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The Proceeding of

ASEAN Bioenergy and Bioeconomy Conference

October 15th, 2021 THAILAND

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

October 15th, 2021

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Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI),

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The Proceeding of

ASEAN Bioenergy and Bioeconomy Conference

October 15th, 2021 THAILAND

EDITED BY

SIRILUCK LIENGPRAYOON

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ABB Conference 2021

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Agenda: ABB2021 Virtual Conference

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

October 15th, 2021, 09.00-15.30 hrs. (GMT+7 Bangkok)

Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.1)

Opening ceremony

Moderator:	**Dr. Worajit Setthapun, Dean of adiCET, Chiangmai Rajabhat University**
09.00 – 09.15	**Starting the conference**
09.15 – 09.30	**Report on the opening ceremony** Dr. Pilanee Vaithanomsat, Director of Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University
09.30 – 10.00	**Opening ceremony** Dr. Chongrak Wachrinrat, President of Kasetsart University
10.00 – 10.45	**Keynote presentation** “Recommended Policy for Promoting Sustainable Energy in Thailand” Dr. Yaowateera Achawangkul, Ministry of Energy
10.45 – 11.00	**Separate to the meeting links** *Session I: Bioenergy (virtual conference link no.1)* *Session II: Bioeconomy (virtual conference link no.2)*

Agenda: ABB2021 Virtual Conference (Cont.)

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

October 15th, 2021, 09.00-15.30 hrs. (GMT+7 Bangkok)

Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.1)

Session I: Bioenergy

Chairman:	**Dr. Worajit Setthapun**
11.00 – 11.30	Invited presentation 1 Novelty of biomass cazy's families to improve the value-added of agro-industrial by product as energy source **Prof. Dr. Ni Nyoman Tri Puspaningsih** Head of University CoE-Research Center for Bio-Molecule Engineering, Universitas Airlangga, Indonesia
11.30 – 12.00	Invited presentation 2 Anaerobic digestion: an essential step of sustainable organic waste management towards circular economy **Dr. Pornpan Panichnumsin** National Science and Technology Development Agency, Thailand
12.00 – 13.00	*Lunch*
13.00 – 13.20	Oral presentation 1 (EN-R001) Utilising waste CO_2 to increase algal biomass for biofuel production **Dr. Supatchalee Sophonthammaphat** Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand
13.20 – 13.40	Oral presentation 2 (EN-R002) A review green economy and biocircular economy model in Thailand and other countries **Dr. Robert Edyvean** Department of Chemical and Biological Engineering, The University of Sheffield, UK.

Agenda: ABB2021 Virtual Conference (Cont.)

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

October 15th, 2021, 09.00-15.30 hrs. (GMT+7 Bangkok)

Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.1)

Session I: Bioenergy

13.40 – 14.00	Oral presentation 3 (EN-R003) Comparisons of heating methods in corn cob pretreatment by 1-butyl-3-methylimidazolium tetrafluoroborate and dimethylsulfoxide to enhance the enzymatic hydrolysis **Ms. Manita Kuntapa** Energy Technology Program, School of Energy, Environment and Materials, King Mongkut's University of Technology Thonburi
14.00 – 14.20	Oral presentation 4 (EN-R004) Strategies of biogas production supplement in three stages high solid anaerobic digestion (TSHS-AD) with digestate reusing. **Mr. Burachat Sripitak** Energy Technology Program, Faculty of Engineering, Prince of Songkla University, Songkhla, Thailand.
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Agenda: ABB2021 Virtual Conference (Cont.)

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Sustainable Bioresources for Green Energy and Economy

October 15th, 2021, 09.00-15.30 hrs. (GMT+7 Bangkok)

Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.1)

Session I: Bioenergy

14.40 – 15.00	Oral presentation 6 (EN-R006) Methane production from two-stage anaerobic co-digestion process treating waste activated sludge and DAF slurry in tuna canning factories **Ms. Khaliyah Sani** Energy Technology Program, Faculty of Engineering, Prince of Songkla University, Songkhla, Thailand
15.30	**Closing bioenergy session** Dr. Chakrit Tachaapaikoon, Vice Chairman of ABB2021

Agenda: ABB2021 Virtual Conference (Cont.)

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

October 15th, 2021, 09.00-15.30 hrs. (GMT+7 Bangkok)

Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.2)

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Chairman:	**Asst.Prof.Dr. Patthra Pason**
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11.30 – 12.00	Invited presentation 2 Bio-based and biodegradable plastics from renewable resources and sustainable processes **Prof. Dr. Kumar Sudesh** School of Biological Sciences, Universiti Sains Malaysia, Malaysia
12.00 – 13.00	*Lunch*
13.00 – 13.20	Oral presentation 1 (EC-R001) The dynamics of non-structural carbohydrate and involved enzymes, in relation with latex yield of rubber trees **Mr. Tucksin Lerksamran** Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), Kasetsart University, Bangkok, Thailand
13.20 – 13.40	Oral presentation 2 (EC-R002) The physiological responses and sugar partitioning mechanisms of maize (*Zea mays* L.) at flowering stage under different drought stress regimes **Mr. Artit Pongtip** Department of Agronomy, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

Agenda: ABB2021 Virtual Conference (Cont.)

ASEAN Bioenergy and Bioeconomy Conference 2021:

Sustainable Bioresources for Green Energy and Economy

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Bangkok International Trade and Exhibition Centre (BITEC), Bangkok, Thailand

(Virtual conference link no.2)

Session II: Bioeconomy

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KAPI, Kasetsart University, Thailand

PREFACE

Dr. Chongrak Wachrinrat
President
Kasetsart University, Thailand

It is my pleasure to extend to all of you a warm welcome on behalf of Kasetsart University to the "ASEAN Bioenergy and Bioeconomy Conference 2021".

I will start by wishing you and your families good health and safety during these difficult times as the global COVID-19 epidemic continues. Consequently, the ABB2021 conference is conducted online to ensure the safety and good health of all attendees.

Allow me to extend a special welcome to the distinguished keynote speaker, Dr. Yaowateera Achawangkul, from the Ministry of Energy, and to our honorable speakers invited to address us during the bioenergy and bioeconomy sessions, Prof. Dr. Ni Nyoman Tri Puspaningsih, Head of University CoE-Research Center for Bio-Molecule Engineering; Dr. Pornpan Panichnumsin, National Science and Technology Development Agency, Thailand; Dr. Sousuke Imamura, Distinguished Researcher, NTT Space and Environment Energy Laboratories, Japan; and Prof. Dr. Kumar Sudesh, School of Biological Sciences, Universiti Sains Malaysia. We sincerely thank you for honoring our invitation despite your busy schedules.

Today's symposium will open more opportunities for researchers, scientists, and technologists to share their expertise, innovation, and research methods. We all share the collaborative commitment to develop Sustainable Biomass programs throughout the ASEAN community.

I would like to express my sincere appreciation to the organizing committee, led by Dr. Pilanee Vaithanomsat, Director of Kasetsart Agricultural and Agro-Industrial Product Improvement Institute (KAPI), for organizing this conference and ensuring the continuity of this event. My gratitude is also given to King Mongkut's University of Technology Thonburi, Chiang Mai Rajaphat University, and Informa Markets (Thailand) Co., Ltd. as well as the other companies, universities, and organizations who cooperated and contributed to this important conference.

I am confident that this symposium will achieve its objectives and provide tremendous value to our global society. In closing, I wish you a fruitful discussion and successful symposium. I am honored to declare this conference open.

KEYNOTE

Dr. Yaowateera Achawangkul
Ministry of Energy, Thailand

Dr. Yaowateera has graduated in bachelor's degree of Engineering (Mechanical Engineering) from Mahidol University in Year 2004, and he holds the Ph.D. (Systems Engineering) from Mie University, Japan in 2014. His interesting issues involve biomass energy, combustion and incineration, new and renewable energy, including life cycle assessment (LCA).

Dr. Yaowateera Achawangkul is now working in the Energy Research Division, Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy of Thailand, as a Mechanical Engineer: Senior Professional Level. He has experiences in alternative and renewable energies, especially, biomass to energy. He has been invited to be a guest speaker in both local and international symposiums. Dr. Yaowateera is also a special lecturer in many institutes, for example, Thammasat University, NIDA, Naresuan University, Mie University, etc. In addition, Dr. Yaowateera has been nominated to be a judge in many energy-related competitions, such as Thailand Energy Awards, ASEAN Energy Awards, Youth for SDGs Contest, etc.

Dr. Yaowateera also holds the positions in the international forums. For example, he is now a member of UNESCAP's expert working group on energy, and the representative of ASEAN's renewable energy sub-sector network (RE-SSN).

Invited Presentation

BIOENERGY

INVITED Speaker 1

Bibliography

Prof. Dr. NI NYOMAN TRI PUSPANINGSIH
Department of Chemistry, Faculty of Science and Technology, Universitas Airlangga,
Surabaya, Indonesia

She received the B.S.degree in Chemistry from Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Airlangga, Surabaya, in 1986, the M.Sc, degree from Department of Chemistry (Biochemistry) Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, in 1994, and the Doctorate degree from Department of Biology (Microbiology), Faculty of Mathematics and Natural Sciences, Institut Pertanian Bogor, in 2004. On 1999, 2002 and 2003, she joined JSPS short course fellows in Japan. She joined post-doctoral fellows program KNAW Netherlands on 2005 and 2007 at University of Groningen and also got KNAW-Multi networking Grant, The Netherlands on 2009 collaboration with Laboratory of Protein Crystallography, University of Groningen, The Netherlands.

She achieved the Professor in Biochemistry on 2010 and she was appointed as Adjunct Professor at Asia University in Taiwan in 2017-2018. From 1987 to present, she worked as Biochemistry lecturer at Dept. Of Chemistry, Faculty of Science and Technology in Universitas Airlangga. From 2011 to present, she appointed as the Head of Proteomic Laboratory at Institute of Tropical Disease in Universitas Airlangga that rebuilt as Center for Bio-Molecule Engineering in 2019. From 2007 to 2017 worked as Academic Director at Universitas Airlangga, then June 2017- December 2019, she is appointed as Excecutive Director for Airlangga Global Engagement at Universitas Airlangga. Since 2021-now she is appointed as Vice Rector for Research, Innovation and Community Development. The research grants during five years (2013 – 2019) are (1). Join Research with Institute for protein Research-Osaka University Japan on Crystallization for CBM of *Geobacillus thermoleovorans* IT-08 , (2). RAPID Research Grant and (3) STRANAS Grant, funding by

Indonesian Ministry of Research, Technology, and Higher Education and her current research interests include structure, mechanism and function analysis of lignocellulolytic Enzymes.

