilized rice bran, named as RBM™; a blend of rice bran oil and palm oil (RiBO™) with determined Polyunsaturated: Monounsaturated: Saturated fatty acid ratios and improved antioxidant content for maximal hypocholesterolemic effect and an antioxidant rich nutraceutical formulation (E-Ory™) with enhanced bioavailability.



RiBO™

Oryzanol

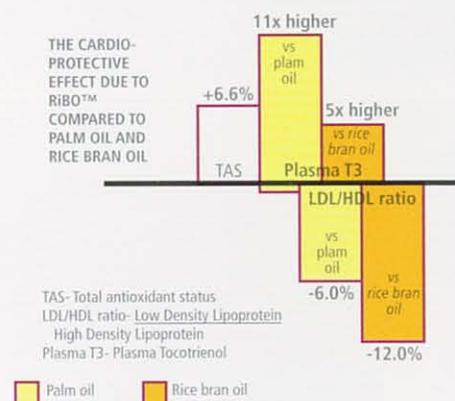
Cucur Bran

Microspheres

Enzymes, microorganisms and insects are major causes of deterioration of rice bran. Under normal milling conditions, the oil in bran and the potent lipase would come into mutual contact resulting in immediate degradation and lowering of bran quality. Without proper stabilization, the bran produced is unpalatable and not suitable for human consumption. Therefore in the first phase of this research programme, a study was conducted to determine optimal parameters for stabilization procedures and the effect of packaging material at various temperatures on shelf life. Microwave treatment at 240 Mhz for 2 min had given the best results with more than nine months shelf life (Azrina *et al.* 2000).

The stabilized rice bran had versatile applications as health food products. RBM™ can simply be sprinkled onto foods or drinks to increase intake of total dietary fibre intake. It can be incorporated as an ingredient in extruded cereal products or in a variety of baked products including pizza bread and muffin. Incorporation of rice bran into ready mix local cake recipe even as much as 20% was still acceptable. CucurBran™, the newly formulated high fiber 'jempur-jempur' for example, has also been tested and accepted by consumers.

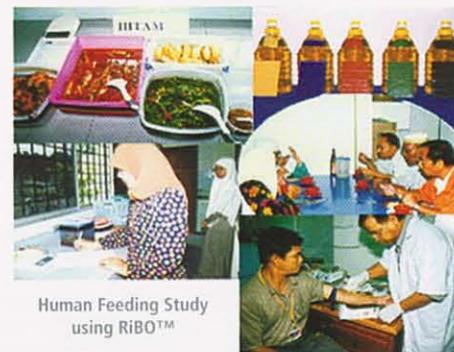
Further processing of RBM™ has produced up to 20% oil by hexane extraction and slightly less percentage from Soxhlet extraction (19%) and supercritical fluid extraction (SFE) method (18%). However, oryzanol content of SFE extracted oil at 5000 psi and 40°C was found to be the highest, being six times more than solvent extracted oil (Maznah *et al.*, 2003). Rice bran oil has generally been considered to be one of the highest quality vegetable oil due to its high level of polyunsaturated and monounsaturated fats.



Our research findings on the cardioprotective properties of rice bran revealed that both full fat and defatted rice bran had shown hypocholesterolemic effect on animal model tested. Of the two rice bran components, the oil component (-26%) had displayed better hypocholesterolemic effect than the fiber (-13%) component. Based on these observations, a human feeding study was conducted in a single-blind crossover design using blends of cooking oil as the vehicle to incorporate rice bran oil into diets of normal to mild hypercholesterolemic subjects. Results from this human feeding study (figure above) revealed that RiBO™ compared to control oils (refined palm oil and rice bran oil) had caused higher plasma total antioxidant status (TAS) especially plasma tocotrienol. Furthermore, RiBO™ had induced positive changes in some of the risk factors of the subjects such as 6% and 12% reduction in the LDL/HDL ratio as compared to palm oil and rice bran oil respectively. The observed effect of RiBO™ could be due to synergistic action of both

tocotrienol and gamma-oryzanol. The health benefits of oryzanol has long been observed and reported but its synergistic mechanism in humans as seen in this study is new especially when involving palm oil. As such, oryzanol even at low concentration when in combination with tocotrienol offers double protection against lipid peroxidation *in vivo*.

Although oil blends have high level of antioxidants, their bioavailability need to be investigated for their maximum utilization. Bioavailability is a crucial issue since functional properties of these nutraceuticals could be limited by their low absorption. Our results show that bioavailability of oryzanol in the presence of tocotrienol in a new formulation as E-Ory™ had increased three fold.



