



Faculty of Science,
Kasetsart University, Bangkok Thailand

I-KUSTARS 2018

30 - 31 May, 2018

The International Kasetsart University
Science and Technology
Annual Research Symposium



ABSTRACT BOOK



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Kasetsart University, Bangkok Thailand

I-KUSTARS 2018

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The International Kasetsart University
Science and Technology
Annual Research Symposium



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Dear Colleagues,

On behalf of the organizing committee, it is my privilege to welcome all of the participants in the International Kasetsart University Science and Technology Annual Research Symposium 2018 (I-KUSTARS 2018), from 30th May – 1st June 2018 at the Faculty of Science, Kasetsart University. The symposium aims to provide a platform for the exchange of interdisciplinary scientific information, as well as offering an open forum for the discussion among senior students in the Asian country who participate in I-KUSTRAS 2018. The scientific program comprises session that illustrate the relevance and value of modern science and technology.



We are looking forward to giving a warm welcome to you, and your colleagues at I-KUSTARS 2018. We hope that you will find the symposium both interesting and enjoyable. We thank you for participating and contributing to the symposium.

With best wishes,

Apisit Songsasen
Dean of Faculty of Science





PROGRAM COMMITTEE

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	Srisom Suwanwong	Department of Botany
Wanrada Surat	Department of Genetics	





PROGRAM SCHEDULE AT A GLANCE

May 30, 2018 Floor 3 Building 45th Anniversary

Time	Session
8.30 A.M. - 9.00 A.M.	Registration
9.00 A.M.- 9.30 A.M.	Opening Ceremony (Room 341)
9.30 A.M.- 10.30 A.M.	Plenary Lecture Design and application of small-molecule biosensors in natural product biosynthesis studies <i>by Prof. Dr. Shuang-Yan Tang</i>
10.30 A.M.- 10.45 A.M.	Coffee break
10.45 A.M.- 11.15 A.M.	Invited Lecture 1 Research utilization and innovation of natural rubber in Thailand 4.0 <i>by Dr. Wirasak Smitthipong</i>
11.15 A.M.- 11.45 A.M.	Invited Lecture 2 From genes to genome: Implications for economic wildlife management and conservation <i>by Assistant Professor Dr. Kornorn Srikulnath</i>
11.45 A.M.- 1.00 P.M.	Lunch
1.00 P.M.- 4.00 P.M.	Poster Session (Ground Fl., DaviYannasugondha Bldg.)
5.00 P.M.- 8.00 P.M.	Welcome Reception (Room 352 Floor 3 Building: 45 th Anniversary)





May 31, 2018 Floor 3 Building 45th Anniversary

Time				
9.00 A.M.-10.30 A.M.	Biology & Bioscience and Technology (Room 301)	Genetics (Room 302)	Microbiology Botany (Room 302)	Physics (Room 375)
				Computer Science & Mathematics
10.30 A.M.-10.45 A.M.	Coffee break			
10.45 A.M.-12.00 A.M.	Biology & Bioscience and Technology (Room 301)	Genetics (Room 302)	Microbiology (Room 303)	Earth Sciences & Materials Science (Room 375)
12.00 A.M.-1.00 P.M.	Lunch			
1.00 P.M.-1.30 P.M.	Biology & Bioscience and Technology (Room 301)	Genetics (Room 302)	Botany (Room 303)	Earth Sciences & Materials Science (Room 375)
1.30 P.M.-2.30 P.M.	Zoology (Room 301)			
2.30 P.M.- 2.45 P.M.	Coffee break			
2.45 P.M. - 2.00 P.M.	Biochemistry (Room 301)	Genetics (Room 302)	Botany (Room 303)	
3.00 P.M.- 3.30 P.M.				
3.30 P.M.- 4.00 P.M.	Closing ceremony			





PROGRAM SCHEDULE

May 30, 2018	
Time	Room 341 Floor 3 Building: 45th Anniversary
8.30 A.M. - 9.00 A.M.	Registration
9.00 A.M. - 9.30 A.M.	Opening Ceremony (Room 341)
9.30 A.M.- 10.30 A.M.	Plenary Lecture Design and application of small-molecule biosensors in natural product biosynthesis studies <i>by Prof. Dr. Shuang-Yan Tang</i>
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1.00 P.M. - 4.00 P.M.	Poster Session (Ground Fl., DaviYannasugondha Bldg.)
5.00 P.M.- 8.00 P.M.	Welcome Reception (Room 352 Floor 3 Building: 45 th Anniversary)





PROGRAM SCHEDULE (Oral Presentations)

May 31, 2018 Room 301 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
	Biology & Bioscience and Technology	
9.00 A.M.- 9.15 A.M.	Some biological and morphological of papaya mealybug, <i>Paracoccus marginatus</i> Williams and Granara de Willink (Hemiptera: Pseudococcidae) on cassava <i>by Pham Huynh Dong Anh, Le Khac Hoang and Tran Thi Thanh Thao</i>	1
9.15 A.M.- 9.30 A.M.	Establishment of fungal combs with three species of fungus-growing termites <i>by Khoirul Anwar, Lisdar I Sudirman and Dodi Nandika</i>	2
9.30 A.M.- 9.45 A.M.	Effect of biochar on microbial activity and growth of cocoa seedlings (<i>Theobroma cacao</i>) growing in Acrisols soil in greenhouse condition <i>by Nguyen Duc Xuan Chuong and Jonathan L. Deenik</i>	3
9.45 A.M.- 10.00 A.M.	Feasibility study of cantrang (danish trawl) fisheries biology perspective at makassar straits and bone gulf, south sulawesi province, Indonesia <i>by Sri Suro Adhawati, Achmar Malawal, Aris Basol and A. Adri Arief</i>	4
10.00 A.M.- 10.15 A.M.	Initial study of <i>PTEN</i> expression in Vietnamese in nasopharyngeal carcinoma patients <i>by Nguyen Hoang Danh, K Trong Nghia, Ngo Dong Kha, Lao Duc Thuan and Le Huyen Ai Thuy</i>	5
10.15 A.M. - 10.30 A.M.	Fungal endophytes across tissue layers of <i>Canarium ovatum</i> Engl. (Burseraceae) fruit <i>by Jonathan Jaime G. Guerrero and Teresita U. Dalisay</i>	6
10.30 A.M.- 10.45 A.M.	Coffee break	



**May 31, 2018 Room 301 Floor 3, Building: 45th Anniversary**

Time	Presentation	Page
10.45 A.M.- 11.00 A.M.	Biology aspect of <i>Carcharhinus limbatus</i> as a main targeted fishery in Muncar Banyuwangi East Java <i>by Euis Zulfiaty, Chuldyah J Harsindi and Ranny R Yuneni</i>	7
11.00 A.M.- 11.15 A.M.	Development of SRAP-SCAR marker on sugarcane white leaf disease (SCWLD) susceptible and non-susceptible varieties in Vietnam <i>by Dinh My An, Nguyen Doan Nguyen Phuong, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	8
11.15 A.M.- 11.30 A.M.	Identification and evaluation of the expression level of surfactants encoding genes of <i>Bacillus amyloliquefaciens</i> in biological control of Corynespora Leaf Fall (CLF) disease on the rubber tree <i>by Truong Ngoc Thao, Nguyen Doan Nguyen Phuong, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	9
11.30 A.M. - 11.45 A.M.	Effect of temperation on the life cycle, survival, sex ratio and longevity of <i>Stethorus pauperculus</i> (Coccocilide: Coleoptera) feed on spider mite <i>by Nguyen Thi Bich Han, Tran Thi Thanh Thao and Le Khac Hoang</i>	10
11.45 A.M.- 12.00 A.M.	Study on biological characteristics of <i>Dysmicoccus brevipes</i> (Pseudococcidae: Hemiptera) <i>by Nguyen Thi Minh Thi, Le Cao Luong and Nhan Thi Minh Uyen</i>	11
12.00 A.M. - 1.00 P.M.	Lunch	





May 31, 2018 Room 301 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
1.00 P.M. - 1.15 P.M.	Recovery and valorization of snakehead fish (<i>Channa striata</i>) surimi wash water as bulk active albumin tablet <i>by Ikbal Syukroni, Wini Trilaksani and Uju</i>	12
1.15 P.M. - 1.30 P.M.	Effect of Pest Exclusion Net (PEN) on the sustainable production of late season Broad Leaf Mustard (BLM) in Nepal <i>by Ram Chandra Neupane</i>	13
1.30 P.M. - 1.45 P.M.	Systematic approach to engineer <i>Escherichia coli</i> chromosome for butanol production <i>by Hongjun Dong, Chunhua Zhao, Tianrui Zhang, Huawei Zhu, Zhao Lin, Wenwen Tao, Yanping Zhang, Yin Li</i>	14
1.45 P.M. - 2.00 P.M.	Reconstructing Biosynthetic Pathway of the Plant-Derived Cancer Chemopreventive-Precursor Glucoraphanin in <i>Escherichia coli</i> <i>by Han Yang</i>	16
	Zoology	
2.00 P.M. - 2.15 P.M.	Cryptic species (<i>Sinalpheus</i>) in Tidung Kecil Island <i>by Chuldiah J. Harsindhi and M. Halim., A. Ruzanna</i>	17
2.15 P.M. - 2.30 P.M.	Exploration of stingless bees in South and West Sulawesi, Indonesia: Morphological and nest structure characteristics <i>by Tiara Sayusti, Rika Raffiudin and Sih Kahono</i>	18
2.30 P.M. - 2.45 P.M.	Coffee break	





May 31, 2018 Room 301 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
2.45 P.M. - 3.00 P.M.	Bear cuscus (<i>Ailurops ursinus</i>): Daily activities, diet, and habitat characteristics in tanjungperopa wildlife reserve, South-East Sulawesi <i>by Rahmia Nugraha and Abdul Haris Mustari</i>	19
3.00 P.M. - 3.15 P.M.	Study of the pymetrozine resistance on brown plant hopper (<i>Nilaparvata lugens</i> Stal.) in Tien Giang province, Vietnam <i>by Huynh Thi Ngoc Diem, Ho Van Chien and Le Thi Dieu Trang</i>	20
	Biochemistry	
3.15 P.M. - 3.30 P.M.	Anti-bacterial activities of green synthesized zinc oxide nanoparticles <i>by Phakkhathorn Ruangsai and Nattanan T-Theinprasert</i>	21
3.30 P.M. - 4.00 P.M.	Closing ceremony Room 341 Floor 3 Building: 45th Anniversary	





May 31, 2018 Room 302 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
	Genetics	
9.00 A.M.- 9.15 A.M.	Identification of two sumatran stingless bees: The presence of <i>COI</i> -like gene in molecular identification <i>by Sri Bening, Rika Raffiudin and Windra Priawandiputra</i>	22
9.15 A.M.- 9.30 A.M.	Association of <i>CYP2A6</i> gene related to fatty acid composition in javanese fat tailed sheep <i>by Kasita Listyarini, Mutasem Ali Abuzahra, Jakaria, Cece Sumantri, Muhammad Jasim Uddin and Asep Gunawan</i>	23
9.30 A.M.- 9.45 A.M.	Phylogenetic reconstruction and connectivity analysis of the endangered species <i>Sphyrna lewini</i> based on mitochondrial DNA <i>by Sutanto Hadi, Nurlita Putri Anggraini, Ester Restiana, Effin Muttaqin, Benaya Meitasari Simeon, Muhammad Ichsan, Beginer Subhan and Hawis Madduppa</i>	24
9.45 A.M.- 10.00 A.M.	Toll-like receptor 4 (<i>TLR4</i>) as a marker gene for <i>Salmonella</i> disease resistance in selected sentul chickens <i>by Janet Mamutse, Asep Gunawan, Cece Sumantri and Sri Murtini</i>	25
10.00 A.M.- 10.15 A.M.	Initial study of relative quantification Epstein Barr Virus (EBV)-encoded <i>RPMS1</i> expression in the Vietnamese nasopharyngeal cancer patients <i>by Nguyen Hoang Nhat Minh, Nguyen Thi Thuy Trang, Thieu Hong Hue, Lao Duc Thuan and Le Huyen Ai Thuy</i>	26
10.15 A.M.- 10.30 A.M.	Polymorphysm of myostatin gene is associated with carcass characteristics with maternal immunization against myostatin on post-hatch in sentul indonesian indigenous chicken <i>by Rajma Fastawa, Isyana Khaerunnisa, Yong Soo Kim, Sri Murtini, Asep Gunawan and Cece Sumantri</i>	27
10.30 A.M. - 10.45 A.M.	Coffee break	





May 31, 2018 Room 302 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
10.45 A.M. - 11.00 A.M.	Association of <i>APOA5</i> gene related to flavour and odour compound in javanese fat and javanese thin tailed sheep <i>by Asep Gunawan, Kasita Listyarini, Mutasem Ali Abuzahra, Jakaria, Muhammad Jasim Uddin and Cece Sumantri</i>	28
11.00 A.M.- 11.15 A.M.	Isolation, cloning and cellulolytic potential assay of endoglucanase and cellobiohydrolase genes of <i>Trichoderma harzianum</i> <i>by Imrana Niaz Sultan, Afrasiab Khan Tareen and Pramuk Parakulsuksatid</i>	29
11.15 A.M. - 11.30 A.M.	Antibacterial Activity of Snail Mucus (<i>Achatina fulica</i>) against Acne Inducing Bacteria (<i>Propionibacterium acnes</i>) <i>by Jaruwan Bangperng, Pramote Chumnanpuen and Teerasak E-kobon</i>	30
11.30 A.M. - 11.45 A.M.	Comparative transcriptome of foot and mantle in <i>Semperula siamensis</i> <i>by Tanawat Akepitaktam, Pramote Chumnanpuen and Teerasak E-kobon</i>	31
11.45 A.M. - 12.00 A.M.	Expression and purification of Saglin in <i>E.coli</i> <i>by Lukman Dulthara and Anchanee Kubera</i>	32
12.00 A.M. - 1.00 P.M.	Lunch	





May 31, 2018 Room 302 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
1.00 P.M. - 1.15 P.M.	Effects of Optical Tweezers on gene expression in yeast <i>by Wanrosmani Doloh and Sompid Samipa</i>	33
1.15 P.M. - 1.30 P.M.	Genetic Relationship of Santol using RAPD markers <i>by Siriluck Tongoran and Sompid Samipak</i>	34
1.30 P.M. - 1.45 P.M.	Jatropha Plant tissue culture and transformation <i>by Apisit Burapapiruin and Sompid Samipak</i>	35
1.45 P.M. - 2.00 P.M.	Candidate novel SNP of <i>EDG1</i> gene in Bali cattle <i>by Sutikno, Rudy Priyanto, Cece Sumantri and Jakaria</i>	36
2.00 P.M. - 2.15 P.M.	Reconstruction of secondary metabolism of <i>Cordyceps militaris</i> <i>by Warasinee Mujchariyakul, Hon Wai Leong and Wanwipa Vongsangnak</i>	37
2.15 P.M. - 2.30 P.M.	Putative anticancer and antioxidant peptides screening from the transcriptome of <i>Cordyceps militaris</i> <i>by Pornpavee Nualnisachol, Teerasak E-kobon and Pramote Chumnanpuen</i>	38
2.30 P.M. - 2.45 P.M.	Coffee break	
2.45 P.M.- 3.00 P.M.	Bioinformatic analysis of variants in children with rare genetic diseases <i>by Paphawarin Soonkum, Chulaluck Kuptanon and Teerasak E-kobon</i>	39
3.00 P.M.- 3.15 P.M.	Designing and cloning artificial miRNA structure for silencing <i>MoCOD1</i> gene of rice blast fungus <i>Magnaporthe oryzae</i> <i>by Nguyen Kim Hong and Nguyen Bao Quoc</i>	40
3.30 P.M.- 3.00 P.M.	Closing ceremony Room 341 Floor 3 Building: 45th Anniversary	



**May 31, 2018 Room 303 Floor 3, Building: 45th Anniversary**

Time	Presentation	Page
	Microbiology	
9.00 A.M. - 9.15 A.M.	Comparison of lactate dehydrogenase and asetylactate synthase deficient mutants of <i>Klebsiella pneumoniae</i> TWO on 1,3-propanediol production <i>by Febri Sembiring, Antonius Suwanto and Iman Rusmana</i>	41
9.15 A.M.- 9.30 A.M.	Blast disease reduction by phyllosphere bacteria producing antifungal compounds <i>by Sri Martina Wiraswati, Aris Tri Wahyudi, Abdjad Asih Nawangsih and Iman Rusmana</i>	42
9.30 A.M. - 9.45 A.M.	Antibacterial activity of <i>Xestospongia</i> sp. associated fungi from Karimunjawa National Park, Central Java Indonesia <i>by Mada Triandala Sibero, Tao Zhou, Yasuhiro Igarashi, Tian Xing, Ocky Karna Radjasa, Agus Sabdono, Agus Trianto and Tiara Ulfa Bachtiarini</i>	43
9.45 A.M.- 10.00 A.M.	Alpha glucosidase inhibitors of endophytic actinobacteria from <i>Ficus deltoidea</i> : An antidiabetic agent <i>by Isra Janatiningrum, Dedy Duryadi Solihin, Anja Meryandini and Yulin Lestari</i>	45
10.00 A.M. - 10.15 A.M.	Tidal lands characters from sponge-associated actinobacteria <i>by Dwi Retnowati, Dedy Duryadi Solihin, Munif Ghulamahdi and Yulin Lestari</i>	46
10.15 A.M. - 10.30 A.M.	Biosynthetic silver nanoparticles (AgNPs) from <i>Serratia</i> sp. NBL1001 have antibacterial properties <i>by Mary Faith Y. Adan, Zyne K. Baybay, Nacita B. Lantican, Lilia M. Fernando, Erlinda S. Paterno, Leodevico L. Ilag and Andrew D. Montecillo</i>	47
10.30 A.M.- 10.45 A.M.	Coffee break	





May 31, 2018 Room 303 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
10.45 A.M.- 11.00 A.M.	Growth promoter and antifungal activities of actinomycetes isolated from rhizosphere of soybean plant <i>by Hima Dewi Mariastuti, Resti Afrista, Aris Tri Wahyudi, Sri Listiyowati and Alina Akhdiya</i>	48
11.00 A.M. - 11.15 A.M.	Isolation and selection of some bacterial species capable of treating nitrogen compounds in the white shrimp (<i>Litopenaeus vannamei</i>) culture model by biofloc technology <i>by Truong Phuoc Thien Hoang, Ha Thi Huyen, Luu Thi Le Hang, Nguyen Phu Hoa and Nguyen Thi Thanh Truc</i>	49
11.15 A.M. - 11.30 A.M.	Isolation, identification and antibacterial screening of coral associated bacteria from Karimunjawa National Park <i>by Tiara Ulfa Bachtiarini, Mada Triandala Sibero, Agus Trianto, Adindalifa Hayu Lupita, Defi Puspita Sari, Enjuro Harunari and Amit Raj Sharma</i>	50
11.30 A.M.- 11.45 A.M.	Development of transposon based markers for discriminating various phytopathogenic fungi <i>by Nguyen Ngoc Xuan Thanh, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	51
11.45 A.M. - 12.00 A.M.	Identification and characterization of endophytic bacteria producing β -indol acetic acid isolated from rice rootstocks <i>by Nguyen Thi Kim Thoa, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	52
12.00 A.M. - 1.00 P.M.	Lunch	



**May 31, 2018 Room 303 Floor 3, Building: 45th Anniversary**

Time	Presentation	Page
	Botany	
1.00 P.M. - 1.15 P.M.	Diversity of fungi mychorrizal arbuskular at Jintan Hitam Rizhosfer's <i>by Faisal Al Asad</i>	53
1.15 P.M.- 1.30 P.M.	Survival and growth of the seagrass <i>Thalassia hemprichii</i> with transplanted technique on the amount of different stands <i>by Muhammad Halim, Chuldyah J Harsindhi, An Nisa Nurul Suci, Fanny Kristiadhy, Firman Wira Pratama and Sutanto Hadi</i>	54
1.30 P.M.- 1.45 P.M.	Physiological responses and metabolite analysis of rice (<i>Oryza sativa</i> L.) under Fe toxicity condition <i>by Turhadi, Miftahudin, Munif Ghulamahdi and Hamim</i>	55
1.45 P.M. - 2.00 P.M.	Flowering manipulation on mandarin citrus through bending and defoliation <i>by Rahmat Budiarto, Roedhy Poerwanto, Edi Santosa and Darda Efendi</i>	56
2.00 P.M. - 2.15 P.M.	Income analysis of farming pattern of sweet corn (<i>Zea mays L. Saccharata</i>) - vegetable in Katulungan village, Sukamaju distrit, Luwu Utara Regency <i>by Dewi Marwati Nuryanti</i>	57
2.15 P.M. - 2.30 P.M.	Allelochemical potential of rice straw extract on weed and crop plants <i>by Rara Tiara, Hamim and Srisom Suwanwong</i>	58
2.30 P.M. - 2.45 P.M.	Coffee break	
2.45 P.M. - 3.00 P.M.	Comparative Phytochemistry of The Genus <i>Acmella</i> (Asteraceae) in Thailand <i>by Theerawut Tunang and Srunya Vajrodaya</i>	59
3.30 P.M. - 4.00 P.M.	Closing ceremony Room 341 Floor 3 Building: 45th Anniversary	





May 31, 2018 Room 375 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
	Physics	
9.00 A.M. - 9.15 A.M.	Study of the stability of Brazilin compounds and their derivatives as 12-lipoxygenase enzyme inhibitor <i>by Luluk Muthoharoh, Fahmi Rahmatia, Abdurrahman Bahtiar and Tony Sumaryada</i>	60
9.15 A.M.- 9.30 A.M.	Compound analysis of Indonesian mole crab (<i>Emerita Emeritus</i>) shell on sintering process <i>by Multazimul Haq, Irmansyah and Akhiruddin Maddu</i>	61
9.30 A.M. - 9.45 A.M.	Optical properties of two-dimensional gold nanowire array deposited on gold substrate <i>by Natthaphol Kamolsiriwat and Sukosin Thongrattanasiri</i>	62
9.45 A.M. - 10.00 A.M.	Constraints on dark matter annihilation into electrons and positrons by fermi <i>by Kritaporn Butsaracom and Maneenate Wechakama</i>	63
	Computer Science & Mathematics	
10.00 A.M. - 10.15 A.M.	Analyzing an irrationality proof <i>by Chalongrat Khaoroek and Vichian Laohakosol</i>	64
	Earth Sciences & Materials Science	
10.15 A.M.- 10.30 A.M.	Increasing potential of biomass burning based on the variability of hotspot on visibility and temperature in Kalimantan <i>by Elania Aflahah</i>	65
10.30 A.M. - 10.45 A.M.	Coffee break	



**May 31, 2018 Room 375 Floor 3, Building: 45th Anniversary**

Time	Presentation	Page
10.45 A.M.- 11.00 A.M.	Material properties and in vitro biocompatibility of nanocellulose produced by bacterial isolates from Philippine nata starter <i>by Rose Ann Gabriel Franco, Lilia M. Fernando, Andrew D. Montecillo and Byong-Taek Lee</i>	66
11.00 A.M.- 11.15 A.M.	Synthesis of carbonated hydroxyapatite (CHA) from Tilapia fish bone (<i>Oreocromis niloticus</i>) using microwave irradiation as bone substitute material <i>by Dina Yauma Asra, Yessie Widya Sari, Reny M, Mulya Sari, and Sofiatun H</i>	67
11.15 A.M. - 11.30 A.M.	Modeling sorption isotherm of parboiled rice <i>by Hasniar, R. Hasbullah and I.W. Astika</i>	68
11.30 A.M.- 11.45 A.M.	Green synthesis of nanoparticle C-dots from rice husks with hydrothermal method <i>by Tiara Hardyanti Utama, Akhiruddin Maddu and Laksmi Ambarsari</i>	69
11.45 A.M. - 12.00 A.M.	The influence of ultrasonication and stirring in synthesis of nanohydroxyapatite based chicken eggshell <i>by Zudah Sima'atul Kubro and Kiagus Dahlan</i>	70
12.00 A.M.- 1.00 P.M.	Lunch	





May 31, 2018 Room 375 Floor 3, Building: 45th Anniversary

Time	Presentation	Page
1.00 P.M. - 1.15 P.M.	Preparing dopant materials for light sensors based on ferroelectric thin films using chlorophyll powder from vegetable crops <i>by Endah Kinarya Palupi and Irzaman</i>	71
1.15 P.M. - 1.30 P.M.	Phase change material based fatty acids from marine fish oil by epoxidation process <i>by Yeyen Laorenza, Hanifah Husein H and Bambang Riyanto</i>	72
1.30 P.M. - 1.45 P.M.	Synthesis and characterization of barium hexaferrite magnetic material added zinc powder through mechanical milling method <i>by Ahmad Fauzi and Paduloh</i>	73
1.45 P.M.- 2.00 P.M.	Comparison of upper ordovician - lower silurian life diversity at Pa Kae and Khao Noi, Satun, Thailand <i>by Saran Bunma and Wasinee Aswasereelert</i>	74
2.00 P.M.- 2.15 P.M.	Lithostratigraphy of Pa Kae formation and Wang Tong Formation at Pa Kae and Khao Noi, Satun, Thailand <i>by Kantima Faramee and Wasinee Assawasereelert</i>	75
2.15 P.M.- 2.30 P.M.	Paleoenvironment of Thale Noi, Phattalung <i>by Krid Thuansiriwong and Wasinee Assawasereelert</i>	76
2.30 P.M. - 2.45 P.M.	Coffee break	
3.30 P.M. - 4.00 P.M.	Closing ceremony Room 341 Floor 3 Building: 45th Anniversary	





PLENARY SESSION





Design and application of small-molecule biosensors in natural product biosynthesis studies

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Overproduction of nature products using engineered microbial cells has greatly reduced the production cost and promoted environmental protection. Notably, the rapid and sensitive evaluation of the intracellular concentrations of the desired products greatly facilitates the optimization process of cell factories. For this purpose, many genetic components have been adapted into *in vivo* biosensors of small molecules, which couple the intracellular concentrations of small molecules to easily detectable readouts such as fluorescence, absorbance, and cell growth. We have developed a platform technology of designing customized small-molecule biosensors by engineering specificity of regulatory proteins. These biosensors have been successfully applied in high-throughput screening natural product hyper-producing strains and real-time monitoring intracellular metabolic flux. Thus, this technology of biosensor design is of great significance for natural product studies.





