

Malaysia International Biological Symposium

Sustainable Bioresources for Bioeconomy

28th-29th October 2014

**Palm Garden Hotel
IOI Resort, Putrajaya**



MALAYSIA INTERNATIONAL BIOLOGICAL SYMPOSIUM

"Sustainable Bioresources for Bioeconomy"

PROGRAM AND ABSTRACTS

28th – 29th OCTOBER 2014 | PUTRAJAYA, MALAYSIA

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Published 2014

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PREFACE

From a broad economic perspective, bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products and processes. It encompasses the production of renewable biological resources and their conversion into food, feed, chemicals, energy and healthcare wellness products via innovative and efficient technologies. Bioeconomy could make major socioeconomic contributions globally. These benefits are expected to improve health outcomes, boost the productivity of agriculture and industrial processes, and enhance environmental sustainability.

In a way the bio-economy is not a recent discovery. It has provided us with food, fuel and fibre over the centuries. In many ways we took it for granted. Today as we face into a future where the supply of fossil fuel – the driver of all economies – is finite and where the consequences of our reliance on such fuels have given rise to serious environmental problems, we are looking again to the natural world to answer our many demands – for food, fuel, fibre, new products and chemicals. Today we are more acutely aware than ever before about the need for sustainable production systems; about the importance of producing more, using less resources and polluting less. In that context we know that waste is no longer acceptable; that many by-products can also become products with a real value.

We require a revolution in our ways of thinking and doing. That revolution requires us to bring people with us on the path and to provide the knowledge and information to empower them so that they want to be a part of the revolution – a revolution that can only yield positive results. We need to harness the innovative minds of our scientists, researchers, farmers, food processors, manufacturers, entrepreneurs and many others – so that we can deliver the diverse range of goods the bioeconomy has to offer and the many innovations we have not yet thought of. With that spirit, it is very appropriate to sustainably use our bioresources. Thus, the theme chosen for this *i-SIMBIOMAS* 2014 is "Sustainable Bioresources for Bioeconomy". A greater focus on research and innovation can provide us with new products derived from biomass and new services required for realization of the bioeconomy development.

The diversity of expertise participating in this symposium makes it a remarkable scientific meeting that can contribute in helping to meet the most pressing global challenges, such as the increasing global population, depletion of fossil fuel and natural resources, and increasing environmental pressures and climate change. By bioeconomy development we may help combat climate change, reduce waste and create new jobs.

We are proud to have been the vehicle for this symposium to run successfully.

The Organising Committee
Malaysia International Biological Symposium 2014
(i-SIMBIOMAS 2014)

FOREWORD

It gives me a great pleasure and privilege on behalf of the Department of Biology, Faculty of Science, Universiti Putra Malaysia (UPM) to welcome all the distinguished guests, speakers and participants of i-SIMBIOMAS 2014.

This scientific community meeting started in 2003 as a small-scale event. When the standard of the meeting was improved in 2009 and then upgraded to international level in 2012, it has gathered local and international participants from various institutions of higher learning and research institutes. I congratulate the organizing committee for their efforts in bringing together experts from various fields in Biology to share their findings and expertise.

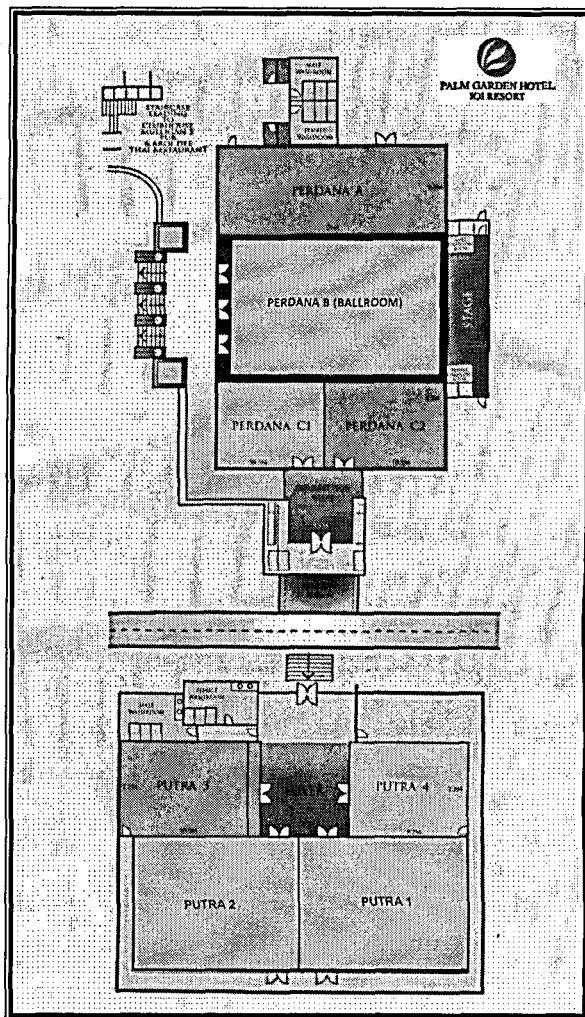
Malaysia, as one of the mega-biodiversity countries has also recognised the importance of a bioeconomy. The theme chosen for this symposium: "Sustainable Bioresources for Bioeconomy", is a continuity of the previous theme "Sustainable Management of Bioresources". The fact that we face imminent limits to our present way of producing and consuming can no longer be ignored. We need to encourage an economic transition that move away from dependency on fossil resources towards sustainable production, use of biomass and bioresource management. This effort must be developed with a view to tackling societal challenges, rather than being influenced by sector based interests. A sustainable management of bioresources for bioeconomy is certainly a possible path, but requires bridge building and partnerships. A sustainable bioeconomy must take account of these challenges. This symposium is a good platform for us to share ideas and later, wherever possible, to collaborate in order to be able to address the challenges in an efficient way.

To all symposium participants, over these two days we look forward to hearing of the exciting advances you have made in your respective fields. We look forward to an active discussion of the issues presented.

Thank you.

Prof. Dr. Ahmad Ismail
Head
Department of Biology
Faculty of Science
Universiti Putra Malaysia

VENUE MAP



SYMPOSIUM SCHEDULE

Tuesday, 28th October 2014

7:30 AM - 8:25 AM Registration
 8:25 AM - 9:05 AM Opening Ceremony
 Welcoming Note (8:25 AM – 8:30 AM)
 Opening (8:30 AM – 8:45 AM)
 Photo Session (8:45 AM - 9:05 AM)
 Master of ceremony: Dr. Nurul Izza & Dr. Wan Norhamidah
 Venue: Perdana Ballroom

9:05 AM - 9:20 AM Morning Coffee Break
 9:20 AM - 10:00 AM PLENARY SESSION 1 – Y.Bhg Dato' Syed Danial Syed Ariffin
 10:00 AM - 10:30 AM Keynote Biodiversity and Conservation – Assoc. Prof. Dr. Peter Boyce
 10:30 AM - 11:00 AM Keynote Genetics - Prof. Dr. Sadequr Rahman
 Chairperson: Prof. Dr. Ahmad Ismail
 Venue: Perdana Ballroom

PARALLEL SESSION 1
 11:10 AM – 12:25 PM

11:10 AM	OB01 Sulaiman Sani Kankara	Biodiversity and Conservation	Ecology	Genetics & Physiology
11:25 AM	OB02 Abu Hena Mustafa Kamal	Chairperson: Dr. Rosimah Nulit	Chairperson: Dr. Wan Norhamidah	Chairperson: Dr. Christina Yong
11:40 AM	OB03 Nor Latii Ibrahim	Venue: Perdana Ballroom	Venue: Putra 1	Venue: Putra 2
			OE01 Nurul Izzati Mat Akhir	OG01 Siah Chai Har
			OE02 Shahrizad Yusof	OG02 Estri Laras Arumingtyas
			OE03 Cheng Wan Hee	OG03 Miftahuddin

11:55 AM	OB04 Chona Camille E Vince Cruz	OE04 Najla Mohd Abu Shaala	OP01 Cheong Jee Yin
12:10 PM	OB05 Abdul Wahab Ibtisam	OE05 Mohammed Muzammel Hoque	OP02 Muhammad Shafiq Abu Hassan
12:30 PM - 2:00 PM	Lunch Break		

PARALLEL SESSION 2

2:00 PM - 3:30 PM

Biodiversity and Conservation	Ecology	Genetics and Physiology
<i>Chairperson: Dr. Nur Ain Izzati Mohd Zainudin</i>	<i>Chairperson: Assoc. Prof. Dr. Muskhazi Mustafa</i>	<i>Chairperson: Dr. Meenakshi adp Nallappan</i>
<i>Venue: Perdana Ballroom</i>	<i>Venue: Putra 1</i>	<i>Venue: Putra 2</i>

2:00 PM	OB06 Tapan Kumar Nath	OE06 Munirah Hanapiah	OG04 Geetha Annavi
2:15 PM	OB07 Looi Ley Juen	OE07 Chew Wei Yun	OP03 Alvin Hee Kah Wei
2:30 PM	OB08 Sharon J. Spiridin	OE08 Saifulah A. S. M.	OP04 Noraini Abu Bakar
2:45 PM	OB09 Inhan Shaflnaz Abd Manaf	OE09 Faradiella Mohd Kusin	OG05 Rosazlina Rusly
3:00 PM	OB10 Nur Adilah Auyob	OE10 Bede Emeka Udechukwu	OP05 Sujithra Devi A.
3:15 PM	OB11 Sohana Shabnam	OE11 Seyed Mousa Sadeghi	

3:30 PM - 5:00 PM

Poster Presentation and Judging

Venue: Perdana Ballroom

5:00 PM - 5:30 PM

Evening Tea Break

8:00 PM - 11:00 PM

Symposium Dinner
(*Venue: Putrajaya Lake Club*)

Wednesday, 29th October 2014

9:00 AM - 9:40 AM

PLENARY SESSION 2 - Prof. Dr. Nobuyuki Miyazaki

9:40 AM - 10:10 AM

Keynote Physiology - Prof. Dr. Ramli bin Abdullah

10:10 AM - 10:40 AM

Keynote Ecology - Prof. Dr. Mashhor Mansor

Chairperson: Dr. Syaizwan Zahmir Zulkifli

Venue: Perdana Ballroom

10:40 AM - 11:00 AM

Morning Coffee Break

PARALLEL SESSION 3

11:00 AM - 12:30 PM

Biodiversity and Conservation

Chairperson: Dr. Nor Azwady Abd

Aziz

Venue: Perdana Ballroom

11:00 AM

OB 12 Mohd Akmal Mohd Raffi

11:15 AM

OB 13 Juddy E. Jainol

11:30 AM

OB 14 Siti Fatimah Md Isa

11:45 AM

OB 15 Runglawan Sudmoon

12:00 PM

OB 16 Evika Sandi Savitri

12:15 PM

OB 17 Teng Suk Kuan

12:30 PM - 2:00 PM

Lunch Break

Physiology

Chairperson: Dr. Mashitah Shikh Maidin

Venue: Putra 1

Ecology Workshop

Chairperson: Dr. Mohd Noor Amal & Dr.

Syaizwan Zahmir Zulkifli

Venue: Putra 2

OW01

Ahmad Ismail

OW02

Yasuhiko Naito

OW03

Aqilah Mukhtar

OW04

Kagari Aoki

OW05

Che Abd Rahim Mohamed

OW06

Nordiani Sidi

PARALLEL SESSION 4

2:00 PM – 3:00 PM

Biodiversity and Conservation

Chairperson: Dr. Geetha Annam

Venue: Perdana Ballroom

Ecology

Chairperson: Dr. Shamarna Shohaimi

Venue: Putra 1

Genetics and Physiology

Chairperson: Dr. Mohd Hafiz

Venue: Putra 2

2:00 PM

2:15 PM

2:30 PM

2:45 PM

OB 18 Mohd Ridzuwan Endot

OB 19 Nik Noradiah Nik Kob

OB 20 Noormassheela Uluu Azmi

OB 21 Shahrizim Zukliffy

OE 12 Fatin Zahidah Abdul Aziz

OE 13 Wong Koe Wei

OE 14 Zarifi Sufani Baharom

OE 15 Lim Mei Peng

OG06 Azzarina Anor Basah

OG07 Khalid Rehman Hakeem

OP11 Elroda Abdelhalim Ibrahim

OP12 Khaled M.A. Hussin

3:10 PM - 3:50 PM

PLENARY SESSION 3 - Dr. Sharifah Shahriul R Syed Alwee

Chairperson: Dr. Shahrizad Yusof

Venue: Perdana Ballroom

4:00 PM - 4:45 PM

Closing Ceremony

Master of Ceremony: Dr. Shahrizim & Dr. Nurul Izza

Venue: Perdana Ballroom

4:45 PM - 5:15 PM

Evening Tea Break

Plenary & Keynote

Future Approach In Addressing Climate Change

Dato' Syed Danial Syed Ariffin

Managing Director, Puncak Niaga (M) Sdn Bhd

This paper will highlight the impact of climate change, how does it affect one of our most fundamental basic needs – WATER. The occurrence of extreme weather anomalies due to climatic change, e.g. drought and flood will have a profound effect on our water source, quality and supplies and its consequences, in particular, the water rationing exercise carried out in Selangor and Kuala Lumpur in early 2014. This paper also examine the readiness of water utilities to adapt and mitigate climatic change impact in which a series of adaptation and mitigation measures, both short-term and long-term, that have been carried out by the Malaysian Government. In the search for solutions, we need to be more innovative and creative, and the answers provided should be "green, holistic and sustainable" that we should adopt in the future. Ultimately, we hope to see a future where solutions to climatic change should not disrupt the human livelihood, comfort and economic activities. In conclusion, a concerted group effort is necessary to address the climatic change impact.

Keywords: Impacts of climate change, water supplies, water resource, water quality, future approach

Development of advanced technology "Bio-logging system" and its application to conservation of wild animals and ecosystem

***Nobuyuki Miyazaki^{1,2}**

¹*Atmosphere and Ocean Research Institute, The University of Tokyo, Japan,*

²*Marine Science and Technology Foundation, Japan*

The Atmosphere and Ocean Research Institute, the University of Tokyo (AORI), had conducted the 10-year Multilateral Core University Program "Coastal Marine Science (2001-2010)" supported by the Japan Society for the Promotion of Science (JSPS) (Nishida, Fortes, and Miyazaki, 2011). Reviewing these activities, I set up "Bio-logging science" in Japan, which is defined as "investigation of phenomena in or around free-ranging organisms that are beyond the boundary of our visibility or experience (Boyd et al. 2004)". AORI established Bio-logging system (UTBLS: Bio-logging System of the University of Tokyo) using advanced data loggers and camera loggers developed with cooperation of Little Leonardo Co. Japan. This system is very useful for getting information on behavior of wild animals and their habitat use in order to make conservation of wild animals and ecosystem in the world. Thus this system can contribute to making management of the integrated coastal marine ecosystem, and to establishing the new system for "Future Oceans", which involves concept of human welfare. Micro-acceleration meter and salinity meter measure depth, temperature, speed, 3-dimension of acceleration and salinity in high quality. Camera logger is used for getting real scene in nature condition through animals and for confirming phenomena obtained by the data logger. So far these devices have accumulated a lot of superior knowledge for whales, dolphins, manatees, sea turtles, sea birds, fishes, etc. In this presentation, I would like to explain outline of this Bio-logging system and some scientific topics obtained by these new advanced devices with my students and colleagues.

Keywords: Advanced technology, bio-logging system, behavior and habitat use, conservation of wild animals and ecosystem, coastal management

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Sustainable agriculture for future generations: The case for oil palm

***Sharifah Shahrul Rabiah Syed Alwee**

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Bioagriculture means farming using sustainable methods where better use of fertilizers and other agricultural inputs not only leads to improve yields but also benefits the environment and the consumer. Felda Global Ventures (FGV) launched its first sustainability report this year pledging a continuous effort towards a sustainable palm oil business end-to-end. As the world's largest plantation operator, with some 850,000 hectares of predominantly oil palm plantations across Malaysia and Indonesia, FGV is taking a lead in its commitment to agricultural sustainability. FGV is also the first complete palm oil supply chain to attain the International Sustainability and Carbon Council (ISCC). Through its subsidiary companies, FGV is embarking on various projects and programmes, via a multi-pronged technological, biological and social approach, to get the most from its production by reducing waste and increasing efficiency, while ensuring that environmental sustainability remains at the fore in its farming operations. In this paper, we will focus on our R&D efforts in supporting the sustainable agriculture mandate of FGV.

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The shock of the new – Impact of molecular analyses of rheophytic and mesophytic Asian Araceae, and its role in better understanding the origins of the flora of Sunda

***Peter C. Boyce**

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Considerable advances using molecular analyses ("molecular systematics") has in recent years modified generic delimitation in the Araceae, established a reasonably stable internal phylogeny, and provided good estimates for divergence dating. An outcome of these analyses for Asia has been that several aroid genera hitherto considered taxonomically stable have been revealed to be polyphyletic, in some instances, notably *Piptospatha* N. E. Br., profoundly so. These taxonomic changes in turn have generated a need to reassess many of the morphological characteristics previously used to define genera, resulting in the realization that several of these key characters are homoplastic, very likely multiply-derived as advantageous in rheophytic and mesophytic habitats. On Borneo utilization of these better-understood taxa together with understanding of the canalized homoplasies that they possess has enabled a more meaningful mapping of species diversity onto geological and geographic data and through this exposed a previously obscured pattern of biomes, the existence of which impacts significantly on our understanding of the evolution of aroids, and very likely other plants, on Borneo and further afield in Sunda.

Keywords: Araceae, molecular analyses, systematics, Sunda

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Invasive species is a 'cancer' for an ecological ecosystem

***Mashhor Mansor**

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Every habitat in the world is not free from colonization of invasive species. Evidently some species are more robust and resilient. These species can travel and subsequently colonized and became adapted to the ecological ecosystems. As this happens the pristine ecosystems can transform into a disturbed habitat high in invasive species. The gradual ecological changes are seldom recognized. There are several examples of noxious species. *Mimosa pigra* colonies are known to infest most part of wetland, including Mekong Delta. The seriousness of this species has brought environmental catastrophe to the Mekong Delta. River fishing industries in Cambodia and Vietnam are greatly affected by this giant mimosa. Water hyacinth (*Eichhornia crassipes*) populations have affected more than 50 countries in the world. The massive growth of water hyacinth can block and clog a river system. Therefore, basic ecological concepts of invasive species invasion and evolution should be detected and identified. Generally the adaptation of invasive species for dispersal and established should be controlled.

Keywords: Invasive species, *Mimosa pigra*, *Eichhornia crassipes*, wetland, colonization

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Potential application of cloning and stem cell technologies in Malaysia

***Ramli Bin Abdullah** and Wan Khadijah Wan Embong

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Rapid advancement in reproductive technologies was shown in the last five decades. At the beginning of 21st century, cloning and stem cell research projects are actively carried out in various laboratories worldwide. As for cloning, both reproductive cloning and therapeutic cloning are the targets of research detailing on the scientific information and possible applications especially in livestock production and wildlife animals conservation. Stem cell research is mainly conducted to be applied in human regenerative medicine to treat degenerative diseases such as cardiovascular disease, Alzheimer disease and Parkinson disease. This presentation will discuss the basic technique and possible application of cloning and stem cell research in Malaysia.

Keywords: Application, protocols, reproductive cloning, stem cell, therapeutic cloning.

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Towards the molecular ecology of crows and other birds.

Urszula Krzeminska¹, Nur Omar Macha^{1,2}, Teh Ser Huy³, Gan Han Ming¹, Song Beng Kah¹,
Chris Austin¹, Sharifah Syed Hassan², Robyn Wilson¹ and *Sadequr Rahman¹

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²School of Medicine, Monash University Malaysia, Bandar Sunway, Selangor

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Birds are an important part of the ecosystem. Malaysia is host to an abundance of birds but in addition to the native birds, Malaysia also contains introduced species. One of these species is the common house crow (*Corvus splendens*). It is amongst the most-wide-spread bird species and can have many adverse effects on native fauna and flora, including predation, competitive displacement and disease. To study population genetics of this species and to understand its colonization patterns and recent evolutionary history, a set of molecular markers has been developed. The markers include autosomal microsatellites described in the previous studies of passerine birds, mitochondrial markers, the sex-linked *CHD* gene and SNPs identified by NGS. Such a broad set of markers can be used to determine the origin of the house crow populations, gene flow among populations and the rates of changes in the nuclear genome in comparison to the mitochondrial genome. Preliminary results revealed low levels of genetic variation within crow populations in Malaysia and Singapore and confirmed population isolation based on both nuclear and mitochondrial markers. In addition, markers have also been developed to study chickens. Techniques developed for the study of crows and chickens will be used to study birds which are of high conservation concern.

Keywords: *Corvus splendens*, chickens, markers, microsatellites

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Abstracts Biodiversity and Conservation

Ethnobotanical survey of medicinal plants used for traditional maternal health care in Katsina State, Nigeria

*Sulaiman, Sani Kankara^{1,2} and Rusea Go².

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Women in Katsina State, Nigeria have been using medicinal plants to cure various ailments associated with maternal health since time immemorial; however the use of such plants was never documented. In this study an ethnobotanical survey was conducted to document medicinal plants used for traditional maternal health care in Katsina State, Nigeria from August, 2014 to March, 2015. Semi structured questionnaire method was used to interview 300 respondents (50 from 2 Local Government Areas of each of the 3 Senatorial Districts) comprising of herbalists, Traditional Birth Attendants (TBAs), Traditional Physicians (*wanzama*), House Wives, Farmers and others. 111 medicinal plants belonging to 101 genera distributed among 50 families were documented. Most of the reported plants belong to the Fabaceae (22.52%), Asteraceae (7.21%), Malvaceae (5.41%) and Anacardiaceae (4.51%) families. *Acacia nilotica* (L) Delile and *Gueirasenegalensis* J.F. Gmel had the highest Relative Frequency of Citation (RFC) and Fidelity Level (FL) of 0.93; 100% and 0.92; 100%, respectively. Among the 19 categories of ailments, headache, navel pain, postpartum hemorrhage, postpartum wound healing and tooth pain had the highest Informant Consensus Factor (ICF) of 1.00 each. Most of the reported plants (68.47%) were herbs and shrubs and about 84.68% of the surveyed plants were wild. Leaves were the most frequently used (32.14%) plant's part. Most of the medications (32%) were prepared as decoctions and preparations were mostly administered orally (84.68%). Scientific validation of the biological properties of the surveyed plants is highly advocated and cultivation of medicinal plants to minimize the pressure on wild species is also recommended.

Keywords: Ethnobotanical survey, katsina state, maternal health care, medicinal plants, traditional.

Biomass and habitat characteristics of mangrove macro algae in Miri River Estuary, Sarawak

***Abu Hena Mustafa Kamal, Mohd Masum Billah, Mohd Hanafi Idris, Johan Ismail, Hasmida Isa and Nur Raihan**

Department of Animal Science and Fishery, Faculty of Agriculture and Food Sciences, Universiti Putra Malaysia Bintulu Sarawak Campus, 97008 Bintulu, Sarawak, Malaysia

Mangrove macro algae are unique to certain habitats. They are the major source of primary producers, energy sources, carbon sink and storage, habitat for small estuarine invertebrates as well as nitrogen fixers. Ten species of mangrove macro algae were namely, *Bostrychia kelanensis*, *B. radicans*, *B. moritziana*, *B. anomala*, *Caloglossa leuprii*, *C. ogasawaraensis*, *C. stipitata*, *C. adherens*, *Chaetomorpha linum* and *Dictyota* sp. The most common algae that grow in this mangrove ecosystem at Miri river estuary were *Caloglossa leuprii*, *C. adherens*, *C. ogasawaraensis*, *C. stipitata*, and *Chaetomorpha* sp. The number of macro algae was found higher at the bottom (6 – 9 species) compared to the apex (5 – 7 species). *Bostrychia* spp. were the most abundant macro algae at Station 1 for apex and followed by *Caloglossa* spp. The species, *Bostrychia* was more resistant to desiccation than *Caloglossa*. The algae, *Caloglossa* spp. were mostly common at the bottom of the pneumatophores than the apex. The total biomass of macro algae was found within 47.338 ± 68.93 to 100.840 ± 85.98 $\mu\text{g}/\text{cm}^2$ of pneumatophores surface in this estuarine habitat. The nutrients uptake and size of algae may influence on the total biomass of macro algae as nutrients are higher in the coastal and estuarine mangrove area.