Related to the pandemic Covid19, she is appointed as Coordinator of Covid19 Research Product in Universitas Airlangga. She has already published the research at international journal, also awarded of 2 national patents. The research collaboration is being done with overseas universities, research institute, and industries. She is actively also participated as invited speaker related to International Collaboration on Higher Education strategy, output and impact. Prof. Dr. Ni Nyoman Tri Puspaningsih, M.Si is the steering committee Indonesian Society on Biochemistry and Molecular Biology (PBBMI) and Asian Community of Glycoscience and Glycotechnology (ACGG). She is also member of Indonesian Chemical Society, Indonesian Protein Society, Asean Microbiology Network and Utilization (AnMicro).

NOVELTY OF BIOMASS CAZY's FAMILIES TO IMPROVE THE VALUE-ADDED OF AGRO-INDUSTRIAL BY PRODUCT AS ENERGY SOURCE

ABSTRACT

The main component of biomass consists of cellulose, hemicellulose, and lignin. These valuable components can be converted as source of energy. Enzymatic degradation of biomass need consortium enzyme of cellulolytic, hemicellulolytic, and lignolytic, the complex enzyme that produce monosaccharides and oligosaccharides. Xylanolytic enzymes is the one of hemicellulolytic enzymes which is classified into Glycoside Hydrolase (GH) families from 1 until 164. The diversity of GH families also indicated the unique and novelty of bifunctional or single activity between xylanolytic enzymes. Biomass acting enzymes from Indonesian hot spring bacteria have successfully isolated and indicated the novel xylanolytic enzymes either as bifunctional or single activity.

Keywords: Biomass, Xylanolytic Enzymes, Glycoside Hydrolase families

INVITED Speaker 2

Bibliography

Dr. PORNPAN PANICHNUMSIN

Excellent Center of Waste Utilization and Management (ECoWaste), National Center of Genetic Engineering and Biotechnology (BIOTEC), Bangkok, Thailand

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Dr. Pornpan Panichnumsin is a researcher of Excellent Center of Waste Utilization and Management (ECoWaste), National Center for Genetic Engineering and Biotechnology. Dr. Pornpan received a Ph.D. in Environmental Technology with the topic on “Anaerobic co-digestion of cassava pulp and pig manure for energy production” from Joist Graduate School of Energy and Environment (JGSEE), King Mongkut’s University of Technology Thonburi, Thailand in 2011. She has worked on anaerobic digestion technology with experience of more than 20 years. Her research interests mainly on development of anaerobic digestion process for generation of renewable energy from agro-industrial wastewaters and by-products, lignocellulosic biomass and food waste. This includes searching for new potential feedstocks for biogas production, investigation of pretreatment process and optimization of AD process. She also works on characterization of the microbial community in an anaerobic digestion system. A particular focus of her current research is development of wastes integration treatment and alternative bioenergy/chemical production process.

ANAEROBIC DIGESTION: AN ESSENTIAL STEP OF SUSTAINABLE ORGANIC WASTE MANAGEMENT TOWARDS CIRCULAR ECONOMY

Pornpan Panichnumsin[1*], Tunyaporn Puengpraput[2], Phimonrat Niyomwet[2], and Vasimon Ruanglek[3]

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ABSTRACT

Background:

With the concept of applying circular economy as new based economy to replace the linear economy that causes many environmental problems. Anaerobic co-digestion technology is considered an important connecting technology that allows the conversion of organic wastes into both fuels and some potential chemicals. Thus, further development of such technology based on verified laboratory results of multi-waste feedstocks operations are necessary to support the integration of alternative business models where the land area vicinity may already have the neighborhood of industry, agriculture and residential communities connected in one. Once success, this model would add value to sustainable green chemistry production that worth in terms of economic for agricultural based country like Thailand.

Hypothesis/Purpose:

The project is developed to create new choices/paths for waste utilization that could add values to wastes from industry, agriculture, or municipality and turn them into raw materials for fuels or even refined chemicals in the future. At the same time, it is a development of a treatment process that could utilize the retaining value of organic wastes and thus integrate the new cycle of raw materials utilization under circular economy direction.

Methods:

In this study, we examined the potential feedstocks for successful anaerobic co-digestion. In addition, the comparative study of anaerobic co-digestion of the mixtures of 2-4 feedstocks was investigated in three systems 1) Mesophilic single stage (MSS) 2) Thermophilic single stage (TSS) and 3) Mesophilic two stage (MTS). These systems were evaluated in terms of methane production efficiency, COD and solids removal efficiency and effluent quality. The basic economical feasibility of large-scale studies were evaluated by comparing some parameters, namely factory location, waste feedstock availability within the area, the process designed mode of operation, feedstock type and ratio, with pre-treatment choice, and benefits on methane gas utilization.

Results:

The potential feedstocks for anaerobic co-digestion were water hyacinth, waste activated sludge, leachate and cassava pulp which had the biochemical methane potential of 8, 17, 29 and 54 m^3/ton-Feedstock, respectively. This study indicates that the mesophilic two stage (MTS) CSTRs was the promising system for anaerobic co-digestion of the selected feedstocks. Anaerobic co-digestion of the mixtures of 2-4 feedstocks obtained methane productivity of 1.45 Nm^3/m^3 active volumed at OLR 4.5 $kgCOD/m^3$. d and HRT of 30 days. In addition, techno-economical feasibility studies were used to create or select choices of an integrated waste management system consisting of anaerobic digestion technology within the operation. A scenario study illustrates economic return even when challenged with 5 times sensitivity analysis using worst production case scenario. The estimate could cover energy saving of 181 MB during year one. From the 15^{th} and 25^{th} year projection, the payback period of the investment is 3-4 year with 30-31% IRR and Net Present value of 1,025-1,113 MB which is considered as a high return on investment.

Conclusion:

This study illustrates the successful anaerobic co-digestion of several streams of organic wastes. However, more other scenario studies are required and the study may need to evaluate risk of securing different feedstocks, to estimate starting pilot test size, circular business model integration for cost-effective investment, and technology licensing model to expand the process to other potential locations.

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Keywords: Anaerobic co-digestion; Bioenergy; Circular economy; Organic wastes

Invited Presentation

BIOECONOMY

INVITED Speaker 1

Bibliography

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Sousuke Imamura received his Ph.D. from Tokyo University of Agriculture and Technology in 2005. He worked as a JSPS Research Fellow at The University of Tokyo from 2005 to 2009. He joined Chuo University as an assistant professor in 2009. In 2012, he was appointed as an associate professor at Tokyo Institute of Technology. In March 2021, he joined NTT Space Environment and Energy Laboratories, Nippon Telephone and Telegraph Corporation, as a distinguished researcher. He is also a visiting professor at Tokyo Institute of Technology. Dr. Imamura has received prestigious awards from the Society of Genome Microbiology, Japan, in 2010 and Nagase Science and Technology Foundation in 2017. His research interests include regeneration of the global environment, plant molecular biology, and biomass production.

REGENERATION OF THE GLOBAL ENVIRONMENT USING ALGAE: UNDERLYING MOLECULAR MECHANISMS OF CARBON STORAGE MOLECULES AND THEIR APPLICATIONS

ABSTRACT

Background:

Microalgae are suitable organisms to regenerate the global environment owing to their robustness in a wide range of growth conditions and their ability of high CO_2 fixation and useful compounds production. For example, microalgae can accumulate large amounts of

energy-storage compounds, such as triacylglycerols (TAGs) and starch, which are important feedstocks for biofuel production. However, our understanding of how such tiny microalgae accumulate these energy-storage compounds is limited.

Hypothesis/Purpose:

This study aimed to investigate the molecular mechanism underlying the accumulation of TAGs and starch in the unicellular red alga *Cyanidioschyzon merolae*. Furthermore, we tried increasing the TAG/starch contents using genetic engineering approaches based on revealed molecular mechanisms.

Methods:

We previously reported that the inhibition of conserved protein kinase target of rapamycin (TOR) resulted in the accumulation of TAGs/starch in microalgae (Imamura *et al*., 2015 and 2016; Pancha *et al*., 2019a, 2020 and 2021). Based on these findings, detailed molecular mechanisms of the role of TOR in controlling the accumulation of TAGs and starch were determined via omics analyses. After selecting candidate regulators, we overexpressed each of them in *C. merolae* cells and observed the TAG and starch contents under normal growth conditions.

Results:

Crucial regulators were found for TAG and starch accumulation. In the case of TAG accumulation, an endoplasmic reticulum (ER)-localized CmGPAT1 encoding glycerol-3-phosphate acyltransferase is a key player. CmGPAT1 overexpression resulted in a marked accumulation of TAG, even under normal growth conditions, with the maximum TAG productivity increased by 56.1-fold compared with that of the control strain, without negatively impacting algal growth (Fukuda and Hirasawa *et al*., 2018). This indicates that the reaction catalyzed by CmGPAT1 is a rate-limiting step for TAG synthesis in *C. merolae* and a potential target for improving TAG productivity in microalgae.

Regarding starch accumulation, the results indicate that TOR modulates starch accumulation by changing the phosphorylation status of the Ser613 residue of CmGLG1, which is the priming protein, glycogenin that is required for initiating starch/glycogen synthesis in eukaryotes. Approximately 60% reduction was observed in the starch content in a phosphomimicking CmGLG1 overexpressing strain, in which Ser613 of CmGLG1 was

substituted with aspartic acid. This leads us to the hypothesis that the dephosphorylated form of CmGLG1 triggers starch accumulation (Pancha *et al*., 2019a, 2019b and 2021).

In addition to the aforementioned approaches, some key regulators of TAG/starch accumulation, including fatty acid transporter, transcription factors, TAG biosynthesis gene, and starch phosphorylation protein, were identified using data from TOR-related analyses (Takemura *et al*., 2019; Pancha *et al*., 2019b; Takahashi *et al*., 2021). Furthermore, it was revealed that the TOR functions observed in *C. merolae* were conserved among microalgae (Imamura *et al*., 2016).

Conclusion:

TOR plays a critical role in the functions of the carbon storage molecules, TAGs and starch, in microalgae (Pancha *et al*., 2020 and 2021). Therefore, elucidating the functions of TOR in the production of TAGs/starch is critical to improving the contents of these products, and uncovering the detailed functions of TOR will be helpful and indispensable to regenerating the global environment using microalgae.