Human Feeding Study using RiBO™

Further research needs to be done on rice bran especially looking at other cardioprotective properties of rice bran nutraceuticals and their mode of action. Future work will also focus on developing improved formulations of these nutraceuticals for enhanced absorption. Nanoparticles is one of the formulations that has recently been suggested to improve bioavailability of hydrophobic compounds. Recent studies have shown that hydrophobic compounds or drugs, which were given as nanoparticles were found to be more bioavailable, more biologically active and could stay longer in plasma. We would therefore explore this possibility with rice bran antioxidants in the hope of producing better delivery mechanism for these nutraceuticals. **EMC**



Dr. Maznah explaining her invention to Tan Sri Musa, Minister of Education, Malaysia while Vice Chancellor UPM, Dato' Zohadie looks on with a keen eye

WINNER Anugerah Inovasi Perkhidmatan Awam 2003 – Jabatan Perdana Menteri
Silver Medal – Science & Technology Expo 2003
Gold Medal – Science & Technology Expo 2002
Gold Medal – UPM R&D Exhibition 2002 & 2003
Applied Biology Merit Award – IPTA Research & Development (R&D) Expo, 2002

Reader Enquiry

Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 8943
E-mail: maznah@medic.upm.edu.my



Putranet - Virtual Office

AwardWinner



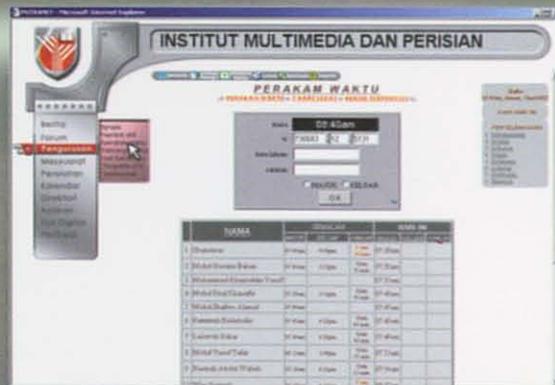
Makhdzir Mardan, Mohd Shafree Ahmad, Wan Mohd Nur Muzaaliff Wan Musa

Usage of Internet as a source of information has been long practiced. It is just as standard for anyone to get information about anything from the Internet these days. With the emerging new technologies, increasing IT literacy among the society and the urge to utilize the Information and Communications Technology (ICT) has made this project possible to develop and progress. The Malaysian government has also emphasised the importance of ICT as a means of maintaining competitiveness.

The objective of this project is therefore to increase communication between individuals in an organization by using the simplest technology available. A software application has been developed to ensure that fast, reliable and accurate information can be broadcasted to reach the targeted users via ICT. Furthermore, office automation is expected to simplify and create a paperless working environment for an organization. This application also employs the concept of transparent management.

The study undertaken has stimulated our research team to undertake further research on developing its strength in various related areas of

office automation and Internet technology as many of the components of automation are influenced by ICT. **EMC**



Screen capture of Putranet: Virtual Office



Reader Enquiry

Multimedia and Software Development
Institute of Multimedia and Software
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Tel: +603 8946 6091 / 6000 / 8423/ 8948 6053
E-mail: makhdzir@imedia.upm.edu.my

Responses of Timber Concessionaires to Selected Policy Instruments



Mohd. Shahwahid Haji Othman* and Awang Noor Abdul Ghani
*Director
Research Management Centre, UPM

Attempts to save the world's remaining tropical rainforests often focus on conserving specific protected areas or prohibiting the harvesting of rare species. A new study from Malaysia, focuses on another approach - improving the efficiency and effectiveness of logging companies.

A Catch-22 situation has occurred in which an increase in both harvesting rates and the number of trees left standing led to more environmental damage. In response to this the researchers made a number of suggestions for regulatory and technological improvements that would allow logging companies to overcome this problem and improve their environmental performance.

What Type of Concessions are Best?

The study was undertaken as there is virtually no empirical evidence about which elements of a concession agreement have the greatest impact on the environmental performance of the company working that concession. The researchers aimed to fill this information gap so that the regulation and taxation of logging activities could be focused to improve environmental quality, economic output and government revenue in forest areas. The researchers analyzed logging data from forty forest compartments in the District of South Terengganu in Peninsular Malaysia. They chose this area because pre- and post-felling inventories existed for the forests in the area. This made it possible to disentangle the impacts of forest conditions, logging company characteristics, fiscal regimes, and regulatory structures on harvesting performance.

