2021

AFOB MALAYSIA CHAPTER INTERNATIONAL SYMPOSIUM

22–23 September 2021

Biotechnology Towards Sustainable Development Goals and Circular Bioeconomy

Organized by

AFOB MALAYSIA CHAPTER
Asian Federation of Biotechnology

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

Co-organized by

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UNIVERSITI MALAYSIA PAHANG

In collaboration with

UPM · Universiti Putra Malaysia · Universiti Teknologi MARA · UNIMAS Universiti Malaysia Sarawak · University of Malaya · International Islamic University Malaysia · MARDI · MPOB · UCSI University · UMS Universiti Malaysia Sabah · UniKL Universiti Kuala Lumpur · Universiti Malaysia Perlis

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10.00 AM	Tea Break / Montage Visit Malaysia / Poster Session 1	**2.00 PM**	Afternoon Technical Sessions
10.30 AM	Opening Ceremony and MOU Signing	**5.10 PM**	Tea Break
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Opening Speech

Prof Datuk Ts Dr Ahmad Fauzi Ismail
Vice Chancellor
Universiti Teknologi Malaysia, Malaysia

Distinguished guests, ladies, and gentlemen, a very good morning and Salam Sejahtera.

First and foremost, I would like to thank the Asian Federation of Biotechnology Malaysia Chapter (AFOBMC) for inviting me to officiate the Asian Federation of Biotechnology Malaysia Chapter International Symposium (**AFOBMCIS 2021**). Today, I am delighted to be part of this highly anticipated event which gathers biotechnology intellectuals comprising of academicians, scientists, private sectors, and students. To all international delegates, I would like to wish "Selamat Datang" and I hope you have a memorable online conference.

I would like to congratulate the Asian Federation of Biotechnology Malaysia Chapter (AFOB) for organizing AFOBMCIS 2021 with the theme **"Biotechnology toward Sustainable Development Goals (SDGs) and Circular Bioeconomy"**.

This theme is timely and in line with the current trend of Biotechnology, which focuses on the sustainable development goals (SDGs) and circular bioeconomy. Biotechnology promises to make a significant contribution in facilitating the sustainable development of, for example, improved health care, enhanced food security, improved supplies of potable water, more efficient industrial development processes for transforming raw materials, support for sustainable methods of afforestation and reforestation, and detoxification of hazardous wastes. It offers new opportunities for global partnerships. In a circular bioeconomy, biological resources are renewable, sustainably managed, recovered and reused as much as possible. This economic model is gaining its momentum to deliver society's need in responding to the current sustainability issues.

I was informed that AFOBMCIS 2021 is jointly organized by Universiti Teknologi Malaysia (UTM) and Universiti Malaysia Pahang (UMP) with several universities (Universiti Putra Malaysia (UPM), Universiti Teknologi Mara (UiTM), Universiti Malaysia Sabah (UMS), Universiti Malaysia Sarawak (UNIMAS), Universiti Islam Antarabangsa Malaysia (UIAM), Universiti Malaya (UM), Universiti Malaysia Perlis (UniMAP), USCI University, Universiti Kuala Lumpur (UniKL) and research institutions (MPOB) and MARDI) in Malaysia as collaborators. These scientist–academia linkages should be encouraged, and I wish to see more collaboration in future for the enhancement of research in biotechnology.

The signing of Memorandum of Understanding (MoU) extension between Asian Federation of Biotechnology Malaysia Chapter (AFOBMC) and Biotechnology and Biochemical Engineering Society of Taiwan (BEST) for another 3 more years will continue the international collaboration between Malaysia and Taiwan researchers in the development of Biotechnology and it enhances research development through global networking. I was told that this collaboration started since 19 August 2018. Finally, this is an opportune time for me to declare the official opening of the "3rd Asian Federation of Biotechnology Malaysia Chapter International Symposium (**AFOBMCIS 2021**)". I hope that you have a pleasant conference in sharing ideas and outcomes for our sustainability and bioeconomy. I wish you to have a fruitful day of interesting and beneficial program.

Thank you.

Welcoming Speech

Prof Ts Dr Suraini Abd-Aziz
President
AFOB Malaysia Chapter
Advisor
AFOB Malaysia Chapter International Symposium 2021

It is my great pleasure to welcome all the participants to the 3rd Asian Federation of Biotechnology Malaysia Chapter International Symposium (**AFOBMCIS 2021**) from 22nd – 23rd September 2021 in which for the first time will be held online. This symposium is jointly organised by AFOB–Malaysia Chapter (AFOB–MC), Universiti Teknologi Malaysia (UTM) and Universiti Malaysia Pahang (UMP). Also, several universities and research institutions in Malaysia as collaborators, which are Universiti Putra Malaysia (UPM), Universiti Teknologi MARA (UiTM), Universiti Malaya (UM), Universiti Malaysia Sarawak (UNIMAS), Universiti Malaysia Sabah (UMS), International Islamic University of Malaysia (IIUM), Universiti Malaysia Perlis (UniMAP), UCSI University, University Kuala Lumpur (UniKL), Malaysia Palm Oil Board (MPOB) and Malaysian Agricultural Research and Development Institute (MARDI). The 3rd AFOBMCIS 2021 was Chaired by Dr Mohd Helmi Sani (UTM) and co–chaired by Dr Rozaimi Abu Samah (UMP).

AFOB Malaysia Chapter (AFOB–MC) is a regional branch of AFOB with headquarters at Incheon, Korea is a non–profit organization, established and registered with the Registrar of Society in 2013. In line with the function of the Asian Federation of Biotechnology (AFOB), AFOB–MC also aims to promote cooperation on scientific grounds, between the scientists from academia and industry in the Asian region, for the general advancement of biotechnology as an interdisciplinary field of research and as a means of bringing the scientific development to the industrial level. As a record, the AFOB–MC had organised the AFOB Regional Symposium 2014 (ARS2014) in Seri Pacific Hotel, Kuala Lumpur, Asian Congress on Biotechnology 2015 (ACB2015) in Hotel Istana, Kuala Lumpur, AFOBMCIS 2018 in Pullman Kuching, Sarawak and AFOBMCIS 2019 at The Everly Hotel, Putrajaya.

The conference theme "**Biotechnology toward Sustainable Development Goals (SDGs) and Circular Bioeconomy**", will contribute to the current biotechnology area with 12 technical sessions that cover vast area of biotechnology. Due to the COVID–19 pandemic, the 3rd AFOBMCIS 2021 will be held virtually on the online platform, I hope that this symposium will be a successful event with the enthusiastic participation of locals and worldwide biotechnologists for the realisation of SDGs and bioeconomy.

I hope that this symposium will help establish collaborative research programs, hence strengthening research relations and networking between universities, industries and government. I would like to express appreciation to the AFOBMCIS 2021 Organising Committee members for their effort and hard work to ensure a successful and meaningful symposium for all of us.

Welcoming Remarks

Dr Mohd Helmi Sani
Chair
AFOB Malaysia Chapter International Symposium 2021

Dear delegates, it is my great pleasure to welcome you to the 3rd Asian Federation of Biotechnology Malaysia Chapter International Symposium (**AFOBMCIS 2021**).

AFOBMC International Symposium (AFOBMCIS) is one of the annual events of the Asian Federation of Biotechnology Malaysia Chapter (AFOB–MC). This year, AFOBMCIS 2021 is jointly organised by Universiti Teknologi Malaysia (UTM) and Universiti Malaysia Pahang (UMP) with several universities (Universiti Putra Malaysia (UPM), Universiti Teknologi Mara (UiTM), Universiti Malaysia Sabah (UMS), Universiti Malaysia Sarawak (UNIMAS), Universiti Islam Antarabangsa Malaysia (UIAM), Universiti Malaya (UM), Universiti Malaysia Perlis (UniMAP), USCI University, Universiti Kuala Lumpur (UniKL) and research institutions (MPOB) and (MARDI) in Malaysia as collaborators.

The 3rd AFOBMCIS 2021 highlights the multidisciplinary focus, emerging scientific and technological developments areas related to biotechnology. AFOBMCIS 2021 is aimed to provide a platform for local and international scientists, academia, and industries to share their knowledge and expertise, ideas and opinions and showcase research outcomes in biotechnology.

The theme of the symposium is "**Biotechnology toward Sustainable Development Goals (SDGs) and Circular Bioeconomy**" covers various fields Agricultural and Food Biotechnology; Applied Microbiology; Biopharmaceutical and Medical Biotechnology; Biocatalysis and Protein Engineering; Bioprocess and Bioseparation Engineering; Bioenergy and Biorefinery; Environmental Biotechnology; Marine Biotechnology; Nanobiotechnology, Biosensors and Biochips; Systems and Synthetic Biotechnology; Tissue Engineering and Biomaterials and Bioindustry Promotion and Bioindustry.

This symposium also invites prestigious speakers in the biotechnology and bioeconomy to share their knowledge and expertise. We would like to thank our Plenary, Keynote and Invited Speakers from various countries and institutions for accepting our invitation. We also would like to express our gratitude to all the oral presenters for sharing your findings and ideas. This symposium also organizing Young Researcher Sessions and 3 Minutes Poster Sessions that will be evaluated by our appointed judges. The best Young Researchers and 3 Minutes Poster Presenters will be awarded.

Along with this symposium, a signing MOU ceremony between AFOB–MC and Biotechnology and Biochemical Engineering Society of Taiwan (BEST) will also be held after the opening ceremony. Besides, suitable topics presented in this symposium will be invited for publication in Special Issues by Frontiers Microbiology, Food Research Journal and Malaysian Applied Biology (MAB).

I would like to extend my gratitude to Prof. Ts. Dr. Suraini Abd-Aziz (President of AFOB–MC and advisor of AFOBMCIS 2021), Dr. Rozaimi Abu Samah (Co–chair), Dr. Lisa Ong Gaik Ai (Secretary), Assoc. Prof. Dr. Phang Lai Yee (Treasurer) and all the organising committee and event team members of the AFOBMCIS 2021 for their efforts and supports in developing such an inspiring and remarkable symposium programme.

On behalf of all organizers, I would like to express appreciation for the sponsorship given by the respective organizations towards the success of this AFOBMCIS 2021. I hope that this symposium will help establish collaborative research programs, hence strengthening research relations and networking between universities, industries, and government.

Best wishes.

Detail Tentative Program

Day 1	22nd September 2021		
09.00 – 10.00	Plenary Speaker 1 **Prof Dr Jo Shu Chang** **Tunghai University, Taiwan** Realizing Circular Bioeconomy *via* a Microalgae Platform Chairperson **Prof Dr Charles Santhanaraju Vairappan** **Universiti Malaysia Sabah, Malaysia** (Webex link 1.1)		
10.00 – 10.30	Morning Tea Break and Poster Session 1 (Webex Link 1.1)		
10.30 – 12.30	Opening Ceremony and MOU Signing Ceremony between AFOBMC and BEST Chairperson **Assoc Prof Ts Dr Mohamad Faizal Ibrahim** **Universiti Putra Malaysia, Malaysia** (Webex Link 1.1)		
12.30 – 14.00	Lunch Break and Poster Session 2 (Webex Link 1.1)		
14.00 – 17.20 Technical Sessions	**Technical Session 1** *Agricultural and Food Biotechnology* Chairperson **Assoc Prof Dr Phang Lai Yee** **Universiti Putra Malaysia, Malaysia** (Webex Link 1.2)	**Technical Session 2** *Environmental Biotechnology* *Tissue Engineering and Biomaterials* Chairperson **Adjunct Prof Datin Dr Zaharah Ibrahim** **Universiti Teknologi Malaysia, Malaysia** (Webex Link 1.3)	**Technical Session 3** *Biopharmaceutical and Medical Biotechnology,* *Systems and Synthetic Biotechnology* *Biocatalysis and Protein Engineering* Chairperson **Dr Mohd Helmi Sani** **Universiti Teknologi Malaysia, Malaysia** (Webex Link 1.4)
	Keynote 1.1 14.00–14.30 **Assoc Prof Dr Sehanat Prasongsuk** **Chulalongkorn University, Thailand** Biotechnological Applications of The Tropical Black Yeast *Aureobasidium* spp.	Keynote 2.1 14.00–14.30 **Prof Dr Thomas Curtis** **University of Newcastle, United Kingdom** Engineering Real Open Biological Systems	Keynote 3.1 14.00–14.30 **Prof Dr Wong Tin Wui** **Universiti Teknologi MARA, Malaysia** The Significance of Pharmaceutical Technology in Precision Medicine
	Invited 1.1 14.30–14.50 **Assoc Prof Dr Hsiu–Wen Chien** **National Kaohsiung University of Science and Technology, Taiwan** Reuse of Spent Coffee Grounds: Be as Antimicrobial Materials	Keynote 2.2 14.30–15.00 **Assoc Prof Ts Dr Cheng Ee Meng** **Universiti Malaysia Perlis, Malaysia** "When Dielectric Meet Scaffold..."	Keynote 3.2 14.30–15.00 **Prof Ir Ts Dr Pau–Loke Show** **University of Nottingham Malaysia, Malaysia** A New Microalgae Biorefinery Technology for Circular Bioeconomy: Internet of Things Liquid Biphasic System
	Invited 1.2 14.50–15.10 **Dr Wan Abd Al–Qadr Imad Wan Mokhtar** **University of Malaya, Malaysia** Bioreactor Biomass as Fish Superfood	Invited 2.1 15.00–15.20 **Asst Prof Dr Sompong O–Thong** **Thaksin University, Thailand** CO_2 in Acetic Acids Bioconversion Process for Biogas Upgrading by *Clostridium thailandense*	Keynote 3.3 15.00–15.30 **Prof Dr Kenji Sakai** **Kyushu University, Japan** Mysterious Ecology and Physiology of Extreme Thermophile Found in Hyperthermal Compost of Municipal Wastewater Sludge in Kagoshima
	Oral 1.1 15.10–15.25 **Dr Nur Nasulhah Kasim** **Universiti Teknologi MARA, Malaysia** Enhancing Growth Performance of Red Spinach (*Amaranthus tricolor*) *via* Zero–Energy Soilless Agriculture (ZESA)	Invited 2.2 15.20–15.40 **Dr Mohd Fauzi Mh Busra** **Universiti Kebangsaan Malaysia, Malaysia** Insight of Multifunctional Natural–based Biomaterials Strategies for Skin Tissue Engineering: Current Update	Invited 3.1 15.30–15.50 **Dr Nor Azlan Nor Muhammad** **Universiti Kebangsaan Malaysia, Malaysia** Insights into The Developmental Pathways of Oil Palm Pest *Matisa plana*

	Oral 1.2 15.25–15.40 **Nur Hailini Zainol Hilmi** **Malaysian Palm Oil Board, Malaysia** Volatile Organic Compounds (VOCs) for Detection of *Ganoderma boninense* in Oil Palm	Invited 2.3 15.40–16.00 **Assoc Prof Ts Dr Nashrul Fazli Mohd Nasir** **Universiti Malaysia Perlis, Malaysia** Antimicrobial Characteristics of Various Malaysian Seashells Based Hydroxyapatite (HA) Concentrations	Invited 3.2 15.50–16.10 **Asst Prof Dr Yang Wei,** **National Taipei University of Technology, Taiwan** Mussel Proteins-Inspired Adhesives
	Oral 1.3 15.40–15.55 **Dr Koh Soo Peng** **Malaysian Agricultural Research and Development Institute, Malaysia** Healthier Gut Microbiota and Its Protection Role of Functional Papaya Beverage Against Streptozotocin–Induced Diabetic Sprague Dawley Rats	Invited 2.4 16.00–16.20 **Assoc Prof Dr Shaza Eva Mohamad** **Universiti Teknologi Malaysia, Malaysia** Phycoremediation of Palm Oil Milll Effluent (POME) by Microalgae	Invited 3.3 16.10–16.30 **Dr Ahmad Bazli Ramzi** **Universiti Kebangsaan Malaysia, Malaysia** Designer Enzyme for Metabolic Pathway Engineering in Bacterial Chassis
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		Oral 2.4 17.05–17.20 **Pratheep Sandrasaigaran** **Manipal International University, Malaysia** Multi–drug Resistant *Salmonella enterica* subsp. *enterica* Serovars Enteritidis and Typhimurium in Street Foods	
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17.25 – 17.28	3MPS 1.1 **Khairun Najibah Mohd Said** **Universiti Malaysia Sarawak, Malaysia** Solid State Fermentation (SSF) of Lignocellulosic Agricultural Waste by *Marasmius* sp. for Laccase Production	3MPS 2.1 **Adriana Connie Lee** **Universiti Putra Malaysia, Malaysia** Bacterial Nanocellulose Using Pineapple Peel as Substrate	3MPS 3.1 **Harika Chittella** **Taylor's University Malaysia, Malaysia** Biodegradation of Natural Glove Rubber Using Gram–Negative Bacteria: *Klebsiella aerogenes*

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15.05 — 15.20	Young Researcher 1.5 **Tan Jiunn Luh** **University of South Bohemia, Czech Republic** A Preliminary Study on The Efficacy of Spinetoram Against Melon Thrips, *Thrips palmi*, in Malaysia	Young Researcher 2.5 **Fitriyatul Aiman Mohd Badran** **Universiti Kuala Lumpur, Malaysia** Study on Antimicrobial Peptides from *Punica granatum* Peel Extract: Characterization and Gene Expression	Young Researcher 3.5 **Fatini Mat Arisah** **Universiti Putra Malaysia, Malaysia** Chromium Hexavalent Resistance in *Pseudomonas aeruginosa* RW9 as a Potential Candidate for Bioremediation	Young Researcher 4.5 **Siti Nur Nadhirah Said Azmi** **Universiti Kuala Lumpur, Malaysia** Effect of Nitrogen Sources Supplementation on Oil Palm Frond Juice for Bacterial Cellulose Production
15.20 – 15.35	Young Researcher 1.6 **Aliyu Dantani Abdullahi** **Chiang Mai University, Thailand** Phenolic Contents and Antioxidant Activities of Miang Extracts Fermented *via* Filamentous and Non–filamentous Fungi–based Processes	Young Researcher 2.6 **Chen Sye Jinn** **Universiti Teknologi Malaysia, Malaysia** Lignocellulose Biomass Degrading Potential of Genus Glutamicibacter Deciphering Its Ability from Genomic Aspect	Young Researcher 3.6 **Nurshafika Abd Khalid** **Universiti Teknologi Malaysia, Malaysia** Microbial Community of Sludge Palm Oil Mill Effluent as Inoculum for Compost Production	Young Researcher 4.6 **Nur Adila Muradi** **Universiti Malaysia Sarawak, Malaysia** Improvement of Very High Gravity Bioethanol Fermentability of Sago Hampas Hydrolysate Using Recycled Yeast Cells
15.35 – 15.50	Young Researcher 1.7 **Jasmin Jaraee** **Universiti Malaysia Sarawak, Malaysia** Physiochemical and Microbiological Changes of *Nypa fruticans* Sap Collected in Sarawak, Malaysia	Young Researcher 2.7 **Siti Suhailah Sharuddin** **Universiti Putra Malaysia, Malaysia** Fundamentals on The Bacterial Biomarker Genes as Bioindicators of Palm Oil Mill Effluent Pollution	Young Researcher 3.7 **Imran Ahmad** **Universiti Teknologi Malaysia, Malaysia** Progressive Algal Biotechnology: A Sustainable and Viable Approach Towards Bioeconomy	Young Researcher 4.7 **Aniket Bhattacharyya** **South Asian University, India** High–level of Recombinant Fungal Laccase Production for Industrial Applications
15.50 – 16.05	Young Researcher 1.8 **Muhammad Arif Darmawan** **Universitas Indonesia, Indonesia** Reduction of The Acidity and Peroxide numbers of Tengkawang Butter (*Shorea stenoptera*) Using Thermal and Acid Activated Bentonites	Young Researcher 2.8 **Siti Fatimah Suboh** **Universiti Teknologi MARA, Malaysia** Antimicrobial Activity of Green Biosynthesis Iron Oxide Nanoparticles Mediated *S. crispus* Leaves Aqueous Extract	Young Researcher 3.8 **Nova Rachmadona** **Kobe University, Japan** An Integrative Bioconversion Process for Biodiesel Production Utilizing Waste from The Palm Oil Industry	Young Researcher 4.8 **Maheswary Thambirajoo** **Universiti Kebangsaan Malaysia, Malaysia** Bilayered Woven Cellulose–Collagen Bioscaffold as Acellular Skin Substitute for Future Use in Diabetic Ulcer Treatment
16.05 – 16.20	Young Researcher 1.9 **Ayuni Amalina Abu Bakar** **Universiti Teknologi MARA, Malaysia** Impact of Irradiation on The Bone Morphometry of Femur in an Osteoporosis Induced Mouse Model	Young Researcher 2.9 **Izzati Sabri** **Universiti Putra Malaysia, Malaysia** Draft Genome Sequence Revealed Genes Related to Phenol Degradation in *Kosakonia oryzae* Strain S10	Young Researcher 3.9 **Aparna Ganapathy Vilasam Sreekala** **Deemed University, India** Ureolytic Biomineralization in Coastal Regions Inhibited by Pesticide Pollution: A Computational Approach	Young Researcher 4.9 **Punnita Pamueangmun** **Chiang Mai University, Thailand** Evaluation of *Bacillus coagulans* MA42 for L–Lactic Acid Production from Lignocellulose Using Consolidated Bioprocessing Fermentation
16.20 – 16.35	Young Researcher 1.10 **Nor Syafira Mohd Masri** **Universiti Kebangsaan Malaysia, Malaysia** Gelatin-PVA Bioinks for Chronic Wound Healing by Using 3D-Bioprinting	Young Researcher 2.10 **Nur Kamilah Mohd Nordin** **Universiti Teknologi Malaysia, Malaysia** Synthesis of Silver Nanoparticles Using Ethanolic Shoot Extract of *in vitro Persicaria odorata* and Its Antioxidant Activity	Young Researcher 3.10 **Muhammad Fakhri Zainuddin** **Universiti Putra Malaysia, Malaysia** Production of Single Cell Oil as Potential Biodiesel by *Yarrowia lipolytica* JCM 2320 Using Detoxified Desiccated Coconut Residue Hydrolysate	Young Researcher 4.10 **Daniel Alejandro Alfaro Sayes** **Kobe University, Japan** Immobilization for The Enhancement of Biomass and Lipid Productivity of *Chlorella sorokiniana*
16.35 – 16.50	Young Researcher 1.11 **Puteri Azira Azmin** **Universiti Malaysia Sarawak,** Malaysia A Comparative Study of Nipa Palm Sugar a.k.a *Gula Apong* in Selected Area of Sarawak	Young Researcher 2.11 **Nur Zawani Mazlan** **Universiti Kebangsaan Malaysia, Malaysia** The Effect of Injectable Hybrid Gelastin Hydrogel for Wound Healing: Epigallocatechin Gallate	Young Researcher 3.11 **Rabindra Kumar Mahato** **South Asian University, India** Biobutanol and Biohydrogen Production from Waste Potatoes Using Novel Saccharolytic α–Amylase from *Bacillus* Strain	Young Researcher 4.11 **Raghuvandhanan Kumarasamy Sivasamy** **Kumaraguru College of Technology, India** Animal Feed Preparation Using Probiotics and Organic Waste Incorporated with Selected Biocontrol Medicinal Plants
17.00 – 18.00	Closing Ceremony Chairperson **Assoc Prof Ts Dr Mohamad Faizal Ibrahim** **Universiti Putra Malaysia, Malaysia** (Webex Link 2.6)			

22nd September 2021 10.00 – 10.30 Poster Session	**Poster Session 1** **(PS 1)** *Agricultural and Food Biotechnology* Chairperson **Ts Dr Sharifah Soplah Syed Abdullah** **Universiti Kuala Lumpur, Malaysia** (Webex Link 1.1)
PS 1.1	**Assoc Prof Ts Dr Mohamad Faizal Ibrahim** **Universiti Putra Malaysia, Malaysia** Formulation of Fortified Media from Oil Palm Biomass for The Enhancement of Bioactive Compounds in Pegaga (*Centella asiatica* (L.) Urban)
PS 1.2	**Dr Jessica Jeyanthi James Antony** **Universiti Putra Malaysia, Malaysia** Establishment of *in vitro* Micropropagation from Meristem Explants *Musa campestris* var. sarawakensis
PS 1.3	**Dr Maizatul Suriza Mohamed** **Malaysian Palm Oil Board, Malaysia** Molecular Diagnostic Tools for Mitigation of Tropical Plant Pathogens: Oil Palm
PS 1.4	**Rosniza Kassim** **Malaysian Agricultural Research and Development Institute, Malaysia** Effects of Different LED–light Quality on Growth, Chlorophyll Concentration and Anthocyanin Content of Green Dwarf Pakchoi *(Brassica rapa chineensis)*
PS 1.5	**Wan Rozita Wan Engah** **Malaysia Agricultural Research and Development Institute, Malaysia** Yield and Its Attribute Performance and Heritability Estimation in Selected F1 Bitter Gourd Population
PS 1.6	**Farahzety Abdul Mutalib** **University of Nottingham Malaysia, Malaysia** Influence of Stem Cutting Diameter, Growth Regulators and Growing Media on Growth Performance of Moringa
PS 1.7	**Irene Lah** **Universiti Teknologi MARA, Malaysia** Development of Loop–mediated Isothermal Amplification (LAMP) for Detection of Banana Blood Disease Bacterium Isolates in Malaysia
PS 1.8	**Isfaniza Barji** **Universiti Malaysia Sarawak, Malaysia** Dilute Sulphuric Acid Hydrolysis of Destarch Sago Hampas for Xylitol Fermentation
PS 1.9	**Anisah Jamaluddin** **Universiti Kebangsaan Malaysia, Malaysia** Down–regulation of Tyrosinase Expression by Fermented Broken Rice, Brewers' Rice and Rice Bran in Highly Pigmented Human Melanoma, MNT1
PS 1.10	**Tan Ying Ju** **Universiti Putra Malaysia, Malaysia** Mapping Milk Microbiota from Healthy, Sub–clinical and Clinical Mastitis of Jersey Fresian Cattle in Malaysia
PS 1.11	**Norhazniza binti Aziz** **Universiti Kebangsaan Malaysia, Malaysia** Influence of SCOBY Fermentation on Antioxidant, Phytochemicals, and Skin–aging Enzyme Inhibition in Jackfruit (*Artocarpus heterophyllus*)
PS 1.12	**Prof Dr Norizan Ahmat** **Universiti Teknologi MARA, Malaysia** The Effect of 6–Benzylaminopurine on Regeneration of *Canarium odontophyllum*
22nd September 2021 12.30 – 14.00 Poster Session	**Poster Session 2** **(PS 2)** *Applied Microbiology* *Biorefinery and Bioenergy* *Environmental Biotechnology* Chairperson **Assoc Prof Dr Madihah Md Salleh** **Universiti Teknologi Malaysia, Malaysia** (Webex Link 1.1)
PS 2.1	**Allison D. Suleiman** **Universiti Putra Malaysia, Malaysia** Potential Applications Studies of Recombinant Serine Protease SpSKF4 as Detergent Additived and in X-ray Recovery
PS 2.2	**Muhamad Aidilfitri Mohamad Roslan** **University Putra Malaysia, Malaysia** Sustainable Agronomic Valorization of Unsulfured Molasses and Defatted Soybean Meal as an Optimized Formulation of Bio–organic Fertilizer Enriched with High Cell Density P–solubilizing Bacteria
PS 2.3	**Kayverne Santhanasamy** **Universiti Teknologi Malaysia, Malaysia** Microbial Community of Two Faecal Contaminants Sources: Sewage Treatment Plant versus Goat Farm
PS 2.4	**Prof Ts Dr Suraini Abd-Aziz** **Universiti Putra Malaysia, Malaysia** Pineapple Biorefinery Toward Zero Wastes for Sustainability
PS 2.5	**Dr Mohd Helmi Sani**

	Universiti Teknologi Malaysia, Malaysia The Cultivation and Growth of *Chlorella sorokiniana* in Lab Scale Photobioreactor
PS 2.6	**Assoc Prof Dr Juferi Idris** **Universiti Teknologi MARA, Malaysia** Production, Activation, and Application of Biochar from The Coconut Shell and Husk Biomass: A Review
PS 2.7	**Assoc Prof Dr Phang Lai Yee** **Universiti Putra Malaysia, Malaysia** Heavy Metal Uptake of *Jatropha curcas* Grown in Bauxite Mine Soil
PS 2.8	**Assoc Prof Dr Gideon Khoo** **Universiti Tunku Abdul Rahman, Malaysia** Fish Diversity in Rehabilitated Tin Mining Ponds of Kampar, Perak, Malaysia
PS 2.9	**Nor Faizah Jalani** **Malaysian Palm Oil Board, Malaysia** Potential of Cellulose–based Material for Palm Oil Mill Effluent Treatment
PS 2.10	**Nurul Afiqah Khairunnisa Azman** **Universiti Teknologi MARA, Malaysia** Screening for Biosurfactant Producing Indigenous Fungi Cultivated in Waste Cooking Oil as Sole Carbon Source
PS 2.11	**Besek Mariam Mohamad Jahis** **Universiti Putra Malaysia, Malaysia** Modification of Oil Palm Decanter Cake Through Fermentation to Produce Fish Dietary Feed Pellet for Patin (*Pangasianodon hypophthalmus*)
PS 2.12	**Kam Kar Yern** **Universiti Teknologi Malaysia, Malaysia** Synergistic Effect of Antibiotic Agents Against *Cupriavidus* Species
PS 2.13	**Nurul Azila Abdul Razak** **Universiti Teknologi MARA, Malaysia** Potential Cellulase Producing Facultative Anaerobic Bacteria Isolated from Black Soldier Fly (*Hermetia illucens*) Larvae
23rd September 2021 09.30 – 10.00 Poster Session	**Poster Session 3** **(PS 3)** *Bioprocess and Bioseparation* *Biopharmaceutical and Medical Biotechnology* *Nanobiotechnology, Biosensor and Biochips* Chairperson **Assoc Prof Dr Phang Lai Yee** **Universiti Putra Malaysia, Malaysia** (Webex Link 2.1)
PS 3.1	**Nur Sulihatimarsyila Abd. Wafti** **Malaysian Palm Oil Board, Malaysia** Clean Synthesis of Palm Polyol Esters as Lubricant Base Stock Using Immobilized Lipases
PS 3.2	**Kee Phei Er** **UCSI University, Malaysia** Application of Alcohol/Salt Aqueous Biphasic System for Purification of Microbial Protease
PS 3.3	**Dr Ainaa Abdul Kahar** **Malaysia Agricultural Research and Development Institute, Malaysia** Effect of Soaking Conditions (Temperature, Time and Water Level) on γ-Aminobutyric Acid (GABA) Content in Mung Bean
PS 3.4	**Hoo Wei Qi** **Universiti Teknologi Malaysia, Malaysia** Molecular Docking Study for Identification of The Potential Fatty Acid Synthase Inhibitors from *Acalypha indica* Ethanolic Extract
PS 3.5	**Hidayat Mohd Yusof** **Universiti Putra Malaysia, Malaysia** Antibacterial Potential of Biosynthesized Zinc Oxide Nanoparticles Against Poultry–associated Foodborne Pathogens: An *in vitro* Study

Plenary Speaker 1

Prof Dr Jo Shu Chang
Chair Professor and Dean of College of Engineering, Tunghai University;
Adjunct Chair Professor of Department of Chemical Engineering, National Cheng Kung University, Taiwan;
President of Biotechnology and Biochemical Engineering of Taiwan (BEST); and
Executive committee member of Asia Federation of Biotechnology (AFOB)

Realizing Circular Bioeconomy *via* a Microalgae Platform

Jo–Shu Chang[1,2,3,4]*
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Abstract: Microalgae are photosynthetic organisms with the capability of fixing atmospheric CO_2 via photosynthesis into organic biomass. The commercial interests of microalgae are driven by their ability to accumulate lipids for biofuels production and to serve as a natural alternative for many synthetic nutraceuticals and pharmaceuticals. While the commercialization of microalgae–based products is challenged by the high cost associated with the cultivation and harvesting of their biomass, our research group has been involved in the mass production of microalgal biomass for over a decade and we have explored the inherent adaptability of microalgae to alternative nutrient sources in many ways. Since microalgae are known as a natural alternative for antioxidants (pigments like chlorophyll, lutein, and astaxanthin) and other bioactive components, co–production of other valuable compounds could be attempted. On the other hand, wastewaters rich in nitrogen, phosphorus, and organic carbon can both serve as a source of water and nutrients for microalgal cultivation, and microalgae are known to remove nitrogen/phosphorus from wastewater by uptake and assimilation. Other wastewater pollutants, such as xenochemicals and heavy metals could also be effectively removed by certain microalgae. Industrial flue gases rich in CO_2 could serve as a low–cost CO_2 source for microalgal cultivation. Microalgae possess robust growth properties and high adaptability to the environment, and certain algal strains can utilize the high concentrations of CO_2 present in the flue gas, biogas (derived from anaerobic digestion), and fermentation off–gas. The potential of microalgae in using these sustainable nutrient resources and current obstacles in their use will be discussed. An algal–based biorefinery and circular economy model, where microalgal biomass is grown in nitrogen–rich swine wastewater using flue gas as a carbon source will be introduced. Processing of the obtained biomass for the recovery of value–added products will be presented. The algal biomass could be processed via biochemical/thermochemical methods for the production of biofuels, such as bioethanol, biobutanol, biohydrogen, syngas, and carbon–rich biochar. The algal biomass rich in carbohydrates can also be used for the production of fine chemicals, such as lactic acid and succinic acid via fermentation. Direct application of algal biomass in the form of animal or aqua–feed is also promising due to its high protein and antioxidant contents.