INVITED LECTURE





Research utilization and innovation of natural rubber in Thailand 4.0

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Natural rubber is a very valuable material, a lot of important everyday items are manufactured from rubber. These everyday items include tyres, elastic bands, rubber tubing, latex gloves, anti-vibration products, etc. Thailand has been the World's leading natural rubber producer for over 20 years. So, the rubber industry is very important for the Thai economy. We exported the natural rubber in raw material forms 86% and transferred the raw materials into the products just around 14%. However, the revenue only from the 14% rubber products was half of the total revenue income (500,000 million Baht) from rubber industry in 2015. Thus, we would like to employ science, technology and innovation to create the added value in rubber products. These new products are very important for our country; they will help us to escape from the middle income trap. Situation of natural rubber industry in Thailand 4.0 and trend of industrial rubber research are discussed. This presentation summarizes the research utilization of industrial rubber research and innovation from global to the Thai visions.

Keywords: Natural rubber





From genes to genome: Implications for economic wildlife management and conservation

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A genome represents the genetic material of an organism as a sequence of DNA or RNA with function or non-function. Rapid advances in the understanding of genomics have encouraged the expansion of biotechnology courses and use of natural resources to promote conservation which may be threatened by global warming. Vertebrate wildlife has species richness and high-level sex diversity through either specific or combinations of genes and environmental factors. Wildlife species are widely hunted and traded for food, medicines, and fashion accessories which have exposed fragmented wild populations to the risk of severe decline through the clandestine poaching trade. By contrast, several species such as crocodiles and snakes are now better understood as agricultural animals. Genome technologies have been applied to several wildlife species and provide a valuable resource for identifying genes with economically important traits to generate potential research strategies for husbandry and management. Here, the utility of genome technologies is discussed with reference to Thai vertebrate wildlife. Accurate information regarding breeding programs, wildlife reintroduction, or *in situ/ex situ* management will also enhance and improve the genetic diversity of subsequent generations. Future wildlife conservation governance will benefit from genomic tools which offer practical forensic knowledge for effective decision-making at national policy levels.

Keywords: Genome, Wildlife management





TABLE OF CONTENTS

	Page
Preface	i
Program Committee	ii
Program Schedule	iii
Plenary Lecture	xx
Design and application of small-molecule biosensors in natural product biosynthesis studies by <i>Prof. Dr. Shuang-Yan Tang</i>	
Invited Lecture 1	xxii
Research utilization and innovation of natural rubber in Thailand 4.0 by <i>Dr. Wirasak Smitthipong</i>	
Invited Lecture 2	xxiii
From genes to genome: Implications for economic wildlife management and conservation by <i>Assistant Professor Dr. Kornorn Srikulnath</i>	
Some biological and morphological of papaya mealybug, <i>Paracoccus marginatus</i> Williams and Granara de Willink (Hemiptera: Pseudococcidae) on cassava by <i>Pham Huynh Dong Anh, Le Khac Hoang and Tran Thi Thanh Thao</i>	1
Establishment of fungal combs with three species of fungus-growing termites by <i>Khoirul Anwar, Lisdar I Sudirman and Dodi Nandika</i>	2
Effect of biochar on microbial activity and growth of cocoa seedlings (<i>Theobroma cacao</i>) growing in Acrisols soil in greenhouse condition by <i>Nguyen Duc Xuan Chuong and Jonathan L. Deenik</i>	3
Feasibility study of cantrang (danish trawl) fisheries biology perspective at makassar straits and bone gulf, south sulawesi province, Indonesia by <i>Sri Suro Adhawati, Achmar Malawal, Aris Basol and A. Adri Arief</i>	4





TABLE OF CONTENTS

	Page
Initial study of <i>PTEN</i> expression in Vietnamese in nasopharyngeal carcinoma patients <i>by Nguyen Hoang Danh, K Trong Nghia, Ngo Dong Kha, Lao Duc Thuan and Le Huyen Ai Thuy</i>	5
Fungal endophytes across tissue layers of <i>Canarium ovatum</i> Engl. (Burseraceae) fruit <i>by Jonathan Jaime G. Guerrero and Teresita U. Dalisay</i>	6
Biology aspect of <i>Carcharhinus limbatus</i> as a main targeted fishery in Muncar Banyuwangi East Java <i>by Euis Zulfiaty, Chuldiah J Harsindi and Ranny R Yuneni</i>	7
Development of SRAP-SCAR marker on sugarcane white leaf disease (SCWLD) susceptible and non-susceptible varieties in Vietnam <i>by Dinh My An, Nguyen Doan Nguyen Phuong, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	8
Identification and evaluation of the expression level of surfactants encoding genes of <i>Bacillus amyloliquefaciens</i> in biological control of Corynespora Leaf Fall (CLF) disease on the rubber tree <i>by Truong Ngoc Thao, Nguyen Doan Nguyen Phuong, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	9
Effect of temperation on the life cycle, survival, sex ratio and longevity of <i>Stethorus pauperculus</i> (Coccocilide: Coleoptera) feed on spider mite <i>by Nguyen Thi Bich Han, Tran Thi Thanh Thao and Le Khac Hoang</i>	10
Study on biological characteristics of <i>Dysmicoccus brevipes</i> (Pseudococcidae: Hemiptera) <i>by Nguyen Thi Minh Thi, Le Cao Luong and Nhan Thi Minh Uyen</i>	11
Recovery and valorization of snakehead fish (<i>Channa striata</i>) surimi wash water as bulk active albumin tablet <i>by Ikbal Syukroni, Wini Trilaksani and Uju</i>	12
Effect of Pest Exclusion Net (PEN) on the sustainable production of late season Broad Leaf Mustard (BLM) in Nepal <i>by Ram Chandra Neupane</i>	13
Systematic approach to engineer <i>Escherichia coli</i> chromosome for butanol production <i>by Hongjun Dong, Chunhua Zhao, Tianrui Zhang, Huawei Zhu, Zhao Lin, Wenwen Tao, Yanping Zhang, Yin Li</i>	14





TABLE OF CONTENTS

	Page
Reconstructing Biosynthetic Pathway of the Plant-Derived Cancer Chemopreventive-Precursor Glucoraphanin in <i>Escherichia coli</i> by Han Yang	16
Cryptic species (<i>Sinalpheus</i>) in Tidung Kecil Island by Chuldya J. Harsindhi and M. Halim., A. Ruzanna	17
Exploration of stingless bees in South and West Sulawesi, Indonesia: Morphological and nest structure characteristics by Tiara Sayusti, Rika Raffiudin and Sih Kahono	18
Bear cuscus (<i>Ailurops ursinus</i>): Daily activities, diet, and habitat characteristics in tanjungperopa wildlife reserve, South-East Sulawesi by Rahmia Nugraha and Abdul Haris Mustari	19
Study of the pymetrozine resistance on brown plant hopper (<i>Nilaparvata lugens</i> Stal.) in Tien Giang province, Vietnam by Huynh Thi Ngoc Diem, Ho Van Chien and Le Thi Dieu Trang	20
Anti-bacterial activities of green synthesized zinc oxide nanoparticles by Phakkhathorn Ruangsai and Nattanan T-Theinprasert	21
Identification of two sumatran stingless bees: The presence of <i>COI</i> -like gene in molecular identification by Sri Bening, Rika Raffiudin and Windra Priawandiputra	22
Association of CYP2A6 gene related to fatty acid composition in javanese fat tailed sheep by Kasita Listyarini, Mutasem Ali Abuzahra, Jakaria, Cece Sumantri, Muhammad Jasim Uddin and Asep Gunawan	23
Phylogenetic reconstruction and connectivity analysis of the endangered species <i>Sphyrna lewini</i> based on mitochondrial DNA by Sutanto Hadi, Nurlita Putri Anggraini, Ester Restiana, Effin Muttaqin, Benaya Meitasari Simeon, Muhammad Ichsan, Beginer Subhan and Hawis Madduppa	24
Toll-like receptor 4 (TLR4) as a marker gene for Salmonella disease resistance in selected sentul chickens by Janet Mamutse, Asep Gunawan, Cece Sumantri and Sri Murtini	25
Initial study of relative quantification Epstein Barr Virus (EBV)-encoded RPMS1 expression in the Vietnamese nasopharyngeal cancer patients by Nguyen Hoang Nhat Minh, Nguyen Thi Thuy Trang, Thieu Hong Hue, Lao Duc Thuan and Le Huyen Ai Thuy	26





TABLE OF CONTENTS

	Page
Polymorphysm of myostatin gene is associated with carcass characteristics with maternal immunization against myostatin on post-hatch in sentul indonesian indigenous chicken <i>by Rajma Fastawa, Isyana Khaerunnisa, Yong Soo Kim, Sri Murtini, Asep Gunawan and Cece Sumantri</i>	27
Association of <i>APOA5</i> gene related to flavour and odour compound in javanese fat and javanese thin tailed sheep <i>by Asep Gunawan, Kasita Listyarini, Mutasem Ali Abuzahra, Jakaria, Muhammad Jasim Uddin and Cece Sumantri</i>	28
Isolation, cloning and cellulolytic potential assay of endoglucanase and cellobiohydrolase genes of <i>Trichoderma harzianum</i> <i>by Imrana Niaz Sultan, Afrasiab Khan Tareen and Pramuk Parakulsuksatid</i>	29
Antibacterial Activity of Snail Mucus (<i>Achatina fulica</i>) against Acne Inducing Bacteria (<i>Propionibacterium acnes</i>) <i>by Jaruwan Bangperng, Pramote Chumnanpuen and Teerasak E-kobon</i>	30
Comparative transcriptome of foot and mantle in <i>Semperula siamensis</i> <i>by Tanawat Akepitaktam, Pramote Chumnanpuen and Teerasak E-kobon</i>	31
Expression and purification of Saglin in <i>E.coli</i> <i>by Lukman Dulthara and Anchane Kubera</i>	32
Effects of Optical Tweezers on gene expression in yeast <i>by Wanrosmani Doloh and Sompid Samipa</i>	33
Genetic Relationship of Santol using RAPD markers <i>by Siriluck Tongoran and Sompid Samipak</i>	34
Jatropha Plant tissue culture and transformation <i>by Apisit Burapapiruin and Sompid Samipak</i>	35
Candidate novel SNP of <i>EDG1</i> gene in Bali cattle <i>by Sutikno, Rudy Priyanto, Cece Sumantri and Jakaria</i>	36
Reconstruction of secondary metabolism of <i>Cordyceps militaris</i> <i>by Warasinee Mujchariyakul, Hon Wai Leong and Wanwipa Vongsangnak</i>	37
Putative anticancer and antioxidant peptides screening from the transcriptome of <i>Cordyceps militaris</i> <i>by Pornpavee Nualnisachol, Teerasak E-kobon and Pramote Chumnanpuen</i>	38





TABLE OF CONTENTS

	Page
Bioinformatic analysis of variants in children with rare genetic diseases <i>by Paphawarin Soonkum, Chulaluck Kuptanon and Teerasak E-kobon</i>	39
Designing and cloning artificial miRNA structure for silencing MoCOD1 gene of rice blast fungus <i>Magnaporthe oryzae</i> <i>by Nguyen Kim Hong and Nguyen Bao Quoc</i>	40
Comparison of lactate dehydrogenase and asetylactate synthase deficient mutants of <i>Klebsiella pneumoniae</i> TWO on 1,3-propanediol production <i>by Febri Sembiring, Antonius Suwanto and Iman Rusmana</i>	41
Blast disease reduction by phyllosphere bacteria producing antifungal compounds <i>by Sri Martina Wiraswati, Aris Tri Wahyudi, Abdjad Asih Nawangsih and Iman Rusmana</i>	42
Antibacterial activity of <i>Xestospongia</i> sp. associated fungi from Karimunjawa National Park, Central Java Indonesia <i>by Mada Triandala Sibero, Tao Zhou, Yasuhiro Igarashi, Tian Xing, Ocky Karna Radjasa, Agus Sabdono, Agus Trianto and Tiara Ulfa Bachtiarini</i>	43
Alpha glucosidase inhibitors of endophytic actinobacteria from <i>Ficus deltoidea</i> : An antidiabetic agent <i>by Isra Janatiningrum, Dedy Duryadi Solihin, Anja Meryandini and Yulin Lestari</i>	45
Tidal lands characters from sponge-associated actinobacteria <i>by Dwi Retnowati, Dedy Duryadi Solihin, Munif Ghulamahdi and Yulin Lestari</i>	46
Biosynthetic silver nanoparticles (AgNPs) from <i>Serratia</i> sp. NBL1001 have antibacterial properties <i>by Mary Faith Y. Adan, Zyne K. Baybay, Nacita B. Lantican, Lilia M. Fernando, Erlinda S. Paterno, Leodevico L. Ilag and Andrew D. Montecillo</i>	47
Growth promoter and antifungal activities of actinomycetes isolated from rhizosphere of soybean plant <i>by Hima Dewi Mariastuti, Resti Afrista, Aris Tri Wahyudi, Sri Listiyowati and Alina Akhdiya</i>	48
Isolation and selection of some bacterial species capable of treating nitrogen compounds in the white shrimp (<i>Litopenaeus vannamei</i>) culture model by biofloc technology <i>by Truong Phuoc Thien Hoang, Ha Thi Huyen, Luu Thi Le Hang, Nguyen Phu Hoa and Nguyen Thi Thanh Truc</i>	49





TABLE OF CONTENTS

	Page
Isolation, identification and antibacterial screening of coral associated bacteria from Karimunjawa National Park <i>by Tiara Ulfa Bachtiarini, Mada Triandala Sibero, Agus Trianto, Adindalifa Hayu Lupita, Defi Puspita Sari, Enjuro Harunari and Amit Raj Sharma</i>	50
Development of transposon based markers for descriminating various phytopathogenic fungi <i>by Nguyen Ngoc Xuan Thanh, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	51
Identification and characterization of endophytic bacteria producing β -indol acetic acid isolated from rice rootstocks <i>by Nguyen Thi Kim Thoa, Nguyen Ngoc Bao Chau and Nguyen Bao Quoc</i>	52
Diversity of fungi mychorrizal arbuskular at Jintan Hitam Rizhosfer's <i>by Faisal Al Asad</i>	53
Survival and growth of the seagrass <i>Thalassia hemprichii</i> with transplantation technique on the amount of different stands <i>by Muhammad Halim, Chuldyah J Harsindhi, An Nisa Nurul Suci, Fanny Kristiadhy, Firman Wira Pratama and Sutanto Hadi</i>	54
Physiological responses and metabolite analysis of rice (<i>Oryza sativa</i> L.) under Fe toxicity condition <i>by Turhadi, Miftahudin, Munif Ghulamahdi and Hamim</i>	55
Flowering manipulation on mandarin citrus through bending and defoliation <i>by Rahmat Budiarto, Roedhy Poerwanto, Edi Santosa and Darda Efendi</i>	56
Income analysis of farming pattern of sweet corn (<i>Zea mays</i> L. <i>Saccharata</i>) - vegetable in Katulungan village, Sukamaju distrit, Luwu Utara Regency <i>by Dewi Marwati Nuryanti</i>	57
Allelochemical potential of rice straw extract on weed and crop plants <i>by Rara Tiara, Hamim and Srisom Suwanwong</i>	58
Comparative Phytochemistry of The Genus <i>Acmella</i> (Asteraceae) in Thailand <i>by Theerawut Tunang and Srunya Vajrodaya</i>	59
Study of the stability of Brazilin compounds and their derivatives as 12-lipoxygenase enzyme inhibitor <i>by Luluk Muthoharoh, Fahmi Rahmatia, Abdurrahman Bahtiar and Tony Sumaryada</i>	60





TABLE OF CONTENTS

	Page
Compound analysis of Indonesian mole crab (<i>Emerita Emeritus</i>) shell on sintering process <i>by Multazimul Haq, Irmansyah and Akhiruddin Maddu</i>	61
Optical properties of two-dimensional gold nanowire array deposited on gold substrate <i>by Natthaphol Kamolsiriwat and Sukosin Thongrattanasiri</i>	62
Constraints on dark matter annihilation into electrons and positrons by fermi <i>by Kritaporn Butsaracom and Maneenate Wechakama</i>	63
Analyzing an irrationality proof <i>by Chalongrat Khaoroek and Vichian Laohakosol</i>	64
Increasing potential of biomass burning based on the variability of hotspot on visibility and temperature in Kalimantan <i>by Elania Aflahah</i>	65
Material properties and in vitro biocompatibility of nanocellulose produced by bacterial isolates from Philippine nata starter <i>by Rose Ann Gabriel Franco, Lilia M. Fernando, Andrew D. Montecillo and Byong-Taek Lee</i>	66
Synthesis of carbonated hydroxyapatite (CHA) from Tilapia fish bone (<i>Oreocromis niloticus</i>) using microwave irradiation as bone substitute material <i>by Dina Yauma Asra, Yessie Widya Sari, Reny M, Mulya Sari, and Sofiatun H</i>	67
Modeling sorption isotherm of parboiled rice <i>by Hasniar, R. Hasbullah and I.W. Astika</i>	68
Green synthesis of nanoparticle C-dots from rice husks with hydrothermal method <i>by Tiara Hardyanti Utama, Akhiruddin Maddu and Laksmi Ambarsari</i>	69
The influence of ultrasonication and stirring in synthesis of nanohydroxyapatite based chicken eggshell <i>by Zudah Sima'atul Kubro and Kiagus Dahlan</i>	70
Preparing dopant materials for light sensors based on ferroelectric thin films using chlorophyll powder from vegetable crops <i>by Endah Kinarya Palupi and Irzaman</i>	71
Phase change material based fatty acids from marine fish oil by epoxidation process <i>by Yeyen Laorenza, Hanifah Husein H and Bambang Riyanto</i>	72





TABLE OF CONTENTS

	Page
Synthesis and characterization of barium hexaferrite magnetic material added zinc powder through mechanical milling method <i>by Ahmad Fauzi and Paduloh</i>	73
Comparison of upper ordovician - lower silurian life diversity at Pa Kae and Khao Noi, Satun, Thailand <i>by Saran Bunma and Wasinee Aswasereelert</i>	74
Lithostratigraphy of Pa Kae formation and Wang Tong Formation at Pa Kae and Khao Noi, Satun, Thailand <i>by Kantima Faramee and Wasinee Assawasereelert</i>	75
Paleoenvironment of Thale Noi, Phattalung <i>by Krid Thuansiriwong and Wasinee Assawasereelert</i>	76





TABLE OF CONTENT: POSTER SESSION

Physical Science Posters

Mathematics

No.	Title	Page
P 001	Some Problems in The Fibonacci Quarterly <i>by Nuttakan Butwongsopha and Kantaphon Kuhapatanakul</i>	77
P 002	Powerful Numbers in Arithmetic Progressions <i>by Chanita Hangaew and Teerapat Srichan</i>	78
P 003	On the denesting roots <i>by Chonnikarn Sengaied and Kantaphon Kuhapatanakul</i>	79
P 004	The scheduling of traffic light at Kasetsart University <i>by Patit Damkam and Charn Khetchaturat</i>	80

Chemistry

No.	Title	Page
P 005	Development of New Synthetic Route to Steroid-based Cyclic Nitron <i>by Tanaporn Supakitmongkhol and Wicha Imaram</i>	81
P 006	Preparation and characterization of CeO ₂ -TiO ₂ photocatalysts for textile dye degradation <i>by Jitpisut Poolwong, Teera Butburee and Sutasinee Kityakarn</i>	82
P 007	An anion sensor based on 3,5-dihydroxytoluene and N-(p-tolyl)acetamide <i>by Yada Yu and Boontana Wannalarse</i>	83
P 008	Effect of organic solvents on the ring-opening process of spirooxazine and selectivity towards spirooxazine-metal ion formation <i>by Natchayapak Phiromphu, Supak Pattaweepaiboon, Narongpol Kaewchangwat, Khomson Suttisintong and Weekit Sirisaksoontorn</i>	84





Chemistry

No.	Title	Page
P 009	Further Design, Synthesis of Phosphodiesterase Type 5 (PDE5) Inhibitors of N^2,N^4 -diaminoquinazoline derivatives <i>by Nuttapas Salaloy, Supa Hannongbua and Matthew Paul Gleeson</i>	85
P 010	Determination of phenanthrene intermediate after degradation with tropical microorganisms by using HPLC <i>by Duangmaneejan Sangkamanee and Tharinee Saleepochn</i>	86
P 011	Determination of caffeine in aqueous matrix <i>by Tatiya Visaratmahakul, Orapin Chienthavorn and Wilai Siriwatcharapiboon</i>	87
P 012	Synthesis ZnO@MOF by using ZnO as nucleating agent to synthesis MOF for study as photocatalyst degradation methylene blue <i>by Tanomluck Natehan and Tanwawan Duangthongyou</i>	88
P 013	Preparation, characterization and release study of caffeic acid-loaded chitosan/PVA hydrogel <i>by Tanawat Phumjan and Peerada Yingyuad</i>	89
P 014	Synthesis of bioactive calcium phosphate composite organogel and its application for dental hypersensitivity treatment via dentine tubule occlusion <i>by Nuttamon Artharn and Khrongkhwan Akkarachaneeyakorn</i>	90
P 015	Isolation and structure elucidation of bioactive compounds from the fungus <i>Menisporopsis theobromae</i> BCC 4162 <i>by Norasian Boosaman and Pakorn Wattana-Amorn</i>	91
P 016	The aggregation-induced emission enhancement (AIEE) of thiophene based chalcone materials: Synthesis, photophysical properties and DFT studies for selective sensing of nitro aromatic compounds <i>by Buchitar Nakwanich and Songwut Suramitr</i>	92
P 017	Applications of Cobalt Doped High Internal Phase Emulsions Polymers (polyHIPEs) as an Absorbent for Triethylamine and Formalin <i>by Marinee Techaboonprathan, Chak Sangma and WannisaSukjee</i>	93





Chemistry

No.	Title	Page
P 018	Detection of dopamine by Ni/PDDA/rGO modified glassy carbon electrode <i>by Raveeporn Suksamran and Wilai siriwatcharapiboon</i>	94
P 019	Search for NS3pro dengue virus inhibitors from Thai traditional medicine using computational techniques <i>by Raweewan Ongjaroen, Autchara Namkhaw and Patchreenart Saparpakorn</i>	95
P 020	Electrochemical detection of ascorbic acid by modified electrode <i>by Rakkan Wannaprapa and Chaiya Prasittichai</i>	96
P 021	Synthesis of MOF-Hybrid Materials for Methane Adsorption <i>by Ratchadaporn Srikhong and Ramida Rattanakam</i>	97
P 022	Solvent Extraction Study of Antioxidants from <i>Zanthoxylum limonella</i> <i>by Wasinee Ousirisombat and Wanchai Pluempanupat</i>	98
P 023	A One-pot Synthesis of Benzo[b]naphtho[2,3-f]oxepine-6,11-dione <i>by Siriyanan Yurayat and Paiboon Ngermmeesri</i>	99
P 024	Biological activities from persimmon leaves extract <i>by Akkharaphak Auisakul and Thitinun Karpkird</i>	100
P 025	Encapsulation of retinoids in porous silicon <i>by Asweena Binlaeh and Junya Jettanasen</i>	101
P 026	Production of ethyl ester biodiesel using calcium oxide as catalyst for transesterification <i>by Tip-Aksorn Tikamram and Vittaya Punsuvon</i>	102
P 027	Development of sponge rubber formula by varying content of CaCO ₃ filler and potassium oleate to apply in human model for practice procedure. <i>by Thiti Pariburana and Wirunya Keawwattana</i>	103
P 028	Study of ethyl ester biodiesel production and study of biodiesel separation with glycerol by adding crude and purified glycerol <i>by Benjamas Rodwong and Vittaya Punsuvon</i>	104





Chemistry

No.	Title	Page
P 029	Preparation of promoted manganese dioxide as a catalytic electrode for micro direct methanol fuel cells <i>by Sarawut Morarat and Pinsuda Viravathana</i>	105

Physics

No.	Title	Page
P 030	Design of an optical modulator using germanium on silicon chips <i>by Khajornsak Dangchot and Papichaya Chaisakul</i>	106
P 031	Experimental and Computational study of Cordycepin-encapsulated liposome <i>by Rawiporn Amornloetwattana, Wasinee Khuntawee and Jirasak Wong-ekkabut</i>	107
P 032	Rotation Mechanism of Chiral Nematic Droplets Induced by Heat Flux <i>by Siriked Nuttabut and Nattaporn Chattham</i>	108
P 033	Determination of Birefringence dispersion in nematic liquid crystal electro-optic cell <i>by Jutarat Kaewthong and Nattaporn Chattham</i>	109
P 034	Measurement of the growth of microalgae by optical method <i>by Nattha Rangsi and Chaiya Luengviriya</i>	110
P 035	Study of Environmental Radioactivity of Water Around Nuclear Research Reactor TRR-1/1 <i>by Tanawat Imboon and Teerasak Veerapaspong</i>	111
P 036	Uncertainty Analysis of the Distance Measurement by Parallax Laser Range Finder <i>by Thanaporn Arunthong and Noparit Jinuntuya</i>	112
P 037	Effect of partially replaced sugar cane fly ash into ordinary portland cement: structural and physical investigation <i>by Nawarat Nomrak and Weeraphat Pon-on</i>	113
P 038	Diffusion of Magnetic Field Lines by Using Random Ballistic Decorrelation <i>by Pathomwong Thaoyabut and Peera Pongkitiwanichakul</i>	114