Keywords: Mangrove, macro algae, biomass, habitats, Sarawak

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Can birds minimize crop damages caused by insect herbivores in oil palm agro-ecosystems?

*Nor Laili Ibrahim¹, Mohamed Zakaria¹, Norman Kamarudin³, Chong Leong Puan², Siti Nurhidayu Abu Bakar¹ and Badrul Azhar²

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Insect herbivores such as bagworms and grasshoppers are common pests in oil palm agriculture. In the case of oil palm agriculture, the use of birds as a biological control agent has not been widely studied. We investigated the association between bird richness and relative abundance with damages caused by insect herbivores in Peninsular Malaysia. We compared the richness and relative abundance of birds between insect outbreak and non-outbreak areas and examined the correlation between bird richness and its relative abundance with leave and crown damages. A total of 3,002 birds from 49 species were collected at the study sites. We found that the richness and relative abundance of insectivores was higher in insect non-outbreak areas (predicted mean of; richness=4.311 species, relative abundance =12.09 birds) than in outbreak areas (predicted mean of; richness=3.605 species, relative abundance=9.26 birds). There was significant negative correlations of bird richness and relative abundance between crown (overall; richness, $r=-0.530$, relative abundance, $r=-0.547$ and insectivore; richness, $r=-0.417$, relative abundance, $r=-0.427$) and leaves damage (overall; richness, $r=-0.560$, relative abundance, $r=-0.568$ and insectivore; richness, $r=-0.434$, relative abundance, $r=-0.432$). This study has shown that oil palm areas with high species richness and relative abundance of insectivorous birds were associated with low level of leaves and crown damages. Hence, we suggest that stakeholders to maintain avian biodiversity in oil palm agriculture in order to improve the productivity of oil palm yields.

Keywords: Insectivorous birds, species richness, relative abundance, leaves damage, crown damage

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Difficulties in species identification of mud crabs (*Scylla* spp.) from the Philippines

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Proper species identification of mud crabs (*Scylla* spp.) is a key step in optimizing management of this important marine natural resource. Currently accepted methods of classifying these organisms recognize four species, *S. serrata*, *S. tranquebarica*, *S. olivacea*, and *S. paramamosain* that are distinguishable based on their frontal lobe spine shape, the presence or absence of their inner and outer carpus spines, the configurations of the pincers in the first pair of chelipeds, and their color. Obvious mismatches in the set of morphological features that define each species for samples collected in five sites all over the Philippines made identification difficult. Morphometric methods were found to be most useful in differentiating the four species into two clusters, with one cluster comprised of the species having distinct inner and outer carpus spines, and the other cluster with those lacking inner carpus spines. Comparison of amplified nuclear ITS-1 and mitochondrial 16-s rDNA sequences from data in the BLASTn database provided more than one possible *Scylla* identities, and some were in conflict with the samples' morphological features. The results imply a need for the incorporation of more distinguishing morphological features, but the proportions of the inner and outer carpus spines, and the length and width of the abdominal flap show promise in providing another dimension to help in differentiating the four species.

Keywords: Mud crab, systematics, biodiversity, natural resource management

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Vomifolliol, a sesquiterpene isolated from *Pandanus leram*

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A compound was isolated as colourless oil from a chloroform fraction of a screwpine or pandan species (family: Pandanaceae). This *Pandanus* plant is scientifically known as *Pandanus leram*. Subsequent to the chloroform extraction of the dried leaves, a column chromatography was performed to obtain the pure metabolite. The silica thin layer chromatographic (TLC) profile of this UV-active compound was also established. A brownish spot appeared, after the TLC plate was sprayed with anisaldehyde reagent, followed with a mild heating. The ¹H and ¹³C Nuclear Magnetic Resonance (NMR) data indicated that this compound belongs to the class of sesquiterpene, having 13 carbon atoms. More details of ¹H and ¹³C spectral evidences of this natural product will be presented. These results were also parallel with those reported in the literatures. Therefore, it was concluded that this compound could be identified as vomifolliol, which is similar to the one isolated from *Pandanus simplex*. It is hoped that the biodiversity and chemotaxonomy of the *Pandanus* genus could be continuously investigated and learnt for future generations.

Keywords: Biodiversity, pandan, sesquiterpene

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**Forest biodiversity conservation through co-management approach:
Experience from Bangladesh**

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Since 2004 the Bangladesh Forest Department (FD), with funding from several donor agencies, has been implementing protected area (PA) co-management project in Bangladesh to protect rapidly deteriorating forest biodiversity. This study was conducted in the Chunati wildlife sanctuary (CWS) to examine forest tree diversity, structure and biomass production, and how co-management works towards forest conservation. Local people are heavily dependent on CWS forests for household consumption and income. They clear forest land for betel leaf cultivation, sun grass production and growing food crops. A forest vegetation survey, in 140 circular plots each of 0.1 ha, identified 93 tree species under 36 families with an average density of 239 trees/ha of which seven exotic species comprised 60%. Nearly 90% trees belong to 5-15 cm diameter class producing a basal area of 2.64 m²/ha and biomass of 33.3 t/ha. The Shannon-Weiner diversity index and index of dominance were 3.15 and 0.09, respectively. A four-tier co-management governance structure was observed at local level consisting of village conservation forums, people's forums, community patrol groups and a co-management committee, with each component having their own functions. Even though the local level co-management structure has no active participation in the managerial decision-making process and has little coordination with the project implementing bodies, community patrol groups have been protecting forests and hence forests seem growing well. Effective involvement of co-management committee in management and creation of alternate income generation activities are needed to ensure sustainability of PA co-management in the CWS.

Keywords: Alternative income generation, community patrol, effective participation, forest biodiversity, land-use changes

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Mercury concentration in selected estuaries and coastal sediments along the Straits of Malacca

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Elevated mercury concentration in sediment could threaten the estuaries and coastal system. Current work outlined the concentration of mercury in sediments of selected estuaries and coastal sediments along the Straits of Malacca. Total mercury were extracted by using modified ultrasound assisted mercury extraction method and analyzed by flow injection mercury system. The mean concentration ($\mu\text{g/kg}$) for total mercury in sediment samples was 61.43 ± 23.25 with the ranged from 16.55 ± 0.61 to $114.02 \pm 1.54 \mu\text{g/kg}$. The highest mercury concentration ($114.02 \pm 1.54 \mu\text{g/kg}$) was documented in Juru station. Compared to Canadian interim marine and freshwater sediment guideline, mercury concentration of sediment was found not to be exceeding the permissible limit. This study could provide latest benchmark of mercury pollution and it is beneficial to future monitoring works in tropical estuaries and coastal sediments.

Keywords: Estuaries, coastal sediment, guideline, mercury contamination, Straits of Malacca

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Effect of yeast extract and coconut water on protocorm proliferation and growth development of *Dimorphorchis rossii*

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Dimorphorchis rossii is an epiphyte orchid that endemic to Borneo, specifically Sabah. Forest clearance and fires on its natural habitat contributed to the extinction of this orchid. In attempt to preserve this exquisite orchid, an efficient propagation protocol was established by means of plant tissue culture. In this study, optimization of media compositions containing complex additives was used to observe protocorms proliferation and shoots development. The main objective was to determine the effect of coconut water (CW) and yeast extract (YE) on protocorm proliferation and growth development. The protocorms used in this study were obtained from *in vitro* seed germination of *Dimorphorchis rossii* and were cultured on Murashige and Skoog basal medium treated with 10%, 15% and 20% (v/v) CW or 0.1%, 0.2% and 0.3% (w/v) YE. Cultures were grown under 16 hour light at $25 \pm 2^\circ\text{C}$ for 130 days of culture. The highest protocorm proliferation ($41.67 \pm 0.51\%$) was observed on 0.2% (w/v) YE, and followed by 0.3% (w/v) YE ($31.25 \pm 0.48\%$). New protocorms produced in both complex additives were 3.20 ± 2.35 and 2.00 ± 1.02 , respectively. Meanwhile, protocorms grown on medium containing 10% (v/v) CW promoted the best complex additive for protocorms developed to seedlings with $78.33 \pm 0.42\%$ and $66.67 \pm 0.48\%$ of the explants produced leaf and root. This medium also recorded the longest length of leaf ($3.43 \pm 2.46\text{mm}$) among other treatments. The highest number of leaf (6.28 ± 3.90) and length of root ($3.71 \pm 3.76\text{mm}$) were obtained on medium treated with 15% (v/v) CW. Thus, it can be concluded that YE is preferred most for protocorm proliferation, while CW is for protocorm growth development to seedlings.

Keywords: *Dimorphorchis*, coconut water, yeast extract, protocorms, proliferation

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Waste marine barnacles as solid catalyst for methyl ester preparation using catfish (*Pangasius*) fat as feedstock

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The total energy demand increase year by year, unfortunately world energy sources rapidly declining. The alternative energy sources especially using waste as feedstock becoming trendy idea recently. Therefore, the waste oils/fats, as well as catalyst from waste materials, for producing methyl esters (biodiesel) via transesterification have been of recent interest. In the present work, the transesterification catfish fat using barnacle as a catalyst was attempted. X-ray diffraction and electron dispersive X-ray (EDX) results show that, upon thermal activation, shell transformed into CaO, the active ingredient that catalyzes the reaction. In addition, the results showed that the methyl esters (ME) content of barnacle was at 93.6 ± 0.3 with the 3 h reaction duration at 65 °C. Optimization of reaction parameters revealed that MeOH: oil, 12:1; catalyst, 4 wt. % as optimal reaction conditions. Furthermore, the catalyst can be reused four cycles while maintaining ME conversion at 89.0%.

Keywords: Transesterification, heterogeneous catalyst, catfish fat, barnacle, biodiesel

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Orchids in the summit region of Gunung Jerai, Kedah

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Species diversity and distribution survey of Orchidaceae was conducted at the summit region in Gunung Jerai, Kedah. Many field collections were carried out since 2004, which covered five trails with elevations above 700 metres above sea level. A total of 73 species that represent 42 genera have been collected. All the species were identified based on their morphological characteristics, which is vegetative structure and floral structure by referring to books and herbarium specimens. Based on individual and population count, the most common species found in this study is *Apostasia nuda*, *Arundina graminifolia*, *Corybas geminiggibus*, *Podochilus microphyllus*, *Podochilus muricatus*, *Podochilus tenuis*, and *Spathoglottis plicata*. There are 17 new records to Kedah, 2 endemic species, and 1 new record to Malaysia. The 17 new records are *Anoectochilus geniculatus*, *Bryobium hyacinthoides*, *Bulbophyllum apodum*, *Bulbophyllum brevipes*, *Calanthe lyroglossa*, *Ceratostylis gracilis*, *Chrysoglossum ornatum*, *Coelogyne swaniana*, *Crepidium rheedel*, *Dendrobium pachyglossum*, *Dendrochilum kingii*, *Eria pilifera*, *Lecanorchis malaccensis*, *Malleola sylvestris*, *Plocoglottis lowii*, *Trichoglottis lanceolaria*, *Trichoglottis winkleri*, and *Zeuxine strateumatica*. *Bulbophyllum sigaldiae* is new record to Malaysia. The 2 endemic species are *Bulbophyllum linearifolium* and *Dendrobium hughii*. Although the same trails had been visited for several times, but chances of discovering new records was always evident with two to three species identified as new records in every visit. Therefore, it is obvious that Gunung Jerai harbors a very diverse orchid species and need to be studied further comprehensively in order to reveal the true status of diversity that could be utilized as data to support conservation plan.

Keywords : Conservation, distribution, diversity, gunung jerai, orchidaceae

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Inoculation of blue green algae in paddy soil using artificial plots

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Studies were carried out to propagate beneficial filamentous blue-green algae isolated from paddy field and to inoculate blue-green algae into the test plots. Three samplings were carried out in the paddy field in Sungai Manik, Perak. In this study, blue-green algae were cultured in Fogg's media using water samples collected in Sungai Manik. The purpose of this culturing was to obtain an adequate amount of blue-green algae for the inoculation in artificial plots. Cultures were also monitored for twenty days to observe the changes in the growth of algae. Results showed that three species were found in Fogg's media: *Oscillatoria* sp., *Anabaena* sp. and *Nostoc* sp. *Oscillatoria* sp. was the predominant species while *Nostoc* sp. became dominant at the end of culture. For algalization study, the plants and roots taken from the inoculated plot were significantly bigger in size ($R < 0.01$), compared to the plants taken from the control plot. Results showed that the percentage increase for the effect of algalization over control for both plant and root growth were 88.90 % and 73.89 % respectively. The changes of algae in Fogg's media showed that green algae from the division Chlorophyta were the predominant species in the beginning of the cycle followed by the blue-green algae that became dominant in the end of the culturing period.

Keywords: Blue-green algae, inoculation, algalization

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Vanilla of Peninsular Malaysia

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Natural vanilla is extracted from at least three *Vanilla* species from Subfamily Vanilloideae of the Orchidaceae family, among which *Vanilla planifolia* is the most known species. It is native to Mexico and supplies 95% of the world commercial natural vanilla. This species does not occur naturally in Malaysia but there are seven species of vanilla, *V. abundiflora*, *V. aphylla*, *V. borneensis*, *V. havilandii*, *V. griffithii*, *V. montana* and *V. kinabaluensis* that are indigenous to Malaysia. However, they are not cultivated and no documentation on their economic significance. To date, there are 110 vanilla species recognized globally and the potential of each species still remains a mystery, as the genus is not comprehensively studied. Currently, all natural species including the widely cultivated *V. planifolia* are considered as threatened as habitat fragmentation and destruction at its natural habitat, and susceptibility to environmental disruptions has caused massive reduction of population in the wild. The recent diversity studies on Peninsular Malaysia's vanilla species revealed that the distributions of the genus are best described as constantly sparse, widespread and in many habitats. Wild vanillas have been recorded in hill dipterocarp forest, lowland dipterocarp forest, peat swamp forest and coastal hill forest. The absences of the reproductive structures have complicated the taxonomic revision, which served as the fundamental process for the utilization study of the local species. However, these species were observed to have differences in vegetative morphological characteristics. Morphological analysis from leaf characteristics showed variations indicating species identification is possible using leaf morphology as descriptors.

Keywords: *Vanilla* species, Peninsular Malaysia, distribution, leaf morphology

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***In vitro* propagation of an epiphytic orchid *Dimorphorchis lowii* through shoot tip culture**

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Multiple shoots were induced from the shoot tip explants derived from the *in vitro* grown seedlings of an endangered and horticultural important epiphyte orchid, *Dimorphorchis lowii*. Shoot tip explants were cultured vertically and/or horizontally on solidified Knudson C media (KC) treated with various concentrations of Kinetin (Kn) and 6-Benzylaminopurine (BAP) for shoots multiplication. The maximum number of healthy shoots was observed on KC with Kn (2.0 mg/l) with an average of 5.05 shoots per explant in 180 days when placed horizontally; where shoot multiplication was initiated after 4 weeks of culture. Regenerated shoots were root-induced on KC with various concentrations of NAA, IAA and IBA. Shoots cultured on KC with IAA (1.0 mg/l) and IBA (0.5 mg/l) combination was the most appropriate plant growth regulator and concentration for rooting. The well-developed *in vitro* rooted plantlets were acclimatized successfully in the potting mixture containing coco peat and sphagnum moss in the ratio of 2:1. This is the first report for *in vitro* propagation of *D. lowii* through shoot tip culture. The protocol developed can be utilized for both large-scale plant production and germplasm conservation of this species.

Keywords: *Dimorphorchis lowii*, *in vitro*, plant growth regulator, shoot multiplication

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Orchid survey in heath forest of Terengganu

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Heath forest occurs on acidic sandy soil is often lacking in nutrient, low in natural fertility and always related with drought and heat load. Thus the heath forest biodiversity is always associated with having low species richness when compared to other lowland rain forest. However, inside the forest exist a very attractive and stunning Orchid species. In this study, we managed to find at least nine genus of Orchidaceae survive in the forest. One of the remarkable genus is *Phalaenopsis pulcherrima* (Lindl.) J. J. Sm., which is previously known as *Doritis pulcherrima*. We managed to find at least ten colour variation of the flower ranging from dark purple to purplish white almost completely alba. We believe the colour variation is related with the environmental and genetic condition of the plant species. This species is very special because can survive in the harsh environment even though does not have bulb vegetative structure which is common vegetative structure for orchid that lives in dry area to store nutrients and water. Yet, it adopted a thick leaves features and velamen root structure which is thought as another survival factor for the species to survive. How this species and other orchid genera survive in the heath environment is still in discussion and need further investigation in relation with their anatomical and vegetative structure, soil properties and the environment. We hope with this finding we can managed our heath forest biodiversity with care and conserve this valuable nature just like any other reserve tropical rain forest rather than being seen as a wasteland.

Keywords: Heath forest biodiversity; Orchidaceae; *Phalaenopsis pulcherrima*; *Doritis pulcherrima*.

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Species diversity and utilization of medicinal plants In Khok Dong Keng Public Forest, Na Dun District, Maha Sarakham Province, Thailand

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Khok Dong Keng public forest is the one housing diversity of edible and medicinal plants for people in Na Dun District, Maha Sarakham Province. This research aims to study the medicinal plants in this forest concerning their species diversity by plot sampling with eight 20×20 m² plots and their medicinal properties by interviewing a forest ranger who is expert in medicinal plants. The questionnaires were performed with two traditional healers and 330 villagers who live around the forest area for medicinal plant utilization. The plot sampling, with a guide from the forest ranger showed 80 species of the medicinal plants. Where the traditional healers have used 71 medicinal plant species, of which 37 species were explored in the forest. In addition, the data from 330 questionnaires revealed that the villagers have used 106 species, with 38 common species as observed in the forest, for curing 46 diseases. Concerning these data, the informant consensus factor (ICF) ranges between 0 and 1. The higher the ICF the more people use the same plant for the specific curing. The highest ICF includes using *Chromolaena odorata* for hemostatic and *Phyllanthus emblica* for antiscurvy, for examples. Furthermore, specificity of the plant used to the disease was determined by fidelity level (FL) which ranges from 25 to 100%. The species with 100% FL are *Chromolaena odorata*, *Cissus quadrangularis*, and *Solanum incanum*, for examples, which have been used for hemostatic, antihemorrhoid, and expectorant, respectively.

Keywords: Species diversity, medicinal plants, Kok Dong Keng public forest, Shannon's diversity index, informant consensus factor, fidelity level

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The influence of elicitor Cu^{2+} and Fe^{2+} to asiaticoside level of pennywort (*Centella asiatica* L.Urban) callus

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Pennywort (*Centella asiatica* L. Urban) is one of medicinal plants that contain a variety of secondary metabolites content including asiaticoside and madecacoside. Secondary metabolites content from pennywort plant has benefits for memory, burns, nerve disease, hypertension, asthma, bronchitis and urethritis. Secondary metabolites content can be increased by elicitation using elicitor such as metal ion of Cu^{2+} and Fe^{2+} . The administering of the metal ion Fe^{2+} on subculture medium will cause the existing of stress so production of secondary metabolites increased. In this research Fe^{2+} give effect on color and asiaticoside content, but has no real effect on the texture and weight of callus. Higher concentration of Fe^{2+} added to the medium increase the color intensity of the callus indicate the increase of secondary metabolites content. The highest callus weight (0,283 g). was obtained from the treatment of 110 μM Fe^{2+} . The highest asiaticoside content (* 3,792 g/100g) was showed by the addition of 100 μM Fe^{2+} . The optimum concentration of Fe^{2+} for development of secondary metabolites content of asiaticoside and madecacoside was the concentration of 100 μM . Cu^{2+} affected the Pennywort callus colour. The more concentrated Cu^{2+} cause the callus to be more brown. Cu^{2+} gave a slight effect on the callus texture, however it had no significant effect on the weight of callus, but there was a tendency of increasing in callus weight compared to initial weight. The highest secondary metabolite contents (4,1595 g/100g) showed by the treatment of 40 μM Cu^{2+} .

Keywords: Elicitor, asiaticoside, callus

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The effect of endogeic earthworm, *Pontoscolex corethrurus* (Müller, 1857) on banana infected by blood disease – a histological study

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The occurrence of blood disease has caused an alarming effect to the banana industry in Malaysia. The disease spread through flower-visiting insects or contaminated soil and planting equipment. Endogeic earthworms are soil biota that help to improve soil physico-chemical and biological properties thus, promote plant growth. The present study was conducted to determine the effect of *Pontoscolex corethrurus* on banana infected by blood disease as there is lack information on such interactions at present. The effect of earthworm was evaluated through histological comparisons of the stem and root section of the plants. *P. corethrurus* was inoculated into polybags planted with banana plantlets. Whilst, inoculation of blood disease bacterium (BDB) into the roots of the plantlets was done using drenching method. All plantlets were maintained under glasshouse condition for 3 weeks. Upon harvest, root and stem sections were preserved in formalin acetic acid (FAA) solution for histological study. Observation under microscope revealed that the vascular bundle of infected root section was blocked compared to its counterpart treated with earthworm and the control. Although the infected plantlets treated with earthworms showed disease symptoms but the disease was less severe. The results suggested the potential role of *P. corethrurus* in buffering the effect of BDB on banana plantlets.

Keywords: Banana, blood disease bacterium (BDB), endogeic earthworm, *Pontoscolex corethrurus*

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Species composition of Lianas in Berembun Virgin Jungle Reserve, Negeri Sembilan, Malaysia.

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Liana is one of the important components in forest dynamics of tropical rain forests. Liana is an autotrophic plant based on its growth habit. However, conservation programme of lianas in timber production forests are at early stage. A study was conducted to determine the liana species composition in a lowland dipterocarp forest at Berembun Virgin Jungle Reserve (VJR), Negeri Sembilan, Malaysia. Four plots of 50 m x 50 m (0.25 ha) were established, and each plot was divided into 10 m x 10 m subplots (0.01 ha) laid out downward perpendicular to the altitudinal gradient. All lianas $\geq$ 1cm and above were tagged, enumerated and voucher specimens were recorded and documented. Floristic composition of the Berembun VJR recorded a total of 246 individual of lianas belonging to 23 families, 45 genera and 68 species. *Omphalea bracteata*, *Spatholobos ferrugineus*, *Spatholobos maingayi* and *Willughbeia tenuiflora* were the most important species in Plots 1, 2, 3 and 4 with the Importance Value Index (IVI) of 36%, 26%, 23.7% and 35.3%, respectively. Furthermore, *Omphalea bracteata* (11%) was the most abundant species followed by *Fibraurea tinctoria*, *Friesodielsia glauca*, *Mitrellia kentii*, *Spatholobos maingayi*, *S. ferrugineus*, *Tetracera fagifolia*, *Byttneria maingayi*, *Friesodielsia affinis*, *Millettia sericea*, *Parameria polyneura*, and *Pyramidanthe prismatica*.

Keywords: Climber, importance value index, virgin jungle reserve, Peninsular Malaysia

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Batch process for bio-hydrogen production on small scale bioreactor from palm oil mill effluent (POME)

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In this study, treatment of palm oil mill effluent (POME) was carried out under anaerobic fermentation process to produce bio-hydrogen by micro flora. Experiment was investigated in 500mL bioreactor under mesophilic operation at and different pH values. Raw POME was collected from cooling pond which is final discharge of effluent from the mill and POME sludge was collected from the anaerobic pond of a POME treatment plant at Labu palm oil mill. The source of inoculum used was POME sludge as hydrogen producing bacteria. A batch reactor was set up producing hydrogen at an optimum parameter of pH 5.5 and 10% POME sludge (w/v) with a maximum hydrogen production yield of 5988.96 mL H₂/ L-med. The maximum hydrogen percentage in the biogas was 36% obtained at pH 5.5. Throughout the study, there no methane gas was observed in the evolved gas mixture.

Keywords: Bio-hydrogen, POME sludge, raw POME, microflora

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Identification of bioactive compounds produced by bacteria-based biopesticides, *Bacillus thuringiensis* ATCC 10792 produced in shrimp pond sludge.