Keywords: Microalgae; Biorefinery; Wastewater treatment; Bio–based chemicals; Circular economy

Plenary Speaker 2

Dr Christian Patermann
Fellow of the International Society of Horticultural Societies, Louvain;
Member of the Georgofili Academy, Florence; and
Member of the first Research and Technology Council "BioEconomy" of the Federal German Government

Bioeconomy–Fit for The Next Decade–Hype or Reality?

Christian Patermann[1]*
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Abstract: In September 2005, 16 years ago, the European Commission in Brussels, Belgium, rediscovered the concept of the so–called Bioeconomy, at that time as a research initiative within the preparation of the world largest international cooperative RTDI programme in the world, the so–called 7th Framework Programme of RTD. Today, about 60 states and a growing number of regions have enhanced this economic model in relevant national and/or regional strategies, action plans or accompanying road maps, and their number is still increasing. In Asia, just a few examples: Japan, People's Republic of China, Malaysia, Thailand and two states of Australia. This recently revitalised economic model preferably uses biological resources (animals, plants, microorganisms, enzymes, proteins etc), partially processed in biorefining infrastructures, benefitting from added value in value chain systems. It covers the majority of our well–established industrial branches, from agro–food–forestry–fisheries–aquaculture to energy. Chemistry, construction, textile, furniture industries, to name some of them in a non–exhaustive manner. Biotechnology is the main technology driver in this economic model, accompanied via a systemic approach by converging technologies like Nano, Info, Digit and AI. Therefore, at the beginning, this concept was named as the Knowledge–Based BioEconomy (KBBE). Today, this concept has been developed into a policy concept, leaving the original area of being a research programme. The bioeconomy is regarded by many as the enabling value economy compared with many other economy concepts, enabling the achievement of quite a few Sustainable Development Goals, (SDGs), optimizing circularity, contributing to green growth, and respecting biodiversity. The products under a biobased economy are renewable, climate friendly, benign for being circular (reused, recycled or gradable) and last but not least, replacing widely fossil resources as they offer new, sometimes better functions, like longer lifetime, less water and energy use and less toxicity. The undisputed partner of sustainability needs however to operate within planetary boundaries, and the availability of biomass is limited: Thus, its implementation faces some very real challenges, apart from being extremely complex, long term–oriented and not cheap in funding demands. Thus, the question is justified, whether this rather young, but in reality, oldest economic concept in the world, in its format of today is fit for the Post COVID–Decade. The answer is yes, but quite a few conditions should be met.

Keywords: Bioeconomy; SDG; Knowledge–based bioeconomy; Post COVID–decade

Keynote 1.1

Assoc Prof Dr Sehanat Prasongsuk
Chulalongkorn University, Thailand

Biotechnological Applications of The Tropical Black Yeast *Aureobasidium* spp.

Sehanat Prasongsuk[1]*
[1]*Plant Biomass Utilization Research Unit, Department of Botany Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand.*

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Abstract: At the Plant Biomass Utilization Research Unit, we successfully isolated a number of tropical strains of *Aureobasidium* spp. In Thailand with various species including *A. pullulans*, *A. melanogenum*, *A. aubasidani* and a novel *A. thailandense*. This black yeast produces a variety of commodities including biopolymer (pulluland and β–glucan), biomass–degrading enzymes (mainly xylanase and xylosidase), biosurfactant, siderophore and antibiotics. We successfully optimized the production of these products and also investigated their potential in food application. Moreover, some agricultural residues were utilized as substrates for enzyme production. Thus, the roles of this tropical black yeast in biotechnology will be presented.

Keywords: Biopolymer; Enzymes; Black yeast; Applications

Keynote 2.1

Prof Dr Thomas Curtis
University of Newcastle, United Kingdom

Engineering Real Open Biological Systems

Tom Curtis[1]*
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Abstract: The most successful biological engineering technologies in the world use real microorganisms to treat wastes. And yet there is precious little biology in the engineering. And often precious little engineering in the biology of such systems. This is perhaps why the wastewater treatment technologies are so inefficient and why we find it so difficult to make better technologies. The key unit in biology is the cell, and by measuring the number of the cells and the rates at which they are working we can both manage existing technologies and, when informed by theory, the design of new ones. However, the ultimate limiting factor on the generation of new technologies is the time it takes to run credible experiments. This problem is not unique to Environmental Engineering. However it can only be overcome by simulation, this will require a complex synthesis of measurement, theory in biology and physics over many scales. The multiscale modeling of microbial systems could revolutionise our ability to not just build a better sewage works, but to harness microbes as a force for good in the world.

Keywords: Microorganism; Wastewater treatment; Environmental engineering; Microbial system

Keynote 2.2

Assoc Prof Ts Dr Cheng Ee Meng
Universiti Malaysia Perlis, Malaysia

"When Dielectric Meet Scaffold…"

Cheng Ee Meng*
Division of Medical Science and Instrument, School of Mechatronic Engineering, Faculty of Electronic Engineering Technology, Universiti Malaysia Perlis, Kampus Pauh Putra,02600 Arau, Perlis, Malaysia

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Abstract: The rapid development of biomedical engineering motivates advent of a rapid and non–invasive sample characterization technique which might bring massive convenience to reveal the biomaterial properties, e.g. microwave characterization techniques. Many biomedical, pharmaceutical, food and agricultural products exhibit remarkable electrical responses when interact with electrical signal, and it subsequently leads to study of electrical properties. Quality of biomaterial, especially scaffolds are conventionally gauged through chemical method. Although this method is accurate, it is also a time–consuming, tedious and skill needed. Scientists are always eager for a simple, rapid and accurate method in measuring the quality of scaffold. The electrical response and behavior due to stimulation of electrical signal is deserved for a proper research study because electrical characterization of biomaterial has not been extensively studied. The material polarization in response to the microwave electric field would illustrate the morphological and physicochemical properties of the bone scaffold. The polarization and energy dissipation within the composite are induced under exposure to the time–varying electromagnetic field. Polarization takes place as the orientation motions of the composite's dipolar molecules, while the direction of polarization switch leads to storage of energy. In Maxwell–Wagner's theory, it can be surmised that the heterogeneous system of the porous composite exhibits the interfacial polarization mechanisms that the charge accumulation at the interface which contributed to the different dielectric properties. An attempt was made to investigate the effect of the starch proportion and the average porosity on the dielectric properties of the porous composites over a broadband frequency range.

Keywords: Bone tissue engineering; Bone scaffold; Biomaterials; Polarization; Dielectric

Keynote 3.1

Prof Dr Wong Tin Wui
Universiti Teknologi MARA, Malaysia

The Significance of Pharmaceutical Technology in Precision Medicine

Tin Wui Wong[1,2]*
[1]*Non–Destructive Biomedical and Pharmaceutical Research Centre, Smart Manufacturing Research Institute*
[2]*Particle Design Research Group, Faculty of Pharmacy, Universiti Teknologi MARA, 42300 Puncak Alam, Selangor, Malaysia*

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Abstract: Medicine is available in different dosage forms such as tablets, pellets, emulsion, suspension and many others. The design of medicine is primarily aimed to promote therapeutic effectiveness and mitigate adverse effects. Precision medicine encompasses six perspectives: personalized, predictive, preventive, participatory, psychocognitive, and public. The personalised perspective denotes analysis of patient's health/omics data and customization of the required therapy. Appropriate drug choice and dosage regimen are designed in order to derive the best healthcare outcome. The delivery of a personalized therapy requires the selected drugs to be dispensed in variable doses with reference to the health requirement of the patients. It is complicated by event of polypharmacy where varying drugs, drug delivery kinetics and sites of action of the host are implicated. On this note, the dosage form preferably can be mixed and matched to provide the required drug dose of which is specific to a patient. It is able to carry two or more drugs in a single dosage form, deliver the drugs with the desired kinetics, can possess same or different drug release kinetics, and may engage different drug–specific delivery strategies. Ideally, the dosage form should provide 100% drug bioavailability. This presentation highlights the recent innovations from nano–to–macroscales at Non–Destructive Biomedical and Pharmaceutical Research Centre related to skin, lung and oral drug delivery. Innovative approaches in material design, dosage form development, and technology device application to realize the true meaning of personalized therapy and precision medicine will be discussed.

Keywords: Dosage form; Nanotechnology; Personalized therapy; Pharmaceutical technology; Precision medicine

Keynote 3.2

Prof Ir Ts Dr Pau–Loke Show
University of Nottingham Malaysia, Malaysia

A New Microalgae Biorefinery Technology for Circular Bioeconomy: Internet of Things Liquid Biphasic System

Pau Loke Show[1]*
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Abstract: In recent year, Liquid Biphasic System (LBS) has become a proven tool used in separation and purification technology for circular bioeconomy in microalgae biorefinery. The application of Internet of Things (IoT) in LBSs in clarification, partitioning and partial purification of biomolecules and bioproducts had showed the rapid development. This method is able to give high recovery yield and high purity in a single step. The LBS shows characteristics of high selectivity and is easily to scale up. Therefore, LBS offers an attractive alternative that meets the requirements of the high demand in industry processes and it is also beneficial in terms of economic and environmental protection. This presentation aims to share on the recent literature works in the development of different type of LBSs and their applications in novel separations and purifications of biomaterials. Hopefully this presentation will be able to build solid research collaborations among industry players and researchers.

Keywords: Microalgae; Internet of things; Circular bioeconomy; Biorefinery; Liquid biphasic system

Keynote 3.3

Prof Dr Kenji Sakai
Kyushu University, Japan

Mysterious Ecology and Physiology of Extreme Thermophile Found in Hyperthermal Compost of Municipal Wastewater Sludge in Kagoshima

Kenji Sakai[1]*
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In Kagoshima City, Japan, the municipal wastewater is treated by activated sludge method. After dewatering, the residual sludge is further composted through the hyper–thermal composting, which proceeds at higher than 80°C. During the investigation we incidentally isolated an extreme thermophile, *Thermaerobacter composti* SS, from the dewatered sludge, not from the compost. Existence of *Thermaerobacter spp.* Not only in the compost but also in dewatered sludges was demonstrated in nested PCR products. Another extreme thermophiles, strain DD2 and D3, quite close from *Calditerricola satsumensis* YMO81 ^{T} and *C. yamamurae* YMO722 ^{T} already isolated from the compost were also isolated from the sludget unexpectedly. All strains showed growth between 50–85°C. When incubated at 75°C, they existed stably. On the other hand, at 25°C, compost isolates YMO81 ^{T} and YMO722 ^{T} were quite labile and dead in an hour, while mesothermal sludge isolates D3 and DD3 showed viability even after a month. Their comparative draft genome analysis indicated existence of functional genes unique to either cold sensitive or cold tolerant group. Further investigation on ecological distribution showed that 75°C–enrichment cultures of volcanic ashes from Mt. Sakurajima nearby Kagoshima contained intact *Calditerricola* cells. In addition, we succeeded in isolation of *Calditerricola* strains from several volcanic ash samples, by the isolation protocol considering cold–sensitivity.

Keywords: Extreme thermophile; *Thermaerobacter* spp.*; Calditerricola* cells; Genome analysis

Keynote 4.1

Prof Dr David Barrie Johnson
Bangor University, United Kingdom

Direct and Indirect Redox Reactions Catalysed by Acidophilic Prokaryotes and How These Mediate Metal Recovery

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[2]*School of Life Sciences, Coventry University, United Kingdom*

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Abstract: Extremely acidophilic microorganisms (defined as those that grow optimally at or below pH 3) are widely distributed throughout all three domains in the tree of life. Chemolithotrophy – the ability to use inorganic electron donor to support growth – is a widespread trait among extremely acidophilic prokaryotes, with iron (II), zero–valent sulfur (ZVI) and reduced inorganic sulfur oxy–anions being the most well–known, though others such as manganese (II) and arsenic (III) have also been reported. While life–forms that grow at low pH are well known to metabolise aerobically, iron (III) is widely used as an alternative acceptor to oxygen (due to its enhanced solubility and often greater abundance) and ZVI (and sulfate) by a more limited number of characterised species. Redox transformations of both iron and sulfur can induce indirect oxidation and reduction of other elements in low pH liquors, which may enhance or depress the toxicities of the latter. This also allows some chemolithotrophic acidophiles to use metals that they cannot respire directly as secondary electrons donors and acceptors. The oxidation of iron and sulfur by extreme acidophiles has been harnessed in the development and application of traditional biomining technologies where they are used to accelerate the oxidative dissolution of sulfide minerals, allowing target metals to be either solubilised (e.g. copper and zinc) or become amenable to chemical extraction (e.g. gold). This approach is also currently being developed for processing and recycling electronic waste. More recently, acidophiles have also been used to extract nickel and cobalt from oxidised lateritic ores ("biomining in reverse gear"). Biosulfidogenesis, the generation of hydrogen sulfide via sulfate or ZVI reduction, can also be used to selectively recover metals from acidic process and waste waters, opening up further opportunities for developing and applying acidophilic biotechnologies in the mining sector.

Keywords: Acidophiles; Biomining; Metals; Redox; Sulfur

Keynote 4.2

Assoc Prof Dr Midhat Nabil Ahmad Salimi
Universiti Malaysia Perlis, Malaysia

Biotechnology Industry in Malaysia

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Abstract: "Science to Business" has been one of the essential criteria being focused by Malaysia in its National Biotechnology Policy. The Policy aims to transform the biotechnology industry into one of the vital economic contributors to the nation. Malaysia is richly endowed with biodiversity and blessed with a wide array of natural resources that are useful for biotechnology research and development (R&D). Ranked 12th in the world as one of the megadiverse countries, it helps to create the necessary motivation towards developing a biotechnology industry in the country.

Keywords: Biotechnology; Economy; Industry

Keynote 5.1

Prof Dr–Ing Misri Gozan
Universitas Indonesia, Indonesia

Production and Purification of Furfural from Oil Palm Empty Fruit Bunch

Misri Gozan[1]*
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Abstract: Furfural can be produced from oil palm empty fruit bunches (OPEFBs). Furfural is one of the top building–block chemicals. This presentation will present the furfural separation process from the acid hydrolysis process made from OPEFB. In the beginning, it is explained that furfural production through hydrolysis of sulfuric acid in cellulose and hemicellulose content is described. Based on the experimental results, the most significant furfural yield was obtained at 170 with a reaction time of 20 minutes at an acid concentration of 0.5 M. The second part describes the simultaneous kinetic model parameters for Levulinic acid and furfural production from POEFBs, pretreated by soaking in aqueous ammonia (SAA). A simultaneous kinetic model is better to calculate LA and furfural production kinetic parameters than separate kinetic models because the simultaneous kinetic model had a lower sum of square error (SSE) when estimating kinetic parameters. In the last section, two furfural separation processes are described. The first separation uses a liquid–liquid extraction (LLE) with the toluene solvent technique. The second separation describes the vapor–liquid equilibrium (VLE) curve for furfural purification with the UNIQUAC Model.

Keywords: Furfural; OPEFBs; Acid hydrolysis; Liquid–liquid extraction; UNIQUAC model

Keynote 5.2

Prof Dr Akihiko Kondo
Kobe University, Japan

Development of Biofoundry Platform for Rapid Construction of Microbial Cell Factories for Production of Chemicals and Fuels from Bioresources

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Abstract: We have developed rapid cell factory construction technology (biofoundry platform), which is an integrated system (DBTL) of advanced technologies such as metabolic design system (Design), rapid breeding technology using long chain DNA–transfected microorganisms (Build), rapid and accurate metabolic evaluation technology (Test), and machine learning or mathematical modelling for further improvement and a new metabolic pathway design (Learn). As metabolic design system, we developed BioProV and M–path, new simulation tools that enable metabolic design for the biosynthesis of unnatural compounds. To efficiently construct cell factories by re–write genome based on designs, we have developed the platform technologies such as genome editing and a large gene cluster synthesis system and integrated to set up the automated systems, namely biofoundry. By tethering the DNA deaminase activity to nuclease–deficient CRISPR/Cas9 system, a genome editing tool that enables targeted point mutagenesis have developed (termed Target–AID or Base Editor). In addition, an efficient DNA assembly method, namely, Ordered Gene Assembly in *B. subtilis* (OGAB) method have developed to construct up to 100 kb DNA. An automated metabolomics analysis system has also been developed to analyse the performance of cell factories in more accurate and higher throughput manner. We are applying this biofoundry platform for construction of various cell factories. By BioProV design tool with enzyme engineering technology, we succeeded in expanding the scope of bioproduction targets. Application of constructing artificial metabolic pathways has demonstrated by the C4 unsaturated compound 1,3–butadien synthesis in *Escherichia coli*. Butadiene biosynthetic pathway is designed in silico, and then realize it by constructing artificial enzyme with rational design. Although butadiene is an important monomer in synthetic rubber and engineering plastics, its bioproduction has not been achieved. Finally, 2.1 g/L of butadiene from glucose was produced with *E. coli* having this artificial synthetic pathway.

Keywords: Biofoundry; Microbial cell factories; Metabolic engineering; Chemicals; Biofuels

Keynote 6.1

Prof Dr Charles Santhanaraju Vairappan
Universiti Malaysia Sabah, Malaysia

Anti–inflammation, Anti–cancer Mechanism and Microarray Gene Expression of Soft Coral Derived Secondary Metabolites

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Abstract: Borneo marine ecosystem is rich with a wide array of flora and fauna at a density of close to 1000 species per m^2. Number of secondary metabolites produced by these marine organisms are believed to be directly related to its biodiversity. We studied the diversity of secondary metabolites in soft corals (*Alcynonacea*). A total of 200 compounds were isolated and their diversity analyzed, in addition their anti–inflammation and anti–cancer activities were investigated. Inflammation of a powerful innate immune system defense that is an orchestrated maneuver designed to eliminate cellular treats. Chronic inflammatory response plays an important role in cancer development and resistance to chemotherapy. Molecular mediators that regulate inflammation and cancer are promising targets for preventing and treating these diseases. In this study, we have identified several soft coral derived novel secondary metabolites with potent anti–inflammation and anti–cancer activities. Their inflammatory potential and mechanism of action was evaluated using RAW 264.7 macrophages, their PGE_2, TNF–α, IL–1β, IL–6, iNOS, and COX_2, were evaluated. Cancer cell bioassay was concluded using HL60 and MCF 7 cell lines, with control normal cells. Apoptosis mechanism was evaluated using Sub–G1 proportion, microscopic technique, Bax, Bcl–xl, Cleaved Capcase 3 and β–actin. In addition, we also investigated the microarray gene expression on the cells when these compounds were tested against human primary breast cancer cells that were derived from primary lobular carcinoma. Data was analyzed using two–dimensional clustering of top genes–expression intensities, AKR1C1/2, TPD52, SPRY2, PLK1, KIF11genes were identified as highly expressed in the influence of these compounds.

Keywords: Anti–inflammation; Anti–cancer; Microarray–gene–expression; Soft corals; Borneo

Keynote 6.2

Prof Dr Chiaki Ogino
Kobe University, Japan

Cancer Therapy by The Combination of Nano–Particle and X-Ray Irradiation

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Abstract: Biological applications of nanoparticles are rapidly increasing, which introduces new possibilities to improve the efficacy of radiotherapy. Here, we synthesized titanium peroxide nanoparticles (TiOxNPs) and investigated their efficacy as novel agents that can potently enhance the effects of radiation in the treatment of pancreatic cancer. The core structures of the PAA-TiOxNPs were found to be of the anatase type. The TiOxNPs and PAA-TiOxNPs showed a distinct ability to produce hydroxyl radicals in response to X-ray irradiation in a dose- and concentration-dependent manner, whereas the TiO2NPs did not. The combination of the PAATiOxNPs and X-ray irradiation induced significantly stronger tumor growth inhibition compared to treatment with either PAA-TiOxNPs or X-ray alone. No apparent toxicity or weight loss was observed for 43 days after irradiation. Thus, TiOxNPs are potential agents for enhancing the effects of radiation on pancreatic cancer and act via hydroxyl radical production; owing to this ability. In addition, the bio-based nano capsule (BNC) delivered from Hepatite B-virus were also developed in our team. Normally, wild type of BNP was capable to recognize the liver tissue by molecular interaction. However, by genetic modification strategies, the targeting potential of BNC is easy altered from liver cell to other organs such like a cancer cells. By combination of PAATiOxNPs and BNC, the simultaneous delivery and therapy for cancer cell could be archived.

Invited Speaker 1.1

Assoc Prof Dr Hsiu–Wen Chien
National Kaohsiung University of Science and Technology, Taiwan

Reuse of Spent Coffee Grounds: Be as Antimicrobial Materials

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Abstract: Spent coffee grounds (SCGs) are wastes left over after coffee brewing. How to recycle a large amount of waste coffee grounds to give them new life is the goal pursued by many scientists. SCGs are mainly composed of macromolecular cellulose and lignocellulose, which can be used for agricultural composting, gardening or mushroom growth. These celluloses are treated with porosity, making SCGs with a high surface area have a strong adsorption capacity. In addition, SCGs also contain many organic compounds, such as amino acids, lipids, minerals, melanoidins, polyphenols, etc. There are a lot of research on extracting the fats in coffee grounds in an attempt to convert them into lipids for use as biodiesel or ethanol. Or use SCGs as an adsorbent for heavy metals. These heavy metal ions form ionic bonds with the negatively charged functional groups in the SCGs to remove heavy metals in the water. Recently, our research team was trying to modify SCGs as antibacterial materials. Our results found that SCGs could be directly immersed in silver ion solution to form silver nanoparticles (AgNPs) on the surface of SCGs. The size distribution of the AgNPs changed according to the pH changes during the reaction. The study used a green synthesis method to modify SCGs without any additives, greatly improving the antibacterial ability of the original SCGs, making them of high value in the development of antibacterial products.

Invited 1.2

Dr Wan Abd Al–Qadr Imad Wan Mokhtar
University of Malaya, Malaysia

Bioreactor Biomass as Fish Superfood

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Abstract: Researchers are looking at technologies that can deliver more fish–feed in less time while using a smaller land area for production as a consequence of rapid rise of the human population and global decrease in accessible cropland per person. This gives a long-term answer to the global problem of decreasing native wild fish stocks. Mushrooms, commonly grown utilizing agricultural waste resulting from the intensive use of arable land, can be grown swiftly in bioreactors. Tilapia were recently fed with fish–feed supplemented with heterotrophic 1–m^2–bioreactor–grown biomass from the medicinal mushroom *Ganoderma lucidum*. Bioreactor biomass (BB) cultivated in a 5 L controlled stirred–tank vessel has a high protein content (32.2%), indicating that it might be used as a superfood raw material. The use of 15 g/kg of BB in the feeding trial resulted in a 100% survival rate, longer body length (> 1.7 cm), and higher (35 g) body weight growth among tilapia after six weeks when compared to the control (30 g). Blood examination of BB–treated tilapia revealed considerable increases in haemoglobin (6.43 g/dl), red blood cells (2.47 x 10^6 mm^3), and white blood cells (164.3 x 10^5 mm^3). In the second trial, BB extract increased catalase activity, indicating that it had an antioxidant reaction. This technique produced mushroom biomass in liquid form to feed tilapia for human consumption under the landless food concept. The mushroom is a highly efficient natural decomposer of waste generated by both animals and humans and conversion of these wastes to fish feed is a circular strategy for self–sustaining. This biomass aided tilapia growth and internal health and took up less space than crop production, which could be beneficial in high–population, low–income nations with small–scale farming practices. In terms of sustainable development goals, this concept combines zero hunger and healthy lives.

Keywords: Mushroom cultivation; Tilapia; Superfood; Food security; Circular bioeconomy

Invited 2.1

Asst Prof Dr Sompong O–Thong
Thaksin University, Thailand

CO_2 to Acetic Acids Bioconversion Process for Biogas Upgrading by *Clostridium thailandense*

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Abstract: Homoacetogens consortium was enriched from peatland soil, digested sludge, and rumen fluid for simultaneous carbon dioxide (CO_2) consumption and acetic acid production in the biogas upgrading process. The homoacetogens consortium enriched from peatland soil (PL3) has a maximum CO_2 consumption and acetic acid production of 95% and 120 mg/L, respectively. The methane content in upgraded biogas and acetic acid production of 98% and 543.4 mg/L was obtained at optimum hydrogen (H_2) to CO_2 at a ratio of 2:1, pH 8, and temperature 30°C. The upgraded biogas (CH_4 > 95%) can be used as vehicle fuel or injected into the natural gas grid. The homoacetogens consortium PL3 was dominated by *Clostridium* sp., *Proteiniclasticum* sp., and *Petrimonas* sp.. While *Clostridium* species are the main homoacetogens responsible for CO_2 reduction using H_2 as an energy source. The homoacetogens consortium PL3 could provide an opportunity for simultaneous biogas upgrading to biomethane and acetic acid production. An acetogenic, obligately anaerobic, Gram positive, endospore-forming bacterium, designated strain PL3^T, was isolated from peatland soil enriched with H_2 and CO_2. Cells of strain PL3^T were 0.8-1.0 x 4.0-10.0 µm, straight rod-shaped, with sub-terminal endospores. Growth of PL3^T occurred at pH 6-7 (optimum, pH 7), temperature of 25-35°C (optimum, 30°C), and 0-1.5% (w/v) NaCl (optimum, 0.5%). Biochemical analyses revealed that strain PL3^T metabolized lactose, maltose, raffinose, rhamnose, lactic acid, sorbitol, arabinose, and glycerol. Acetic acid and ethanol were the predominant products from H_2/CO_2 fermentation. The genomic in silico DNA-DNA hybridization value between strain PL3^T and *C. aciditolerans* DSM 17425^T was 25.1%, with the average nucleotide identity (ANI) value of 80.2%. Based on the phenotypic, chemotaxonomic, and phylogenetic differences with concurrent low genomic identity to other species, strain PL3^T is suggested to represent a novel species within the genus *Clostridium* name *Clostridium thailandense sp*. nov. is proposed. The type strain is PL3^T (=DSM 111812^T= TISTR 2984^T).

Keywords: CO_2 economy; Biogas upgrading; Acetic acid production; Homoacetogens

Invited 2.2

Dr Mohd Fauzi Mh Busra
Universiti Kebangsaan Malaysia, Malaysia

Insight of Multifunctional Natural–based Biomaterials Strategies for Skin Tissue Engineering: Current Update

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Abstract: The great challenge in current management of skin wound healing involving several external factors such as patient's lifestyle, health status, social support, wound types, treatment selection etc. This essential information is needful towards personalized/precision medicine near future. Current standard gold treatment for full–thickness skin wound using split skin graft (SSG) may lead to severe infection and limited source of autologous skin even though it helps in healing process. A major drawback for deep and large open wounds, especially in chronic wounds, is slow healing and scar formation. Besides, the loss of tissue integrity and stability causing easy exposure to external pathogenic microbes. The presence of bacteria could severely delay wound healing and lead to serious infection associated with increased mortality. Thus, rapid skin wound management is a feasible approach to expedite the healing rate and reduce the risk of complications via multifunctional smart biomaterials. Current available skin wound treatment products include hyaluronic acid gel, hydrocolloid dressing, acellular skin substitute, etc. However, these products demonstrated a slow wound healing rate, less angiogenesis and scarring (esthetic issue). Therefore, our Functional Biomaterials Technology research group focuses on developing ready–to–use products from green resources. It includes collagen, gelatin or cellulose etc., incorporating various forms of formulation, including natural products, growth factors, and secretome, which have been explored widely to accelerate skin regeneration.

Keywords: Wound healing; Split skin graft; Smart biomaterials; Angiogenesis; Skin generation

Invited 2.3

Assoc Prof Ts Dr Nashrul Fazli Mohd Nasir
Universiti Malaysia Perlis, Malaysia

Antimicrobial Characteristics of Various Malaysian Seashells Based Hydroxyapatite (HA) Concentrations

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Abstract: Hydroxyapatite (HA) is well known for its use in medical field, especially in bone tissue engineering. It is heavily studied and used because of its chemical similarity with the mineral component of bones. Due to the low cost and easily available, seashells have been widely chosen to be used as potential resource for the biomaterial to be used in HA synthesis. In this project, *Pholas orientalis* (Mentarang) are used as calcium precursor together with the addition of phosphoric acid for the HA synthesis using the wet–chemical precipitation method. The effect of concentration on morphological and chemical composition of HA were analyzed through Scanning Electron Microscopy (SEM) and Fourier Transform Infrared Spectroscopy (FTIR). SEM is used to examine the surface morphology of HA. The chemical composition of HA by identifying the presence of different organic and inorganic functional group of the synthesized HA and the interaction between molecules was done using FTIR. The results obtained are then compared with the commercial HA. As bacterial infection is one of the concerns taken into consideration when using HA in medical application, antimicrobial properties of HA are performed by broth dilution method using Escherichia coli and Staphylococcus Aureus to check for the inhibition of bacterial growth. The result shows that HA used has a low antimicrobial activity against both bacteria strains as in general, pure hydroxyapatite has no antimicrobial property. Incorporating other element like metal ions such magnesium, zinc or silver may help to enhance the antimicrobial property. This can help in ensuring it can be a good candidate as antimicrobial biomaterials to be used for implant and surgical applications.