Reducing "Logging Damage"

The researchers focused on the impact that differences in logging concessions had a condition of the trees left behind after felling had taken place. It is well known that this "logging damage" to residual trees has a significant influence on environmental quality. For example, higher disturbance of the forest following unsupervised logging below the cutting limits increases erosion rates and accelerates surface runoff. Moreover, studies also indicate that when the damage to uncut trees is reduced, the remaining standing forest is healthier and provides more environmental services.

Inventories and Other Information

The researchers collected information on a number of variables for each concession. The data included pre- and post-felling timber inventories. These inventories were conducted by the State Forestry Office (SFO) and were based on a 10% systematic linear sampling system. They provided mean (per hectare) values of the number of trees and timber volume by species and diameter class in each compartment. The researchers also collected data on the logging companies and the logging

contracts they had entered into. In addition, they investigated timber prices and various factors affecting logging costs such as forest type, the average slope of each site and the types of machinery and logging techniques used by each concessionaire. Much of this information was obtained from the concessionaires themselves, from the District Forest Office and from specifications detailed in forest licenses.

The researchers encountered a number of problems in obtaining the data they required. Despite the stipulations of the Malaysian forest management code, they found that information about post-felling inventories was not collected as per the format necessary for pre-felling inventories. This meant that an assessment of damage and harvesting was not straightforward. Instead, a subjective report was collected on the level of damage and the need for rehabilitation activities. The study was also constrained by the limited number of available sample points.

A Dilemma for the Logging Business

The researchers found that the major sources of logging damage were the total number of trees harvested and the total number of residual trees, and that damage is more prevalent among the non-dipterocarp species group. They found that a 1.2% rise in logging damage could be expected for every 1 % increase in the density of residual stands (using current harvesting technology). They also found that for every 1 % increase in the harvesting rate, the logging damage would increase by 0.68%.

According to the researchers this creates a dilemma for those in the logging business. Raising harvesting productivity - by exploiting more trees per ha - increased logging damage. Yet harvesting fewer trees raised the density of residual stands, which also increased the level of logging damage.

The Impact of Concession Periods

The researchers found that there was no significant link between the length of a concession period and the amount of damage caused to the trees left after logging. They suggested that this was because the sub-contracting of harvesting jobs is still widely practised and long-term concessionaires are often not directly involved in felling and transporting out the logs. This means that there is little difference in the behaviour of short- and long-term concessionaires.

In respect to harvesting behaviour, it was found that long-term concessionaires observed the harvesting cutting limits that they had been set by the regulators. They argued that this reflects the companies' need to reserve enough residual trees for their next cutting cycles. In light of this finding, the researchers recommended that the State

Government could offer concessions to integrated and long-term concessionaires so that good management of each concession is in the best interest of the concessionaire.

Improving Logging Techniques

The researchers highlight the fact that the findings from their study should be treated as preliminary, until more data is available from other districts. Nevertheless they felt that their findings held several implications for forest management, at least in the study area. It was found that without raising productivity, concessionaires might not have the incentive to comply with environmental regulations. In other words, compliance costs money and concessionaires have to find a source to compensate this loss.

In light of this observation and their research findings, it is recommended that even well-intended planning that raises the residual stand density - such as setting quotas on the minimum economic cut - may not be good for sustainable management. In place of such policies, it is suggested that the Malaysian government should introduce and encourage more environmental-friendly harvesting techniques where, for example, pre-felling climber cuttings and directional felling are implemented and closely supervised. With the application of these and other less damaging harvesting methods, such as helicopter logging and the incorporation of reduced impact specifications, damages could be much reduced. The application of helicopter logging is not unrealistic, since Malaysia has already experimented with this technique in the state of Sarawak.

Increasing Harvesting Intensity

The researchers also argue for an increase in harvesting intensity using the less-damaging harvesting techniques they had highlighted. They make the case that allowing a higher harvesting intensity would reduce the number of forest areas that have to be opened up to meet annual timber requirements. This would also limit the amount of logging damage associated with high residual stand densities. It is therefore suggested that this approach be incorporated into the government policy.