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Biological controls of destructive pest in forest and agriculture sector using bacteria were proven to minimize the problems caused by the usage of chemical insecticides. However, their application is limited due to high production cost through fermentation. In this study, shrimp pond sludge and wastewater were used as an alternate culture medium for bacteria-based biopesticides production. It has been determined by previous part of this study that *Bacillus thuringiensis* ATCC 10792 in hydrolysed shrimp pond has showed the highest potential to be used as bacteria-based biopesticides based on their high growth rate ($7.44 \times 10^6 \pm 5.16$ CFU/ml) and sporulation ($5.90 \times 10^6 \pm 7.88$ CFU/ml). Bioassay of entomotoxicity also showed high mortality rate, disruption on the target insect physically and affect the life cycle of the target insect. Hence, proteomic analysis using SDS-Page and MALDITOF-MS were conducted to identify the bioactive compound that contribute to the toxicity of the bacteria-based biopesticides produced. Separation and identification of the bioactive components produced by the bacteria during the fermentation were done and two types of protein were produced by the bacteria. Superoxide dismutase and spore coat protein were identified to be produced during the fermentation and respectively play an important roles to the toxicity of the bacteria. This study showed the potential of *Bt* ATCC10792 to be used as biopesticides.

Keywords: Toxin, SDS-Page, MALDITOF-MS, protein

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Biodiversity and succession of freshwater algae in Hutan Simpan Ayer Hitam Forest Reserve, Puchong Selangor

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The succession and dominant of freshwater algae were studied in the north lake of Ayer Hitam Forest Reserve. Sampling was performed for thirteen weeks, from the end of the November 2013 to the end of the February 2014. Water sampling for biological analysis was done during the thirteen weeks. The structural community was determined by population density, class of algae and diversity indices. The community of freshwater algae consisted of 15 species from 5 different phyla which are Ochrophyta, Dinophyta, Charophyta, Cyanophyta and Chlorophyta. The Dinophyta had the highest total density in the thirteen weeks and two species from three species of Dinophyta were the most conspicuous species in the succession which are *Gonyaulax apiculata* and *Gymnodinium palustre*. The dominance of Dinophyta was during week 2, 3, 6, 7, 10 and 11. Dinobryon sertularia from phylum Ochrophyta had the highest density and being dominant during week 1, 4 and 5. For the Cyanophyta, *Anabaena subcylindrica* had the highest density as compared to the other species of Cyanophyta. *Anabaena subcylindrica* was being dominant during week 8, 9 and 13. For diatom *Navicula* sp. (Ochrophyta), the highest density was obtained during week 12. The Shannon-Weaver index had the highest during week 12 and the lowest during week 4. The highest Evenness index occurred during week 3 and the lowest during week 4. The pattern of succession and dominant of freshwater algae in a north lake of AHFR was associated with the physico-chemical parameter especially nutrient status, pH, temperature and light intensity.

Keywords: Algae, freshwater, succession, dominant, north lake of Ayer Hitam Forest Reserve, physico-chemical parameter

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Anatomy of selected *Lygodium* species in Chini Lake, Pahang

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A study on the frond of two species of *Lygodium* namely *L. flexuosum* and *L. microphyllum* was undertaken. The objective of this study is to verify the anatomical characteristics between these 2 species. Sample was collected from Chini Lake, Pahang and method used in this study was sectioning using sliding microtome. The samples were observed after going through the clearing, colouring, dehydration and mounting process. Result showed that three cross section which were lamina, midrib and margin can be used to differentiate between *L. flexuosum* and *L. microphyllum*. Whereas, for the stipe cross section, epidermal peel and clearing of these 2 species showed no different in their anatomical characterization. As for conclusion, results for leaves anatomical characteristics of *Lygodium flexuosum* and *L. microphyllum* can be very useful as additional data for species differentiation and also in identification of species.

Keywords: Anatomy, frond and *Lygodium*

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Bioeconomic study a marine phytoplankton *Chaetoceros calcitran* by using commercial and formulated fertilizer

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Studies were carried out on two different aspect of marine diatom, *Chaetoceros calcitran*. First is the measure of cell growth base on number of cells and dry weight in different culture media such as LCP, LCP + clewat 32, Japanese Media and Conway Media as reference. The second study is looking at the effect of growth in different tank such as glass tank, conical fiberglass tang and rectangular fiberglass tank. All the culture of *Chaetoceros calcitran*, was carried out in outdoor tank, salinity of 23.25 ‰ and ambient air temperature of 27-36 °C. Throughout the study, the weather is sunny. Results shows that *Chaetoceros calcitran* cultured in Conway media has the highest cell at 1.843×10^6 cells (maximum cell number) and 0.870 g/L (maximum dry weight). The Cultivation cost for Conway media and LCP were RM 41.227 and RM 74.833 respectively. The results from second showed growth are in the glass tank which is 1.687×10^6 cell/ml (maximum cell growth) and 0.783 g/L (maximum dry weight). Cultivation in a glass tank also showed that the lowest production cost at RM 45.191 /g dry weight compared to the fiber conical tank and rectangular fiber glass tank.

Keywords: Conway medium, *Chaetoceros calcitran*, marine phytoplankton, diatom, LCP

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Bioeconomic study of *Chlorella vulgaris* in outdoor tank culture by using different types of fertilizer

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Four different culture mediums that were Bold Basal, commercial fertilizer, modified fertilizer and modified Bold Basal were used to cultivate *Chlorella* sp. in outdoor tanks. The modified fertilizer was formulated according to the NPK ratio in Bold Basal medium (control). Clewat 32 (0.01 g/L) was used in modified Bold Basal to replace the micronutrient in Bold Basal medium. The growth of *C. vulgaris* in outdoor culture was determined daily by cell count and dry weight every two days. The result of this study shows that, culture in modified fertilizer has no effect in improving the total production in outdoor culture. Meanwhile, culture in Bold Basal medium has relatively higher productivity (1.14 g/m²/day) at its optimum if compared to modified Bold Basal medium at 1.08 g/m²/day. Thus, the production cost per gram in 100 L outdoor tank culture was less expensive for Bold Basal medium which is about RM 21.13/g but moderately higher in modified fertilizer (RM 26.75/g). Bioeconomic studies revealed the weakness particularly with respect to the biological component. Possible weaknesses in the biological component are low productivity, unsuitable strain of *Chlorella* sp., weather, culture technique and scale of production.

Keywords: Bold basal medium, *Chlorella vulgaris*, cost, bioeconomic, outdoor.

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Comparison of tree composition between logged-over and virgin forest at Ulu Muda Forest Reserve in Kedah, Malaysia

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The present study was carried out to compare the composition of tree species between a logged-over and virgin forest (Compartment 28A and 35A) in Ulu Muda Forest Reserve, located in the state of Kedah, Peninsular Malaysia. The total area covered was two hectares, one hectare each from both forests. Trees having stems with a diameter of ≥ 1 cm at breast height (dbh) were enumerated, identified and their heights measured. The Importance Value Index (IVI) was also calculated. For this study, several SDR 4 (Species Diversity and Richness) equations were used to calculate species diversity such as Shannon-Wiener index, Simpson's index and Evenness. A total of 1110 trees with 332 species in 148 genera belonging to 58 families were recorded in the logged-over forest while 976 trees with 181 species in 93 genera belonging to 41 families were recorded in the virgin forest. The highest importance value was shown by *Ochanostachys amentacea* (IVI=12.53) in the logged-over forest, and *Mallotus kingii* (IVI=18.26) in the virgin forest. Family Importance Value (FIV) was highest for the family Euphorbiaceae in both the logged-over and virgin forests with (FIV=66.10) and (FIV= 53.51), respectively. Euphorbiaceae was the most diverse family in both the logged-over forest (10 genera, 30 spp.) and virgin forest (11 genera, 25 spp.)

Keywords: Species composition, species diversity, Ulu Muda Forest Reserve, stand density, importance value index

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Different salinity effects on the mass cultivation of spirulina (*Arthrospira platensis*) using urea as nitrogen source in Oman and Malaysia

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Mother earth is facing multitude of problems such as desertification, diminishing cultivation land and malnutrition. One way to overcome these problems is through cultivation of *Spirulina* (*A. platensis*). This paper focused on the different effects of salinity and comparative climate patterns to the mass production of *A. platensis* in Oman and in Malaysia. With extremely contrasting environment, *A. platensis* has unique ability to grow in both tropical (Malaysia) and arid (Oman) outdoor conditions. Mass cultivation has been carried out at different salinity 5, 15, 25 and 35 ppt for 10 days with triplicates in both countries. The total volume of culture in each tank and land photobioreactor was maintained at 100 L and 50L respectively. In Oman, the highest optical density (ABS) was 1.691 ± 0.099 at 5 ppt significantly different and higher than 25 and 35 ppt ($p < 0.05$). Though, the highest biomass (g L^{-1}) achieved with 35ppt, 0.848 ± 0.039 was not significantly different from other salinity concentration ($p > 0.05$). While in Malaysia, the highest optical density (ABS) recorded with *Spirulina* dry weight was collected from *Spirulina* culture treatment with 5 ppt, 0.974 ± 0.052 was not significantly different from other salinity treatments ($p > 0.05$) and the dry weight at $0.575 \pm 0.032 \text{ g L}^{-1}$ was significantly different to 25 and 35 ppt ($p < 0.05$). Highest average mean $\pm$ SE of pH in Oman and Malaysia were recorded with salinity treatment of 15 ppt, 10.60 ± 0.058 and 10.20 ± 0.037 .

Keywords: *Spirulina*, *Arthrospira platensis*, salinity, photobioreactor, climate pattern

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Effect of herbal supplements on antimicrobial activity of kombucha tea

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Each microorganism of symbiotic Kombucha association produces metabolites with antimicrobial activity against many pathogenic and opportunistic microorganisms. The aim of this work was to study the effect of various herbs infusions (sage *Salvia officinalis* L., common marigold *Calendula officinalis* L., thyme *Thymus vulgaris* L., peppermint *Mentha × piperita* L., oregano *Origanum vulgare* L., lemon balm *Melissa officinalis* L., St. John's wort *Hypericum perforatum* L.) on the synthesis of Kombucha tea's metabolites having antimicrobial activity. We used seven opportunistic bacterial cultures (*Enterobacter aerogenes*, *Escherichia coli*, *Salmonella enteritidis*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Bacillus subtilis*) as the test culture. The results showed that all studied herbal extracts, except St. John's wort, enhanced the antibacterial activity of Kombucha tea, and it did not change, depending on the test culture and the species of plant. This study supported by a project "Development of technology for production of the biologically active microorganisms association on the basis of the natural strains" of the Pavlodar State Pedagogical Institute, Pavlodar, Kazakhstan.

Keywords: Antimicrobial activity, kombucha, medicinal herbs, test culture

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Effects of NaNO₃ and KNO₃ In kosaric fertilizer on the growth of *Arthrospira platensis*

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This study was carried out to determine whether the replacement of NaNO₃ to KNO₃ in Kosaric media can give better growth to *Arthrospira platensis*. The growth of *A. platensis* in different culture media was which are Kosaric media and Kosaric media with the modifications of NaNO₃ to KNO₃ at concentration of 0.75, 1.25, and 1.75g/L in indoor condition. The pH value for Kosaric media shows the highest reading which is 9.63, followed by both modified Kosaric media with the addition of 1.25g/L KNO₃ and 1.75g/L KNO₃ which have the same reading of 9.58, and 9.56 for modified Kosaric media with the addition of 0.75g/L KNO₃. Cell dry weight is 2.13mg/L for modified Kosaric media, i.78mg/L for modified Kosaric media with the addition of 1.25g/L KNO₃, 1.61 mg/L. for modified Kosaric media with the addition of 0.75g/L KNO₃ and 1.18mg/L for Kosaric media. While for chlorophyll a content, Kosaric media shows the highest value which is 2.79mg/L, followed by modified Kosaric media with the addition of 1.75b/L KNO₃ (1.65mg/L), modified Kosaric media with the addition of 1.25g/L KNO₃ (1.29mg/L), and modified Kosaric media with the addition of 0.75g/L KNO₃ (1.09mg/L). Kosaric media is still the best culture media for culturing of *A. platensis*. Except for cell dry weight, the modified Kosaric media with the addition of 1.75g/L KNO₃ shows the highest reading. The alternative commercial fertilizer that are cheaper than Kosaric media are hoped to replace Kosaric media in culturing *A. platensis*.

Keywords: Kosaric medium, *Arthrospira platensis*, NaNO₃, KNO₃.

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Enhancing barn owl population in rice fields through installation of tree nest boxes

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Barn owls, *Tyto alba* are effective biological control agent for controlling rice field rats, *Rattus argentiventer*. This predatory bird population is now being increased by erecting artificial nesting boxes for them to shelter and breed. At present, most nest boxes are pole type, made from either wooden board or fiber glass and erected on iron poles. The use of iron poles is costly and can easily be stolen due to their high value. As alternative, installment of artificial nest boxes made from plywood, attached to tree trunks instead on iron poles is more appropriate and practical. Cost per unit (materials and labor) is RM161.40 and much cheaper than fiber glass box (RM497) and wooden board box (RM691). Installment of tree nest boxes without the need of using iron poles also greatly reduce the cost. Installment and observation of the effectiveness of these tree nest boxes were conducted at MARDI Seberang Perai. Average crop damage by rat attack was 25.28% and 19 individual rats were caught through trap barrier system (TBS) in one-month period before the installment of the tree nest boxes (Main season 2012/2013). After installment of 20 unit boxes (Off season 2013), the average crop damage was reduce to 5.94% and only 4 individual rats were caught by TBS in three-month period of sampling. This showed that the barn owl population in MARDI Seberang Perai was increased successfully. Several adult owls were observed occupying and actively roosting in the nest boxes. Predation activity also can be sensed by observing the undigested bones and fur of the rats in pellet forms found inside the nest box. This technology brings benefit to farmers by reducing the crop yield loss caused by rat attack. Aside from giving an effective control as well as minimizing the use of chemical rodenticides, barn owl tree nest boxes is a simple technology, cheap, easy for farmers to implement it by themselves, and also has potential to be commercialized.

Keywords: Barn owl, rice field rat, biological control, conservation, tree nest box

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Fatty acid profile of *Chlorella vulgaris* commercial cultured in different concentration of fertilizer and salinity

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Chlorella vulgaris could be consumed as a complete supplementary food in the diet. *Chlorella* sp. is high in fatty content, especially Essential Fatty Acid (EFA). *Chlorella vulgaris* was cultured in different culture media, and then FAME were extracted from the sample following Ostrowski and Divakaran method to the study the fatty acid profile. The result showed the polyunsaturated fatty acid reached to the highest percentage on the seventh day of the cultivation. The cell growth as well as the dry weight reached the peak during the same day. By looking at the PUFA content in different medium, the modified Bold Basal medium has the highest PUFA content among all. The result also showed that the ratio of omega-3: omega-6 is about 2:10. This showed that *Chlorella vulgaris* could be taken as a balance food.

Keywords: *Chlorella vulgaris*, Essential Fatty Acid (EFA), bold basal medium, omega-3, omega-6

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***Fusarium* species isolated from post-harvest fruit rot of tomato**

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Post-harvest fruit rot is one of the most important diseases of tomato worldwide, including Malaysia. Several species of *Fusarium* have been reported as causal agents of the disease. The objective of this study is to characterize and identify *Fusarium* species associated with post-harvest fruit rot of tomato based on the translation elongation factor 1- α (*tef1- α*) gene sequencing. Based on the *tef1- α* gene analysis, five species were discovered, namely, *F. oxysporum* (including *F. oxysporum* f. sp. *lycopersici*), *F. solani*, *F. equiseti*, *F. proliferatum* and *F. verticillioides*.

Keywords: *Fusarium*, *F. oxysporum* f. sp. *Lycopersici*, tomato, translation elongation factor (TEF)-1 α

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Genetic relations by banding patterns and the highest efficiency sequences combination of *rpoB* and *psbA-trnH* spacer for barcoding Solanaceae

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For the genetic evaluation and efficient barcoding of the Solanaceae species in Thailand, the samples were collected and identified. There are 20 species in nine genera namely 1) *Brunfelsia uniflora*, 2) *Capsicum annuum* var. *annuum*, var. *acuminatum* and var. *cerasiforme*, 3) *C. chinensis*, 4) *C. frutescens* var. *frutescens*, 5) *Cestrum aurantiacum*, 6) *Ce. nocturnum*, 7) *Datura metel* var. *metel*, 8) *Nicotiana tabacum*, 9) *Petunia hybrida*, 10) *Physalis angulata*, 11) *Solanum peruvianum*, 12) *S. lasiocarpum*, 13) *S. trilobatum*, 14) *S. wrightii*, 15) *S. capsicoides*, 16) *S. mammosum*, 17) *S. melongena*, 18) *S. torvum*, 19) *S. tuberosum*, 20) *Lycopersicon esculentum*, and a hybrid of *Capsicum*. The dendrogram constructed from RAPD and ISSR banding patterns is used to evaluate genetic similarities (S). The S of intraspecific of *Capsicum annuum* are 0.85-0.92 and interspecific species are 0.76-0.94 of the three *Capsicum* species and 0.75-0.84 of the nine *Solanum* species. In addition, the S of intergeneric species is 0.71 of *S. capsicoides* and *C. annuum* to 0.86 of *Lycopersicon* and *S. peruvianum*. Additionally, the dendrogram shows their polyphyletic group. Barcode constructions were performed with a region and combined regions of the *rbcL* + *psbA-trnH* spacer + *rpoB*. Therefore, here with the Solanaceae plant model, the authors propose the combination of the two regions *rpoB* + *psbA-trnH* spacer and a region *psbA-trnH* spacer to be used for barcoding the other flowering plant groups with the support of the earlier reports.

Keywords: *rpoB* + *psbA-trnH*, *psbA-trnH* spacer, genetic relation, Solanaceae

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Gonad development of hard clam (*Meretrix lyrata*)

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Hard clam are mollusc belongs to bivalvia class that dominating the benthic area from deep sea to lowland area particularly tropical area. This invertebrate is suspension feeder that feeds upon plankton, detritus and dissolved organic matter as the source of metabolic energy to keep it grow. Those foods source are abundance at the open sea which make hard clam proper for mariculture practice. Hard clam production through mariculture gradually increase each year even still behind oyster and cockle production. Knowledge regarding gonad stage development is important for hard clam culture in order to determine proper condition for spawning. Development of bivalve gonad is categorized into resting, early development, late development, mature, spawning and spawned. Gonad development and gender of *Meretrix lyrata* can be identified accurately through histological study.

Keywords: *Meretrix lyrata*, gametogenesis, histological

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How to rapidly accelerate biodiversity inventory in places where most of the species are unknown?

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Biodiversity inventories are vital for monitoring changes in biodiversity over time and space, essential for conservation planning. Yet, most species have never been recorded before, especially in tropical regions which are high in biodiversity but at risk from rapid biodiversity loss. We propose that bioblitz, coupled with DNA barcoding, can provide a rapid and accurate biodiversity inventory for a tropical site and tested this approach through a DNA barcoding bioblitz on the campus of University Kebangsaan Malaysia. Samples were collected using three sweep nets, ten pitfall traps, one malaise trap and one light trap. DNA barcodes for all the samples were obtained by PCR and sequencing. The Automated Barcode Gap Discovery (ABGD) analysis sorted the DNA barcodes into 62 molecular operational taxonomic units (MOTU). Of these 62 MOTU, 18 could be assigned a Linnaean species name, 21 could be assigned a genus name, 37 a family name and 58 an order name. The process from collection to a completed inventory took three days, cost 7.25 USD (RM23.50) per DNA barcode obtained, and required only basic molecular laboratory equipment. For MOTU lacking a Linnaean species name we see this as their first step towards a formal name. They are currently "dark taxa", except they are not completely dark, being searchable through the Barcode of Life Datasystems and interoperable between future biodiversity inventories.

Keywords: Bioblitz, biodiversity inventory, DNA barcoding, ecology, undescribed species, taxonomy

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Identification and quantification of marine siderophores using high-performance liquid chromatography with electrospray ionization mass spectrometry

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Siderophores are low-molecular-weight organic compounds (500 - 1500 Da) produced by heterotrophic bacteria and highly selective for Fe(III). These complexation of iron by siderophores has the potential to affect both the solubility and bioavailability of iron (III) in seawater. We have determined the ferrioxamine siderophores in the seawater samples from high latitude North Atlantic Ocean. The identification and quantification of this siderophore type chelate was done by using recently developed high-performance liquid chromatography-mass spectrometry methods. Five different siderophore type chelates were detected and the compounds comprised of two groups; ferrioxamines and amphibactins group. In the dissolved phase, three types of hydroxamate siderophore have been identified; Ferrioxamine B (FOB), Ferrioxamine G (FOG) and ferrioxamine E (FOE). Concentration of dissolved FOB, FOG and FOE are extremely low between $0-135 \times 10^{-18}$ M. Our present data indicated the presence of low concentrations of dissolved siderophores in the high latitude of the Atlantic Ocean and suggest that siderophore distributions are both spatially and temporally variable.

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Molecular data supports morphological-based species Identification: A case study in gaharu producing tree, *Aquilaria*

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Aquilaria (Thymelaeaceae), endemic to the Indomalesia region, is an endangered gaharu-producing tropical tree. Due to the high price of gaharu, *Aquilaria* is fast becoming a popular plantation tree in Malaysia. Demands for seedlings drive businesses to import species from outside of Malaysia and mixes with local species. The true identity of the planting material is often vague because lack of documentation. Thus, vegetative description of *Aquilaria* saplings is important for growers to check on their planting stock, while molecular study can provide supporting evidence for species identification. For molecular analysis, the DNA barcoding *trnL-trnF* intergenic spacer regions were PCR amplified and sequenced from three local species and compared to 28 sequences derived from the Genbank, belonging to various *Aquilaria* species as well as related genera. The Kimura 2-Parameter (K2P) distances and neighbor-joining (NJ) trees were constructed using MEGA 6.0 software. The length of the *trnL-trnF* region for *Aquilaria* varied from 356-451 bp with 20 variable sites. Morphological studies were based on the sapling's vegetative parts. We demonstrated that by combining both morphological observations and molecular technique, species authentication can be executed for *Aquilaria* saplings, thus helping growers to validate their planting materials.

Keywords: *Aquilaria*, genetic distance, molecular identification, *trnL-trnF* intergenic spacer region, vegetative characteristics

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Morphological characterization of *Setosphaeria rostrata* and *Cochliobolus* species isolated from rice in Selangor

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Rice is one of the important staple foods in the world. The cultivation of rice in large scale is easily exposed towards pathogens, which eventually reduce the yield. This study was conducted throughout Selangor state to isolate the fungi from diseased-rice leaves samples showing leaf spots symptom. The objective of this study was to identify the fungi isolated from diseased-rice leaves samples based on the morphological characteristics. A total of 39 isolates of Ascomycetes fungi were obtained and purified using single-spore isolation technique. Morphological characteristics of the fungal isolates were examined based on macroscopic and microscopic features for species delimitation. Macroscopic features: pigmentation and colony morphology, whereas microscopic features: shapes and sizes of conidia. The isolates were identified as *Setosphaeria rostrata* (36 isolates), *Cochliobolus geniculatus* (2 isolates) and *Cochliobolus eragrostidis* (1 isolate). All the species belong to order Pleosporales.