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Keywords: microalgae; global environment; triacylglycerol; starch; target of rapamycin; biomass

INVITED Speaker 2

Bibliography

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Sudesh Kumar is a professor at the School of Biological Sciences, Universiti Sains Malaysia and is well-known for his research on bio-based and biodegradable plastics produced by microbes, polyhydroxyalkanoates (PHA). His research activities are funded by several international, national and university grants. To date, 30 MSc and 38 PhD students have graduated under his supervision. With more than 200 scientific publications and 8 granted patents, he is among the top research scientists in Malaysia. He is also the Chief Editor of Malaysian Journal of Microbiology and a Fellow of Academy of Sciences Malaysia (FASc).

BIO-BASED AND BIODEGRADABLE PLASTICS FROM RENEWABLE RESOURCES AND SUSTAINABLE PROCESSES

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ABSTRACT

Background:

Polyhydroxyalkanoates (PHAs) are a family of microbial polyesters which have properties like some petrochemical plastics. PHAs are not only 100% biodegradable but they are also bio-based and biocompatible.

Hypothesis/Purpose:

This study aimed to develop efficient and sustainable processes for the biosynthesis of PHA from renewable resources that are readily available in Malaysia and the development of ecofriendly recovery methods to extract and purify the PHA from the bacterial cells.

Methods:

Malaysia is rich in various renewable biomass resources. The oil palm industry generates not only oil but also sugar-rich oil palm trunk sap. Efficient fermentation processes have been developed to produce PHAs from oils and sugars. In addition, a new biological recovery process using mealworms have been developed to recover and purify the PHAs from bacterial cells.

Results:

Palm oil is the most efficiently produced vegetable oil with productivities reaching 3.6 tonnes oil/ha/year (palm oil + palm kernel oil). The total oil palm cultivation area in Malaysia is approximately 5.9 million ha and is expected to grow because of increasing demand. Every 20-25 years the oil palm trees are replanted to improve yield and productivity. During replantation, huge amounts of old oil palm trunks are felled and left in the plantation. Each trunk weighs 1.5 to 2 tones and contains more than 70 wt.% of sap which is rich in sugars and other nutrients. The sap can be used as a bacterial growth medium in fermentation processes to produce various microbial products including PHA. In addition to the sugary sap, the palm oil refining process produces various by-products that are rich in fatty acids and triglycerides which can be efficiently converted into PHA by specific bacteria. Several types of these renewable feedstock from the oil palm industry have been determined to be effective as carbon sources to produce PHA. In addition, the recovery of PHA by using mealworms has enabled the production of kilograms amount of PHA in the laboratory, which are being used to develop various applications.

Conclusion:

PHA is a thermoplastic material with great potential to replace at least some of the currently used petrochemical plastics, especially the ones used for single-use applications. For this, the cost of PHA must be economically feasible. The use of waste materials from the oil palm industry is especially attractive for the high-yield production of PHA.

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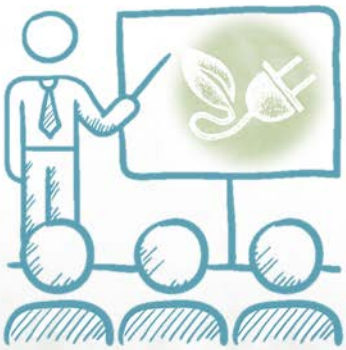
Keywords: bio-based, biodegradable, polyhydroxyalkanoate, palm oil, sustainable



ORAL PRESENTATION
Bioenergy

EN-R001

Utilising waste CO_2 to increase algal biomass for biofuel production

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Abstract

Environmental issues are a major challenge to energy production. The burning of fossil fuels to produce electricity impacts on the amount of “GHGs” in the atmosphere, climate change and global warming. This study reviews CO_2 production from a gas powered electricity plant and looks at how carbon (as CO_2) can be captured and utilised from the offgas by increasing the percentage CO_2 in air provided to grow microalgae in a photobioreactor system. These algae can then be used to produce biofuel. Algal growth rates and yields were measured for additions of 0, 6, 12, 24 and 50% CO_2 (v/v in air). Algae grown in 6-12% CO_2 (v/v) grow rapidly and these are the most suitable conditions for culturing. Bulk colour can identify the efficiency of photosynthesis in a photobioreactor system.

Keywords: Bioenergy, Biofuel, Microalgae, Photobioreactor, Renewable energy

EN-R002

A review green economy and biocircular economy model in Thailand and other countries

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Abstract

With concerns about CO_2 emissions and their required reduction, the world is changing how it looks at its future development. Thailand is one country seeking to develop green economy and biocircular economy solutions to mitigate carbon build up in the atmosphere. This study reviews the Thai policy and planning in these areas, focusing on bioenergy. The aim is to understand the strategic activities required to lead Thailand to smart and green cities and a future sustainable biocircular economy.

Keywords: BCG Model, Biocircular economy, Bioenergy, CO_2 emission, Smart city

EN-R003

Comparison of heating methods in corn cob pretreatment by 1-butyl-3-methylimida zolium tetrafluoroborate and dimethylsulfoxide to enhance the enzymatic hydrolysis

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Abstract

Ionic liquid (IL) is one of the most widely applied chemical pretreatment methods in delignification to enhance the enzymatic hydrolysis of biomass pretreatment. However, the costs of ILs are high when compared with other methods. Among them, 1-butyl-3-methylimidazolium tetrafluoroborate ([BMIM]BF_4) is cheaper, but its limitation is due to fact that ''F- complex cannot be easily separated from [BMIM]BF_4, resulting in [BMIM]BF_3^- which is capable of breaking down H-bonds. This limitation is recently solved by using the low-toxic solvent as a dimethyl sulfoxide (DMSO). In this work, a study of delignification for enhancing the digestibility of enzymatic with different heating methods is presented. Corn cobs are pretreated with [BMIM]BF_4: DMSO. Afterwards, temperature of substrate is increased by hot air oven, autoclave and hot plate to 120°C for 3 hours. It was discovered that delignification with hot air oven is higher than the delignification with autoclave and hot plate by 1.73 and 2.02 folds. According to XRD analysis, the lignocellulosic structures of substrates are more damaged by heating with hot air oven and autoclave than by heating with hot plate, as evidenced by CI values (27.17, 24.22 and 30.18, respectively). In terms of enzymatic digestibility, the hot air oven has the maximum cellulose conversion of 85.51 percent, while autoclave and hot plate have 79.78 and 69.76 percent. Furthermore, 5-hydroxymethyl-2-furaldehyde (HMF), known as an inhibitor, cannot be detected by heating with hot air oven. The results suggest that the heating method by hot air oven for [BMIM]BF_4: DMSO pretreatment is an excellent alternative.

Keywords: 1-Butyl-3-methylimidazolium tetrafluoroborate, delignification, hot air oven, pretreatment

EN-R004

Strategies of biogas production supplement in three stages high solid anaerobic digestion (TSHS-AD) with digestate reusing

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Abstract

This research aimed to enhance and stabilize three stages of high solid anaerobic digestion (TSHS-AD) with digestate reusing. There are two types of enriched sludge including the biogas plant sludge and the digestate reuse sludge mix with cow manure. Two enriched sludge was various cow manure/sludge (0:1, 1:0, 1:1, 1:2 1:3 and 1:4 w/w). The cow manure/sludge (1:2) of two enriched sludge maximizing methane production in each formula. The biogas from plant enrich sludge is 410 mL-CH_4·gVS^{-1} and the digestate reusing enrich sludge is 417 mL-CH_4·gVS^{-1} respectively. The high solid anaerobic digestion batch test was various cow manure: two sorts of enriching sludge (S: I) ratios on volatile solid (VS) basis (1:1, 2:1, 3:1 and 4:1). The 2:1 ratio of S to I of two enriched sludge maximizing methane production. The methane yield of the batch from digestate reusing is greater than methane yield from the biogas plant sludge batch. Especially at the proportion of S to I at 2:1 ratio of digestate reusing batch can produce methane is 323 mL-CH_4·gVS^{-1}, of which kh is 0.12 d^{-1}. Rmax, T90, and Tef parameters increased when S:I increase to 2:1 ratio of S to I and decreased after that. Besides, the lag phase is minimum when 2:1 ratio of S to I. The three stages high solid anaerobic digestion (TSHS-AD) with digestate reuse sludge at 2:1 ratio of S to I, presented the highest cumulative methane yields of 427.16 mL-CH_4·gVS^{-1} which is 10% greater than methane yield obtained from biogas plant sludge. Moreover, digestate reuse sludge process is more economical and has a higher VS reduction rate, and maintains pH

within the optimal range for the methanogen phase. The data produced in this research will benefit farmers producing biogas alongside cattle raising and will also be more helpful to the TSHS-AD scale-up.

Keywords: Biogas, Cow manure, Strategies and digestate reusing, Three stages high solid anaerobic digestion

EN-R005

Effect of operating parameters on removal efficiency and mass transfer of CO_2 and H_2S absorption process for bio-methane production by sodium hydroxide solution

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Abstract

For bio-methane production with the requisite greater heating value, biogas upgrading by removal of CO_2 and H_2S are necessary. This research aimed to investigate the performance of NaOH solution as an absorbent to capture CO_2 and H_2S in the biogas produced from palm oil mill effluent. The effects of biogas flow rate (*G*), NaOH solution flow rate (*L*), and NaOH concentration (*C*) on H_2S and CO_2 removal efficiency and mass transfer were studied in a pilot-scale packed column (10 cm inside diameter, 140 cm height of packed). The suitable condition was achieved at 0.1 M NaOH solution, 300 L/h biogas flow rate, and 90 L/h solution flow rate and gave 99% removal efficiencies of CO_2 and H_2S. 92% of CH_4 was increased by the absorption process. When the biogas flow rate increases, overall mass transfer coefficient of CO_2 decreases while overall mass transfer coefficient of H_2S increases at concentration 0.025-0.1M. The relationship of operating parameters to CO_2 removal efficiency and overall mass transfer coefficient were offered a prediction empirical correlation for particular bio-methane concentration.