The researchers note that lowering cutting limits would require modifications to the current forestry management regulations. Given a thinner residual stand density, they said, cutting cycles would have to be extended beyond the current range of 25 to 30 years. This would mean that the current "bi-cyclical" cutting cycle - where harvesting is done twice within a rotation of 60 years - would no longer be feasible. Instead a single cutting cycle of once in every 50-60 years would have to be implemented to give the residual stand sufficient time to recuperate and regenerate. 

Reader Enquiry

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

Tel: +603 8946 6028
E-mail: msho@econ.upm.edu.my

A Glance at Research Inventions & Innovations at UPM¹

Continued from Issue 3, 4th Quarter (Dec.2003)...

No.	Faculty/ Institute	Researcher	Innovation	Research Cluster	Project Number	Allocation
59.	Economics and 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
60.	Economics and Management	Ahmad Zainuddin Abdullah	Sunk Cost, entry and exit barriers in selected manufacturing industry	EAM	05-02-04-0531 EA001	RM107,000
61.	Economics and 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
62.	Economics and Management	Alias bin Radam	Performance of Malaysia food manufacturing industries	AFF	05-02-04-0420 EA001	RM129,397
63.	Economics and Management	Annuar Md Nasir	Business Failure Prediction Model In Malaysia: An Empirical Analysis	EAM	05-02-04-0191 EA001	RM71,840
64.	Economics and Management	Azali Mohamed	Asian Economic Integration	EAM	05-02-04-0192EA001	RM198,850
65.	Economics and 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
66.	Economics and Management	Kenny Teoh Guan Cheng	To buy local; or to buy foreign. Application of Structured Equation Modeling and Neural Networks to the development of a Consumer Ethnocentrism Scale for Malaysia	EAM	05-02-04-0195 EA001	RM92,900
67.	Economics and 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
68.	Economics and Management	Mohammed bin Yusoff	Trade Balance and Exchange Rate: Evidence from ASEAN	EAM	05-02-04-0199 EA001	RM108,120
69.	Economics and 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
70.	Economics and 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
71.	Economics and Management	Muzafar Shah Habibullah	Monetary services index (MSI), monetary policy effectiveness and economic activity	EAM	05-02-04-0201 EA001	RM176,800
72.	Economics and Management	Salleh Yahya	Measuring Customer satisfaction in Banking, Manufacturing and retailing	EAM	05-02-04-0204 EA001	RM101,200
73.	Economics and Management	Samsinar Md Sidin	The Patterns and Role Structure in Family Decision Making	SSH	05-02-04-0205 EA001	RM98,040
74.	Economics and Management	Shamsher Mohamad	Risk-adjusted Performance of Unit Trust Funds in Malaysia	EAM	05-02-04-0206 EA001	RM57,840
75.	Economics and Management	Tan Hui Boon Human	Capital, Productivity, Innovation and Growth: A Transition to K-Economy	SSH	05-02-04-0207 EA001	RM93,800
76.	Economics and 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
77.	Economics and Management	Zulkornain Yusop	Private Capital Inflow into the Selected ASEAN countries	EAM	05-02-04-0209 EA001	RM96,300
78.	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
79.	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
80.	Educational Studies	Aminah Ahmad	Consequences of Inter role Conflict among Employed Parents	SSH	07-02-04-0223 EA001	RM139,980
81.	Educational Studies	Aminuddin Hussin	Continuous flow nutrient trunk intrusion, efficient and environment friendly fertilizing procedure for oil palm (Elais guineensis Jacq)	AFF	01-02-04-0506 EA001	RM178,000
82.	Educational Studies	Azimi bin Hamzah	Religiosity and Personality Development Index: Application for Nation Building	SSH	07-02-04-0225 EA001	RM135,180
83.	Educational Studies	Habsah Ismail	Congruency of Teachers' Belief and Practices	SSH	07-02-04-0535 EA001	RM155,000
84.	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
85.	Educational Studies	Mohd. Majid Konting	Teacher's Beliefs and Craft Knowledge of Good Practices in The Primary School Classroom	SSH	07-02-04-0732-EA001	RM196,600
86.	Educational Studies	Mokhtar Nawawi	Enhancing Mathematics Learning for Lower Secondary School Student Using Multimedia Mathematics Courseware	SSH	07-02-04-0843-EA001	RM146,800

to be continued...

¹ Data presented IRPA RM-8 (as at Cycle 1, 2004); Total 416 EAR Grants, sorted by PTJ & name.