Keywords: Hydroxyapatite; *Pholas orientalis*; Antimicrobial; SEM; FTIR

Invited 2.4

Assoc Prof Dr Shaza Eva Mohamad
Universiti Teknologi Malaysia, Malaysia

Phycoremediation of Palm Oil Mill Effluent (POME) by Microalgae

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Abstract: Palm Oil Mill Effluent (POME) is an untreated wastewater that is generated from palm oil industry containing soluble materials that are harmful to the environment. Malaysia is currently faced with water pollution issues due to direct discharge of this effluent into the watercourse. Therefore, phytoremediation of POME with microalgae is adequately needed to provide a biofriendly mean of treating the effluent before discharging out. *Chlorella sorokiniana* was shown to be able to remediate high strength wastewater at different dilutions of 80, 60, 40, and 20% (v/v) with distilled water. The remediating ability of the microalgae was measured under two conditions of sterilized and non–sterilized POME; hence 80% v/v dilution was considered as the best condition. Growth of *C. sorokiniana* in 80% dilution of POME presents the highest specific growth rate of about 0.1408 d^{-1} at 15 days cultivation period. The results indicated that *C. sorokiniana* grew well in both sterile and non–sterile POME resulting in efficient removal of nitrate, phosphate, color and COD by 31–71%, 29–64%, 31–86% and 11–91%, respectively. This study showed that cultivation of *C. sorokiniana* in both sterilized and non–sterilized POME can be a possible solution for treatment of POME discharge into environment.

Invited 3.1

Dr Nor Azlan Nor Muhammad
Universiti Kebangsaan Malaysia, Malaysia

Insights into The Developmental Pathways of Oil Palm Pest, *Metisa plana*

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Abstract: The bagworm, *Metisa plana* (Lepidoptera: Psychidae) is a ubiquitous insect pest in oil palm plantations. An infestation of *M. plana* could reduce oil palm productivity by 40% if left untreated for two consecutive years. Despite the urgency to address this problem, the genome and transcriptome of *M. plana* have not been fully elucidated. Here we report a comprehensive transcriptome dataset from four different developmental stages of *M. plana*, consisting of egg, third instar larva, pupa and female adult. De novo transcriptome assembly of the raw data yielded a total of 193,686 transcripts, which were then annotated against UniProt SwissProt, NCBI non–redundant (NR), Gene Ontology (GO), Cluster of Orthologous Group (COG), and Kyoto Encyclopedia of Genes and Genomes (KEGG) databases. From these, 46,534 transcripts were annotated and assigned to 146 known metabolic or signalling KEGG pathways. In addition, 41 differentially expressed transcripts encoding seven genes in the chitin biosynthesis pathways were identified, and their expressions across each developmental stage were further analysed. The genetic diversity of *M. plana* was profiled, with 21,516 microsatellite sequences and 379,895 SNPs loci found in the *M. plana* transcriptome. These datasets provide valuable transcriptomic resources for further investigation of developmental gene expression, transcriptional regulation, and functional gene activities involved in *M. plana* development. Identification of regulatory genes in the chitin biosynthesis pathway may also aid in the development of RNAi–mediated pest management by targeting specific pathways, as well as functional studies of genes in *M. plana*.

Keywords: *Metisa plana*; Transcriptome; Bioinformatics; Systems biology; Developmental stages

Invited 3.2

Asst Prof Dr Yang Wei
National Taipei University of Technology, Taiwan

Mussel Proteins-Inspired Adhesives

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Abstract: Strong and effective adhesion for synthetic polymers to wet surfaces seems severely limited due to the hydration layer on concrete surfaces. Yet, some marine creatures are experts in wet adhesion. For example, mussels could secret remarkably sticky proteins in their byssus that firmly secure themselves even to surfaces under seawater. The mussel byssus contains several adhesive mussel foot proteins, mainly found in the plaque, to contact a solid surface. In this study, the amino acid labeling and mass spectrometry technique were used to identify the configuration of mussel foot proteins adsorbed on a solid substrate by combining the labeling profiles of modified lysine (Lys) and histidine (His). These data provide molecular-level insights regarding the adsorbed mussel adhesive binding sequence. The adhesive interaction between this sequence and a solid surface was further explored using quartz crystal microbalance (QCM) and an atomic force microscope (AFM). Our findings provide detailed mussel-foot-protein binding characterization and could benefit the accurate and efficient mussel protein-inspired sequence for wet adhesive polymer designs on a specific surface.

Keywords: Mussel; Amino acid labelling; Mass spectrometry; Quartz crystal microbalance; Atomic force microbalance

Invited 3.3

Dr Ahmad Bazli Ramzi
Universiti Kebangsaan Malaysia, Malaysia

Designer Enzyme for Metabolic Pathway Engineering in Bacterial Chassis

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Abstract: Metabolic engineering and synthetic biology approaches using microbes as synthetic biology chassis offer modular and scalable bioproduction platforms by which the implementation of iterative Design–Build–Test–Learn synthetic biology cycle has aided in speeding up the development and pre–commercialization process of a variety of bio–based chemicals. 5–aminolevulinic acid (ALA) is a non–proteinogenic amino acid that has been produced and applied as crop fertilizer, cancer prodrug, and precursor for industrially–important peroxidase enzymes but biotechnological production of ALA in native and recombinant hosts is dependent on the catalytic activity of feedback–regulated glutamyl–tRNA reductase (HemA) in the C5 pathway. To address this limitation and make use of ALA as biocatalysts precursor, specially devised designer enzyme and metabolic pathway engineering strategies were employed using *Corynebacterium glutamicum* and *Escherichia coli* as chassis for ALA bioproduction and peroxidase biocatalysis, respectively. To improve ALA bioproduction, enzyme design and screening were carried out on HemA genes from several bacterial strains where the HemA enzymes were rationally designed to be deregulated from feedback inhibition by heme compound. Using *C. glutamicum* as ALA chassis, the best–performing HemA enzyme from *Salmonella typhimurium* was selected for improving ALA production through subsequent pathway engineering via the C5 biosynthetic pathway. By introducing the ALA biosynthetic pathway in another bacterial chassis, we also showed the biocatalytic activities of heme–containing peroxidase enzyme can be improved intrinsically through increased availability of intracellular ALA and heme cofactors in the bacterial system. In this work, the expression of the ALA pathway in engineered *E. coli* gave out improved and higher–performing recombinant dye–decolorizing peroxidase (rDyP) from *Bacillus subtilis* as compared to hemin–supplemented rDyP biocatalytic system. Overall, the findings from these studies demonstrated the beneficial uses of the Design and Build of ALA–producing engineered microbes especially for green biocatalysis and industrial biotechnology applications.

Keywords: Designer enzyme; 5–aminolevulinic acid; Dye–decolorizing peroxidase; Metabolic engineering; Synthetic biology chassis

Invited 4.1

Dr Heera Rajandas
AIMST University, Malaysia

Role of Sequencing Technology in Addressing Sustainable Development Goals

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Abstract: From the introduction of Sanger to the development of Next–Generation and third generation sequencing platforms, these technologies have become a game changer in the field of Biotechnology. Over the years, the main players in the field of sequencing, Illumina, Oxford Nanopore and PacBio have consistently improved their respective technologies, making them more robust and providing us short and long read sequencing data with higher accuracy from small amounts of starting materials. Researchers therefore, now have many cost–effective options to answer the burning fundamental questions in their fields, be it agriculture, medical sciences, environmental sciences, biodiversity studies, etc., which in turn generates valuable data to address some of the United Nation's Sustainable Development Goals. In addition, sequencers are becoming more portable such as the Oxford Nanopore's MinION that enables scientist to perform real–time sequencing in the field. In this presentation, I will address these by providing examples of 2 sequencing–based projects that is currently being carried out at our Centre, Centre of Excellence for Omics–Driven Computational Biodiscovery (COMBio), AIMST University.

Keywords: Sequencing; affordable; precision agriculture; antimicrobial resistance (AMR); Sustainable Development Goals (SDGs)

Invited 4.2

Dr Khanom Simarani
Universiti Malaya, Malaysia

Novel Natural Compound Synthesis by *Nigrospora Sphaerica* for Breast Cancer (*NONACOS–BC*)

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Abstract: NONACOS is Vinca alkaloid that produced by a novel endophytic fungus isolated from *Catharanthus roseus,* the medicinal plant produces a lot of important compounds especially vinblastine and vincristine. Vinblastine used in chemotraphy to treat a breast cancer, testicular cancer and Hodgkin's disease. This plant also produces vindoline and catharanthine, the major monomer alkaloids function as a biosynthetic precursor for vinblastine and vincristine. The plant associated fungus isolated and could produce the similar Vinca alkaloid as the host plant. Study was done to produce and compare the effectiveness of anti–carcinogenic alkaloids by *C. roseus* and endophytic fungi on cell line cancer using cytotoxicity test through MTT assay. The production of crude fungal extract (CFE) was carried in the shake flask containing 250 mL of yeast extract sucrose broth (YESB) medium, incubated at 25°C for 3 weeks. Meanwhile, the crude extracts of *C. roseus* leaves were prepared by soaking 5 g powdered of samples with 90% (v/v) ethanol for 12 h each at room temperature. This vinca alkaloid from both samples were extracted and purified by using high performance liquid chromatography (HPLC) and tested for cytotoxicity activity using MTT assays on the breast cell line cancer (MDA–MB 231). A positive result with a value of Half Maximal Inhibitory Concentration (IC_{50}) of > 32 ug/mL was observed compared to standard (IC_{50}) of 350 ug/mL only. It showed that a vinblastine produced by *N. sphaerica* has a high cytotoxicity activity even though the concentration of vinblastine produced by this endophytic fungus was only 0.868 ug/mL. This finding will help to fill the demands of the drugs. In fact, the manufacturing cost of the drugs from endophytic fungi is cheaper than production from the plants since it takes a shorter period to produce it.

Keywords: Endophytic fungi; Natural product; Vinblastine;, Vinca alkaloid; Cytotoxicity test

Invited 5.1

Prof Dr Chi–Wei Lan
Yuan Ze University, Taiwan

The Application of Electro Fermentation on Improving Production of Echineone by Marine Microorganism

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Abstract: This first-attempt study tended to decipher synergistic interactions of model redox mediators (RMs) to echinenone production for electrochemically-steered fermentation (ESF). The findings indicated that supplement of RMs could significantly stimulate the production performance of fermentation (e.g., 36% for 4-aminophenol) which was parallel with stimulation of bioelectricity generation in microbial fuel cells (MFCs) as prior studies mentioned. Although redox mediators could usually enhance electron transport extracellular compartment, the mechanisms of bioelectricity generation in MFCs and echinenone production in ESF were very likely functioned in the extracellular and the intra- cellular compartment, respectively. In MFCs, electron transfer towards biofilm anode for bioelectricity generation must be taken place. However, for ESF echinenone accumulation was very likely occurred in the intracellular compartment, thus electron transfer was predominantly implemented in the intracellular, not the extracellular compartment.

Invited 5.2

Asst Prof Dr Sureewan Sittijunda
Mahidol University, Thailand

Valorization of Crude Glycerol Derived from The Biodiesel Production Process for Bioenergy and Biochemical Production

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Abstract: Environmental issues caused by climate change are now escalating into a major global crisis. As a result, the relevance of technology in the bioconversion of wastes into renewable and environmentally friendly products is appealing. Crude glycerol is an attractive feedstock for bioenergy and biochemical production due to its contain high carbon content and waste stream derived from the biodiesel production process. Therefore, this research aims to utilize crude glycerol to produce bioenergy (hydrogen, ethanol) and biochemical (1,3-propanediol). The influences of organic loading rate (OLR) on the formation of hydrogen, ethanol, and 1,3-propanediol was investigated in an up-flow anaerobic sludge blanket (UASB) reactor. In addition, the effect of fermentation temperature (mesophilic (37ºC) and thermophilic (55ºC)) was also investigated. Results showed that a change in hydrogen, ethanol, 1,3-propanediol productions, and glycerol consumption was due to a change in OLR. The optimum OLR of 50 and 62.5 g/L d were obtained when operated at mesophilic and thermophilic temperatures. At the mesophilic temperature, the microorganisms preferred conversion of glycerol to ethanol with a COD distribution of 26.7%. The 1,3-propanediol was produced as a secondary metabolite with a COD distribution of 25.30%. Hydrogen production at mesophilic temperatures was relatively low, with a COD distribution of 4.60%. In contrast, microorganisms fermented glycerol into 1,3-PD with a COD distribution of 35.60% at a thermophilic temperature. Hydrogen was produced as a secondary metabolite with a COD distribution of 25.6%, while ethanol was observed as a third product with a COD distribution of 16.30%. The analysis of microbial communities showed that the changes in OLR induced changes in the microbial community structure. An operation at different temperatures caused a shift in the metabolic pathway from oxidative to reductive.

Keywords: Biofuels; Dark fermentation; Waste glycerol; Bioconversion; Microbial conversion

Invited 5.3

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Organosolv Pretreatment for The Production of Various Bioproducts Towards Sustainable Biorefinery Processing

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Abstract: *Pennisetum purpureum* or Napier grass, a native to African grass happened to be one of the most promising candidates for bioethanol production. However, literature studies on the organosolv pretreatment process for *P. purpureum* were relatively rare. Therefore, in this research, organosolv pretreatment on *P. purpureum* was studied and compared with different types of solvent (1–pentanol and ethylene glycol) and homogeneous catalysts (sodium hydroxide and sulfuric acid) in order to provide the feasibility study and filling the current research gap. The chemical composition of *P. purpureum* was found to comprise of 21.50% lignin, 54.67% alpha cellulose and 23.83% of beta cellulose and hemicellulose. The substantial composition of cellulose and hemicellulose in *P. purpureum* proved its promising potential as a raw material for bioethanol production. Ethylene glycol with concentration of 50.0% (v/v) with addition of 2.0% (v/v) of sodium hydroxide had proven to be the most effective organosolv pretreatment combination in removal of lignin (83.4%). In terms of lignocellulosic component recovery, this pretreatment solvent achieved up to 70.10% alpha cellulose recovery and 97.90% beta cellulose and hemicellulose recovery.

Keywords: *P. purpureum*; Organosolv; Bioethanol; Lignin; Cellulose

Invited 5.4

Assoc Prof Dr Nor'Aini Abdul Rahman
Universiti Putra Malaysia, Malaysia

Phosphate Microbial Solubilization: Higher P Use Efficiency and Crop Productivity

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Abstract: Biofertilizers are the substances containing variety of microbes having the capacity to enhance plant nutrient uptake by colonizing the rhizosphere and make the nutrients easily accessible to plant root hairs. Biofertilizers are well known for their cost effectiveness, environment–friendly nature, and composition. Phosphorus (P) is the second most important macronutrient for plant growth. Many soils are P–deficient because low levels of soluble phosphate are available for plant growth, although they may have high levels of total P. To use the P accumulated in soils, P–solubilizing microorganisms (PSMs) that are able to transform insoluble P to soluble forms can function as biofertilizers to increase the soluble P content. In this work, we isolated and screened the best P solubilizing microrganism; bacteria and fungi and identified using molecular analysis. The best selected fungus and bacterium were identified as *Aspergillus niger* SA1 and *Enterobacter hormaechei* 40a, respectively. *A. niger* strain generated 800 mg soluble P L^{-1} NBRIP medium after 5 d of culture while *E. hormaechei* 40a demonstrated the highest soluble P at 65 mg/L in NBRIP media at 24 h fermentation. Besides, the effect of the medium formulation and cells protection for the shelf life of the biofertilizer were also optimized and tested in pot experiment.

Keyywords: Biofertilizers; Phosphorus–solubilizing; *Enterobacter hormaechei* 40a; *Aspergillus niger* SA1

Invited 6.1

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Nanobiotechnology Towards Nano–Diagnostics for Screening of Infectious Diseases

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Abstract: Infectious diseases (ID) are caused by pathogenic microbes and can be infected between individuals in the population. It became the critical medical issue in the public health and depleted the economy. Various types of ID are the leading causes of the death and disability worldwide. Current diagnosis procedures that involve ID are costly and require consuming times either by using clinical or molecular methods. Low–cost diagnostic instruments, as well as speedy and reliable diagnostics, have become essential factors in the rising demand for Point of Care diagnostics (PoC). Due to its tremendous potential in terms of low–cost diagnostic tools, ease of operation, and sensitivity analysis, Nano Lab–on–Chip (LoC) technology leads to improvements in biomedical applications. New study based on producing Nano LoC for ID diagnosis, such as cervical cancer caused by Human *Papillomavirus* (HPV) infection and COVID–19 virus, is quickly gaining traction in the medical community. LoC can be applied in the field region by using real–time measurement due to the incorporation of digital and mobile technology. The fundamental s of biological route research has been the primary pathway for developing LoC integration with nanoparticles to improve detection signal and expand detection surface area in ID. The biological path to create nano–diagnostic will be described in this research study.

Keywords: Infectious diseases; Lab–on–Chip; Cervical cancer; Human *Papillomavirus*; COVID–19; nano–diagnostic

Invited 6.2

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Biological Potentials of Halogenated Secondary Metabolites from Japanese Marine Red Algae *Laurencia* spp.

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Abstract: Various species of Rhodophyta contain diverse chemically and biologically interesting halogenated secondary metabolites. Members of the marine red algal genus *Laurencia* are prolific producers of halogenated secondary metabolites. To date, more than 700 structurally unique halogenated compounds, such as non–terpenoids of C_{15} acetogenins, sesquiterpenoids, diterpenoids, triterpenoids, and indoles, have been isolated from these red algae. These *Laurencia*–derived halogenated compounds are promising bioresources for medicinal and agricultural research owing to their various biological potentials. For ecological reasons, the chemical components of *Laurencia* are reported as chemotaxonomical markers at the species level. Chemical races are defined as populations that are morphologically similar and not reproductively isolated, but produce different compounds that may be generated via different biosynthetic pathways. Representative examples of chemical races are *L. nipponica* in Japanese coastal areas, *L. pacifica* in California, USA, and Mexico, and *L. majuscula* in North Borneo, Malaysia. All the race–index compounds are halogenated, and some exhibit a wide range of biological activities, such as antibacterial, insect repellent, and antifouling. In the course of our studies on the chemical components of the Japanese marine red algae *Laurencia* spp., we report that the specimens collected at Hokkaido, Chiba, Kanagawa, Shizuoka, and Hiroshima, contained two new C_{15} acetogenins and three new sesquiterpenoids together with several known compounds. Herein, we discuss their chemosystematics and investigate their repellent activity against selected pests as well as growth inhibitory activity on plants.

Keywords: Marine red alga; *Laurencia*; Halogenated secondary metabolite; Repellent activity; Growth inhibitory activity

Invited 6.3

Assoc Prof Ts ChM Dr Mohd Sani Sarjadi
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A Review of Antioxidant Potential from Seaweed – Extraction, Characterization, Benefits and Application

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Abstract: Potential natural antioxidant from seaweed is used to improve oxidative stability of foods, also function as active ingredients. Different perspectives on antioxidants have been taken from other researchers and included in this article for the new researchers for this field. There are three (3) classes of antioxidants consisting of vitamins, carotenoids and polyphenols. Researchers employ a variety of ways to evaluate antioxidants, including screening approaches and chemical composition. Solid–liquid extraction, pressured liquid extraction, supercritical fluid extraction, and other green extraction techniques are among the seaweed antioxidant extraction methods utilized and reviewed in this article.

Keywords: Antioxidant; Application; Extraction; Characterization; Benefit

Oral 1.1

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Enhancing Growth Performance of Red Spinach (*Amaranthus tricolor*) *via* Zero–Energy Soilless Agriculture (ZESA)

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Abstract: Conventional plant growth using soil had shown some disadvantages in plant management such as high water consumption, large space planting area and usage of chemicals during farming. Hydroponic and fertigation have been shown to have overcome the aforementioned problems. However, both techniques are lacking in terms of waste energy consumption and nutrients supply. Therefore, Zero–energy Soilless Agriculture (ZESA) – a modification from combination of hydroponic and fertigation plant growth system was introduced. It uses a porous soilless growing medium of biomass and self–nutrients intake system, and suitable for fast harvest plants such as red spinach. This planting system can be placed under sheltered areas and small spaces such as greenhouse and house balconies with less monitoring of watering and nutrients. In this study, the effect of different soilless mediums was investigated on the red spinach growth performance. A study on ZESA using different medium treatments and ratio of soilless mediums (cocopeat, biochar and eggshell) were carried out using a randomized design. Plant growth parameters such as plant height, number of leaves and fresh weight were investigated. One way ANOVA with repeated measures model was used to perform statistical analysis. The findings showed that cocopeat consists of higher minerals and moisture content exhibited the most positive response on the plant height and number of leaves. The soilless medium ratio of 4:1 biochar and cocopeat greatly affected the fresh weight of red spinach. Overall, treatment with 100% cocopeat showed the most efficient results on the plant growth performance ($F = 2.111$, p–value = 0.049). Statistical analysis using one way ANOVA of all treatments showed p–value of less than 0.05, indicating that the data were acceptable. In conclusion, ZESA has high potential to be implemented as a new growing technique to improve plant growth management by reducing water usage, small planting areas and minimizing pesticides.

Keywords: Zero–energy soilless agriculture (ZESA); Soilless growing medium; Self–nutrient intake; Plant growth performance; *Amaranthus tricolor*

Oral 1.2

Nur Hailini Zainol Hilmi
Malaysian Palm Oil Board, Malaysia

Volatile Organic Compounds (VOCs) for Detection of *Ganoderma boninense* in Oil Palm

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Abstract: Basal stem rot disease caused by the white rot fungus *Ganoderma boninense* is a major threat to the oil palm industry, and hence, the ability to detect this infection at an early stage of development is desired. In this study, a headspace solid–phase microextraction (HS–SPME) method coupled with gas chromatography–mass spectrometry (GC–MS) was employed to analyse the volatile organic compounds (VOCs) released from *G. boninense* cultures and infected oil palm wood. Several factors affecting the HS–SPME extraction efficacy were investigated; 0.25 g of sample homogenized in liquid nitrogen was shown to be the most useful preparation procedure, while fibre divinylbenzene/carboxen/polydimethylsiloxane (DVB/Car/PDMS) was shown as the optimum extraction phase. The optimized method was capable of sampling VOCs with high reproducibility with balanced VOCs profile of various chemical classes. We examined VOCs released from three types of samples: *G. boninense* mycelium, oil palm wood and oil palm wood colonized by *G. boninense*. This preliminary study led to the tentative identification of 57 VOCs, including alcohols, alkanes, volatile acids, ketones, aldehydes, esters, sesquiterpenes and polycyclic aromatic hydrocarbon groups. Aliphatic compounds with eight–carbon atoms, such as 1–octen–3–ol, 3–octanone, 1–octanol and (E)–2–octenal, were the most abundant constituents of the Ganoderma samples, whereas furfural and hexanal were the major compounds detected in the oil palm wood samples. Chemometric analyses using cluster heat maps and principal component analyses were used to discriminate between the VOCs profiles. The results indicated that the novel method described here could be used to detect *Ganoderma* disease, and more generally for chemoecological studies of plant–pathogen interactions.

Keywords: Oil palm; *Ganoderma boninense*; HS–SPME–GCMS; VOCs

Oral 1.3

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Healthier Gut Microbiota and Its Protection Role of Functional Papaya Beverage Against Streptozotocin–Induced Diabetic Sprague Dawley Rats

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Abstract: Diabetes mellitus is silent killer illness, characterized by hyperglycemia and can cause many health complications. A new functional papaya beverage was produced *via* selected pure symbiotic culture of bacteria & yeast (SCOBY) which offers an alternative food therapy in regulating blood glucose and its efficacy was evaluated using Streptozotocin (STZ)–induced diabetic Sprague Dawley rats for one month treatment. Under moderate diabetes condition, SCOBY papaya beverage was shown able to reduce high blood glucose of diabetic rats to normal level, comparatively effective with commercial drug, Metformin. Not only that, it also helped restoring body weight of diabetic rats to a healthier state with gradual increment of body weight observed weekly. In contrast, untreated diabetic rats experienced a sharp rise in blood glucose with stunted diabetic rats body weight. Nutrigenomic studies were conducted to identify the mechanisms that support the effectiveness of SCOBY papaya beverage as an anti–diabetic therapy. Evidence from quantitative polymerase chain reaction (qPCR) analysis disclosed significant higher expression on gene markers related to insulin receptor substrates (Irs1), glucose transporters (Slc2a8) but lower expression of gene markers indicative of inflammation (NF–κB) and oxidative stress (NO_2) in diabetic rats treated with SCOBY papaya and Metformin ($p < 0.05$). SCOBY papaya treated diabetic rats showed an increment of short chain fatty acids content and gut microbiota enriched with some beneficial microbes particularly for *Alloprevotella*, *Lachnospiraceae* UCG–001 and *Prevotellaceae* NK3B31 compared to untreated diabetic rats. These data support the effectiveness of SCOBY papaya as functional beverage in improving the intestinal health by changing the environment of microbiome of diabetic rats, in turn offering cost–effective food therapies in blood glucose regulation.

Keywords: Short chain fatty acids; qPCR; Streptozotocin; Microbiome; Hyperglycemia

Oral 1.4

Assoc Prof Ts Dr Farhan Mohd Said
Universiti Malaysia Pahang, Malaysia

Box–Behnken Design for Optimizing Production of *Monascus purpureus* Pigments in Mechanically Mixed Drum Bioreactor

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Abstract: A three–level Box–Behnken experiment design was used to optimize the production of food pigments by *Monascus purpureus* FTC5357 grown on oil palm frond substrate at 30°C in 9–day batch fermentations. The experimental factors were the initial moisture content in the substrate (A), the aeration rate (B) and concentration of the soy peptone (C). The fungus was grown in solid–state culture in a 5 L mechanically mixed drum bioreactor. The experimental responses were the productivity of red, yellow, and orange pigments. In all cases, the developed statistical models fitted the measured data with regression coefficient values of ≥ 0.95. The significant of the factors to all pigments resulted similar trends as follows: B > C > A. The optimal fermentation conditions resulted in an initial moisture content (A) of 70% (w/w), an aeration rate (B) of 1.30 vvm and a soy peptone concentration (C) of 4.40% (w/w). Production of all pigments was found to be largely growth–associated.

Keywords: Box–Behnken; Oil palm frond; Pigments; Bioreactor; Growth–associated

Oral 1.5

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Universiti Teknologi Malaysia, Malaysia

Evaluation of Silver Nanoparticles Synthesis Using *in vitro Persicaria odorata* Extracts

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Abstract: *Persicaria odorata* has been reported to contain valuable bioactive compounds with high antioxidant activity. However, green biosynthesized silver nanoparticles using ethanolic extracts of *in vitro P. odorata* was not fully investigated. The study aimed to optimize shoot biomass induction of *P. odorata* for evaluation of antioxidant activity and AgNPs biosynthesis. Shoot biomass was induced from nodal explants of *P. odorata* which were treated with different combinations of BAP and NAA concentrations. Ethanolic shoot extracts of *P. odorata* (PO) were extracted *via* the Soxhlet extraction rotary evaporator. Then, ethanolic PO extracts were further evaluated for total phenolic content (TPC), total flavonoid content (TFC) and antioxidant activities (DPPH and FRAP assays). PO extracts with the highest antioxidant capabilities were further utilized to synthesis AgNPs. The formation of PO–AgNPs was characterized by UV–vis, TEM and FTIR. Moreover, the identification of phytocompounds from selected PO extract was analysed using Gas chromatography–mass spectrometry (GC–MS). Results showed that the combination of 2.0 mg/L BAP + 0.2 mg/L NAA yielded the highest percentage of shoot regeneration (96%), shoot length (5.43 ± 0.38 cm), number of shoots per explant (2.80 ± 0.24) and dry weight (0.76 ± 1.50 g). In addition, the 2 mg/L BAP + 0.2 mg/L NAA combination produced the lowest IC_{50} concentration (35.00 ± 1.00 µg/mL) and the highest FRAP (9159.35 ± 35.44 µM Fe^{2+}/g) as compared to other treatments. Formation of PO–AgNPs was achieved at 464.50 nm after 72 h incubation at room temperature. Characterization of PO–AgNPs was spherical in shape with sizes ranging from 13 to 25 nm. GC–MS analysis identified five main compounds; alpha–Terpineol, Phenol, 2,4–bis(1,1–dimethyl ethyl), Diphenyl sulfone, 2–Propyl–1–pentanol and 1–Tetradecanol. In conclusion, plant growth regulator–treated shoot extracts of *P. odorata* could enhance antioxidant activities and be capable of synthesizing AgNPs. Further optimization such as solvent type, pH and temperature could be evaluated for a stable AgNPs synthesis.

Keywords: *Persicaria odorata*; Silver nanoparticle; Antioxidant activity; Plant growth regulator

Oral 1.6

Ts Dr Sharifah Soplah Syed Abdullah
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Conversion of Nata de Coco into Microfibrillated Cellulose by Physical and Chemical Methods

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Abstract: Microfibrillated cellulose (MFC) is commonly separated from wood pulp or lignocellulosic materials. However, this study investigated the conversion of nata de coco (NDC) or also known as bacterial cellulose (BC) to MFC due to simpler process compared to isolation from other sources. The NDC sample was treated with alkaline solution and cut into cubes with the size of 0.125 and 1 cm^3 prior to fibrillation process. The NDC cubes were then fibrillated by four different methods to evaluate the best method which included homogenization, ultrasonication, combination of homogenization and ultrasonication and TEMPO–mediated oxidation, respectively. The effects of NDC size, homogenization speeds, amplitudes of ultrasonication were evaluated. The MFC samples obtained were characterized in terms of morphology, water retention value (WRV), FTIR and thermal stability (TGA). It was found that the NDC cube sizes did not significantly affect the WRV of MFC obtained by homogenization process. In contrary, the smaller size of NDC cubes gave higher WRV value for MFC samples produced by ultrasonication process. The WRV was positively correlated to homogenization speeds and amplitudes of ultrasonication. Meanwhile, the combination of ultrasonication and homogenization method gave the highest WRV value which reflects the smallest size of MFC fibrils obtained (0.61 μm) as compared to other methods. The FTIR pattern of MFC showed that the functional groups remain the same with some shifting of the wave numbers and intensities from the main NDC spectra peaks. The significant decrease of thermal resistance verifies the smaller size of MFC produced by combination of homogenization and ultrasonication. This study promotes a simple and environmental safe method of MFC production from pure nata de coco using ultrasonication and homogenization process.