Keywords: Rice, morphology characteristics, *Setosphaeria rostrata*, *Cochliobolus geniculatus*, *Cochliobolus eragrostidis*

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Novel biomass crops in Malaysia, potential and challenges, napier grass as an example

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The development of novel biomass crops is a major challenge in Malaysia and throughout the world. Although in some countries cases, certain crops are grown specifically for their biomass, in many countries food crops have been converted to essentially biomass crops and thus form a real threat to world food security. Moreover, overdependence on a single crop or limited number of crops puts the country's economy at risk to environmental, socio-economic and political changes. Although Malaysia ranks 14th on the list of the 17 mega-diverse countries that contain around 70% or more of the planet's (terrestrial, freshwater and marine) biodiversity, most biomass in Malaysia is derived from agricultural wastes, over 90% of which comes from the monoculture of oil palm. Napier grass or also known as elephant grass a native crop in Africa is an important fodder crop in tropical areas. Recent studies indicated that the crop also has a high potential to be developed as a second generation biomass crop. Although abundant Napier grass accessions exist, little effort has been done to study its genetic variability or diversity for genetic improvement as well as its agronomic improvement. CFFRC is developing new underutilised biomass species to complement the oil palm to make it more sustainable as a source for renewable energy. This paper will discuss the potential of Napier grass as a biomass crop in Malaysia and the issues involved

Keywords: Napier, biomass, Malaysia

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Small mammals distribution peculiarities within Kazakhstan Irtysh river biotopes

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The distribution peculiarities of micro mammals that live in natural (forest and steppe zones) and human changed (a zone of settlements) environment were discussed. The fauna of small mammals within Kazakhstan Irtysh river biotopes is represented by 22 species of rodents and 3 species of the insectivorous. The majority of the found species are inhabitants of open biotopes and belong to ecological group of exoanthrops. The small mammal community of steppe is characterized by the high Margalef's diversity index and the high Evenness index, with a low Berger-Parker index of domination (*Allocrietulus eversmanni*). Exoanthrops prevail in the steppe (86%), here 14% of micro mammals are hemisynanthrops. Diversity of landscape elements creates optimal conditions for living of most plastic rodent species in the steppe biotope. Hemisynanthrops and exoanthrops in a forest zone were represented practically equally (43% and 57%). A species diversity of small mammals in the forest zone is slightly poorer than in the steppe zone, but the high Evenness index and the low Berger-Parker index of domination (*Apodemus uralensis*) in a forest zone show a balance and maturity of small mammal communities in this area. In a zone of human settlements a small mammals species diversity is very poor and is represented by dominants - a house mouse. Study supported by project No. 0972/GF 2 "State Natural Reserve "Floodplain of the Irtysh river": current condition and prognosis" of the Ministry of Education and Science of Republic of Kazakhstan.

Keywords: Biodiversity, ecology, Kazakhstan Irtysh river, small mammals

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The cell structure and growth rate of three species of marine microalgae (*Chlorella vulgaris*, *Tetraselmis chuii* and *Isochrysis* sp.) before and after cryopreservation

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Three species of marine phytoplankton *Chlorella vulgaris*, *Tetraselmis chuii* and *Isochrysis* sp. were cultured using Conway media in 20 °C with the light intensity of 90 $\mu\text{mol m}^{-2}\text{s}^{-1}$ and a photoperiod of 12:12 h L/D cycle. Cells were harvested in stages at logarithmic and stationary phases. Equilibration time for cyroprotectant exposure was 10 to 20 minutes before the samples was placed in the programmable freezer for a controlled rate of cooling at -1 °C /min. The temperature was reduced uniformly from 200C until it reaches -40 °C where the samples were maintained at this temperature for 30 minutes before direct immersion into liquid nitrogen at -196 °C. Samples were stored in liquid nitrogen for one week. Percentage of viable cells was relatively higher in the stationary phase for the three species that is 95.13 % for *Chlorella vulgaris*, 79.09 % for *Isochrysis* sp. and 69.36 % for *Tetraselmis chuii*. The growth rate of viable cells for *Chlorella vulgaris* a both logarithmic and stationary phases and *Tetraselmis chuii* at logarithmic phase showed insignificant differences ($p > 0.05$) before and after cryopreservation. *Tetraselmis chuii* of stationary phase and *Isochrysis* sp. of both phases gave significant differences ($p < 0.05$) for growth rate before and after cryopreservation due to photo-oxidation. The cell structure after cryopreservation showed disorganization and abnormality in the ultra-structure but this did not seem to affect the growth rate of the viable cells.

Keywords: *Chlorella vulgaris*, *Tetraselmis chuii*, *Isochrysis* sp., conway media

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The effectiveness of commercial fertilizer N:P:K (15, 15, 15) and (12:12:17) with magnesium and iron to increase the growth of *Arthrospira platensis*

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The study was carried out to see whether cheap commercial fertilizer supplemented with iron and magnesium can give good growth to *A. platensis*. This Study was conducted in the laboratory under controlled condition and in outdoor conditions. Kosaric media which is routinely used in *A. platensis* culture is used as reference media. In this study two type of commercial fertilizer were used that is N: P: K (15:15:15) and fertilizer N: P: K (12:12:17) with the addition of 0.05g/L iron and 0.1 g/L magnesium. The results obtained showed that growth of *A. platensis* in Kosaric media in indoor condition and the fertilizer N: P: K (12:12:17) which enrich with iron and magnesium in indoor condition was highest in optical density reading. These are at 0.787 and 0.845 respectively on day fourteen. The dry weight and productivity for fertilizer N: P: K (12:12:17) addition with iron and magnesium in indoor condition and fertilizer N: P: K (15:15:15) addition with iron and magnesium in indoor condition was the highest. These are 73 and 61 mg/L. Results of additional of iron and magnesium indicated the best growth media for indoor mass culture of *A. platensis*. This study also revealed the weakness of *A. platensis* cultivated under outdoor condition. It is difficult to adapt *A. platensis* and grow in outdoor condition because of weather changes and need to control the environment for better productivity development of *A. platensis*.

Keywords: Kosaric medium, *Arthrospira platensis*, spirulina, magnesium, iron

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The extraction and characterization of chitosan from *Cunninghamella elegans*

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Chitosan is a nature biopolymer which can be isolate from two main source; from shellfish source such as cockle and crab through crustacean and from fungi. This research is conducted to extract chitosan from *Cunninghamella elegans* fungi and to determine the characteristics of chitosan by the degree of deacytelation, molecular weight and the colours of chitosan. The extraction process involved two steps; the first step is a alkyl treatment and the second steps is an acid treatment. In alkyl treatment, chitosan was extracted using NaOH 1M, 121°C for 15 minutes. In acid treatment, chitosans was shaken in acetic acid 0.5% for 12 hours at 95°C. The weight of dry miselium that obtained from this study is a 0.11 gram to 0.47 gram. About 0.37 gram weights of dry chitosan be produced. The degree deacytelation of chitosans was determined using First Derivation Ultraviolet Spectrophotometry, FDUVS. Percentage of degree deacytelation of chitosans is a 77.08%. The molecular weight of chitosans is 4.318×10^3 Dalton using the Tube Ubbelohde. The chitosans give the higher lightness for colour (79.86). Therefore, *Cunninghamella elegans* can be considered as a source of chitosans and for use in the commercial production of chitosans in the future.

Keywords: Characterization, extraction, *Cunninghamella elegans*

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Tree species richness and importance value of a regenerated hill dipterocarp forest, after supervised logging

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Tree species richness and importance value index (IVI) of a supervised-logged-over hill dipterocarp forest (HDF) at Ulu Muda Forest Reserve (UMFR), Kedah, Malaysia was investigated after 12 years. A total of 20 plots 20 m × 50 m with systematic sampling layout representing the 20 ha of study area were established for this objective. All trees greater than 1 cm at diameter breast height (DBH) was enumerated measured and identified. In 2-ha of sampling area a total of 2096 trees were enumerated. In term of species composition, 63 families, 173 genera and 380 species and one variety were identified. Five top families provided 37.6% of the total species richness. Euphorbiaceae contributed the highest value (12.9%) followed by Fabaceae (7.1%), Lauraceae (6.6%), Annonaceae (5.8%) and Rubiaceae (5.3%). With regards to the relative dominance the maximum rate of IVI and family importance value (FIV) was given by *Shorea macroptera* Dyer in the family Dipterocarpaceae and Euphorbiaceae, respectively. However, in conventionally logged area of UMFR the highest value of IVI and FIV was given by *Macaranga hosei* King ex Hook.f., (Euphorbiaceae), a secondary species and Euphorbiaceae. In a logged-over HDF, Tekai Tembeling Forest Reserve as a comparison, *Shorea curtisii* Dyer ex King contributed the highest IVI which 42.9%. Likewise, further studies over a longer period is required to look into the richness of the area after logging.

Keywords Hill dipterocarp forest, tree composition, species richness, importance value index, family importance value

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Tributyltin-resistant bacteria from contaminated surface sediment

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Resistance to tributyltin (TBT) was examined in pure bacteria cultures isolated from TBT-polluted sediments. We defined a TBT-resistant bacterium as one which grows in a TBT concentration above the reported concentration at the sampling site (Kong Kong Laut), which was less than 1000µg/l. More than 15 pure colonies of bacteria were isolated which are mostly Gram negative and more than 80% percent of these isolates are possible TBT-degrading bacteria due to their ability to resist TBT concentration of up to 1000µg/l. All TBT-resistant bacteria are potential TBT degrading bacteria but may not degrade the TBT. However, TBT degrading bacteria must be TBT resistant bacteria. These TBT-resistant bacteria were also examined for their biodegradability and they shows capability of degrading TBT, suggesting that these microorganism can utilize the carbon source in the pollutant. This study has successfully shown that these bacteria isolated from Kong Kong Laut are potential TBT-degrading bacteria and this also paves a major pathway for sustainable remediation solution.

Keyword: Tributyltin, resistance, biodegradation, sediment, bacteria

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Abstracts

Domain Ecology

Estimation of GHG emission from different land use changes associated with oil palm plantation

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The release of nitrous oxide (N₂O) from agricultural activities contributes to the increase of greenhouse gases in the atmosphere. In this study, the amount of nitrogen fertilizer used in an oil palm plantation of different stages (immature and mature) was estimated. Data of fertilizing scheme at the oil palm plantation for oil palms varying in age (planted between 1986 and 2009) was used. Estimation of nitrous oxide emission and the resulting CO₂-equivalent emission were calculated for each category of the oil palm. The amount of N-fertilizer applied were between 194-260 kg N/ha. The resulting N₂O emissions were between 2.75-3.13 kg N₂O-N/ha, which corresponds to CO₂-equivalent of between 261.99-346.94 kg CO₂-eq/ha. Despite increase of N₂O emission from immature stage until maturely-developed up to 20 years, there is no clear relationship between N₂O emission per ha and the age of oil palm. Generally, the N₂O emissions found in this study are still low compared to the default value for synthetic nitrogen fertilizer-induced emissions for tropical regions.

Keywords: CO₂-equivalent, global warming, nitrous oxide, N-fertilizer, oil palm plantation

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Utilization of Java Medaka (*Oryzias javanicus*) in ecotoxicological studies***Shahrizad Yusof and Ahmad Ismail***Department of Biology, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang
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An increasing number of chemicals due to human activities enters our environment every day. This study promotes Java medaka (*Oryzias javanicus*) as test organism for the impacts of these chemicals. Java medaka is a small tropical fish native to Malaysia, Indonesia, Singapore, Thailand and Vietnam, commonly found in abundance in estuaries. The fish have been successfully cultured in the laboratory in ambient temperature and controlled photoperiod of 14 hours light and 10 hours dark. Some ecological aspects of the fish in their natural habitat were studied in order to understand their response to chemicals. The fish occur abundantly all year round in the west and south coasts of Peninsular Malaysia. They migrate tidally within a large salinity range (1.2 – 29.0 ppt), making them suitable to represent the coastal environment. The sensitivity of different life stages of Java medaka to environmental pollutants was tested. All life stages of the fish have been utilized and they have shown particular sensitivity. The embryos were sensitive to low concentrations (0.01 – 0.05 ppm) of heavy metals (Cd, Hg, Pb, Cu and Zn) in terms of developmental impairments. In exposure to glyphosate-based herbicide embryonic death was found to be the most prominent response while swimming disorder was observed in the juveniles. Teratogenicity is another developmental endpoints in embryos exposed to the pollutants tested. The responses shown by all the life stages of the fish indicated that this fish species can be a useful to investigate short term and long term effect of pollutants in the future.

Keywords: Java medaka, test organism, pollution, coastal areas, environment

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Ag and As concentrations in mangrove snails, *Nerita lineata*

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Marine trace metal pollution has always been a concern in the field of ecotoxicological studies. Therefore the background concentrations of trace metal of potential marine gastropods were established for biomonitoring purposes. In this study, the background concentration and the ability of the *Nerita lineata* as a good biomonitoring agent for Ag and As were determined. Mangrove snails, *Nerita lineata*, and sediments were collected from 10 geographical sites of the western and southern part of Peninsular Malaysia in April 2011. The concentrations of Ag and As were determined in the shells, opercula and soft tissues of the *N. lineata* and the sediments by using ICPMS. The ranges of mean concentrations of Ag and As in the snail samples collected from Peninsular Malaysia were BDL – 0.089 and 0.007 – 9.020 µg/g respectively, whilst the sediments range were 0.133 – 1.686 and 21.809 – 59.488 µg/g respectively. The trace metals accumulation in the snails were in decreasing order of soft tissues > opercula ≥ shell for all metals. There were no significant correlation ($P > 0.05$) between the sediments and the snails (shells, opercula and soft tissues) showing poor ability of the snail as a biomonitor for the trace metals.

Keywords: Trace metals, sediments, biomonitor, *Nerita lineata*, gastropods

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Lethal Concentration 50 (LC50) of Tributyltin Chloride (TBTCI) on Nauplii of Brine Shrimp (*Artemia salina*)

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Fouling is an undesirable phenomenon and cause major problems for many marine related industries. It is involved in the spread of invasive species across the world's oceans, which are regarded as a threat to native aquatic fauna, causing demise or the native species to vanish by competitive exclusion, introduction of diseases, or predation. Organotin is one of the most effective antifouling biocides invented to reduce the threats pose by the fouling. However, some of the biocides cause adverse effects to non-targeted organisms and eventually threat the marine ecosystem as a whole. Current study was conducted to investigate selected toxicological effects of tributyltin chloride (TBTCI) on a testing organism species, brine shrimp (*Artemia salina*). The instar 1 nauplii of *A. salina* were cultured in the recommended culture environment. For routine purpose, a 24-hour LC₅₀ bioassay method was carried out to study acute toxicity of TBTCI on nauplii of *A. salina*. According to the range test, the doses of TBTCI were between 200 ng.L⁻¹ to 900 ng.L⁻¹. Results showed the LC₅₀ of TBTCI was between 420 ng.L⁻¹ to 490 ng.L⁻¹. These results indicate that TBTCI is environmentally toxic substances. Further in-depth investigation should be conducted to establish *A. salina* as bioindicator for TBTCI contamination.

Keywords: Antifouling biocides, *Artemia salina*, tributyltin chloride, LC₅₀, toxicity

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Litter production in relation to some climatic variables in a mangrove ecosystem of Sarawak, Malaysia

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Assessment of litter productivity is essential to discern the status of nutrient cycling, forest health and inter-relation with climatic variables. Although Sarawak is endowed with numerous pristine and estuarine mangroves, research on main primary productivity of these forests in relation to climatic variables is scanty. So litter fall of dominant and co-dominant species of Sibuti mangrove was estimated by using litter traps from January to December 2013. Annually 1640.82 g m⁻² dry weight of litters was estimated out of which *Rhizophora apiculata* had 92% contribution followed by *Xylocarpus granatum* (4%) and others (4%). Leaves were the highest contributory components (57.21%) of litters followed by propagule (11.89%), flower (10.85%), twigs (8.56%) and stipules (8.45%), respectively. No significant correlations were found for the total and major components of litters of both species with climatic variables. Total litter fall of both species did not show any seasonal variations throughout the year, however leaf litter of *Rhizophora apiculata* showed significant seasonality between intermediate and wet seasons. Flowering of *Rhizophora apiculata* was found profound in dry season followed by fruiting in wet season. The litter productivity of this forest is high compared to other tropical mangroves of the world. The higher productivity of the forest could be due to nutrient availability, pristine in nature, stand density rather than climatic influence. The findings of this study suggest that litter productivity of pristine mangroves in tropical regions is not remarkably influenced by the monthly climatic variables.

Keywords: Litter production, climatic variables, *Rhizophora apiculata*, Sibuti mangrove, Sarawak

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Determination of trophodynamic structure in the mangrove area of Tanjung Kupang, Malaysia: In sight of stable isotope analysis

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The Malaysian coastal water area comprises of various ecosystems including the mangrove ecosystem. Nowadays, many areas have been reclaimed and developed due to high demand from community and industries. Deteriorating environmental health in a particular area will indirectly affect the stability of the existing food web. Current study aimed to investigate the existing trophodynamic structure in the mangrove area of Tanjung Kupang using stable isotope analysis. A total of 40 samples was collected from the area. All the samples had undergone stable isotope preparation method and was analyzed by the used of CF-IRMS to obtain dual isotope signatures ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$). Animal species had $\delta^{13}\text{C}$ values ranging from -27.02 to $-14.83 \pm 0.54\text{‰}$ meanwhile for plants part range from -30.17 to $-19.89 \pm 1.04\text{‰}$ meanwhile, $\delta^{15}\text{N}$ value reflects 4.09 to $15.89 \pm 0.56\text{‰}$ and 3.00 to $5.42 \pm 0.22\text{‰}$ for animal and plants, respectively. Calculation of trophic level estimation (TLE) and Discriminant Analysis (DA) could be used to strengthen the trophic positioning of a species. In coming years, further in depth investigations should be conducted to create a comprehensive trophodynamic structure of food web in the area. This preliminary study is important in planning strategies for better management and conservation of mangrove ecosystem important bioresources who rely on the area.

Keywords: Trophodynamic structure, stable isotope analysis, food web, mangrove ecosystem, trophic level

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Distribution of heavy metals (Cd, Cu, Fe, Ni, Pb, and Zn) In the different parts of *Asystasia gangetica* In Kg. Ayer Hitam, Sg. Kembung, and Chukai, Peninsular Malaysia

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In this paper, an invasive weed *Asystasia gangetica*, was collected from Kg. Ayer Hitam (Selangor), Sg. Kembung (Selangor), and Chukai (Terengganu). The samples were separated into pericarp (P), seed (S), flower stalk (Fs), leaf (L), stem (St), and root (R). They were determined for Cd, Cu, Fe, Ni, Pb, and Zn. The ranges of heavy metal concentrations ($\mu\text{g/g}$ dry weight) in all the different plant parts were 0.02-1.44 for Cd, 3.81-33.1 for Cu; 17.8-1359 for Fe, 0.03 – 3.90 for Ni, 0.18 – 14.4 $\mu\text{g/g}$ for Pb, and 9.18 – 135 $\mu\text{g/g}$ for Zn. The pattern of heavy metal accumulations was, for Cd was $R < L < P < St < Fs < S$, for Cu was $S < P < Fs < St < L < R$, for Fe was $S < P < Fs < L < St < R$, for Ni was $P < St < L < Fs < R < S$, for Pb was $P < S < St < Fs < L < R$ and for Zn was $P < Fs < S < L < St < R$. These patterns showed that root (R) always accumulated highest levels of metals and therefore, this part is a potential biomonitoring tissue for future studies.

Keywords: Biomonitoring, weeds, metals, distribution

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Interlinkage among primary production, phytoplankton abundance, chlorophyll and environmental conditions of a mangrove estuary in Sarawak, Malaysia

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Primary production, Chlorophyll a, water nutrient and environmental conditions of mangrove dominated Kuala Sibuti river estuary in Sarawak, Malaysia was investigated from January 2013 to December 2013 to find an interlinkage among the different variables. *In situ* measurements of environmental parameters (pH, salinity, turbidity, conductivity, dissolved oxygen, light attenuation coefficient) and primary production along with laboratory analysis of phytoplankton abundance, chlorophyll a estimation, water nutrient viz. nitrate, phosphate and ammonium determination were conducted and 3 stations were plotted for sampling. The estuary was found meso-haline in nature, considering its salinity gradients. Physical, chemical and biological parameters of this estuarine water showed a seasonal rhythm. Surface water temperature ranged from 27.4°C to 32.2°C with a range of salinity from 0.70 PSU to 27.10 PSU followed by Dissolved Oxygen (DO) from 1.94 to 6.71 mg/L. The concentration of chlorophyll a ranged from 0.02 to 0.16 mg/m³. Nitrate, phosphate and ammonium concentrations ranged from 0.40 to 3.53mg/L, 0.01 to 1.92 mg/L and 0.06 to 1.24 mg/L, respectively. The Estuarine water quality index showed very good standing (4.95). The primary production showed little seasonal variation with a mean of $0.50 \pm 0.14 \text{ gCm}^{-2}\text{hr}^{-1}$ ($0.35\text{-}0.75 \text{ gCm}^{-2}\text{hr}^{-1}$). The mean abundance of phytoplankton was 53240 cells/L with significant seasonal variation. Canonical correspondence analysis (CCA) showed a significant linkage among primary production, chlorophyll a concentration, and phytoplankton abundance. Primary production, chlorophyll a distribution were found primarily influenced by water nutrient. Analysis of variance (ANOVA) showed no significant seasonal differences in terms of primary production, chlorophyll a distribution rather demonstrated significant seasonal difference for salinity, water temperature and, TDS.

Keywords: Primary production, chlorophyll a, phytoplankton, environmental condition, mangrove estuary

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Greenhouse gas emissions during the agricultural stage of palm oil-based biofuel production associated with land use changes

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The environmental impacts with regard to agro-based biofuel production have been associated with the impact of greenhouse gas (GHG) emissions. In this study, we attempted at investigating the GHG emissions during the plantation (agricultural) stage of palm oil-based biofuel production in relation to land use changes for oil palm plantation development. Three different sites of different land use changes prior to oil palm plantation were chosen; transformed land-use (large and small-scale) and logged-over forest. Sampling of soil was undertaken at these sites according to the age of the palm, i.e. < 5 years (immature), 5-20 years and >21 years (mature palms). Field data verifications of N, P, K contents in soil and soil organic carbon were carried out at the respective site for estimation of the resulting CO₂-eq emissions, i.e. impact on GHG emissions and the carbon stock changes. The field nitrous oxide emission constituted the largest portion of GHG emissions among the major inputs of GHGs during the agricultural stage of oil palm development. Generally, it was found that the conversion of tropical forest into palm plantation has resulted in relatively higher GHG emissions compared to transformed land use for oil palm development. The conversion from previously grassland areas into oil palm plantation would increase the carbon savings within the area thus sustaining the environmental benefits from the palm oil-based biofuel production.

Keywords: Biofuel, oil palm, greenhouse gases, N-fertiliser, carbon stocks

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Elemental speciation, bioavailability and risk assessment of selected heavy metals in the intertidal surface sediments of Sungai Puloh mangrove, Malaysia.

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The speciation profile of selected heavy metals, the total organic carbon (TOC) and pH were determined in 42 surface sediment samples from Sungai Puloh intertidal mangrove ecosystem. The four stage sequential extraction technique (SET) (exchangeable, acid – reducible, oxidizable – organics, and residual fractions) was employed to investigate the heavy metal distribution pattern. The Risk assessment Criteria Code (RAC) was applied to estimate the metals bioavailability and implication to food chain. The result showed the total mean metal concentrations for Cd, Ni, and Zn were $(1.04 \pm 0.36, 37.76 \pm 7.65, \text{ and } 1034.56 \pm 410.79) \mu\text{g/g}$ respectively. More than 80% of Zn in all sampling stations existed in the non-residual fraction and as high as 15% in exchangeable fraction indicating that Zn may be easily remobilized. The non-residual fraction of Cd 53%, Ni 51%, showed that Cd and Ni are at the borderline for remobilization. Cadmium speciation, like Zn revealed elevated levels of 11.94% in exchangeable fraction. The possibility of remobilization of heavy metal in the study area is in the order of $\text{Zn} > \text{Cd} > \text{Ni}$. Based on the RAC, Ni poses low risk. However, Cd and Zn pose medium to high risk for the possibility to enter into the food chain indicating that the food web and aquaculture activities within Sg. Puloh mangrove may be impacted. The TOC values ranged from 2.31 to 4.12%, and the pH varied from 3.49 to 4.83. The relationship obtained for TOC, pH, and non-resistant fractions indicated TOC has more significant effect on the distribution of elements among phases than pH.

Keywords: Bioavailability, heavy metal, chemical speciation, risk assessment, total organic carbon

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Biomass and horizontal structure of supervised-logged-over hill dipterocarp forest in Ulu Muda forest reserve, Kedah, Malaysia

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The horizontal structure and biomass of a hill dipterocarp forest were studied at Ulu Muda Forest Reserve, Kedah in Peninsular Malaysia twelve years after supervised logging (SL). Twenty plots of 50 m × 20 m with a systematic sampling design were established for this purpose. A total of 2096 trees ≥ 1 cm in the sampling plots (2 ha which was representative of 20 ha of study area) were enumerated, measured and identified. In terms of tree density, the mean value of density was 1048 tree ha⁻¹. The basal area of trees was 19.60 m² ha⁻¹. The above ground, below ground and total biomass were 313.457 × 10³, 56.422 × 10³ and 369.879 × 10⁴ kg ha⁻¹, respectively. In terms of stand density and above-ground biomass the supervised-logged site was richer than conventional-logged (CL) forest which was 45% and 64.9%, respectively. In the SL and CL sites (UMFR) the highest value of basal area was from *Shorea macroptera* Dyer and *Macaranga hosei* King ex Hook.f., which was 1.25 and 0.40 m² ha⁻¹, respectively. But in a logged-over hill dipterocarp forest, Tekai Tembeling Forest Reserve, Malaysia *Shorea curtisii* Dyer ex King contributed the highest amount of basal area which was 1.46 m² ha⁻¹. We concluded that in the SL area Dipterocarp trees are dominated, but in CL site are not dominated.