Keywords: Absorption, Bio-methane, Carbon dioxide Removal, Groundwater

EN-R006

Methane production from two-stage anaerobic co-digestion process treating waste activated sludge and daf slurry in tuna canning factories

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Abstract

This study aimed to treat and enhance methane production from waste activated sludge (WAS) and dissolved air flotation (DAF) slurry discharged from food processing factories by using a two-stage anaerobic co-digestion process. The experiment was carried out using a 50-L continuous stir tank reactor ($CSTR_1$) as the first stage followed by a 250-L continuous stir tank reactor ($CSTR_2$) as the second stage. Secondary sludge (4.7±0.00 g-VS/L), precipitated sludge (23.53±2.27 g-VS/L) and dewatered sludge (102.2±0.71 g-VS/L) as a WAS were used to co-digest with DAF slurry. Using dynamic influent data from the operation in ambient temperature at the organic loading rate (OLR) of 2.65-15.53 g-VS/L/d and 0.67-3.11 g-VS/L/d and hydraulic retention time (HRT) of 3-4 and 15-20 days for the first and second stages respectively. Using dewatered sludge at 4-day HRT in the $CSTR_2$ provided greater results for treating and enhancing methane production than secondary and precipitated sludge. The average biogas production rate achieved was 0.1 L-biogas/L.d, containing with hydrogen below 3% and methane around 45%, total volatile fatty acid was produced 2.64 g/L. Meanwhile, in the second stage, the average biogas production rate of 1.22 L-biogas/L.d, corresponding to methane yield of 386 mL-CH_4/g-Volatile solid was observed. Organic removal efficiency obtained from the two-stage anaerobic process is 60% (VS basis) and 70% (COD basis). This research work demonstrated a potential approach to use the two-stage anaerobic co-digestion process treating WAS and DAF slurry in the food processing factories to generate valuable bioenergy.

Keywords: biogas production, co-digestion, DAF slurry, two-stage anaerobic, waste activated sludge

ORAL PRESENTATION
Bioeconomy

EC-R001

The dynamics of non-structural carbohydrate and involved enzymes, in relation with latex yield of rubber trees

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Abstract

The dynamics of Non-structural carbohydrates (NSCs) and enzymes involved in their metabolisms can affect the yield of latex. This research aims to study the effect of two tapping methods (downward and upward) on NSCs metabolisms and enzymes activities (SuSy, INV, SPS, AGPase, and AMY) in bark and wood of rubber trees related to the latex yield potential. These enzymes play an important metabolic role in starch and sucrose biosynthetic pathways for latex synthesis. The experiment has been studied in rubber tree clone RRIM600. NSCs and enzymes extracted from bark and wood were measured by the enzymatic method. The results showed that upward tapping significantly induced more latex yield production than downward tapping. According to the effect of tapping methods on the metabolisms of NSCs and the enzyme activities, it indicated that upward tapping induced higher SuSy activity used for sucrose utilization than downward tapping because of a more concentrated sucrose gradient in the upper than lower position along the trunk. Furthermore, downward tapping induced AGPase activity used for starch accumulation involved with a starch gradient to decrease in the bottom up on the trunks. Upward tapping induced AMY activity involved with starch hydrolysis in wood. It was concluded that SuSy was the key enzyme that strongly related to sucrose content whereas, AGPase and AMY were the main enzymes linked with starch content in bark and wood during tapping periods. Therefore, NSCs dynamic and specific enzyme activities are relevant to evaluate the long-term latex yield potential of the rubber trees.

Keywords: Enzyme activities, Latex yield, Non-structural carbohydrates (NSCs), Rubber trees (*Hevea brasiliensis Muell. Arg.*), Tapping methods

EC-R002

The physiological responses and sugar partitioning mechanisms of maize (*Zea mays* L.) at flowering stage under different drought stress regimes

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Abstract

Low maize yield, closure of stomata and high rate of evapotranspiration were caused by drought stress, which limited sugar partitioning and decreased seed and biomass production. The effects of different drought stress regimes and maize varieties on physiological responses, sugar partitioning, and grain yield production of maize (*Zea mays* L.) was studied. The experiment was arranged in a split-plot in RCBD with four replications. The main plot was four different drought stress regimes (60 (well-watered), 40, 30, and 20 % of soil moisture content; SMC). Sub plot was two maize varieties (SW4452 and NS 3). The experiment was conducted in greenhouse condition at Bangkok, Thailand during November 2018 to March 2019. At 20% of soil moisture content (SMC) provided the lowest leaf area index (1.46), net photosynthetic rate (20.643 µmole CO_2 m^{-2} s^{-1}), transpiration rate (3.238 mmole H_2O m^{-2} s^{-1}), stomatal conductance to H_2O (0.108 mole H_2O m^{-2} s^{-1}), the relative water content of leaves (64.80 %), the total soluble sugar content of silk (1.48 mg g^{-1} FW), and yield component. Furthermore, grain yield significantly correlated to the translocation of total soluble sugar content of stem to accumulated in total soluble sugar content of silks (-0.6553 and 0.5725, respectively). High rate of sugar translocated to accumulate in silk which was a major mechanism of drought adapted to maintain of grain yield. Moreover, SW 4452 variety provided the highest total soluble sugar content of silk (1.77 mg g^{-1} FW), which high correlated to maintained of yield component. The management of soil water levels (more than 30% SMC) and variety selection (SW4452) might be extended to improve late rainy and dry season maize productivity in order to increase maize grain supply for bioeconomy expansion based on maize demand.

Keywords: Drought stress, Grain yield, Maize, Photosynthetic rate, Soluble sugar content,

EC-R003

Genetic diversity and physiological characteristics of quinoa under different ecotype conditions

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Abstract

Quinoa, the new functional grain crops which suitable for highland cultivation. However, the environmental response was still the barrier for high yield production. The experiment was aimed to study for genetic diversity and physiological responsibility in different ecotype conditions and evaluate yield potential. This research was used the 24 accessions of quinoa and arranged based on randomized complete block design with 4 replications and combined with 3 locations. AFLP marker was performed over the 24 accessions, including cluster analysis with UPGMA. Yield stability was analyzed using GGE Biplot. The experiment found that genetic background was diverse among quinoa accessions. Geometrically profile of those 24 accessions adapted and responded in all parameters except LAR was significantly affected by different both of genetically background and environment. The positive correlation showed significantly positive between yield and crop growth rate, dry weight, and harvest index, while significantly negative to net assimilation rate, leaf area index and leaf area ratio during the harvesting period. From the UPGMA, the 24 accessions of quinoa were clustered into three major groups upon the AFLP marker. Yield stability from GGE biplot method showed the KU23 was the best yield potential at DP, while KU16 was the most suitable to yield potential at PD and HT. Moreover, KU06 and KU11 provided good adaptation and yield stability in all locations even though potential yield showed moderate potential. The experiment concluded that KU18 was the most recommended for growth potential and provided high yield production in all locations. Furthermore, the breeding programs based on the optimum ecotype could be enhancing the expansion of quinoa production area including bioeconomic based on local highland agricultural system development.

Keywords: Quinoa, Cluster analysis, Genotypic, Phenotypic, Genetic diversity

EC-R004

Utilization of banana peel biomordant for dyeing silk fabric with marigold flower extraction and its UV protection property

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Abstract

Banana peel are rich source of phenolic compound which could be used as a biomordant in the natural textile dyeing process. This research was focused on the dyeing of silk fabric with marigold flower dye and banana peel extract as a biomordant. Two different mordanting techniques which were pre-mordanting and post-mordanting were carried out by exhaustion method. Then, the mordanted silk fabrics were dyed by marigold flower dye extraction at 90℃ for 1 h. The effect of mordanting parameters namely time and temperature was studied. The optimal condition of mordanting time and mordanting temperature have been decided according to the color strength value and color co-ordination of the dyed fabric. Color fastness and UV protection properties of dyed silk fabric have also been investigated. It was found the optimum mordanting condition was carried out at 90℃, 120 min by the post-mordanting method. The wash fastness and light fastness of the resulted fabric did not improve comparing to the unmordanted fabric while UV protection property of the mordanted and dyed silk fabric showed the improvement.

Keywords: Banana peel, Marigold flower, Natural dye, Silk fabric, UV protection

EC-R005

Effect of source-sink balance management and optimum harvesting times on maize seed vigor and storability

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Abstract

The maize seed maturity induction by the balance of source that causes those photosynthate substances is most important and promotes seed formation, filling, to develop well with high quality. Seed yield and quality also depend on the proper harvesting time. The aim of this study was to study the effect of source-sink balance management and harvesting time on seed vigor and storability of maize. The experiment was arranged in split-plot in randomized complete block design with four replicates. Main plot the pattern of leave cutting with 5 levels were D_1=control, (without leaf removal), D_2=defoliating all leaves, D_3= defoliating leaves under the ear, D_4=remain 2 top leaves, D_5= remain ear leaf. Leaf cutting date with 13 days after silking. Sup-plot had Sup-plot had two different harvesting times were H_1= 100 Days after emergence (DAE; R5), H_2= 110 DAE (R6). Complete defoliation severely reduced 100 - seed weight ($P < 5\%$). Defoliation treatments had a major affected on produced seed germination and seed vigor traits. Leaf defoliation intensity and leaf position affected total dry matter. The results suggested that the under leaves should defoliated, because this treatment has positive effect on the seed qualities and vigor. Harvesting stage had a significant effect on some parameter's studies. Seeds collected at harvesting maturity (H_2 stage) recorded the highest germination percentage and vigor index. In conclusion the combination of defoliation and optimum harvesting period management could induced maize seed maturity and maintained seed vigor as well as storability.

Keywords: Maize, Seed Vigor, Sink, Source, Storability

Bioenergy Poster

EN-P001

Biodiesel production of low-quality crude palm oil from community palm oil mills

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Abstract

One main problem of community palm oil mills (CPOM) is the production of crude palm oil (CPO) with high content of free fatty acid (FFA). Using the conventional technology of hot air drying for a long time of pretreatment of palm fruits, the hot air promotes the decreasing of FFA but the FFA was more than 5% and decreasing of carotenoids content in the oil leading to a low quality, low price and limit the market share of the CPO. The CPOM can add the value of low-quality CPO by using it as raw material for biodiesel production instead of using common low FFA oil. Response surface methodology (RSM) was applied to determine the optimum condition for biodiesel production by two steps as acid catalyzed esterification and base catalyzed transesterification. The RSM evaluated the factor relationship between the amount of catalysts, alcohol, and reaction time. The results showed that the optimum condition for the esterification was 1% of H_2SO_4 catalyst, 2.84 mole ratio of methanol to oil and 50 min of reaction time. The optimum condition for the transesterification was 1% of KOH catalyst, 7.10 mole ratio of methanol to oil for 55 min of reaction time. The properties of biodiesel obtained from the optimum condition in the two-step process met the ASTM standards. Finally, the data analysis by the ANOVA indicated that significant factors on the quality of biodiesel were the amount of catalyst and alcohol.