The description of the some of the above Inventions and Innovative research products available for commercialisation at UPM are contained in the book— "R&D at UPM: Creating New Frontiers of Innovative Research", First Edition, Editor: Nayan Deep S. Kanwal, Published by Research Management Centre (RMC), UPM, available from Publications & Promotion Unit, 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

Synthesis Reportage

R&D Commercialization Luncheon

The first R&D Commercialization Luncheon organized by Research Management Centre was held at IDEAL, UPM on 13th January 2004. The event was officiated by Professor Dr. Muhammad Awang, Deputy Vice Chancellor (Academic), UPM.

Dr. Roshidah Ismail from Malaysian Vaccine and Pharmaceuticals Sdn. Bhd., Mr. Emeri Johari and Mr. Shaikh Taufik Shaikh Yusof from Malaysian Technology Development Corporation Sdn. Bhd. were the guests from the industry sector.

The function was also attended by Prof. Dr. Mohd. Hair Bejo from the Faculty of Veterinary Medicine who presented his research findings on *Infectious Bursal Disease Vaccine*, Prof. Dr. Mohd Zamri Saad (Dean, Faculty of Veterinary Medicine), Assoc. Prof. Dr. Johari Endan (Managing Director, University Business Centre), Prof. Dr. Azni Idris (Director of Commercialization, UBC), Prof. Dr. Aini Ideris (co-researcher), Assoc. Prof. Dr. Abdul Rahman Omar (co-researcher), and Assoc. Prof. Dr. Abdul Rahim Motalib (Head, Department of Veterinary Pathology and Microbiology, UPM).

Also in attendance at the event were Director, RMC, Assoc. Prof. Dr. Shahwahid along with his three deputy directors, Assoc. Prof. Dr. Zulkifli Idris (Policy, Planning & Finance Unit), Assoc. Prof. Dr. Sidek Hj. Abd. Aziz (Publication & Promotion Unit) and Assoc. Prof. Dr. Nor Aripin Shamaan (Research Grant Unit).

Signing of MoU

The research community continued to push the boundaries of their creativity with new research focuses and new levels of excellence broached in existing programs. True to the spirit of globalization, a Memorandum of Understanding was signed between Universiti Putra Malaysia (UPM) and Malaysian Institute for Nuclear Technology Research (MINT) on 1st March 2004 to further accelerate national collaborations and industry linkages. Vice Chancellor, Dato' Zohadie represented the university while Director-General, MINT, Dato' Dr. Ahmad Sobri represented MINT.

A workshop attended by researchers from UPM and MINT followed the signing of the Memorandum of Understanding.

Hearing from the Nobel Laureate on Creativity!

The Nobel Prize needs no introduction. Since its inception a century ago, the immense importance and sterling significance of this internationally prestigious and sought after award has always been the dream and vision of every respectable nation in the world. And Malaysia, a fast-developing independent democratic Nation which has firmly set 2020 as the target year to become a fully developed Nation, has farsighted vision for one of its citizens to carve a niche in the august hall of Nobel Laureates.

In conjunction with this vision, a Science Motivation Dialogue jointly organized by Academy of Sciences Malaysia, Ministry of Science, Technology and the Environment, and National Science Centre was held at Grand Maya Hotel in Kuala Lumpur on 2nd March 2004. Born in 1946, in The Netherlands, the World famous Nobel Laureate in Physics, Professor Gerardus 'T' Hooft shared his research experiences with almost 30 National Young Scientist Award winners from Malaysia and provided them a stimulus in acquiring creativity and excellence in Science. National Young Scientist Award winners from Universiti Putra Malaysia who attended this session were Assoc. Prof. Dr. Sidek Hj. Ab. Aziz (1997), Assoc. Prof. Dr. Zulkarnain Zainal (1998), Assoc. Prof. Dr. Husaini Omar (2000), and Assoc. Prof. Dr. Taufiq Yun Hin (2002).

International Invention Exhibition Geneva 2004

The 32nd International Exhibition of Inventions New Techniques and Products will be held in Geneva from 31st March to 4th April 2004. The participating delegation from Universiti Putra Malaysia will include the following scientists.

Professor Dr. Mohd Azmi Mohd Lila from the faculty of Veterinary Medicine will be demonstrating two inventions, "Imuron™ total solution for maximizing antibody responses", and "Nucleoceptin™ novel vaccine for fertility control in animals.

Professor Dr. Ir. Radin Umar from Engineering faculty will be exhibiting his new researched product, "Biocomposite helmet for tropical countries".

"CRFNanopath – novel nanocomposite based controlled release formulation" will be exhibited by Professor Dr. Mohd Zobir Hussein and his research team from the faculty of Science and Environmental Studies.