Keywords: Biomass, Basal area, Hill dipterocarp forest, supervised-logged-over, Malaysia

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**Acute test of the antifouling biocide Zinc Pyrethrin on Javanese Medaka
(*Oryzias javanicus*)**

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The uses of organotin as active biocide in antifouling paints have been completely banned for application on vessels registered in countries membered under the International Maritime Organization (IMO). The replacement biocides have been proposed for similar purposes. Zinc pyrethrin (ZnPT) one of booster biocides that is effective against bacteria, fungi and algae. ZnPT is used in various commercial products such as active ingredients in anti-dandruff shampoos or as additive in cosmetics and dermatitis treatment. ZnPT could be introduced into aquatic environment through the municipal household wastewater and harbor activities. Although studies showed ZnPT rapidly degrades in the water column to less toxic compound due to photolysis process, it can persist longer in marine environment. Acute toxicity exist within short period sometimes cause major problem. In present study, Javanese medaka (*Oryzias javanicus*) was chosen to find out the correlation between the effects of ZnPT towards its survival. Each experimental concentration consists of 30 individuals and replicates into 3 difference glass aquaria. Animals were not fed during the short-term exposure and the number of dead specimens was recorded daily in order to calculate 48-LC50. The result highlight potential ecological hazard posed by the biocide ZnPT, the NOEC (no observed effect concentration) and 100% survivor of *O. javanicus* was at 100 µg/L and 100% dead starting at 250 µg/L. Besides, LC50 (median lethal concentration for 50% of sampled animals) in a 48h exposure was 180 µg/L. Toxic effect of ZnPT resulted significant increase the no of lethal fish with the increasing of concentration.

Keywords: Zinc pyrethrin, antifouling biocides, Javanese medaka, toxicity, LC50

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Comparisons of As and Cu in the *Corbicula javanica* and sediments collected between Pangsun and Kajang sampling sites

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Determination of As and Cu was done in freshwater clams *Corbicula javanica* and sediments collected from two sampling sites at Langat River between July 2012- November 2012. These sites included an upstream remote village at Pangsun and a busy township at Kajang. The mean of Cu concentrations ($\mu\text{g/g}$ dry weight) of Pangsun were 5.01, 2.42 and 12.13 for soft tissue, shell and sediments, respectively. Those from Kajang site were 5.35, 0.66 and 16.26 for soft tissue, shell and soil respectively. The mean of As concentrations ($\mu\text{g/g}$ dry weight) of Pangsun were 2.96, 0.20 and 16.89 for soft tissue, shell and soil respectively, while Kajang was recorded to have mean As levels as 6.34, 0.39 and 61.35 for soft tissue, shell and soil respectively. Geochemical study of the sediments has shown that the majority of the Cu (66.40% for Pangsun and 80.56% for Kajang) belongs to non-resistant fractions, indicating the most of the Cu in these two sites is anthropogenic originated. 4.46% and 13.46% (Pangsun and Kajang respectively) of As are belong to non-resistant fraction indicating most of As in these two sites are non-anthropogenic origin. Higher Cu and As concentrations in Kajang than Pangsun showed that Kajang site was more polluted in term of both Cu and As. The Cu and As concentrations in soft tissue of *C. javanica* increased as the clams and sediments being transplanted to the Kajang site for three days, indicating the potential of soft tissue of *C. javanica* as a biomonitor for Cu and As pollution.

Keywords: Clam, biomonitor, heavy metals, Cu, As

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Heavy metal concentrations in fish organs from upper stream area of Kelantan River, Malaysia

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In the present study, level of heavy metal concentrations on fish organs in the Kelantan River basin was assessed using the utility of different organs and tissues as indicators of heavy metal pollution. The concentrations of Cu, Zn, Pb, Ni and Mn were detected in muscle tissue, liver and gills of ten native fish species caught using gill nets. The fishes were sampled at three different sites in the upper stream of the Kelantan River, namely Gua Musang, Kuala Geris and Limau Kasturi, isolated from each other by different local riverine characteristics. Although heavy metal pollution is believed to be one of the main threats to the fish population in the area, there is a lack of knowledge of the exact level of heavy metals in their tissues. Fish and water samples were analyzed by means of Inductively Coupled Plasma- Mass Spectrometry (ICP-MS). The initial results for both samples at all locations showed that the concentrations of Pb were higher than the permissible limit set by FAO/WHO 2004 as well as Food Act 1983 and Malaysian Food Regulations 1985. The level of heavy metal concentration in water and fish organs shall be considered as an important matter as the locals are consuming these fishes and it represents the quality of the river itself. The next step would be to determine whether these heavy metals are potentially harmful for human health as the freshwater fish are among the main in their diet.

Keywords: Heavy metals, fish organs, Kelantan River

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Radioactivity Levels of ^{234}Th and ^{210}Po in the Green Mussel (*Perna viridis*) at the Straits of Johor and the Estimated Accumulations to Human Body

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The radioactivity levels of ^{234}Th and ^{210}Po were analyzed in various sizes of green mussel obtained around Straits of Johor, Malaysia. Edible tissues of green mussel were treated with radiochemical separation techniques and quantified using gross alpha/beta counting system and alpha spectrometry. The levels of studied radionuclides were varied according to the body parts (stomach vs. the rest) and origin (wild, cage and market) of the organism. Stomach part had the highest radioactivity levels of ^{234}Th (mean: 388 ± 315 Bq/kg) and ^{210}Po (mean: 150 ± 65 Bq/kg). Meanwhile, samples obtained from the wild origin had the highest radioactivity levels of ^{234}Th (mean: 641 ± 509 Bq/kg in stomach and 260 ± 166 Bq/kg in other tissue) and ^{210}Po (mean: 257 ± 62 Bq/kg in stomach and 70 ± 18 Bq/kg in other tissue). It is seen that the natural radioactivity levels from this organism was relatively higher than other marine organisms from different areas in Malaysia as well as the world wide values. Therefore, we presumed the green mussels may contribute slightly higher radiation risks to the seafood consumers in the Straits of Johor than the permitted levels recommended by the USEPA with estimated effective radiation dose of ^{234}Th (mean value: 3.37×10^{-2} mSv/year) and ^{210}Po (mean value: 4.75 mSv/year). Results presented here are showing the capability of green mussel as effective in-situ bio-indicator and also suggest that the Straits of Johor may susceptible to some degree of radioactive contaminations.

Keywords: Radioactivity, green mussel, bio-indicator, radiation

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Availability and suitability of Kuala Gula mangroves for Milky Stork Reintroduction Program In Malaysia: a re-evaluation

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The Milky Stork population is endemic to a small part of the Southeast Asia region and is considered as an endangered species as its number has gone considerably low throughout its home-range. In Malaysia alone, the species numbers have dwindled significantly and the last group of the wild population was last recorded in 2010. Hence, the work to repopulate the species is currently being done in Kuala Gula, Perak as the location is still considered as pristine and of high importance to large numbers of resident and migratory birds. However, the recent increase of anthropogenic activity in the area has raised considerable attention among environmentalist and scientist as the mangroves along Kuala Gula coast are being reclaimed excessively to give way to the aquaculture industry. Accordingly, this study was undertaken to re-evaluate the availability and suitability of Kuala Gula as nesting and foraging grounds for the reintroduction of the Milky Stork population. Important nesting and foraging areas were surveyed and data on the habitat, including size, types, forest composition and structure were recorded. In general, at least one nesting site and two foraging areas have been affected and could no longer benefit the waterbirds population. The findings suggest that urgent attention be given to protect remaining mangroves from further development and reclamation activity to ensure the success of the reintroduction program in the future.

Keywords: Milky Stork, reintroduction, habitat availability, suitability, Kuala Gula, mangroves

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Co-toxicity of mercury and beach plastic litter to *Portunus pelagicus* in the marine environment

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Plastic materials disposed along the seacoast from various sources witnessed marine pollution, recently. Our studies revealed total mercury (T-Hg) in plastic litter causing toxic effect to marine crustaceans. Unlike common methods and instrumentation that indicated analytical limitations, precise and reproducible results were achieved using a direct mercury analyzer (DMA-80) with the least detection limits of 0.0015ng.g-1. In the present study, the inclusion of common beach plastic litter to crustacean *Portunus pelagicus* revealed significant T-Hg concentrations as well as bioaccumulation factor (BAF)>1 when they were exposed for 180d and indicating the effects of litter in scenic beaches.

Keywords: Blue crab, bioaccumulation, beach pollution, mercury, Kuwait

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Distribution of rare earth elements in sediment cores of Sedili and Tanjung Pelepas, Johor as pollution indicator

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Sediment core samples obtained from the harbor of Sedili and Tanjung Pelepas, Johor were sliced into few layers which have an interval of 3 cm to 5 cm. Analysis of rare earth elements (REEs) including La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu were conducted by using the Inductively Couple Plasma – Mass Spectrometry. The summation of LREEs and HREEs in Sedili harbor were 1640.11µg/g and 162.68µg/g, respectively, as both are higher than the value obtained in Tanjung Pelepas harbor (853.77µg/g of LREE and 105.78µg/g of HREE). The measured concentration of REEs was normalized with Al as enrichment factors signal, but normalized with Fe was used to define as a potential source of REEs at sampling sites. The positive value ratio of Ce/Ce* anomalies (1.10-1.18) shown by Sedili harbor whereas Tanjung Pelepas showed negative Ce/Ce* anomalies value (0.87-0.96). However, both stations showed the weak positive Eu/Eu* anomalies value which are 0.76-0.84 (Sedili Harbor) and 0.96-1.0 (Tanjung Pelepas Harbor). Fractionation index also use to define the relative behavior of LREEs to HREEs by the ratio of (La/Yb)_n, and from this study the REEs are advocate to use as an Indicator for pollution.

Keywords: Rare earth elements, core sediment, harbor, pollution indicator

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Effect of cadmium on DNA changes of *Lpomoea aquatica* Forssk***Tawatchai Tanee^{1,2}, Lamyai Neeratanaphan^{2,3} and Penkhae Thamsenunapap¹**¹*Faculty of Environment and Resource Studies, Mahasarakham University, Maha Sarakham 44150, Thailand*²*Genetics and Environmental Toxicology (GET) Research Group, Khon Kaen University, Khon Kaen 40002, Thailand*³*Department of Environmental Science, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand*

Ipomoea aquatica Forssk. is a popular vegetable, especially in Asian dish. For plant growing with inorganic fertilizer, cadmium (Cd) is one of the highest metals and health-risk factors included. This research aimed to assess the bioaccumulation of Cd by the plant and its genetic changes. The plant was grown in the soil supplemented by Cd at 0, 15, 30, 60 and 120 mg/kg. After 21 days, the plant height was measured. Accumulations in the roots, stem and leaves, were analyzed using Atomic Absorption Spectrophotometer (AAS), then the bioconcentration factor (BCF) and translocation factor (TF) were calculated. DNA changes were accessed by random amplified polymorphic DNA (RAPD) with genomic template stability (GTS) test. The height ranged from 1.6 to 9.7 cm. The Cd accumulation in the each plant part ranged from 0 to 12,333 mg/kg, 0 to 5,909.27 mg/kg, and 0 to 1,653.26 mg/kg, respectively. The BCF and TF values ranged from 0 to 21.15 and 0 to 1.21, respectively. From RAPD fingerprints, the GTS values ranged from 52.3 to 91.1%. At the highest concentration of Cd supplemented (120 mg/kg), the DNA resulted in the highest changes (GTS = 52.3%). Thus, RAPD assay could be used as an investigation tool for environmental toxicology and as a useful biomarker assay for the detection of genotoxic effects of Cd pollution on plants. These results, including BCF and TF values, also indicated that *I. aquatica* is a Cd-hyperaccumulator, therefore, consuming the plants growing in the Cd-polluted area is a health risk.

Keywords: Cadmium, *Lpomoea aquatica* forks, bioconcentration factor, translocation factor, genotoxicity

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Efficient bacterial species for arsenic bioremediation of gold mining soil

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To improve arsenic (As) contamination levels in soil, the use of microorganisms to efficiently treat As was investigated. The five sites examined for microorganisms and contaminated soil collections were affected gold mining areas. The highest As concentration in gold mining soil is 0.72 mg·kg⁻¹. Microorganism strains isolated from the gold mining soil samples were tested for As removal capacity. Two bacterial isolates were identified by 16S rRNA gene sequence analysis and morphological characteristics as *Brevibacillus reuszeri* and *Rhodococcus* sp. The ability to treat As in nutrient agar (NA) at 1,600 mg·l⁻¹ and contaminated soil samples at 0.72 mg·kg⁻¹ was measured at 168 h, revealing more efficient As removal by *B. reuszeri* than *Rhodococcus* sp. (96.67% and 94.17%, respectively). Both species have the capacity to remove As, but *B. reuszeri* shows improved growth compared to the *Rhodococcus* sp. These data indicated that *B. reuszeri* might be suitable for adaptation and use in As treatment. *B. reuszeri* has a high efficiency and can be used for soil As treatment, being able to tolerate a concentration of 0.72 mg·kg⁻¹ and as high as 1,600 mg·l⁻¹ in NA.

Keywords: Arsenic-polluted soil, arsenic treatment, gold mining soil, efficient bacteria

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Estimation of phytomass at highly degraded area and logged over forest of oil palm plantations

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This study was conducted to determine the aboveground biomass in different scales of oil palm plantation covering biomass of the non-woody plants or known as phytomass such as grass. Sampling sites chosen for this study were an oil palm plantation at Chepor, Perak which was categorized as a logged-over forest area and second site was at Universiti Putra Malaysia (UPM) which was categorized as highly degraded area. Four different identical ages (1992, 2009 and 2011) of palm oil cultivation were chosen at both sites, except for the oldest palm oil tree in UPM, planted in 1973 while in Chepor, planted in 1986. The objectives of this study were to identify the phytomass present in different cultivation ages and in different land usage history, and to determine the contribution of phytomass for carbon sequestration and net carbon balance in the soil of oil palm plantation. The amount of phytomass of four different oil palm ages in UPM were higher in very old and very young cultivation while phytomass at Chepor plantation were at uniform amount at all four plots. In comparing phytomass at Chepor and UPM, the amount of phytomass at Chepor, Perak is 517.95 tonnes per hectare far less than the phytomass at UPM which is 1178.8 tonnes per hectare. The results indicated that history of the land usage has no influence on the amount of phytomass instead of the plantation management. In comparison with the soil carbon stock, this study found that soil in UPM plantation contain higher organic carbon compared to the soil in Chepor plantation. For the carbon storage, it was said that the carbon sequestration is assumed to be about 50% from the biomass amount. In conclusion, phytomass in oil palm plantations influence soil's carbon storage. Soils in highly degraded area in UPM act as effective carbon storage compared to logged-over forest at Chepor plantation.

Keywords: Phytomass, carbon stock, highly degraded area, logged-over forest, carbon sequestration

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Gonadal histology of tiny scale barb, *Thynnichthys thynnoides* Bleeker 1852, during mass migration season in Rui River, Perak

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This study was conducted to evaluate the gonadal histology of tiny scale barb or locally known as "ikan loma", *Thynnichthys thynnoides* Bleeker 1852, during the mass migration season in Rui River, Gerik, Perak. A total of 62 (46 males: 16 females) and 60 (44 males: 16 females) fish were randomly collected along the Rui River in Kampung Kuala Rui (downstream of Rui River) and Kampung Kerunai (midstream of Rui River), from October to December 2013. The collected fish gonads were separated, fixed in 10% formalin and processed for H&E staining. The results showed that female samples collected at Kampung Kuala Rui and Kampung Kerunai was at the stage of ripe and running period which indicated by higher percentage of vitellogenic oocytes compared to other stages of oocytes. Gonads collected from Kampung Kuala Rui demonstrated only massive number of vitellogenic oocytes than other type of oocytes with no presence of atretic oocytes, while all samples from Kampung Kerunai showed the presence of atretic oocytes with the mean at $9 \pm 3\%$ from overall oocytes counted, indicating that the fish already released their eggs. The atretic oocytes are characterised by thick ovarian wall, non-oval, shrank and wrinkled shape with less yolk granules in the ooplasm. For male gonads, 100% of samples taken from Kampung Kuala Rui demonstrated ripe and spawning stage which indicated by compacted spermatozoa in seminiferous tubules. However, at Kampung Kerunai, 57% of the samples showed ripe and spawning stage while the other 43% demonstrated spent stage or post spawning characteristics which indicated by flaccid with hollow appearance of seminiferous tubules with little amount of spermatozoa in the tubules. As a conclusion, the results revealed that *T. thynnoides* migrated from Perak River into Rui River in order to spawn in the area between Kampung Kuala Rui and Kampung Kerunai.

Keywords: Gonadal histology, *Thynnichthys thynnoides*, mass migration, Rui River

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Identification of chlorophyll-a and biogenic silica from western Street of Johor during Southwest Monsoon

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Chlorophyll-a (chl a) is a pigment used by photosynthetic organisms in the production of energy. While, biogenic silica (BSi) consists of marine phytoplankton that depend on silicon for the formation of the cell wall. In this study, concentration of nitrite, orthophosphate, dissolved silica and BSi have been identified as to explain the distribution of chl a. Samples were collected at western Street of Johor during the southwest monsoon which on June 2014. Published procedure of SCOR/UNESCO was used in order to obtain a concentration of chl a. While determination of nitrite, orthophosphate and dissolved silica conducted based on detection of colour formed. Wet alkaline digestion followed by colour formation was used to detect BSi. Results shown that nutrient input from the river caused the highest concentration of chl a at J6 (13.02 µg/L) correspond to the highest concentration of dissolved silica (12.81 µM) and BSi (33.23 mg/g). In contrast, at J1, the lowest concentration of chl a (0.9145 µg/L) yet the highest concentration of BSi (28.02 mg/g) was recorded. This may suggest that BSi in this area consists of disintegrated diatom. Low concentration of orthophosphate (0.44 – 2.88 µM) compare to nitrite (1.56 – 7.29 µM) and dissolved silica (5.85 – 12.81 µM) suggest that orthophosphate as the limiting factor for the growth of phytoplankton. The unparallel concentration of BSi and chl a suggest that BSi is less suitable in explaining phytoplankton distribution.

Keywords: Chlorophyll a, biogenic silica, nitrite, orthophosphate

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Imposex study on *Thais bitubercularis* in Merambong Shoal, Johor

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Imposex in *Thais bitubercularis* was observed in Merambong Shoal. About 18% from female individuals of the species were found to have male sexual organs, which is imposex at various stages. Stage 2 is the highest level of imposex discovered. The imposex occurrence was determined by calculated the proportion of females with imposex to the total number of female in sample and the degree of imposex was assessed using the vas deference sequence index and the percentage of females possessing the imposex characteristics. There are no significant relationship between the shell height and the number of spines between the degrees of imposex occurrence in *T. bitubercularis*. The present study also provided an overview of the present condition of the population health of *T. bitubercularis* at Merambong Shoal. Based on the male to female ratio, the population in Merambong Shoal showed in normal ratio which is 5:7 and this ratio is closer to normal ratio condition which is 4:7. The imposex incidence in the population reveals that *T. bitubercularis* in Merambong shoals are no exception from being exposed with the pollutant that can promote imposex occurrence. Tributyltin (TBT) which was recorded as the most suspected pollutant causing imposex in gastropod is expected contaminating the Johor Straits. However, the low incidence of imposex can be explain as the sample was collected from a shoal that receive high water current. The condition causing very low suspended particles or organic matter in the sediment resulting low TBT deposition in the sediment, then automatically low uptake by the biota living in the shoal.

Keywords: Imposex, *Thais bitubercularis*, tributyltin (TBT), Johor Straits

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Metal (Cu, Fe, Mn, Zn) Pollution Assessment of Surface Sediments in Miri River Estuarine Mangrove, Sarawak, Malaysia

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Rapid urbanization and industrialization make Miri river estuary vulnerable to metal pollution. The heavy metal pollution status and their ecological risk in Miri river estuary was evaluated using USEPA sediment quality guidelines and the contamination assessment methods (pollution load index, contamination factor as well as enrichment factor). Intertidal surface sediments samples were collected from 3 stations of Miri river estuary. Acid extracted heavy metals (Cu, Fe, Mn, Zn) were measured by Atomic Absorption Spectrophotometer. On average, higher Fe (7664.30 mgkg⁻¹) and Zn (26.68 mgkg⁻¹) concentration was found in surface sediment compared to Mn (14.33 mgkg⁻¹) and Cu (13.43 mgkg⁻¹). Our results show that Miri river estuary is enriched with Fe, over two hundred folds higher concentration than that of USEPA sediment quality guideline, whereas other metals (Cu, Mn, Zn) were found below this guideline. We suspect that the higher concentration of Fe in the study area is because of estuarine mangrove sediment and suggesting input from the urban and industrial runoff. Overall, lower values found for pollution load index, contamination factor and enrichment factor. Comparatively, higher concentrations of studied metal found in the present study than those found in the aquatic environment of other regions, suggesting anthropogenic input from nearby sources that may be toxic for this estuarine biota.

Keywords: Heavy metals, estuary, mangrove, sediments, USEPA

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Natural thorium isotopes and recent sedimentation rates in Port of Tanjung Pelepas (PTP), Johor, Malaysia

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Sediments core was collected at the Port of Tanjung Pelepas (PTP) of the Sungai Pulau located in Malay Peninsula's most southern tip in the state of Johor. The sediment core was analyzed to determine the activities of ^{232}Th , ^{230}Th and ^{210}Pb . Then, the objectives of this study are to provide a concentration activity level of thorium and lead isotopes and also to estimate the sedimentation rate using the chronology ^{210}Pb at the study area. The activity of ^{232}Th in core sediments collected from PTP show a consistent profile from bottom to top layer of sediment core ranged between 3.13 ± 0.46 to 5.52 ± 0.55 while the concentrations of ^{230}Th were decreasing from bottom to the upper layer of the core with the activity ranged from 2.42 ± 0.37 dpm/g to 3.99 ± 0.51 dpm/g, while the activity ratio of $^{230}\text{Th}/^{232}\text{Th}$ was calculated in the ranged of 0.55 to 1.58. Most of the upper layers (0-19.5 cm) show the ratio < 1 while lower layer > 19.5 cm show the ratio > 1 . These results suggest the decreasing input of ^{230}Th at the recent time to the study area. The degradation of mangrove forest at this area might be leads to decreasing the activity of ^{230}Th from bottom to the top area of core sediments. The sedimentation rate of sediment core from PTP was successfully estimated by using ^{210}Pb model. The sedimentation rate at PTP was 0.28 cm/year which indicates low deposition process occurred at this area.

Keywords: Thorium isotopes, sedimentation rates, Port of Tanjung Pelepas (PTP), ^{210}Pb , mangrove forest

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Population characteristics, length–length and length–weight relationship of *Cherax quadricarinatus* (Von Martens 1868) from natural and man-made habitats in Malaysia

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The population characteristics of freshwater crayfish *Cherax quadricarinatus* were recorded for the first time from Similiajau river and Sri Rajang stream in Sarawak and Parit Sulong waterway in Johor. The crayfish was collected using baited traps collected from May 2013 to February 2014. Data collected consisted of total length, carapace length, total weight and sex. The population structure, length- weight and length-length relationship of *C. quadricarinatus* were examined based on 413 specimens comprised of 231 male and 182 female crayfish. The mean total length of male and female were 112.03 ± 20.28 mm and 110.37 ± 19.03 mm. The differences in average length of males and females were not significant ($p > 0.05$). The equation calculated for length-weight relationship was $W = 0.000025L^{2.9896}$ ($r^2 = 0.850$) for male and $W = 0.000070L^{2.751}$ ($r^2 = 0.899$) for female. The equation for length-length relationship was $1.6721TL + 22.423$ ($r^2 = 0.8178$) for male and $1.5897TL + 27.114$ ($r^2 = 0.7491$) for female. The sex ratio was found to be 1: 1.27 (male: female).