Keywords: Biodiesel, Community palm oil mill, Low quality CPO, Response surface methodology

EN-P002

Co-production of biohydrogen and bioethanol from water hyacinth by a consortium EZ15 through consolidated bioprocessing

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Abstract

Water hyacinth is an invasive floating plant that has caused much water pollutions. It contains cellulose and hemicellulose as the main components which can be used as a substrate for biofuel, e.g., biohydrogen and bioethanol. A finding an efficiency inoculum for hydrogen and ethanol production is focused. It should combine many steps into a single operation. At the same time investigating the effect of media conditions on growth and end-products. The co-production of hydrogen and ethanol by consortium namely EZ15showed the maximum accumulative hydrogen and ethanol production as 25.73 mL H_2/ gTS and 1.767 g/L of hydrogen and ethanol from non-pretreat water hyacinth with BM7+CO_2 medium. In addition, consortium EZ15 produced cellulase and xylanase for water hyacinth hydrolysis to remove biomass as 43%. Microbial diversity of EZ15consortium presented major microorganism of genus *Thermoanaerobacterium* and *Clostridium*. Consequently, fermentable sugars were converted to biohydrogen by *Clostridium*, *Thermoanaerobacterium*, *Enterobacter* and *Enterococcus*. At the same time, bioethanol was produced from *Thermoanaerobacterium*, *Thermoanaerobacter*, *Geobacillus* and *Caloramator*. Hence, the EZ15 consortium can be applied for co-productive biofuel productions via consolidated bioprocessing. The consortium namely EZ15 showed powerful production of hydrogen and ethanol from non-pretreat water hyacinth with BM7+CO_2 medium. It presented Cysteine HCl and CO_2 that is the key factor for high potential of production and microorganism growth.

Keywords: Consolidated bioprocessing, Dark fermentation, Ethanol production, Hydrogen production, Water hyacinth

EN-P003

Biobutanol production from rice straw by *Clostridium diolis* BC-2 under anaerobic condition

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Abstract

The interest in microbial production of butanol is based on the awareness that biobutanol is a chemical and advanced biofuel, with the potential to meet the demand of sustainable and green energy systems. The fermentative biobutanol production from hemicellulose hydrolysates is hindered by lignocellulose-derived, especially lignin, microbial inhibitory compounds. Isolation and characterization of solventogenic bacteria from soil sediment were carried out. Five butanol-positive strains were selected for evaluation of their rice straw and cellulose degrading characteristics. Best potential solvent-producing cultures were selected for 16S rRNA gene analysis. In this work, *Clostridium* sp. BC-2 was isolated using cellulose as a carbon source and investigate utilization of rice straw without the need of pretreatment. New isolates of solventogenic bacteria exhibited high rice straw degrading ability. The 16S rDNA sequence was 97% identical to that of *Clostridium diolis*. Butanol titer was 0.405 g/L from 0.5% rice straw was remarkable after 3 days of fermentation. The isolated strains utilized glucose and xylose (major rice straw component). The major fermentation products from glucose and xylose were butanol and ethanol (BE). The total BE concentration produced by strain BC-2 was 13.1 g/L from glucose and 16.3 g/L from xylose. Therefore, this research demonstrated that rice straw, rich in glucose and xylose, could be an efficient feedstock for enabling the production of butanol using this solventogenic bacteria with lignocellulose degrading ability.

Keywords: Anaerobic bacteria, Butanol, Clostridium, Rice straw

EN-P004

Coppicing ability of *Acacia* species in Thailand

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Abstract

One of the attributes of tree species suitable as bioenergy crop is the coppicing ability. Bioenergy plantations are generally managed in short rotations of 2-3 years. Therefore, coppicing ability is a desirable trait as it reduces the need to invest in seedlings, site preparation and planting of new plantations. In Thailand, *Acacia* species, such as *A. auriculiformis* and acacia hybrid (*A. mangium* x *A. auriculiformis*) are known to be fast growing in addition to nitrogen-fixing ability. However, the ability to coppice of these acacias is not well understood. This study investigated the coppicing ability of these acacias in a 24-month-old stand planted at Kanchanaburi province, west of Thailand. The stand consisted of six acacia hybrid clones (BV5, BV10, BV32, BV71 and BV75 from Vietnam) and one clone (TS1) from Tha Sae, south Thailand. In addition, there were two entries of *A. auriculiformis* (AA1 – seedlings raised from seed imported from Vietnam, and AA2 – a local pure species clone propagated from an outstanding tree). The stand was divided into three plots in which each plot was assigned for tree felling at 24, 30 and 36 months of age respectively. Overall, coppicing was higher for trees cut at 24 and 30 months old (mean 83%) than those cut at 36 months old (mean 68%). In addition, the magnitude of significant differences among species and among clones increased with age. The results suggested that the acacia species in this study could be subjected to coppice at age 30 months or younger. However, further monitoring of coppice growths is needed in order to understand the best management practice of coppiced crops.

Keyword: *Acacia* hybrid, *Acacia* species, Bioenergy plantation, Coppicing ability, Energy crop

EN-P005

Fuel properties of two bamboo species, *Bambusa beecheyana* and *Dendrocalamus sericeus*, cultivated in Thailand

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Abstract

This study determined fuel properties of two bamboo species, *Bambusa beecheyana* and *Dendrocalamus sericeus*, which are commonly cultivated in Thailand for production of non-timber forest products. Both species were analyzed for higher heating value (HHV) and components of the proximate and ultimate analysis as well as major elements in the ash. Samples were collected from 1-, 2- and 3-year-old stems of each species. Results showed that *D. sericeus* had higher HHV than *B. beecheyana* (19.39 and 18.88 MJ/kg respectively) but both species met the requirement as bioenergy raw materials. The two species also differed in most of the other traits assessed although the differences were not always significant. The differences between sample ages were observed but there appeared to be no clear pattern of the age effect except for some traits such as S content increased with age in the ultimate analysis, while K and P contents in the ashes decreased with an increase in bamboo age. Our study suggested that the stems of the two bamboo species are suitable for use as biofuel regardless of their age from one to three years.

Keywords: Age effect, Bamboo, Biomass energy, Fuel properties,

Bioeconomy Poster

EC-P001

Feasibility of silk fabric dyeing with a natural pigment produced by actinomycetes

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Abstract

This research aims to investigate the potential of using pigment produced by actinomycetes isolate SN11L-16 to dye silk fabrics. The actinomycete was isolated from soil samples of Chet Sao Noi Waterfall National Park, Saraburi Province using sodium caseinate agar. This isolate was cultivated in a broken-milled rice medium as solid fermentation. The pigment was extracted by 70% ethanol from the fermented solid substrates. The solubility of pigment was tested with different solvents, such as, hexane, ethyl acetate, dimethyl sulfoxide, ethanol, and distilled water. Ethanol was found to be the most suitable solvent to dissolve this pigment. The suitable dyeing conditions on silk fabric were at pH 5.0, dyeing temperature of 70°C and dyeing time of 60 min. However, color strengths (K/S) were quite low. The addition of salt to the dyebath had no effect on colour strength, however alum as a mordant marginally increased pigment fixing, resulting in higher colour strength. The pigment could be applied as dye in textile industry. However, increasing of pigment concentration and effects of alum on silk dyeing should be studied further.

Keywords: Actinomycetes, Dyeing, Pigment, Silk,

EC-P002

Nondestructive prediction of oil content in a breeding program of corn by near-infrared spectroscopy

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Abstract

Oil corn is used as a raw material to produce food for humans and animals. Therefore, agricultural biotechnology as the breeding program is used to improve oil corn varieties having higher oil content to meet consumer demand and increase the economic value of the product. During the breeding program, oil content should be detected in every population. Generally, the soxhlets extraction method is used as an accurate oil analysis method. But it is not fast and destroys the seed samples. In this study, near-infrared spectroscopy (NIRS) was explored to predict the oil content of corn seeds. It allows for fast measurement without destroying the seed sample. Totally, three hundred and two oil corn samples were scanned by a NIR spectrometer. NIR spectra of oil corn were collected in the 1200 to 2400 nm region, and their oil contents were determined by the soxhlets extraction method. Partial least square regression (PLSR) calibrations were developed, implemented, and updated every cycle of selection in the breeding program. The final NIR calibration model developed from the multiplicative scattering correction (MSC) combined with the first derivative pretreated NIR spectra in the whole wavelength region, which provided the lowest root mean squares error of cross validation (RMSECV) of 0.5667 %w/w. Our developed NIR oil prediction model was employed to predict the oil in all populations, and those predicted high oil corns were recombined in the next breeding program. Finally, we obtained the new corn population with increasing oil content when we finish three cycles of the breeding program. The results showed a high possibility of using the NIRS method to determine oil content in oil corn seeds for rapid selection of the breeding program.

Keywords: Breeding program, Corn, Near-infrared spectroscopy, Oil, Seed

EC-P003

Investigation of process parameters to enhance the recovery of γ-oryzanol from rice bran acid oil using full factorial design with the steepest ascent method

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Abstract

γ-Oryzanol (OZ) is an antioxidant that has been widely used in the food, cosmetic and pharmaceutical industries. Rice bran acid oil (RBAO), an inexpensive byproduct of rice bran oil (RBO) refining is a rich source of OZ. The recovery of OZ from fatty acid ethyl ester (FAEE) prepared from (RBAO) is presented using an acid-base extraction method. Full factorial design (FFD) was used to determine the factors and their interactions that significantly affected the yield of OZ and FAEE. Three factors, including NaOH concentration (A), % ethanol (B), and % hexane (C) in the total volume of hexane and aqueous ethanol, were investigated and analyzed statistically. The results showed that the main factors and their interactions (except the AC) affected the yield of γ-oryzanol, while the yield of FAEE was only affected by the A and AC. Thus, to enhance OZ yield and minimize the loss of FAEE caused by alkali hydrolysis, the significant factors were further optimized using the steepest ascent method. The optimum condition was achieved as follows: 1.8 M of NaOH, 76% of ethanol, and 20.5% of hexane, resulting in the maximum yields of OZ and FAEE of 76.51% and 59.04%, respectively. The results indicated that the presented method is simple, rapid, and effective for recovery of OZ from RBAO. In addition, the FFD and steepest ascent method were useful tools for investigating the process parameters for enhancing the added value of RBAO.