Keywords: Microfibrillated cellulose; Bacterial cellulose; Nata de coco; Ultrasonication; Homogenization

Oral 2.1

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Investigating Schwann Cell Adhesion on Graphene/Polycaprolactone Composite Biomaterial for Peripheral Nerve Repair Application

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Abstract: The use of a nerve guidance conduit (NGC), a hollow tube to repair peripheral nerve injury, is available clinically, and the conduit can produce comparable outcomes as nerve autograft, but typically restricted to a regeneration distance of just a few millimeters. Graphene could be a promising biomaterial candidate for such application since it has an excellent electrical conductivity. Moreover, electrical stimulation has been shown to improve peripheral nerve regeneration. This study aims to investigate Schwann cell adhesion on graphene/polycaprolactone (PCL) composite films for potential peripheral nerve repair application. The composite films with different concentrations of graphene were fabricated using the spin–coating technique, and the surface hydrophilicity was analyzed using water contact angle measurement. Rat Schwann cells were cultured on the composite films, and Schwann cell adhesion on the films was studied using immunofluorescence analyses. Increasing graphene concentration from 0% to 0.6% (w/v), reduced the water contact angle measurement by at least 13%, suggesting graphene improved surface hydrophilicity. The cell culture study shows Schwann cells attached and grew on graphene/PCL films of all groups. However, cell length and density measurements in all graphene concentration groups and PCL–only film were significantly lower than the control surface (glass coverslip), indicating reduced cell adhesion. Therefore, this preliminary study supports the potential of graphene/PCL composite as biomaterial to develop NGC to repair peripheral nerve injury. Nevertheless, further investigation into the cell–biomaterial interactions is needed to improve cell adhesion.

Keywords: Graphene; Polycaprolactone; Schwann cell; Nerve guidance conduit; Peripheral nerve repair

Oral 2.2

Dr Musliana Mustaffa
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The Effectiveness of Obturation with GuttaFlow Bioseal in Single Rooted Mandibular Premolars: A Scanning Electron Microscopy Study

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Abstract: The efficacy of obturation with GuttaFlow Bioseal is not well documented due to the limited scientific evidence. Further evaluation in various aspects related to obturation is beneficial to provide further insight for future clinical application. This study aims to evaluate the volumetric percentage of obturated root canals, extrusion of material beyond the apical foramen and duration taken for obturation procedure. A total of 30 single rooted extracted mandibular premolars were selected. A standard access cavity preparation was done, and the root canals were prepared using Hyflex CM rotary files. The samples were equally divided into 3 groups (n=10) based on the obturation techniques; continuous backfill, interrupted backfill and injectable groups. A matched–taper gutta–percha and GuttaFlow Bioseal were used for the obturation. The obturation procedure was timed using a digital timer and the obturation radiograph was taken immediately after obturation. All samples were sectioned perpendicular to obtain three root segments; apical, middle and coronal. The resected roots were observed under scanning electron microscope (SEM) at 70x magnification. The SEM images were transferred to the SketchAndCalc Area Calculator software for evaluation of the obturated root canals. There were no statistically significant differences in regard to the volumetric percentage of obturated root canals at any level of evaluation and extrusion of material beyond the apical foramen ($p > 0.05$). Duration of obturation using continuous and interrupted backfill techniques were statistically significant longer than injectable technique ($p < 0.05$). The volumetric percentage of obturated root canals and the extrusion of material beyond the apical foramen in all obturation techniques were comparable and the duration of obturation procedure was slightly longer in the continuous and interrupted backfill techniques. Obturation using GuttaFlow Bioseal is a predictable approach and effective.

Keywords: GuttaFlow Bioseal; Continuous backfill; Interrupted backfill; Injectable method; Scanning electron microscopy.

Oral 2.3

Dr Rozaimi Abu Samah
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Application of Ionic Copper Concentrate Natural Mineral Base (INCZM) to Promote Plant Growth of Pepper (*Capsicum annuum*)

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Abstract: Nanotechnology is not a new thing in various industries, especially in the agriculture sector. A lot of researchers studied nanotechnology and found better outcomes to make sure nanotechnology is safe to be used in daily life without polluting the environment and threatening other living creatures. As a result, nanotechnology has given a positive impact on the agriculture food sector. However, a proper concentration must be used because it can be extremely toxic to plants, animals, and even the environment. The main aim of this work is to study the effect of the ionic copper concentrate natural mineral base (INCZM) towards *Capsicum annuum*. Plant growth parameters such as length of stem, length of root, number of leaves, and leaf surface were determined after applying INCZM in the soil. Length of stem and length of root were measured using a measuring tape. Total leaf area was evaluated using an app named Petiole. Other than that, the chlorophyll content of *C. annuum* leaves was determined by conducting extraction of chlorophyll from the leaves using acetone and analysed using a spectrophotometer. The results show that 400 ppm of INCZM gave the best results (18.8 cm of stem length, 24.1 cm of root length, 305.4 cm^2 of leaf area, and 30.78 mg/L of chlorophyll content). Meanwhile, at the concentration above 500 ppm, the growth parameters decreased. It is concluded that INCZM could act as a growth promoter for pepper plants if a proper dosage is applied.

Keywords: Ionic copper concentrate natural mineral base; *Capsicum annuum*; Nanoparticles; Copper; Sulphur; Zinc

Oral 2.4

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Multi–drug Resistant *Salmonella enterica* subsp. *enterica Serovars* Enteritidis and Typhimurium in Street Foods

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Abstract: In Malaysia, cooked deli foods such as chicken nuggets, fish balls and meatballs are famously sold in the night market and roadside stalls. Studies have indicated that the street food handlers mostly lacked food safety knowledge and sanitation, thus, the hygiene level of foods being sold here are often questionable. Therefore, this study is aimed to analyse the prevalence of antibiotic–resistant *Salmonella Enteritidis* and *Typhimurium* in street foods, the two most widespread foodborne pathogens that are frequently reported in severe food poisoning cases and deaths. In this study, deli foods (n = 312) were sampled from night markets, street stalls and mobile food trucks were homogenised and diluted (10^{-1}, 10^{-2} and 10^{-3}) in triplicate tubes. All nine tubes were incubated at 37 °C overnight. Cloudy tubes with bacterial growth were then subjected to DNA extraction and touchdown multiplex PCR amplification for targeted amplicons: ST11/ST15 (*Salmonella* spp.), *sdfI* gene (*S. enteritidis*) and *fliC* (*S. typhimurium*). Tubes with positive PCR amplicons were then scored against the most probable number (MPN) statistical analysis. The tubes with bacterial growth were also cultured on XLD agar and the isolated *Salmonella* bacteria were subjected to antibiotic susceptibility tests. Results found that 5.1% of deli foods were contaminated with *S. enteritidis* while 1.6% by *S. typhimurium*. The highest density of *S. enteritidis* (150 MPN/g) was detected in pork sausage sold in the street stall while the highest density for *S*. Typhimurium was detected in meat sausage sold in the night market. These *Salmonella* strains were also found resistant to many common clinical antibiotics such as gentamicin, kanamycin, tetracycline, streptomycin, ampicillin, and chloramphenicol. These findings show that while the *S. enteritidis* and *S. typhimurium* contamination in cooked deli foods are lower, however, the resistance to multiple drugs may imply serious consequences if right the interventions are not taken by the authority concerned.

Keywords: Antibiotic resistance; *Salmonella enteritidis*; *Salmonella typhimurium*; Street foods

Oral 3.1

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Bacterial Indicators for Biomonitoring The Palm Oil Mill Effluent Pollution in Rivers

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Abstract: The aquatic ecosystem is continuously threatened by the discharge of many anthropogenic pollutants. This issue requires an improvement of monitoring system to become more specific to the targeted pollutant. In this study, bacterial indicator is proposed as one of the promising approaches to specifically monitor the river water contamination due to palm oil mill effluent (POME) final discharge. The effect of POME final discharge towards bacterial community in the receiving river was assessed by using flow cytometry and high–throughput Illumina MiSeq. The bacterial community dynamics in POME final discharge was compared with the bacterial community in the unpolluted and polluted rivers due to final discharge, and the results were correlated with the physicochemical properties of the final discharge and the polluted river water. The shift of low nucleic acid (LNA) to high nucleic acid (HNA) bacterial cells in the affected river suggests the transformation of dormant to active cells due to POME final discharge. Besides, the *Chromatiaceae* and *Alcaligenaceae* which were not detected in the upstream but were detected in the downstream part of the river were proposed as the bioindicators to indicate the river water contamination caused by the POME final discharge. These bioindicators were also shown to be present in the different final discharges produced from different biotreatment processes, but not present in the other polluted river water. In addition, the reliability of bioindicators was proven as both of them were remained detected in the POME final discharge (> 0.5%) despite the changes of environmental factors; temperature, pH, total suspended solid and ultraviolet irradiation time, with a positive correlation with biological oxygen demand (BOD_5) concentration. Therefore, the *Alcaligenaceae* or *Chromatiaceae* or both could be regarded as reliable and specific bacterial indicators to indicate the river water pollution caused by POME final discharge, due to its consistent present in POME final discharge and the affected rivers.

Keywords: Bacterial indicator; Palm oil mill effluent; Wastewater; River water pollution; Biomonitoring

Oral 3.2

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Isolation of Three Flavonoids, A Coumarin and A Phenolic Acid from *Macaranga hypoleuca (Rchb.f. & zoll.)* Müll.arg.

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Abstract: *Macaranga* (mahang) is the major genus belongs to Euphorbiaceae family with over 300 species worldwide. This genus is native to tropical Africa, Madagascar, South–East Asia, Australia and the Pacific region. Traditionally, the leaves are used to treat swelling, fresh cuts, sores, bruises and boils. *Macaranga* is a rich source of flavonoids and stilbenoids which possess broad spectrum of bioactivities. The phytochemical study on the leaves and stem bark of *Macaranga hypoleuca* was carried out using several chromatographic methods and spectroscopic techniques. The powdered leaves of *M. hypoleuca* (2.5 kg) was macerated in methanol at room temperature for 24 hours and repeated thrice. The crude extract (700 g) was subjected to liquid–liquid partition using *n*–hexane and ethyl acetate. The crude ethyl acetate (370 g) was fractionated using vacuum liquid chromatography (VLC) to give eight fractions (HL1–8). Fraction HL5 (2.34 g) was subjected to VLC, column (CC) and preparative thin layer (p–TLC) chromatography to give a pure compound **(1)** (5.8 mg). Fraction HL6 (10.6 g) was fractionated using VLC twice followed by purification using CC, high performance liquid chromatography (HPLC) and p–TLC to afford pure compounds **(2)** (26.4 mg), **(3)** (6 mg) and **(4)** (2 mg). Another pure compound **(5)** (6 mg) was obtained from the crude acetone extract of the stem bark through fractionation, isolation, and purification processes. The pure compounds were characterised based on the NMR, UV–Vis and IR analyses as well as comparison with literature data. Three flavonoids known as tomentosanol D (**1**), quercetin (**2**) and kaempferol (**3**) as well as a phenolic acid namely 3,4–dihydroxybenzoic acid (**4**) were purified from the leaves while a coumarin elucidated as scopoletin (**5**) was isolated from the stem bark of *M. hypoleuca*. Compounds **2** – **3** exhibited good activity on DPPH radical scavenging with the percent inhibition values of 93.85% and 93.81%, respectively.

Keywords: Coumarin; Flavanone; Flavonol; *Macaranga hypoleuca;* Radical scavenging

Oral 3.3

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Metabolic Pathway of Rhamnolipid Biosynthesis by a Non–pathogenic *Burkholderia thailandensis* E264: The Metabolomics Approach

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Abstract: Rhamnolipid, is a glycolipid–type biosurfactant. At present, *Pseudomonas aeruginosa* is still the best characterized and most frequently applied organism for rhamnolipid production but their production at industrial scale is limited due to its opportunistic human pathogen status. Studies have indicated that *Burkholderia thailandensis* E264 is the potential candidate for a sustainable production of rhamnolipid because it is considered as non–pathogenic bacteria. Current knowledge on the metabolic pathway for rhamnolipid biosynthesis by *P. aeruginosa* is well studied. However, it is expected that the metabolic pathway of rhamnolipid biosynthesis by *B. thailandensis* is different than that in *P. aeruginosa* due to differences in rhamnolipid congeners distribution and the genomic arrangement of the rhamnolipid genes in both strains. Although there are studies that have been conducted to elucidate the metabolic pathway of rhamnolipid biosynthesis in *B. thailandensis*, the biosynthetic pathways are not fully identified. One possible approach to examine the microbial metabolic pathway is through metabolomics. Numerous reports have shown that metabolomics is a reliable and successful approach for studying the microbial metabolic pathways. Thus, this paper proposes a potential metabolic pathway for the rhamnolipid biosynthesis by *B. thailandensis* that will be identified and proven using the metabolomics approach.

Keywords: Rhamnolipid; Biosurfactant; *Burkholderia thailandensis*; Metabolic pathway; Metabolomics

Oral 4.1

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Potential of Halophilic *Meridianimaribacter* sp. CL38 as a Microplastic Degrading Enzymes Producer from Genomic Perspective

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Abstract: The COVID–19 pandemic has significantly affected every aspect of human life. To deal with the spreading of virus, every country started to implement the mandatory use of face mask as a preventive measure. Thus, the production of face mask has increased dramatically as compared to the era before COVID–19 pandemic. The extensive usage of face mask that made up of microplastic components has generated tons of waste in a short period of time. The microplastic waste which consists of polyethylene, polystyrene, polypropylene, and polyester with cellulose fibres are toxic to the aquatic life when they are released to the marine environment. Therefore, the searching of halophilic bacteria and their enzymes with microplastic degrading ability are in–need. In this study, a previously isolated bacterial strain from mangrove sediment, *Meridianimaribacter* sp. CL38 was examined in terms of its microplastic degrading ability from genomic aspect. Based on the genome mining, a total of 31 annotated genes are possibly participated in the microplastic degradation. Several hydrolases are encoded, for instance, 1 lipase, 4 serine proteases and 6 esterases, and they could potentially modify the surface structure of microplastics to increase the hydrophilicity of the microplastics. While a number of enzymes encoded including 1 amidase, 1 alkane monooxygenase, 7 serine hydrolases, 1 fumarylacetoacetase, and 1 homogentisate 1,2–dioxygenase are possible to act on the certain inner building blocks of microplastics. Furthermore, there are also 9 cellulases encoded in the genome, which are helpful in degrading cellulosic fibers of the face mask. The genome mining provides some insights on the potential of strain CL38 in producing different enzymes to work synergistically to degrade the microplastics in the marine environment.

Keywords: *Meridianimaribacter*; Microplastic degrading enzymes; Halophiles; COVID–19; Face mask pollution

Oral 6.1

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Characterisation of Locally Isolated Bionanocellulose Producing Bacteria

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Abstract: Bionanocellulose (BNC) is a multifunctional nanomaterial produced by mainly bacteria, with diverse potential applications in the medical, pharmaceutical, and food industries. A distinct advantange of BNC as compared to nanocellulose derived from plants is that its easily extracted from solution since there are no other contaminating plant materials such as lignin, pectin, or hemicellulose, making it a better alternative compared to plant nanocellulose. In our pioneering work in search of potential BNC producing bactera, wastes and wastewater such as rotten fruit wastes, pineapple and tapioca industry wastewater were used to harness bacteria for BNC production. Initial characterization of BNC involved morphological, chemical, and thermal properties of BNC produced. The BNC was characterized using several physicochemical characterizations that included Fourier transformed–infrared spectroscopy (FTIR), Scanning electron microscope (SEM), X–ray diffractometry (XRD) and Thermogravimetric analysis (TGA). The results had shown that BNC exhibited high crystallinity (more than 80%), thermally stable and produced thin, fine fibril structure of nanocellulose (30–50 nm). These studies had shown that locally isolated bacteria have good potential applications for the production of the BNC.

Keywords: Bionanocellulose; *Glucanoactbacter* sp.; *Asaia* sp.; Field–emission scanning electron microscope (; Thermogravimetric analysis; Fourier transformed–infrared spectroscopy

Young Researcher 1.1

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Investigation of Flavonoids from *Bouea macrophylla* Griff

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Abstract: *Bouea macrophylla* Griff., a species belongs to Anacardiaceae family is a flowering plant native to Southeast Asia and also known as kundang, kundang daun besar and setar in Malaysia. The fruit can be eaten raw or as pickle, while the young leaves can be consumed as salads. It has been claimed to be able to accelerate wound healing, prevent cancer, reduce the risk of stroke and good for blood circulation. Present study was designed to isolate and elucidate bioactive compounds from this plant. The twig extract of kundang was purified by using several chromatographic techniques including Vacuum Liquid Chromatography (VLC), Column Chromatography (CC), preparative–Thin Layer Chromatography (p–TLC) and High–Performance Liquid Chromatography (HPLC). The structures of isolated compounds were characterized by using spectroscopic method including Nuclear Magnetic Resonance (NMR), infrared (IR) and ultraviolet (UV) spectral data as well as comparison with literature. Four flavonoids were obtained from the twigs of *B. macrophylla* which includes one flavonol which is resokaempferol; one flavanol characterized as catechin; and two flavandiol known as mollisacacidin and guibourtacacidin. This is the first report describing elucidation of the stated compounds from *B. macrophylla*.

Keywords: *Bouea macrophylla;* flavonoid; NMR

Young Researcher 1.2

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Development of Functional Beverages from Blends of *Ficus deltoidea* Leaves and Brown Rice Powder

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Abstract: Functional foods and beverages offer a promising opportunity to improve public health. *Ficus deltoidea* (Ficus: Moraceae) has great potential as a functional food. Administration of this herb has been reported to reduce hyperglycemia and increase insulin secretion in diabetic rats by reducing oxidative tissue damage. However, the potential benefits of adding *F. deltoidea* to food or beverage products remain to be investigated. This study primarily aimed to develop a new beverage formulation with the addition of *F. deltoidea* and examine the phytochemical and physicochemical profile, antioxidant properties, consumer acceptance, and the safety of the formulation. The new beverage formulations were prepared by mixing the *F. deltoidea* leaves powder with a commercial brown rice beverage product in two different ratios (2.5:32.5 and 5.0:30 g). The formulated beverages were subjected to phytochemical and physicochemical analyses. The antioxidant properties of the formulated beverage were measured using FRAP and DPPH assays. Consumer acceptance on the appearance, color, aroma, taste, aftertaste and overall acceptability was assessed using 9–point hedonic scale. The acute toxicity study was conducted for 14 days to determine the safety of *F. deltoidea*–added formulations. The results showed that adding *F. deltoidea* to a brown rice beverage decreased the pH but increased the moisture content, ash, and viscosity. In general, samples with higher ratio of *F. deltoidea* leaves were lighter, greener and yellower. The significantly increment of total phenolics, flavonoids, and tannins content in *F. deltoidea*– added formulations, indirectly contributing to a significant increase in antioxidant activity. The sensory evaluations showed that the new formulation beverages were accepted by the consumer with the mean scores value of each parameter were higher than 5.0. The oral LD_{50} of *F. deltoidea*–added formulation was higher than 2000 mg/kg body weight. In conclusion, these results suggest that adding *F. deltoidea* leaves to brown rice was not only safe to consume but also improves the phytochemical and physicochemical profile, antioxidant activities, and consumer's acceptance of the formulation.

Keywords: Functional beverages; *Ficus deltoidea*; Sensory evaluation; Antioxidants; Nine–point hedonic scale

Young Researcher 1.3

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Effect of Concentration of *Nicotiana Tabacum* Extract on Protein Content and Growth of Soybean (*Glyncine max* L.) Grobogan, Devon, and Wilis Varieties

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Abstract: Soybeans are one of the agricultural commodities that are needed in Indonesia, because soybeans are a source of vegetable protein that has high nutritional value. Soybeans can also be used as a source of animal feed in the form of soybean straw which contains good nutrition for livestock. The increasing demand for soybeans in Indonesia is not accompanied by an increase in soybean production, so imports from other countries are still needed. Giving tobacco extract as organic fertilizer is an alternative to this problem. This study aims to determine the effect of tobacco extract on the yield and protein content of soybeans. The research was conducted in the village of Kutamandiri, Kec. Tanjung Sari, Kab. Sumedang in April–July 2019. The design used was a Randomized Block Design (RAK) split plot design, 2 factors, namely tobacco extract (1 ml/L, 2 ml/L, and 3 ml/L) and plant varieties (Grobogan, Devon , and Wilis) with 1 control, 3 treatments, and 3 repetitions. Data analysis used the Analysis of Variance (Anova) followed by a follow–up test of LSD (Least Significance Different) at a significance level of 95%. Parameters observed were number of pods, wet and dry weight (tops, roots, and nodules) and protein content. The result of the interaction between concentration and variety only had a significant effect on the crown weight of 66 DAP. Varieties only had a significant effect on the number of pods. Meanwhile, the other parameters did not have a significant effect on the concentration factor, variety, and the interaction of the two.

Keywords: Soybean; Tobacco extract; Yield; Protein content

Young Researcher 1.4

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Optimisation of Soft Cheese Production Conditions using Papain as Plant–based Enzyme by Response Surface Methodology (RSM)

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Abstract: When the demand for cheese products increases, rennet enzyme supplied for cheese production is reduced due to the limited availability of ruminant stomach. Therefore, plant–based enzymes are one of the alternatives for animal–based enzyme substitution. Papain enzyme is chosen due to its capability of coagulating milk as it is a proteolytic enzyme. The aim of this study was to optimize the yield and viscosity of soft cheese using response surface methodology (RSM). The physicochemical and textural properties of soft cheese produced from papain were determined also. Experimental design was generated using RSM by MINITAB software version 19 with three selected variables including papain concentration (0.2–1 g), incubation time (1–5 h) and incubation temperature (30–50°C). The optimum condition for yield and viscosity were achieved at papain concentration of 0.26 g, incubation time of 1.30 h and incubation temperature set at 34.82°C with the predicted yield and viscosity of 11.78 % and 4.77 Pa.s, respectively. The optimum condition was verified with the experimental value of yield and viscosity at 12.60% and 4.67 Pa.s respectively with no significant differences at $p > 0.05$, indicating that the model optimization prediction using RSM was achieved. Characterization of soft cheese produced using papain enzyme at optimal condition was determined and compared with commercial soft cheese. There was significant difference ($p < 0.05$) between these cheeses in term of its physicochemical characteristics.

Keywords: Papain; Soft cheese; Physicochemical; Response surface methodology

Young Researcher 1.5

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A Preliminary Study on the Efficacy of Spinetoram against Melon Thrips, Thrips palmi, in Malaysia

A Preliminary Study on The Efficacy of Spinetoram Against Melon Thrips, *Thrips palmi*, in Malaysia

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Abstract: *Thrips palmi* Karny is one of the major pests for eggplants, chilli and bell pepper in Cameron Highlands, Malaysia. Most of the farmers depend on chemical insecticides to suppress the population of *T. palmi*. However, chemical control is typically not recommended in the control of *T. palmi* due to the nature of this species which will easily develop resistance against a wide range of insecticides. Through a survey among Solanaceae growers in Cameron Highlands, spinetoram was found to be the most popular insecticide used to control *T. palmi* population. Leaf–dipped bioassay was carried out and the mortality results obtained were used to determine the lethal dosages at 50% mortality (LD_{50}) using Probit Analysis in the Statistical Analysis System (SAS). The resistance ratio (RR) of the *T. palmi* populations against spinetoram was found to be 1.69. This indicates low resistance among *T. palmi* population against this insecticide. However, the RR value of more than 1.5 can signify a decrease in the effectiveness of spinetoram in suppressing *T. palmi* population. Therefore, it is suggested to continue monitoring the RR for *T. palmi* in the area. In addition, the RR of *T. palmi* from other vegetable growing regions in Malaysia should be investigated for a better understanding of the status of insecticide resistance for this pest in Malaysia. In conclusion, the feasibility of alternative strategies, such as integrated pest management, should be studied to manage the *T. palmi* populations more sustainably in order to avoid insecticide resistance.

Keywords: Cameron Highlands; Insecticide resistance; Solanaceae; Thrips palmi; Vegetable thrips pest management

Young Researcher 1.6

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Phenolic Contents and Antioxidant Activities of Miang Extracts Fermented *via* Filamentous and Non–filamentous Fungi–based Processes

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Abstract: The impact of fermentation process on the phenolic contents, antioxidant and anti–inflammatory activities of Miang extracts', an ethnic fermented tea product of Northern Thailand; was investigated in this study. The 80% acetone extracts of Miang fermented via non–filamentous fungi–based process (NFP) and filamentous fungi–based process (FFP) showed increased levels of total polyphenols, total tannins and condensed tannins compared to young and mature tea leaves. In addition, a better IC_{50} values was observed for fermented leaves in both DPPH and ABTS radical scavenging activity assays as well as improved ferric reducing antioxidant power (FRAP) when compared to young and mature tea leaves. At concentrations of 50 and 100 ppm, NFP and FFP–extracts showed better protective effects against hydrogen peroxide (H_2O_2)–induced intracellular reactive oxygen species (ROS) production in HT–29 colorectal cells with no cytotoxicity exerted. Additionally, lipopolysaccharide (LPS)–induced production of nitric oxide was also inhibited by extracts of NFP and FFP with an IC_{50} thus 17.15 µg/mL (NFP), 20.17 µg/mL (FFP), 33.96 µg/mL (young tea leaves) and 31.33 µg/mL (mature tea leaves). Hence, both NFP–Miang and FFP–Miang could be potentially targeted as natural bioactive functional ingredients with preventive properties against free radicals and inflammatory–mediated diseases.

Keywords: Miang extracts; Phenolic contents; Antioxidant; Fermented tea

Young Researcher 1.7

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Physiochemical and Microbiological Changes of *Nypa fruticans* Sap Collected in Sarawak, Malaysia

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Abstract: Nipa sap is a sweet and translucent beverage originated from nipa palm (*Nypa fruticans)* tree. In Sarawak, fresh nipa sap usually consumed as beverages whereas the fermented nipa sap consumed as alcoholic drink and vinegar. This study aimed to establish the physicochemical and microbiological changes of nipa palm sap from fresh to fermented. The nipa sap was collected and allowed to undergo natural fermentation at room temperature for 56 days. Samples were collected every 24 h for the first week and once a week on the subsequent week. The selected physiochemical qualities were analysed using high performance light chromatography (HPLC) while the microbial content was analysed using spread plating. In general, fresh nipa sap has the highest load of sugar (334.2 ± 12 g/L) with sucrose as the main sugar present (231.5 ± 4.3 g/L), followed by fructose (42.1 ± 1.2g/L) and glucose (29.7 ± 3.2 g/L). Fresh nipa sap contains the lowest load of ethanol (0.08±0.03 g/L), lactic acid (1.09 ± 0.06 g/L), acetic acid (0.05 ± 0.01 g/L) as well as microbial and yeast concentration. Once the nipa sap fermented, the ethanol started to accumulate on day 4 (9.80 ± 0.1 g/L) onwards and the highest peak was detected on day 21 (19.1 ± 2.01 g/L). The acetic acid slowly increased concurrently with the ethanol, which confirmed the ethanol biochemical reaction took place. The pH values of the sap dropped from 5.21 ± 0.3 to 3.14 ± 0.1 due to the production of organic acids. The concentration of yeasts and bacteria changed as well, affecting the quality of nipa sap. Since nipa sap plays an important role among local people in Sarawak, this study provides better understanding of the microbiology and biochemistry of its fermentation process. Hence proper planning of handling fresh nipa sap should be considered to ensure the quality of value–added products production.

Keyword: Fermentation; High performance light chromatography (HPLC); Nipa sap; *Nypa fruticans*

Young Researcher 1.8

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Reduction of The Acidity and Peroxide Numbers of Tengkawang Butter (*Shorea stenoptera*) Using Thermal and Acid Activated Bentonites

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Abstract: Tengkawang fat (*Shorea stenoptera*), from an indigenous plant of the Kalimantan forest, has excellent potential as an alternative source of vegetable fat because it has a high level of fatty acids composition. Activated natural bentonite can be used as a bleaching agent to improve the quality of tengkawang fat. This research aims to reduce the acidity, peroxide number values and identify the physicochemical properties (fatty acid composition, nutrients, and thermal) of tengkawang butter. Initially, tengkawang samples from Nanga Yen and Sintang were pre–treated using the degumming process with 1% phosphoric acid and the neutralization process with a 1 M NaOH 10% w/w solution. The results show that the acidity (mg NaOH/g) of the tengkawang fat samples was reduced from 11.00 to 3.36 when using bentonite activated at 200 ^{o}C. The bentonite activated with 0.5 M HCl reduced the acidity to 3.61. The peroxide number (meq O_2/kg) of the tengkawang fat samples was reduced from 9.45 to 4.84 and 3.47 by bleaching with thermal–activated and acid–activated bentonites, respectively. Peroxide value correlates with β–carotene content. The smaller of the β–carotene content, the smaller the peroxide value. The acidity, peroxide number, and iodine number values from tengkawang fat after treatment adhere to the SNI 2903: 2016 standard. The main content of fatty acids in tengkawang fat is palmitic acid, stearic acid, and oleic acid. These results show that both products are suitable for the food industry in terms of the acid and peroxide numbers. The application of this study may assist local people to increase the economic value of the product from tengkawang plant, which is an indigenous plant from Kalimantan.

Keywords: Acidity; Bleaching; Fatty acid; Peroxide number; Tengkawang butter

Young Researcher 1.9

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Impact of Irradiation on The Bone Morphometry of Femur in an Osteoporosis Induced Mouse Model

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Abstract: Although deterioration of bone architecture post theraphy is known, an immediate effect of radiation on osteoporosis bone at dosage of clinical applicaions, is not fully discovered. Hence, the aim of the study was to investigate the influence of irradiation on bone morphometry using micro– focused computed tomography (μCT). Induced–osteoporosis BALB/c mice model (n = 6, 38 weeks) were irradiated using the Cs–137 chloride source at 30 Gy. After seven days, the mice were euthanised and the femurs were dissected. The distal femurs were imaged with μCT Skyscan 1172 (Bruker μCT, Kontich, Belgium); voxel size 8 μm, 20.5 min scan and analysed using CT–analyser (CTAn) for bone quantification. μCT analysis showed that compared with control littermates (n=6), irradiated mice had a reduced trabecular bone mass (BV/TV: 41.65%, p = 0.24, n = 6), trabecular number (Tb. N: 30.56% (p = 0.39), trabecular thickness (Tb.Th: 21%, p = 0.05) and increased bone porosity by 50.95% (Tb.Sp., p = 0.39). The same trend can be found for cortical bone at the diaphysis region. There were reduction in Tt.Ar by 1.75% (p = 0.904), Ct.Ar by 4% (p = 0.904) and increased in Ct.Th by 10.56 (p = 0.027). Here, we report that irradiation mice developed reduced bone mass and microarchitecture. These changes might relate to altered systemic metabolism, where increased osteocytes might be found in these irradiation mice. This leads to increased bone resorption and reduced bone formation. Our findings suggest that irradiation at 30 Gy does severely alter microarchitecture in osteoporosis bone. These findings suggest that a therapy is needed to ameliorate the deleterious effects on the bone caused by the irradiation. This may inhibite osteocytes and improve bone formation and thus, improve cancer treatment strategies in osteoporosis patients.