Professor Dr. Abdul Salam and Assoc. Prof. Dr. Maznah Ismail from the Faculty of Medicine and Health Sciences will be exhibiting their invention "E-ORY – atural antioxidant rich nutraceutical formulation".

Assoc. Prof. Dr. Ahmad Husni and his research team from the faculty of Agriculture will be exhibiting their new product "ZAPPA – he rice seeds germination enhancer".

Also from the faculty of Engineering will be Assoc. Prof. Dr. Fakhru'l-Razi exhibiting his invention "Carbon nanotubes and carbon nanofibers synthesis for nanotechnology applications". Dr. Robiah Yunus exhibiting her new invention on "Palm oil based synthetic bio lubricant", Dr. Wong Shaw Voon with his invention on "Heavy duty pendulum impact test ring for crashworthiness studies", and Mr. Mohd. Hanif for his new invention, "Optical layer automatic protection switch".

Malaysia Toray Science Foundation (MTSF)

Established in 1993 through a RM4 million initial endowment, MTSF is a premier privately-funded charitable organization with the primary objective of advancing science and technology in Malaysia. Malaysian Scientists, Researchers, Educators and Teachers currently residing in Malaysia are hereby encouraged to apply for the prestigious prizes and grants mentioned below.

Closing date:

Applications should reach the Foundation by 31st May 2004.

For further details and application forms for the year 2004, please contact Deputy Director, Research Grant Unit, Research Management Centre (RMC) at 03 8946 6188, email at naripin@rmc.upm.edu.my or visit the MTSF website at www.mtsf.org to download the application forms. 

FACT FILE

For the record



Ms. Zuliana Zakaria has joined Research Management Centre as a Research Assistant to assist the Policy, Planning and Finance Unit with effect from 8 March 2004.

Having worked in the private and public sectors on issues pertaining to R&D, she states she is ambitious and outgoing and prefers to work in a fairly organized environment. She says, "she is realistic about completing tasks successfully and hopes to build contacts in other walks of life and broaden my network".

Zuliana holds a Bachelors degree in Food Science and Technology from UPM. 

Ms. Zuliana Zakaria, Policy, Planning and Finance, RMC.

Letters to the Editor

If you have any comments about the content of the publication or any contributions that you may wish to make for the forthcoming issues, please send them to: The Managing Editor, *Synthesis*, Publication and Promotion Unit, Research Management Centre, 3rd Floor, Administration Building, 43400 UPM, Serdang, Selangor, Malaysia or via the Internet to editor@rmc.upm.edu.my. The editor reserves the right to edit articles for clarity and space before publication.

The opinions and views expressed in this publication are not necessarily those of *Synthesis* or the Research Management Centre (RMC). Acceptance and publication of articles in this publication does not imply recommendations by RMC.

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

Are you reading your own copy of the UPM R&D Digest?

Synthesis is the first and only quarterly R&D digest at Universiti Putra Malaysia published in March, June, September and December with the focus on award-winning innovations. It covers research happenings emerging from the various faculties and institutes across the university and provides a brief summary of some of the important research findings of the study conducted at UPM. It brilliantly features special topics that are of national interest in various fields and disciplines.

Scientists must be made aware of how important the impact of their work is and its possible applications on society and public opinion. It is hoped that this digest will provide the opportunity to interact particularly through feedback or direct mail to the scientist from either the private sector or by scientists from other government research institutions.

Synthesis is the official research bulletin of the University and is published by Research Management Centre. It is available free of charge to the academic community.

Readership

Researchers, academicians, postdoctoral researchers, technicians, postgraduate studentships, research institutions, techno-entrepreneurs, venture capitalists and laypeople.

If you would like to receive a copy of the *Synthesis* for research updates every 4 months, or would like further information about Research Management Centre, please contact at the address given on this page or send an e-mail message to editor@rmc.upm.edu.my with the only content in the body of the email message being "subscribe synthesis" to be added to the mailing list.



Research Management Centre

UNIVERSITI PUTRA MALAYSIA
Chancellory
Administration Building
43400 UPM, Serdang,
Selangor Darul Ehsan
Malaysia

Tel
+603 8946 6028 / 6192 / 6183
Fax
+603 8942 6539

E-mail
editor@rmc.upm.edu.my
ndeeps@admin.upm.edu.my

Website
<http://www.admin.upm.edu.my/research>
<http://rmc.upm.edu.my/>