Keywords: Acid-based extraction, Fatty acid ethyl ester, Full factorial design, γ-Oryzanol, Rice bran acid oil

EC-P004

Selection of edible bird's nest type and effects of amplitude and time of sonication on N-acetylneuraminic acid (NANA) content through ultrasonic assisted extraction

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Abstract

Edible bird's nest (EBN) is the salivary secretion from the species of swiftlets. It is a traditional food popular in Asia and has been proved to have various medicinal properties. Besides, EBN consists of N-acetylneuraminic acid (NANA) as a major bioactive compound (9%) known for its beneficial health effects such as neurological enhancing, anti-neuroinflammatory effect, brain development, learning ability, beauty-enhancing, anti-aging, and immune promoting. This study aimed to determine the NANA content in two EBN samples from different cleaning processes, namely Cookie and Katoey EBN. Both free NANA and total NANA were extracted and analyzed by high performance liquid chromatography (HPLC) technique. Based on amounts of free and total NANA, Cookie EBN was chosen for the source of NANA extraction in this work and further study because it was found to contain a higher amount of NANA (free NANA = 0.47%w/w, db and total NANA = 12.24%w/w, db) compared to Katoey EBN (free NANA = 0.35%w/w, db and total NANA = 11.80%w/w, db). Effects of amplitude and time of sonication on NANA content of EBN were studied. It was found that no significant difference (p>0.05) between NANA content extracted with low and high amplitude. Therefore low amplitude was chosen as a condition for ultrasonic extraction because of cost and expense in terms of electric energy consumption. Time of sonication also affected NANA extraction efficiency, and the NANA content increased with an increase of time during 10-30 min of sonication. NANA contents obtained from ultrasonic extraction for 0, 10, 20, and 30 min were found to be 0, 0.15, 0.51, and 0.79%w/w, db, respectively. This study can conclude that sonication can be used as a green technology for free NANA extraction to identify the quality of EBN in the authentic market.

Keywords: edible bird's nest (EBN), green technology, N-acetylneuraminic acid (NANA), ultrasonic

EC-P005

Utilization of mango seed kernel oil and proteins for niosome production to apply in cosmetic products

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Abstract

Mango (*Mangifera indica* Linn.) is one of the most important tropical fruits in the world including Thailand. There are approximately 2.9 million tons of mango seeds as by-products from mango consumption in Thailand. From environmental impact perspectives, it is important to efficiently utilize mango seed waste, reduce environmental problems associated with processing waste disposal and adds value to the waste. Available scientific information regarding the nutritional importance of mango seed indicated that mango seed kernel could be an ideal raw material for obtaining extracts rich in bioactive compounds with good antioxidant properties that suits the cosmetic and health product industry. This work aimed to extract oil from mango seed kernel of "Kaewkamin" variety and further developed in a form of niosome for cosmetic applications. The mango seed kernel contained 3.52% oil content. It consisted of 47.97% total saturated fatty acids and mainly stearic acid, while oleic acid was the major unsaturated fatty acid. It also consisted of phytosterols including β-sitosterol and tocotrienols that naturally act as the antioxidant. Since niosome is widely used for various purposes in both pharmaceuticals and cosmetic industries due to its simple preparation and better stability as compared to liposomes, the obtained oil at concentration 0.5% was used in combination with mango seed kernel protein extract at concentration 5% for niosome preparation and its stability and efficiency were studied. After forming vesicles in cholesterol and Tween 60, dissolved in chloroform and evaporated to obtain a thin film. It was further dispersed in water and niosome sizing was done using a microfluidizer. Freeze drying was used to preserve the obtained niosome for further studies. It was found that the particle size of niosome was 300 nm and the entrapment efficiency determined by the gel filtration method of this niosome was 93.06%. For the antioxidant activity, the DPPH assay gave the SC_{50} value at the concentration of 7.30 mg/mL while IC_{50} of tyrosinase enzyme

inhibition was at 8.86 mg/mL (Dopachrome method). Moreover, microbiological quality and toxicity were detected by colony plate count method and MTT colorimetric assay, respectively. The growth of fungus, yeast, bacteria and toxicity on human skin fibroblasts cells were not found. From this study, the niosome held oil and protein extracted from mango seed kernel was effective and stable to apply as cosmetic active ingredient. In addition, niosome active ingredient could increase the efficiency of delivery active compound system for the products. Furthermore, utilization of agricultural by products would help to build domestic cosmetic raw materials market and reduce importation. It can also add value to the mango supply chain of the country.

Keywords: Fatty acid composition, Mango seed kernel oil, Niosome, Unsaponifiable

EC-P006

Business feasibility assessment of environmental – friendly sound and thermal interior building insulation material from pineapple leaf fiber

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Abstract

This research aims to study the business feasibility of sound and thermal insulation materials of the pineapple leaf fiber (PALF) panel. The PALF was extracted by a conventional decorticating machine and then mixed with recycled polyethylene terephthalate fibers (r-PET) in the process of non-woven forming in a pilot scale for prototype testing. Heat-absorbing properties (K-value) and sound absorption property (NRC value) of the developed sound and thermal insulation materials of PALF and r-PET fibers were evaluated in terms of technical evaluation. The production cost of produced PALF insulation, market trend, and price of insulation were also evaluated and both primary and secondary data were collected in order to compare to commercial sound and thermal insulation products made from various materials. All collected data were analyzed in three aspects, technique cost and market, to assess business feasibility. The results show that the thermal properties of PALF composites were better than that of commercial composites containing asbestos and PET fibers, but were similar to glass fiber composites. Sound absorption property of PALF composites was lower than that of polyester fiber, but better than that of glass fiber and comparable to that of asbestos. The NRC value of PALF composite product was a little bit lower than the sound insulation materials made of PET fiber, which was a similar type of material in PALF composites. However, the price of PALF composite is lower than that of polyester composite at 3.17 baht per square meter.

The market of sound and thermal insulation materials in construction sector are continuously growing. Moreover, there is a trend for energy saving and environmental conservation of buildings. As a result, the sound and thermal insulation material market has tended to develop as a biodegradable green or recyclable product in recent years. Considering

market trend and demand for environmentally friendly products, the market feasibility of the product developed from this research is in line with this trend. As the result of market trend, quality of product and reduction of production cost, this developed sound and thermal insulation material can be competitive in the real market. It can be summarized that the developed PALF sound absorption and heat insulation panel has the opportunity to commercialize in terms of production technology, market trend and competitive cost.

Keywords: Business feasibility assessment, Environmentally friendly products, Pineapple leaf fiber, Sound absorption, Thermal insulation

EC-P007

Effect of salinity stress on phenolic compounds and antioxidant activity in *Grammatophyllum speciosum*

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Abstract

Grammatophyllum speciosum (Tiger orchid) is a Thai traditional medicine. It contains bioactive compounds and exhibits pharmacological properties. The effect of salinity stress on the total phenolic content and antioxidant activity in *G. speciosum* was investigated under axenic condition. Plantlets were cultured in sterile liquid medium supplement with NaCl (0, 50, 100 and 200 µM) for 72 hours. Under the salinity condition, the total phenolic compound was highest in 100 µM of NaCl (111.06 ± 2.24 mg GAE/g DW) when compared to control condition (83.71 ± 2.47 mg GAE/ g DW). At the best concentration of NaCl for antioxidant activity was 100 µM, the antioxidant activity was determined by 2, 2-diphenyl-1-picrylhydrazyl (DPPH) assay and ferric reducing antioxidant power (FRAP). The DPPH-antioxidant activity was 36.09 ± 0.77 % when compared to ascorbic acid (44.54 ± 1.07 %). The FRAP values were found to range from 576.64 ± 0.84 to 591.78 ± 1.62 µM AE/ g DW. These results suggested that the addition of NaCl stimulated total phenolic compound accumulation and powerful antioxidants in *G. speciosum*.

Keywords: 2, 2-diphenyl-1-picrylhydrazyl, Ferric reducing antioxidant power, Salinity stress, Tiger orchid, Total phenolic compound

EC-P008

Development of shampoo product from local herbs in Bang Ka Chao community for sustainable enhance income and life quality improvement in community

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Abstract

Bang Ka Chao, the best urban in Asia, is an agricultural area. It consists of 6 districts and one of them as Bang Kor Bua district, which has the largest population. Most community members are related to agriculture, therefore they have many herbs in their area. The local herbs' value can be enhanced by develop them into active ingredients for cosmetic products. Originally, Bang Kor Bua herbal community enterprise had herbal foot spa products to relax muscles and deodorize feet. In herbal foot spa products, there is kaffir lime skin as an ingredient while the kaffir lime juice is normally useless and discarded. Researcher appreciates the benefits of kaffir lime juice mixing in shampoo as active ingredient to nourish the scalp and hair. In addition, the community has planted butterfly peas and gingers which possess natural solution for hair loss, boost hair growth and darkening hair naturally. Thus, we decided to use these 3 local herbs as active ingredients in shampoo products. The shampoo products were a dark green liquid with L* a* b* values of 38.59±0.32, -5.49±0.21 and 7.39±0.11, respectively. And pH value is 6.54±0.01, which is a suitable value for the scalp and hair. Microbiological quality of product passed the Thai Industrial Standard basis. This product has a shelf life for 2 years. In this project, the extraction technology and the shampoo production process were propagated to people in the community. The Satisfaction score of the project were the most satisfactory level and the increasing of the yearly income of the society of 60,000 Baht.

Keywords: Bang Ka Chao Community, Local Herbs, Products Development, Shampoo Product Sustainable Development

EC-P009

Production of water resistant paper from pineapple pulp mixed with banana pulp or cattail pulp for packaging application

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Abstract

This research aims to study the utilization of pineapple leaf, banana pseudostem, and cattail stem which were agricultural wastes and weed found in Thailand. First, pineapple pulp, banana pulp and cattail pulp were treated with 30% (by oven dried weight of raw material) sodium hydroxide at 100 ^{o}C for 3 h, and then the obtained pulps were bleached with 40% (by oven dried weight of pulp) hydrogen peroxide. The bleached pineapple pulp was then mixed with banana pulp or cat tail pulp at the ratio of 70 to 30 to prepare handmade paper at basis weight of 200 g/m^2. Then these papers were coated with solution containing 0.6% (v/v) chitosan and 2.0% (v/v) water resistant agent in order to improve mechanical properties and water resistant properties of paper. The mechanical and water absorptiveness properties of coated paper were measured according to TAPPI standards. The results show that pineapple leaf/banana paper provided better strength properties, including tensile tear and burst index as well as water resistant properties than those of pineapple/cattail paper. Then, all properties of pineapple leaf/banana paper were compared with commercial paper bag at 190 g/m^2. The pineapple/banana paper had higher mechanical and water resistant properties than those of commercial paper bags. These pineapple/banana mixed papers can be used as packaging paper.

Keywords: Banana pulp, Cattail pulp, Package, Pineapple leaf pulp, Water resistant paper

EC-P010

In vitro phytochemical compounds, antioxidant and α-glucosidase inhibition activities of flowers and stem extracts from *Dendrobium chrysotoxum* Lindl.