Physics

No.	Title	Page
P 039	Eucalyptus Tree Growth Modeling by Image Analysis <i>by Pannate Wongsripan and Noparit Jinuntuya</i>	115
P 040	A FRET-based biosensor for BRCA1 detection <i>by Maytinee Thitichai, Chalernpol Kanchanawarin and Chittanon Buranachai</i>	116
P 041	Flywheel for energy storage <i>by Lutfee Karat, Puchong Kijamnajsuk and Sutharat Chotikaprakhan</i>	117
P 042	To measure the resistance of composite Ne and Fe <i>by Siwapong Tongkham and Sutee Boonchui</i>	118
P 043	Photodegradation performance of Dye on TiO ₂ decorated activated Fly Ash blended cement <i>by Siriwimol Noymak and Weeraphat Pon-on</i>	119
P 044	Microwave Drying for Eucalyptus Wood Kernel <i>by Suwinus Thuenhan and Noparit Jinuntuya</i>	120
P 045	Synthesis and characterization of silver nanoparticles based on <i>Brassica oleracea capitata</i> Recucion <i>by Hathainut Jaroenrit and Chatchawal Wongchoosuk</i>	121
P 046	Fabrication of low cost electronic tongue for salinity measurement <i>by Anyamanee Sinjaroen and Chatchawal Wongchoosuk</i>	122
P 047	Single Slit Diffraction Pattern Produced by Reflection from Thin Stripes <i>by Chaturaporn Kordkaew and Noparit Jinuntuya</i>	123

Computer Science

No.	Title	Page
P 048	The Portable Access Counting System <i>by Wastpol Thinlek and Narawut Nontapa</i>	124





Earth Science

No.	Title	Page
P 049	Characteristics of mantle xenoliths enclosed in alkali basalt at Khao Lun Tom, Bo Phloi District, Kanchanaburi Province <i>by Pornchanit Sawasdee and Prayath Nantasin</i>	125
P 050	Petrology of Petrified Wood in Petrified Forest, Tak Province, Thailand <i>by Kritsana Sangsawang and Ladda Tangwattananukul</i>	126
P 051	Petrographic Study and Geochemistry of Corundum-Bearing Marble of Skallevikshalsen, <u>Lützow-Holm</u> Complex, East Antarctica <i>by Kantawee Jintanon</i>	127
P 052	Integrated Electromagnetic and Resistivity Measurement for Effective Infiltration Management <i>by Chantima Bunpra and Desell Suanburi</i>	128
P 053	The Influences of Indian Ocean Dipole (IOD) on Rainfall of Thailand <i>by Jaruwan Wasthaisong and Pongsakorn Jiwapornkupt</i>	129
P 054	Modified Ground Electromagnetic and Magnetic Instrument for Marine Measurement to Locate Buried Electric Cable Offshore. <i>by Chavit Sangsri and Desell Suanburi</i>	130
P 055	Cause of Flash Flood in Kasetsart University Bangkok Branch <i>by Chutima Pansuk and Pongsakorn Jiwapornkupt</i>	131
P 056	Comparison of Storm Surge intensity caused by Tropical Storm Linda in 1997 and Tropical Depression 30W (Wilma) in 2013 in the Gulf of Thailand, Thailand. <i>by Natrika Sirinaspokin and Panu Trivej</i>	132
P 057	Geology of Huai Yuak, Sukhothai Province, Northern Thailand. <i>by Donrudee Thonglor and Ladda Tangwattananukul</i>	133





Earth Science

No.	Title	Page
P 058	Shallow seismic reflection survey of the landslide area in Banhui-King, Moo.6, Mae-Moh district, Lampang province, Thailand. <i>by Songsak Muangnoi and Passakorn Pananont</i>	134
P 059	Heat Treatment of Amethyst Samples Using Alcohol Burner <i>by Teepakorn Jaturanon and Somruedee Satitkune</i>	135
P 060	The Multichannel Analysis of Surface Waves survey at the landslide area in Ban Huai King, Mae Moh district, Lampang province, Northern Thailand. <i>by Thanissawan Himma and Passakorn Pananont</i>	136
P 061	Mineral paragenesis sequence related to gold mineralization of Huai Kham On, Phrae Province, Northern Thailand <i>by Thawatchai Polsri and Ladda Tangwattananukul</i>	137
P 062	The ground penetrating radar survey at landslide area in Ban Huai King, Mae Moh District, Lampang Province, Thailand. <i>by Thanchanok Tunsuthep and Passakorn Pananont</i>	138
P 063	Dyeing Cotton with Malachite and Goethite <i>by Noppawan Kaewpradit and Somruedee Satitkune</i>	136
P 064	Petrography and mineral chemistry of Cal-silicate at Akarui Point, Lützom-Holm Complex, East Antarctica <i>by Bowornlak Amnatmetta and Prayath Nantasin</i>	140
P 065	Petrology and geochemistry of volcanic rock in Huai Kham On, Phrae province, Northern Thailand <i>by Bussayawan Sukbunjong and Ladda Tangwattananukul</i>	141
P 066	Environmental Risk Assessment of Heavy Metals by Pollution Indicators in Agriculture Soil, near Khonkean Municipal Landfill, Khonkean Province, Thailand <i>by Puchanit Sukchan Somkid Tangkan and Unnop Homchan</i>	142
P 067	Contouring map of As, Cr, Fe and Mn distribution in agricultural top soil, near Khonkaen municipal landfill, Khonkaen province, Thailand <i>by Pitchapa Nuangsri Somkid Tangkan and Unnop Homchan</i>	143





Earth Science

No.	Title	Page
P 068	Application of GIS to locate shallow groundwater at the margin of Chao Phraya basin. <i>by Peeraphat Srimongkol and Desell Suanburi</i>	144
P 069	Petrography and mineral chemistry of ruby-bearing calc-silicate at West Ongul Island, Lützow-Holm Complex, East Antarctica <i>by Penchun Thaworndumrongsakul and Prayath Nantasin</i>	145
P 070	Modeling of cadmium, nickel, lead, and zinc distribution in agricultural top soil, near Khonkaen municipal landfill, Khonkaen province, Thailand. <i>by Phraeraphee Kungwong Somkid Tangkan and Unnop Homchan</i>	146
P 071	Apply Multi Frequency Electromagnetic Technique for Shallow Groundwater Map at Nong Ya Sai – Dan Chang Area <i>by Yotsawat Chuhakamolrat and Desell Suanburi</i>	147
P 072	Hydrogeology of Muaeng Paeng hot spring, Pai district, Mae Hong Son province. <i>by Wanas Khannoi and Kannaree Chuangcham</i>	148
P 073	2D Resistivity Imaging Survey of Landslide location at Ban Huai King, Mae Moh, Lampang Province, Thailand <i>by Weraphat Sengson</i>	149
P 074	Accumulation of heavy metals in cassava near Khonkaen municipal landfill, Khonkaen province, Thailand <i>by Sirilak Klindokkaew Somkid Tangkan and Unnop Homchan</i>	150
P 075	Shallow Resistivity Analysis to Locate Appropriate Infiltration Construction <i>by Suphachok Satakurama and Desell Suanburi</i>	151
P 076	Hydrological Characteristics on Upper and Lower of PaSak Watershed <i>by Suwipa Doongkhokkrowd and Pongsakorn Jiwapornkupt</i>	152
P 077	Mineral paragenesis sequence related to gold mineralization of Huai Yuak, Sukhothai province, Northern Thailand <i>by Aprisara Semapongpan and Ladda Tangwattananukul</i>	153





Statistics

No.	Title	Page
P 078	The Comparison Efficiency of Classification Methods for Precipitations in Bangkok <i>by Kwanjira Tanpoonkai, Kwanjira Thongthai Kananan Lakananan and Wandee Wanishsakpong</i>	154
P 079	A Comparison of Missing Data Estimation Methods in Multiple Regression Analysis <i>by Chotepipat Chatkoonbunmai, Rinyaphat Jiraitсарawat, Sunisa Theansan and Boonorm Chomtee</i>	155
P 080	A Comparison of test for Heteroscedasticity in Simple Linear Regression <i>by Pisut Sukpool, Chanida Rattanawichit, Benyapa Kongkaew, Suchada Angkatip and Apinya Hirunwong</i>	156
P 081	Comparison of Gold Bar Price Forecasting with ARIMA model and GARCH model <i>by Usawadee Leelapojsan , Kanyanath Pawanarith Nattida Wechsilpa, Suchanya Mahaphom and Jeeraporn Thaithanan</i>	157
P 082	A comparison of Two-phase Sampling and Inverse Sampling <i>by Jitta Cheewalertwiboon, Pattamaporn Senluang Pataimas Kiratan, Wanwarin Chinsaengchai and Mena Patumasut</i>	158
P 083	A Comparison of Factor Analysis by Orthogonal Rotation That Affects Prices of Jasmine Rice <i>by Chanida Pankum, Theptat Santanon, Sarunrat Chauyruksa, Sukanya Loesawanwaree and Chutima Sirijantra</i>	159
P 084	Performance Comparison of the Multivariate Cumulative Sum Control Charts <i>by Narisara Kerdpakprak, Kuntaree Suwannaphum Khwangamol Lurjoy, Napaporn Chueachumluang and Sudarat Nidsunkid</i>	160
P 085	A Study of the Number of Rounds of Kasetsart University's Welfare Bus Route (Bangkhen Campus) by using Queueing Theory <i>by Nichapon Chinbuatong, Pattarnit Thanariyachai Daungkamol Nantakasri, Mallika Pongkansup and Saowapa Chaipitak</i>	161





Statistics

No.	Title	Page
P 086	Efficiency Comparison of the Standard Deviation Estimation Methods for a Normal Distribution <i>by Pattaratorn Boonyavaha, Nutchicha Pratchayalamlert, Benjira Boonpet and Juthaphorn Sinsomboonthong</i>	162
P 087	Performance Comparison of Forecasting by Theil's Validation of Forecasts for Various Time Series Forms <i>by Parawee Patchaiwong, Puttipong Chanchaem Suphak Sangkhanan, Apinya Junjom and Chantha Wongoutong</i>	163
P 088	Comparison of Power of Non-Parametric Tests for Two Dependent Populations <i>by Supaporn Ketpradit, Kittida Sukkasemrat, Phattra Thussanangam, Supachai Pankamon and Thidaporn Supapakorn</i>	164
P 089	A Comparison of Nonparametric Statistics for Multiple Comparisons <i>by Orawan Thavranon, Maridsanan Cheawcharn Pasin Subanek and Ampai Thongteeraparp</i>	165
P 090	Analysis of Factors Affecting the Success in Education of Kasetsart University, Bangkhen campus by Using Logistic Regression Analysis <i>by Monbha Setthipat, Rotsanan Hirunviwatkul, Waris Hirankarn and Chantha Wongoutong</i>	166
P 091	Time series Analysis and neural network to forecast export quantity and value of rubber <i>by Niramon Tangtrakalkul, Prarinkorn Prapamonton, Natchapol Teerakravekul, Chudit Nopakulsatit and Apinya Hirunwong</i>	167
P 092	Forecasting Models For BTS Passengers <i>by Tachit Yongstar, Charisa Phuthimongkhonkun, Theptip Teachersripaitoon, Paradorn Sawawiboon and Mena Patumasut</i>	168
P 093	Comparison of time series forecasting method for produce energy power of Thailand Electricity Generating Authority <i>by Surapat Nattisut, Thunchanok Kitpattanaroj, Sanhapat Rattananrungrueangchai and Chutima Sirijantra</i>	169





Statistics

No.	Title	Page
P 094	Efficiency Comparison of Population Ratio Estimators in Simple Random Sampling <i>by Nuntida Ounrittichai, Patsaporn Utha, Phadungdet Retanu and Saowapha Chaipitak</i>	170
P 095	A Comparison on Detecting Outlier Method in Simple Linear Regression <i>by Piyoros Phonmak, Panadda Surichai, Chayanee Detpradid, Thanapat Phutangon and Ampai Thongteeraparp</i>	171
P 096	Efficiency Comparisons of DEWMA, GWMA and DEWMA-TUKEY Control Charts for Normal Process <i>by Phongsatron Kampang, Pattaradanai Kitkancharoensin, Tanaporn Rerksopa, Prapapan Pungthai and Thidaporn Supapakorn</i>	172
P 097	Efficiency Comparison for the Different Types of Exponentially Weighted Moving Average Control Charts <i>by Pichayaporn Jaritngam, Rattiyaporn Jarupak Sakpol Rungrounrittichai and Juthaphorn Sinsomboonthong</i>	173
P 098	An Accuracy Comparison of Some Statistical Procedures Based on Selected Statistical Platforms <i>by Pachalapol Hongsamart, Suwipa Prasertsang, Phitphibun Kongsakpornchai and Winai Bodhisuwan</i>	174
P 099	A Study of Regression Analysis Using Weka Program <i>by Rawiwan Chitvises, Tararat Sengriab, Paranee Yamaqupta, Thanisorn Arayawanichkul and Boonorm Chomtee</i>	175
P 100	Study on Influence of Fertilizer Affection of Arabica Coffee Yields <i>by Sirinthip Ngamchaluay, Korn Patchararat, Chadaporn Areechon, Theerawat Senkram and Jeeraporn Thaithanan</i>	176





Statistics

No.	Title	Page
P 101	Artificial Neural Network for Prediction the Amount of Rain in the Next Three Hours of a Day in Summer for Nakhon Ratchasima and Khon Kaen Provinces <i>by Sarat Lapayanan, Onwanya Arjareeyawut, Suchada Janthananat and Lily Ingsrisawang</i>	177
P 102	A Comparative Optimal Model for Temperature Forecasting of Southwest Region in Thailand using ARIMA and ARIMAX Model <i>by Peerasak Puttapruek, Wirawat Keypun, Wathanya Asawapichaid, Sukitta Jansiripol and Wandee Wanishsakpong</i>	178





Biological Science Posters

Microbiology

No.	Title	Page
P 103	Ethanol production from cellulosic material by thermotolerant yeast <i>Kluyveromyces marxianus</i> DMKU 3-1042 using simultaneous saccharification and fermentation process <i>by Warattaya Wattanathavorn and Noppon Lertwattanasakul</i>	179
P 104	Antimicrobial properties of Lactic Acid Bacteria isolated from small intestine and feces of chicken broiler <i>by Kanokwan Chuchuai and Wanna Malaphan</i>	180
P 105	The isolated yeasts from wild mushrooms, and their ability to increase mushrooms yield <i>by Kanistha Nerapoo Sri and Yaovapa Aramsirirujiwet</i>	181
P 106	Ability to produce indole-3-acetic acid (IAA) by actinomycetes isolated from Kantulee swamp forest <i>by Kamonluk Kiatwatheerata and Kannika Daungmal</i>	182
P 107	Effect of Lingzhi mushroom extract against cancer cells <i>by Kedsupang Whangsupangkul and Ingorn Kimkong</i>	183
P 108	Screening and identification of phytase-producing fungi <i>by Jaruvit Khawchurak and Saeree Jareonkitmongkol</i>	184
P 109	Yeast Diversity in Grease Trap of Kasetsart University Canteens <i>by Jirameth Angchuan, Wanatchaporn Boontham and Nantana Srisuk</i>	185
P 110	Cultivation of <i>Ganoderma lucidum</i> mycelia for hydrophobin extraction for studying antitumor activity on breast cancer cell <i>by Chananan Noppanamas, Ingorn Kimkong and Chestsada Pothiratana</i>	186
P 111	Production of tempe starter in laboratory scale from rice germ treated by autoclave and tyndallization <i>by Chalita Lapjit and Surang Suthirawut</i>	187





Microbiology

No.	Title	Page
P 112	Microbiological quality of crushed / cube ice from drinking shop in Kasetsart University , Bangkhen campus <i>by Chutima Rotchum and Kooranee Tuitemwong</i>	188
P 113	Improvement of rice and coconut water vinegar fermentation by static culture of <i>Acetobacter pasteurianus</i> SKU1108 G40 and its adapted strain <i>by Natthanicha Anantao and Gunjana Theeragool</i>	189
P 114	Study on antimicrobial activity of Piperaceous plant extracts against acne-inducing bacteria <i>by Nuttida Asuraphong, Theerachart Leepasert, Chalernpol Suwanphakdee and Churapa Teerapatsakul</i>	190
P 115	Detection of <i>Listeria monocytogenes</i> , <i>Salmonella</i> spp. and <i>Shigella</i> spp. by Multiplex Polymerase Chain Reaction (Multiplex PCR) technique <i>by Natvadee Chantasirirat, Chaivat Kittigul and Akkaraphol Srichaisupakit</i>	191
P 116	Comparative study of soybean Tempe production by 1 times and 2 times boiling process <i>by Nicharee keardsang and Surang Suthirawut</i>	192
P 117	Extraction of Lipopolysaccharide of <i>Brucella abortus</i> using n-butanol method <i>by Treechat Upasen, Kreeson Packthongsuk and Patcharaporn Siwayaprahm</i>	193
P 118	A study of <i>Ganoderma</i> , <i>Auricularia</i> and <i>Lentinus</i> from forest in Thailand <i>by Thanaporn Paethong and Yaovapa Aramsirirujiwet</i>	194
P 119	Induction of Phenanthrene Biodegradation of Fungal-bacterial Co-culture by using Phenanthrene substitutes. <i>by Nadnapha Jantraruangrit, Churapa Teerapatsakul and Chetsada Pothiratana</i>	195
P 120	Antimicrobial properties of probiotic microorganisms and growth of probiotic cultures in fermented soybean meal <i>by Pavitra Aramcharoen and Wanna Malaphan</i>	196
P 121	Studies on the effect of Shiitake extract against cancer cells <i>by Phakamas Wuepchaiyaphumi and Ingorn Kimkong</i>	197





Microbiology

No.	Title	Page
P 122	Study on Factors Affecting Phytase Production of <i>Aspergillus</i> sp. <i>by Pimonpun Chunban and Saeree Jareonkitmongkol</i>	198
P 123	Optimization of succinic acid production from hydrolysates of sugarcane bagasse as carbon sources by <i>Corynebacterium glutamicum</i> CS176 isolated in Thailand <i>by Phapfhan Hemsuwan and Savitr Trakulnalaemsai</i>	199
P 124	Enzyme production and plant material degradation for animal feed industry of <i>Bacillus</i> and <i>Paenibacillus</i> isolated from termite guts <i>by Maneeploy Nualkul and Pinsurang Deevong</i>	200
P 125	Plant growth promotion of heavy metal resistant actinomycetes isolated from zinc mine soils <i>by Yanyong Jannoon and Pinsurang Deevong</i>	201
P 126	Xylanase production from <i>Streptomyces</i> <i>by Ramita Kemavit, Kannika Duangmal and Thidarat Nimchua</i>	202
P 127	Investigation of thermotolerant genes, <i>hspD</i> and <i>serA</i> , expression on growth, acetic acid and bacterial nanocellulose (BNC) production in <i>Komagataeibacter</i> spp. at high temperature <i>by Ratikarn Leekitcharoenphon and Gunjana Theeragool</i>	203
P 128	Calcium carbonate precipitation by urease producing bacteria isolated from soil <i>by Laxmi Leeprasert and Chanita Boonmak</i>	204
P 129	Adaptation of raw material to enhance the nutritional value of <i>Hericium erinaceus</i> <i>by Danita Paimariya and Yaovapa Aramsirujiwet</i>	205
P 130	Comparative study of Tempe production from splitted soybean by 1 time and 2 times boiling process <i>by Sriarun Chaisombatnet and Surang Suthirawut</i>	206
P 131	Microbiological studies of bacteria in vermicompost and selection of starter culture for vermicompost fermentation <i>by Sonsiri Samutchinda and Wanna Malaphan</i>	207





Microbiology

No.	Title	Page
P 132	Improvement of bacterial nanocellulose production by adapted strain of <i>Komagataeibacter xylinus</i> MSKU 12 <i>by Suwatjane Kaewheang and Gunjana Theeragool</i>	208
P 133	Screening of phytase-producing yeasts <i>by Anunya Kongsri and Saeree Jareonkitmongkol</i>	209
P 134	Detection of <i>Vibrio parahaemolyticus</i> , <i>Vibrio cholerae</i> and <i>Escherichia coli</i> O157:H7 by Multiplex Polymerase Chain Reaction (Multiplex PCR) Technique <i>by Areeya Sukmoolsiri, Chaivat Kittigul and Akkaraphol Srichaisupakit</i>	210
P 135	Antimicrobial efficiency of Piperaceous plant extracts against food-spoilage microorganisms <i>by Warit Prommawan, Theerachart Leepasert, Chalernpol Suwanphakdee and Churapa Teerapatsakul</i>	211

Biochemistry

No.	Title	Page
P 136	Quantification of melittin and histamine in crude bee venom extracts by reverse-phase HPLC <i>by Benyapa Thanatummat and Chomdao Sinthuvanich</i>	212
P 137	Functional study of the <i>OsSALI</i> on drought tolerance mechanism in rice by RNA interference <i>by Kamonrat Sukchom and Wannarat Phonphoem</i>	213
P 138	EXPRESSION AND PURIFICATION OF ANTIGENIC PROTEIN FROM BACTERIAL DISEASE IN NILE TILAPIA (<i>Oreochromis niloticus</i>) <i>by Chutikarn Jaengphop and Sasimanas Unajak</i>	214
P 139	DEVELOPMENT OF VACCINE DELIVERY SYSTEM FOR FIS <i>by Titinun Nuntapramote and Sasimanas Unajak</i>	215
P 140	Development of Detection kit for Feline immunodeficiency virus <i>by Natchaya Rasri and Kiattawee Choowongkomon</i>	216
P 141	Effect of temperature on the anthocyanin content in mulberry <i>by Nattakarn Wongsrangsap and Wannarat Phonphoem</i>	217





Biochemistry

No.	Title	Page
P 142	Site-directed mutagenesis of beta-glucosidase to release isoflavones in soybean <i>by Pornpan Ponlah and Prachumporn Kongsaree</i>	218
P 143	Expression and purification of single-stranded DNA binding protein from <i>Sulfolobus solfataricus</i> for application in long range PCR. <i>by Phatcharin Phetphiri and Somchai Pombanlualap</i>	219
P 144	Optimization for recombinant Ribosome inactivating protein (RIP) production from <i>Jatropha</i> in <i>E. coli</i> <i>by Renu Hemthanon and Chotika Yokthongwattana</i>	220
P 145	Biological activities of protein extracts from silkworm pupae against NCDs <i>by Wirunya Hangtrakul and Suttida Chukiatsiri</i>	221
P 146	Evaluation of antioxidative properties of protein hydrolysate from Thai rice <i>by Ananya Jindaruk and Pichamon Kiatwuthinon</i>	222
P 147	The simulation of tyrosine kinase protein in EGFR cause of drug resistant by computational program <i>by Arniruj Shinaprapha and Kiattawee Choowongkomon</i>	223
P 148	Characterisation of titin isoforms and their localisations in side-specific aortic valve endothelial cells. <i>by Anirut Makchai and Napachanok Mongkoldhumromgkul</i>	224
P 149	Characterization of proteins in response to hydrophobic substrate in <i>Yarrowia lipolytica</i> <i>by Threesara Lertvatisilp and Napapol Poopanitpan</i>	225
P 150	Study of salt-responsive proteins in salt tolerant rice strains <i>by Rungrawee Kongkitimanon and Chotika Yokthongwattana</i>	226





Botany

No.	Title	Page
P 151	Effect of Garden Balsam (<i>Impatiens balsamina</i> L.) Extracts on Fungal Infection of Rice <i>by Rasaya Pinyapap and Minta Chaiprasongsuk</i>	227
P 152	Water Limitation Affects Photosynthesis and Yield of Aged Chili Plants <i>by Rawinnipha Waewsorn and Ornusa Khamsuk</i>	228
P 153	Comparative Phytochemistry of <i>Polyalthia debilis</i> (Pierre) Finet & Gagnep. and It's Antifungal Activity Against Fungi Cause Diseases in Agricultural Products. <i>by Kittikan Kongsomboon and Srunya Vajrodaya</i>	229
P 154	Morphology and Anatomy of the Genus <i>Peltophorum</i> (Vogel) Benth. (Fabaceae, Caesalpinioideae) in Thailand <i>by Kanisorn Kampeera and Chatchai Ngernsaengsaruy</i>	230
P 155	Anatomical characters of <i>Thespesia populnea</i> (L.) Soland ex. Correa and <i>Talipariti tiliaceum</i> (L.) Fryxel <i>by Thapranee Wongsan and Prasart Kermanee</i>	231
P 156	Effect of Sunflower Pericarp Aqueous Extract on <i>Mimosa pigra</i> L. <i>by Nattapon Sunthonchote and Srisom Suwanwong</i>	232
P 157	Comparative Phytochemistry of <i>Oldenlandia corymbosa</i> L. (Rubiaceae) and It's antifungal activity against fungi cause diseases in Agricultural products. <i>by Duangruthai Jitcharoen and Srunya Vajrodaya</i>	233
P 158	Morphology and Anatomy of Leaves in some species of the Genus <i>Cycas</i> L. <i>by Tanakrit Pomhom and Prasart Kermanee</i>	234
P 159	<i>CrLIP4</i> expression analysis in <i>Chlamydomonas reinhardtii</i> <i>by Nonthapon Vejpanich and Jaruswan Warakanont</i>	235
P 160	Wood anatomy and Properties of Species in the Family Ebenaceae in Thailand <i>by Nuttapim Junyoo and Prasart Kermanee</i>	236





Botany

No.	Title	Page
P 161	Anatomy of <i>Lycopodium</i> s.l. found in Thailand. <i>by Wareerat Kanjananuch and Prasart Kermanee</i>	237
P 162	Host Tree Characters Affect Occurrences of Epiphytic Bryophytes <i>by Amarisa Noinakhon and Ekaphan Kraichak</i>	238

Genetics

No.	Title	Page
P 163	Production of recombinant ATG12 protein for checking autophagic activity <i>by Kamonchanok Taway and Anongpat Suttangkakul</i>	239
P 164	Detection and genotyping of Dengue virus in <i>Aedes aegypti</i> male mosquitoes <i>by Kamolwan Hongthong and Wunrada Surat</i>	240
P 165	Population structure of the short mackerel, <i>Rastrelliger brachysoma</i> (Bleeker, 1851) from spawning grounds in The Gulf of Thailand <i>by Khwankamon Wongta and Akarapong Swatdipong</i>	241
P 166	Genetic Code on the mitochondria of <i>Betta mahachaiensis</i> <i>by Juthathip Puapanpipat and Akarapong Swatdipong</i>	242
P 167	Genetic diversity of firefly, <i>Pteroptyx malacca</i> (Coleoptera; Lampyridae) in Thailand <i>by Thitiya Mongkolveerapan and Ajaraporn Sriboonlert</i>	243
P 168	Evolution of Dictyostelids <i>mtcox1/2</i> gene and its relationship to <i>mtcox1</i> in other amoebozoza <i>by Panida Plodpai and Passorn Wannapinij</i>	244
P 169	Co-evolution of fungus-growing termites and their symbiotic partners <i>by Pornsinee Kongthong and Mingkwan Nipitwattanaphon</i>	245
P 170	Exploring new targets from <i>Anopheles</i> to inhibit malaria transmission <i>by Pattaweeya Paochan and Anchane Kubera</i>	246