Keywords: Redclaw, crayfish, *Cherax quadricarinatus*, freshwater, Malaysia

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Preliminary studies of ligament lines: Is it suitable to determine the age of cockle (*Anadara granosa*) in tropical area?

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Cockle culture is extensively operated in Malaysian estuary especially at the Straits of Malacca. Not only it has a major important economic value, this animal is a benthic organism and has very limited mobility which makes it as a good bioindicator especially for the wild breed. However, a method to estimate the age of wild cockle is important to obtain the actual data representing the period of pollution exposure. For that reason, this study has been conducted to identify the age of cockle *Anadara granosa* by observing the ligament lines. This method offers simpler, convenient, practical and time-saving. The samples were collected along the mudflat area of Kong Kong Laut Johor in July 2014. Both of the ligaments and the length of the cockles were been measured and calculated. Based on regression analysis, the treadlines reveals significant relationship between ligament lines and the shell length. Further study has to be made to further clarify these findings.

Keywords: Mollusk, ligament lines, age, bioindicator, pollution

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Preliminary study of selected heavy metal contamination in surface sediment of Merambong Shoal Seagrass Bed

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Surface area of Merambong Shoal Seagrass Bed (MSSB) is an Important area for aquatic organisms as well as human communities for fishing activity. Present study was conducted to evaluate the current status of selected heavy metals contamination in surface sediments collected from the MSSB. Samples of surface sediments were collected from multiple locations along MSSB. The heavy metal concentrations of the present study were compared with previously conducted studies in similar location, as well as other location in Malaysia. Geofractionation of heavy metals were also determined. Based on the obtained mean concentration of each metal, a few indices were used to demonstrate the present level of contamination in the surface sediment of MSSB. The findings of this research are important for monitoring heavy metals pollution and conservation management.

Keywords: Heavy metals, surface sediment, pollution level, Merambong Shoal Seagrass Bed

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Profile of Heavy Metals Level in Catfish (*Hexanematchthys sagor*) and Green Mussel (*Perna viridis*) from Kong Kong Laut, Johor Straits

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This study aimed to investigate the bioavailability of heavy metals on catfish (*Hexanematchthys sagor*) and green mussel (*Perna viridis*), and to estimate the potential human health risk through the consumption of aquatic organisms from Kong Kong Laut, Johor. The catfish tissues (muscle, gill, and liver) in different sizes and green mussel soft tissues were tested for Cu, Cr, Mn, Pb and Fe concentration by using a flame atomic absorption spectrophotometer (FAAS). There are a significant difference of the heavy metals concentration in different fish tissues (Cu, Mn, Pb at $p < 0.05$ and Fe at $p < 0.1$), except the Cr ($p > 0.05$). Significant positive relationships were found between the catfish length with the concentration of Fe ($p < 0.1$) and Mn ($p < 0.05$) in the catfish muscle. A significant positive relationship was found between the catfish weight with the Fe concentration in the catfish muscle ($p < 0.05$) tissues. The estimated daily intake (EDI) values for Cr in catfish; Cr and Pb in green mussel have exceeded RfD value and may have toxic effects due to high intake of the heavy metal. The target hazard quotients (THQ) value of Pb in green mussel's soft tissue indicates the person who consuming green mussel from the study area may have potential health risks related.

Keywords: *Hexanematchthys sagor*, *Perna viridis*, Kong Kong Laut, estimated daily intake, target hazard quotients

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Safety consumption of heavy metals (Cd and Pb) in edible tissues of paddy eel, *Monopterus albus*, from paddy cultivation areas

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Present study investigated the level of cadmium and lead metal and daily intake in edible tissues (muscle and skin) of paddy eel, *Monopterus albus* in 2011 collected from paddy cultivation areas. From the results obtained, Cd mean concentrations in muscle and skin were 0.77 and 1.44 µg/g respectively throughout the paddy seasons. Yet, Pb accumulated 9.46 and 16.05 µg/g in muscle and skin respectively during the paddy seasons observed. However, the daily intakes of Cd in muscle tissues were ranged from 0.053 to 0.8 µg/day and 2.993 to 7.363 µg/day for Pb. In comparison with the reference doses, the daily intake of Cd and Pb are 1 µg/day and 3.57 µg/day. These suggest that, the muscle of paddy eel might be contaminated with Pb and Cd. Furthermore, more precaution steps should be taken in order to prevent the serious Cd and Pb toxicity. Consumption of a variety of different sizes of fish is encouraged for adults and children with levels of ages.

Keywords: Heavy metals, edible tissues, paddy eel, daily intake, paddy cultivation areas

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The efficiency of using manganese dioxide (MnO₂) and limestone in the removal of manganese from Acid Mine Drainage

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Recent years, developing an alternative system to treat Acid Mine Drainage (AMD) had been given much of attention. One of the common components in the AMD is manganese. Manganese in mine water that requires a high pH to achieve complete oxidation is relatively difficult to be removed due to its high solubility and the characteristics of manganese in water. If discharged to the stream without proper treatment, questions will arise whether this water is safe for potable water usage or aquatic consumption. This study will investigate the efficiencies of using limestone (calcite and dolomite) and residue from industry consists of manganese dioxide for manganese removal in mine water. Batch experiment will be performed to test these substrates using real mine water from Bestari Jaya mining pool. Manganese concentration will be measured every 2 hours using atomic absorption spectroscopy (AAS). The nature of limestone and the residue will be confirmed by using XRD analysis. The Scanning Electron Microscopy (SEM) will also use to retrieve the morphological surface images and distinguish the elemental composition in the substrates pre- and post treatment. Limestones are well known as the best substrate for promoting manganese oxidation in a passive system due to its availability and low cost in many countries. The complete oxidation of manganese can help the removal of manganese from mine water. Meanwhile, the application of residue contains manganese dioxide to the mine water can be achieved by adsorption or precipitation after its contact with the Mn²⁺ solution.

Keywords: Acid mine drainage, manganese removal, limestone, manganese dioxide's residue

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The potential use of mixed substrates in passive treatment of acid mine drainage: batch experiments

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Acid mine drainage (AMD) is an acidic solution which contains a high concentration of heavy metals. Basically, passive treatment is an economical and low maintenance of AMD treatment in terms of biological remediation. In laboratory-scale, batch tests are generally used as a preliminary procedure of acid mine drainage (AMD) treatment. This test is to evaluate the efficiency of each treatment medium and the potential use of mixed substrates as treatment media for AMD. The batch test is performed by using different treatment media such as limestone, activated sludge, and mushroom compost. In addition, different ratios of all treatment media combined as mixed substrates are also being tested. The best proportion will be selected to be used in column experiment. All of treatment media would be single-tested in different 1000ml beakers with liquid to solid ratio of 0.4. The anaerobic condition beakers are placed on a rotary shaker with 180rpm agitation. Parameters conducted are pH, temperature, alkalinity, and heavy metals (Zn, Pb, Cu, Fe, Mn) throughout 0h, 72h, and 168h. The heavy metals are analysed by using ICP-OES. The results show the pH and alkalinity of AMD increases while heavy metals show the reduction of concentration in the end of experiment. The suitable proportion of mixed substrates has been selected with limestone (40%), spent mushroom compost (30%), activated sludge (20%), and woodchips (10%). Overall, the best proportion of will be used in the column experiment for further study to evaluate the efficiency of the treatment media in larger scale.

Keywords: Acid mine drainage (AMD), Passive treatment, Batch tests, Heavy metals.

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Tracing Carbon and Nitrogen fluxes In soil of log-over forest and highly degraded area of oil palm plantations using stable Isotope analysis

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The role of soil organic matter in the world's climate has become the focus of recent studies, particularly with suggestions by the Kyoto protocol that soils may act as a potential sink for CO₂. With approximately 1500 Gt C contained in the upper meter of the world's mineral soils. Changes in climate and land-use will have significant effects on the carbon budget, particularly with respect to the turnover rate of soil carbon. Conversions of tropical forests in to oil palm plantations may effects on the amount of organic carbon in soil and consequently release the carbon into the atmosphere as carbon dioxide (CO₂). For this reason, this study will focus on use of natural abundance level of stable carbon and nitrogen isotopes as tracer of soil organic matter and nitrogen cycling in oil palm plantation with different land history. Furthermore, this work will include identification of relationship between C¹³ and N¹⁵ abundance in vertical soil profile and also the soil C and N concentration. Later the relationship of stable isotopes and heavy metals concentration which used extensively in this area will also be determined. At the end of this study, the selection of best land for oil palm plantation will be established for better environmental justice.

Keywords: Stable isotopes, Organic carbon, heavy metals, Oil palm plantation, CO₂ emission.

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Abstracts for Workshop (Domain Ecology)

Integrated approach to solve pollution and biodiversity conflicts In Malaysia

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Pollution and human activities affect biodiversity and it can be either direct or indirectly. A direct one usually occur through oil spill, acute chemical pollution, deforestation, overharvesting, etc. while indirect one often contaminate the environment affecting single or a group of organism within the food chains. Continuous chemical accumulation of hazardous chemicals not only disrupt target organism but also cause impairments or abnormalities in subsequent generations. For examples, there were many studies that highlighted the effects of heavy metals to waterbirds population including their young such as thinning of eggshells, deformities, low survival, etc. Many other cases relating to us humans are also well publicised as our health and life quality deteriorates in conjunction with hazardous chemical pollution, overexploitation and habitat degradation. The important question remains, how to solve pollution problems? Integrated approach that considers fundamental sciences, land availability and its uses, social awareness and education background is very much needed to help solving this issue. Through public recognition and support, implementing a green policy would be easier. This process can be hastened by providing accurate and up to date evidence for the public to act upon. Hence, the ultimate goal of any good scientist is not only to obtain important information from our surroundings, but also to deliver the right message and help promote awareness, develop commitment and to seek balance between public's needs and ecosystem's stability.

Keywords: Pollution, integrated approach, public support, ecosystem stability

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Bio-logging as a key technology to assess foraging behavior of marine top predators

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Foraging behaviour is central to animal ecology and a key to understand the interaction between animals and their environment. Without our understanding on the foraging behaviour it is unable to understand how animals react to environmental and ecological changes. Marine top predators have potential impact on the ocean environment due to their large magnitude of foraging demand and thereby wider foraging range. Their foraging trait tends to accelerate the ecological changes through either top down or bottom up effect by disruption of the food webs. However information about such changes is very much limited, and therefore our understanding is still inadequate due to our poor inability in observing the prey predator interaction quantitatively and thus our studies have depended on the theoretical approaches to some extent using proxy of foraging metrics. Towards more complete understandings of the ocean ecosystems we recently developed a technique to observe foraging behaviour of the marine animals in situ in very fine scale by using animal-born instruments, i.e. bio-logging. Firstly we could measure feeding behaviour by counting jaw motion in seals, head strike motion in penguins and swimming motion in a fish. Secondly using algorithm of jaw motion movement we could develop long term recorders of jaw motion event and swim stroke event of seals which can record more than a half year. Thirdly we developed video system linked with feeding behavior.

Keywords: Bio-logging, foraging behaviour, ocean ecosystem, top predators

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Determination of food web in Merambong shoal, seagrass area; Evidence from stable isotope analysis

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Stable isotope was analyzed in aquatic ecosystem to identify the carbon-13 ($\delta^{13}\text{C}$) and nitrogen-15 ($\delta^{15}\text{N}$) stable isotope ratio distribution in primary producers, ranging from phytoplankton, zooplakton, algae, seagrass and also pelagic consumers, include gastropod, bivalva, enchinoderm and fish. All samples were collected from Merambong shoal, seagrass area located between Tanjung Adang and Tanjung Kupang in south of Johor, Malaysia in January 2014. The $\delta^{13}\text{C}$ ratio potential in indicate the relative trophic interaction of the organisms based on the food uptake, whereas $\delta^{15}\text{N}$ ratio interpret the trophic level of organism in the food web. Both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ ratios complementary for examining the transport of organic matter along the food chain and determine the trophic structure of the pelagic ecosystem in seagrass area. The stable isotope analysis in R 4.0 (SIAR 4.0) and calculation of trophic level (TL) also had been used for determining the contribution of different prey and consumer to the diet. The concentration of diet depending on the percentage of carbon and nitrogen of dietary items into the SIAR 4.0 model, whereas the trophic level calculation depends on the consumer and primary consumer of $\delta^{15}\text{N}$ ratio. From the previous study, the organism which has a high isotope ratio of carbon and nitrogen may have a high trophic level in the food chain and vice versa.

Keywords: Stable isotope analysis, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, seagrass, SIAR 4.0

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Visual and behavioral evidence indicates active hunting by sperm whales

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Sperm whales are thought to employ active pursuit strategies for hunting their prey, mainly deep-sea squid at depth, but no visual evidence has been obtained to test this hypothesis. Using animal-borne cameras and accelerometers simultaneously deployed on 17 whales, we recorded the hunting behavior of sperm whales at depth. A total of 42.8 h diving data including 17715 images was obtained. Although the vast majority of the still images were empty water and uninformative (98.5 % of images), five classes of image with visible material were identified: (1) suspended possibly squid ink material ($n = 17$), (2) unidentified particles ($n = 4$), (3) possible animal body parts ($n = 2$), (4) other individual whales ($n = 221$) and (5) the sea bottom ($n = 8$). Class (4) images were only recorded at depths shallower than 339 m, suggesting that tagged whales swam alone while foraging at greater depth. In contrast, the other classes of image were only recorded at deeper depths (mean $\pm$ SD = 785 ± 140 m). Simultaneous use of the speed and image sensors revealed that class (1) images were associated with bursts of speed up to approximately twice (3.3 ± 1.0 m s⁻¹, max. 6 m s⁻¹) the mean swim speed (1.8 ± 0.4 m s⁻¹). The bursts of speed linked with the images likely derived from prey support the hypothesis that sperm whales attempt to capture their prey by active hunting.

Keywords: Animal-borne camera, cetacean, data-logger, diving behavior, hunting, swim speed, *Physeter macrocephalus*

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Natural Radionuclides in Malaysian Waters

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South China Sea was boundary with many countries such as Malaysia, Indonesia, Thailand, Vietnam, Philippine, Singapore, Brunei, Taiwan and mainland of China. In general, the thickness of water column in the coastal area was less than 1000 m with heavily horizontal particles transport from the land. Studies on natural uranium-thorium decay series in marine Malaysian waters were well published by scientist from Universiti Kebangsaan Malaysia and Malaysia Nuclear Agency in waters, sediments, biota, suspended particles and marine aerosol. In east coast Peninsular of Malaysia e.g., coast of Mersing, the concentration levels of ^{210}Po and ^{210}Pb were varied between 0.76 to 2.24 mBq/L and 0.16 to 1.60 mBq/L, respectively. While the phosphorus concentrations include total dissolved phosphorus (TDP), soluble reactive phosphorus (SRP) and dissolved organic phosphorus (DOP), were in the range of 6.06 to 23.31 $\mu\text{g/L}$, 2.24 to 13.42 $\mu\text{g/L}$ and 0.47 to 16.10 $\mu\text{g/L}$. The concentration of TDP and salinity shows weak positive correlation ($r = 0.39$) might due to the shallow area of Mersing River. There are high positive correlation ($r = 0.85$) of ^{210}Po activity and SPM concentration and moderate positive correlation ($r = 0.59$) of ^{210}Po and TDP in water. While in other studies shows the distributions of ^{210}Pb and ^{210}Po activities in PM_{10} were varied between 162 to 881 $\mu\text{Bq/m}^3$ (mean: $347 \pm 170 \mu\text{Bq/m}^3$) and 85 to 1009 $\mu\text{Bq/m}^3$ (mean: $318 \pm 202 \mu\text{Bq/m}^3$), respectively. It is seen that the ^{210}Po activity in Malaysia waters lies in a broader and/or higher than the global range, which contribute from external sources (i.e., biomass burning) injected to the local atmosphere. However in sediment cores the concentration levels of ^{234}U was ranging from $1.66 \pm 0.12 \text{ dpm/g}$ to $3.73 \pm 0.32 \text{ dpm/g}$, and ^{238}U ranged from $1.79 \pm 0.32 \text{ dpm/g}$ to $3.70 \pm 1.32 \text{ dpm/g}$ with highest activity recorded at the top layer. But ratio value of $^{234}\text{U}/^{238}\text{U}$, e.g., at upper layer of Kota Kinabalu and Labuan port was ≥ 1.14 and ≤ 1 , respectively. Further discussion on the behavior and distribution of natural radionuclides in Malaysian marine waters will highlight during presentation.

Keywords: Natural radionuclides, seawater, sediment, trans-boundary, particulate

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Physicochemical Properties of Sediment Pore Water in Merambong Seagrass Bed, Johor

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Sediment pore water chemistry provides valuable information on chemical changes occurring in sediment, on equilibrium reaction between nutrients cycling and water, on transports of the contaminants into the sediment/water interface and pore water. These processes will affect the availability of nutrients and toxic chemicals to biota. In this study, baseline measurements were made for physicochemical properties (pH, temperature, electrical conductivity, salinity, dissolved oxygen, total dissolved solid, redox potential) and nutrients concentration (HCO_3 , Cl, SO_4 and NO_3) of sediment pore water. A total of 60 sediment pore water samples were extracted in triplicate at 20 sampling points during extreme low tide at Merambong Seagrass Bed off South Western Johor coast, Malaysia in June 2013. Principal component analysis (PCA) was applied to understand variation of nutrients and physicochemical pattern of sediment pore water. This study output will be a baseline frame for future studies involving pore water, sediment and biota samples. Pore water, sediment and biota samples of future monitoring studies will help in understanding a biogeochemical process and for determining the role of sediment diagenesis in nutrient cycling.

Keywords: Pore water, physicochemical properties, nutrient, and Merambong Seagrass Bed

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Abstracts

Domain Genetics

De Novo transcriptome sequencing, functional annotation and pathway analysis in callus culture of *Aquilaria malaccensis* Lam.

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Aquilaria malaccensis is an endangered tree species listed in the Appendix II of CITES. It is a main producer of highly valuable resinous wood known as gaharu (agarwood), which is rich in secondary metabolites. De novo assembly of sequences produced by transcriptome sequencing using Next Generation Sequencing technologies offers a rapid approach to obtain expressed gene sequences for non-model organisms such as *Aquilaria*. To investigate the genes and pathways that might control molecular mechanism of *Aquilaria malaccensis* under controlled environment, we sequenced two transcriptome libraries constructed from mRNAs of healthy and stressed callus tissues using Illumina sequencing. We obtained 200,062,275 and 166,544,202 reads for healthy and stressed callus libraries, respectively. We compiled 259,264 transcripts and identified 107,593 transcripts by similarity analysis against the National Center for Biotechnology Information (NCBI) public database. A total of 96,743 transcripts were functionally annotated using the Gene Ontology (GO) and Kyoto Encyclopedia of Genes and Genomes (KEGG) analyses. We assigned 46,076 of the transcripts to a total of 144 KEGG pathways. We focused on genes identified as contributing to fragrant compound synthesis and stress response pathways, which are important pathways leading to gaharu compounds formation. This study provides abundant transcriptomic data and valuable sequence resources for future genomic studies on *A. malaccensis*.

Keywords: Agarwood, gaharu, fragrance compounds, next generation sequencing, secondary metabolite pathway

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Developing molecular marker for drought stress in soybean (*Glycine max* L. Merr)

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There are many genes and proteins involved in drought stress tolerance. Identification of proteins which could be used as the base for the development of molecular probe for drought tolerance has been done. From the previous research proteins with molecular weight of 13 and 52 kDa which may relate to drought tolerance were identified. The two protein bands, 13 kDa and 52 kDa were separated using 2D-PAGE and sequenced. The result shows that the 13 kDa protein band show high homology to *auxin binding protein* and *germin like protein*, which has enzymatic activity as detoxification enzyme *oxalate oxidase* and *superoxide dismutase*. These enzymes have a role in the drought tolerance mechanism. In this research confirmation of the protein expressed in the field when plant was subjected to drought season was done. Seven varieties of local Indonesia soybean: Tanggamus, Nanti, Seulawah and Tidar (drought tolerant), Willis and Burangrang (moderately drought tolerant) and Detam-1 (drought stress sensitive) were used in this experiment. The protein profile identified using SDS-PAGE show some differences between the tolerance and sensitive varieties.

Keywords: Protein profile, drought tolerance, molecular marker

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Cloning an aluminum tolerance gene candidate from rice

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Aluminum (Al) toxicity is the major limiting factor for crop production in acid soil. Rice is considered as the most Al-tolerant grass species; however, the exact mechanism of Al tolerance in rice is still unclear. It has been proven that the Al tolerance trait in rice is genetically controlled. Unfortunately, until today there are very limited amount of Al tolerance genes that have been cloned from rice. The objective of this research was to clone a rice Al tolerance gene using rice/rye micro-colinearity approach. A rice/rye syntenic relationship has been identified between an Al tolerance locus region in rye and a region in a rice BAC clone. Both regions were bordered by the same flanking markers, MALT1 and MALT2. In between both markers, there were several putative gene candidates residing in the rice BAC clone. One of the putative genes, called *RALT* gene, showed higher expression level in Al-tolerant rice than that of in Al-sensitive rice under Al stress. This research has successfully isolated and cloned the Al tolerance gene candidate from an Indonesian local rice cv Hawara Bunar. Transgenic tobacco plants overexpressing the gene showed more tolerant to Al stress than that of non-transgenic tobacco plants. Bioinformatics analysis showed that the *RALT* protein was predicted as a transcription factor.

Keywords: Aluminum, Al-tolerant gene, rice, syntenic relationship

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Cross-species amplification of microsatellite markers in Malayan tapir (*Tapirus indicus*)

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Malayan tapir (*Tapirus indicus*) is listed as endangered species by IUCN due to population decline caused by habitat loss and fragmentation, and increasing hunting pressure throughout its ranges. Malayan tapir is the only one species of genus Tapiridae, distributed in the tropical rain forest of Southeast Asia. Tapirs are known as the key actors in forest dynamics as they are functionally important seed dispersers and seed predators. Despite their endangered status and functional role in ecosystems, little information is known about their social structure, mating system, population structure and dispersal pattern which are required for better conservation and management. Studies through traditional field methods are extremely difficult because tapirs are shy, cryptic, nocturnal, and prefer to inhabit deep tropical forest. Molecular genetics techniques now provide an alternative way to resolve ecological questions related to tapir. In this study, we tested cross-species amplification of 12 microsatellite markers designed for Lowland tapir (N = 9) and Bairdii tapir (N = 3) in Malayan tapir using fecal DNA. Result showed that all microsatellite markers failed to amplify in Malayan tapir. Poor quality and quantity of DNA, co-purification of PCR inhibitors, unsuitability of DNA extraction and preservation method and high genetic divergence are some of the factors contributing to this result.

Keywords: Malayan tapir, *Tapirus indicus*, microsatellite markers, non-invasive techniques, cross-species amplification

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Spatial distribution pattern of *Cryptocoryne xpurpurea* Ridl. nothovar. *purpurea*, a natural aquatic plant hybrid of the Malay Peninsular

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Amplified fragment length polymorphisms (AFLPs) were used to investigate the clonal and spatial genetic structure of *Cryptocoryne xpurpurea* Ridl. nothovar. *purpurea* (Araceae), a clonal rhizomatous herb, which can form large patches of continuous cover. This plant hybrid has been suggested to have *C. cordata* var. *cordata* and *C. griffithii* as parents owing to observable morphological characters (broad collar zone – *C. cordata*, and purple, rough spathe limb – *C. griffithii*), while also producing sterile pollen. There is some variation in the colouration and also in the surface structure of the limb of the spathe in plants from different localities, an indication that the hybrid has arisen several times independently from different parental populations. The particular interest of this study was to investigate how the population history affects them, which could provide some useful insights into the clonal structure and invasive history of this hybrid. We sampled two distinct (based on geographical distance) populations inferred by plotting the arrangement of individuals in the precise position in a plot, using AFLP profiles generated by three selective primer pairs. Within these, 198 ramets were sampled and assigned to 25 putative genets. The pairwise F_{ST} values 0.415 revealing high values, with significant differentiation between the populations (indicating arisen from different parental populations). It was concluded that within *C. xpurpurea* nothovar. *purpurea* populations, clonality is a significant factor, but the spatial structuring of genetic variation suggests that both low levels of restricted gene flow and repeated recruitment of genets occurred.