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Abstract

This research aimed to determine phytochemical compounds antioxidant and α-glucosidase inhibitory activities of flower and stem from *Dendrobium chrysotoxum* Lindl, which were extracted with 80% (v/v) methanol by soxhlet extraction method. The results showed that the extraction yield of flower extract was higher than that of stem extract, with percentage yields of 26.92±1.03% and 15.86±0.71%, respectively. The flower extract had a higher total phenolic content (41.56±1.85 mg GAE/g extract) than stem (27.96±1.01 mg GAE/g extract) extracts, while total flavonoid content of the flower and stem extract were not significant ($p>0.05$). The antioxidant activity was determined using DPPH and superoxide anion assay showed that stem extract (IC_{50} = 0.53±0.00 and 0.94±0.04 mg/ml, respectively) exhibited higher antioxidant potential than flower extract (IC_{50} = 0.60±0.00 and 3.90±0.13 mg/ml, respectively). In contrast, flower extract had a higher nitric oxide (NO) inhibitory activity than stem extract with IC_{50} values of 9.48±0.82 and 12.32±0.77 mg/ml, respectively. Similarly, flower extract showed high α-glucosidase inhibitory activity with IC_{50} values of 28.08±0.10 mg/ml. The results of correlation study showed that the phenolic content had a stronger relationship with the DPPH radical scavenging activity (r = 0.980), nitric oxide (r = 0.834) superoxide anion (r = 0.982) and α-glucosidase inhibition activity (r = 0.986). The results indicated that the extract from the flowers and stem of *D. chrysotoxum* Lindl had high potential as an antioxidant and antidiabetic resources to be used bioactive ingredient in health care products.

Keywords: Antioxidant activity, *D. chrysotoxum* Lindl., Phytochemical, α-Glucosidase inhibition activities

EC-P011

Preparation and characterization of crystalline nanocelluloses, carboxymethyl cellulose, and phenolic acid-rich extracts from sugarcane bagasse

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Abstract

To increase the utilization of sugarcane bagasse (SCB), the high-valued substances, i.e., crystalline nanocelluloses (CNCs), carboxymethyl cellulose (CMC), and phenolic acid-rich extracts were produced from SCB for use as further facial mask production. This research aims to study the preparation and characterization of CNCs, CMC, and phenolic acid rich extracts from SCB steam explosion pretreatment. The steam explosion process was done at the temperature of 195 °C, a pressure of 1.3 MPa for 15 min. The obtained fibers were dark brown and containing α-cellulose of 49.9 %. The cellulose (~ 77.5% of α-cellulose) was prepared by chemical bleaching with $NaClO_2$ of steam-exploded SCB prior to CNCs and CMC production. Then, the purified cellulose fibers were acid hydrolyzed with H_2SO_4 (conc. 60% v/v) to obtain nanomaterial. The average size of obtained crystalline nanocelluloses were 12.4 nm and 236 nm for diameters and lengths, respectively. To prepare CMC, cellulose was modified with 2 steps, i.e., alkalization with NaOH and etherification with sodium-monochloroacetate (Na-MCA). The mole ratios of cellulose:Na-MCA were varied as 1:1, 1:2, 1:3, 1:4, and 1:5. The obtained products showed the degree of substitution (DS) in the ranges of 0.50-1.22. The CMC products could dissolve in hot water and exhibited film forming ability. Phenolic acid rich extract was prepared by extracting of non-bleaching SCB fiber, which exhibited antioxidant and anti-acne causing bacterial strain properties.

Keywords: Carboxymethyl cellulose, Crystalline nanocelluloses, Phenolic acid-rich extracts, Steam explosion, Sugarcane bagasse

EC-P012

Environmentally friendly approaches toward the synthesis of silver nanoparticles by herb and their possible application as antifungal agents in agricultural area

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Abstract

Silver nanoparticles (AgNPs) have been well studied and used as a potential antimicrobial principle. Green synthesis of nanomaterials is rapidly growing in the nanotechnology field due to its eco-friendliness, cost effectivity, and possibilities of large scale production. This research study on AgNPs synthesis by the green chemistry approach were investigated using the medicinal plant. Twenty seven species of plant were tested for the ability of AgNPs biosynthesis. Mangosteen peel (*Garcinia mangostana* Linn.) and emblica fruits (*Phyllanthus emblica* Linn.) showed high tendency to synthesize AgNPs. The optimized parameters including concentration of the extract (1-30 %w/v), Silver nitrate ($AgNO_3$) (5-50 mM) and reaction temperature (30-90 ºC), that effect to synthesize AgNPs were determined to obtain high yield of AgNPs. The high AgNPs synthesis were achieved by adding 20% of mangosteen peel and emblica fruit extracts on 10 mM $AgNO_3$ and incubated at 90ºC for 3 h and 4 h, respectively. The AgNPs were characterized by EDS and FESEM. AgNPs in the range of 35-88 nm and 150-310 nm were achieved by mangosteen peel and emblica fruit extracts. The antifungal activity of synthesized AgNPs by mangosteen peel extract could inhibit the growth of 4 species of fungi causing postharvest decay of fruit (*Aspergillus niger, Colletotrichum gloeosporioides, Lasiodiplodia theobromae* and *Rhizopus stolonifer*) with the MIC value ranged from 117.18 to 234.37 µg/ml. With respect to its antifungal properties, AgNPs can act as smart weapons against plant pathogen and as a talented substitute for fungicide.

Keywords: Antimicrobial activity, Biosynthesis, Green synthesis, Medicinal plant, Silver nanoparticles

EC-P013

Development of laboratory eco-friendly packaging manufacturing process from pineapple leaf and rice straw pulps

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Abstract

The purpose of this research is to develop an eco-friendly packaging using a laboratory semi-automatic paper plate making machine. Due to the required properties of eco-friendly packaging are predominantly depended on types of pulp and chemicals used, these parameters are hard to be adjusted in pulp and paper industrial manufacturing. These caused problem in controlling the stock quality prepared using the various types of pulp raw materials and chemicals used. The experiment consisted of the development of laboratory eco-friendly packaging manufacturing process; and the study of effect of pulp types and chemicals used on the properties of eco-friendly packaging properties. From the results, the development of laboratory eco-friendly packaging manufacturing process showed that the process could be developed in laboratory, the pineapple leaf fiber and rice straw pulps can be used as natural pulp materials to manufacture the eco-friendly packaging. Moreover, the mixing ratio of pineapple leaf fiber and rice straw pulp was appropriately obtained. The results showed that the qualities of the obtained eco-friendly packaging were improved and had sufficient potential for replacing the used of foam and plastic packaging.

Keywords: Eco-friendly packaging, Pineapple leaf fiber, Pulp and paper, Rice straw

EC-P014

Effect of enzyme type on peptide size and antioxidant activity of partially purified albumin extract from Khao Dawk Mali 105

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Abstract

The partially purified albumin (PPALB) was extracted from Khao Dawk Mali 105 defatted rice bran using the rice bran to water ratio of 1:20 at 60°C for 60 min using the protein precipitation method. The extract consists of 64.26±3.64% protein, 1.60±0.04 g GAE/100 g of phenolic compound, antioxidant activity of DPPH (IC_{50}=1.84±0.02 mg/mL) and FRAP (56.07±1.07 µmol/g). The effects of protease types (alcalase, bromelain and protamax) on peptide size and PPALB antioxidant activity were then investigated. Then, they were separated hydrolysates into three fractions: large peptides; MW>10 kDa, medium peptides; 3-10 kDa, and small peptides; <3 kDa. The alcalase-treated hydrolysate showed a significantly higher DPPH scavenging activity than those the bromelain- and protamax-treated hydrolysates. The large-size peptides provided a higher DPPH radical scavenging activity than the medium- and small-size peptides, whereas small-sized peptides (MW<3 kDa) were more effective in FRAP assay. Thus, the hydrolyzed PPALB is a source of potential antioxidant peptides for food and nutraceutical applications.

Keywords: Antioxidant activity, Partially purified albumin, Rice bran, Rice bran protein hydrolysate

EC-P015

Development of filter paper for cloth face masks from bacterial cellulose mixed with eucalyptus pulp

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Abstract

The ongoing Coronavirus disease 2019 (COVID-19) pandemic has resulted in insufficient supplies for disposable face masks worldwide. Cloth face masks and air filter papers are developed as an alternative reusable mask. In this paper, bacterial cellulose (BC) which is waste from food and beverage industry is utilized to blend with eucalyptus pulp (EP) to form the filter paper for cloth face masks. The effects of different BC contents (0, 5, 10, 50 and 100 wt%) and basis weight (50 and 80 g/m^2) on mechanical properties, water absorption property, and air permeability of the blended filter papers were investigated. At high BC addition (100 wt% of BC), the blended filter paper showed higher tensile and tear indices than those of 0 wt% of BC. While the air permeability and water absorption (Cobb values) of the filter paper at high BC content were reduced. In term of the different basis weight (at the same BC content), it could be pointed out that the filter paper at a basis weight of 50 g/m^2 had an acceptable tensile index and improved in tear index, water absorption, and air permeability. Moreover, modified starch (MS) was applied for coating on the filter papers. The results showed that tensile and tear indices of the MS-coated filter papers were clearly improved even at different BC content and basis weight. In addition, the coating of MS affected to reduced air permeability of coated filter papers. The resulting MS-coated filter paper is considered as a promising filter paper for cloth face masks due to its improvement of mechanical properties, low water absorption, and acceptable air permeability. This should be an alternative way to utilize BC which has low air permeability to apply for filter paper for cloth masks.

Keywords: Bacterial cellulose, Eucalyptus pulp, Face masks, Filter paper

EC-P016

Synergistic antibacterial and antioxidant efficacy of fruit peel extracts

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Abstract

This research aimed to evaluate antibacterial, and antioxidant efficacy of extracts of fruit peel waste consisting of mangosteen, pomegranate and rambutan in binary mixture. The experiment are combined into (mangosteen: pomegranate, MP), (mangosteen:rambutan, MR) and (Pomegranate:Rambutan, PR). The synergistic antibacterial and antioxidant activities were determined at 11 ratios of the 3 combinations using the FIC_{index} and isobologram analysis of the minimum inhibitory concentration value (MIC) from broth micro dilution method and the half-inhibitory concentration (IC_{50}) value from DPPH assay, respectively. Among the 3 combinations, MP and MR showed synergistic antibacterial effect against acne-causing bacteria**:** *Propionibacterium acnes***,** *Staphylococcus aureus* and *Staphylococcus epidermidis* at ratio 9:1 and 8:2 of MP and at ratio 9:1 of MR combinations with minimum inhibitory concentration, MIC value of 4, 8, 4 µg/ml, and 4, 8, 8 µg/ml respectively. The combination of MR showed high potential of antioxidant activity with synergistic effect at all ratios especially the ratio of 2:8 showed the highest efficacy with the (IC_{50}) value of 1.28 µg/ml. These results provide evidence that the combination of mangosteen and rambutan extracts and the combination of mangosteen and pomegranate extracts can be used as a potential source of effective natural antibacterial and antioxidant blend in cosmetic and pharmaceutical industries.