Genetics

No.	Title	Page
P 171	Molecular Cloning of Repetitive DNA Elements in The Genome of Snakes <i>by Preaploy Chanlawong and Kornorn Srikulnath</i>	247
P 172	Development of recombinant ATG8 as a marker for studying autophagy in <i>Cucumis sativus</i> <i>by Prawpran Juchang and Anongpat Suttangkakul</i>	248
P 173	Expression of <i>Phytochrome Interacting Factor 4 (PIF4)</i> in Oil Palm <i>by Sakawrut Homklintiant and Chatchawan Jantasuriyarat</i>	249
P 174	Gene cloning and protein expression of <i>Anopheles</i> proteins those are important for <i>Plasmodium</i> development <i>by Sarocha Vijitsangrat and Anchane Kubera</i>	250
P 175	Application of mtDNA sequence of ancient pigs to understand the livelihood of the log-coffin culture community who used to live in the highland Pang Mapha, Mae Hong Son province, Thailand <i>by Sulak Wetchaphan and Passorn Wonnapijij</i>	251
P 176	DNA extraction and nucleotide sequence analysis of ancient cattle <i>by Anita Vorajenwanich and Wunrada Surat</i>	252
P 177	Meiotic Chromosome behavior of the seed bugs, <i>Lygaeus pandurus</i> Scop. <i>by Inchalita Laibua and Mingkwan Nipitwattanaphon</i>	253
P 178	Effect of non-polymorphic residues to HIV1-Protease activity and drug resistance <i>by Petcharat Namwong and Anchane Kubera</i>	254
P 179	Genetic variation of Circadian clock genes in <i>Anopheles scanloni</i> <i>by Sansanee Nokthong and Uraiwan Arunyawat</i>	255
P 180	Genetic variation of VRI gene in malaria mosquito (<i>Anopheles dirus</i>) <i>by Anantaya Mana and Uraiwan Arunyawat</i>	256





Applied Radiation and Isotopes

No.	Title	Page
P 181	Development of lead-free gamma shielding materials from EPDM rubber <i>by Worawat Poltabtim, Ekachai Wimolmala, and Kiadtisak Saenboonruang</i>	257
P 182	Application of Thermoluminescence Technique for Detection of Irradiated Spices and Herbs <i>by Korawee Saejia and Wanwisa Sudprasert</i>	258
P 183	Antioxidant Activity and Radioprotective Effect of Instant Green Tea in Human Lymphocytes <i>by Kasama Homkhaow and Paiboon Reungpatthanaphong</i>	259
P 184	Investigation on Properties of Gamma-irradiated Reduced Graphene Oxide (rGO) <i>by Gitti Sucharajit and Kiadtisak Saenboonruang</i>	260
P 185	Enhancement of Cellulose Fiber Degradation from Water Hyacinth (<i>Eichornia crassipes</i>) by Gamma Radiation for Ethanol Production <i>by Gadesuda Jankaew and Ridthee Meesat</i>	261
P 186	Study of Genetic Variation of Canna Wild Type and Mutants through ISSR Marker <i>by Jariyaporn Rakkaew and Katarut Chusreeaeom</i>	262
P 187	Effects of gamma rays on chemical properties and antinutrients of mulberry leaves <i>by Charinrat Chansirichok and Wanwisa Sudprasert</i>	263
P 188	Measurement and Analysis of Radioactivity in Japanese Imported Sauce Products by Gamma Spectrometry with High Purity Germanium (HPGe) Detector <i>by Thatchakorn Kitiratkun and Paiboon Reungpatthanaphong</i>	264
P 189	Measurement of Radionuclides in Thai Rice and Japanese Rice by Gamma Spectrometry with High Purity Germanium (HPGe) Detector <i>by Thipakorn Phakakaew and Paiboon Reungpatthanaphong</i>	265





Applied Radiation and Isotopes

No.	Title	Page
P 190	Antioxidant Activity and Radioprotective Effect of Leaves of Japanese Green Tea in Human Blood Lymphocytes <i>by Tanyada Tanadonchonhirun and Paiboon Reungpatthanaphong</i>	266
P 191	Development of neutron-shielding particleboards using B ₂ O ₃ powders <i>by Thitisorn Anekratmontre, Kiadtisak Sanbunruang and Ekachai Wimolmala</i>	267
P 192	Ability of Chitosan to Adsorb Radionuclides from Wastewater <i>by Nalinrat Pivcharorn and Wanwisa Sudprasert</i>	268
P 193	Measurement of Radionuclides in Coffee Bean by Gamma Spectrometry with High-Purity Germanium (HPGe) Detector <i>by Pajaree Bourdom and Paiboon Reungpatthanaphong</i>	269
P 194	Effect of gamma radiation on physical properties of mulberry leaves <i>by Pornpanit Toungpiyakul and Wanwisa Sudprasert</i>	270
P 195	Effects of Gamma Radiation on Some Biochemical Change of Turmeric <i>in vitro</i> propagation <i>by Pitchayapa Nilsiri and Katarut Chusreeaeom</i>	271
P 196	Production of Sugar from Cellulose Fibers Degradation of Incense Burner (<i>Typha angustifolia</i> L.) for Ethanol Production by Gamma Irradiation <i>by Pattawut Chomchidcharoensuk and Ridthee Meesat</i>	272
P 197	The Optimization of Chitosan Concentration for Radionuclide Adsorption in Aqueous Solution <i>by Patrawan Yangkul and Wanwisa Sudprasert</i>	273
P 198	Radiosensitivity of <i>Curcuma Longa L.</i> to Acute and Chronic gamma irradiation <i>by Maneephan Saetun and Katarut Chusreeaeom</i>	274
P 199	The Use of Photostimulated Luminescence Technique to Identify Irradiated Spices and Herbs <i>by Wiranut Boon-mee and Wanwisa Sudprasert</i>	275
P 200	Preliminary Study on <i>In Vitro</i> Phototoxicity for Safety Evaluation <i>by Suphakit Chitchainagm and Paiboon Reungpatthanaphong</i>	276





Applied Radiation and Isotopes

No.	Title	Page
P 201	Effects of Gamma Radiation on Physical Properties and Main Active Compounds of Garlic Bulb <i>by Supapich Sukjit and Wanwisa Sudprasert</i>	277
P 202	<i>In Vitro</i> Phototoxicity Study of Thai Gac Fruit Extracts <i>by Sunattawadee Chotchom, Sareeya Reungpatthanaphong and Paiboon Reungpatthanaphong</i>	278
P 203	Fabrication of a Prototype PDMS-Based Microfluidic Device for Gamma H2AX Detection <i>by Sureenipa Buangklang and Wanwisa Sudprasert</i>	279
P 204	Indoor radon investigation using a solid state alpha track detector technique at Kasetsart University <i>by Suwannee Phulsong and Chanis Pornnumpa</i>	280
P 205	Design and Fabrication of Polydimethylsiloxane (PDMS)-Based Microchannel for a Microfluidic Device Used as a Radiation Biodosimeter <i>by Apidech Phothong and Wanwisa Sudprasert</i>	280
P 206	Study of counter and timer for radioactive measurement <i>by TRADON URASUK, KANTAPAT CHATSOPONPAN and MANIT JITPUKDEE</i>	282
P 207	Effect of UHMWPE powders on neutron attenuation properties of particleboards <i>by Kriangkrai Muencharoen and Kiadtisak Sanbunruang</i>	283
P 208	Investigation on anthropogenic in infant formula <i>by Jiradit Sangsawang and Kiadtisak Saenboonruang</i>	284
P 209	Investigation on natural radionuclides in infant formula <i>by Tattep Mongkolsawat and Kiadtisak Saenboonruang</i>	285
P 210	Effects of Bi ₂ O ₃ particle sizes on x-ray attenuation properties <i>by Narut Makboon, Kiadtisak Saenboonruang and Ekachai Wimolmala</i>	286
P 211	Effects of powdered eggshell as fillers on mechanical properties of gamma-vulcanized natural rubber composites <i>by Pipat Noiprom and Kiadtisak Sanbunruang</i>	287





Applied Radiation and Isotopes

No.	Title	Page
P 212	Study of process synthesis for plastic scintillator <i>by YINGSAK INTARAKOSIT, SASIN PHIMSIRI and MANIT JITPUKDEE</i>	288
P 213	Wireless Radiation Detection and Measurement Robot <i>by Rachai Tunaumpai and NARIPPAWAJ NGERNVIJIT</i>	289
P 214	Background radiations estimation from soil sample in Kasetsart University <i>by Wanatchaphon Phueaphae and Chanis Pornnumpa</i>	290
P 215	Comparative properties of natural rubber (NR)/Bi ₂ O ₃ composites as x-ray shielding materials <i>by Silamate Karnjanapradit, Kiadtisak Saenboonruang and Ekachai Wimolmala</i>	291
P 216	Development of biodegradable PLA/B ₂ O ₃ composites for neutron shielding applications <i>by Sirawish Khammeng and Kiadtisak Saenboonruang</i>	292
P 217	Green and environmental friendly PLA/Sm ₂ O ₃ composites for use as neutron-shielding materials. <i>by Arkarapol Thumwong and Kiadtisak Saenboonruang</i>	293

Zoology

No.	Title	Page
P 218	Classification of Indochina Rice Varieties Using Insertion-Deletion Marker <i>by Nutthalak Laksanavilat, Pattaraborn Moonsap Chatchawan Jantasuriyarat and Piyama tasanasuwan</i>	294
P 219	Microscopic structures of the ovary and female genital ducts of the water monitor <i>Varanus salvator</i> (Reptilia: Squamata: Varanidae) <i>by Pavarist Bussabong and Nopparat Srakaew</i>	295
P 220	Cladoceran community in different macrophytes in Thale-Noi, Phattalung Province <i>by Sarach Gerdmolee and Supiyanit Maiphae</i>	296





Zoology

No.	Title	Page
P 221	Insecticidal Efficacy of Widebetal Leafbush (<i>Piper sarmentosum</i> Roxb.) against <i>Nilaparvata lugens</i> (Hemiptera: Delphacidae) <i>by Natnaree Bunyangkun and Narisara Piyasaengthong</i>	297
P 222	Larvicidal Activity of <i>Morinda citrifolia</i> Extract against <i>Aedes aegypti</i> (Diptera: Culicidae) and <i>Culex quiquefasciatus</i> (Diptera: Culicidae) <i>by Nutthapol Martcharoen and Narisara Piyasangthong</i>	298
P 223	Physical parameters in tourism effected and pristine areas: A case study in Don Hoi Lot, Samut Songkhram Province <i>by Thanakorn Bowornpattaraanan and Koraon Wongkamhaeng</i>	299
P 224	Effect of <i>Tiliacora triandra</i> leaf extract on glycogen storage in chronic high glucose intake mice. <i>by Theerayut Nimnuan and Wachiryah Thongasa</i>	300
P 225	Tourism effect in distribution of gammarid amphipod in Don Hoi Lot, Samut Songkhram <i>by Prasit Khositpanich and Koraon Wongkamhaeng</i>	301
P 226	Antioxidant and Anticancer Peptide Screening From Giant African Snail (<i>Achatina fulica</i>) Genome <i>by Nadecho Athaveesin, Teerasak E-kobon and Pramote Chumnanpuen</i>	302
P 227	An ability of <i>Cordycepsmilitaris</i> on colon cancer cell Growth inhibition via <i>FOXMI</i> suppression <i>by Suracheth Leechai and Mesayamas Kongsema</i>	303
P 228	Annotation of metabolic transporters in <i>Cordyceps militaris</i> at a genome-scale <i>by Amorntep Kingkaew and Wanwipa Vongsangnak</i>	304
P 229	Acute effect of p-Coumaric acid on cerebral cortex neuron and corpus callosum in ischemia reperfusion mice <i>by Chanikarn Sakdapitak and Wachiryah Thong-asa</i>	305
P 230	Habitat use of <i>Cyclemys oldhami</i> at Sakaerat Environmental Research Station, Nakhon Ratchasima Province <i>by Thitichai Asawathawornwanich and Anchalee Aowphol</i>	306





Zoology

No.	Title	Page
P 231	Species diversity of bdelloid rotifer in freshwater habitats in Kasetsart University <i>by Praphatsorn Panmee and Supiyanit Maiphae</i>	307
P 232	Diversity of the Cladocera in peat swamp in Rayong Botanic Garden, Rayong Province <i>by Yordkhun Akkarakraivoraphan and Supiyanit Maiphae</i>	308
P 233	Effects of polyvinyl alcohol-silver nano hydrofilm on wound healing in mice <i>by Sopitkul Oatnoi, Wirasak Fungfuang and Apirat Laobuthee</i>	309
P 234	Morphological variation of <i>Sphenomorphus maculatus</i> in Thailand <i>by Sarana Hansuwandumrong and Anchalee Aowphol</i>	310
P 235	Effects of polyvinyl alcohol-silver nano hydrogel on wound healing in mice <i>by Suchada Kongmaneeapun, Wirasak Fungfuang and Apirat Laobuthee</i>	311
P 236	Daily activity of flat-headed cat (<i>Prionailurus planiceps</i>) in captivity at Songkhla zoo <i>by Suthida Piriyarom and Patchara Danaisawadi</i>	312
P 237	Morphometric Analysis of Butterfly Lizard Genus <i>Leiolepis</i> in Thailand <i>by Sunantha Sangramat and Patchara Danaisawadi</i>	313
P 238	The isolation and culture of the pigment producing microalgae from nature <i>by Kankorn Jahnschombhu, Chotika Yokthongwattana and Mesayamas Kongsema</i>	314
P 239	Effect of Antidepressants Fluoxetine to non-target organism by using <i>Artemia</i> sp. As a study model <i>by Panat Rattanawimonchai and Mesayamas Kongsema</i>	315
P 240	Comparative genomics of <i>Mucor circinelloides</i> strain WJ11 and the closely related oleaginous species <i>by Kanokwadee Siritthep, Amornthep Kingkaew, Kobkul Laoteng and Wanwipa Vongsangnak</i>	316





Some biological and morphological of papaya mealybug, *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) on cassava

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Vietnam is the second exporter of cassava products in the world. In currently, insect pests have affected the productivity and quality of cassava, which has severely damaged the economy. In that, the papaya mealybugs usually appear and cause severe damage, but research and documentation on insects are very limited. Female have three instars (first, second and third instar). Males have four instar (first, second instars, prepupal and pupal). The adult female have no wings, is yellow and covered with a white waxy coating. Adult females are approximately $2,33 \pm 0,07$ mm long and $1,21 \pm 0,04$ mm wide. The adult male have wings, colored pink, but have colored yellow in the first and second instar. Adult males are approximately $1,29 \pm 0,07$ mm long and $0,31 \pm 0,04$ mm wide. Females usually lay $215,5 \pm 88,7$ eggs and occurs over in about 8 days. Eggs are greenish yellow and approximately $0,30 \pm 0,02$ mm long and $0,17 \pm 0,01$ mm wide. The life cycle, longevity and sex ratio of *P. marginatus*, were performed under laboratory conditions ($28 \pm 2^{\circ}\text{C}$, $70 \pm 5\%\text{RH}$). The life cycle of *P. marginatus* was completed successfully in 36 ± 2.1 days. The longevity of *P. marginatus* was 43 ± 2.5 days with female and 27 ± 3.4 days with male. The sex ratio ($\text{♀}:\text{♂}$) of *P. marginatus* is 1:1.

Keywords: life cycle, longevity, sex ratio.





Establishment of fungal combs with three species of fungus-growing termites

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Fungus-growing termites are Macrotermitinae subfamily widely distributed in Africa and Asia. They have unique habit of fungal growing in their nest in special substrate called fungal combs. However, there is no report about fungal comb forming that related to *Termitomyces* and termite species. Therefore we reared 3 genera of termite alates (*Macrotermes*, *Microtermes*, and *Odontotermes*) and one species of *Termitomyces* sp1. in order to make the fungal combs. One pair of alates were reared in a bottle. The bottle was contained of the soil, tissue paper, cotton and wood. When the alates made termite colonies, the basidiospore suspensions of *Termitomyces* sp1 from the field were inoculated to the bottles. Some bottles were not inoculated by basidiospore as controls. The development of termite colonies was observed periodically and the soldiers were taken for species identification. There were 3 species of alates i.e. *Macrotermes gilvus*, *Microtermes insperatus*, and *Odontotermes bogoriensis*. Only *M. insperatus* were successful of making fungal combs with 1-2 cm in diameter, 0-4 pseudorhiza, and 70-150 nodules. Based on separate results that *Termitomyces* sp1 is *T. cylindricus* and it was always found in *M. insperatus* nests in the field. *M. gilvus* and *O. bogoriensis* were not successful of making fungal combs because they probably need different species of *Termitomyces*. The research is in progress in order to obtain the fruiting body of *Termitomyces*.

Keywords: development, fungus-cultivating termite, *Termitomyces*, comb





Effect of biochar on microbial activity and growth of cocoa seedlings (*Theobroma cacao*) growing in Acrisols soil in greenhouse condition

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Biochar application to low fertility agricultural soils has the potential to improve productivity. Biochar has been reported to improve soil physical properties (i.e., water holding capacity, bulk density) chemical (pH, nutrient availability), and biological properties (microbial diversity and activity). However, the benefits vary depending on biochar feedstock and pyrolysis conditions. The study includes two experiments. The first experiment was carried out on cocoa seedlings (six months old) growing in the pots of acrisols soil with different rates (0.5%; 1%; 2% and 4% by weight) of two types of biochar (anaerobic digestion which anaerobic digester 20% dairy sludge and 80% woodchips and hilo, produced at 500°C in a clay Kiln) in the greenhouse condition. The second experiment was conducted in jars with different biochar application rates for two types of biochar as the first experiment placed in the incubator at 25°C. The main objectives of this study are to evaluate effects of two biochars differing in feedstock and production techniques on cocoa seedling growth, nutrient uptake and soil respiration. Results showed that biochars had minimal effects on leaf number and stem diameter of cocoa seedlings. Biochars significantly increased plant height and leaf chlorophyll of cocoa seedlings in seven weeks after transplanting. However, plant height of cocoa seedlings decreased at highest rate of biochars (4%). The increase of cocoa seedlings biomass by biochar application rate was higher in anaerobic digestion biochar than hilo biochar. Biochars increased microbial respiration in soil. Hilo biochar showed more positive effects on microbial activity in soil than anaerobic digestion biochar.

Keywords: biochar, cocoa, microbial activity, acrisols





Feasibility study of cantrang (Danish Trawl) fisheries biology perspective at Makassar straits and bone gulf, south Sulawesi province, Indonesia

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The purpose of this research is to analyze the feasibility of the catch of cantrang in the Strait of Makassar and Bone Gulf after the moratorium policy of the use of fishing equipment in the Fisheries Management Area of the Republic of Indonesia. The research was conducted in August 2016 - July 2017. The research was conducted at 3 locations namely in L1 (Takalar), L2 (Pangkep) and L3 (Palopo). The location of the study was determined deliberately by considering the presence of cantrang and the representation of the waters of Makassar Strait and Bone Gulf. The study sample consisted of 2 types: cantrang and dominant catch fish. The number of samples of cantrang vessels is 73 (seventy-three) both units with classification in L1, 44 (forty-four) both units, in L2, 24 (twenty four) both units and in L3, 5 (five) both units. Fish samples consist of 6 species of dominant fish of catchrang catch that is; *Leiognathus sp*, *Parapeneus cyclostenus*, *Upeneus sulphureus*, *Clupea harengus*, *Sphyraena sp* and *Lethrinus lentjan*. The total number of fish samples as many as 1800 heads or 600 heads per research location. Parameters observed include; both size, mesh size nets, fish catch type, fish body circumference, fish body length, fish body weight, and fish gonad condition. Research result; (1) mesh size used by fishermen in the three research sites is smaller than 2 inches. (2) The type of fish catch is a mixture of palagis fish and demersal fish with the number of species as many as 28 species. (3) *Lethrinus lentjan* at all three locations, entering the catch-catching category with the percentage of catch in mature gonad condition above or greater than 50%. (4) *Sphyraena sp*, *Clupea harengus*, *Upeneus sulphureus*, *Parapeneus cyclostenus* and *Leiognathus sp* at all three entry sites in unacceptable caught categories with the percentage of catches under conditions having matured gonads below or below 50%.

Keywords: capture fish cantrang, *Lethrinus lentjan*, *Sphyraena sp*, *Clupea harengus*, *Upeneus sulphureus*, *Parapeneus cyclostenus* and *Leiognathus sp*, Makassar Strait and Bone Bay





Initial study of *PTEN* expression in Vietnamese in nasopharyngeal carcinoma patients

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The loss of *phosphatase and tensin homolog (PTEN)* occurs frequently in nasopharyngeal carcinoma (NPC), a human malignancy derived from epithelial cells, through the activation of the PI3K/AKT pathway. Notably, NPC has been reported to be common in Vietnam, however, the molecular basic as well as the expression of *PTEN* has not been studied yet. Here, we conducted Real-time PCR assay to determine the *PTEN* expression status in Vietnamese NPC patients whether or not relative to the NPC. In current study, total of 44 NPC biopsy samples and 25 non-cancerous samples were collected from NPC patients and healthy volunteers in Cho Ray Hospital, Ho Chi Minh City, Vietnam. The expression of *PTEN* was evaluated by Real-time PCR and calculated through the $2^{-\Delta\Delta C_t}$ value, compared to the *GAPDH* gene's expression as internal control. As the results, the frequency of *PTEN* gene's expression were 31.81% (14 of 44 samples), 76% (19 of 25 samples) in NPC biopsy samples and non-cancerous samples, respectively ($p < 0.0004$). Additionally, the *PTEN* expression levels was 2.45 times lower in NPC biopsy samples compared to non-cancerous samples ($2^{-\Delta\Delta C_t} = 0.41$). In conclusion, the down-regulation of *PTEN* expression was observed in NPC biopsy samples, therefore, it supports the implication that *PTEN* function plays an important role in NPC and may be served as the potential biomarker for detection of NPC in Vietnamese population.

Keywords: PTEN, nasopharyngeal carcinoma, down-regulation





**Fungal endophytes across tissue layers of *Canarium ovatum* engl.
(*Burseraceae*) fruit**

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Canarium ovatum, locally known in the Philippines as pili, is an economically important tree because of its high valued fruit. In this study, fungal endophytes were isolated from the different tissues of the fruit and results form the first record of such fungi associated with the pili fruit. Surface sterilized tissue samples from peel, shell, and kernel were plated on potato dextrose agar and incubated for seven to ten days. Each fungus was transferred to agar slants and grown for another seven days at 25-30°C. Identification was carried out using existing keys, and by molecular sequencing of the ITS 1 and 4. A total of fifteen fungi were identified, four of which were teleomorphic ascomycete while the rest were mitosporic asexual fungi. *Fusarium oxysporum* was the highest contributor to endophytic community. There was a decreasing occurrence of fungal endophytes from peel to kernel while high similarity index between adjacent tissues (peel-shell and shell-kernel) than with peel-kernel. Further, evidence reveal the possibility of fungal quiescence in the endophytic *Aspergillus* which may later on manifest as a post-harvest pathogen. All isolates, except *Talaromyces atroroseus* and *Trichoderma longibrachiatum*, are pathogens of other crops but all are considered endophytes of pili because they do not cause any fungal disease of the pili fruit. Their potential application is a possible researchable area.

Keywords: *Canarium ovatum*, endophytes, pili, *Talaromyces atroroseus*





Biology aspect of *Carcharhinus limbatus* as a main targeted fishery in Muncar Banyuwangi east java

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Common blacktip shark (*Carcharhinus limbatus*) was a top predator in cycle of food chain. In IUCN status, this shark was categorized by Near Threatened (NT) which means the population of this species was in condition near to Vulnerable level, so we need to keep the balance of this species. The purpose of this study is to analyze the size body of landed, relation of length and weight, and correlation (r) between total length and clasper length of *Carcharhinus limbatus*. The result that was done in three mounts (March - May 2016). The study result are Sexs ratio of male: female (1:0, 48) with correlation Total length and clasper length is 81.3%. Sex ratio indicated the population are not balancing, a total female are lowest than a male whereas a male is able to impregnate female more than one individu. The range of total length is 103 – 294 cmTL, than a length and weight relationship of *Carchcarhinus limbatus* $W=0,0006L^3,1506$ (isometrik).

Keywords: length, population, sex, shark, weight





Development of SRAP-SCAR marker on sugarcane white leaf disease (SCWLD) susceptible and non-susceptible varieties in Vietnam

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Sugarcane white leaf (SCWL) is one of the most devastating diseases causing serious yield losses in the main sugarcane growing regions, particularly in South East and South Asia. This disease is caused by phytoplasma, a phloem-restricted bacterium without a cell wall, belonging to the class *Mollicutes* that has small and AT-rich genome. Until now, all manual preventive measures are not effective enough to control SCWL disease in the field. Therefore, the early diagnosis by molecular approaches and markers assisted selection (MAS) of disease-free varieties are the best options. For developing molecular markers linked with phytoplasma susceptible and non-susceptible sugarcane varieties, sequence – relative amplified polymorphism (SRAP) is one of the simplest and most reliable techniques because it amplifies the most important target of ORFs in the genome and generates large numbers of dominant, high-density bands clearly. The objective of this study is to detect SRAP markers related to the susceptibility and non-susceptibility to SCWL disease, then followed by the development of SRAP-SCAR markers for discriminating between various phytoplasma susceptible and non-susceptible sugarcane varieties in Vietnam. The SRAP reactions were performed with 62 sugarcane varieties of which 27 and 35 varieties showing respectively susceptibility and non-susceptibility to phytoplasma by using 30 pairs of SRAP primers (5 forward and 6 reverse primers). The results of this study showed that 4 distinct markers when using 4 pairs of primers: me2 – em5, me3 – em2, me5 – em2 and me5 – em5, was found. The sequences of these specific bands were used to design SRAP-SCAR markers. Re-amplification of SCAR primers was conducted to generate trait specific amplified products resulting a potential application of these markers for controlling SCWL disease in the field.