Keywords: Micro–computed tomography (μCT); Irradiation; Bone morphometry; Osteoporosis; Bone effects

Young Researcher 1.10

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Gelatin-PVA Bioinks for Chronic Wound Healing by Using 3D-Bioprinting

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Abstract: The 3D *in vitro* model is an alternative approach to skin safety testing for pharmaceutical and cosmeceutical applications. Prolongation and stability are key successes of 3D model development from natural–based materials. Thus, the combination of gelatin and polyvinyl alcohol (PVA) as a natural and synthetic polymer, respectively, could provide a better improvement of physicochemical, mechanical strength and excellent biocompatibility. This study aimed to develop and characterise in–house hybrid gelatin–PVA (G–PVA) bioinks of the printed hybrid G–PVA hydrogels crosslinked with natural crosslinker–genipin (GNP). Gelatin with different concentrations of PVA (3% and 5%) was fabricated with 0.1% genipin by using the conventional 3D–bioprinting approach, respectively. The physicochemical analysis tests including swelling ratio, biodegradation, wettability, water vapour transmission rate and crosslinking degree were evaluated. The mechanical strength via compression and resilience was also performed to explore its ability to withstand pressure. The cell biocompatibility towards the G–PVA has been analysed by using live/dead assay. The G–PVA hydrogels crosslinked with GNP demonstrated excellent physicochemical properties compared to non–crosslinked hydrogels. The crosslinked hydrogels significantly demonstrated the acceptable swelling ratio (> 500%), biodegradation rate (< 0.03 mg/h), hydrophilicity (< 90º) and water vapour transmission rate (> 1500 $g/m^2\ h^{-1}$). Besides, the crosslinked gelatin hydrogels also significantly indicated the improvement of mechanical strength (> 70%) after a combination with 3% and 5% PVA compared to non–crosslinked hydrogels. In addition, G– PVA bioinks influenced the cell biocompatibility, which successfully indicated > 80% of cell viability. Hybrid G–PVA hydrogels crosslinked with GNP was proven to have excellent properties and excellent biocompatibility required as a potential bioinks for in vitro 3D–skin model.

Keywords: 3D–bioprinting; Skin; Wound healing; Natural–based bioinks; Synthetic–based bioinks

Young Researcher 1.11

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A Comparative Study of Nipa Palm Sugar a.k.a. *Gula Apong* in Selected Area of Sarawak

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Abstract: In Sarawak, the indigenous people usually process the nipa sap into syrup and a block of brown sugar known as *gula apong* which is useful for food seasoning and making traditional cuisine. The objectives of this study were to study the physico–chemical and antioxidant properties of nipa sugar from different places in Sarawak. The conversion into sugar was performed by first sieving and boiling the nipa sap. Characterization of fresh nipa sugar was quantified by High Performance Light Chromatography (HPLC). Our research showed that the content of sucrose, glucose, moisture, acetic acid, and lactic acid of nipa sugar from Kuching, Kota Samarahan, Saratok and Pusa were significantly different (p value < 0.05). On the other hand, our study revealed that the pH of nipa sugar was not significantly different. (p value > 0.05). In general, our data showed that nipa sugar from Kota Samarahan exhibited the best quality of sucrose, glucose and lactic acid among all nipa sugar. They have the highest content of sucrose (90.7 g/L), glucose (37.69 g/L) and lactic acid (7.68 g/L) while the moisture content (11.9%) and acetic acid (0.04 g/L) content were remained low with zero content of ethanol. In term of antioxidant properties, nipa sugar from Kuching showed higher total phenolic content (0.54 mg/mL) and flavonoid content (0.23 mg/mL) than other nipa sugar samples. Overall, it can be concluded that nipa palm sugar in Sarawak offers potential sweetener source to be used in food production with the presence of antioxidant composition.

Keywords: *Nypa fruticans*; Sucrose; Phenolic content; Flavonoid content; Ethanol

Young Researcher 2.1

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Preliminary Evaluation on *in vitro* and *in silico* Study of *Andrographis paniculata* on Fatty Acid Synthase Expression in Breast Cancer

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Abstract: Fatty acid synthase (FASN) which is a crucial enzyme in fatty acid synthesis has been reported to be upregulated in breast cancer. Hence, FASN has emerged as a promising therapeutic target in cancer treatment. Available FASN inhibitors are unstable and have been associated with adverse side effects. Therefore, this present study aims to investigate the potential of *Andrographis paniculata* ethanolic extract as an effective FASN inhibitor in breast cancer cells. In this study, breast cancer cell lines; EMT6 and MDA–MB–231 and normal cell lines; HSF1184 and HaCaT were treated with different concentrations of *A. paniculata* extract. The cells were then subjected for MTT cytotoxicity assay and Annexin V–FITC apoptosis assay. In another experiment, the extract was investigated for their effects on FASN expression in EMT6 cells using flow cytometric (FACS) and immunofluorescence (IF) analyses. On the other hand, literature–based identified *A. paniculata* bioactive compounds were subjected to molecular docking studies and ADMET properties prediction using Auto Dock Tools 1.5.6 software and SwissADME web tool. The docking analysis of these compounds was compared with standard inhibitor namely orlistat. Results from this study demonstrated that treatment with *A. paniculata* extract significantly reduced cancer cell viability. Furthermore, the extract has shown to promote apoptosis among EMT6 cells population. In addition, FACS and IF analyses indicated that the plant extract drastically reduced FASN expression in EMT6 cells. Moreover, docking studies showed that compounds from *A. paniculata* gave better binding interactions to the binding site of Thioesterase domain with lower free binding energy values and estimated inhibition constant compared to orlistat. All four bioactive compounds also possessed drug–likeness properties which are in accordance with the Lipinski's rule of five. Results from this study provide evidence on the potential role of *A. paniculata* on lipid metabolism in cancer; however, more detailed studies should be conducted to evaluate their effectiveness.

Keywords: Andrographis paniculata; Fatty acid synthase; Molecular docking; Thioesterase; Apoptosis

Young Researcher 2.2

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Antibacterial and Antibiofilm Activity of *Coriandrum sativum* Essential Oil Against *Streptococcus mutans* and *Staphylococcus aureus*

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Abstract: To date, chlorhexidine is recognised as gold standard in treating dental problems due to its effectiveness in reducing plaque formation and treating gingivitis. However, chlorhexidine tends to cause adverse effects such as burning and disturbance in taste sensation, irritation on oral mucosa and tooth staining. In recent years, the research interest in natural compounds is escalated to explore their potential to be an alternative for chlorhexidine in oral care products. This study aims to evaluate the antibacterial activity of essential oil extract from leaf part of *Coriandrum sativum* against two selected oral pathogens, namely *Streptococcus mutans and Staphylococcus aureus.* Specifically, Minimum inhibitory concentration (MIC) assay was performed to determine the MIC value, followed by biofilm retention assay and Scanning Electron Microscopy (SEM) imaging study to evaluate the effect of essential oil against oral bacteria selected. Therefore, this study will examine the potential effect of *Coriandrum sativum* essential oil to be an alternative agent that may be useful for the treatment of dental diseases.

Keywords: Essential oil; Antibacterial; Biofilm retention; Scanning Electron Microscopy; Oral Bacteria

Young Researcher 2.3

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Oryzias latipes (Japanese Medaka) as Genetic Model to Study Causative Genes of Epilepsy Disease

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Abstract: Epilepsy is a chronic central nervous system (neurological) disorder that causes abnormal brain activity, recurrent seizures, odd behaviors, and it has affected around 50–70 million people worldwide. The cause remains unclear for about 50% of cases globally. Due to the ethical reason, various animal models have been used in the epilepsy research. To expand the knowledge on the disease, new animal model is suggested to be explored considering the genetic and phenotypic heterogeneity that suggests the complexity of the disease. This present study was undertaken to analyze 14 causative genes of epilepsy disease on *Oryzias latipes* (Japanese medaka), human, as well as the established model of this disease which is *Danio rerio* (zebrafish) by assessing the variation of the genes, predict the motif and secondary structure of the protein. Nucleotide and protein sequence of 14 genes of the 3 species were retrieved from National Centre of Biotechnology Information (NCBI). Pairwise comparison was done using MEGA X and the conserved and variable regions were identified in Sequence Data Explorer. The prediction of motifs and secondary structure were conducted using PROSITE and GORIV respectively. Results obtained from the variation analysis showed there was no conserved percentage that was less than 60% and 50% of the genes of Japanese medaka were found to be more conserved than zebrafish. The motifs present in the genes in Japanese medaka showed the same motifs present in the human and all the genes secondary structure of Japanese medaka contained the alpha helix, extended strand, and random coil. According to the results obtained, it can be inferred that Japanese medaka could be a reliable animal model of the epilepsy disease as the genes observed were found to be conserved and have functional similarity with human.

Keywords: Epilepsy; Animal model; Japanese medaka; Zebrafish

Young Researcher 2.4

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DNA Barcoding of Nuclear Ribosomal ITS1, ITS2 and *rbcL* and Phylogenetic Analysis for *Nepenthes* Originated from Endau–Rompin National Park, Johor

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Abstract: Nepenthecea, a largest carnivorous family in the order of Caryophyllales comprising the genus of *Nepenthes* with distinctive features of modified leaf pitfalls trap. Even though most of the *Nepenthes* species have unique morphology, their vegetative stages are similar and identification by morphology was challenging. In this study, *Nepenthes* spp have been collected for DNA barcode work from National Park Endau–Rompin. Genomic DNA of the selected species was extracted, amplified using specific primers and subsequently sequenced through Sanger sequencing. An analysis of barcodes was conducted using BLASTn, pairwise genetic distance and diversity. The present study showed successful DNA barcode amplification for *rbcL*, ITS2 and ITS1 fragments at different sizes. Outcomes of the analysis showed that ITS1 amplified sequences have the average lower AT nucleotides content (32.7%) but higher in GC contents (67.3%) when compared to AT (34.8%) and GC (65.2%) of ITS2 amplified sequences. While, *rbcL* DNA barcodes was shown to have 54.5% AT and 45.5% GC. The mean genetic distance K2P between was higher in ITS1 DNA barcode (0.269) when compared to both ITS2 (0.059) and *rbcL* (0.047). The phylogenetic analysis based on *rbcL* DNA barcodes could not effectively differentiate between *Nepenthes* species as ITS2 can only distinguish *N. ampullaria*. In this study, our finding showed that ITS1 was the best discrimination power between species than the other two DNA markers. This study represented the potential of DNA barcodes for efficient and reproducible identification of *Nepenthes* species.

Keywords: *Nepenthes*; *DNA* Barcoding; ITS1; *ITS2*; *rbcL*

Young Researcher 2.5

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Study on Antimicrobial Peptides from *Punica granatum* Peel Extract: Characterization and Gene Expression

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Abstract: Antibiotic resistance leads to higher medical costs, prolonged hospital stays, and increased mortality. Having appropriate medical device is a significant consideration in some cases as it would optimize the quality of patient care, improving care outcomes, and long–term cost containment. Antimicrobial agent could be greatest alternative to improvise the material construction of medical devices that able to increase the resistance ability towards bacterial infection. With the emergence of antibiotic resistance, researchers have recently focused on antimicrobial peptides as potential drug candidates and development of antimicrobial film for material constructions. Antimicrobial peptides (AMPs) are important endogenous antibacterial molecules that contribute to broad activity to directly kill bacteria, yeasts, fungi, viruses and even cancer cells. This study focusing on discovering of AMPs from *Punica granatum* peel extract and expression of respective AMPs by molecular approach. Ethanol (80%) shows the best extraction solvent in extracting AMPs as illustrated by disc diffusion assay with appearance around 30 mm of inhibition zone. Based on the result obtained, the peptides had shown a good resistance towards Gram–positive bacteria as well as fungi. The characterization of AMPs was further verified by sodium dodecyl sulphate–polyacrylamide gel electrophoresis (SDS–PAGE) and zymography assay. Then, the sequence of recombinant DNA technology process was performed until recombinant AMPs was successfully expressed in *Escherichia coli* DH5a cell. The present of inhibition zone by disc diffusion assay shows the remarkable result from the expression of recombinant AMPs.The information gathered will be helpful in the search for novel AMPs distributed in the plant kingdom, as well as providing future directions for the further developing potential new technique recombinant AMPs expression by molecular approach.

Keywords: Antimicrobial peptides; *Punica granatum* peel; Extraction; Characterization; Expression

Young Researcher 2.6

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Lignocellulose Biomass Degrading Potential of Genus Glutamicibacter, Deciphering Its Ability from Genomic Aspect

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Abstract: The genus Glutamicibacter is one of the genera reclassified from the genus Arthrobacter in year 2016. Although the members of genus Glutamicibacter were identified from various locations previously, little is known about their potential applications in the industries. In this study, a bacterial strain CP92 was isolated from oil palm compost and found to have the ability to produce beta–glucosidase and lignin peroxidase. This result was further supported by quantitative assay with the crude enzyme activities of 0.61 U/mL per min (β–glucosidase activity) and 0.33 U/mL per min (lignin peroxidase activity). After 16S rRNA sequencing analysis, the strain was identified as a member of genus Glutamicibacter, with closest similarity to *Glutamicibacter mishrai* S5–52. In order to identify the genes that are related to lignocellulose degradation, genome sequence of *Glutamicibacter mishrai* S5–52 was analyzed. Based on the genome annotation, a total of 44 genes were identified as carbohydrate active enzymes (CAZymes). Particularly, these genes consisting of 5 auxiliary activities (AA) domains, 27 carbohydrate binding modules (CBM), 6 carbohydrate esterase (CE) domains, 45 glycoside hydrolase (GH) domains and 33 glycoside transferase (GT) domains. Among them, 3 genes contain GH3 and 1 gene contains AA2 were identified to encode for beta–glucosidase and lignin peroxidase, respectively. Besides, a more detailed analysis via InterProScan v86.0 revealed that fibronectin type 3 (FN3) domains were commonly found in the gene sequences of GH families, which could indicate their roles in promoting enzyme activities and stabilities in the hydrolysis of lignocellulosic substrates. The preliminary genome–based analysis could facilitate the exploration of this genus for its applications in the industry such as lignocellulosic wastes degradation and bio–ethanol production.

Keywords: Glutamicibacter: Lignocellulolytic bacteria; Genome analysis; Carbohydrate active enzymes; Lignocellulosic biomass degradation

Young Researcher 2.7

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Fundamentals on The Bacterial Biomarker Genes as Bioindicators of Palm Oil Mill Effluent Pollution

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Abstract: The palm oil sector is one of Malaysia's major industrial players. However, this industry has always been linked to water pollution issue due to the massive amounts of wastewater generated, known as palm oil mill effluent (POME). Most palm oil mills discharge the treated and partially treated POME into the nearby river as a common practice, leading to unfavourable impacts on the river water ecosystem. To date, the POME monitoring system in river water has been ineffective due to lack of accurate and specific water pollution indicators. Hence, the development of a specific POME contamination bioindicator utilising bacterial genes is proposed in tandem with the promotion of a sustainable palm oil industrial practice. However, more knowledge is needed to understand the functional mechanisms of bacterial communities in the receiving river water. Hence, physicochemical analyses complemented with the application of metatranscriptomics are used to provide a comprehensive overview of the effect of POME on the bacterial communities in the receiving river water. The bacterial community transcriptional patterns are unravelled using Ribodepleted Shotgun RNA Sequencing, followed by the expression of selected upregulated genes involved in POME biodegradation. The preliminary data shows that the introduction of POME into the river water has caused significant changes in natural physicochemical properties in the downstream part of the river. The overview of the assembled transcriptome also shows samples similarity between POME and receiving downstream river, indicating that the discharge of POME influenced the expression profiles of the receiving river. The findings of this study will be used to discover the key genes that govern POME biodegradation and potential biomarkers for better monitoring of POME pollution in river water. This study is crucial to help us comprehend the influence of POME discharge on the river water, which will ultimately improve the sustainability of the palm oil industry.

Keywords: Biomarkers; Environmental biomonitoring; Metatranscriptomics; POME; River water pollution

Young Researcher 2.8

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Antimicrobial Activity of Green Biosynthesis Iron Oxide Nanoparticles Mediated *S. crispus* Leaves Aqueous Extract

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Abstract: Nanoparticles that range from 1–100 nm can be synthesized through chemical, physical and biological processes. Nanoparticles that were synthesized through physical and chemical methods are generally high in cost, require difficult process, and not eco–friendly. Hence, these problems can be overcome through green biosynthesis method using plants sources to synthesize nanoparticles. *Strobilanthes crispus* is plant species from the family of Acanthaceae, known as 'pecah kaca' or 'jin batu' among Malaysian. *S. crispus* is bush–like plants that are claimed to have anti–diabetic, diuretic, laxative, antimicrobial and wound healing properties which are usually used as traditional medicine. The study aimed to investigate the antimicrobial activity of iron oxide nanoparticles mediated *S. crispus* (IONP–SC) leaves aqueous extract against tested human pathogens namely *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cereus*, *Salmonella typhi*, *Candida albicans* and *Aspergillus niger*. The antimicrobial properties of IONP–SC at four different concentrations (0.05 M, 0.1 M, 0.2 M and 0.3 M) was measured through the disc diffusion test. The largest mean diameter zone of inhibition exhibited is at concentration of 0.2 M (11.50 ± 0.288 mm) and 0.3 M (9.00 ± 0.577 mm) against *S. aureus*. Then, the properties and structural of IONP–SC was investigated through UV–Vis, SEM, XRD and FTIR method. Thus, based on XRD analysis showed that IONP–SC at concentration of 0.2 M and 0.3 M is orthorhombic and cubic shaped with chemical formula Fe_3O_4. Through SEM method it was found that 0.2 M and 0.3 M IONP–SC has crystal shape. Also, FTIR method showed transmittance band between 410 to 683 cm^{-1} that indicate the presence of metal–oxygen bond. In addition, absorption peak was observed between 280–400 nm that showed the presence of IONP–SC through UV–Vis method. Hence, these data concluded that IONP–SC have antimicrobial properties against tested human pathogens to act as new antimicrobial agent in pharmaceutical industry.

Keywords: *Strobilanthes crispus*; Antimicrobial activity; Nanoparticles; Disc diffusion test; Iron oxide nanoparticles characterization

Young Researcher 2.9

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Draft Genome Sequence Revealed Genes Related to Phenol Degradation in *Kosakonia oryzae* Strain S10

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Abstract: *Kosakonia oryzae* strain S10 was previously isolated from palm oil mill effluent (POME) treatment pond in a palm oil mill in Negeri Sembilan, Malaysia. It has shown a phenol–degrading capability when grown on medium supplemented with phenol as a sole carbon source. However, the genes that are responsible for the biodegradation is unknown. In this study, whole–genome of *K. oryzae* strain S10 was sequenced by using Illumina MiSeq platform to understand the genetic makeup of this strain and to screen for the genes that are involved in phenol degradation. The raw data was assembled using a *de novo* assembler, St. Petersburg Genome Assembler (SPAdes) and aligned to other closely related *K. oryzae* strains for scaffolding. Then, the assembled genome was annotated by using Prokka Genome Annotation. Bioinformatics analysis of the whole–genome sequencing data revealed that this strain has a total of 5,447,498 nucleotides with a genome size of 5.45 Mbp, 54.11% GC content, 5,145 coding–sequences (CDS), 12 rRNA genes and 82 tRNA genes. Kyoto Encyclopaedia of Genes and Genomes (KEGG) analysis shows that several genes that are related in phenol–degradation pathway were identified in *K. oryzae* strain S10. 4–hydroxybenzoate decarboxylase that responsible in converting phenol to 4–hydroxybenzoate was found in this strain. Complete pathway of conversion of 4–hydroxybenzoate to ubiquinol–n via ubiquinone biosynthesis pathway was present in *K. oryzae* strain S10. However, the key genes responsible for the degradation of phenol via ortho or meta cleavage pathway in phenol biodegradation was not found, suggesting that phenol degradation in *K. oryzae* strain S10 did not proceed through the formation of catechol. The result demonstrates that *K. oryzae* strain S10 is able to metabolise phenol and could serve as a valuable microbe for phenol biodegradation and bioremediation.

Keywords: *Kosakonia*; Phenol; Whole–genome; Bioinformatics; Biodegradation

Young Researcher 2.10

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Synthesis of Silver Nanoparticles Using Ethanolic Shoot Extract of *in vitro Persicaria odorata* and Its Antioxidant Activity

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Abstract: *Orthosiphon stamineus* (*O. stamineus*) or locally known as 'misai kucing' exhibits antioxidant activities. However, antioxidant activities of *O. stamineus* grown *in vitro* are not yet investigated. In addition, the effect of plant growth regulators on shoot biomass and antioxidant activity of *O. stamineus* is still yet to be explored. Therefore, a present study was conducted to evaluate the effect of plant growth regulators (PGRs) on shoot regeneration frequency, shoot biomass and antioxidant activity of *O. stamineus*. Nodal explants (1 cm) were treated with PGRs in the range of 1–4 mg/L 6–Benzylaminopurine (BAP) and incubated for 6 weeks. Antioxidant activities were evaluated by using FRAP and DPPH assays. Remarkable among the treatment, shoot of explants treated with 4 mg L–1 BAP explant has resulted highest number of shoots (15.80 ± 0.76), with highest antioxidant potential for FRAP (7200.00 ± 103.02 µM Fe (II)) and lower EC_{50} (56.65 ± 0.17 µg/mL) for DPPH. In conclusion, PGR did enhance antioxidant activities in in vitro *O. stamineus* shoots.

Keywords: *Orthosiphon stamineus* shoot; Regeneration; Plant growth regulators; FRAP and DPPH

Young Researcher 2.11

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The Effect of Injectable Hybrid Gelastin Hydrogel for Wound Healing: Epigallocatechin Gallate

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Abstract: Immediate treatment for cutaneous injury is a realistic approach to improve the rate of healing and minimize the risk of complications. Functionalized biomaterials have been proven to be a potential strategy to embark the chronic skin wound management e.g diabetic ulcer. This study aimed to evaluate the effectiveness of gelatin–elastin (Gelastin) injectable hydrogel incorporated with epigallocatechin gallate (EG) to promote wound closure and newly–formed skin. Briefly, gelatin hydrogel was pre–mixed homogenously with EG followed by the crosslinking with genipin (GNP). The gross morphology of the fabricated hydrogels were observed, followed by the physicochemical properties via the mechanical profile, swelling ratio, enzymatic biodegradation crosslinking degree, and WVTR. The cellular compatibility was tested using live & dead assay. The crosslinked hybrid biomatrix demonstrated better mechanical strength (compressed <1 5% and resilience 100%), swelling ratio (500 ± 10%), degradation rate (< 0.005 mg/hour) and crosslinking degree (< 70% free amine group) compared to the non–crosslinked hybrid biomatrix. In addition, WVTR demonstrated > 1500 g/m^2 h, an optimal moisture content for cell proliferation and regular function supported by live and dead results with excellent cell viability (> 80% live cells) for EG–incorporated Gelastin (Gelastin–EG) hydrogel. In conclusion, the Gelastin–EG hydrogels provide the optimum characteristics to be used as a provisional skin biotemplate.

Keywords: Wound healing; Chronic skin wound; Epigalocatechin gallate; Injectable hydrogel; Elastin

Young Researcher 3.1

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Production and Optimization of Laccase By *Marasmius cladohpyllus* UMAS MS8 Using Agro–industrial Waste as Substrate

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Abstract: Fungal laccases are preferred due to their high redox potentials and low substrate specificity. For large–scale enzyme applications, low enzyme yield and high cost of production has remained the challenge. Therefore, this research investigates the feasibility of utilizing various types of lignocellulosic agroindustrial waste such as sago “hampas”, rice husk, and empty fruit bunch (EFB) as substrate in the production of laccase enzyme by endophytic fungus, *Marasmius cladohpyllus* UMAS MS8 under both solid–state fermentation (SSF) and submerged fermentation (SmF). The substrate that produces the highest laccase enzyme either under SSF or SMF will be selected for further optimization. The optimization parameters include the incubation period, effect of inducer (Remazol Brilliant Blue R (RBBR) and copper) and supplementation of different nitrogen sources. Among the three agroindustrial wastes tested as substrate, EFB under SmF was found to be the most ideal substrate and fermentation bioprocess to produce laccase enzyme as it gives rise to the highest laccase activity of 0.0919 U/g after 12 days of incubation as compared to other substrates either under SSF or SmF. However, both inducer RBBR and copper had no induction effect on the production of laccase enzyme. While the supplementation of nitrogen source, peptone better yield on laccase enzyme production by EFB after 12 days of incubation. In conclusion, these shows the potential of EFB as a cost–effective substrate for laccase enzyme production, offering an alternative use for this common and abundant agro–industrial by–product.

Keywords: Laccase; Lignocellulosic; Empty fruit bunch; *Marasmius cladophyllus*; Agroindustrial waste

Young Researcher 3.2

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Biochar from Oil Palm Trunk as Bioadsorbent for Polishing and Purification Applications

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Abstract: Oil palm plantation is one of the major plantation industries in Malaysia. The plantation and processing industry contributed to the generation of biomass residues such as, trunk, frond, empty fruit bunch, kernel shell and so on. The biomass produced has the potential to be used as value–added products such as bioadsorbent, composite and biofuel. In this study, the oil palm trunk was used as alternative bioresource for biochar production as bioadsorbent for polishing and purification applications. The trunk consists of three main compartments; peripheral (OPTP), core (OPTC), and bark (OPTB), respectively. For lignocellulosic composition, the OPTB contained the highest lignin content (13.6 wt%) compared to OPTP (9.0 wt%) and OPTC (1.3 wt%), which then affect the yield of biochar. The biochar produced through carbonisation process under absence or limited–oxygen condition reactor at 500ºC for the temperature and 3 hours as residents time, the result showed OPTB and OPTC showed the highest yield of biochar (30.4 wt%), which the OPTB yield correlated to lignin composition, while for OPTC, the result contributed by the high fixed carbon content (19.3 wt%). As one of the important factor for adsorption, the surface area was analyse using Brunauer–Emmett–Teller (BET) analyser, the result observed OPTP biochar had the highest value (3.27 m^2/g) compared to OPTC (3.07 m^2/g) and OPTB biochar (2.69 m^2/g). Then, pH value for produced biochar was determined as the higher value, the better adsorption will be occured. The resulted value showed the OPTC is the highest (9.57), followed by OPTP (9.12) and OPTB (9.01). Then, the carbonised materials undergo adsorption analysis using methylene blue (MB). MB adsorption showed that OPTC removed MB from aqueous solution greater than OPTB and OPTP, which > 50% by using 2 g/L of adsorbent. Thus, as summary, the OPTC biochar which showed better pH value and adsorption ability, though slightly lower surface area compared to OPTP, can be potentially fuctionalize further to be used as bioadsorbent for polishing and purification applications, effectively.

Keywords: Oil palm trunk; Biochar; Bioadsorbent; Purification; Polishing

Young Researcher 3.3

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Biodiesel Production from Grease Trap Waste and Its Purification Using Bioadsorbents Derived from Biomass

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Abstract: Recently, the global energy demand is increasing due to rapid industrialization and population growth. Furthermore, the main energy resources like gas, oil and coal are decreasing from day to day. Biodiesel has attracted extensive research worldwide because it has many advantages such as clean, safe and non–hazardous due to its biodegradability, renewable and carbon neutral fuel. Presently, grease trap waste appears to be a cost–effective feedstock for biodiesel, while woodchips is more suitable as bio–adsorbents for biodiesel production and purification. In this study, production of biodiesel from grease trap waste was achieved by using both esterification and transesterification processes. Prior to esterification, grease trap waste was analysed for its physicochemical properties. After esterification, the FFA content in the esterified oil is 0.61% with 95% of FFA conversion. Under the optimized conditions, 77% of fatty acid methyl ester (FAME) yield was achieved. In addition, the activated carbon produced from wood chips biomass was utilized as bioadsorbents to remove impurities from the crude biodiesel. The purification process was performed using different adsorbent dosing (0.025 to 0.125 g/L) under continuous stirring conditions at 150 rpm for 1 h. Approximately 98.62% of soap content and 67.9% of free fatty acid content were successfully removed after purification at 0.05 g/L of bioadsorbents loading, which met the European Biodiesel Standard (EN14214).

Keywords: Biodiesel; Grease Trap Waste; Yield; Purification; Wood chips biomass

Young Researcher 3.4

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Preliminary Study of Paddy Processing Waste as Potential Feedstock for Glucose Production

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Abstract: In the paddy industry, grains that do not meet the specification to become seed were removed from the milling factory during the cleaning process. The biomass with the distinctive feature of 'empty and partially filled grain' (EPFG) is not fully explored to their potential usage, however, they are commonly being dumped to the landfill. EPFG commonly accounted for about 20% of the annual paddy yield. This waste is due to the lack of awareness and information on technology transfer regarding waste management to the paddy industry. Re–directing utilization of EPFG toward intermediate product such as glucose using biological conversion platform would (a) provide sustainable feedstock for further biofuel/chemical production (b) tackle the environmental problems associated with disposal of EPFG as waste. In this study, EPFG was converted into glucose by using mild hydrothermal pretreatment and enzyme hydrolysis. The EPFG was pretreated using autoclave at 121°C for 60 minutes to allow disruption of lignocellulose and starch structure prior to enzymatic hydrolysis treatment. Enzymatic hydrolysis was performed using glucoamylase and cellulase using shake flask study. An amount of 20 g/L of glucose was achieved using 10 U/g of glucoamylase and 10 FPU/g cellulase for 14% substrate. The glucose produced accounted for 30% of total glucose yield. Increasing the enzyme loading is expected to improve sugar recovery, however, it is crucial to identify the optimum enzyme concentration to reduce excess enzyme dosing. Finally, it can be concluded that EPFG could be a potential source of glucose production provided that further investigation needs to be done to improved glucose yield from the biomass.

Keywords: Paddy mill; Damage grain; Starch; Lignocellulose; Enzyme hydrolysis

Young Researcher 3.5

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Chromium Hexavalent Resistance in *Pseudomonas aeruginosa* RW9 as a Potential Candidate for Bioremediation

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Abstract: Metals are the worst type of pollutants globally due to their non–biodegradability. Among the most hazardous pollutants highlighted by the United States Environmental Protection Agency (USEPA) is the chromium hexavalent (Cr(VI)) due to its toxicity over minimal concentration. Microbial remediation has been recognized as an efficient method to treat the pollutant. The genus *Pseudomonas* is the most studied due to its efficiency which is attributed to the presence of heavy–metal–resistant genes and ability to produce rhamnolipid. However, the efficiency of Pseudomonads was reported to be strain–dependent which relied on the removal mechanisms employed. This study investigated the potential of a locally isolated *Pseudomonas aeruginosa* RW9 for Cr(VI) remediation and its removal mechanisms. Experiments were conducted in growth media supplemented with a range of Cr(VI) concentrations. The result showed the cells were able to resist up to 80 mg/L of Cr(VI). However, cell growth and its removal efficiency were decreased as the Cr(VI) concentration increased. Characterization analysis by using Field Emission Scanning Electron Microscope (FESEM) was conducted to assess the effect of Cr(VI) on the cells. It was observed that the cells elongated at higher Cr(VI) concentrations. Based on Cr(VI) distribution analysis, extracellular sequestration was found to be the main mechanism employed by the cells, followed by surface–bound and intracellular accumulation. The extracellular sequestration might be attributed to the production of metabolites; the extracellular reductase and rhamnolipid. The presence of rhamnolipid was confirmed by Fourier Transform Infrared (FTIR) and anthrone analyses. To elucidate the main metabolite involved in the mechanism, substrates were added to the culture. It was found that the substrates improved removal efficiency and did not contribute to the rhamnolipid production, signifying extracellular reductase as the primary component that assisted the process. The findings obtained showed the potential utilization of this local strain for bioremediation of Cr(VI) contaminated water.