Keywords: Araceae, AFLP, hybrid, genetic variation

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Cloning of Genes Encoding for a Key Enzyme in Gaharu Synthesis, δ -Gualene Synthases from *Aquilaria malaccensis* Lam.

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Gaharu, also known as agarwood, is a fragrant wood from the genus *Aquilaria*. The high demands especially from consumers in countries in Asia, Europe and the Middle East have caused all species of *Aquilaria* to be listed as endangered. *Aquilaria* is a tropical tree that is not well-studied despite its valuable gaharu; sesquiterpenes and phenylethyl chromones are its main components. To understand the mechanism of gaharu production, we studied sesquiterpene biosynthesis and its regulation via the terpenoid pathway using molecular methods. Here, we report the cloning of two genes encoding for δ -gualene synthases from *Aquilaria malaccensis*. Delta-gualene is a sesquiterpene compound often found in gaharu. The two genes, designated as *AmGS2* and *AmGS3* were cloned from callus RNA, using specific primers derived from transcriptomic data, in a reverse transcription-PCR reaction. The full length cDNA sequences of *AmGS2* and *AmGS3* are 1644 bp, encoding a peptide of 547 amino acids. Although sharing the same length, their predicted amino acid sequences had about 5% differences. Sequence alignment analysis showed that they share between 95 to 99% identity with δ -gualene synthases from *Aquilaria crassna* and *Aquilaria sinensis*. Terpenes have an active part in plant secondary metabolite research because of their diverse functions. Our findings provide new genomic resources for the purpose of generating specific compounds of interest via in vitro methods such as in metabolic engineering. These compounds have been extensively utilized in pharmaceutical, fragrance, cosmetic, and other related industries.

Keywords: Agarwood, gaharu, fragrance compounds, next generation sequencing, secondary metabolite pathway

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Proteomics and bamboo research

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Bamboo, being one of the fastest growing plants needs only between 3 and 4 years to mature before they are ready for harvesting and utilization. This makes bamboo the best possible alternative to replace timber in the future. As a result, bamboo has been the focus of research in recent years. Currently, there is a growing demand for thicker walled and rapidly growing bamboo from the industry due to its mechanical strength, high durability and uninterrupted as well as sustainable supply. However, the information on the physical, mechanical and chemical properties for different bamboo species and age-groups is rather limited. In the current *Omics* era, 'Proteomic Analysis' has now become one of the basic technologies to obtain essential information of the biological systems. Proteomics is a powerful tool to study the global changes in protein synthesis in response to environmental stimuli as well as during development. At present, we are performing the proteomics studies on various commercially important known species of bamboo to understand the molecular mechanisms of rapid growth as well as thick wall lumen. This will help us to better understand the growth characteristics and physical properties of bamboo at molecular level by identifying the novel proteins associated with the production of thick wall and rapidly growing culms of bamboo. We believe that the present proteomics study shall provide a new dataset and the gene screening list, which will be a useful resource for future genetic as well as genomic studies for the development of high quality bamboo cultivars.

Keywords: Proteomics, bamboo, thick wall lumen

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Identification and expression analysis of putative SDP1 homologue in rice (*Oryza sativa*)

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Oryza sativa is an important staple food for half of the world population. Although the main product from paddy is polished rice, oil can also be produced from the bran. However, genes involved in the production and breakdown of lipids in rice bran are not well characterized. A *SUGAR-DEPENDENT 1* gene (*SDP1*) was identified in *Arabidopsis thaliana* and was found to encode a patatin-like phospholipase. Its expression was detected in non-oil storage tissues. This gene encoded protein has triacylglycerol lipase activity during seed germination and the mutant plant was found to have retarded growth, impaired oil metabolism and oil accumulation in different tissues. Due to its potential to accumulate plant oil, homologue of this gene in rice was studied. To study the expression pattern of this gene, rice RNA samples were collected from different *Indica* and *Japonica* rice in different development stages. The putative *SDP1* was found expressing in non-oil storage tissues. Transcriptomics study of selected Bangladesh BD 192 white rice and Indonesia black rice showed no differences in term of this gene expression, but expressed significantly higher in seedling tissues than in leaf. For gene characterization study, a full length *SDP1* cDNA clone was used as template for transformation. Amplified *SDP1* gene was then cloned into an expression vector and transformed into *Escherichia coli* as host for protein expression. Two amino acid bands were observed on 12% SDS-PAGE that were about 40kDa, but their identity remains unknown. Further protein analysis will be done in the near future.

Keywords: *SUGAR-DEPENDENT 1* gene, *Oryza sativa*, gene expression, triacylglycerol lipase, transcriptomics

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Identification of novel rice genes influencing starch digestibility

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Rice is one of the most versatile crops cultivated worldwide. It serves as the primary dietary source of carbohydrate for most Asians. Eating and cooking qualities of rice are influenced by the physiochemical properties of starch in endosperm, primarily by the amylose. Rice with improved carbohydrate qualities could offer potential as dietary strategy for preventing and managing several chronic diseases, thus promoting population health. Glycemic Index (GI) is a concept used to compare the blood glucose raising responses to carbohydrates of different foods in response to consumption of equal quantities of glucose as a reference. Consumption of low GI food was found to have a beneficial effect in lowering postprandial glucose responses. Thus is it important to study commonly consumed rice in Malaysia with low GI. In this study, twelve healthy individuals were subjected to consume five different rice lines (and their blood samples were collected to determine glucose and insulin responses). Data obtained from the *in vivo* results of our study revealed two of the rices as low GI whilst the remaining three as intermediate. Sequence differences between the three rices in the Waxy gene have been uncovered. Further work will also involve transcriptome sequencing to identify differences between rices. Research is still in progress to establish an *in vitro digestibility* test which will facilitate the identification of genes associated with low GI trait by analysing suitable crosses. Development of markers and the *in vitro* test should enable the rapid development of low GI varieties optimised to Malaysian conditions.

Keywords: Endosperm, glycemic index (gi), incremental area under the curve (iauc), postprandial glucose response

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Isolation, subcellular localization and phylogenetic of Transaldolase genes from *Zea mays* cv sweet corn bi-color

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The Pentose Phosphate Pathway (PPP) also is known as 6-phosphogluconate pathway which occurs in the cytosol of the plant cell. There are two main arms in PPP; the oxidative and non-oxidative arms. The main functions of this pathway is to generate reducing equivalents in the form of NADPH, for reductive biosynthesis reactions within cells in the biosynthesis of fatty acids and steroid. This pathway also provide the cell with ribose-5-phosphate (R5P) for the synthesis of the nucleotides and nucleic acids. Transaldolase (TAL) is an enzyme which plays an Important role in the non-oxidative portion of the pentose phosphate pathway. The actual reaction is between glyceraldehydes 3-phosphate and sedoheptulose 7-phosphate, resulting the formation of C₄ product erythrose 4-phosphate and fructose 6-phosphate. In this study, transaldolase (TAL) has been successfully isolated and identified from *Zea mays* cv Sweet corn bi-color. The objectives of the study were achieved where the specific primer designed has function effectively in isolated TAL with 773 bp of nucleotide sequences. Analysis of homology through multiple sequence alignment revealed that TAL from *Z. mays* cv Sweet corn bi-color is highly similar with the plant species compared to animal and bacteria. ClustalW analysis found that TAL from *Z. mays* hit the score of 85.0 as they are close related in terms of taxonomy level which they are from the family of Poaceae. Other plants such as *Solanum lycopersicum* and *Solanum tuberosum* are from family Solanaceae, *Dimorcarpus longan* is from family Sapindaceae whereas *Hyacinthus orientalis* is from Hyacinthus family. However, it is discovered that TAL from *Z. mays* cv Sweet corn bi-color with TAL in *Oryza sativa* subsp. *Indica* only possess score of 64.0.

Keywords: Transaldolase, pentose phosphate pathway, subcellular localisation, phylogenetic.

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Strain Improvement of *Aspergillus brasiliensis* through mutagenesis for overproduction of xylanase in submerged fermentation

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One of the major outlooks in biotechnology is to enhance enzymes production using various strains of microorganisms. Filamentous fungi such as *Aspergillus brasiliensis* has been found to be the most promising strain as it produces extracellular enzymes such as xylanase which is easily extracted as compared to other intracellular enzymes. Xylanase has been involved in many industrial applications such as pulp and paper, baking, detergent, food and beverage. The main objectives of this study were to improve the production of xylanase by *A. brasiliensis* using physical and chemical mutagenesis and thus to determine the most effective mutagenesis approach for the overproduction of xylanase. In this study, ultraviolet ray irradiation (UV) and chemical mutagens such as ethyl methane sulfonate (EMS) and N-methyl-N'-nitro-N-nitrosoguanidine (MNNG) were selected as the mutagenesis methods due to their cost-effectiveness compared to DNA recombinant technology. The wild type was able to produce 3.097 ± 0.089 U/mL of xylanase at 48 h of submerged fermentation. Nonetheless, the highest xylanase overproduction of 4.86 ± 0.095 U/mL by mutant of *A. brasiliensis* was achieved after being exposed to UV for 20 min at a distance of 10 cm. In fact, UV exposed *A. brasiliensis* mutant experienced the highest percentage of increment with 56.93% in the overproduction of xylanase as compared to EMS and MNNG treated mutants with only 1.34% and 17.14%, respectively. In conclusion, UV mutagenesis was among the most effective mutagenic approach in inducing the overproduction of xylanase by *A. brasiliensis* compared to EMS and MNNG.

Keywords: Mutagenesis, xylanase, *Aspergillus brasiliensis*, submerged fermentation

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Preparation, characterization and reduction of burst release of bovine serum albumin (BSA) from biodegradable PLGA microspheres

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In this study, model protein bovine serum albumin (BSA) loaded poly(lactide-co-glycolide) (PLGA) microspheres have been prepared by a conventional water-in-oil-in-water (w/o/w) and a modified water-in-oil-in-oil-in-water (w/o/o/w) double emulsion solvent evaporation method. The prepared microspheres were characterized with respect to their morphology, particle size, encapsulation efficiency, production yield, thermal properties and *in vitro* drug release. By using w/o/o/w method, a significant decrease in mean particle size and a significant increase in encapsulation efficiency were observed when a binary solvent mixture of ethyl acetate and dichloromethane was used. In w/o/o/w double emulsion solvent evaporation method, the optimized formulation of BSA loaded microspheres was nonporous, smooth-surfaced, and spherical shape under field-emission scanning electron microscope (FE-SEM) with a mean particle size of 3.95 μm and encapsulation efficiency of 98.46%. From 72 days *in vitro* release studies, microspheres prepared by modified (w/o/o/w) method with a combination of hydroxyl and carboxyl terminated PLGA polymers exhibited a significantly lower initial burst release followed by sustained and almost complete release compared to microspheres prepared by conventional w/o/w technique using a single PLGA polymer. It can be concluded that the modified w/o/o/w method can be proposed as a potential delivery system of therapeutic proteins.

Keywords: Sustained release, poly(lactide-co-glycolide), protein drugs, encapsulation efficiency, burst release

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Abstracts Domain Physiology

Extraction and purification of astaxanthin by *Aeromonas hydrophila*

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Lactic acid fermentation (LAF) was effectively extracting carotenoid from shrimp shells meanwhile the use of chemicals and maillard reaction causes pollution to the environment. Lactic acid fermentation can be costly and perhaps not feasible to be conducted without specific equipments. In this study, *Aeromonas hydrophila* (aerobic fermentation) were used as a substitute to LAF to investigate the extractability of carotenoids (mainly astaxanthin) in shrimp shells. Various cell disruption methods (heating, dry and wet autoclave, autolysis and sodium carbonate treatment) were adopted to enhance extractability of carotenoids. Extracted carotenoids were purified using Thin Layer Chromatography developed with different mobile phases and Identified using High Performance Liquid Chromatography. Astaxanthin was found to be present after fermentation with *A. hydrophila*. Cell disruptions did not gave a significantly higher availability of astaxanthin with heat treatments resulting in astaxanthin depletion. As the control treatment were found to yield astaxanthin more significant; $2.30 \pm 0.118 \mu\text{g}$, cell disruptions were not considered. During purification, n-hexane: acetone 3:1 (v/v) was found to be the best solvent system for the separation of extracted carotenoids. Retention factor (R_f) of 0.33 was suspected to be astaxanthin and is further determined by HPLC. Thus concluding that *A. hydrophila* undergoing aerobic fermentation is able to extract astaxanthin.

Keywords: *Aeromonas hydrophila*, astaxanthin, extraction, purification, TLC

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Comparative study on protein expression of chicken meat between Malaysian broilers and indigenous chicken

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High consumer demand towards poultry meat has increased the production of broilers chicken. Due to high feed conversion ratio in broilers and administration of antibiotics in their feeds, broilers undergoes rapid juvenile growth in short time. The rapid growth has brought many health issues including metabolic diseases and other defects that could alter the meat quality. Thus, proteomics approach will be done to compare the protein profile between broilers and indigenous chicken meat. Two types of meat sample from aforementioned chickens were homogenized with extraction buffer and quantified by using Bradford assay. Then, the protein samples were examined by using SDS-PAGE and further resolved by using 2D-PAGE. Highest protein expressed distributed between 40-50 kDa on SDS-PAGE and predicted to be actin and myosin. 2D-PAGE result showed that three protein spots were expressed higher in broilers compared to indigenous chicken. The candidates for this proteins are Serotransferrin (pI: 6-7; mW: 50-75 kDa), myosin binding protein (pI: 5-6; mW: 50-75 kDa) and T-complex protein 1 subunit epsilon (pI: 5-6; mW: 50-75 kDa). In conclusion, three proteins have been identified and it may contribute to the changes of meat quality in broilers.

Keywords: Broilers chicken, proteomics, SDS-PAGE, 2D-PAGE

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Identification of attractant-derived bioactive compounds in the haemolymph of pest male carambola fruit fly, *Bactrocera carambolae* and melon fly, *B. cucurbitae*

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Carambola fruit fly (CFF), *Bactrocera carambolae* and melon fly, *B. cucurbitae* are important fruit pests of economic importance. These flies are known to be strongly attracted to two different groups of male attractants- CFF to methyl eugenol (ME), and melon fly to raspberry ketone (RK) that have been successfully used in male annihilation and quarantine detection. Pharmacophagy of those attractants resulted in the biotransformation of ME to (*E*)-coniferyl alcohol (CF) that is a booster component of male sex pheromone in CFF whilst RK was sequestered unchanged as one of the male sex pheromone components in the melon fly. The presence of either CF or RK that sequestered in the rectal gland prior to emission during courtship period at dusk was investigated in the male circulatory system. These results and their implications in relation to that known about the oriental fruit fly, *B. dorsalis* will be discussed.

Keywords: Methyl eugenol, raspberry ketone, (*E*)-coniferyl alcohol, carambola fruit fly, melon fly, haemolymph

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Developmental exposure to mercury (II) chloride alter behaviour of zebrafish (*Danio rerio*) larvae

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Considering the potential of adverse effect that may arise from exposure to low concentrations of mercury, there is a high push from the scientific community to develop testing strategies that can speed up the process of Developmental Neurotoxicity (DNT) testing by applying a simple alternative approach. This study was done to assess behavioural alterations after exposure to low concentrations of mercury (II) chloride (HgCl_2) during developmental stages of zebrafish (*Danio rerio*). The embryos were exposed to 6 different nanomolar concentrations of HgCl_2 (7.5, 15, 30, 100, 125 and 250) from 5 hours post fertilization (hpf) until hatching. To avoid bias in the behavioural testing, we excluded embryos with morphological abnormalities. Exposure to HgCl_2 induced significant decrease in spontaneous tail coiling at 24 hpf and resulted in significant decreased of the heartbeat at 48 hpf in a dose dependent manner. Exposure to concentrations below 30 nM did not produce significant alterations in the larvae swimming activity, whereas exposure to 100 nM caused a decrease in swimming activity. This study emphasizes the idea that embryonic exposure to HgCl_2 affected the normal behaviour at sublethal concentrations as compared to the control even when no morphological abnormalities observed. This finding revealed that behavioural parameter is a profound parameter that can be used as the endpoint for DNT testing.

Keywords: Zebrafish (*Danio rerio*), mercury (II) chloride, developmental neurotoxicity, behaviours, swimming

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The comparative study on the collagen and gelatin derived from earthworms *Eudrilus eugeniae* and *Lumbricus rubellus*

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Collagen and gelatin have found prominent importance in the medicinal, cosmeceutical, food processing and small industries with its high strength and stability in forming fibers through cross linkage which is a vital component of gelatine stability. This study was done to compare the collagen and gelatine quality obtained from *Eudrilus eugeniae* and *Lumbricus rubellus*. Earthworms were cultured in a medium of 70% Empty fruit bunch + 15% spinach + 15% tofu waste for twelve weeks. A total of 10 worms (average weight of 1g) were introduced into each treatment and earthworm powder was prepared. Collagen and gelatine were extracted using the standard procedure protocols of acid-alkaline treatment method. The properties of collagen and gelatin were analysed using proximate analysis to determine the protein yield, fat, ash and moisture content. The gel strength and rheology properties of gelatin were also obtained. This study suggest that there is a significant difference in the properties of collagen and gelatin between *Eudrilus eugeniae* and *Lumbricus rubellus* ($p < 0.05$) in which collagen and gelatine extracted from *Eudrilus eugeniae* is of higher quality and quantity. With the positive characteristic of collagen and gelatine obtained, this suggests that earthworm collagen and gelatin could potentially be a good replacement for the use in industries.

Keywords: *Eudrilus eugeniae*, *Lumbricus rubellus*, collagen, gelatine

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Ethanol Induces alteration In swimming activity in zebrafish larvae

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Consumption of alcohol during pregnancy could induce perturbation to the normal development of the nervous system. To understand the adverse effects of exposure to ethanol at very low concentrations where no morphological abnormalities could be found, we investigate behavioural alterations after embryonic exposure to ethanol started from 5 hours post fertilization (hpf) until hatching in zebrafish embryos. The embryos were exposed to several concentrations of ethanol (0.25%, 0.50%, 0.75%, 1.5% and 2.00%) with the daily renewal of the medium. We record spontaneous tail coiling in embryos at 24 hpf and swimming activity in larvae at 6 days post fertilization (dpf). We found that exposure to ethanol induced significant decrease of spontaneous tail coiling as the concentration increased. In addition, we also found that exposure to ethanol lead to alterations in the swimming behavior of the larvae at 6 dpf. Exposure to 0.75% ethanol significantly increased swimming activity in the larvae. These findings demonstrated that ethanol affects behavioral activities in zebrafish. Further experiments need to be done in order to understand the mechanisms underlying the changes in the behavioral of the larvae exposed to ethanol.

Keywords: Ethanol, developmental neurotoxicity, locomotor activity, tail coiling, swimming activity

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Mycoremediation of phenanthrene by a fungal isolate from coastal sediment

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Polycyclic Aromatic Hydrocarbons (PAHs) as organic contaminants are a group of persistent organic compound found in the environment many of which pose potential threat to the ecosystem. The present study demonstrates the isolation of a *Trichoderma* sp. from sediment samples alongside its further evaluation to degrade the PAH; phenanthrene. Forty-four fungi isolates were subjected to screening on non-phenanthrene amended and phenanthrene-amended solid media at a concentration of 250 mg.l⁻¹. *Trichoderma* sp. (SY1) a filamentous fungus isolated from Bagan Lalang sediment was the best performing strain capable of withstanding phenanthrene with a good percentage of growth of 76.9% at 72hours and efficient substrate utilization of 60.4% after 10 days incubation in liquid medium. GC-MS analysis revealed a phenanthrene biotransformation by the fungus to metabolites such as 9,10-dihydrophenanthrene, 9,10-dihydro-9,10-dihydroxyphenanthrene, 9-Phenanthrol, phthalic acid, and 1,2,3,4-tetrahydrophenanthrene; suggesting a ligninolytic and non-ligninolytic degradation mechanism with major attack on K-region of phenanthrene (C-9 and C-10). This isolate could thus, serve as a promising inoculum for bioremediation of phenanthrene and other PAHs.

Keywords: *Trichoderma* sp, PAHs, metabolites, bioconversion.

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Alpha-tocopherol reduce endosulfan-Induced toxicity of goats semen

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Antioxidants functions as counteragent in limiting lipid peroxidation (LPO) caused by harmful chemicals. However, there is a definitive data deficient on effect of antioxidant in goats; specifically on sperm polyunsaturated lipid membrane. The study observed the effect of α -tocopherol against endosulfan on percentage motility, progressive score and abnormalities of spermatozoa in *Capra hircus* *in vitro*. There are five Treatment groups; Control, T1 (50 nmol/mL endosulfan), T2 (100 nmol/mL endosulfan), T3 (50 nmol/mL endosulfan, 1000 μ mol/L of α -Tocopherol) and T4 (100 nmol/mL endosulfan, 1000 μ mol/L of α -Tocopherol). The percentage motility, progressive score and sperms abnormalities were observed and recorded for 0, 1, and 2 hours. Result showed that T3 and T4, supplemented with vitamin E, had significantly increased ($p \leq 0.05$) sperm motility (T3: $76.05 \pm 1.45^{a,b}$; T4: $76.05 \pm 1.45^{a,b}$) and progressive score (T3: 0.50 ± 0.03^b ; T4: 0.52 ± 0.01^b) as well as decreased sperm abnormalities (T3: 0.75 ± 0.17^a ; T4: $1.06 \pm 0.31^{a,b}$) which contradicted observations in T1 and T2. These observation suggested that the ability of vitamin E in maintaining motility of sperm and protecting polyunsaturated lipid membrane from ROS activity generated by endosulfan leads to the preservation of membrane fluidity. Therefore, lipid peroxidation was prevented. Vitamin E also maintains axoneme and microtubule structure of sperms' tail thus reduced abnormalities and non-motile sperms. Conclusively, vitamin E proved to increase motility, progressive score and reduces abnormalities of spermatozoa in *Capra hircus* by counteracting toxicity produced by endosulfan.

Keywords: Sperm motility, lipid peroxidation, abnormality, sperm, vitamin E

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**Preliminary study on antinociceptive effect of aqueous extract of
Boesenbergia pandurata in formalin-induced nociception test in mice**

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Pain is an unpleasant sensation associated with body state dysfunction that negatively affects the productivity of patients. Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used as over-the-counter pain reliever medication due to its cost effectiveness. However, prolonged usage of NSAIDs usually accompanied with adverse side effects such as ulcer, nausea and even kidney failure. Hence, researchers are now focused on traditional herbal research to search for potential analgesic substances that are with minimal or no adverse effects. *Boesenbergia pandurata*, it is also known as *temu kunc* in Malaysia is a perennial herb that belongs to Zingiberaceae family. *Boesenbergia pandurata* is widely distributed in Southeast Asia and its rhizomes are commonly used as food ingredients or as traditional medicine to treat diseases conditions such as inflammation, cancer, and fungal infection. The aim of this study is to evaluate the inhibitory effect of aqueous extract of *Boesenbergia pandurata* (AEBP) on formalin-induced nociception test in mice. Mice were pre-treated with AEBP via intraperitoneal injection 30 min before challenged with intraplantar injection of formalin. It was demonstrated that intraperitoneal administration of AEBP at doses (0.3, 1, 3 and 10 mg/kg) produced significant antinociceptive response in both neurogenic and inflammatory phases of pain response induced by formalin. The findings indicated preliminary study on antinociceptive effect of AEBP, but further study should be conducted to explore the exact mechanism of pain inhibition by AEBP.