Keywords: sugarcane white leaf (SCWL), phytoplasma, SRAP, SCAR, markers assisted selection (MAS)





Identification and evaluation of the expression level of surfactants encoding genes of *Bacillus amyloliquefaciens* in biological control of *Corynespora* Leaf Fall (CLF) disease on the rubber tree

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The ascomycete fungus, *Corynespora cassiicola*, has been known as a widespread causal agent of *Corynespora* Leaf Fall (CLF) disease resulting serious damages in rubber trees around the world. According to previous study, antifungal activity of *Bacillus amyloliquefaciens* (T3) was reported its ability in the inhibition of the growth of *C.cassiicola* and the expression of cassiicolin gene (*cas*) known as a fungal toxin in plant cells. However, a little evidence has demonstrated the correlation between the inhibitory activity of this bacterial strain and the production of bacterial surfactants encoded by *sfp*, *itu* and *fen* genes. Herein, primers of various *sfp*, *itu* (A, B, C), and *fen* (A, B, C, D, E) were designed for identifying the presence of these genes in *B. amyloliquefaciens* (T3). Inoculation induced by *C.cassicola* isolate containing *cas2* gene was done on detached rubber leaves with and without the treatment of T3 bacterial isolate at various time intervals including 1, 2, 3, 5, and 9 days post inoculation. Expression profiles of *cas2* gene and bacterial surfactants encoding genes will be evaluated, and discussed in this study. The results obtained here are necessary for understanding molecular mechanisms not only of fungal pathogenicity but also of bacterial antagonism in order to find out effective methods in the prevention of CLF disease on the rubber tree.

Keywords: *Corynespora* Leaf Fall (CLF), rubber, cassiicolin, *Bacillus amyloliquefaciens*





Effect of temperation on the life cycle, survival, sex ratio and longevity of *Stethorus pauperculus* (Coccocilide: Coleoptera) feed on spider mite

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The species of *Tetranychus* sp., is known a spider mite, is dangerous to plants and highly developed in tropical climates, especially in Vietnam. Additionally, this pest is considered as the most resistant species to pesticides. The present study focused on controlling *Tetranychus* sp. by natural enemies bring effective. The black ladybug *Stethorus pauperculus* are among predators of spider mites. Therefore, this study focused on the effect of temperatures on the biological characterization of ladybugs to select suitable condition for mass rearing and using them control spider mite. Samples were collected and maintened from cassava fields then increased in the number of samples under laboratory conditions. The life cycle, survival, sex ratio and longevity of *S. pauperculus* were recored at two temperatures (25 and 30°C) and 60%RH, prey on *Tetranychus*. The life cycle of ladybug was 23.95 ± 1.47 and 15.6 ± 0.82 days, respectively. The survival rate from egg to adult and the sex ratio (♀: ♂) of *S. pauperculus* was 60% and 1:1, respectively. At 25 and 30°C, the longevity of predator was recorded around 122 and 97 days for female, 85 and 56 days for male, respectively. Overall, the survival rate and the sex ratio (♀: ♂) of ladybug *S. pauperculus* are no difference at 25 and 30°C. In other hand, the results of the experiments show that the life cycle of *S. pauperculus* develop rapid at 30°C and the longevity of ladybug was better at 25°C.

Keywords: *Stethorus pauperculus*, *Tetranychus* sp., temperatures, biological characterization





Study on biological characteristics of *Dysmicoccus brevipes* (Pseudococcidae: Hemiptera)

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The pineapple mealybug *Dysmicoccus brevipes* is the most dangerous pests on various crops such as pineapple, bananas, cocoa, palm oil, peanuts, dates, mangos, soybeans, sugarcane, coffee, sesame. They damages on the foliage, stems and fruit. The banana plants are reduced vigour and general debility, reduced of photosynthetic area, losed their market value. The experiments focused on the banana, pumpkin, *D. brevipes* in banana field. In there, the life cycle, fecundity, longevity of *D. brevipes*, were performed under laboratory conditions ($28 \pm 0,5^{\circ}\text{C}$, $70 \pm 1\%\text{RH}$). The community of the pineapple mealybugs were maintained by collecting them from natural and massing on pumpkin. In this study, banana and pumpkin were used for evaluation the efficacy of different host plants on the life cycle of *D. brevipes*. The life cycle was completed in 41.0 ± 1.26 and 46.03 ± 0.85 days on pumpkin, banana, respectively. A female *D. brevipes* laid an average of 288.93 ± 43.45 in 9.17 ± 0.79 days and 338.50 ± 41.50 in 10.20 ± 0.41 days on pumpkin, banana, respectively. The average longevity of adult was 29.73 ± 1.02 and 32.10 ± 1.09 days on pumpkin, banana, respectively. The results showed that *D. brevipes* developed their life cycle better when using pumpkin. In addition, the fecundity when using pumpkin was higher than banana. The female give birth to living without the male.

Keywords: biological characteristics, *Dysmicoccus brevipes*, life cycle, host plants





Recovery and valorization of snakehead fish (*Channa Striata*) surimi wash water as bulk active albumin tablet

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Surimi washing process is aimed to concentrate the myofibril protein by removing, cathepsin enzyme, fat, pigment, blood, and sarcoplasmic protein which is soluble in wash water. The soluble substances cause trouble environment if it was untreated. In addition recovery protein will give benefit both in reducing trouble environment and utilizing soluble protein as sources of albumin protein. The objectives of research were to recover albumin from snakehead fish surimi wash water and to valorize as bulk active albumin tablet. Recovery of albumin use 0.05 μm ultrafiltration membrane and the valorization of albumin tablets was by direct compression. The protein band with molecular weight of 67.741 kDa on the retentate was detected as albumin. Concentration of protein recover by ultrafiltration membrane increased 89.98% and the albumin content 3.5 ± 0.4 g/dl. Based on the result of chemical composition and microbiology analysis, albumin of snakehead surimi wash water appropriate with Indonesia National Standard (SNI) quality requirement about snakehead fish albumin extract. The best formulation in the preparation of surimi wash water albumin tablet was by using corn starch excipients with uniformity weight value 410.39 ± 0.09 g, hardness value 7.65 ± 0.8 kp, uniformity size of tablet with diameter 1 cm and thickness 0.59 cm, friability value 2.3% and disintegration time of the tablet is 2 minutes 16 second.

Keywords: albumin, recovery, sarcoplasm, tablet, valorization





Effect of Pest Exclusion Net (PEN) on the sustainable production of late season Broad Leaf Mustard (BLM) in Nepal

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Broad Leaf Mustard (*Brassica juncea* L. Var. *rugosa*) is one of the most widely consumed vegetable crops in Nepal. The production of crop in open field is constrained by major pests like Mustard aphid and Flea beetle that lead to low yield and quality. This study aimed at determining the effects of Pest Exclusion Net (PEN) on pest-infestation and yield of Broad Leaf Mustard cultivar “Khumal Broad Leaf”. The experiment was carried out in Randomized Complete Block Design (RCBD) with five treatments and four replications. The treatments included Black plastic mulch only, Black plastic mulch + no net + pesticide spray, Reflective Plastic mulch only, Control (no mulch + no net + no pesticide spray), and Pest Exclusion Net + Black plastic mulch + no pesticide spray. Data was analyzed with RSTAT software package and means were separated by DMRT at 5% level of significance. The result revealed that crop under Pest Exclusion Net had highest plant height (39.28 cm), lowest number of Aphid (0 – 0.86 per plant), Flea Beetle (0-1.07 per plant) and highest Total Marketable Yield (77.50 ton/ha). Economic analysis revealed highest benefit-cost ratio in Net (9.90). This study indicate that the use of Pest Exclusion Net protect Broad Leaf Mustard against Aphid and Flea Beetle, increases yield and can be considered economically and environmentally a viable technology for Broad Leaf Mustard production by smallholder growers of Nepal.

Keywords: broad leaf mustard, pest Exclusion Net (PEN), mustard aphid, flea beetle





Systematic approach to engineer *Escherichia coli* chromosome for butanol production

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Butanol is a kind of bulk chemical and a potential biofuel replacing gasoline due to its higher energy content, lower water absorption, etc. It is naturally produced via the anaerobic fermentation of biomass substrates by some clostridia species; this is referred to as ABE fermentation because it is coupled with the production of acetone and ethanol. However, it is very difficult to improve the butanol production by *Clostridium*, because of time-consuming and tough genetic manipulation of *Clostridium* strains and its relatively unknown mechanisms of genetic system and complex physiology. Of the other heterologous hosts investigated to date, engineered *Escherichia coli* has shown a superior butanol yield than the natural butanol-producing clostridial strains. However, all reported





butanol-producing *E. coli* strains contain vectors and inducible promoters, which means antibiotics and inducers are required in the fermentation. Our aim was to develop a completely chromosomally engineered *E. coli* strain capable of producing butanol efficiently in the absence of vectors, antibiotics, and inducers. To address this problem, the butanol pathway was engineered into the chromosome in the first place, then the host and the butanol pathway was iteratively engineered through rational and non-rational strategies to develop an efficient butanol producer where the heterologous butanol pathway fits the host well. The final strain EB243 produced 20 g/L butanol with a yield of 0.34 g/g glucose (83% of theoretical yield). This systematic approach may be suitable for other products.

Keywords: butanol production, *Escherichia coli*





Reconstructing biosynthetic pathway of the plant-derived cancer chemopreventive-precursor glucoraphanin in *Escherichia coli*

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Epidemiological data confirmed a strong correlation between regular consumption of cruciferous vegetables and lower cancer risk. This cancer preventive property is mainly attributed to the glucosinolate products, such as glucoraphanin found in broccoli that is derived from methionine. Here we report the first successful reconstruction of the complete biosynthetic pathway of glucoraphanin from methionine in *Escherichia coli* via gene selection, pathway design, and protein engineering. We used branched-chain amino transferase 3 to catalyze two transamination steps to ensure the purity of precursor molecules and used cysteine as a sulfur donor to simplify the synthesis pathway. Two chimeric cytochrome P450 enzymes were engineered and expressed in *E. coli* functionally. The original plant C–S lyase was replaced by the *Neurospora crassa* hercynylcysteine sulfoxide lyase. Other pathway enzymes were successfully mined from *Arabidopsis thaliana*, *Brassica rapa*, and *Brassica oleracea*. Biosynthesis of glucoraphanin upon co-expression of the optimized enzymes *in vivo* was confirmed by liquid chromatography–tandem mass spectrometry analysis. No other glucosinolate analogues (except for glucoiberin) were identified that could facilitate the downstream purification processes. Production of glucoraphanin in this study laid the foundation for microbial production of such health beneficial glucosinolates in a large-scale.

Keywords: *Escherichia coli*, plant-derived cancer





Cryptic species (*Sinalpheus*) in Tidung Kecil Island

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Cryptic species were a small animals that have a high similarity. This animals were the common organism that live in slip gap of dead coral like *Pocillopora* sp. Or *Acropora* sp. which has type of live form was massive. This small animals was still not known their role in marine ecology but it was believed it can be as stabilizer ecosystem or as bio-indicator for loss environment. If inside the dead coral have any lived Cryptic species means it can be a pioneer species for other animals. The purpose from this research was to know the cryptic species that live in dead coral in Tidung Kecil Island using their morphology. The result showed that the cryptic species had found in Tidung Kecil Island was from *Sinalpheus* 97 specimens.

Keywords: dead coral head, *Sinalpheus*, morphology, Tidung Kecil Island





Exploration of stingless bees in south and west Sulawesi, Indonesia: morphological and nest structure characteristics

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Indonesia is part of Indo-Malayan and Australasian ecoregions with highly species diversity of stingless bees. As part of Australasian region, Sulawesi had unique island formation and is separated by Wallacea Line with the Sundaland region. Thus, Sulawesi is home of many endemic fauna, including stingless bees. A total number of 4 species of stingless bees have been reported from Sulawesi. We conducted an exploration for further study of stingless bee species from Sulawesi based on morphological characteristics and the bee nest structure. Exploration of stingless bees were conducted at four districts of South Sulawesi Province: Marros, Soppeng, Wajo, North Luwu, and one district of West Sulawesi Province: Majene. Morphological identification samples were collected using dry preservation method for ten characters: width ratio of second antenna flagellum and malar space, width ratio of gena and eye, mandible, scutum, scutellum, propodeum, width ratio of hind basitarsus and hind tibia, elliptical disc on the inner hind basitarsus, posterior fringe of hind tibia, body length and body colour. Nest entrance and brood cells arrangement were examined. Based on those morphological characters, five species of stingless bees that belongs to three genus were identified: *Tetragonula biroi*, *T. fuscobalteata*, *T. laeviceps*, *Lepidotrigona terminata*, and *Wallacetrigona incisa*. The two species: *T. biroi* and *T. laeviceps*, are not listed in stingless bee record data, therefore, both species are potential to be a new record for Sulawesi stingless bees. Three types of entrance nest were observed: (1) extended brown funnel entrance of *L. terminata*, *T. biroi* and *T. fuscobalteata*, (2) short dark brown funnel entrance of *T. laeviceps*, and (3) reddish longitudinal slit entrance of *W. incisa*. Further, two kinds of brood cells arrangements were found: (1) horizontal layered comb of *L. terminata* and *T. biroi* and (2) cluster brood cells form of *T. laeviceps* and *T. fuscobalteata*. In this exploration, we did not achieve to observe the brood cells arrangement of *W. incisa* due to the nest is still in a tree trunk. However, based on the reference colony, *W. incisa* has horizontal layered comb. Here, we conclude based on the Sulawesi exploration, five species of stingless bee in South and West Sulawesi are recorded and two species (*T. biroi* and *T. laeviceps*) are potential as the new record of stingless bee in Sulawesi. Three types of entrance nest characterization and two kinds of brood cells arrangements were observed from five species of stingless bees in Sulawesi.

Keywords: wallacea line, *Wallacetrigona incisa*, *Tetragonula biroi*, brood cells arrangements comb





Bear cuscus (*Ailurops ursinus*): daily activities, diet, and habitat characteristics in Tanjung Peropa wildlife reserve, south-east Sulawesi

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Bear cuscus (*Ailurops ursinus*) is an endemic protected marsupial that lives in the lowland forests of Sulawesi. This species is vulnerable according to the IUCN Redlist. Its declining population is due to deforestation and poaching. A distribution research of bear cuscus in South-East Sulawesi were studied at Buton and islands adjacent. However, there is a lack of study of *A. ursinus* in the mainland of South-East Sulawesi. This research was aimed to identify daily activities, diet, and habitat characteristics of *A. ursinus* in Tanjung Peropa Wildlife Reserve, South-East Sulawesi. Three individual *A. ursinus* were observed using *ad-libitum* sampling for daily activities. Diet were recorded using direct and non-direct observation and habitat characteristics were identified using vegetation analysis. We measured the microclimate at the studied area of *A. ursinus*. The results revealed that daily activities of *A. ursinus* were dominated by resting (89.05%) which might be due to gain extra energy in digesting young leaves as their diet. The other activities showed low percentages: 5.83, 2.71, and 2.41% for moving, foraging, and feeding, respectively. Bear cuscus has slow moving behavior, thus leads to high possibility of pouching. In our attempt to understand the tree diet species of this endemic Sulawesi marsupial, we recorded a total of 80 species of potential diet vegetations. Among the other vegetation parts, shoot and young leaves were the two highest percentage consumed by *A. ursinus*, those were 36.19 and 36.19%, respectively. Shoot and young leaves were chosen by this folivore marsupial due to higher protein, lower tannins, lignin, and coarse fiber compare to the mature leaves, thus, they are easy to be digested. Besides as the feeding site, the trees are important for all daily activities of this arboreal marsupial, particularly the sub-canopy layer. *Chisocheton ceramicus* (44.72%) and *Pisonia umbellifera* (28.33%) are the most important *A. ursinus* diet and shelter, since they were the two highest important value index trees. All daily activities of the studied *A. ursinus* were encountered at altitude ranging 38 – 310 m asl, temperature of 25 – 28.5 °C, and humidity between 86% – 92%. We conclude a conservation of *C. ceramicus* and *P. umbellifera* trees are essentially needed to prevent the declining population of this Sulawesi endemic marsupial.

Keywords: Sulawesi, bear cuscus marsupial, daily activities, IUCN Redlist





Study of Pymetrozine resistance on brown plant hopper (*Nilaparvata lugens* Stål) in Tien Giang province, Vietnam

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Most of farmers has been used pesticides to control BPH with using frequency from 1 to 4 times per crop, average is 1.7 times. 20.6 % farmers used higher doses than the recommended dose (1.6 times in average) to control BPH. 52.5 % farmers from 3 investigated districts used pymetrozine for killing BPH in three consecutive crops: 15.2 % used fenobucarb, 13.6% used buprofezine, the rest of 18.7 % farmers using other pesticides. Only on winter spring crop 2016, 90.9 % farmers used pymetrozine to control BPH. BPH collected from Cai Lay, Chau Thanh and Cai Be districts, Tien Giang province had very high resistance to pymetrozine, in which, BPH from Cai Be showed higher resistance than that of Chau Thanh and Cai Lay. Pymetrozine resistance of BPH increased over 7 generations countinuously selected. LD₅₀ of BPH from Cai Lay increased 1.31 times after 7 selected generations with pymetrozine and Ri reached from 964,06 to 1242,98; LD₅₀ of BPH from Chau Thanh increased 1.25 times, Ri reached from 1003,03 to 1256,59; LD₅₀ of BPH from Cai Be increased 1.26 times and Ri reached from 032,82 to 1299,52. Resistant of populations did not show cross-resistance between pymetrozine and nitenpyram. The results showed that pymetrozine reduced egg laying ability of BPH collected. Effect Dose to 50 % (ED₅₀) of BPH from Cai Be reached 0.2495 µg/g. It was higher than ED₅₀ of BPH from Cai Lay (reached 0.0996 µg/g) and ED₅₀ of BPH from Chau Thanh (reached 0.1856 µg/g), it means BPH population from Cai Be were higher than resistance of Chau Thanh and Cai Lay.

Keywords: brown planthopper (BPH), pymetrozine resistance, LD₅₀, ED₅₀





Anti-bacterial activities of green synthesized zinc oxide nanoparticles

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Zinc oxide nanoparticle (ZnO NP) is one of the most popular nanoparticles used for various aspects such as food industries, agriculture, cosmetics including oral hygiene materials. In addition, ZnO NP has demonstrated good antibacterial activities on a broad spectrum of bacteria. However, current chemical synthesis of ZnO NP produces toxic chemicals such as H₂S, metallic precursor and toxic template that affect environments. Hence, a green synthesis of ZnO NP is essential. This study therefore aimed to synthesize ZnO NP from crude extract of banana peels and examine effects of pH on the sizes of newly prepared ZnO NPs including analysis of their antibacterial activities. As a result, this study successfully generated ZnO NPs from crude extract of banana peels. The pH and concentration of banana peel crude extract are crucial factors for yields of newly made ZnO NPs. Moreover, the results from X-ray diffraction indicated that the concentration of crude extracts from the banana peels affected purities and sizes of ZnO NPs. By performing an agar disc-diffusion method, the results showed that ZnO NPs possess anti-bacterial activity specifically against Gram-positive bacteria, *Bacillus subtilis* and *Staphylococcus epidermidis*, but not the Gram-negative bacteria, *Enterobacter aerogenes*, *Escherichia coli* in both light and dark conditions.

The findings of this study shed light on a high potential of green synthesis of NPs from food waste (banana peels) and opportunity to increase values of agriculture wastes.

Keywords: zinc oxide nanoparticles, X-ray Diffraction, green synthesis, anti-bacterial activity





Identification of two Sumatran stingless bees: the presence of *COI*-like gene in molecular identification

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The highly species diversity of stingless bees are very valuable, due to their important role as pollinator. However, the phenomena of cryptic species occur abundantly in these bees, thus, a confirmation using molecular data is needed to support the morphological identification. In this study we aimed to identify the stingless bees from Riau, Sumatra, by using morphology and molecular approaches. Two species of stingless bees were collected from Rumbio Village, Riau, Sumatra. Morphological identifications were conducted on the bases of the mouth, head, thorax, body, and wings characters. Total bee genome was extracted from the bee thorax, *Cytochrome Oxidase subunit I (COI)* gene of mitochondrial DNA (mtDNA) was amplified, followed by bioinformatics and molecular tree construction. The results showed that one bee species is identified as *Geniotrigona thoracica*, characterised by having reddish body colour, longer malar space, and two teeth in mandible. The bee molecular data encountered a premature stop codon in the deductive amino acids translation and several insertions and deletions in their DNA alignment. Those two molecular characters showed a *COI-like* gene sequence phenomena, which is derived from the nuclear *COI* gene. The second stingless bee species is identified as *Heterotrigona itama* characterised by having black body colour, short malar space, and one weak tooth in mandible. The *COI* gene sequenced of *H. itama* clearly show no indication of *COI-like* gene, however, the BLAST analysis revealed 92% similarity with the reference sequence from GenBank. By using several outgroup bee species, the molecular phylogenetic tree clustered the studied stingless bees with 100% bootstrap, although the tree presumably consists of two genes. In the next study, we will conduct a mitochondrial DNA extraction of the stingless bee to amplify their targeted mtDNA *COI* gene.

Keywords: *COI-like* gene, morphological identification, *Geniotrigona thoracica*, *Heterotrigona itama*





Association of CYP2A6 gene related to fatty acid composition in Javanese fat tailed sheep

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Cytochrome P450, family 2, subfamily A, polypeptide 6 (CYP2A6) gene is suggested as candidate gene which is involved in fatty acid metabolism. The aim of this study was to analyse the genotype polymorphism and to study association of CYP2A6 gene (g.49170107 G>T) related to fatty acid composition. A total of thirty five ram Javanese fat tailed sheep were using in this study. Identification of genes polymorphism and associations of CYP2A6 gene was performed using PCR-RFLP method and GLM analysis. The results showed that there were two genotypes (TT and GT) found in this study. Association analysis showed that CYP2A6 (g.49170107 G>T) was significant ($P<0.05$) associated with polyunsaturated fatty acids (PUFA) and unsaturated fatty acids including Linoleic acid (C18:2n6c) and Eicosadienoic acid (C20:2). The genotype GT exhibited greater unsaturated fatty acids (Linoleic Acid (C18:2n6c) and Eicosadienoic acid (C20:2)) than the genotypes TT ($P<0.05$). These results will improve the understanding of the functions of the CYP2A6 in fatty acid metabolism especially in term of unsaturated fatty acid and will shed light on CYP2A6 as a candidate in the selection of sheep with high unsaturated fatty acids in Javanese fat tailed sheep.

Keywords: association, CYP2A6 gene, fatty acid composition, Javanese fat tailed sheep





Phylogenetic reconstruction and connectivity analysis of the endangered species *Sphyrna lewini* based on mitochondrial DNA

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Sphyrna lewini is a shark species with a wide distribution and one of the most endangered species. Although The International Union for Conservation of Nature (IUCN) classified this species as endangered and the species was already protected by law in Indonesia, *S. lewini* are currently high exploited because of their high economic value. This study conducted to analyze the phylogenetic reconstruction and connectivity the *S. lewini* in Aceh ($n = 30$) and Tanjung Luar, Lombok ($n = 30$) using a molecular approach based on the mtDNA. Molecular analysis was conducted at the Laboratory of Biodiversity and Marine Biosystematics, Faculty of Fisheries and Marine Sciences, Bogor Agricultural University. DNA amplification with the CO1 gene successfully identified 60 individuals of *S. lewini* with an average 628-bp nucleotide length. The value of haplotype diversity (H_d) in Aceh = 0.630 and genetic diversity (π) = 0.026 higher than the value at Tanjung Luar ($H_d = 0.320$; $\pi = 0.006$). The structure between the population was high enough and significant ($F_{st} = 0.356$, $p = 0.000$). The results of phylogenetic analysis showed the connectivity of *S. lewini* in 4 clades of 11 haplotypes. This study showed that low genetic diversity and significant differences in genetic structure between populations made this species vulnerable to extinction in Indonesia and required special treatment.

Keywords: conservation, population genetic, hammerhead shark, mtDNA





Toll-like receptor 4 (TLR4) as a marker gene for Salmonella disease resistance in selected sentul chickens

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Sentul chickens are an Indonesian breed with the potential to be bred as a dual purpose breed. However, Salmonella is a threat in the population. Although the disease does not lead to the death of the infected chickens, it leads to bacterial-contamination of poultry products. This is of great concern because the eggs of Sentul chickens are consumed as raw. Molecular assisted selection (MAS) was reported to be the most effective method to control diseases in chickens. In addition, numerous studies have reported the potential candidacy of TLR4 for salmonella disease resistance in Indonesian native chickens. Currently, there are limited studies on the potential of TLR4 gene in Sentul chickens. Therefore the aim of the current study was to determine the potential of TLR4 gene as a marker for Salmonella resistance in Sentul Chickens. The gene, TLR4, was genotyped using PCR-RFLP. To determine the associated traits, IgY titers and Salmonella specific antibodies were found by using indirect ELISA and Clearance test; respectively. Three genotypes were identified; AA, AG, GG. Although the antibody titers produced were very high (2.94-3.98mg/ml), the study reported no significant difference between the genotypes. The study therefore concluded that whilst basing on Salmonella specific antibodies titers, TLR4 cannot be used as a marker for Salmonella disease resistance in selected Sentul chickens.