Keywords: Metals; Chromium; Bioremediation; *Pseudomonas*

Young Researcher 3.6

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Microbial Community of Sludge Palm Oil Mill Effluent as Inoculum for Compost Production

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Abstract: Sludge Palm oil mill effluent (POME) is the major liquid waste produced by the oil palm industry in Malaysia. Currently, Sludge POME is used for co–composting with the oil palm empty fruit bunch (OPEFB) in a few oil palm mills in Malaysia. Biological hydrolysis of lignocellulose materials of OPEFB by microbes and enzymes is a great potential because of its obvious advantages such as environmentally friendly procedures and low in energy demand. In this study, a metagenomics sequence–guided strategy was used to facilitate targeted discovery of lignocellulolytic microbes and enzymes. The microbial diversity of sludge POME from Felda Maokil, Johor was analysed using Shotgun metagenomics sequencing. Besides, the phylogenetic distribution of CAZymes in sludge POME was also been studied. The sequence result shows that 59% of the total gene fragments was bacteria and 35% of the total gene fragment was archaea. The main bacterial lineage found was *Pseudomonas stutzeri* with 16% of the total gene fragments. While the main archaeon lineage found was *Methanotrix soehngenii* with 9% of the total gene fragments. Most archaeon found in sludge POME were methanogens. This analysis provides fundamental data for an improvement in biodegradation of lignocellulose materials in the composting process as well as increasing the efficiency of oil palm waste utilisation.

Keywords: Shotgun metagenomics; Microbial diversity; Palm oil mill effluent; Lignocellulose compost; Lignocellulolytic enzyme mining

Young Researcher 3.7

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Progressive Algal Biotechnology: A Sustainable and Viable Approach Towards Bioeconomy

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Abstract: Rapid urbanization, industrialization together with excessive energy demand and reliance on fossil fuels have caused detrimental impacts on the environmental sustainability and wellbeing of human society. This led to the advent of algae that has the advantage to utilize light, fix atmospheric CO_2 and produce adenosine triphosphate (ATP), termed as energy currency of life during their growth. Algae can grow in varying environments (pH, salinity, temperature, light etc.) and have better photosynthetic efficiency to generate higher quantity and quality of biomass. They can be grown in non–arable land thus solving the food–fuel duel and their water footprint is also less as compared to other crops. Furthermore, many algal species are the potential source to produce protein, carbohydrates, lipids, pigments as well as other metabolites that are currently obtained from conventional agriculture which is having many limitations in terms of sustainability. Algae are the emerging area of study and due to continuous and progressive research they are expected to become bio–factories for the sustainable production of myriad products, especially biofuels as future energy sources. This paper will summarize different emerging technologies involving algae like bio technological modifications to enhance the production of biofuels; production of green chemicals and biomaterials (green chemistry); and synthetic biology. The overall objective of the technological advancement in algal research is to tap its hidden potential in an economically viable and environmentally sustainable manner. To overcome the bottlenecks in algal cultivation and harvesting aspects researchers are going for the bioeconomy approach, so that the upstream cost issues can be compensated by downstream production. Algal biotechnology has an enormous potential for clean and green future. While algae biotechnology can be further improved to make it commercial. We expect a never–ending road for algal research ahead.

Keywords: Microalgae; Cultivation; Green chemistry; Biofuels; Bioproducts; CO_2 sequestration

Young Researcher 3.8

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An Integrative Bioconversion Process for Biodiesel Production Utilizing Waste from The Palm Oil Industry

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Abstract: This study was focused on utilizing the palm oil industry waste to produce biodiesel. The concept integrates the palm oil mill effluent (POME) and artificial palm SAP approach using streams of palm oil waste with activated carbon from coconut shells served as the bio–catalyst to produce fatty acid ethyl ester (FAEE) via a reaction mediated with *Thermomyces lanuginosus* lipase (TLL). This concept could solve many of the environmental issues of the palm industry and increase the value of palm oil waste. After 48 hours in a lower bioethanol concentration (63% v/v), esterification at 40ºC and 35 rpm yielded 98.11% w/w FAEE. Evaluations of changes in the Gibbs free energy (ΔG) and the activation energy (Ea) were used to characterize the reaction. Further, a kinetic study on triacylglycerol (TAG) and free fatty acid (FFA) was performed to elucidate the superiority of oil with a high FFA content for faster reactions. This study should help to establish the sustainability of an integrated approach to biorefinery operations from the palm oil industry.

Keywords: Biodiesel; Bioethanol; Immobilized lipase; Esterification; Palm oil waste

Young Researcher 3.9

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Ureolytic Biomineralization in Coastal Regions Inhibited by Pesticide Pollution: A Computational Approach

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Abstract: Biomineralization is a natural phenomenon that helps in producing various biominerals. Microbially induced calcium precipitation (MICP) usually occurs due to the microbially induced chemical alteration in the environment, where, the ureolytic bacteria hydrolyses urea leading to calcite precipitation. The microbial activity depends upon various environmental factors, like, pH, calcium ions concentration, dissolved inorganic carbon levels, etc. India is blessed with a long coastline of about 7500 kilometres, but is severely contaminated with a number of pollutants like heavy metals, sewage, micro plastics and pesticides. Among the pesticides, organochlorines are the most prevalent and persistent agrochemicals that lead to coastal pollution. The most commonly found negative effects of these agrochemicals are thinning of oyster shells, sea shells, and egg shells of some marine birds as a result of biomagnification. The present study focuses on the urease inhibitory activity of some selected pesticides prevalent in the Indian coastal areas. Eleven pesticides (organochlorides, HCH, etc.) were considered in this work and molecular docking studies have been implemented to evaluate their interactions with urease enzyme of *Bacillus pasteurii* and *Lysinibacillus sphaericus* whose biomineralization potentials have been reported. Urease structure of *Lysinibacillus sphaericus* was predicted using homology modelling while that of *Bacillus pasteurii* was retrieved from Protein Data Bank (PDB). Even though all the selected pesticides interacted with these enzymes differently, the strongest interaction was offered by o,p'–DDT with binding energies –11.4 kcal/mol for *B. pasteurii* and –9.6 kcal/mol for *L. sphaericus*. This computational study suggested that these selected pesticides have the capacity to bind to several regions on the enzyme surface of both ureases. Among the model organisms chosen, *B. pasteurii* urease has been found to interact more with selected pesticides than the *L. sphaericus* urease. Thus, being the robust and extensively studied organism in biomineralization, this ability could halt the natural biomineralization in the presence of these organochlorines especially in the coastal regions.

Keywords: Biomineralization; Coastal pollution; Urease; Molecular docking; Pesticides

Young Researcher 3.10

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Production of Single Cell Oil as Potential Biodiesel by *Yarrowia lipolytica* JCM 2320 Using Detoxified Desiccated Coconut Residue Hydrolysate

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Abstract: Nowadays, the replacement of petro–diesel with biodiesel has raised the concern among the community for the utilization of improper feedstocks and the cost involved. However, these issues can be solved by the production of single cell oil (SCO) from lignocellulosic biomass hydrolysates by oleaginous microorganisms. In this study, *Yarrowia lipolytica* JCM 2320 was introduced with a desiccated coconut residue hydrolysate as a carbon source in generating SCO. To visualize the effect of inhibitors on *Y. lipolytica*, an inhibitory study was conducted by adding 0.5–5.0 g/L of potential inhibitors to the YPD medium. *Y. lipolytica* was found to be a robust strain with listed evidence: furfural at 0.5 g/L would increase the lag phase and beyond that was detrimental to *Y. lipolytica*; increasing concentration of HMF would increase the lag phase of *Y. lipolytica*; while for acetic acid and levulinic acid, it showed a negligible effect. To screen the detoxifying potential of adsorption resins in minimizing the effects of fermentation inhibitors, five different resins were tested, Amberlite® XAD–4, Amberlite® XAD–7, Amberlite® IR 120, Amberlite® IRA 96 and Amberlite® IRA 402 with different concentrations at 1%, 3%, 5%, 10% and 15%, respectively. At resin concentration of 10%, Amberlite® XAD–4 recorded single cell oil yield of 2.8960 ± 0.01 g/L, whereas Amberlite® IRA 402 recorded 2.5820 ± 0.0 g/L, that was higher than that of the control and overliming, with only 1.2900 ± 0.01 g/L and 1.2680 ± 0.03 g/L SCO accumulation, respectively. Moreover, the fatty acid profile of the oil produced was rich in oleic acid (33.6%), linoleic acid (9.90%), and palmitic acid (14.90%), which indicate a good biodiesel raw material.

Keywords: Single cell oil; Desiccated coconut hydrolysate; Fermentation inhibitor; Detoxification; Adsorption resin

Young Researcher 3.11

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Biobutanol and Biohydrogen Production from Waste Potatoes Using Novel Saccharolytic α–Amylase from *Bacillus* Strain

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Abstract: Waste potatoes are rich in carbohydrates having > 20% starch, which can be a suitable feedstock for production of biofuels. In this study, we collected the waste/spoiled potatoes from the local markets in Delhi (India) and used as substrate for clostridial fermentation. These waste potatoes were smashed, and autoclaved (for sterilization purpose) then subjected to clostridial fermentation. For saccharification of waste potatoes, we externally added α–amylase produced from *Bacillus* st. IBT108. α–Amylase from st. IBT108 has distinguished properties such as it acts on both α–1,4 and 1,6 glycosidic linkages in the starch, it is resistant to salts (NaCl and KCl), surfactants (SDS, CTAB, and Tween), and reducing agents (DDT), besides it is catalytically active in presence of 1M solvents (acetone, butanol, and ethanol). Our investigation showed that adding 2–3 mL of IBT amylase, fully digest the high concentration of waste potatoes (> 300g/L) and supported the clostridial fermentation. After 5–7 days of fermentation, clostridial fermentation added with IBT amylase produced > 20g/L of butanol, and > 3 L/L of hydrogen, simultaneously clostridia inoculated to waste potatoes without IBT amylase did not grow and support butanol production. The new IBT amylase facilitated the integrated bioprocess of simultaneous saccharification and production of biobutanol from waste potatoes.

Keywords: α–Amylase; Agro–residues; Carbon source; Starchy substrate; Wheat bran

Young Researcher 4.1

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A 96 Well Plate–based Method for Monitoring α–amylase Activity Using Miniaturises 3,5–Dinitrosalicylic Acid (DNSA) Colorimetric Method

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Abstract: The *in vitro* inhibition of α–amylase enzyme has become an important parameter for the evaluation of antidiabetic agents. The DNSA assay has been widely used for the determination of α–amylase enzyme activity. However, the conventional method requires a large volume of samples and other assay materials. In addition, the inconsistencies of the assay protocols: the concentration of α–amylase enzyme solution, percentage of starch solution as well as the incubation temperature of the reaction demanding further optimization. Hence, the present study paved the way for an unsophisticated assay to be a good alternative to the traditional protocol and provide the optimum α–amylase enzyme assay conditions. The proposed method was conducted and partially validated according to the maltose calibration curve plotted. The linearity test was conducted by determining a linear regression equation (y = mx + c), slope (m), y–intercept (c) and coefficient of determination (R^2) of the maltose standard curve (0 – 10 mg/mL). The percent coefficient of variance (% CV), limit of detection (LOD) and limit of quantification (LOQ) were also evaluated. Based on the standard curve obtained, a significantly higher R^2 value of 0.9980 ± 0.0008 was shown by the proposed method as compared to the traditional method. The % CV of each data point was less than 15% indicating an excellent data precision. The adaptation of the proposed method towards the α–amylase enzyme assay managed to identify the optimum assay conditions, which were 2 units of enzyme solution and 5% starch solution at 50°C incubation temperature. These assay conditions were tested for α–amylase inhibition by acarbose tablets and revealed the IC_{50} value of 0.026 ± 0.005 mg/ mL. It was concluded that the proposed method is practical to be applied with the reproducible result.

Keywords: 3,5–Dinitrosalicylic Acid (DNSA); α–amylase enzyme assay; α–amylase inhibition; Maltose

Young Researcher 4.2

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Sequential–Substrate Feeding and Sequential–Enzymes Loading of Enzymatic Saccharification to Enhance Fermentable Sugar Production from Sago Hampas

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Abstract: Sago hampas is a starchy and lignocellulosic based biomass that has the potential to be a major source of renewable sugar for biofuel production. On top of that, the bioconversion of cellulosic wastes into bio–products is a crucial step that can minimize the environmental pollution caused by the agricultural wastes. However, the production of fermentable sugar always hampered by its low production during batch system of saccharification caused by the limitation of the substrate that can be loaded. Therefore, in this study, sequential–substrate feeding and sequential–enzymes loading strategies were employed to enhance the saccharification process and subsequently improved the fermentable sugar production. The amount of substrate loading in the system were fed sequentially at the selected intervals along with the sequential–enzymes loading. This strategy was found to be effective in improving the saccharification process where the total substrate concentration of 20% and enzymes concentration of 14.3 U/g and 10 FPU/g for amylase and cellulase, respectively has produced high fermentable sugar at 119.90 g/L compared with the 80.33 g/L in the batch system. The results indicate that by employing the substrate and enzymes feeding strategies, not only the total amount of substrate and fermentable sugar produced are able to increase, but it also can reduce the amount of enzymes used in the system where it has been reduced up to 80% and 50% for both amylase and cellulase, respectively.

Keywords: Sago hampas; Biomass; Saccharification; Fermentable sugar

Young Researcher 4.3

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Biohydrogen Production from Crude Glycerol by *Clostridium* Strain G117

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Abstract: Biohydrogen has become one of the promising alternatives to conventional fossil fuels in recent years. This study evaluated the potential of utilizing crude glycerol as a major substrate co–fermented with agro–residual hydrolysates such as rice bran, sugarcane bagasse, and wheat bran for increased hydrogen production from the laboratory strain G117 by applying the Response Surface Methodology (RSM) to the medium components. Sp. G117 ferments crude glycerol (5 g/L) and produces biohydrogen from reinforced clostridial medium (RCM). While increasing the crude glycerol concentration in RCM from 5 to 15 g/L, the biohydrogen production was enhanced gradually. Besides, adding agro–residual hydrolysates (5–15 g/L of total sugar) obtained from autoclave (121°C for 15 min) treatment and ferrous chloride (0.1–1 mM) to the crude glycerol–based RCM–medium further enhanced the hydrogen production. Subsequently, to optimize the media components for the maximum level of hydrogen production, the RSM–based central composite design (CCD) was employed with crude glycerol, ferrous chloride and rice bran hydrolysate. According to RSM–CCD, a set of twenty experiments were performed in triplicates, and the results were analyzed by using the Design–Expert tool (version 12). Under optimized medium supported > 4L/L of biohydrogen production by *C. beijerinckii* G117. The results suggest that the selected components, crude glycerol, rice bran hydrolysate, and ferrous chloride, were significant ($p < 0.01$) for biohydrogen production.

Keywords: Biohydrogen; Crude glycerol; Agro–residues; Response surface methodology

Young Researcher 4.4

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Antioxidant Capacity of Fermented Traditionally Processed Sago with Endophytic Fungi

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Abstract: Free radicals known as reactive oxygen species (ROS) are capable in oxidizing biomolecules which can cause damage to cells and tissues. Excessive ROS can cause gradual damages which eventually disrupt normal cell functions, and consequently lead to cell death. This can cause many diseases such as heart disease, stroke, and cancer. To prevent excessive ROS from damaging biomolecules, antioxidant compounds has been extensively studied for its health promoting and nutraceutical benefits. Traditionally processed sago starch, locally known as sago "*lemantak*" is a local produce in Sarawak, derived from the underutilized sago palm. Unlike the other parts of the palm, sago starch has not been studied of its phytochemical properties, in particular its antioxidant capacity. Therefore, this study aimed to evaluate the effect of sago "*lemantak*" fermentation on its total phenolic content and antioxidant activity. To improve the productivity of antioxidant, two different fermentation types and utilization of three different endophytic fungi namely, *Aspergillus niger*, *Penicillium chermesinum* and *Fusarium* spp. were incorporated. Total phenolic content, DPPH radical scavenging activity and ferric reducing power were measured after seven days of fermentation. Combination of endophytic fungi AP showed higher scavenging activity in SSF, ranging from 76–96% in different concentrations (0.03125–2 mg/mL) while monoculture *Aspergillus niger* showed higher scavenging activity in SmF, ranging from 15–90% at different concentrations (0.03125–2 mg/mL). For ferric reducing power, combination of PF showed higher reducing power in SSF at 2 mg/mL (0.912) while in SmF, monoculture of *Fusarium* spp. showed better reducing power at 2 mg/mL (0.306). These results showed that the production of antioxidant can vary depending on the fermentation conditions. The potential of sago "*lemantak*" as health benefit food is limitless. This demonstrates the significance of fermented sago starch potential as an alternative antioxidant producer.

Keywords: Fermentation; Sago *lemantak*; Antioxidant; Endophytic fungi; *Fusarium* spp.

Young Researcher 4.5

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Effect of Nitrogen Sources Supplementation on Oil Palm Frond Juice for Bacterial Cellulose Production

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Abstract: Bacterial cellulose (BC) is one of biopolymers that received positive feedbacks from industry due to excellent properties of the materials. However, the major challenges in BC production at industrial scale are low productivity and high cost in up–scaling the production. Thus, this study was aimed to utilize one of abundant oil palm biomass namely as oil palm frond (OPF). The petiole part of fresh OPF was pressed to get the juice which served as a potential and low cost fermentation medium for BC production. The effect of nitrogen sources supplementation on OPF juice was investigated to improve BC production. The nitrogen sources added to OPF juice were yeast extract, peptone, yeast extract combine with peptone, corn steep liquor, ammonium sulphate and ammonium phosphate. The BC was produced by *Acetobacter xylinum* 0416 under static fermentation at room temperature for ten days. The BC pellicles formed was purified and analyzed in terms of yield, thickness, swelling ratio, Fourier transform infrared (FTIR) analysis, thermogravimetric (TGA) analysis and crystallinity index. It was found that OPF juice supplemented with corn steep liquor gave the highest yield of BC. Interestingly, the BC produced from OPF juice supplemented with CSL exhibited better performance compared to Hestrin and Schramm (HS) medium with yield of 8.93 ± 0.6 g BC/g glucose, thickness of 0.89 ± 0.08 cm, swelling ratio of 343 ± 41% and crystallinity index of 84%. FTIR spectrum also exhibited similar vibration bands with the BC produced from HS medium indicated that BC produced in OPF juice had similar chemical structure with BC from HS medium. Therefore, OPF juice promise as a good alternative fermentation medium which is believed can reduce the production cost of BC production.

Keywords: Bacterial cellulose; Oil palm frond juice; Oil palm biomass; Nitrogen sources

Young Researcher 4.6

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Improvement of Very High Gravity Bioethanol Fermentability of Sago Hampas Hydrolysate Using Recycled Yeast Cells

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Abstract: The osmotic stress in very high gravity (VHG) fermentation resulted to poor yeast metabolism, cell lysis and mortality, which eventually caused slow and incomplete bioethanol fermentation. In this study, an ample amount of active yeast cells was produced from VHG fed–batch bioethanol fermentation using sago hampas hydrolysate (SHH) supplemented with yeast extract and peptone. The cells can be recycled to start a new cycle of bioethanol fermentation, which could reduce the time and operational cost of fermentation. This study investigates the effect of utilising recycled yeast in batch VHG bioethanol fermentation using SHH as the feedstock. Yeast cells were allowed to naturally settle at the bottom of the fermenter for 6 h to separate cells from the fermentation broth. This approach was used instead of the conventional methods to prevent contamination and detrimental effect on yeast cells. After the fermentation, broth was withdrawn from the fermenter. The concentration of viable cells recorded was 1.21 $x10^6$ ± 0.135 cells/mL. Fresh fermentation media was added to the fermenter, and a new fermentation cycle began. The results showed that the fermentation using recycled cells had attained similar ethanol fermentability (YE/s: 0.505 ± 0.02, PE: 126.20 ± 3.0 g/L) to the control experiment. As a whole, the findings suggest that utilising recycled yeast cells can be an alternative strategy to enhance VHG ethanol fermentation with fewer operational steps and tools. This result could provide applicable insights for the development of bioethanol fermentation using sago based substrates in the near future.

Keywords: Recycled yeast; Very high gravity fermentation; Sago hampas hydrolysate; Bioethanol

Young Researcher 4.7

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High–level of Recombinant Fungal Laccase Production for Industrial Applications

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Abstract: Laccase is a multicopper containing, versatile catalyst used for numerous applications in several industries including biofuel industries, biomass valorisation, wastewater treatment/bioremediation, chemical/pharma industries, food/feed/beverage industry, and biosensor/fibre board preparation. Fungal laccases are the most preferred enzymes for foresaid applications in industries. In this study, the nucleotide sequence of laccase gene from *Trametes cinnabarina* was codon optimized for expression in *Pichia pastoris* host. The codon optimized laccase gene was transformed into *P. pastoris* by pD915 vector. The recombinant *Pichia* was cultured in BMGY media and secreted the laccase to the fermentation media. The recombinant cells were immobilized by using different matrices including agar–agar, polyacrylamide, calcium alginate and tested for laccase secretion. Among tested, calcium alginate was found to support high level of laccase expression and showed the high degree of recyclability. Subsequently, concentration of calcium alginate and the bead sizes were optimized. The optimum concentration was 4–6% of calcium alginate, and the optimum bead size was 2.5–3.1 mm. Under optimized conditions, the calcium alginate beads could be reused for >10 cycles and produce > 5000 U/L of laccase. Employing this immobilized *Pichia* cells, fungal laccase can produce at low cost, which can largely assist to meet the demands of chemical, pharma, biofuel, and biochemical industries.

Keywords: Laccase; *Pichia pastoris*; *Trametes cinnabarina*; Immobilization; Calcium alginate

Young Researcher 4.8

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Bilayered Woven Cellulose–Collagen Bioscaffold as Acellular Skin Substitute for Future Use in Diabetic Ulcer Treatment

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Abstract: Wound re–epithelialisation is one of the crucial phases in wound healing. The mechanism is dynamic and well–orchestrated, yet it is a complicated process. The hallmark of wound healing is to promote wound regeneration in lesser time without invading of skin pathogens into the injury site. This study aimed to develop a bilayered woven cellulose–collagen (WCC) bioscaffold as an acelllular skin substitute for future use in chronic wounds. The bioscaffold was prepared by layering the woven cellulose onto the ovine tendon collagen type I (OTC–I). The WCC was then post cross–linked with 0.1% genipin (GNP) as a natural crosslinking agent. The physicochemical characteristics of bioscaffolds were evaluated through Ninhydrin assay for crosslinking degree, water retention ability, wettability (hydrophilic or hydrophobic), resilience, compression, and water vapour transmission rate. The results demonstrated less concentration of free amine group in cross–linked bioscaffold which was 0.3 mg/ml than in non–crosslinked group (0.7 mg/mL) , water retention capacity around 900–1100% in cross linked group than in non–crosslinked group (1500–1700%), the hydrophilicity < 90º in both cross linked and non–cross linked groups, ability of the cross linked bioscaffold to return to its original state was more than 80% in cross linked group compared to non–crosslinked group which was 50%, resist extra pressure after applied load was lesser than 20% in crosslinked group than in non–crosslinked group which was 50% and water being evaporated from cross linked group after 24 hours was 2000– 2100 g/m^2/h than in non–crosslinked group which was 1700–1800 g/m^2/h. In conclusion, these results portrayed that WCC bioscaffold as a potential acellular skin substitute for treating diabetic wounds in future.

Keywords: Diabetes; Wound regeneration; Skin pathogens; Skin substitute; Woven cellulose–collagen.

Young Researcher 4.9

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Evaluation of *Bacillus coagulans* MA42 for L–Lactic Acid Production from Lignocellulose Using Consolidated Bioprocessing Fermentation

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Abstract: Second–generation lactic acid production requires the development of sustainable and economically possible processes using the renewable lignocellulose biomass as a starting substrate. *Bacillus coagulans* MA42 was isolated from soil sample in Chiang Mai province, Thailand and showed the highest production of L–lactic acid and lignocellulolytic enzymes among other isolates. *B. coagulans* MA42 produced 7.20 g/L of L–lactic acid from mixed sugar (glucose 5 g/L and xylose 5 g/L) in anaerobic condition with control pH at approximately 6–7 during fermentation process at 55°C. In addition, *B. coagulans* MA42 was able to grow in the medium containing various lignocelluloses as the sole carbon source and produced lignocellulolytic enzymes at high temperature ranged from 45–55°C. *B. coagulans* MA42 produced L–lactic acid 127.59, 78.08, 122.00, 110.54 and 79.97 mg/g total carbohydrate when sugarcane bagasse, sugarcane trash, corn stover, rice straw and water hyacinth were used as the sole carbon source, respectively. The results of study indicate that *B. coagulans* MA42 is a potent bacterial candidate for consolidated bioprocessing process (CBP) application in L–lactic acid production. However, the optimization process for achieving the higher yield of L–lactic acid from lignocellulose substrates has to be further investigated.

Keywords: Lignocellulose; Consolidated bioprocessing process (CBP); *B. coagulans*; L–lactic acid

Young Researcher 4.10

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Immobilization for The Enhancement of Biomass and Lipid Productivity of *Chlorella sorokiniana*

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Abstract: The effects of alginate immobilization on the growth and lipid productivity of the microalga *Chlorella sorokiniana* were studied. To this end, the microalga strain was cultured both in free and in immobilized conditions under optimal autotrophic growth parameters. The microalga was immobilized in calcium alginate beads generated by mixing the algal cells with a sodium alginate solution followed by extrusion into a Ca^{2+} solution. The results clearly showed that the growth inside the alginate beads is enhanced and achieves a dry cell weight that is 1.4–fold higher than that of a free–cell culture, and the light transmittance in the alginate–immobilized culture was also higher than that in a suspension culture, while the lipid productivity was increased from 53.79 ± 2.35 mg/L/d in the free–cell culture to 92.97 ± 3.26 mg/L/d in the immobilized culture. These results show the effectiveness of the immobilization technology for promoting growth and lipid productivity in the microalgae *Chlorella sorokiniana*.

Keywords: *Chlorella sorokiniana;* Biomass*;* Lipids; Alginate; Immobilized cell

Young Researcher 4.11

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Animal Feed Preparation Using Probiotics and Organic Waste Incorporated with Selected Biocontrol Medicinal Plants

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Abstract: Numerous diseases in animals were controlled by the use of different antibiotics and anti–parasitic agents which were administered along with the feed. Some of these antibiotics were also used for promoting growth, the use of antibiotics can cause side effects or toxicity to them as well as humans. Consumption of these animal products and meat contain the residues of these drugs, which leads to several health complications. Probiotics are an alternate source for reducing the usage of these drugs because probiotics are not pathogenic and have potential health benefits to the host when administered in passable amounts. It has proven benefits for humans and animals. Organic waste rich in nutritional supplements have become a rising problem in recent years because of its environmental impacts. In this study, potential probiotic microorganisms were isolated from curd and tested for their primary probiotic characteristics such as tolerance to acidic pH, bile, and antimicrobial activity. This probiotic and selected medicinal plants along with certain organic waste such as agricultural and vegetable wastes were used as a substrate for formulating an animal feed. The agricultural wastes were partially fermented by solid–state fermentation using *Lactobacillus* species as an inoculum. The remaining substrates were allowed for natural fermentation with an optimized process. The proximate analysis of the substrates was performed before and after fermentation. The amount of carbohydrates, fiber, protein, ash, and moisture, anti–nutritional factors such as tannin, lectins, saponins and phytic acid were measured. In addition, the fermented organic substrates were further incorporated with leaves of edible medicinal plants such as *Trigonella foenum–graecum, Azadirachta indica* and *Ocimum tenuiflorum*. This study aims to develop an effective probiotic feed with cheap substrates for poultry, cattle, and pigs.

Keywords: Probiotics; Solid state fermentation; Proximate analysis; Animal feed; Medicinal plants

3MPS 1.1

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Solid State Fermentation (SSF) of Lignocellulosic Agricultural Waste by *Marasmius* sp. for Laccase Production

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Abstract: Laccases are extracellular enzymes, making the purification procedures easy and able to exhibit a considerable level of stability in the extracellular environment. It is suitable for application in biopulping, biobleaching and the treatment of dyed industrial wastewater. In pulp and paper industry, laccase was used as lignin degrading enzyme in separation and degradation of lignin in wood pulp. Two types of fermentation were used in the production of laccase which are solid state bioprocessing (SSB) and submerged bioprocessing (SmB). SSB is a fermentation that involved solid in the absence or near absence of water while SmB is a fermentation process that uses liquid during the process of fermentation. Different types of lignocellulotic agricultural wastes, such as sago *hampas,* rice straw, oil palm empty fruit bunch (EFB), sago bark and rice husk were used as the substrate in this bioprocess experiments. The objective of the research is to perform solid state bioprocessing (SSB) using different types of lignocellulosic agricultural waste for the production laccase. From the result obtained, it is shown that the fermentation of rice straw using SSB had the highest production recorded as 1.009 U/g of substrate based on its laccase enzyme activity. To the best of our knowledge, this is the first report on the induction of laccase production by *Marasmius* sp. under SSB using rice straw waste as the substrate.

Keywords: Laccase; Lignocellulosic; Rice straw; *Marasmius* sp.; Agroindustrial waste

3MPS 1.2

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Prokaryotic Diversity of Tropical Peat Swamp Forest Determined Using 16S rRNA Metagenome Sequencing

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Abstract: Tropical peat swamp forest is a global store of carbon and source of greenhouse gases in deep layers of waterlogged, anoxic, and acidic environment. The roles of prokaryotes including bacteria and archaea in supporting this forest through the formation of peat, carbon sequestration and nitrogen cycling for efficient functions and sustainability of the ecosystem is still poorly understood. This study aimed to identify and characterize the bacteria and archaea diversity from different soil microcosms; total soil (Rtot), partitioned heterotrophic (Rh), and rhizospheric (Rr) in the tropical peat swamp forest ecosystem of Bintulu, Sarawak. A total of nine extracted soil genomic DNA were amplified using 16S rRNA primer targeting the V3–V4 region, sequenced on an Illumina MiSeq sequencer and analyzed. The results showed that no significant difference was found for diversity and evenness among the soil microcosms of prokaryotic community. The OTU richness and Chao 1 estimator were higher in Rtot, whereas Shannon and Simpson's indices were higher in Rh. A total of 85% of the 16S rRNA genes were assigned to bacteria, whereas 15% belonged to Archaea in Rtot followed by 94% and 6% in Rh, and 95% and 5% in Rr, respectively. The dominant taxa belonged to Proteobacteria and Acidobacteria in the microbiome. The relative abundance of prokaryotic phylum and genus differed between soil microcosms and between vegetation. At the genus level, the most abundant taxa belonged to Acidobacteria (*Candidatus Koribacter, Holophaga*), Proteobacteria (*Rhodoplanes, Herbaspirillum*), Actinobacteria (*Actinoallomurus*, *Mycobacterium*), Thaumarchaeota (*Nitrosovibrio, Nitrososphaera*), Euryarchaeota (*Thermoplasma*, *Thermofilum*), and Bacteroidetes (*Rhodothermus*). *Terracidiphilus savannae* (Acidobacteria) was found to be the major bacterial species in this forest that decompose carbon (CO_2), which potentially be the contributing factor to the low CO_2 gas emissions. Overall, the findings demonstrated diverse prokaryotic communities and provide valuable insights on microbial ecology related to biogeochemical processes and tropical peatland management.