Keywords: Antimicrobial activity, Antioxidant activity, Extract, Fruit peel, Synergistic effect

EC-P017

Non-destructive corn seed moisture content evaluation during late grain filling period by using leaf greenness index combining artificial neural network technique

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Abstract

Thailand is the major corn seed exportation hub in the Southeast Asia region which has market value approximately 900.93 billion baht in 2018 but there were still lack evaluation of large-scale seed moisture content status before harvesting. This research aimed to study the correlation pattern and develop the prediction model of CSMC. The experiment was conducted on the sampling grid 8x6 blocks based on the RCBD with 4 replications, and the data were collected during two development stages (R5 and PM). Pool data size was 192 datasets. The prediction models were developed based on multiple regression and model enhancing with the neural network. The experiment found that Pearson's correlation showed LGI significantly correlated to CHLA and CHLB, and CAR including with coefficients -0.2116, -0.2345, 0.2116, respectively. LGI was directly positive correlated to CSMC with a coefficient 0.1642. CHLA and CHLB were redundant variables then CHLB had a great potential as and CSMC predictor with R^2 equals 0.3958, RSME equal 9.0764. CHLB was more suitable directly predictor of CSMC than LGI. The enhanced model with ANN showed greater efficiency with R^2 equal to 0.4518 and RSME equal 8.1775 with 10 epochs training cycles. Conventional regression model was limited by the single time calculation even the fitting model with the weight variables. Fortunately, the ANN can re-calculate with new fitting weight every single time of training cycle. However, the performance of the ANN model depends on the size of database which big would greater precision. Conclusion, LGI was the useful corn seed moisture content prediction even the database extension or more input variables adding might increase the ANN model performance. Furthermore, the database extension and model implement in many trial cases need to make the promising model.

Keywords: Artificial neural network, Color index, Corn seed, Prediction model, Yield

EC-P018

Effect of early harvesting time and drying on maize seeds vigor and storability

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Abstract

Improper environmental incidents cause need for early maize harvest. Unfortunately, according to early harvested seeds, maize seed had contained high seed moisture content. Consequently, seed drying became very important process to dry seed moisture content down to a desired level that could maintain seed quality. The experiment was aimed to evaluate the effect of harvesting time and drying on maize storability and seed vigor after early harvested. The experimental design was arranged in 2x4 factorial in Randomized Complete Block Design (RCBD) with four replications. The effect of two different harvesting times were H_1: 100 day after emergence (DAE; R5), H_2: 110 DAE (R6), and four drying temperatures (T_1: 30℃,T_2: 35 ℃, T_3: 40 ℃, T_4: 45 ℃) were observed. Then, seed qualities and vigor were tested. H_2 had the highest speed of germination. At 0 month, the highest germination percentage, speed of germination, shoot length, root length (RL), seedling dry weight (SDW), and seedling growth rate were obtained at 45 ℃. At 6th month of storage, the highest germination percentage, AA-test, RL and SDW were obtained at 35 ℃ and 40 ℃. The experiment concluded that seed drying at 45 ℃ can be used for immediate use of seeds without storage. Unfortunately, maize seeds vigor was decreased during long term storage. The anticipation of harvest time and seeds drying at temperatures for 35 ℃ and 40 ℃ could maintained maize seed storability after early harvested. Finally, the experiment could be concluded that the optimum of early harvesting and seed drying management could enhanced for maize seed vigor and storability.

Keywords: Drying management, Harvesting time, Maize, Seed vigor, Storage

EC-P020

The effect of de-tassellation on maize (*Zea mays* L.) hybrid seed yield and quality

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Abstract

High seed quality was one of major requirement for seed production and farmers. According of maize seed production processes, detasseling process was one of major problem that damaged top leaves. Those leaves damaged maize seed photosynthetic source decreased that impacted on imbalance of source and sink relationship. Then, limitation of photosynthate translocation and accumulation in major sink or seed reduced seed yield and quality. Thus, the experiment was aimed to evaluate the balance of source and sink management by several top leaves removed during detasseling process on maize seed yield quality. The experiment was conducted on randomized complete block design with 4 replications, the remain of top leaf (upper of ear) was a experimental treatment consisted of 4 levels; 3 top leaf remained (T1), 2 top leaf remained (T2), 1 top leaf remained (T3) and No top leaf (T4). The results showed that T1 had the ear weight (45.5 g), ear length (11.27cm), row per ear (12.7 row), seed per ear (142.92) and total seed weight per ear (33.25 g). According to seed quality found that the levels of remained leaves had no affected on seed germination percentage, root: shoot ratio and seedling dry weight. Unfortunately, high levels of leaves removed significantly reduced seed vigor paramotors (AA test, and Speed of seed germination).T1 treatment showed greatest of AA test, and emergence (50 percentage , and 15.77 seed day^{-1} , respectively) while T3 and T4 significantly decreased seed vigor and yield. Then the experiment could be concluded that high level of top leaves removed during detassellation process induced of source and sink photosynthate accumulation in maize seed was limited during seed development, that decreased on yield, seed maturity, and quality

Keywords: De tessellation, Seed Physiology, Seed Production, Seed Quality, Yield

EC-P021

Comparison of pineapple wine fermentation among yeast *Saccharomyces cerevisiae* var. *burgundy*, *S. cerevisiae* var. *montache*, and *S. cerevisiae* var. *kyokai*

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Abstract

This study deals with the investigation fermentation properties of wine yeasts in pineapple juice fermentation. The chemical content of fresh pineapple juice including pH, Total Soluble Solids (TSS), Total Titratable Acidity (TAA, as citric acid) and nitrogen content were 3.5±0.012, 15.0±0.0°Brix, 0.917±0.07% (w/v) and 0.08±0.01% (w/v), respectively. The pineapple juice was fermented with *Saccharomyces cerevisiae* varieties, at 25°C for 10 days. Based on their fermentation characteristics, *S. cerevisiae* var. *burgundy*, *montache*, and *kyokai* could generate alcohol content during 10 days fermentation to 10.2, 10.7 and 11.1% (v/v), respectively. The fermentation profiles in the last day of fermentation of those wine yeasts were similar. However, sensory evaluation (appearance, aroma, taste, sweetness and overall liking) of all treatments were not significantly different ($p \leq 0.05$).

Keywords: Fermentation, Low-grade-pineapple, Pineapple wine, *Saccharomyces cerevisiae*

EC-P022

The grain milling processes on saponin content and physical grain qualities to enhancing bioeconomy of quinoa (*Chenopodium quinoa* Cv. Yellow Pang-da) grain for Thai market

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Abstract

The quinoa grains contained a thin layer of bitter-tasting saponin compound. It was necessary to remove saponin before being consumed. The experiment aimed to study quinoa grain milling processes on the saponin content and physical grain qualities in enhancing bioeconomy focusing on the Thai market. The experiment was arranged in a factorial in completely randomized design with three replications. The milling processes was conducted by adapted the rice milling machine with two factors: (a) the rubber-roller distances (0.4, 0.6 and 0.8 mm) and (b) milling cycles (1, 2 and 3 times). Physical grain quality analysis (%total grain loss, % grain loss, %broken grain, and %non-abrasive grain) was an indication of quality in post-process quinoa grain. The results showed that three times of milling cycles could reduce saponin content to 797.60 mg 100 g^{-1} DW compared to non-processed grain (1253.07 mg 100 g^{-1} DW) but not significantly different from 2 times (952.00 mg 100 g^{-1} DW). Unfortunately, the rubber-roller distances and interaction between factor a and b could not reduce saponin content significantly different. Milling the grain with rubber-roller distance 0.4 mm for one time could maintain most of the physical properties of quinoa grain (%total lost grain, %loss grain, and %broken grain). Finally, this experiment could be concluded that milled quinoa grain for three times at rubber-roller 0.4 mm could be the optimum of saponin removal technique. This technique could best reduce the saponin content and maintained most of the physical properties of quinoa grain. Finally, quinoa milling process could improve for enhanced the bioeconomy of quinoa for the Thai market.

Keywords: Grain qualities, Milling processes, Quinoa grain, Saponin removing, Spectrophotometric method

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Development of water soluble film packaging from cellulose fiber in sugarcane bagasse

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Abstract

This research aimed to develop water soluble carboxymethyl cellulose (CMC) films from sugarcane bagasse, a by-product of sugar industry containing high cellulose. The sugarcane bagasse was subjected to alkaline treatment to remove lignin followed by bleaching to prepare cellulose fiber. The cellulose fiber was modified by adding carboxymethyl groups to enhance their water solubility and absorption capacity. The CMC with low (DS of 0.362; LDS-CMC) and high (DS of 0.627; HDS-CMC) degree of substitution (DS) from sugarcane bagasse cellulose fiber were prepared. LDS-CMC and HDS-CMC films were casted from 2% CMC aqueous solutions (w/w) containing 0, 10, 20, 30 and 40% glycerol by dried weight of CMC. The properties of CMC films considerably depended on DS and glycerol contents. LDS-CMC films possessed lower water absorption, tensile strength and elongation as well as water vapor transmission rates (WVTR), but greater hot water solubility than HDS-CMC films at similar glycerol contents. Increasing glycerol contents generally enhanced WVTR and elasticity, while reduced tensile strength of both LDS-CMC and HDS-CMC films. The CMC film solubility was, on the other hand, not affected by glycerol contents. These CMC films were further applied as soluble sachets for dry food products. Although LDS-CMC films generally exhibited greater hot solubility and lesser WVTR, HDS-CMC film sachet was more effective in preventing moisture absorption and maintaining the quality of seasoning samples inside after storage at 50% relative humidity (RH) for a month. HDS-CMC film sachet containing 10% glycerol was found the most suitable for being used as a soluble film sachet for dry food products.

Keywords: Carboxymethyl cellulose, Cellulose, film, Food packaging, Sugarcane bagasse

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