Keywords: TLR4 gene, Salmonella, polymorphism, sentul chickens





Initial study of relative quantification Epstein Barr Virus (EBV)-encoded *RPMS1* expression in the Vietnamese nasopharyngeal cancer patients

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Many previous studies reported that *RPMS1*, the major transcript which spliced of Epstein-Barr Virus BamHI-A rightward transcripts (BARTs), has been shown to have a significant effect on nasopharyngeal tumorigenesis. In Vietnam, the expression of *RPMS1* has not been studied yet. Therefore, in current study, we aimed to establish a process for evaluation of *RPMS1* gene expression by Realtime-PCR assay. Experimentally, total of 20 nasopharyngeal cancer biopsies and 20 non-cancerous brush-samples, which were collected from Cho Ray Hospital, Ho Chi Minh City, Vietnam. As the results, the frequencies of *RPMS1* transcript expression were 100% (20/20) and 70% (14/20) in biopsies and oral brush-samples, respectively ($p = 0.03$). For relative quantification, the expression of *RPMS1* was 18.22 times higher in cancer cases than non-cancerous samples by calculation of $2^{-\Delta\Delta C_t}$. Additionally the odds ratio (OR) and relative risk (RR) were 18.38 ($p = 0.05$) and 1.43 ($p = 0.01$), respectively. In conclusion, the EBV-encoded *RPMS1* was up-regulated in the biopsy sample, and the expression of *RPMS1* may serve as a potential biomarker for nasopharyngeal cancer in the Vietnamese population.

Keywords: *RPMS1*, EBV gene expression, nasopharyngeal carcinoma, relative quantification





Polymorphysm of myostatin gene is associated with carcass characteristics with maternal immunization against myostatin on post-hatch in Sentul Indonesian indigenous chicken

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Myostatin (MSTN), a member of the transforming growth factor β (TGF- β) superfamily, is a negative regulator of skeletal muscle growth. Improving muscle growth is very important to increase the economic value of Indonesian indigenous chicken especially in sentul chicken. This study aims to identify the polymorphism of the Myostatin gene in Sentul Indonesian indigenous chicken with maternal immunization against Myostatin on post hatch and to evaluate its effect on carcass traits. In this study, hens will be immunized against MSTN and examine the effect of MSTN immunization on production studies. The gene polymorphism was identified using PCR-RFLP and the effect of genotype on carcass characteristics was analyzed using SAS General Linear Model Procedure. The product of amplification was 247 bp. This locus was polymorphic in sentul indonesian indigenous chicken with two alleles (G and T) and three genotypes (GG, GT, TT). Association analysis were not significant in carcass characteristics. It was confirmed that there was a maternal passive immunization against myostatin at 2 and 12 weeks, carcass, drum sticks, breast weight, wings weight, breast muscle weight, things muscle weight. These results suggest that passive maternal immunization against myostatin used in this study is not potent enough to stimulate carcass characteristic in sentul indonesian indigenous chickens.

Keywords: Myostatin, Sentul Chicken, Maternal Immunization, Carcass





Association of APOA5 gene related to flavour and odour compound in Javanese fat and Javanese thin tailed sheep

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Apolipoprotein A5 (APOA5) gene is an apolipoprotein that plays an important role in regulating the plasma triglyceride levels. APOA5 gene are suggested as candidate gene which are involved in sheepmeat flavour and odour. The aim of this study was to investigate the polymorphism and association of APOA5 gene as a candidate gene related to sheepmeat flavour and odour in Javanese fat and thin tailed sheep. Identification of APOA5 gene polymorphism and associations was performed using PCR-RFLP method and GLM analysis. The c.26896677 C>T APOA5 were polymorphic with two alleles (C and T) and two genotypes (CC and TT). In this study, we showed that the APOA5 association analysis indicated that a Single Nucleotide Polymorphism (SNP) in the coding region c.26896677 C>T of the APOA5 gene was not significantly associated with sheepmeat flavour and odour including 4-methyloctanoic (MOA), 4-ethyloctanoic (EOA), 4-methylnonanoic (MNA), and 3-methylindole (MI). It could be conclude that no evidence was found for an association of c.26896677 C>T APOA5 gene related to sheepmeat flavour and odour in Javanese fat and thin tailed sheep.

Keywords: association, APOA5 gene, flavour and odour, Javanese fat and thin tailed sheep





Isolation, cloning and cellulolytic potential assay of endoglucanase and cellobiohydrolase genes of *Trichoderma harzianum*

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Cellulases are hydrolases of great importance to industries, especially due to their ability to produce ethanol via hydrolysis of cellulolytic materials. Basidiomycetes are the producers of these enzymes, particularly the genus *Trichoderma sp.* The *Trichoderma* obtained from Kasetsart University (Kampansan, campus) was identified as *Trichoderma harzianum* based on morphological, micromorphological and ITS4-ITS5 sequence similarities. The strain was investigated for its cellulolytic activity too. The endoglucanase (EG), and cellobiohydrolase (CBH) genes of *Trichoderma harzianum* were cloned to study the molecular characteristics of their gene product. The EG, and CBH genes were recognized firstly by degenerate primers designed from *Trichoderma* endoglucanase and cellobiohydrolase genes, and subsequently identified flanking region by inverse PCR technique. The EG, and CBH genes were further sequenced. The SDS-PAGE analysis of purified EG, and CBH genes were done for obtaining protein bands. The purified enzymes were further subjected to cellulolytic potential assay. The properties of EG, and CBH genes, especially substrate specificity, indicate the usefulness of these genes in various biotechnological applications including biomass hydrolysis.

Keywords: cellulase, endoglucanase, cellobiohydrolase, *Trichoderma harzianum*





Antibacterial activity of snail mucus (*Achatina fulica*) against acne inducing bacteria (*Propionibacterium acnes*)

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Propionibacterium acnes or *P. acnes* is an aerotolerant anaerobic Gram-positive bacterium that resides in sebaceous follicles and acts as cutaneous flora. *P. acnes* play an important role in the pathogenesis of acne vulgaris by releasing lipases to digest triglycerides to fatty acids in the sebum glands. These released fatty acids cause irritation and inflammation to the surrounding tissues. This study aimed to determine antibacterial activities of snail mucus (*Achatina fulica*) against *P. acnes*. Eleven bacterial isolates were collected by facial swap and cultured on agar medium. Colony observation and microbiological Gram staining identified one *P. acnes* isolate which was confirmed by PCR amplification using *P. acnes*-specific primers, and nucleotide sequencing of 16s rRNA gene. The effect of the *A. fulica* mucus on the growth of *P. acnes* was conducted by 96-well plate assay and the results are currently in progress. Our results could support the application of *A. fulica* mucus in acne-preventing cosmetic and pharmaceutical products.

Keywords: *Propionibacterium acnes*, *Achatina fulica*, snail mucus, acne, antibacteria





Comparative transcriptome of foot and mantle in *Semperula siamensis*

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Semperula siamensis is a terrestrial gastropod or a land slug commonly found in Thailand, also considered as a pest of agricultural and ornamental plants. Previous study showed the high viscosity characteristics of *S. siamensis* mucus which is mainly secreted from foot and mantle to moisturize their body surface and protect against microbial infections. Recently, the Transcriptome analysis has been applied to understand functional genomics of certain gastropod species. However, the genes involved in the mucus biosynthesis of this slug has not been revealed. This study aimed to compare the transcriptomes of foot and mantle tissues in *S. siamensis* using RNA sequencing and bioinformatics analysis. RNA extraction protocols were compared and optimized for mucus-rich tissues. RNA sequencing is currently in progress. Assembled reads will be annotated and the comparative transcriptomes between the foot and mantle tissues will be performed to identify the mucus biosynthesis associated genes. Our results will provide basic understanding of *S. siamensis* mucus biosynthesis which can be applied to new material invention and pharmaceutical products.

Keywords: *Semperula siamensis*, land slug, mucus, transcriptome, bioinformatics





Expression and purification of Saglin in *E. coli*

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Malaria is the disease that is found around 99 countries in the world. The cause of the disease is *Plasmodium sp.* that has female *Anopheles* mosquito as a vector. This study aimed to express and purify the recombinant *Anopheles* Saglin protein. Saglin protein is important for the interaction of the *Plasmodium sp.* in the mosquito's salivary gland. In previous study, the *saglin* gene was cloned in pET28b plasmid and transformed into *E. coli* BL21. The small scale expression was performed in various conditions. The results showed that saglin was induced with 0.5 mM Isopropyl β -D-1-thiogalactopyranoside (IPTG) supplemented with either 3% ethanol or 1% glucose. The large scale expression and purification of this protein will be performed.

Keywords: saglin protein, small scale expression





Effects of optical tweezers on gene expression in yeast

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Optical tweezers is a powerful tool for study at molecular level. They can trap manipulating microscopic objects at the focal point of laser beam. The use of Infrared light under optical tweezers have proven to be an ideal tool for studying in biological with less optical damage to living cells. Many cells have been successfully manipulated such as bacterial cell, plant protoplast and yeast cells. Many biological applications have been done using this instrument such as gene transformation, drug discovery, and cancer cell detecting system. In this study *Saccharomyces cerevisiae* will be trapped by optical tweezers. Effects on budding frequency and growth pattern will be investigated using 1064 nm optical tweezers by time-shared multiple optical traps in a rectangular shape. Then, RNA extraction will be performed on trapped and non-trapped yeast cells using UPzol™ RNA Isolation Solution. The RNA samples will be sent for Macrogen Company (Korea) for transcriptome sequencing. Data will be analyzed to find set of genes that expressed differently due to optical tweezer treatment.

Keywords: gene expression, optical tweezers, *Saccharomyces cerevisiae*





Genetic relationship of santol using RAPD markers

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Santol (*Sandoricum koetjape*) is a traditional fruit that can be grown around the country. It is eaten fresh as fruit snack and also has medicinal properties. In Thailand there are many varieties of santol with different fruit characteristics and different tastes. The price in the market can be very high upto 100 baht per kilogram. In this experiment, twenty-six santol accessions were collected from Chonburi and their genetic relationships were analyzed by sixty Random Amplified Polymorphic DNA (RAPD) markers. Total genomic DNA of santol samples were extracted and subjected to polymerase chain reaction with RAPD primers, and the amplified products were analyzed on Agarose gel electrophoresis. The result shows that RAPD markers illustrate DNA polymorphism in santol. This experiment is ongoing.

Keywords: *Sandoricum koetjape*, DNA marker, RAPD marker





Jatropha Plant tissue culture and transformation

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Physic nut (*Jatropha curcas*) is a biodiesel plant. The oil from *Jatropha* can be directly converted by simple esterification into biodiesel for use in diesel engines. To test transformation rate of *Jatropha*, a DNA construct containing group VII ethylene response factors (ERFVIIIs) followed by the hemagglutinin tag under the control of CAMV 35S promoter was transformed into *Agrobacterium tumefaciens*. The *Agrobacterium* was co-cultivated with *Jatropha* cotyledon. Then the cotyledons were grown and selected on solid medium supplemented with indole-3-butyric acid (IBA), 6-benzylaminopurine (BAP). Selected the transgenic plant by kanamycin, rifampicin, and cefotaxime. DNA will be extracted from obtained shoots while polymerase chain reaction using primers specific for the DNA construct will be performed to determine the rate of successful transformation.

Keywords: transformation, transgenic, tissue cultures





Candidate novel SNP of EDG1 gene in Bali cattle

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In cattle, the endothelial differentiation sphingolipid G-protein-coupled receptor 1 (EDG1) gene was associated with intramuscular fat content and marbling scores. This study aimed to identify single nucleotide polymorphisms (SNP) c.-312A>G located in 5' untranslated region (UTR) of EDG1 gene in Bali cattle. Blood samples were collected from Bali (n=44) and Limousin (n=18). Gene variation was analyzed using PCR-RFLP and verified with sequencing (each genotype 2 samples) method. PCR primers were 5'-CGCAGATCTTTCCTGGACAG-3' and 5'-TTCTGCCTC TGAAGACCTCC-3' with MscI enzyme for genotyped the c.-312A>G SNP (the A allele digested, but not to G Allele). In this study, SNP (c.-312A>G) was polymorphic in Limousin cattle that had two genotypes AA and AG, respectively. The Frequency of allele A and G were 0.94 and 0.06, respectively. The observed heterozygosity (Ho) and expected heterozygosity (He) values were 0.11 and 0.10, respectively. Hardy-Weinberg equilibrium test did not significant ($P > 0.05$). While for Bali cattle SNP (c.-312A>G) was monomorphic which had GG genotype only. The result of sequencing analysis, In Bali cattle found two candidate SNPs at position c.-399C>T and c.-273C>G, respectively. Those SNP need to be verified in large population who potential to be candidate genetic marker in Bali cattle.

Keywords: EDG1gene, novel SNP, Bali cattle





Reconstruction of secondary metabolism of *Cordyceps militaris*

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Cordyceps militaris is one of entomopathogenic fungi which is widely used for bio-metabolite products e.g. cordycepin, cordycepic acids, cordymin, ergosterol, adenosine, and polysaccharides. Currently, genome sequence of *C. militaris* is available; however there remain poorly understanding on secondary metabolism. Therefore, this study aims to reconstruct secondary metabolism of *C. militaris* using bioinformatics approach. To perform a network reconstruction, initially we used 9,651 total protein sequences from JGI database for Enzyme Commission (EC) annotation using EnzDP and NetA tools. The predicted EC list was then used for metabolic network reconstruction using KEGG database. After using EnzDP, NetA tools and manual curation, the results showed 15 highlight pathways for secondary metabolism i.e. Puromycin biosynthesis, Indole diterpene alkaloid biosynthesis, Betalain biosynthesis and Carbapenem biosynthesis were identified. Moreover, gene cluster prediction was used for prediction of secondary metabolic pathways. Amazingly, we found fumosorinone biosynthesis that has an experimental evidence to support this annotation. The findings were then used for secondary metabolism reconstruction. Overall, this study provides the knowledge in secondary metabolite biosynthesis in *C. militaris* and can be useful for further metabolic analysis of this fungal species.

Keywords: Bioinformatics, *Cordyceps militaris*, Secondary metabolism





Putative anticancer and antioxidant peptides screening from the transcriptome of *Cordyceps militaris*

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Cordyceps is an entomopathogenic fungal genus consisting of several hundred species in mountain regions, particularly in Tibet, China, Japan, and other eastern Asian countries. These days, several *Cordyceps* species (including *Cordyceps militaris*) have been cultured in artificial media and popularly used for medicinal and nutraceutical purposes i.e. anti-cancer, anti-oxidant and anti-inflammatory agents. Usually, the experimental screening processes of these bioactive peptides are costly, time consuming, and infeasible due to limited protein contents in the samples. This study aimed to develop an *in silico* screening for antioxidant peptides (AOPs) and anticancer peptides (ACPs) from available transcriptome data of *Cordyceps* species. By mimicking the translation (from mRNA to protein) in the fungal cells and tryptic digestion process in mammalian intestinal tract, the python-written program constructed the trypsinized peptidomes of *C. militaris*. The putative AOPs and ACPs were predicted from these peptides using available bioinformatics tools and databases e.g. AntiCP, APD, CancerPPD, and AOP-Pred. The established data set from this analysis could be used for further screening of other bioactive peptides and designing of novel peptides.

Keywords: *Cordyceps*, bioactive peptides, *Cordyceps militaris*, antioxidant, anticancer





Bioinformatic analysis of variants in children with rare genetic diseases

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Rare genetics disorders are one of human healthcare problems. Many cases with rare genetic disease, especially in children, are difficult to diagnose due to the lack of genetic information and user-friendly tools for genetic data analysis. This project aimed to identify genetic causes of rare genetic diseases in child patients from whole exome data analysis by comparing different bioinformatics tools together with our data visualization program written by Python. The whole exome data files of two child patients were processed through variant calling and annotated to identify pathogenic mutations (single nucleotide polymorphisms and insertions/deletions) located in the exome using wANNOVAR and SeattleSeq programs. The wANNOVAR program ran faster and had friendlier user-interface compared to SeattleSeq. The highly-ranked pathogenic variants were selected and confirmed by searching against ClinVAR and other clinical databases. We currently check the significance of these pathogenic variants and their relevance to the rare genetic disease. Together with our visualization program, this study helps identifying potential variants to the rare genetic disease and allows easy comprehension of the annotated variant data.

Keywords: rare genetic disorders, bioinformatic tools, whole human exome, pathogenic variants





Designing and cloning artificial miRNA structure for silencing *MoCOD1* gene of rice blast fungus *Magnaporthe oryzae*

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Magnaporthe oryzae caused the rice blast disease that has been considered as one of main causal agents leading to serious losses of rice-yield and productivity of rice cultivation in Vietnam. In 2011, a short report of Department of Plant Protection, the Ministry of Agriculture and Rural Development indicated serious attack of the rice blast disease up to than 45.600 ha of winter-spring rice cultivation in Vietnam. Moreover, high-yield/quality rice varieties such as IR17494, ML202, Jasmine, BC15 that are susceptible or weak-resistant with *Magnaporthe oryzae*, have been the favorite choice of Vietnamese farmers for their cultivation resulting the increase of the blast infection. Therefore, current studies in our country have mainly been focused on blast resistant rice varieties by breeding and selection. However, the disadvantages of this approach are time-consuming, labor and low stability due to the break of resistance in long-termed production. The resistance to the blast in transgenic rice varieties using HIGS method has researched and developed. The mechanism of this technique is to transfer the silencing structure of the target gene involving infection structure formation and development of the pathogen into plant. Zn(II)2Cys6 transcription factor genes were found to play important roles in development and pathogenicity of the rice blast fungus. Thus, *MoCOD1* gene (MGG_05343) was chosen to design and clone artificial miRNA structure which can silence *MoCOD1* gene. The sequence of *MoCOD1* gene was used to design artificial miRNA by using web microRNA designer WMD3. Structure of artificial miRNA was synthesized by using overlapping PCR with primers which designed overlap. After that, PCR product was inserted into pGEM-T Easy vector. Then, the ligate reaction was transformed into *E. coli* JM109 competent cells by thermal shock method. Colonies containing recombinant vectors were screened based on resistance to ampicillin antibiotics ampicillin and colony PCR. This research designed an artificial miRNA that can silence the target gene is the *MoCOD1* gene. Then, the amiR05343.6 structure was synthesized by overlapping PCR and cloned amiR05343.6 successfully in *E. coli* JM109.

Keywords: HIGS, gene silencing, *Magnaporthe oryzae*, microRNA





Comparison of lactate dehydrogenase and acetolactate synthase deficient mutants of *Klebsiella pneumonia* TWO on 1, 3-propanediol production

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The microbiological production of 1, 3-propanediol (1, 3-PDO) has attracted much attention as an alternative way to produce important platform chemical from glycerol. Metabolic engineering has emerged as a powerful tool to enhance the production of 1, 3-PDO by multiple strategies. Knocking-out lactate dehydrogenase (encoded by *ldh* gene) and acetolactate synthase (encoded by *budB* gene) have been extensively studied as a competitor on 1, 3-PDO production. However, there is a lack of information which comparing the profiles between *ldh* and *budB* gene deficient mutants on glycerol metabolism. An inactivation of *ldh* and *budB* gene in *Klebsiella pneumoniae* TWO were successfully constructed by insertion of a spectinomycin-streptomycin resistance marker. All mutants were incubated in flask experiments with 20 g/l glycerol over 30 h. Compared with the wildtype and mutant strains, the highest productivity of 1, 3-PDO was produced by *budB* inactivation (8.71 g/l), whereas reduced *ldh* activity decreased 11% in the productivity of 1, 3-PDO (6.93 g/l) and led to the 29% increase of ethanol production (2.32 g/l). These result suggested that the activity of *budB* could be a key factor on the enhancement of 1, 3-PDO production between 2, 3-BDO and lactate production, as the competitor by-products.

Keywords: 2, 3-butanediol, ethanol, homologous recombination, lactate





Blast disease reduction by phyllosphere bacteria producing antifungal compounds

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Pyricularia oryzae is pathogenic fungi that cause blast disease on rice. The use of beneficial rice phyllosphere bacteria producing antifungal compounds to control this disease is an important method. In the previous study, we have successfully isolated seven rice phyllosphere bacteria with antifungal activity against *P. oryzae* in vitro. The present study aims to examine the antifungal activity of those isolates to control blast disease in a greenhouse experiment. This experiment used a completely randomized design with rice phyllosphere bacteria and commercial chemical fungicide "Fujiwan 400 EC" as a single factor. We used Ciherang rice cultivar that is susceptible to *P. oryzae*. The rice growth parameter, blast disease severity and percent inhibition was observed and analyzed at 40 days after planting. Application of rice phyllosphere bacteria in a greenhouse was able to reduce blast severity up to 68.65%. Isolates STGG 14, STGG 8 and SKBV 1 were significantly reduced blast severity up to 68.65%, 67.31% and 64.23%, respectively. Those three isolates were identified as *Bacillus subtilis* subsp. *subtilis* strain 168, *B. amyloliquifaciens* strain P2, and *B. subtilis* strain NC1B 3610, respectively. In addition, the rice phyllosphere bacteria also influenced the number of tillers and dry weight of rice plants. Isolate STGG 8 significantly increased the number of tillers to 24.33 and dry weight to 13.79 gram compared with pathogen inoculated control rice plants (IC). These results indicated that rice phyllosphere bacteria producing antifungal compounds were able to reduce blast disease on rice. Those isolates can be recommended as bioagents to control the blast disease on rice caused by *P. oryzae*.

Keywords: *Pyricularia oryzae*, blast disease, rice phyllosphere bacteria, biocontrol agent.





Antibacterial activity of *Xestospongia* sp. associated fungi from Karimunjawa National Park, Central Java Indonesia

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As marine microorganisms, sponge associated fungi are used to produce unique compounds such as antimicrobial compounds to protect them selves from other associated microorganisms. These antimicrobial compounds could be applied to treat the human infectious diseases. We isolated fungus KJMT.FP.4.5 from marine sponge *Xestospongia* sp. KJMT.SP.04 collected in Karimunjawa National Park. Previous study showed this fungus inhibited pathogenic bacteria. The aims of our current study were to identify the fungus through molecular approach, obtain semi-purified antibacterial substances, and characterize the active fractions. Primer ITS 1 and ITS 4 were applied to amplify fungal DNA, fungal metabolites were separated using silica gel column chromatography then tested against *Bacillus subtilis*, *Escherichia coli*, *Micrococcus luteus*, *Salmonella enterica* ser. Typhi and *Staphylococcus aureus*. Active fractions were characterized using HPLC with diode array detector (DAD). The result showed that according to sequence analysis in ITS region, fungus KJMT.FP.4.5 was identified as *Curvularia geniculate* with accession number MH045265. Seven fractions were obtained from silica fractionation





step. The yield and characteristic of the fraction were: 41.7 mg and red-solid (Fr. 1); 24.0 mg and red-semi solid (Fr. 2), 336.7 mg and yellow oil (Fr. 3); 63.2 and yellow powder (Fr. 4); 89.8 and yellow-semi solid form (Fr. 5); 189.1 and yellow-semi solid (Fr. 6); 59.9 and yellow-solid. Inhibition zone was performed by Fr. 2 against *B. subtilis* (10.3 ± 0.14 mm), *M. luteus* (4.01 ± 0.21 mm) and *S. enterica* ser. Typhi (7.65 ± 0.07 mm), in addition Fr. 3 also inhibited *B. subtilis* (15.9 ± 0.42 mm), *M. luteus* (12.0 ± 0.07 mm), and *S. enterica* ser. Typhi (10.5 ± 0.21 mm). HPLC analysis result showed that Fr. 2 had 4 major peaks at retention time 17, 20, 21 and 22 while major peaks of Fr. 3 were appear at retention time 11, 14, 15, 17, and 19. We confirmed that fungus KJMT.FP.4.5 was *C. geniculata* MH045265. From seven fractions, Fr.2 and Fr. 3 successfully inhibited *B. cereus*, *M. luteus* and *S. enterica* ser. Typhi. Fr. 2 was characterized as red semi solid, with yield of 24.0 mg and contained 4 major peaks in 4 retention times while Fr. 3 was characterized as yellow oild with yield of 336.7 mg, and contained 5 major peak in 4 retention times.

Keywords: antibacterial, fractionation, sponge associated fungi





Alpha glucosidase inhibitors of endophytic actinobacteria from *Ficus deltoidea*: an antidiabetic agent

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Diabetes mellitus is one of the most common metabolic disorder diseases which mediated by defects in either insulin secretion or insulin action. An α -glucosidase inhibitor is one of treatments to control glucose levels of diabetics. Empirically, *Ficus deltoidea* has long been known to treat various diseases including diabetes mellitus. Endophytic actinobacteria play an important role to produce various secondary metabolite compounds in host plants. Exploration of potential endophytic actinobacteria from *F. deltoidea* is expected to obtain potential isolates that can produce α -glucosidase inhibitor. Fourty endophytic actinobacteria isolates from root, stem, leaf, and fruit of *F. deltoidea* were tested for their ability to inhibit the alpha glucosidase. The inhibitor activity to alpha glucosidase was determined spectrophotometrically at 400 nm using p-Nitrophenyl-alpha-D-glucopyranoside as a substrate, and acarbose as a positive control. The results showed, a total of 29 isolates from *F. deltoidea* have ability to produce alpha glucosidase inhibitors and 50% of the potential isolates was isolated from leaf. The highest inhibition activity was shown by TBL 24 which can produce an optimum α -glucosidase inhibitor activity when grown in ISP 2 medium for 10 days fermentation. Alpha glucosidase inhibitor compounds have been extrated using some organic solvents, and N-hexane extract has shown to have the highest inhibitor. The N-hexane extract of TBL 24 had IC_{50} 637.71 μ l/mL, higher than IC_{50} of N-hexane extract from *F. deltoidea* leaf. Qualitative phytochemical analysis of TBL 24 extract have some bioactive compounds such as flavonoids, alkaloids, saponins, triterpenoids, and tanins. Production of bioactive compounds which function as alpha glucosidase inhibitors from *F. deltoidea* related to the contribution of endophytic actinobacteria that live in plant tissues.