Keywords: bacteria; archaea; 16S rRNA; peat swamp forest; Illumina MiSeq

3MPS 1.3

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Amino Acids Using Starch Extracted from Pineapple (*Ananas comosus*) Plant Stem

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Abstract: Pineapple plant (*Ananas comosus*) is one of the largest productions in Asia and its increasing production has generated a huge amount of pineapple wastes. Pineapple plant stem is made up of high concentration of starch which can potentially be converted into value added products, including amino acids. Due to the increasing demand in animal feed grade amino acids, especially for methionine and lysine, the utilisation of cheap and renewable source is deemed to be an essential approach. This study aimed to produce amino acids from pineapple plant stem hydrolysates through microbial fermentation by *Pediococcus acidilactici* Kp10. Dextrozyme was used for hydrolysis of starch and Celluclast 1.5 L for saccharification of cellulosic materials in pineapple plant stem. Pineapple plant stem showed high starch content of 77.78%. Lignocellulosic composition of pineapple plant stem, consisted of 46.15% hemicellulose, 31.86% cellulose and 18.60% lignin. The hydrolysates obtained were used in the fermentation to produce methionine and lysine. It was observed that higher methionine and lysine production were produced from starch–based hydrolysis (40.25 mg/L and 0.97 g/L, respectively) as compared to cellulosic–based saccharification (37.31 mg/L and 0.84 g/L, respectively) of pineapple plant stem.

Keywords: Pineapple plant stem; Starch; Amino Acids; Methionine; Lysine

3MPS 2.1

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Bacterial Nanocellulose Using Pineapple Peel as Substrate

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Abstract: Due to its flexible properties, bacterial nanocellulose (BNC) has been attracting tremendous attention. In this study, BNC was produced by *Acetobacter xylinum* ATCC2376 and an isolate that was identified by 16S rRNA called *Bacillus cereus* MMS1. The production of BNC process was utilizing pineapple peel extract (PPE) (wastes discarded after cutting the fruit) as the alternative substrate or carbon source substituting the commercial D–glucose (control) in Hestrin–Schramm (HS) medium under agitated conditions. In order to optimize the production of BNC, concentrations of the carbon source, as well as the incubation period and agitation speed were all studied by using one factor at a time (OFAT) method while using the same inocula size (250 ml conical flasks) and temperature (30°C) throughout the experiment. The highest BNC yield was attained at 2% carbon source concentration, 12 days of incubation period and 150 rpm agitation speed which was 5.83 g/L by *A. xylinum* ATCC2376.

Keywords: Bacterial nanocellulose; Pineapple peel extract; *Acetobacter xylinum* ATCC2376, *Bacillus cereus* MMS1

3MPS 2.2

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Effect of Used Cooking Oil as Stabliser of Biolubricant Produced from *Calophyllum inophyllum* L. (Nyamplung) Seed Oil

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Abstract: Biolubricant plays a critical role in defeating negative factor of mineral oil such as non–biodegradable and toxic and widely used in various industry especially automotive. It. It has been recently reported that *Calophyllum inophyllum* L. (Nyamplung) seed oil can be used as base oil to produce biolubricant through transesterification process. However, the biolubricant produced has low qualities due to its thermal oxidative stability. Thus, in this study the *C. inophyllum* L. seed oil was mixed with used cooking oil in different proportions with the aim to determine the mechanism of used cooking oil as stabiliser in the biolubricant production and to optimize the formulation of biolubricant between mixture of both oils. Five different ratio mixture of *C. inophyllum* L. seed oil and used cooking oil were formulated and tested for viscosity, oxidative stability, and presence of ester, of which the findings showed CI80 resembled characteristics to the commercial lubricant. The optimization of CI80 biolubricant was assisted by response surface methodology (RSM) – central composite design (CCD). It was conducted using three variables including temperature, time of reaction, and mixed oil to ethylene glycol molar ratio. The optimum conditions were obtained at temperature of 110°C, time of 110 min and mole ratio of 3:1 for 76.92% biolubricant yield.

Keywords: *Calophyllum inophyllum* L. seed oil; Used cooking oil; Biolubricant; Transesterification

3MPS 2.3

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C4–dicarboxylic Acid Production Utilising Lignocellulosic Oil Palm Trunk Bagasse as Feedstock

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Abstract: The C4–dicarboxylic acids i.e., succinic acid remains a promising bio–based platform chemical alternative to various other petrochemicals. Sugar polymers (cellulose and hemicellulose) from lignocellulosic biomass such as oil palm trunk (OPT) bagasse serve as an interesting feedstock for succinic acid production via biotechnological route. In this study, an efficient process was developed to produce succinic acid using dilute oxalic acid (catalyst) as an alternative to the conventionally used dilute sulphuric acid, for pretreating OPT bagasse. The pretreated whole slurry of OPT bagasse was further saccharified to produce a total of 43.3 g/L sugars (xylose and glucose), and subsequently fermented with *Actinobacillus succinogenes* DSMZ 22257 to yield 17.5 g/L of succinic acid, which was corresponded to 0.44 g/g. Mass balance calculations showed that 175.2 kg of succinic acid could be produced from a tonne of OPT bagasse. The sequential dilute oxalic acid pretreatment followed by enzymatic saccharification of the resultant whole slurry appears to be an interesting process for platform chemical production, with an anticipated high sugar yield, low level of inhibitory products and good fermentability.

Keywords: Oil palm biomass; Dilute organic acid pretreatment; Platform chemicals; Succinic acid

3MPS 3.1

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Biodegradation of Natural Glove Rubber Using Gram–Negative Bacteria: *Klebsiella aerogenes*

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Abstract: Due to the complex three–dimensional structure of rubber, degradation by natural processes is very difficult, which causes the rubber to remain in the environment for more than 80 years. The current existing waste management measures like landfills, burning, and open dumping threaten the environment as they emit toxic gases into the atmosphere. The most prominent bacteria capable of degrading rubber belongs to the gram–positive actinobacteria. Very few gram–negative bacteria belonging to group Myxobacteria and *Xanthomonas* sp. have been reported to degrade the rubber. The present work was conducted to determine the rubber degrading capacity of the gram–negative bacteria *Klebsiella aerogenes* (ATCC® 13048™). The experiment was carried through submerged fermentation by incubating the glove rubber pieces with the bacteria for 21 days at 35°C at pH 6, 7 and 8. The biodegraded rubber was then extracted and analyzed using dry weight analysis, Schiff's staining and FTIR analysis. The growth of the bacteria was determined by measuring the optical density of the culture at 600nm and plotting the growth curve. The dry weight analysis of the biodegraded rubber showed 16.03%, 16.15% and 7.84% of weight loss in pH 6, 7 and 8 samples, respectively, after 21 days of incubation indicating that pH 6 and 7 could be preferred for biodegradation. Upon Schiff's staining, the biodegraded rubber samples turned into dark pink colour, indicating the presence of aldehydes confirming the occurrence of biodegradation. FTIR analysis showed characteristic peaks at C–H stretch off C=O (2853.84 cm^{-1}, 2850.68 cm^{-1}, 2852.28 cm^{-1}) indicating the presence of aldehydes, C=O stretch (1729.42 cm^{-1}, 1731.61 cm^{-1}, 1730.00 cm^{-1}) indicating carboxyl group and C≡C stretch (2162.29 cm^{-1}, 2162.29 cm^{-1}, 2162.33 cm^{-1}) indicating alkynes group in pH 6, 7 and 8 samples which were absent in the control. The formation of the C=O group indicates an oxidative reduction in the biodegraded samples. The above results indicated that *Klebsiella aerogenes* can degrade natural glove rubber and can be an effective method in managing rubber waste.

Keywords: Biodegradation; Rubber waste; Gram–negative bacteria; Submerged fermentation

3MPS 3.2

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Isolation and Characterization of Phosphofungi as a Potential Biofertilizer

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Abstract: Phosphorus (P) is one of the major macronutrients that has largely contributed to the plant maturity and growth after Nitrogen (N) and Potassium (K). P deficiency in soil is the most common problem faced in the agriculture field which leads to the commercial fertilizer usage by farmers to overcome these problems despite helping to increase plants productivity. The excessive usage of commercial P slowly gives a negative impact towards the environment such as causing groundwater pollution, waterway eutrophication, reducing soil fertility and left toxic residues in the soil. Hence, many studies have shown several microbes that have promising solubilization ability where the insoluble P in the soil can be utilized by plants, thus enhancing plant growth and crops yield. Therefore, the main objective of this study is to isolate and identify efficient phosphofungi from food wastes which is a noteworthy microorganism in amending the phosphorus availability to plant using both solid and liquid Pikovskaya (PVK) medium containing tricalcium phosphate (TCP). Among several phosphate–solubilizing fungi isolate, 8 isolates showed positive results for P with solubilization index (SI) ranged between 2.00 to 3.00. Based on the phylogenetic analysis of the internal transcribed spacer region sequence, the isolated phosphofungi belonged to the genera of *Aspergillus niger* isolate SA1 and showed the highest phosphorus solubilization ability at 836.67 µg/mL after 7 days of incubation. A reduction in the pH was recorded in which indicating the secretion of organic acids in the solubilization process. The present study indicated the presence of phosphofungi may serve as a potential biofertilizer. Therefore, further study is needed to investigate the efficiency of phosphofungi application under field conditions.

Keywords: *Aspergillus niger*; Biofertilizer; Phosphofungi; Phosphate–solubilizing fungi (PSF)

3MPS 3.3

Dr Nahrul Hayawin Zainal
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Comparative Assessment of Activated Carbon from Oil Palm Kernel Shell versus Coconut Shell for POME Purification

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Abstract: The conversion of palm wastes to activated carbon has attracted significant attention due to its lignocellulose chemistry and abundance. The highly porous material is efficient for application in gas, heavy metals adsorption, pesticide adsorption, and wastewater treatment. Therefore, this research aimed to evaluate the performance of activated carbon oil palm kernel shell (AC–OPKS) as bio–adsorbent to remove organic and inorganic pollutants found in palm oil mill effluent (POME) final discharge. The effectiveness of AC–OPKS as a bio–adsorbent was compared to AC–COCONUT in this study. The batch adsorption system was tested using AC–OPKS and AC–COCONUT dosages of 5–25 g at a constant pH of 8.03 with different treatment times of 0–12 h to determine the optimal adsorbent capacity. When compared to AC–COCONUT, AC–OPKS had performed effectively for the reduction of biological oxygen demand (BOD), color, and total suspended solids (TSS) at 84.72%, 98.90%, and 91.85%, respectively compared to 78.61%, 90.12%, and 77.41% when using AC–COCONUT. The POME final discharge treated with AC–OPKS had BOD and TSS values of 14.90 mg/L and 56.00 mg/L, respectively, which is below the standard limit (BOD 20 mg/L and TSS 200 mg/L) set by the Department of Environment Malaysia (DOE) under the Environmental Quality Act 1974. It is also suggested that spent activated carbon be reactivated or used as an organic fertiliser for vegetative plants because it contains beneficial enrich nutrients such as nitrogen, phosphorus, and potassium from POME final discharge adsorption.

Keywords: Oil palm kernel shell; Coconut shell, Palm oil mill effluent, Activated carbon, Color removal

PS 1.1

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Formulation of Fortified Media from Oil Palm Biomass for The Enhancement of Bioactive Compounds in Pegaga (*Centella asiatica* (L.) Urban)

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Abstract: Pegaga (*Centella asiatica*) has been known as one of the most beneficial herbs in Malaysia because of its bioactive compounds. The three most dominant Pegaga in Malaysia are Pegaga Kampung, Pegaga Salad and Pegaga Nyonya. The results showed that Pegaga Kampung has the highest total phenolic content (TPC) of 9.22 mg/g (GAE), 76% of antioxidant activity, 0.259 mg/g of triterpene (asiaticoside) concentration and 1.16 cm diameter of inhibition clear zone towards *Candida albicans* and *Candida tropicalis* for its antimicrobial properties. In order to enhance the bioactive compounds properties, Pegaga Kampung was cultivated in a formulated fortified media composed of oil palm empty fruit bunch (OPEFB) biocompost, oil palm shell (OPKS) biochar, organic fertilizer, inorganic fertilizer and soils at different ratios of 14 formulation (T1–T14). Results showed that treatment T7 which comprised of soil, biocompost at a ratio of 25:75 and enriched with inorganic fertilizer has enhanced TPC by 33%, decreased in antioxidant activity by 14% and triterpene by 29% followed by T14 which comprised of soil, biocompost, biochar at a ratio of 50:25:25 and enriched with organic fertilizer has enhanced TPC by 30%, antioxidant activity by 16% and decreased in triterpene by 15% as compared to cultivation in 100% of soil only (control). In conclusion, this study had shown that Pegaga Kampung has the highest TPC, antioxidant and triterpene properties. Formulation of the fortified media composed of biocompost and biochar with inorganic fertilizer had significantly increased the bioactive compound properties in Pegaga Kampung.

Keywords: Pegaga; Centella asiatica; Bioactive compounds; Total phenolic content; Antioxidant properties

PS 1.2

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Establishment of *in vitro* Micropropagation from Meristem Explants *Musa campestris var. sarawakensis*

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Abstract: Banana is one of the crops known for its fruit, but to some extent even wild bananas such as *Musa campestris var sarawakensis* have their own potential value that is still unexplored. *Musa campestris var sarawakensis* is grown in the middle and southern parts of Sarawak state and north western of Indonesia. This banana originated from wild are eaten raw, used as tobacco paper and cut flower from the male flower bud. *Musa campestris var sarawakensis* delays in sprouting time, takes longer growth and flowering stage which influences its plantlet formation. Hence, micropropagation method using meristem bud offers a solution to overcome the slow growth and increase in plantlet production. This study aimed to establish multiple plantlets of *Musa campestris var sarawakensis* through *in vitro* micropropagation using meristem bud. Current research was conducted to select optimum size of the Musa sp. explant (*Musa campestris var sarawakensis*) and optimum media components (*Musa campestris var sarawakensis*) for micropropagation of bananas *in vitro*. The growth index and shoot formation of *in vitro* meristem buds was assessed based on the following parameters such as different clorox concentration (70, 80, 90 and 100%), activated charcoal (0, 1, 2, 3, 4 g/L), explant sizes (1–2, 3–5 and 6–7 mm), Murashige and Skoog medium strength (½ MS, 1 MS and 2 MS media) and sucrose concentration (0, 15, 30 and 45 g/L). Results indicated that optimal *in vitro* plantlet of *Musa campestris var sarawakensis* was identified with the explant size of 1–2 mm, sterilized with 100% clorox and cultured on full strength MS medium supplemented with 4 g/L of activated charcoal and 30 g/L of sucrose.

Keywords: *Musa campestris var sarawakensis*; Meristem buds; Activated charcoal; Sucrose

PS 1.3

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Molecular Diagnostic Tools for Mitigation of Tropical Plant Pathogens: Oil Palm

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Abstract: The oil palm (*Elaeis guineensis Jacq.)* is a fruit oil crop in the tropical region such as Malaysia, Indonesia, Thailand and Colombia. In Malaysia, the oil palm industry plays an important role in the growth of the agricultural sector of the country and has made a significant contribution to the gross domestic product (GDP), foreign currency exchange and labour usage. Like other tropical fruit crops, oil palm prone to some diseases especially after the large expansion of oil palm cultivation where serious outbreak of devastating diseases has been reported in several parts of the world. Some of important diseases including basal stem rot disease caused by several species of *basiodiomycete* fungus from the genus of *Ganoderma*, vascular wilt by *Fusarium oxysporum f. sp. elaeidis* (Foe), bud rot – *oomycetes*, *Phytophthora palmivora,* red ring – nematode, *Rhadinaphelenchus cocophilus*, and sudden wither – protozoa *Phytomonas staheli*. Basal stem rot disease has been reported cause significant profit losses to oil palm plantations in Malaysia and other country in the Southeast Asia. While vascular wilt and bud rot disease were predominately affecting in African region and South America such as Colombia respectively. In order to protect the oil palm industry, the outbreak of disease needs to be contained in the affected regions and implementing a strict biosecurity. A rapid and robust pathogens detection kit is one of the important biosecurity tools to keep the invasive pathogen outside the border and assists to monitor the outbreak/incidence of the disease locally. We have developed diagnostic kits for the detection of *Ganoderma*, CCCVD viroid, *Fusarium oxysporum* (Foe) and pathogenic *Phytophthora* as part of the initiative plan to mitigate the diseases of oil palm using several molecular methods such as polymerase chain reaction (PCR), loop–mediated isothermal amplification (LAMP), rt–PCR, and probe.

Keywords: Phytopathogens; Diagnostic; Oil palm; Plant diseases

PS 1.4

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Effects of Different LED–light Quality on Growth, Chlorophyll Concentration and Anthocyanin Content of Green Dwarf Pakchoi *(Brassica rapa chineensis)*

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Abstract: Understanding the effects of different light quality on plant development and the accumulation of important elements such as antioxidants is crucial for achieving the ideal light conditions for the production of high–quality vegetables in indoor vertical farming. *Brassica rapa chineensis* (green dwarf pakchoi) is a brassica vegetable that grows quickly and has been discovered with health–promoting properties, particularly anthocyanin, a beneficial antioxidant for dietary intake. Light treatments consisted of six different wavelengths combinations; full spectrum, which is white light (WL) as a control, 100% Red (100R), 82% Red: 18% Blue (82R18B), 50% Red: 50% Blue (50R50B), 100% Blue (100B) and 69% Red: 24% Blue: 7% Green (69R24B7G) were used in this study. The research was carried out at the LED Light Research Lab in MARDI, a walk–in growing chamber with a 12–hours photoperiod for 40 days with the photosynthetic photon flux density (PPFD) range level set in between 200 and 210 µMol/m^2/S. The plant height and plant width were shown the highest value under 100R while the lowest value was detected under white light treatment (control). On the other hand, the light treatment with 69R24B7G exhibited the highest yield of fresh and dry mass while the lowest yield was found in the while light treatment group (control). Interestingly, treatment with 50R50B had considerably produced greater chlorophyll and anthocyanin content than the other light treatments. It appears that light supplemented with R and B wavelength assists in optimum growth, physiology and secondary metabolism in green dwarf pakchoi. While the inclusion of a small proportion of G wavelength in the growth light sources could enhance the plants' quality.

Keywords: LED light; Vertical farming; *Brassica rapa chineensis*; Sustainable agriculture; Food security

PS 1.5

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Yield and Its Attribute Performance and Heritability Estimation in Selected F1 Bitter Gourd Population

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Abstract: Bitter gourd is one of the potential vegetable crops in Malaysia to be highlighted. It is rich in nutrients and has been clinically proven with several uses due to its medicinal advantages. However it gets less attention than other vegetable crops. The main objective of this study was to obtain detailed information on important agronomic characteristic and to determine the pattern of inheritance of morphological characteristic in bitter gourd. Four varieties namely P11, P13, P92 and P105 were selected as the parents in this study. As a result of the hybridization, four F_1 generations namely P105 x P11, P11 x P92, P92 x P13 and P13 x P92 have been successfully generated. All parents along with F_1 generations were studied and evaluated in this breeding study. Result of analysis of variance showed that parents and F_1 generations were significantly different at $p < 0.01$ for some agronomic characteristic such as vine length 90 (DAS), days of first harvest after flowering, fruit number, fruit weight, fruit length, fruit girth, flesh thickness and yield. It also exhibited significantly different at $p < 0.05$ on days to first male flower appearance and days to first female flower appearance. The highest yield value was recorded by the progeny P11 x P92 with value of 5376 g, followed by the parent P92 of 4885 g. In addition, yield character has shown a very significant correlation ($p < 0.01$) on the characters that contributes to higher yield such as fruit weight (r = 0.81), fruit length (r = 0.73), fruit girth (r = 0.63) and flesh thickness (r = 0.65). It also displayed significant at $p<0.05$ with vine length 90 (DAS) (r = 0.33) as well as fruit number (r = 0.27). This indicates that higher magnitude of variability for selection with a larger scope of breeding program in future. Furthermore, the percentage heritability (*h2*) obtained was in between 68.16 and 99.81%. The highest *h2* value was recorded by the fruit weight (99.81%), followed by fruit length (99.30%) and yield (99.15%). In term of genetic advance (GA), the highest value was recorded by the yield value of 3220.53% with the lowest value of 1.35% displayed in the first fruit harvest after flowering. High GA values indicated some characters will be inherited to the next generation.

Keywords: Bitter gourd, Heritability, Hybridization, Genetic advance, Correlation

PS 1.6

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Influence of Stem Cutting Diameter, Growth Regulators and Growing Media on Growth Performance of Moringa

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Abstract: *Moringa oleifera* is the most underutilised multipurpose tropical crop known as Horseradish or Drumstick–tree. The tree is famous for its versatility as a source of food for humans and livestock. Vegetative multiplication is essential for producing true to type plant without recombination as occurs in seed production. Stem cutting is the most commonly used method for vegetative propagation from herbaceous to woody plants of many types. The objective of this study was to evaluate the efficiency of different diameters of stem cuttings, growing media and hormones to improve the growth performance of moringa. The experiment consisted of three diameters of stem cutting, D_1 (16–25 mm), D_2 (26–35 mm), D_3 (36–45 mm) treated with three growth hormones (moringa extract powder, aloe vera extract powder, commercial Seradix IBA powder) and control and then raised in two growing media: a) sand: peat moss (9:1) and b) topsoil: coconut coir: peat moss (5:2:1). Results showed that the survivability of stem diameter 36–45 mm (67%) was significantly higher than stem diameter 26–35 mm (43%) and 16–25 mm (39%) respectively. Most of the growth parameters including number of shoots, shoot length, shoot branch diameter and biomass of shoot and root were superior for stem cuttings diameter of 36–45 mm with no hormone treatment or treated with aloe vera extract powder when compared to the rest of the treatments. The sand: peat moss (9:1) growing media was observed significantly affecting moringa stem cuttings with higher shoot and root growth when compared to the topsoil: coconut coir: peat moss (5:2:1) growing media. Based on the results, it can be concluded that hormone application was not required for the rooting process of the moringa stem cuttings. Vegetation multiplication of the moringa tree could be achieved using a stem cutting diameter of 36–45 mm planted in growing media of sand: peat moss (9:1).

Keywords: Vegetative propagation; Plant hormone; Sprouting

PS 1.7

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Development of Loop–mediated Isothermal Amplification (LAMP) for Detection of Banana Blood Disease Bacterium Isolates in Malaysia

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Abstract: Loop–mediated isothermal amplification (LAMP) is a technique that rapidly amplifies DNA with high specificity and sensitivity under isothermal conditions. To prevent the associated economic losses, and particularly those related to bacterial diseases where their management relies on removal of the infected material from production, a convenient, accurate and inexpensive method for detecting blood disease bacterium by a LAMP technique are needed. A set of four primers was designed to replicate the gene coding for the flagellar subunit, fliC, UDP–(3–*O*–*acyl*)–*N*–acetylglucosamine deacetylase gene (Ipx*C*) and conditions for detection were optimized to complete in 60 min at 650C. These results showed that the LAMP primers specifically amplified only the Ipx*C* gene. Moreover, the presence of LAMP amplicon was simply determined by adding SYBR Green I in the reaction. In conclusion, this LAMP technique for detection of blood disease bacterium in banana has potential to be used under field conditions to enable disease forecasting more accurate and efficient.

Keywords: Banana blood disease bacterium; Loop–mediated isothermal amplification; Detection; Gene–based diagnostics

PS 1.8

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Dilute Sulphuric Acid Hydrolysis of Destarch Sago Hampas for Xylitol Fermentation

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Abstract: Destarch sago hampas which contains lignocellulosic material can be exploited for the production of value–added product such as xylitol. Microbial xylitol production has gained a lot of attention because of its extensive substrate availability, ease of operation, and eco–friendliness. In this study, the destarch sago hampas was initially undergone dilute sulphuric acid hydrolysis process for xylose production which later used for xylitol fermentation process. During dilute acid hydrolysis process, three parameters involved in this study were solid to liquid ratio (5:100–40:100), sulphuric acid concentration (0–6 %, w/w) and effects of heat pretreatment (high pressure steam and microwave). The acid hydrolysis process integrated with high pressure steam pretreatment was shown to exhibit the highest xylose (11.56 g/L) and glucose (22.51 g/L) production in which the temperature was set at 121ºC with the solid to liquid ratio at 30:100. Then, the leftover hydrolysate from high pressure steam pretreatment was used for xylitol fermentation using *Candida tropicalis*. The maximum xylitol concentration of 11.75 ± 0.09 g/L was obtained after 60 h of batch fermentation process. This work indicated that the pretreatment of destarch sago waste lignocellulosic with high pressure steam can be served as an alternative raw material for xylitol production.

Keywords: Pretreatment, Destarch sago; *Candida tropicalis*; Xylitol

PS 1.9

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Down–regulation of Tyrosinase Expression by Fermented Broken Rice, Brewers' Rice and Rice Bran in Highly Pigmented Human Melanoma, MNT1

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Abstract: This study was carried out to evaluate the potential of fermented rice by–product extracts namely fermented broken rice (FBR), Brewers' rice (FBrR) and rice bran (FRB) as anti–melanogenic agent through *in vitro* study in highly pigmented human melanoma, MNT–1 cell line. The water extract of FBR, FBrR and FRB was tested for their cytotoxic effect on MNT–1 cell. The extracts were then assessed for anti–melanogenic potential through their effect on melanin content production as well as the intracellular tyrosinase activity. The underlying mechanism involved was examined by evaluating the mRNA expression of melanogenic enzymes of tyrosinase (TYR), tyrosinase–related protein 1 (TRP–1) and tyrosinase–related protein 2 (TRP–2). The results indicated that 50 and 100 µg/ml of FBR, FBrR and FRB has low cytotoxicity effect on human melanoma, MNT–1 whereby the cell viability recorded was more than 95%. The 100 µg/ml of the studied extracts exhibited melanin reduction in MNT1 as good as the positive control, kojic acid (100 µg/ml) used in this study. Evaluation on the intracellular tyrosinase enzyme activity demonstrated a reduction in tyrosinase enzyme activity in both concentrations for all tested extracts. The mRNA expression of TYR was also found down–regulated by the FBR, FBrR and FRB. Based on these results, the anti–melanogenic effect shown by FBR, FBrR and FRB were confirmed through the down–regulation of tyrosinase (TYR) mRNA and tyrosinase enzyme activity, indicating these extracts have great potential as anti–melanogenic agent for treating the pigmentation disorder.

Keywords: Anti–melanogenic; Broken rice; Brewers' rice; Rice bran, Tyrosinase

PS 1.10

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Mapping Milk Microbiota from Healthy, Sub–clinical and Clinical Mastitis of Jersey Fresian Cattle in Malaysia

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Abstract: Bovine mastitis is the persistent, inflammatory reaction of udder due to physical trauma or microorganism's infection. The milk from healthy and mastitis cows presents an ecosystem of microbial communities, which can influence the mechanisms and pathophysiology of mastitis. Hence, there is a possible shift of microbiome composition in healthy, subclinical, and clinical mastitis in cows. This study reported the composition of microbiota presents in milk which was sampling from healthy, sub–clinical and clinical mastitis groups of Jersey Fresian cows from one of the local farms located in Pahang, Malaysia. From the 16s amplicon sequencing analysis, the core microbiota was dominated by phyla of *Firmicutes*, *Proteobacteria*, *Actinobacteriota*, and *Bacteroidota*. Most of the predominant genera from healthy groups were mainly *Ralstonia*, *Staphylococcus*, *Corynebacterium*, *Turicibacter*, *Acinetobacter*, *Escherichia*, *Aerococcus*, and *Streptococcus*. Majority of subclinical mastitis milk populated by genera *Ralstonia*, *Escherichia*, *Aerococcus*, and *Corynebacterium.* While *Streptococcus*, *Ralstonia* and *Escherichia* were predominated presents in clinical mastitis milk samples. The alpha and beta diversity analysis indicated that microbiota from healthy and subclinical groups were more diverse compared to clinical mastitis microbiota. Therefore, predominant genera from clinical mastitis samples might be the potential of causative mastitis pathogens in the respective farm. The use of culture independent analysis presented here revealed a wide bacterial diversity and variation between different clinical statuses.

Keywords: Bovine mastitis; Milk microbiota; Jersey Fresian; 16S amplicon sequencing

PS 1.11

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Influence of SCOBY Fermentation on Antioxidant, Phytochemicals, and Skin–aging Enzyme Inhibition in Jackfruit (*Artocarpus heterophyllus*)

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Abstract: A fermentation procedure involving pure symbiotic culture of bacteria and yeast (SCOBY) was examined as a bio–processing technique to increase the bioactive characteristics of jackfruit (*Artocarpus heterophyllus*) pulp and leaves. Fermentation was carried out for 8 days and samples were withdrawn at 2 days interval for analysis. The antioxidant characteristics investigated were total phenolic content (TPC), ferric–reducing antioxidant power (FRAP), and DPPH radical scavenging activity. The fermented extract was further examined for inhibitory effects on skin ageing enzymes elastase and tyrosinase. The amounts of phenolic acid and organic acids were also measured using high performance liquid chromatography (HPLC). The FRAP value in jackfruit pulp and leaves extract increased by up to 2.8 and 22%, respectively, towards the end of the fermentation process, but no significant changes in DPPH radical scavenging activity were identified. Fermentation enhanced jackfruit's elastase and tyrosinase inhibitory properties, with inhibition rates ranging from 81.0 to 95.4%. With values ranging from 16.0 to 16.8 mg/mL, acetic acid was the most common organic acid detected following fermentation. The SCOBY fermentation can also raise the levels of beneficial organic acids such as kojic, citric, and quinic acid. Higher quantities of phenolic acids such as vitexin, salicyclic acid, and benzoic acid were found in fermented jackfruit leaves. After the fermentation process, several phenolic acids that were not present in the unfermented jackfruit pulp, such as benzoic acid and salicylic acid, were discovered. The present study showed that fermented leaves contain more phenolics than the pulp and demonstrated stronger suppression of tyrosinase and elastase activity. According to the findings, the inhibitory activities of fermented jackfruit components on skin aging–related enzymes and bioactive compounds provide evidence for its potential use as natural and functional ingredient in cosmeceutical products.