Keywords: *Boesenbergia pandurata*, antinociceptive, neurogenic, inflammatory pain

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Activity of cardamonin on chemical model of nociception in mice

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Non-steroidal anti-inflammatory drugs (NSAIDs) and opioids are among the most widely used medication in reducing pain. Prolonged usage of these drugs leads to undesirable side effects such as gastrointestinal bleeding, respiratory depression and tolerance. Thus, there is a demand to search for new pharmacologically potent analgesic compounds with fewer or no adverse effects. Cardamonin is a naturally occurring chalcone, which are commonly found in plant kingdom. Previous reports showed that cardamonin has anti-inflammatory effects and inhibit generation of nitric oxide and prostaglandin E₂ via interruption of NF- κ B pathway. In the present study, we evaluated the antinociceptive property of cardamonin using acetic acid-induced abdominal writhing test in mice. Cardamonin (0.3, 1, 3 and 10 mg/kg), vehicle (10 ml/kg) or indomethacin (10 mg/kg) was administered either intraperitoneally or orally, 30 minutes or 60 minutes respectively before injection of 0.8% acetic acid. The number of abdominal writhes was recorded for 30 minutes, starting from 5 minutes after acetic acid injection. Cardamonin showed significant reduction in abdominal writhes. These findings suggested that cardamonin exerted pronounced antinociceptive activity when assessed in chemical model of nociception in mice.

Keywords: Cardamonin, nociception, acetic acid

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Kenaf Water Use Efficiency Under stress

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Research on kenaf water use efficiency received more attention these days regarding to different water supply problems in countries growing kenaf (*Hibiscus cannabinus* L.) traditionally for fiber production as a source of raw material for rope, canvas and sacking and recently as a multi-purpose crop for energy and paper pulp production. Some recent studies used Deficit irrigation (DI) methods of high crop water use efficiency (WUE) which can maintain high crop yields if it is properly used. Deficit irrigation is a kind of irrigation to maximizing WUE for higher yields per unit of irrigation water applied. This current study exposed kenaf to certain levels of water stress throughout growing season based on crop evapotranspiration (ETc) using Tensiometers for soil moisture measurement and Irrigation Scheduling. The expectation is that any yield reduction will be economically not significant compared with the benefits due to saving water, increase planted area and irrigates more crops around the year. Through this research we can explain the critical period of water deficit for kenaf life cycle and try to avoid it and re-arrange irrigation schedules. Kenaf has a great potential in terms of dry biomass production, achieving a maximum of 21–24 t ha as total biomass and 18–19 t ha as stems, under no water limitations (100% ETc restoration), also (50% ETc restoration) may be advantageous, since a 44% irrigation water saving, when compared to the fully irrigation treatment, against no significant yield reduction.

Keywords: Kenaf, water use efficiency, deficit irrigation (DI)

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Macroscopic evaluation of wounds healing progress treated with collagen-calcium alginate film dressing with therapeutic ultrasound

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Twenty four healthy female Sprague-Dawley rats weighing between 300 to 350g were used in this study over a 20-day period. They were allocated randomly into 4 groups of 6 animals each. After the creation of 2cm x 2cm open wound, Group I was control treated with Gentamycin ointment. Groups II, III and IV were treated with Therapeutic ultrasound massage, collagen-calcium alginate film and Collagen-calcium alginate film with therapeutic ultrasound. On application, the Collagen-calcium alginate film with therapeutic ultrasound was well accepted by the animals without any adverse reaction. On bacteriological examination, *Staphylococcus aureus*, *Pseudomonas*, *Escherichia coli*, *Proteus* and *Klebsiella* species were isolated from all the groups. Mean percentage of epithelialisation, wound contraction and total healing were significantly better in Group IV ($P < 0.05$). Collagen is a biocompatible protein that does not interfere with the body's normal immunologic response and can be used in non-healing chronic wounds, which require a trigger to stimulate the normal healing process. In extensive wounds when there is a lack of autologous tissue, biomaterials like Collagen-Calcium alginate may be beneficial and can be used.

Keywords: Macroscopic, collagen-calcium alginate, wound healing, wound contraction

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Anti-inflammatory activity of *Jatropha curcas* extracts

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The *Jatropha curcas* plant or locally known as "pokok jarak" has been widely used as remedies for various conditions including arthritis, gout, jaundice, wound and inflammation. In this study, the seed, leaves, stem and root of *J. curcas* plant were screened for anti-inflammatory (nitric oxide inhibition) and cytotoxic activities (MTT assay) by using RAW 264.7 murine macrophage cells. The highest anti-inflammatory activity was observed in the methanolic extract of root. However, root extract showed high inhibition towards RAW 264.7 cells growth due to its cytotoxicity. Further extraction procedure by using four solvents (hexane, chloroform, ethyl acetate and water) with different polarities was conducted on the root sample. The hexane partition showed high anti-inflammatory activity, at the same time high cytotoxicity towards RAW 264.7 cells at 1 mg/mL. Analysis of this extract by GCMS showed the presence of high levels of terpenes and diterpenes which are known to possess cytotoxic activity. Fractionation process of the hexane partition using column chromatography gave five spots, where two spots (H-4 and H-5) showed anti-inflammatory activity and low cytotoxicity. The two spots showed the presence of hexadecanoic acid and octadecanoic acid by GCMS analysis. This finding suggests that these two compounds are responsible for producing the anti-inflammatory activity of the *J. curcas* root.

Keywords: Plant extracts, RAW 264.7 cells, 3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide (MTT) assay, gas chromatography mass spectrophotometer analysis

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Cytotoxicity effect of 6-mercaptopurine and 6-mercaptopurine riboside on RAW 264.7 and HIG-82 cell lines

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6-mercaptopurine (6-MP) is a purine sulfur derivative which approved as an antitumor drug by Food and Drug Administration (FDA) in 1953. The combination of 6-MP with other antitumor drugs are the main treatment for 80% of children with leukaemia. To date, there is no related report which explains on the anti-proliferation and anti-rheumatic activities of the drug. In this study, the cytotoxicity effect of 6-MP and 6-mercaptopurine riboside (6-MPR) were evaluated on murine macrophages (RAW 264.7) and rabbit synoviocytes (HIG-82) cell lines by using MTT cell viability assay. RAW 264.7 and HIG-82 cell lines were stimulated into inflammatory state by using LPS and PMA, respectively. The results showed that the proliferation of RAW 264.7 cells was significantly inhibited by 6-MP at the concentrations of 6.25 to 100µM, 6-MPR at the concentrations of 12.5 to 50µM and diclofenac (a NSAID drug) at all the concentrations used (3.125 to 100µM). However little reduction on cell proliferation was shown by all drugs tested except diclofenac which significantly reduced ($p > 0.05$) the proliferation of HIG-82 cell at the concentrations of 3.125 to 50µM. All drugs tested did not show any cytotoxic effect on both cell lines at the concentrations below 50µM. Meanwhile, 100µM diclofenac has cytotoxic effect to HIG-82 cell. These results suggest that 6-MP and 6-MPR inhibit the proliferation of RAW 264.7 and HIG-82, which are the two important cell lines in rheumatoid arthritis (RA). This finding opens new avenues for treating RA and the anti-rheumatic activities of 6-MP and 6-MPR will be further studied.

Keywords: 6-Mercaptopurine, 6-Mercaptopurine riboside, HIG-82, RAW 264.7, Cytotoxicity

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Effect of pomegranate on metabolic indexes and inflammatory biomarkers in STZ-NA induced diabetic rats

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Type 2 Diabetes is associated not only with hyperinsulinaemia and hyperglycemia but also with other disorders such as atherosclerosis, hypertension, inflammatory disorders and abnormal lipid profiles in dyslipidemia. Fruit extracts have been used universally in treatment of chronic diseases, because they are natural, safe, and readily accessible. Pomegranate (*Punica granatum* Linn) has been used, as pomegranate fractions have therapeutic potential stated by multitudinous scientists using various *in vitro* assay systems which is due to the presence of unique bioactive compounds and polyphenolic constituents. This study was performed to evaluate the pomegranate juice and seed consumption and their potential effect on treatment of diabetes and its associated complications such as abnormalities in plasma glucose, insulin, inflammatory factors, lipid profile level and pancreatic tissue in STZ-NA induced diabetic rats. Forty adult healthy male Sprague Dawley rats were dedicated in 5 groups of 8 rats each. Diabetes mellitus was induced in 4 groups by administration of streptozotocin-nicotinamide. Diabetic animals were further treated differently for 21 days, by using oral gavage by force-feed with needle. Rats in all groups were sacrificed on day 22. The results of the study suggests that the antioxidant flavonoids and Polyphenolic active constituents present in pomegranate are possibly responsible for hypolipidemic and anti-inflammatory effect in diabetic rats which can help the cure and management of diabetes. Although the biochemical mechanisms underlying Pomegranate seed and juice activities are not yet clear, our results demonstrated that *Punica granatum* has a suppressor effect versus lipid abnormalities and overexpression of inflammatory cytokines which are side effects of diabetes.

Keywords: Diabetes, pomegranate polyphenolic constituents, lipid abnormalities, inflammatory cytokines

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Evaluation on the effectiveness of bacteriophage cocktail to control the growth of *Escherichia coli* on food contact surface during simulation study

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A bacteriophage cocktail containing *Escherichia coli* bacteriophages was evaluated for its effectiveness to control the growth of *E.coli* strain on food contact surface (stainless steel) during simulation study. The experiment was carried out using a high density *E.coli* cell culture (10^8 cfu/ml) and also a low density *E.coli* cell culture (10^4 cfu/ml) respectively. The cultures respectively, were introduced to a sterile 25 x 25 cm stainless steel plate surfaces and later, bacteriophage cocktail containing approximately 10^{10} pfu/ml cell count was applied to treat them. The control surfaces were not treated with bacteriophages. The experiment was also conducted using two different concentrations ratio of bacteria to bacteriophage as below: (i) Bacteria:Bacteriophage (1:2) (ii) Bacteria:Bacteriophage (1:4). The effectiveness of bacteriophage cocktail was evaluated by comparing the number of viable *E.coli* organisms (cfu/ml) recovered from the test and control surfaces at every hour intervals until 3 hours of bacteriophage treatment to the surfaces. The results showed that for a low density *E.coli* cell culture (10^4 cfu/ml) with bacteria to bacteriophage ratio of 1:2, the *E.coli* count was totally reduce after 3 hours of bacteriophage treatment and same pattern was evaluated for 1:4 ratio. As for a high density *E.coli* cell culture (10^8 cfu/ml), the bacteria count was reduced from 10^8 cfu/ml to approximately 10^4 cfu/ml after 3 hours of bacteriophage treatment for both 1:2 and 1:3 ratio respectively. The results suggest that the bacteriophage coctail used in this study may have potential for reducing contamination of *E.coli* on food contact surface. These bacteriophages may be used in the future as biological agent for decontamination of food processing plants and facilities.

Keywords: Bacteriophage, *Escherichia coli*, food contact surface, simulation study

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Feed Intake and kidding rate of goats under intensive and semi-intensive management system in Peninsular Malaysia

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Reproductive efficiency of goat production in Malaysia is low despite an increase in production of kidding rate from year to year. It has been reported that, feed intake most probably affect the reproductive performance of goat and this has been shown in sheep. By examining the variables such as type of feed and breed which may affect the kidding rate in semi-intensive and intensive feeding management, it should be possible to develop an appropriate extension message to increase goat's productivity. Therefore, we assess the kidding rate of three common breeds in Peninsular Malaysia (Boer, Jamnapari and Katjang) and their dietary intake in two different animal husbandries; semi-intensive and intensive management system. A survey on kidding rate of goats and type of feed intakes was conducted from intensive and semi-intensive management farms in every states of Peninsular Malaysia from January 2014 until July 2014. The results shows that the mean kidding rate $\pm$ SD of goats in intensive management system was 1.22 ± 0.64 while in semi-intensive management system the kidding rate was 1.08 ± 0.53 . The kidding rate for both management systems are not significantly different ($p=0.12$, $p>0.05$) although the feeding systems in intensive farms seems to be more controlled and generally well-managed compared to the semi-intensive system. The kidding rate between each breed in both farm management system were not significantly different from each other ($p>0.05$). This study shows that the breed of goats (Boer, Jamnapari and Katjang) and the feed intake (Napier grass, soya hulls, oil palm fronds and pellet) do not have any significant effect on the kidding rate of goats in Peninsular Malaysia under intensive and semi-intensive system. A further study should be done in details on amount and frequency of feeds given in a day. Furthermore, it will be better to collect more data from both goat production system as well as further research of reproductive attributes of goats for comparison with the different breeds and feed.

Keywords: Kidding rate, goat breed, feed, questionnaire survey

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Histopathologic toxicity evaluation of liposome-encapsulated diclofenac sodium

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Diclofenac sodium is a non-steroidal anti-inflammatory drug (NSAIDs) which is commonly prescribes as worldwide used in the treatment of acute and chronic inflammatory conditions. Non-steroidal anti-inflammatory drug is related to gastrointestinal, hepatic and renal adverse events are commonly reported. Liposomal drug delivery systems have been shown to improved toxicity profiles of encapsulated drugs. Present study was conducted to compare the toxicity profiles between nanoencapsulated and free form diclofenac in Sprague Dawley rat via liver, stomach and kidney histopathological assessment. Sprague Dawley rats were divided into eight groups (n=10), each administered with different dosage of either liposome-encapsulated or free form diclofenac for 14 days. Organ collection of stomach, liver and kidney were performed on day-15 and subjected to histopathological assessment. Both macro and microscopic examinations of organs shown significant improvement ($P < 0.05$) in toxicity parameters for liposome encapsulated diclofenac when compared to free form drug at the same dosage. A positive correlation was observed between the pathological changes of organs with the increases of treatment dosage. Collectively, results of present study indicated that nanoencapsulated diclofenac were promising in reducing NSAIDs adverse drug reactions thus led to an improved drug toxicity profiles.

Keywords: NSAIDs, diclofenac sodium, toxicity, histopathology

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Morphology study of *Chaetoceros anastomosans* and *Chaetoceros baculites* isolated from coastal water of Pahang, Malaysia

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This study was conducted to study the morphological features of *Chaetoceros anastomosans* and *Chaetoceros baculites* under Genus *Chaetoceros* isolated from Coastal water of Pahang, Malaysia. The species will be isolated, cultivated and viewed under LM and Scanning Electron Microscope (SEM) at International Islamic University Malaysia Kuantan Campus. Based on results, *C. anastomosans* had special features which were silica bar on the setae intersection and the production of mucous. Not only that, the length of aperture opening was new information from this study. New data obtain for *C. baculites* where it was include the size of aperture, the terminal setae, spine arrangement and the thinness of the cell wall. Not only that, this was a new record of this species in tropical water. Details data of each species will be added on the taxonomy information for feature studies.

Keywords: *Chaetoceros anastomosans*, *Chaetoceros baculites*, morphology, LM, SEM, coastal water

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Morphology study of two varieties *Chaetoceros affinis* isolated from coastal water of Pahang, Malaysia

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This study was conducted to study the morphological features of the varieties of *Chaetoceros affinis* under Genus *Chaetoceros* isolated from Coastal water of Pahang, Malaysia. The species will be isolated, cultivated and viewed under LM and Scanning Electron Microscope (SEM) at International Islamic University Malaysia Kuantan Campus. Two varieties were successfully been isolated and cultivated into pure culture as followed: *Chaetoceros affinis* var. *affinis* and *Chaetoceros affinis* var. *willei*. Both varieties of *C. affinis* were considered as distinct taxon whereby both strains can be distinguished based on morphology characteristics whereas *C. affinis* var. *affinis* had thick cell wall compared to *C. affinis* var. *willei*. For the cultivation, *C. affinis* var. *affinis* formed brown color cultivation whereas *C. affinis* var. *willei* yellow color cultivation. All the morphological features for both varieties were acceptable and agreed with previous researches. Details data of each variety will be added on the taxonomy information for feature studies.

Keywords: *Chaetoceros affinis*, morphology, LM, SEM, coastal water

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Nitric Oxide (NO) secretion inhibition and cytotoxicity effects of LPS-Induced RAW 264.7 macrophage cells and PMA-Induced HIG-82 cells by 6-Hydroxy-2-mercaptapurine and 6-Thioguanine

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Activation of immune cells leads to the mediator secretion of pro-inflammatory cytokines thus amplifying the inflammation. Nitric oxide (NO) produced by activated cell plays critical role in the inflammatory process. 6-hydroxy-2-mercaptapurine and 6-thioguanine are purine nucleoside analogues which being tested in the NO inhibition of inflammation-induced RAW 264.7 and HIG-82 cell. In this study, the cytotoxicity effects and anti-inflammatory role of 6-hydroxy-2-mercaptapurine and 6-thioguanine on inhibition of NO secretions are evaluated in LPS-induced RAW 264.7 cell and PMA-induced HIG-82 cell. The nitrite accumulated in culture medium was measured as an indicator of NO production based on Griess reaction following the cell proliferation determined by methyl thiazolyl tetrazolium (MTT) assay. There is undetectable NO synthesized by HIG-82 cell line under PMA-induce culture condition. 6-hydroxy-2-mercaptapurine was found to reduce NO production in a dose-dependent manner compared to 6-thioguanine. The increase of NO secretions in LPS-induced RAW 264.7 cell is regulated by reactions such as superoxides and nitrogen oxide species. Purine analogues drugs induced cytotoxicity in medium culture might be due to apoptosis and correlated with intracellular drug accumulation. These results provide a new rationale for the use of 6-hydroxy-2-mercaptapurine and 6-thioguanine in the inflammatory inhibition therapy.

Keywords: Rheumatoid arthritis (RA), Nitric oxide (NO), cytotoxicity, inflammation.

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Possible participation of protein kinase c and cyclic guanosine monophosphate pathway in antinociception of ethanol extract of *Ficus deltoidea* var *angustifolia* leaves in mice

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This study was conducted to evaluate the involvement of protein kinase C (PKC) and cyclic guanosine monophosphate (cGMP) pathway in the antinociception of ethanol extract of *F. deltoidea* (EEFD) leaves. To evaluate the involvement of PKC, the mice were treated with EEFD or acetylsalicylic acid (ASA, 100 mg/kg) 30 minutes before receiving phorbol 12-myristate 13-acetate (PMA, 0.03µg/paw) intraplantarly at the right hind paw. The mice were observed to record the licking and biting the injected paw. To estimate the involvement of cGMP, the mice were divided into four groups (n = 7). Two groups were pre-treated with methylene blue (20 mg/kg) and after 20 minutes, they were given EEFD or vehicle. Another two groups were pre-treated with vehicle 20 minutes before EEFD or vehicle administration. After 30 minutes, induced with 0.6% acetic acid and the number of abdominal writhing was recorded. EEFD produced significant effect of inhibition of abdominal writhing in dose dependent manner. Similarly, administration of EEFD at the similar doses resulted in significantly reduced in nociception induced by intraplantar injection of PMA as it showed reduction in paw licking time. The pre-treatment with methylene blue significantly enhanced the anticeptive activity of EEFD. The present results suggested that PKC and cGMP pathway possibly inactivated in the antinociceptive action exerted by EEFD.

Keywords: *Ficus deltoidea*, antinociception, PKC, cGMP

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Potential of fresh POME as a growth medium in mass production of *Arthrospira platensis*

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The prospects of utilizing fresh Palm Oil Mill Effluent (POME) as an alternative and inexpensive growth medium in *Arthrospira platensis* cultivation was evaluated in outdoor large scale cultivation system. The aim of this study is to find the optimum fresh POME concentration (T1; 0%, T2; 1%, T3; 2%, T4; 3% and T5; 4% v/v) for good growth and pigments production of *Arthrospira platensis* as in control (modified Kosaric medium). The relative performance of the different concentrations of fresh POME were investigated with respect to their productivity, specific growth rate and pigments production. The productivity ($0.211 \pm 0.0034 \text{ g L}^{-1} \text{ d}^{-1}$) and specific growth rate ($0.250 \pm 0.0026 \text{ d}^{-1}$) of *Arthrospira platensis* cultured in T2 (1% v/v fresh POME) was significantly higher ($p < 0.05$) compared to control and other treatments. *A. platensis* in T2 also was shown high pigment contents in % dry weight: 1.045 ± 0.024 for chlorophyll, 0.573 ± 0.005 for carotenoid and 12.013 ± 0.110 for phycocyanin, which were comparable with control and significantly higher ($p < 0.05$) compared to other treatments. Therefore, 1 % v/v fresh POME has been proven to be a suitable medium to culture *Arthrospira platensis* without adversely affecting its growth and pigments production.

Keywords: *Arthrospira platensis*, fresh POME, Growth; Pigments, Cost-effective medium

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Study on growth and digestion of climbing perch (*Anabas testudineus*)

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The climbing perch is a carnivorous species, which is one of the common freshwater species. This study has provided important information for aquaculture sector. Main objective of this study was to investigate the growth of Ikan puyu started from juvenile stage, gastric emptying time and analyzing nutrient absorption along the alimentary tract. The fish were collected from aquaculture farmers for growth experiment, x-radiography for gastric emptying time and analyzing absorption of micro nutrient. In growth experiment, body weight and body length show differences in growth of ikan puyu in every set of aquarium a,b,c within the same temperature, density and food intake. Result from the experiment shows that growth of ikan puyu has been affected by internal factors. The gastric emptying process in the present was best described using a square root model. Determination of the parameters in the model were based on the non-linear iterative method, where the calculated parameters were maximum meal size at time zero (S_x)= 2.61342, gastric emptying rate (p)= 0.22733 and gastric emptying coefficient (α)= 0.5 Result on nutrient absorption shows that protein shows the higher percentage compared to lipid and carbohydrate. Digestion processes were carried out by the digestive enzymes while the food is transferred along the digestive tract. Results of this study have provided useful and important information to fisheries biologist and aquaculturist about climbing perch potential, growth and digestion.

Keywords: Climbing perch (*Anabas testudineus*), gastric emptying, growth

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The morphology, physiology and biochemical changes in *Oryza sativa* planted under cyclic water stress with different potassium input

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Four levels of potassium rates (Control, 80 kg K₂O/ha, 120 kg K₂O/ha and 160 kg K₂O/ha) and two types of potassium (KCl and K₂SO₄) were exposed to rice to investigate the influence of potassium fertilization in minimizing the impact of cyclic water stress in rice production. It was observed that panicle dry weight/hill, root dry weight, rice yield, Catalase activity, proline, malondialdehyde and harvest index were influenced by potassium rates. The leaf numbers, total tillers and 1000-grain weight, was influenced by potassium types. Interaction effects (potassium rate x potassium type) was observed in shoot dry weight, leaf area, total spikelet/ panicle, net assimilation rate, transpiration rate and instantaneous water use efficiency. It was found as fertilization rates increased from 80<120<160 kg K₂O/ha, the production of proline was increased. The increases of proline production was simultaneously enhanced the production of Catalase and malondialdehyde (MDA). Proline have a significant positive correlation with Catalase ($r^2 = 0.891$; $p \leq 0.05$) and malondialdehyde ($r^2 = 0.912$; $p \leq 0.05$). As the potassium rate increased from 80>120>160 kg K₂O /ha the transpiration rate was observed to be increased in both MOP and K₂SO₄. The result suggested that high potassium rates would reduce water stress effects by having high transpiration rate. The study has showed that application of potassium fertilizer would minimize the effects on rice growth and physiology under cyclic water stress condition.

Keywords: Cyclic water stress, potassium, physiology, biochemical changes

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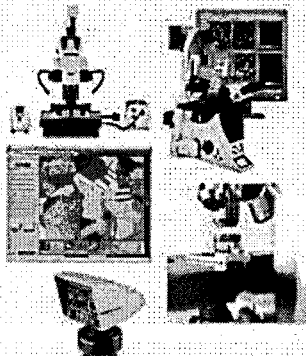
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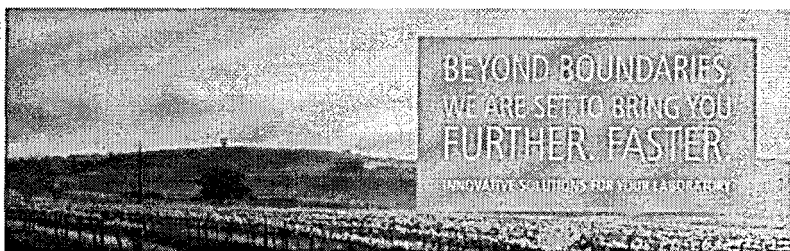


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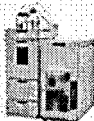
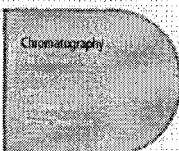
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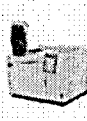
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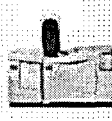
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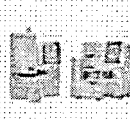
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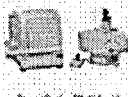
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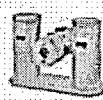
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