Keywords: *Ficus deltoidea*, endophytic actinobacteria, diabetes mellitus, alpha glucosidase inhibitor





Tidal lands characters from sponge-associated actinobacteria

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As the productive agricultural land is decreasing, the tidal lands becomes one of the focus of agricultural land development. Rice productivity in tidal land is still low due to high concentration of Fe, Al, and low pH. The use of plant growth promoting bacteria (PGPB) can enhance the yield of rice productivity. In stimulating plant growth, the PGPB may have various mechanisms. Actinobacteria is the targeted PGPB, however, most of the studies used soil actinobacteria. The potential of sponge-associated actinobacteria has rarely been reported. This work aimed to characterize the sponge-associated actinobacteria as PGPB based on their tidal lands characters. The selected strains were characterized for their ability to grow in the presence of different tidal environmental stress conditions, e.g. Fe, Al, NaCl, and pH. There were ten actinobacteria isolates which have various ability to produce HCN, ACC-deaminase, and siderophore. The highest siderophore producer was Crc29t with 82.11%. They can grow in the medium with the Fe and Al concentrations up to 1000 mg/L. This capability was also shown by Car21t. At that Fe and Al concentrations, the Car21t produced dry weight of mycelium to about 0.289 g and 0.204 g, respectively. There were nine isolates grew in pH 3 on the medium, with the highest dry weight of mycelium produced by Cal24h isolates. The tested isolates were able to grow in relatively high salinity condition (7%), with DBi22t showed the highest ability. The results suggest that sponge-associated actinobacteria have the potency as PGPB based on their tidal lands characters.

Keywords: plant growth promoter, sponge-associated actinobacteria, tidal lands characters





Biosynthetic silver nanoparticles (AgNPs) from *Serratia* sp. NBL1001 have antibacterial properties

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The synthesis of silver nanoparticles (AgNPs) by a wildtype isolate, *Serratia* sp. NBL1001, its preliminary characterization and antibacterial activity were studied. Extracellular biosynthesis of AgNPs from silver nitrate (AgNO_3) was observed by visual inspection of crude cell-free NBL1001 supernatant at 30°C showing color changes of orange-brown characteristic of AgNPs. UV/Vis scanning spectroscopy of the AgNO_3 -NBL1001 supernatant solution, upon incubation overnight at 35°C, showed peaks at 430-440 nm typical for silver nanoparticles. Scanning electron microscopy and energy dispersive x-ray (SEM-EDX) confirmed the presence of silver nanoparticles in the solution with size range of 15.29-61.78 nm and mean size of 28.80 nm (n=30). Agar-well diffusion assay showed that the AgNPs exhibited antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus cereus* and *Staphylococcus aureus*. The mean value of the antimicrobial indices exhibited by the AgNPs was highest against *B. cereus* at 1.29, followed by those of *E. coli* at 1.19, then *S. aureus* at 1.10, and the least would be that of the *Ps. aeruginosa* at 1.0. The results demonstrated that *Serratia* sp. NBL1001 conditioned media can mediate extracellular synthesis of AgNPs with antibacterial activities against both Gram-positive and Gram-negative bacteria.

Keywords: silver nanoparticles, *Serratia* sp., biological synthesis, extracellular, antibacterial, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Staphylococcus aureus*





Growth promoter and antifungal activities of Actinomycetes isolated from Rhizosphere of soybean plant

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Rhizosphere actinomycetes have been known in having role as the producer of bioactive compound and they also have ability to promote plant growth. This study aimed to do screening of rhizosphere actinomycetes which have an ability to promote plant growth and produce antifungal bioactive compounds. 40 isolates of actinomycetes have been isolated from rhizosphere of soybean plant. 20 isolates of them had an ability to produce indole acetic acid (IAA) in various concentration. Isolate coded ARK-48 produced the highest concentration of IAA appoximately 16.7 ppm whereas the lowest concentration of IAA was produced by isolate coded ARK-143 with the value about 1.92 ppm. The growth promotion by Ragdoll method resulted that 17 out of 20 isolates of actinomycetes were able to promote soybean sprout, significantly. These were indicated by increasing of three parameters including length of hypocotil, radicula, and number of the secondary roots. Antifungal activity tested by dual culture method showed that 11 isolates inhibited growth of *Fusarium oxysporum*, 2 isolates inhibited the growth of *Phytium* sp, and 7 isolates inhibited the growth of *Rhizoctonia solani*. The highest inhibition index was 73.5% as shown by isolate ARK-94 and the lowest one was 38.69% as shown by isolate ARK-63 in inhibiting against *Fusarium oxysporum*. Two isolates, i.e ARK-94 and ARK-92, showed antagonism activity toward three plant pathogenic fungi. The property of antifungal activity of that isolates might be due to bioactive compound produced by the actinomycetes. The isolates of actinomycetes which had ability to promote plant growth and inhibit the growth of plant pathogenic fungi could be recommended as biological agent to increase plant growth and health.

Keywords: Rhizosphere actinomycetes, soybean plant, growth promoter, antifungal compounds





Isolation and selection of some bacterial species capable of treating nitrogen compounds in the white shrimp (*Litopenaeus vannamei*) culture model by biofloc technology

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Nowadays, agglomeration of nitrogen compounds in *Litopenaeus vannamei* ponds is a popular phenomenon. The degree of accumulation depend on the biomass increasing and the amount of food. *Litopenaeus vannamei* has high demand of protein but most of the food is not consumed and excreted out as nitrogen compounds that influence the growth and health or lethal to vannamei. Biofloc technology is an advanced solution for the shrimp farming. By adding carbon into the farming system with a ratio of C / N and maintaining in a fit level, heterotrophic bacteria rapid development is applied both waste treatment and food source for farming. The purpose of this research is to subdivide and select strains that can generate floc and process nitrogen in model white shrimp rearing technology Biofloc with 4 additional treatments are corresponding molasses the rate of C / N is different. The results showed that the particle size and volume floc in treatment with molasses in higher concentration than others similarly, and the highest treatment has ratio of C / N reached 20 with the floc particle size and volume floc turn is $20.03 \pm 8.08 \mu\text{m}$ and $14.42 \pm 11.75 \text{ ml / l}$. In addition, this research isolate 6 strains that can generate and processe nitrogen compounds *Bacillus pumilus*, *Pseudomonas stutzeri*, *Pseudomonas stutzeri*, *Kocuria rosea*, *Rhodococcus corynebacterioides*, *Agrobacterium tumefaciens*. Besides, *Pseudomonas stutzeri* strain had the highest floc formation at 47%. *Bacillus pumilus* and *Rhodococcus corynebacterioides* are capable of treating high ammonium at 99.69% and 99.86% at 12 hours. *Pseudomonas stutzeri*, *Pseudomonas stutzeri* and *Agrobacterium tumefaciens* showed the highest nitrite treatment rates of 99.86%, 99.86% and 99.77%, respectively, after 30 hours. *Pseudomonas stutzeri* has a high nitrate treatment capacity of 98.1% after 30 hours.

Keywords: biofloc, floc, nitrogen, ammoniac, nitrite, nitrate, biofloc technology





Isolation, identification and antibacterial screening of coral associated bacteria from Karimunjawa National Park

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Coral associated bacteria in a neglected source of bioactive compounds. This study was designed to isolate coral associated bacteria, screen the antibacterial properties against multidrug resistant (MDR) bacteria, identify the potential candidate and characterize the secondary metabolite. Corals were collected from Karimunjawa National Park, Central Java, Indonesia. Bacteria were cultivated in marine broth and extracted by ethyl acetate. Bacterial crude extract was tested against *B. cereus*, *E. coli*, *K. pneumonia* and MRSA strain *multidrug resistant* (MDR) then characterize by thin layer chromatography (TLC). Prospective candidate was identified through 16S rRNA. We isolated 64 coral associated bacteria from seven corals. Among them only isolate TNKJ CR 24.7 showed antibacteria againts *K.pneumonia* and MRSA. This bacterium had 99% similarity to *Vibrio owensii*. The result of thin layer cromathography (TLC) showed that the crude extract had Rf 0.64 and 0.81.

Keywords: antibacterial, coral associated bacteria, MDR, *Vibrio*





Development of transposon based markers for discriminating various phytopathogenic fungi

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Plant diseases caused by fungal pathogens seriously affect food production annually. Their dominance has been compared to other microbial pathogens such as bacteria, viruses and phytoplasmas. Recently advanced DNA based techniques have met agricultural needs, particularly in rapid detection of phytopathogenic fungi and their discrimination from the lab to the field. The objective of this study is to figure out transposon based molecular markers for discriminating fungal pathogens. Herein, quantitative estimation of amplified single-stranded polymeric transposons was evaluated with different transposon primers. The sequence of specific band in each fungal pathogen was designed, and then followed by the PCR amplification with 20 different fungal pathogens. At least two specific SCAR markers were developed successfully to discriminate two fungal pathogens causing serious diseases in plants including *Lasiodiplodia theobromae* and *Magnaporthe oryzae* with the sizes of 600 bp and 700 bp respectively. The results obtained in this study are essential for identifying fungal pathogens in plants providing a potential application of SCAR markers for the development of commercial kits and in-field rapid detection of plant fungal diseases.

Keywords: molecular marker, transposon, SCAR, phytopathogenic fungi





Identification and characterization of endophytic bacteria producing β -indol acetic acid isolated from rice rootstocks

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The role of endophytic bacteria is to promote the transformation of the plant, the growth of root hairs and the elongation of roots that can help the plant to easily absorb water and nutrients. They also play a role in stimulating plant growth, increasing yield and they can act as biological control of plant pathogens. Various mechanism such as dissolving insoluble inorganic phosphorous, biosynthesis of β -indole acetic acid and creating siderophores can be stimulated by endophytic bacteria as described previously. The objective of this study is to identify and characterize endophytic bacteria producing β -indole acetic acid (IAA) isolated from rice rootstocks. Herein, 55 bacteria strains were isolated from rice rootstocks in some provinces in the Mekong Delta and Binh Chanh district, Ho Chi Minh City. Based on biochemical tests and observation of bacterial morphology, two of seven IAA biosynthetic isolates (BCI7 and BTII2) showing the best production of IAA, were used for evaluating the growth the rice roots *in vitro*. The results indicated that BCI7 stimulated the growth of rice in both high yielding and winter rice varieties in comparison with that of BTII2. Sequences of 16S rRNA of BCI7 and BTII2 showed high similarity with *Delftia lacustris* and *Rahnella aquatilis* respectively.

Keywords: β -indole acetic acid, endophytic bacteria, rice, rootstocks





Diversity of fungi mycorrhizal arbuskular at Jintan Hitam Rizhosfer's

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Black seed was any benefited for health, that ususaly was strategic position to developed. In Indonesia development that was trouble climate and next will be different land conditions. Although that, black seed can grow and finished of live cyle in Indonesia. Generally land conditions in Indonesia netral decrease. Inoculation of fungi micorrhizal arbuskular (FMA) is one of method for resolved it. First step to develop of FMA is exploration and identification of FMA to association with black seed. The aim of this reasearch was to knowing and get of FMA genus from various black seed accession. This research used randomized block design one factor, this is black seed accession. There six accessions from Amrica (N1), Turkey (N2), Hongkong (N3), Slovenia (N4), India (N5), and Kuwait (N6). The results showed that FMA had asosiated with black seed and *Glomus*, *Gigaspora*, *Acaulospora*, *Scutellospora*, *Dentiscutata*, and *Entrophospora* found it.

Keywords: black seed, exploration, identification, fungi micorrhizal arbuskular (FMA), diversity





Survival and growth of the seagrass *Thalassia hemprichii* with transplantation technique on the amount of different stands

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Seagrass transplantation is a method developed for rehabilitation in damaged seagrass beds. This research was conducted to knowing the rate survival and growth of seagrass *Thalassia hemprichii*; furthermore, knowing the optimum stands for the survival and growth of seagrass *Thalassia hemprichii* in transplantation technique. This research was conducted in Bintan Island, Indonesia, by the TERFs (*Transplanting Eelgrass Remotely with Frame systems*) method; Amount of stands given 5 treatments; 1 stand (T1), 2 stands (T2), 3 stands (T3), 4 stands (T4), and 5 stands (T5) with 5 repetitions for each treatment. The results obtained for the survival rate of seagrass *Thalassia hemprichii* for each treatment are T1 (80%), T2 (90%), T3 (80%), T4 (90%), and T5 (52%); the analysis statistical using ANOVA obtained significant value 0,331 or α ($p > 0,05$), so the treatment does not effect the survival rate of seagrass *Thalassia hemprichii* transplanted by the TERFs method. The result obtained average values for growth rate of seagrass *Thalassia hemprichii* for each treatment are T1 (0.29 cm), T2 (0.52 cm), T3 (0.53 cm), T4 (0.31 cm), and T5 (0.27 cm); the analysis statistical using ANOVA obtained significant value 0.004 or α ($p < 0.05$), so the treatments gives effect to growth rate of seagrass *Thalassia hemprichii* transplanted by TERFs method. The optimal treatments seagrass *Thalassia hemprichii* survival and growth transplanted by the TERFs method were selected based on statistical analysis of survival rate and growth rate. The 2 stands are optimal treatment for seagrass transplantation, because the treatment with the least amount of stands, but has the highest survival rate and growth rate.

Keywords: seagrass transplantation, TERFs, *Thalassia hemprichii*





Physiological responses and metabolite analysis of rice (*Oryza sativa* L.) under Fe toxicity condition

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Although the tolerance strategies of rice to Fe toxicity has been revealed, but the relationship between metabolites which is involved in their tolerance have not yet been investigated. The objective of this research was to analyze the relationship between metabolites of rice in related to the physiological aspects in their tolerance strategies to Fe toxicity. The experiment using Fe-sensitive rice (cv. IR64) and Fe-tolerant (cv. Pokkali). Two-week-old seedlings were grown in hydroponics system with and without 400 ppm $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ during 10 days. The metabolite of the root and shoot tissues were analyzed using GC-MS. To distinguish the tolerance level of those rice genotypes to Fe toxicity, in this research also analyzed some morpho-physiological traits. The result showed that the Fe toxicity inhibited the plant growth and it condition increased the lipid peroxidation. Furthermore, the Fe toxicity changed the metabolite profile inside the cells. Fifty six metabolites detected in both root and shoot tissues. There were 43% metabolites significantly changed in the root, while 33% metabolites significantly changed in the shoot due to Fe toxicity. Alpha-linolenic acid and neophytadiene in the shoot of rice cv. Pokkali increased under Fe toxicity condition, but those metabolites decreased in the rice cv. IR64. Alpha-linolenic acid and neophytadiene suggested as metabolites that involved in the tolerance strategies in rice under Fe toxicity.

Keywords: alpha-linolenic acid, GC-MS, neophytadine, tolerance strategies





Flowering manipulation on mandarin citrus through bending and defoliation

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Mechanical canopy manipulations through bending and defoliation were applied on mandarin citrus (*Citrus reticulata* Blanco cv. Borneo Prima) to stimulate flushing and flowering during the rainy season in the tropical lowland of Bogor, Indonesia. Four-year-old mandarin citrus trees were treated with bending, defoliation and their combination; and were replicated ten times with single tree as an experimental unit. All manipulated shoot exhibited rapid flushing, particularly of those with defoliation. Defoliation seemed to reduce apical dominant in a branch as a whole, resulted in the growth of flush from the entire canopy. Unfortunately, no flower was produced on trees treated with defoliation or their combination. Bending stimulated a larger number of flowering and fruiting trees than control. Flower drop was lower in bending, resulted in higher number of fruit set and fruit than control. Bended trees have better canopy performances such more foliage, less negative and dead branches than control used to gain more assimilates; therefore bending showed better flowering response than control. At the generative stage, mandarin showed high C/N ratio due to low nitrogen content, irrespective of treatment. The failure to produce flower on defoliation and their combination could be ascertained by steady C/N ratio. Here we showed the success of bending treatment to stimulate mandarin flowering in the tropical lowland, leading to the shifting of harvesting period in October-November, when offseason for most of our mandarin farmers.

Keywords: *Citrus reticulata* Blanco, canopy manipulations, off season, flushing





Income analysis of farming pattern of sweet corn (*Zea Mays L. Saccharata*)-vegetable in Katulungan village, Sukamaju district, Luwu Utara regency

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This research was conducted in Ketulungan, Sukamaju district, Luwu Utara Regency, in July 2017 until February 2018, aiming to know the income of farming pattern of "Sweet Corn-Vegetable". The location of the study was chosen purposively based on the number of farmers who cultivate the most cultivation of "Sweet Corn-Vegetable" cropping pattern of 244 farmers. Respondents were randomly selected for 10% of the population of 24 farmers. Data in this research consists of Primary data that is data obtained directly from respondents through interviews based on the list of questions and observations of the object under study, while secondary data obtained from relevant institutions related to this research. This research uses cost and income analysis method with the formula $P_i = TR_i - TC_i$, then continued with R/C analysis to determine business feasibility. Result of research indicate there are 4 farming pattern that is 1). Farming pattern of "Sweet Corn (*Zea mays L. Saccharata*)-Water spinach (*Ipomoea aquatica* Forsk)-Spinach (*Amaranthus*)" 83.33% with income of Rp 7.468.203 and R/C Ratio 1.62; 2). Farming pattern of "Sweet Corn-Yardlong Bean (*Vigna cylindrica (L.) Skeels*)-Cucumber (*Cucumis sativus L*)" 8.33% with income of Rp 7,301,005 and R/C Ratio 1.96; 3). Farming pattern of "Sweet Corn- Yardlong Bean-Bitter Gourd (*Momordica charantia L*)" 4.17% with income of Rp 7.287.160 and R/C Ratio 1.98; and 4). Farming pattern of "Sweet Corn-Cucumber" 4.17% with income of Rp 6.892.670 and R/C Ratio 1.91. Of the 4 patterns of farming is the most feasible cultivated is farming pattern of "Sweet Corn- Yardlong Bean-Bitter Gourd" because Rp.100 the expenses generated generate revenue of Rp. 198.

Keywords: sweet corn, farming pattern





Allelochemical potential of rice straw extract on weed and crop plants

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The objective of this experiment is to investigate the effect of allelochemical compounds extracted from rice straw on weed (*Mimosa pigra* L.) and crop plant (*Zea mays* and *Vigna radiata*). Rice straw was extracted using four different concentrations 0%, 25%, 50%, and 75% and was prepared to different parameters, including total phenolic compound of extracted rice straw was analyzed, seeds germination, seedling growth, ultrastructure changes, cell division, and lipid peroxidation of the three treated plants were recorded. The results showed that the aqueous extract of rice straw contain phenolic compound. On *Mimosa pigra*, the extract was slightly inhibit seed germination but significantly inhibit seedling growth. The extract, significantly inhibit *Zea mays* seed germination and seedling growth, but did not have inhibitory effect but even induced the seedling growth of *Vigna radiata*. The ultrastructure was changes for treated plant indicated by epidermal damage. The extract had negative effect on cell division but did not affect on lipid peroxidation.

Keywords: total phenolic compound, seeds germination and seedling growth, ultrastructure changes





Comparative phytochemistry of the genus *Acmella* (Asteraceae) in Thailand

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The Genus *Acmella* (Asteraceae) is small herb, consists of thirty species which are mainly distributed in the tropical and subtropical regions around the world. They are used as vegetable and medicinal plants. In Flora of Thailand only two species are found. Identification of *Acmella* spp. are still unclear. This research aims to use phytochemical for supporting species identification. Eleven samples were collected from seven natural habitats (Changwat): Chiang Mai (Doi Pui), Phrae (Rong Khwang), Phitsanulok (Phu Soi Dao), Srakaew (Tapraya), Trat, Trang and Kanchanaburi (Thongphaphum) during January 2017 to March 2018. The voucher specimens were identified and compared with specimens deposited in the Forest Herbarium (BKF). All collected samples could be identified into 4 species i.e. *A. ciliata*, *A. calva*, *A. paniculata* and *A. brachyglossa*. By means of chromatographic technique the lipophilic whole plant extracts (chloroform) were analysed by using Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC). Nearly all HPLC profiles correspond to species identification, interestingly for *A. ciliata*, HPLC profiles could be separated into 3 groups. Therefore, more methods should be used for accurate identification. From TLC analysis some groups of compounds could be detected by using specific reagents and observed the colour appearance and colour changing. Terpenes, phenols, steroids, sterols, sugar and coumarins could be detected in the extracts of different species, especially *A. ciliata* from Trat which show similarity in HPLC profile with the collection from Trang, but their TLC profiles are different when detected under UV long wavelength (365 nm). They may depend on the different environment.

Keywords: *Acmella*, toothache plant, Phytochemistry





Study of the stability of Brazilin compounds and their derivatives as 12-lipoxygenase enzyme inhibitor

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Indonesia has many advantages with having high biodiversity, one of which is the abundance of herbal medicines. The Department of Health and Human Services reports that the process of discovery of a drug from some herbal ingredient needs a long process, which includes studies of the discovery and development of new drugs, pre-clinical testing, clinical testing, FDA approval, and drug safety monitoring on the market (FDA 2017). Secang wood (*Caesalpiniasappan* L.) is a *Caesalpinaceae* family plant widely found in Indonesia. It is often consumed by the people as a healthy drink and also acts as anti-inflammatory. We have simulated the stability tests of brazillin compounds from secang bark extract and their derivatives against antiinflammation process. The purposes of this simulation were to observe and analyse brazillin compounds as inhibitors of 12-lipoxygenase enzymes that could reduce inflammatory activity. The initial stage of this simulation was to determine the active compound on secang wood by searching in *online application* Pubchem: OPEN CHEMISTRY DATABASE and continuing with docking process. The brazillin compound on wood secang was made up of five derivatives and has fulfilled the Lipinski rule, *brazilin* 1 (PCID: 73384), *brazilin* 2 (PCID: 22215), *brazilin* 3 (PCID: 44135406), tetraacetyl*brazilin* 1 (PCID: 6918855) and tetraacetylbrazilin 2 (PCID: 192761). The molecular docking results showed that based on the ability to interact with lipoxygenase enzyme, *brazilin* 3 had the best free Gibbs energy of -8.7 kCal/mol.

Keywords: brazilin, docking simulation, 12-lipoxygenase enzyme, secang wood





Compound analysis of Indonesian mole crab (*Emerita Emeritus*) shell on sintering process

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Emerita emeritus is one type of mole crabs from Indonesia which is still not much in the elemental content, especially the content of the shell. Basically, Crab shells contain calcium carbonate compounds. The thermal (sintering) process of purifying mineral elements such as Ca, Mg, C have to pass through high-temperature heating to 1000 °C. This research aims to determine the content element of phase changes during the thermal process (sintering). Parameters studied at temperatures of 200, 300, 450, 600, 700, and 800 °C. DT analysis at 215 °C and 804 °C undergoing energy absorption (endothermic), at a temperature of 612 °C over an exothermic process. The degradation analysis also showed significant element release at 300, 450, 700, and 800 °C at 5.62%, 12.64%, 10.47%, 28.22% (Total degradation 56.96%). The XRD and FTIR analysis before the sintering process showed $\pm 32.06\%$ of carbon content, $\pm 15.09\%$ of calcium, 8.74% of nitrogen, $\pm 2.18\%$ of magnesium, 0.36% of aluminum, 0.63% of phosphorus, and 0.47% sodium. In addition, some of the content was lost during the sintering process, such as carboxyl groups and water. It shows the process of purification of mineral elements such as calcium, magnesium, and carbon in *Emerita emeritus* shells.

Keywords: thermal properties, TGA-DTA analysis, *Emerita Emeritus*, shells, calcium





Optical properties of two-dimensional gold nanowire array deposited on gold substrate

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We investigated optical properties; namely, reflectance and absorbance, of two-dimensional gold nanowire array deposited on gold substrate. We used theoretical analysis to find reflectance and absorbance of nanostructure system by calculating the scattering field of plane electromagnetic wave, and then we compared the results with the numerical analysis using a finite element method with the same configuration.

Keywords: Nanowire, Nanostructure, Finite element method





Constraints on dark matter annihilation into electrons and positrons by Fermi

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Astrophysical and cosmological evidences have suggested that dark matter is one of the three components of the Universe. We have studied the properties of dark matter by indirect detection. We have assumed that dark matter and anti-dark matter annihilate into standard model particles such as electrons, positrons, muons, antimuons, taus, antitau, bottoms, anitibottoms, tops and anitops. In this research, we have constrained dark matter properties by using the electron and positron spectrum measured by Fermi-LAT in the solar neighborhood. We have compared the upper limits of dark matter annihilation of different annihilation channels with the thermal relic cross-section $\langle\sigma v\rangle = 3 \times 10^{-26} \text{ cm}^3 \text{ s}^{-1}$.

Keywords: astroparticle physics, cosmology, dark matter





Analyzing an irrationality proof

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Laczkovich proved, in 1997, that π was irrational by analyzing the infinite series

$$f_k(x) = 1 - \frac{x^2}{k} + \frac{x^4}{k(k+1)2!} - \frac{x^6}{k(k+1)(k+2)3!} + \dots$$

The proof follows from the fact that if $x \neq 0$ and x^2 is rational, then $f_k(x) \neq 0$ and $f_{k+1}(x)/f_k(x)$ is irrational for every rational number $k \neq 0, -1, -2, \dots$

Here, we used Laczkovich's method to analyze the infinite series

$$f_k^c(x) = 1 - \frac{x^c}{k} + \frac{x^{2c}}{k(k+1)2!} - \frac{x^{3c}}{k(k+1)(k+2)3!} + \dots$$

to derive a similar result and apply it to deduce some irrationality result about Bessel function.

Keywords: irrationality proof, Laczkovich's method





Increasing potential of biomass burning based on the variability of hotspot on visibility and temperature in Kalimantan

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Forest fires are a recurring occurrence in Indonesian territory, especially of Sumatra and Kalimantan islands. Increasing potential of biomass burning in Kalimantan is a threat to sustainable development. Biomass burning have a wide-ranging impact on the health, environment, economic of the community, both in Indonesia and neighboring countries like as, Malaysia, Singapore, and it is expected that similar disasters would not be repeated in the future. So, needed mitigation and minimize losses due to the impact and disaster. The purpose of this study is to obtain information on increasing potential of biomass burning to the variability of hotspot on visibility and temperature in Kalimantan so that forest fire control can be monitored effectively and efficiently. To know biomass burning, the reseacher use airport visibility report, hotspot, and temperature data since 2007-2016. The Airport Visibility Report provides the longest quantitative biomass burning records available in Indonesia. Airport Visibility Report is influenced by temperature data, hotspots and analyzes each data associated with elnino and monsoon phenomena. This study uses monthly linear regression for each data, and calculates monthly and annual correlation between visibility with hotspot, visibility with rainfall, visibility with temperature, hotspot with temperature, and hotspot with rainfall at Airport Station in Kalimantan. The results show that a strong correlation was found between visibility and hotspot number in North Kalimantan with R^2 of 0.781, and the lowest correlation in West Kalimantan with R^2 of 0.324. It was revealed that an increase in hotspot would cause a decrease in visibility. In addition, the temperature and number of hotspots showed a strong correlation in South Kalimantan with R^2 of 0.66, and the lowest correlation in West Kalimantan with R^2 of 0.068. The more hotspots the higher the temperature so that it will have an impact on the increased potential of biomass burning. It is also reported that 7 Airport Stations in Kalimantan, namely Temindung, Tjilik Riwut, Iskandar, Supadio, Sepinggan, Syamsudin Noor and Tarakan, are consistent with visibility, hotspot and temperature data with 50% confidence intervals. The correlation between numbers from hotspots and visibility is 2 Airport Station which has a correlation value of <50% from Sepinggan Airport and Tarakan, while the correlation between the number of hotspots and temperatures is only 1 Airport Station which has a correlation value >50% of the 7 Airport Stations in Kalimantan namely Syamsudin Noor Airport. Burning of biomass is strongly influenced by monsoonal, climatic factors such as Dipole Mode, Anomalous Sea Surface Temperature and El Nino.