Keywords: Fermentation: Jackfruit; Antioxidant; Elastase; Tyrosinase

PS 1.12

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The Effect of 6–Benzylaminopurine on Regeneration of *Canarium odontophyllum*

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Abstract: *Canarium odontopyllum* can be conventionally propagated by seed. However, the success regeneration rate is low as this seed depends on its dormancy. In Malaysia, hot weather interrupts its germination process as it needs its own chilling requirement. Therefore, a micropropagation technique can be used to study the response of *C. odontophyllum* seed in different concentrations of 6–benzylaminopurine (BAP) growth hormone on where the surrounding environment can be controlled in the growth room. A study on the effects of different concentrations of BAP hormones on the *in vitro* growth of *C. odontophyllum* seed had been done. Murashige and Skoog media were added with single BAP hormones (0, 0.25, 0.5, 1.0, 2.0, and 3.0 mg/L), respectively. The MS media without hormone (MSO) were used as the control. The result showed that seed from MS medium with BAP 1.0 mg/L were comparatively more responsive (100% seed germination) followed by MSO (75% seed germination) in as early as 6 days. Root started to induce as early as 6 days in BAP 1.0 mg/L. Apical bud starts to induce at 4 weeks on all treatments except for treatment with 1.0 mg/L of BAP hormone and 2.0 mg/L BAP hormone. The height of the stem in treatment with 1.0 mg/L of BAP hormone is the longer (4cm) followed by treatment with 2.0 mg/L of BAP hormone (3.5 cm). Therefore, the best BAP hormones concentration for root induction and stem elongation was 1.0 mg/L while for leaves induction was 0.5 mg/L.

Key words: Micropropagation; Seeds germination; Growth hormone; Stem elongation; Regeneration

PS 2.1

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Potential Applications Studies of Recombinant Serine Protease SpSKF4 as Detergent Additives and in X–ray Recovery

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Abstract: The serine protease gene from a new thermophilic *Geobacillus thermoglucosidasius* SKF4 was amplified, cloned and expressed in *E. coli* BL21 (D3). The recombinant and wild type of the enzyme were partially purified by heat treatment, affinity chromatography and gel filtration. The stability and activity of the partially purified enzyme at high temperature and pH and in surfactants were determined. The capability of the enzyme as a detergent additive and its gelatinolysis action for the recovery of silver from x–ray film were carried out. The gene analysis showed an open frame of 1206 bp coding for a protein of 401 amino acids. The protein contains a prosequence and a signal peptide. The mature protease region has a high homology with subtilisin–like serine proteases from *Geobacillus* and *Bacillus* species and a very high homology of > 60% with serine protease from *Thermoactinomyces vulgaris* and >90% with serine protease from *Bacillus* sp. Ak1. The cloned gene was successfully expressed in *E. coli* by T7 promoter using the Blunt–end E1 expression vector. SDS–PAGE analysis of the protein revealed a mature protein of 29 kDa which was also confirmed by the Western blot. Optimization of SpSKF4 protein for soluble expression under different culture conditions revealed an increase in expression and activity (200 U/mL) at IPTG concentration of 0.4 mM and a temperature of 20ºC. Maintaining the temperature at 20ºC and 0.4 mM IPTG concentration with an induction time of 12 h further improved the solubility and activity of the protein of SpSKF4 enzyme. The recombinant alkaline serine protease was partially purified and its stability at high temperature, pH and surfactants determined. The protease was thermostable with activity between 20–100°C with optimum at 80°C. It shows high stability at pH 10 retaining it over 60% of its activity after 24 h at 80 °C. The protease showed weak stability with Tween–20 and Tween–80 at the concentration of 10 mM as 40 and 33% respectively, while the activity and stability of the enzyme was increased by 20% with SDS, and the protease retained 70% of its activity at concentration of 10 mM with Triton–100 .Its potentials in industrial applications as a detergent additive and in the recovery of silver in X–ray film was studied and the enzyme showed high potentials in its capacity as a detergent by retaining average of 91 % of its activities when used as additive in detergent. It also showed high capacity in washing and removal of blood in blood stained cloth and in silver recovery from X–ray film.

Keywords: *Geobacillus thermoglucosidasius* SKF4; Alkaline serine protease; Detergent additive; X–ray recovery

PS 2.2

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Sustainable Agronomic Valorization of Unsulfured Molasses and Defatted Soybean Meal as an Optimized Formulation of Bio–organic Fertilizer Enriched with High Cell Density P–solubilizing Bacteria

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Abstract: The application of plant beneficial bioinoculants such as phosphate solubilizing bacteria is a sustainable approach to expanding crop performance in agriculture. However, bioinoculant strains, particularly non–sporulating bacteria are often exposed to detrimental conditions throughout the production process and a long period of storage. This will negatively influence their viable cell density and eventually limit its efficacy in the field. To overcome such scenario, an optimal formulation of biofertilizer should be prioritized. In this report, a sustainable valorization of molasses and defatted soybean meal as formulation of biofertilizer enriched with Enterobacter hormaechei 40a was proposed. Through the two–level factorial design and central composite design, the optimal formulation and fermentation conditions of bio–organic fertilizer to achieve maximum cell density of strain 40a were achieved. The highest cell density of strain 40a in the optimized molasses–DSM (OMD) medium was 12.56 log CFU/mL after 24 h which was 99.7% accuracy towards the predicted value. Interestingly, the solubilized P was increased by 62.4% in the OMD medium (174.07 µg/mL P) as compared to the standard P medium (65.38 µg/mL P). The shelf life of strain 40a after 180 days of storage was improved significantly around 10 log CFU/mL, when the OMD medium was amended with 0.1% sodium alginate. The strategy described here offers opportunities for agronomic formulation and large–scale bio–organic fertilizer production in the agriculture industry.

Keywords: Biofertilizer; Unsulfured molasses; Defatted soybean meal; Phosphate–solubilizing bacteria; Bioinoculant

PS 2.3

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Microbial Community of Two Faecal Contaminants Sources: Sewage Treatment Plant versus Goat Farm

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Abstract: Faecal contamination is a threat to water sources. Although faecal indicator bacteria are useful for monitoring faecal contamination, it could not differentiate the source of contaminants as human or animal due to its ubiquitous presence in the gut of all mammals. Microbes unique to each contaminant source would be better for tracking. This study aimed to identify these unique microbes. Dischargers from the sewage treatment plant and goat farm were subjected to 16S rRNA gene amplification of its V3–V4 hypervariable region, sequenced, and taxonomic assignment against the 16S rRNA database (SILVA release 132). Findings from the 16S rRNA sequencing showed that the microbial communities from both discharges featured the classic gut core phyla *Firmicutes/ Bacteroidetes/ Proteobacteria*, although at different portions. Goat farm discharge, but not sewage treatment plant, was best represented by gut bacteria, the sample's most abundant genera. On the other hand, human pathogens were the concern of effluent from the sewage treatment plant. In conclusion, the two faecal contaminant sources have different makeup to their microbial communities and with the possibility of differentiating both sources by their most abundant member.

Keywords: Sewage; Humans; Goat farm; Metagenome; Effluent

PS 2.4

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Pineapple Biorefinery Toward Zero Wastes for Sustainability

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Abstract: The concerns of sustainable development have encouraged efforts toward increasing the efficiency utilisation of agricultural by–products as alternative for range of bio–based products from low to high value products. Biorefinery is suggested as one of the approaches that represents an innovative approach in environmental management. Products/by–products after oil extraction of respective plants at the end of their service life or waste materials, products/by product are seen as valuable resources for high production of value–added bioproducts and are produced from renewable sources. A biorefinery is defined as the integrated and sustainable biomass processing into various marketable chemicals, materials, fuels and energy resources. Pineapple is one of the most common tropical fruits widely cultivated around the world for their fruits. Pineapple leaves, the major part of the plant that is currently unused needs global attention for its commercial exploitation. After fruit harvesting at the plantation and fruit processing at the factory, range of by–products were produced. The efficient utilisation of these by–products will contribute to sustainability of pineapple and zero wastes concept to produce value–added products.

Keywords: Pineapple; Biorefinery; Zero wastes; Value–added products; Sustainability

PS 2.5

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The Cultivation and Growth of *Chlorella sorokiniana* in Lab Scale Photobioreactor

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Abstract: Fossil fuels have been used globally as a source of energy for many applications. However, the dependency towards fossil fuels have been shifted gradually to biofuel due to its unrenewable characteristics. Among the biofuel generations, third– generation biofuels which are derived from microalgae have been preferred by commercial industries. *Chlorella* sp. is one of the freshwater microalgae that are being mass cultivated due to its unique characteristic in polyunsaturated fatty acids (PUFAs) production particularly fatty acid methyl ester (FAME) which is the key element in biofuel production. Furthermore, *Chlorella* sp. are likely to produce more fatty acids when they are cultivated under stressful condition such as high light intensities, pH and aeration. Generally, the cultivation of *Chlorella* sp. requires light, nutrient, and constant aeration which is crucial for the exponential growth of *Chlorella* sp. The focus of the study was on the morphological identification and the growth profile of *Chlorella* sp., it also covered the comparative study on the growth performance between freshwater *Chlorella* sp. that are isolated from two different environment and cultivated in a closed photobioreactor. The mass cultivation of *Chlorella* sp. is expected to have a significant effect on the production of third–generation biofuels which is a new source of sustainable energy. Hence, through the mass cultivation of *Chlorella* sp., the raw material of the third–generation biofuel would be secure and ensure the sustainability of the energy.

Keywords: *Chlorella sorokiniana*; Freshwater microalgae; Growth performance; Biofuel; Photobioreactor

PS 2.6

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Production, Activation, and Application of Biochar from The Coconut Shell and Husk Biomass: A Review

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Abstract: Biochar production is one of the methods applied for the management of the coconut waste biomass. Biochar is a carbon–rich material produced by a selected biomass conversion technology which is used for different application especially as an adsorption material. Pyrolysis, gasification, and self–sustained carbonization technology are used to produce biochar derived from the coconut shell and coconut husk biomass. The proximate (i.e., moisture, ash, volatile matter, and fixed carbon), ultimate (i.e., carbon, hydrogen, oxygen, nitrogen) and surface characteristics (i.e., BET surface area, pore diameter, pore volume, and surface functional group) of coconut–based biochar are varied depending on the reactor and its operating parameters (i.e., heating rate, temperature, and retention time). Furthermore, at different temperature, the physical activation (i.e., carbon dioxide (CO_2) and steam (H_2O)), chemical activation (phosphoric acid (H_2SO_4) and potassium hydroxide (KOH)) and metal impregnation (zinc chloride ($ZnCl_2$)) can change surface characteristics of the coconut–based biochar. Moreover, the biochar produced from the coconut shell biomass and coconut husk biomass are used for the purpose of both industrial application and environmental remediation. There is a growing interest in the production of the coconut–based biochar, but a review to specifically describe the production, activation, and application of biochar from the coconut waste feedstock, especially coconut shell and coconut husk, is still limited. Therefore, this paper presents a review of the production, activation, and application of biochar from the coconut shell and coconut husk biomass. It is observed that the characteristics of coconut shell biochar and coconut husk biochar produced from different biomass conversion technologies promote their ability for both environmental and industrial application.

Keywords: Coconut shell; Coconut husk; Biochar; Production; activation; Application

PS 2.7

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Heavy Metal Uptake of *Jatropha curcas* Grown in Bauxite Mine Soil

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Abstract: Rampant bauxite mining without proper regulation has led to heavy metal contamination in Kuantan, Pahang, Malaysia. Agricultural settlements like FELDA Bukit Goh now faces the threat of becoming a wasteland. Phytoremediation could offer a more cost effective and sustainable solution than the conventional remediation methods. Thus, this study was carried out to determine the heavy metal uptake of *Jatropha curcas* growing in bauxite mine soils. Bauxite mine topsoil and subsoil from FELDA Bukit Goh were sampled for the pot experiment in this study. Nursery soil was used as a control in the pot experiment. The bioavailability of Al, As, Cd, Cr, Fe, Pb and Zn in the soils was assessed through Mehlich 1 extraction and detection using ICP–OES before and after the pot experiment. Heavy metal uptake of *J. curcas* was examined by growing it in nursery soil, topsoil and subsoil for 120 days in a greenhouse before being analysed for heavy metals using the dry ashing method and detection of heavy metals using the ICP–OES. The most bioavailable heavy metal in both topsoil and subsoil was Al, notching values as high as 2613.47 mg/kg and 1458.00 mg/kg, respectively. The highest heavy metal removal in topsoil was measured in Al, with a reduced bioavailability of 24.72%. Whereas the bioavailability of Fe experienced the highest reduction in subsoil, with a value of 11.83%. The majority of heavy metals absorbed by *J. curcas* was accumulated in the plant roots, except for Pb and Zn in the topsoil plants where they had higher accumulation in the plant shoots. High bioconcentration factor (BCF) indicated that *J. curcas* was suited for phytostabilization of the heavy metals studied. In conclusion, *J. curcas* showed a potential as phytoremediator under harsh conditions. Further investigation on improving the growth and heavy metal uptake of *J. curcas* is recommended.

Keywords: *Jatropha curcas*; Growth performance; Bauxite mine soil; Heavy metal contamination; Phytoremediation

PS 2.8

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Fish Diversity in Rehabilitated Tin Mining Ponds of Kampar, Perak, Malaysia

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Abstract: Tin mining industry was once a major contributor to the Malaysian economy from 1820–1992. This transformed areas like Kampar, which is rich in tin resource, into a busy tin–mining town. When the mining industry ended, the mining sites were left deserted, thus forming freshwater ponds over time. These freshwater ponds were able to sustain a variety of organism such as fishes and shrimps, but their diversity remained largely unknown. Hence, with the aim to study the fish diversity in these ponds, the rehabilitated mining ponds surrounding the Universiti Tunku Abdul Rahman, Kampar campus in Perak were sampled over a period of four months. Samples were collected at four different sites to study the differences of the fish diversity and abundance at different habitat. Water samples were collected in order to study the water quality of disused tin mining ponds, including the level of dissolved oxygen, nitrate, nitrite, ammonia, turbidity, suspended solids, pH, water hardness, temperature and salinity. A total of 3022 fishes which belong to 12 species and 8 families were sampled. *Gambusia holbrooki* was the most abundant (35.24%), followed by *Cichlasoma urophthalmus* (29.09%), *Parambasis ranga* (8.88%), *Stigmatogobius poecilosoma* (6.59%), *Plecostomus* spp. (6.3%). The remaining species contributed the remaining 13.9% of the total catch. Fish diversity in the ponds was found to be closely related to human activities. Introduced species such as *G. holbrooki* and *C. urophthalmus* dominated the fish diversity in the ponds as they were more competitive and reproductive than native species. At site C, the number of species and individuals was the highest, resulting in the highest mean of Shannon–Weaver's Diversity Index (0.536). However, site D contained the highest mean of Simpson's Diversity Index (0.657) and Pielou's Evenness Index (0.84) due to a more uniformly distributed data. The water quality of sampling sites was found to be under Class IIA based on the Interim National Water Quality Standards for Malaysia.

Keywords: Tin mining ponds; Teleosts; Diversity; Water quality; Kampar

PS 2.9

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Potential of Cellulose–based Material for Palm Oil Mill Effluent Treatment

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Abstract: The inconsistency of existing technologies in treating palm oil mill effluent (POME) made difficulties to meet the standard discharge limit. The pollutant cannot be removed using biological or physical treatment solely. This study aims to remove the organic pollutants especially colour in POME using organic–based flocculant that derived from cellulose, namely hydroxyethyl cellulose or HEC. Prior to flocculation treatment with 1% HEC, POME that treated using secondary treatment is subjected to coagulation treatment using 10% ferric chloride. Jar test experiments were conducted for looking best parameters such as pH (4–9), coagulant dosages (10–20 mL) and flocculant dosages (1–5 mL). As results, at optimum pH of 8, coagulant dosages of 10 mL and flocculant dosages of 1 ml managed to reduced turbidity, COD and colour by 98%, 86% and 84%, respectively. The treatment also reduced heavy metals content mainly Fe and Cu to less than 2 ppm and 0.3 ppm, respectively. These results showed that HEC is potentially to be used as an alternative to chemical flocculant for POME treatment thus producing greener environment. Usage of HEC may diversify the cellulose application and may also add value when cellulose is being extracted from waste material such as oil palm biomass.

Keywords: Cellulose; Palm oil mill effluent; Colour; Pollutant; Heavy metals

PS 2.10

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Screening for Biosurfactant Producing Indigenous Fungi Cultivated in Waste Cooking Oil as Sole Carbon Source

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Abstract: Biosurfactants are microbial–based surface–active emulsifiers capable of reducing water surface tension. This study aims to identify the best indigenous fungi isolated from contaminated soils to produce biosurfactants using waste cooking oils as sole carbon source. Soil samples were collected from various locations including garbage dump site and automobile garage situated in Kuching, Sarawak. Initial fungal isolates were cultivated in Mineral Salt Medium (MSM) enriched with 2% (v/v) waste cooking oil at 30°C for 7 days to induce the production of biosurfactants. The drop collapsing test, oil displacement test and emulsification index (E24) test were then used to determine the presence of crude biosurfactants in the initial fungal cultures. The initial screening tests indicated that four fungal isolates, KCH–002 (*Trichoderma* spp.), KCH–012(*Rhizopus oryzae*), KCH–013 (*Trichoderma* spp.) and KCH–025 (*Penicilium citrinium*) were able to produce biosurfactants in MSM enriched with 2% (v/v) waste cooking oil. The KCH–025 isolate was the best biosurfactant producer, showing the greatest readings in oil displacement (1.28 ± 0.26 cm) and emulsification index (82.78 ± 1.4) KCH–025 isolates also yield the highest biomass (5.2 g/L) in the MSM enriched with waste cooking oil. Interestingly, the highest yield of crude biosurfactants were obtained from KCH–013 isolates (0.17g/L) which KCH–025 (0.15 g/L) although with much lower biomass (4.86 g/L) as compared to KCH–025. KCH–002,KCH–012 and KCH–013 isolates can produced biosurfactants but KCH–025 isolates choosen as the best isolates producing biosurfactants based on the results of drop collapsing test, oil displacement test and emulsification index test also selected to the next stage of the identification and biosurfactants characterization.

Keywords: Biosurfactants; Fungi; Drop collapsing test; Oil displacement test; Emulsification index test

PS 2.11

Besek Mariam Mohamad Jahis
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Modification of Oil Palm Decanter Cake Through Fermentation to Produce Fish Dietary Feed Pellet for Patin (*Pangasianodon hypophthalmus*)

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Abstract: Palm oil industry is one of the significant contributors in the agriculture sector. As there is a steady growth in palm oil demand, the plantation area is continuously growing and resulting in abundant palm oil waste production. This has led to the search for an alternative way to manage the waste. In this study, palm oil waste, specifically oil palm decanter cake (OPDC) will be analyzed as potential protein ingredients for animal feed. Protein is a primary energy source for aquatic animals, including fish. However, low protein and high–fat content in the OPDC will greatly influence the body composition of the fish. To achieve high digestible protein as fish feed ingredients for Patin fish (*Pangasianodon hypophthalmus*), oil palm decanter cake (50–100 g) will be subjected to the fermentation process and statistically optimize using response surface methodology (RSM). Crude protein and crude lipid will be optimized based on substrate, inoculum (*Ganoderma lucidum* and *Bacillus cereus*) and temperature. By applying the significant parameters, protein increment and higher fat reduction of OPDC are expected. After all, fermented OPDC can be implemented in the animal feed industry as an alternative and ideal protein–rich feed substance.

Keywords: Animal feed; Oil palm waste; Fermentation; *Ganoderma lucidum*; *Bacillus cereus*

PS 2.12

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Synergistic Effect of Antibiotic Agents Against *Cupriavidus* Species

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Abstract: Antibiotics are commonly prescribed in the medical setting to fight against bacterial infection. However, the rising of antibiotic resistance bacteria has caused a severe consequence includes high mortality rate in the population. *Cupriavidus metallidurans* (*C. metallidurans*), a pathogen that was known to cause wide range of diseases was isolated from the environment setting in Johor, Malaysia is the main focus in this study. Antibiotic combination therapy is proposed to tackle the issue of multiple antibiotic resistant (MAR) bacteria and prevent virulence of MAR bacteria in the future. The bacteria were isolated from the river (P3W1), and fish species, *Lates calcarifer* (G2) respectively. They were subjected to antibiotic susceptibility test by broth microdilution method for determining minimum inhibitory concentration (MIC) towards seven antibiotics namely, ampicillin, chloramphenicol, ciprofloxacin, gentamicin, rifampicin, sulfafurazole and tetracycline. Antibiotic activity was assessed by minimal bactericidal concentration (MBC) later. Double antibiotic combinations were carried out to determine synergistic effects and further validated with time kill assay. P3W1 was susceptible to all the antibiotics tested while G2 was resistant to tetracycline, intermediate to ciprofloxacin and susceptible to other antibiotics. All the antibiotics exhibited bacteriostatic towards P3W1. Chloramphenicol, gentamicin and sulfafurazole exhibited bacteriostatic towards G2 while the other antibiotics act bactericidal. Double antibiotic combination between ciprofloxacin and tetracycline exhibited synergistic effect on G2 with fractional inhibitory concentration index of 0.250. The synergistic effect of ciprofloxacin and tetracycline was validated in time kill assay. *In vivo* testing could be carried out in order to provide stronger evidence on the antibiotic combination effect. As the MAR issue is growing and creates health concern towards the public, this study providea insight into the synergy effect of combination drugs, to tackle multidrug resistant bacteria for shorter treatment and hospitality duration, and create awareness of MAR and provide better understanding to the public.

Keywords: Antibiotic resistance bacteria; *Cupriavidus metallidurans*; Antibiotic combinations; Synergistic effect; Time kill assay

PS 2.13

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Potential Cellulase Producing Facultative Anaerobic Bacteria Isolated from Black Soldier Fly (*Hermetia illucens*) Larvae

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Abstract: Microbial cellulases are useful for improving the fibre digestion in ruminants. These enzymes can be commercialized for enhancing the nutritional values of forages in animal feed industries. The gut of black soldier fly (*Hermetia illucens*) larvae comprised of different genus of promising cellulose degrading bacteria. This study aims to isolate and identify potential cellulase producing bacteria from BSF larvae fed with vegetable wastes as main food sources. A total of nine pure bacterial isolates were successfully isolated from the gut of BSF larvae. Four of them, LAB_101, LAB_104, LAB_107 and LAB_111 possessed the ability to digest cellulose when cultivated in Minimal Salt Medium (MSM) enriched with 2% (w/v) Carboxymethyl cellulose (CMC). DNS assay indicated the LAB_101 (*Bacillus thuringiensis*) have the highest crude cellulase activities (60.05 U/mL). Initial study also indicated that the LAB_101 was able to produce optimal cellulase activity at 37℃, with pH of the initial MSM cultivation medium were fixed at pH 6.53. The results from this study can be further utilized to optimize the production of microbial cellulase that can be commercialized for local animal feed industries.

Keywords: Cellulase, *Hermetia illucens*, *Bacillus thuringiensis*, DNS assay

PS 3.1

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Clean Synthesis of Palm Polyol Esters as Lubricant Base Stock Using Immobilized Lipases

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Abstract: Synthetic esters based on polyols and fatty acids possess suitable properties for lubricant application, even at extreme low temperatures. In our present work, enzymatic synthesis of palm polyol esters from polyhydric alcohol and alkyl methyl ester were synthesized using different commercial immobilized lipases. The potential of these enzymes to produce the palm polyol esters in a solvent–free medium were screened at various reaction conditions including reaction time (8–72 h), operating pressure (0.1–1.0 mbar) and enzyme dosage (1–10% w/w based on total substrate mixture) at fixed temperature of 70°C. The highest yield of the palm polyol ester achieved was 95.68±3.60% at reaction time of 23 h, pressure at 0.1 mbar and enzyme dosage of 5% w/w. The physicochemical properties of the palm polyol esters including viscosity index (VI), oxidative stability, pour point (PP) and cloud point (CP) indicated that the synthesized palm polyol esters are able to withstand at low temperature environment with VI of 208, oxidative stability of 42 min, PP of –30°C and CP of –15°C.

Keywords: Palm polyol esters; Immobilized lipases; Enzyme; Physicochemical properties; Oxidative stability

PS 3.2

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Application of Alcohol/Salt Aqueous Biphasic System for Purification of Microbial Protease

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Abstract: Microbial protease dominates the global enzyme market with diverse useful applications, especially in the food and feed, pharmaceutical, detergent and leather industries. Aqueous biphasic system (ABS) with simple, ease of scaling–up, cost–effective and environmentally friendly properties has been recommended as a potential technology for the downstream processing of microbial protease to improve the enzyme specificity and catalytic activity. To overcome the limitations of polymer–based ABS used for protease recovery such as high viscosity and low phase separation rate, alcohol/salt ABS is proposed as a potential alternative with comparatively low cost, low viscosity and rapid phase settling rate that is feasible to enhance the protease recovery process at industrial level. In the present study, alcohol/salt ABS was employed to recover and purify protease from recombinant *Bacillus subtilis* crude feedstock. The effect of ABS parameters including types and concentration of phase–forming alcohol and salt, concentration of crude load, system pH and concentration of sodium chloride addition on protease recovery were evaluated through a single–factor experiment. Protease was recovered and purified in alcohol/salt ABS of pH 7 comprising 20% (w/w) 2–propanol and 22% (w/w) potassium phosphate, loaded with 25% (w/w) crude feedstock without the addition of sodium chloride. The partition coefficient (K) of 3.14 ± 0.09 and selectivity (S) of 2.61 ± 0.08 were recorded in the alcohol/salt ABS with recovery yield (Y_T) of 86.25% ± 0.32 and purification fold (PF) of 2.32 ± 0.06 achieved in alcohol–rich top phase. Therefore, alcohol/salt ABS could serve as a promising approach for the industrial–scale recovery and purification of microbial proteases with minimal investment cost and processing time.

Keywords: Aqueous biphasic system; Recovery; Purification; Protease; Alcohol

PS 3.3

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Effect of Soaking Conditions (Temperature, Time and Water Level) on γ-Aminobutyric Acid (GABA) Content in Mung Bean

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Abstract: Gamma–aminobutyric acid (GABA) offers numerous beneficial effects on human health especially as blood pressure regulators and stress control. This functional compound is usually found in grains including mung bean. Mung bean (*Phaseolus aureus*) is one of the famous grain in South East Asia and usually used in cooking as porridge or dessert by local people. It is highly nutritious with protein and antioxidant. In this study, it is intended to determine the optimum soaking to enhance GABA content in mung bean. A RSM with five–level, three–factorial, Central composite Rotatable Design (CCRD) were used to determine the soaking parameters to obtain maximum GABA content, essential amino acid (EAA) and total amino acids (TAA) in mung bean. The factors that were included in the RSM analysis were temperature, time and weight of beans to water ratio. GABA and amino acids were determined by using UPLC. The optimum condition for significant GABA production ($p < 0.05$) were determined as 40°C, 4 h and 1:5 of temperature, time and soaking water level, respectively with the highest GABA content quantified as 130.12 mg/100 g dry weight. Model optimization and validation were done according to the optimum conditions from the RSM analysis resulting in 124.17 mg/100 g DW of GABA, closer to predicted value (130.07 mg/100 g DW). The optimum conditions determined by RSM could be beneficial to the industry especially the functional food production to cater the demand on health promoting products in the market.

Keywords: Mung bean; Soaking conditions; GABA; Amino acids

PS 3.4

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Molecular Docking Study for Identification of The Potential Fatty Acid Synthase Inhibitors from *Acalypha indica* Ethanolic Extract

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Abstract: Abnormal lipid metabolism is recognized as one of the characteristics of malignant transformation in breast cancer. It is associated with a high expression level of fatty acid synthase (FASN) which is the key enzyme that is responsible for the condensation of malonyl–CoA to palmitate in the de novo fatty acid synthesis. Therefore, human FASN in particular the thioesterase (TE) domain is an attractive molecular target for the treatment of breast cancer. *Acalypha indica* is a polyphenols–rich herbal plant with various medicinal properties such as antibacterial, antioxidant and anticancer activities. However, studies on the effectiveness of A. *indica* ethanolic extract as natural FASN inhibitor is still less explored. This study was designed to investigate the binding affinity and molecular interactions of selected phenolic acids and flavonoids from *A. indica* ethanolic extract with the FASN TE domain through molecular docking approach. The phenolic acids studied were gallic acid, ferulic acid, and caffeic acid while the flavonoid compounds were rutin and quercetin. Molecular docking of these polyphenols were performed using AutoDock 4.0 and the molecular interactions were investigated using protein–ligand interaction profiler (PLIP) web server. The computational results showed that the binding positions of all the studied compounds are within the TE active site, mainly in the distal pocket. This suggested that *A. indica* ethanolic extract may inhibit the FASN's biological activity in a way to compete with the natural substrate, palmitate. Flavonoids were considered as the most potential competitive inhibitor due to their lower binding energy values (Quercetin: –6.39 kcal/mol; Rutin: –6.22 kcal/mol) compared to phenolic acids and the reference inhibitor, Orlistat (–5.47 kcal/mol). Quercetin showed the best inhibitory potency, followed by rutin with the expected IC_{50} value of 27.36 uM and 20.79 µM, respectively. Our findings indicated that *A. indica* ethanolic extract may serve as a potential anti–breast cancer drug through its ability to inhibit FASN TE domain.

Keywords: *Acalypha indica*; Breast cancer; Fatty acid synthase (FASN); Anticancer; Molecular docking

PS 3.5

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Antibacterial Potential of Biosynthesized Zinc Oxide Nanoparticles Against Poultry–associated Foodborne Pathogens: An *in vitro* Study

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Abstract: Since the emergence of multidrug–resistant bacteria in the poultry industry is currently a serious threat, there is an urgent need to develop a more efficient and alternative antibacterial substance. Zinc oxide nanoparticles (ZnO NPs) have exhibited antibacterial efficacy against a wide range of microorganisms. Although the *in vitro* antibacterial activity of ZnO NPs has been studied, little is known about the antibacterial mechanisms of ZnO NPs against poultry–associated foodborne pathogens. In the present study, ZnO NPs were successfully synthesized using *Lactobacillus plantarum* TA4, characterized, and their antibacterial potential against common avian pathogens (*Salmonella* spp, *Escherichia coli*, and *Staphylococcus aureus*) was investigated. Confirmation of ZnO NPs by UV–Visual spectroscopy showed an absorption band center at 360 nm. Morphologically, the synthesized ZnO NPs were oval with an average particle size of 29.7 nm. Based on the dissolu–tion study of Zn^{2+}, ZnO NPs released more ions than their bulk counterparts. Results from the agar well diffusion assay indicated that ZnO NPs effectively inhibited the growth of the three poultry–associated foodborne pathogens. The minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were assessed using various concentrations of ZnO NPs, which resulted in excellent antibacterial activity as compared to the bulkier counterparts. *S. aureus* was more susceptible to ZnO NPs compared to the other tested bacteria. Furthermore, the ZnO NPs demonstrated substantial biofilm inhibition and eradication. The formation of reactive oxygen species (ROS) and cellular material leakage was quantified to determine the underlying antibacterial mechanisms, whereas a scanning electron microscope (SEM) was used to examine the morphological changes of tested bacteria treated with ZnO NPs. The findings suggested that ROS–induced oxidative stress caused membrane damage and bacterial cell death. Overall, the results demonstrated that ZnO NPs could be developed as an alternative antibiotic in poultry production and revealed new possibilities in combating pathogenic microorganisms.

Keywords: Antibacterial; Zinc oxide; Nanoparticles; Foodborne pathogens

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