Keywords: biomass burning, hotspot, visibility





Material properties and *in vitro* biocompatibility of nanocellulose produced by bacterial isolates from Philippine nata starter

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Two nanocellulose-producing bacteria were isolated from separate local nata starter cultures and were characterized to determine its identity using polyphasic method of identification (cultural, morphological, biochemical and genomic analysis of the 16S rDNA). The cellulose produced by the two bacterial isolates were compared to determine if differences between material properties and *in vitro* biocompatibility were species-dependent. Cellulose membranes were produced by inoculating the bacterial isolates to HS media using different carbon sources (glucose, mannitol and sucrose). The material properties of cellulose membranes were characterized using scanning electron microscopy, fourier-transform infrared spectroscopy, X-ray dispersive spectroscopy, calcofluor staining and percent rehydration. The biocompatibility of the cellulose membranes was evaluated using MC3T3 pre-osteoblast cells and was analyzed using CCK-8 cell viability assay. Adhering cells were viewed stained and viewed under confocal laser scanning microscope.

Keywords: bacterial nanocellulose, nata starter, material characterization, biocompatibility





Synthesis of carbonated hydroxyapatite (CHA) from Tilapia fish bone (*Oreocromis niloticus*) using microwave irradiation as bone substitute material

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Current synthetic bone grafts commonly are made by hydroxyapatite (HA) which has a similar composition to bone mineral apatite. Although HA synthetic has the ability to bond bone, but the rate of osseointegrations are relatively slow. The way to enhance osseointegration is add an incorporate ion which is present in bone mineral such as carbonate ion. Tilapia fish bone became potential waste which can be used for biomaterial synthesis because it contains rich of calcium phosphate. This research aims to synthesize calcium phosphate by microwave assisted methods. CHA (carbonated-hydroxyapatite) was successfully synthesized by mixing a calcium phosphate solution from tilapia fish bone with an aqueous solution of NaHCO_3 in hotplate stirrer 300 rpm for 30 minutes and directly transferred into microwave oven. According to atomic absorption spectrophotometry (AAS) analysis showed that Ca contains in Tilapia fish bone is approximately 59.17%. Microwave offers fast reaction, easy reproducibility, narrow particle distribution, high yield, high purity, and efficient energy transformation. After precipitation process, samples were irradiated in microwave oven for 30 minutes with microwave power used 400W. The functional groups of CHA powder was determined by FTIR. There are functional groups of phosphate (PO_4^{3-}), hydroxyl (OH^-), and carbonate (CO_3^{2-}). The FTIR spectrum indicates that the prepared sample is B- type CHA because part of phosphate groups in the HA structure is replaced by carbonated groups. The phase composition was evaluated by XRD and indicated the presence of HA and CHA both type A & B. Morphology and particle size was determined by SEM. The quantitative analysis with EDX showed that Ca/P ratio is 1.63, which indicates that the obtained product is non-stoichiometric HA. The effect of microwave irradiation in CHA type B synthesis can shorten synthesis time by cutting aging, filtering, and drying processes. Moreover, it can produce higher relative masses, precision lattice parameters approaching 90%, and also increase crystallinity. The successful synthesis of CHA is a critical step forward in our efforts to fabricate bone tissue engineering scaffold.

Keywords: biomaterial, CHA, microwave, Tilapia





Modeling sorption isotherm of parboiled rice

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Moisture sorption isotherm food product describes the relationship between equilibrium moisture content and relative humidity at constant temperature. Moisture sorption isotherms have an important role to play in the quantitative approach to the prediction of the shelf life of dried foods due to their sensitivity to moisture changes. Equations for fitting water sorption isotherms in foods are important in storage life of a food product. Moisture sorption isotherms of parboiled rice were determined at temperature 30 °C and relative humidity from 0.07 to 0.92, using the standard gravimetric static method. The Hasley, Oswin, Henderson, Chen-Clayton and Caurie models were applied to the sorption eksperiment data. The mean relative deviation was used to evaluate the goodness of each models. The Chen-Clayton model was found to be the best model to describe the experimental sorption data for parboiled rice. The water sorption isotherm parboiled rice has sigmoid shape.

Keywords: sorption isotherm; modeling; parboiled rice





Green synthesis of nanoparticle C-dots from rice husks with hydrothermal method

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Carbon dots (C-dots) are zero carbon nanomaterial dimension classes that have favorable characteristics such as excellent water solubility, biocompatibility, and good photostability. In this study, synthesis C-dots of rice husks were successfully performed by hydrothermal and by treatment of urea variations of 0.1 M, 0.3 M, 0.5 M and 0.7 M. Physical properties of C-dots color of rice husk showed blackish brown. The results of fluorescence C-dots rice husks are wavelength 540 nm; fluorescence intensity decreased with high urea levels. The absorbance spectrum of light at wavelength 330-380 nm, the resulting absorbance spectrum is not much different from each sample. Then for FTIR results do not show differences in functional groups in the presence of variations in urea levels. The functional groups identified in C-dots rice husks are C-O, C = C, N-H, O-H, and C-H.

Keywords: carbon nanomaterial, hydrothermal method





The influence of ultrasonication and stirring in synthesis of nanohydroxyapatite based chicken eggshell

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Hydroxyapatites is a natural bio ceramic materials which mainly uses in bio medical applications due to its structural similarity to the bone and teeth in the human body. Bone substitution materials should have certain characteristics such as biocompatibility and also the ability integrate with the bone tissue which have needle shape and nano structure. Compare with conventionally hydroxyapatite, nano-structure hydroxyapatite can promote osteoblast adhesion and proliferation, oseointegration, and the deposition of calcium-containing minerals. Nano-size hydroxyapatite can improve the sintering kinetics because of higher surface area and subsequently improve mechanical properties. Thus, this research is focus on the synthetic routes of nano-size hydroxyapatite powders or nanohydroxyapatite based on chicken eggshell which containing 94% calcium carbonate that can be converted as a calcium oxyde by calcination process at high temperature and assisted by ultrasonic irradiation and stirring methods. This research uses ultrasonic irradiation and stirring methods with three different methods to produce nanohydroxyapatite. They are synthesis of hydroxyapatite with ultrasonication of calcium oxide from biowaste eggshell, ultrasonication during precipitation processes and ultrasonication of hydroxyapatite product. The structures and particle size distribution of the nanohydroxyapatite are also evaluate by GBC Emma x-ray diffractometer, Shimadzu xrd-7000 x- x-ray diffractometer, Passco particle size analyzer and zetazier nano ZS malvern. The results show that the second method is the best optimum method to produce nanohydroxyapatites. The characterization of x-ray diffractometer shows that phase majority formed by this method is hydroxyapatite and some other phases such as octacalcium phosphate and tricalcium phosphate. This method also presents the smallest particle size distribution about ± 15 nm. The characterization of x-ray diffractometer for the first method shows beside phase majority is hydroxyapatite, there are other phases such as octacalcium phosphate and tricalcium phosphate. The particle size distribution of this method is about ± 130 nm. The characterization of x-ray diffractometer for the third method shows that phase majority formed is hydroxyapatite but there are also other phases such as octacalcium phosphate and tricalcium phosphate. This method presents particle size distribution is about ± 150 nm. This particle size analyzer also revealed that nanostructure hydroxyapatite high state of agglomeration.

Keywords: hydroxyapatite, PSA, ultrasonication, XRD





Preparing dopant materials for light sensors based on ferroelectric thin films using chlorophyll powder from vegetable crops

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Successfully extracted chlorophyll powder from vegetable leaf (case study: spinach, mustard, cassava, and papaya) using traditional homemade method. From every 500 grams of fresh vegetable leaves, it produces about 4-5 grams of chlorophyll powder. The powder was dissolved with 10 ml of 96% ethanol to test fluorescence spectroscopy and absorbance using a spectrophotometer uv-vis. Conductivity of properties were tested using lcr meter and elemental content using EDX. The results show that all samples fluoresce at a wavelength of 680nm. The highest fluorescence intensity is owned by cassava leaf extract and the lowest is papaya leaf extract. From the absorbance value, the concentration of chlorophyll is obtained and it is proven that the chlorophyll of the four types of extract has high absorption so that chlorophyll extract can improve the working of thin film to absorb light. The lcr meter results show that these four chlorophyll types have a conduction value. The results of this test are supported by EDX analysis, where the composition of the dominant element in this extract is magnesium (Mg) which indicate the conductor material.

Keywords: chlorophyll, spectrophotometer uv-vis, lcr meter, EDX, conductor material





Phase change material based fatty Acids from marine fish oil by epoxidation process

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The phase change material (PCM) is a latent heat storage material that has the potential to store energy. PCM refers to the properties of solid-liquid materials that can absorb and release heat. Fish oil is a potential source of fatty acids that can be obtained from fish canning waste. PCM from fish oil is made through the epoxidation process by adding H_2SO_4 , H_2O_2 , and Acetic Acid, then stirred at 700 rpm for 4 hours to obtain PCM from fish oil. PCM were analyzed for peroxide value, iodine value, and fatty acid performance. The double bond of fish oil breaks after the epoxidation process, as indicated by the decrease in iod value fish oil of 115.99 ± 0.09 $gI_2/100g$ to 43.14 ± 0.5 $gI_2/100g$ after epoxidation process. The termination of the fish oil double bond is also shown by the decrease in crude oil fatty fish from 59.80 to 17.19 after the epoxidation process. Saturated fatty acids (SAFA) decreased from 19.5 to 14.3. Mono unsaturated fatty acid (MUFA) decreased from 11.56 to 2.37. Poly unsaturated fatty acids has decreased from 28.73 to 0.52. The value of crude fish oil peroxide was 11.57 ± 0.8 meq / kg increased after the epoxidation process became 158.73 ± 0.6 meq / kg. In conclusion, fatty acids from marine fish oil can be good sources of PCM.

Keywords: phase change material, fish oil, epoxidation





Synthesis and characterization of barium hexaferrite magnetic material added zinc powder through mechanical milling method

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Synthesized barium hexaferrite magnetic material from barium carbonate and ferrite. The material is given the addition of zinc powder to know how much it affects the crystal structure and its magnetic properties. Barium hexaferrite synthesized using the formula $\text{BaFe}_{12-x}\text{Zn}_x\text{O}_{19}$ with the addition of ZnO where $x = 0$, $x = 0.4$, $x = 0.6$ and $x = 0.8$ using mechanical milling method. The results of the milling were 4 samples, after which 4 samples were pressed in the form of coins with a diameter of 25 mm and in sintering 1200°C for 3 hours using furnace. The calcination result is expected to be 4 samples with sample composition 1 ($\text{BaFe}_{12}\text{O}_{19}$), sample 2 ($\text{BaFe}_{11.6}\text{Zn}_{0.4}\text{O}_{19}$), sample 3 ($\text{BaFe}_{11.4}\text{Zn}_{0.6}\text{O}_{19}$) and sample 4 ($\text{BaFe}_{11.2}\text{Zn}_{0.8}\text{O}_{19}$). The synthesized results of 4 samples were characterized by XRD to see the crystal structure and characterized by a permagraph to see its magnetic properties. XRD results from 4 samples obtained crystal size given ZnO addition with $x = 0.8$ with size of 151,509 nm which is smaller than from 3 other sample. this proves that the addition of more ZnO that is substituted to barium hekasferit can decrease the size of the crystal. Magnetic results are tested with permagraph obtained coercivity given ZnO addition with $x = 0.8$ has a coercivity value of 58.97 kA / m where the value is smaller than the 3 samples. This shows that the addition of ZnO into barium hexaferrite can reduce the value of coercivity, nwhere the value of coercivity is smaller then the material includes soft magnetic material. This magnetic soft material can be used for microwave absorption applications.

Keywords: barium hexaferrite, soft magnetic, permagraph, coercivity





Comparison of Upper Ordovician – Lower Silurian life diversity at Pa Kae and Khao Noi, Satun, Thailand

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Life diversity through time is a result of evolution of living organisms in order to adapt to their environment. Life diversity and evolution were recorded in forms of fossils. Therefore, study of fossils deposited in sedimentary rocks of various ages can lead to interpretation of geologic events. This study investigates life diversity recorded in upper Ordovician Pa Kae Formation and lower Silurian Wang tong Formation around Pa Kae and Khao Noi areas, Satun Geopark, Satun Province. These areas are very interesting due to continuous deposition of sedimentary rocks and evidence of Ordovician and Silurian boundary. Consequently, comparison of type and number of fossils found around Pa Kae and Khao Noi areas can be used as crucial information for stratigraphic correlation between the two areas. Based on field survey and thin section analysis, the fossils found in both areas are totally different. Ordovician Pa Kae Formation has much more fossils than Silurian Wang tong Formation does in terms of both number and type of fossils. It shows that there was a major change during late Ordovician, consistent with the end Ordovician mass extinction event. Eventually, it can be concluded that the boundary between the Pa Kae Formation and the Wang tong Formation is one of significant evidence of the global geological event.

Keywords: Satun; life diversity; Ordovician; Silurian





Lithostratigraphy of Pa Kae Formation and Wang Tong formation at Pa Kae and Khao Noi, Satun, Thailand

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Lithostratigraphy is study of relative order of rock strata compared to other strata and their relationship to the geological time scale. It focuses on lithology, especially rock texture, which are products of sea level changes or geological processes. Stratigraphic study is very important for geological research and natural and energy resource exploration. This research studies two rock formations including the Pa Kae Formation which was deposited in Upper Ordovician epoch and the Wang Tong Formation which was deposited in lower Silurian period at Pa Kae and Khao Noi areas of Satun Geopark, Satun Province. The Satun Geopark represents remarkable geology and records of marine ecosystem from Cambrian period to present. To understand stratigraphy and paleoenvironment of the study area, rock types and texture and structure of strata were analyzed. Based on field and the laboratory studies, with petrographic thin sections studied under a polarizing microscope. Seven lithofacies can be classified as follow: wackestone, red sparse biomicrite and fossiliferous biomicrite which are exposed at Pa Kae and light grey sparse biomicrite, graptolitic black shale, black shale and quartz wacke which are exposed at Khao Noi. All lithofacies can be interpreted to represent three depositional environments including shallow water (wackestone and fossiliferous biomicrite), deep water (red sparse biomicrite, light grey sparse biomicrite, graptolitic black shale and black shale) and near shore deposits (quartz wacke).

Keywords: Satun Geopark, Upper Ordovician, lower Silurian





Paleoenvironment of Thale Noi, Phattalung

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Sediment can represent paleoenvironment of an area it was found so component analysis of lake sediment can lead to interpretation of environmental change within lake during its deposition. This project studies lake sediment from Thale Noi which is freshwater lake in Kuan Khanun District, Phattalung Province. Physical properties and Total Organic Carbon (TOC) are analyzed. Based on TOC values and physical properties, lake sediment samples can be divided into 5 units consisting of unit A, B, C, D and E. The lowest sediment unit, unit E and D have TOC of 0.3 to 0.4 weight percent. However, unit E is yellowish gray clay and unit D is light yellow clay. The next unit, unit C, is represented by black clay with high content of visible organic matter. Unit C TOC is about 20 to 30 weight percent. Then, unit B can be divided into 3 units from top to bottom, which are unit B1, B2 and B3. Unit B3 and B1 are dark gray clay, whereas unit B2 is light gray clay. Sediment of unit B1 is obviously coarser than that of unit B2 and B3. TOC values of unit B range from 1 to 4 weight percent. The uppermost unit, unit A, consists of the coarsest sediment with 4 to 9 weight percent TOC. Based on physical properties and TOC values, it can be interpreted that there was a transgression during Unit E and D deposition. After that, Unit C was deposited in a wetland environment. Then, lake level increased and the area became a tidal flat during unit B deposition. Finally, unit A has been depositing in a freshwater lake environment as seen now.

Keywords: lake sediment, total organic carbon, songkhla lake





Some Problems in The Fibonacci Quarterly

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The Fibonacci sequence $\{F_n\}_{n=0}^{\infty}$ is the most famous sequence among integer sequences which is defined recursively by the relation $F_n = F_{n-1} + F_{n-2}$ with initial conditions $F_0 = 0$ and $F_1 = 1$. Another well-known sequence is the Lucas sequence $\{L_n\}_{n=0}^{\infty}$ which satisfies the same recurrence relation with the initial conditions $L_0 = 2$ and $L_1 = 1$. The Fibonacci and Lucas sequences have many important applications to diverse fields such as mathematics, computer sciences, physics, biology and statistics.

The Fibonacci Quarterly is a journal which provides a focus for worldwide interest in the Fibonacci numbers and related mathematics. In this work, we interest the content of the problem sections of The Fibonacci Quarterly and we will try to solve some interesting problems.

Keywords: Fibonacci numbers, Lucas numbers





Powerful Numbers in Arithmetic Progressions

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Let an integers $q \geq 2$ and for integer $0 \leq l < q$. Let $x > 1$,
we derive the asymptotic formula for

$$\sum_{\substack{n \leq x \\ n \equiv l \pmod{q}}} f(n),$$

where $f(n)$ denote the characteristic function for the powerful numbers.
We use Perron's formula and the residue theorem to prove the results and some
properties of the Dirichlet L –function is the main ingredient.

Keywords: Powerful number





On the denesting roots

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Denesting means rewriting the expression so that only rational numbers appear inside roots. Two simple examples of formulas that

$$\sqrt{5 + 2\sqrt{6}} = \sqrt{2} + \sqrt{3} \quad \text{and} \quad \sqrt{4 + 3\sqrt{2}} = \sqrt[4]{2}(1 + \sqrt{2}).$$

The left hand side of above equations are examples of a nested radical.

In this work, we wish to simplify of expressions containing nested radicals involving a square root inside a cubic root or a cubic root inside a square root whenever possible.

Keywords: denesting, nested radicals





The scheduling of traffic light at Kasetsart University

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In this work we study about the route in Kasetsart University to simulate traffic light scheduling. This project is only a simulation of the traffic lights. Because the traffic is a lot of users. Traffic simulators in Kasetsart University are divided into four traffic intersections include Vibhavadi intersection, Ngamwongwan 1 intersection, Ngamwongwan 3 intersection and dormitory intersection. By using the theory of Stoffers and Roberts and the required tools are basic graph theory and linear programming. The result is that traffic flows and can be manage the traffic light appropriately.

Keywords: Linear Programming





Development of New Synthetic Route to Steroid-based Cyclic Nitron

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Free radicals have been associated with many human diseases such as cancer. Recently, EPR spin trapping has emerged as a powerful technique to study the oxidative damages from reactive free radicals. Cyclic nitron spin traps are a group of spin traps that have been widely used to capture transient free radicals, allowing enough time to be studied by EPR. In this experiment, we aimed to synthesize a steroid-based cyclic nitron spin trap, which will be used to study lipid peroxidation in lipophilic cellular compartment. The spin trap was designed to be synthesized from cholesterol and L-proline in 4 steps. Those steps involved esterification to couple cholesterol and prolines, oxidation to nitrones, addition by a Grignard reagent to the nitrones to form hydroxylamines, and oxidation to furnish the target nitrones, respectively. The results from each step will be discussed. In comparison with previous report, these experiments would allow us to obtain a shorter synthetic method to synthesize cyclic nitron spin traps with lower cost.

Keywords: cholesterol, EPR Spin Trap, free radical, proline, nitron, spin trap.





Preparation and characterization of CeO₂-TiO₂ photocatalysts for textile dye degradation

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Textile industries heavily use both synthetic and natural dyes, and release a lot of wastewater containing these chemicals into the environment. This severely causes detrimental impacts on the aquatic ecosystem. Therefore, treatment of wastewater from textile industries is very important. Photocatalytic dye degradation is considered as one of the most promising approaches for water remediation, as it is clean and economical. In this work, we develop three-dimensionally ordered mesoporous structures (3DOM) of cerium-doped titanium dioxide (Ce/TiO₂) as the efficient photocatalysts for dye degradation. Polymethyl methacrylate (PMMA) and Pluronic 123 (P123) were used as the soft templates for assisting the formation of hierarchical-Ce/TiO₂. The crystal structure, morphology and optical properties were studied by X-ray diffraction spectrometry (XRD), Scanning electron microscopy (SEM) and Ultraviolet-visible (UV-vis) spectroscopy, respectively. The specific surface area was determined by Brunauer-Emmett-Teller (BET) method. Their photocatalytic performance was evaluated in reactive red dye degradation. The results indicated that the 3DOM-Ce/TiO₂ powder showed superior photocatalytic reactivity compared to that of commercial TiO₂.

Keywords: TiO₂ thin film, dye degradation, Photocatalysts, Ce-doped, Hierarchical TiO₂





An anion sensor based on 3,5-dihydroxytoluene and N-(p-tolyl)acetamide

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2-(3-hydroxy-5-methylphenoxy)-N-(p-tolyl)acetamide, L₁, has been synthesized by condensation reaction of 3,5-dihydroxytoluene and N-(p-tolyl)acetamide using K₂CO₃ as a base and CH₃CN as a solvent. The sensor L₁ was characterized by ¹H and ¹³C NMR, ESI-MS spectrometry and Elemental analysis. The binding behaviours of sensor L₁ and anions (C₆H₅COO⁻, CH₃COO⁻, CN⁻, F⁻, Cl⁻ and Br⁻) including sugars (glucose, fructose and galactose) were investigated by ¹H NMR and UV-Vis Spectroscopy. For ¹H NMR studies, the -NH₂ and -OH resonance signals of L₁ were shifted to large downfield and broad peaks due to hydrogen bonding interaction when addition of F⁻, CN⁻, Cl⁻, Br⁻, CH₃COO⁻ and C₆H₅COO⁻. The -CH₂ peak would moved to upfield shift upon addition of F⁻ ion. This phenomena occurred under the enhancement of electron density. In the case of sugar, there is no change of proton pattern. For UV-Vis studies, addition of F⁻ to the solution of sensor L₁, it was found the new band at 306 nm due to π-π* transition. Moreover, the ratio of complexation between sensor L₁ and F⁻ ion was 1:1 form using Job's method

Keywords: 3,5-dihydroxytoluene, Anion sensor, UV-Vis spectroscopy, Job's method





Effect of organic solvents on the ring-opening process of spirooxazine and selectivity towards spirooxazine-metal ion formation

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Spirooxazine, a photochromic molecule, has been developed as an optical probe for detection of toxic heavy metal ions. In this research, we aim to synthesize a spirooxazine derivative and study the selectivity and sensitivity of spirooxazine towards metal ions such as Na⁺ K⁺ Mg²⁺ Ca²⁺ Sr²⁺ Ba²⁺ Pb²⁺ Cr³⁺ Mn²⁺ Fe²⁺ Fe³⁺ Co²⁺ Ni²⁺ Cu²⁺ Zn²⁺ Cd²⁺ Sn²⁺ and Hg²⁺. The result shows that the as-synthesized spirooxazine can selectively form complexes with Cu²⁺ and Fe³⁺ in acetonitrile. The color of spirooxazine solution changes from colorless to yellow for Cu²⁺ and pink for Fe³⁺ as observed by the presence of new absorption peaks at 467 and 514 nm, respectively. Meanwhile, the other metal ions do not exhibit any distinct absorption peak in the similar visible region, indicating no complex formation was observed. The stoichiometry of the ligand-metal complex determined by Job's method was found to be 1:1 as the ratio of an open-form spirooxazine, known as merocyanine, with Cu²⁺ or Fe³⁺. The detection limits of the spirooxazine derivative in this work were determined as 3.38 μM for Cu²⁺ and 3.74 μM for Fe³⁺, respectively. Moreover, we are trying to develop a spirooxazine sensor to determine the quantity of Cu²⁺ and Fe³⁺ in water dispensers.





Further Design, Synthesis of Phosphodiesterase Type 5 (PDE5) Inhibitors of N^2,N^4 -diaminoquinazoline derivatives

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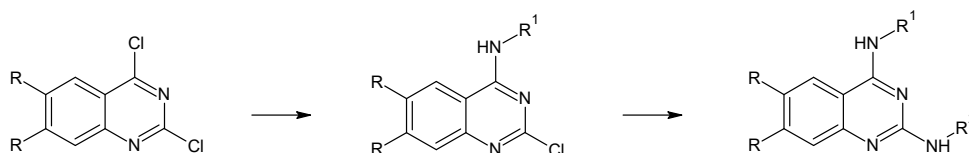
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Cardiovascular diseases (CVDs) are the number one cause of death in the world. Estimates are that approximately 17.7 million people die every year due to this disease (World Health Organization). Erectile dysfunction (ED) is a recognized consequence of cardiovascular disease. Both of the conditions are caused by enzyme phosphodiesterase type 5 (PDE5). Sildenafil is a selective, potent inhibitor of phosphodiesterase type 5 (PDE5) which has been implicated as a major cause of cardiovascular disease and erectile dysfunction (ED). Quinazoline derivatives have shown a wide range biological activity including antimalarial, anticancer, antihypertensive and penile-erection-promoting activities. We have designed and synthesized 6 N^2,N^4 -quinazolinediamine derivatives substituted at the 2- and 4-positions and evaluated inhibitory activity at phosphodiesterase type 5. The objective of this work is to obtain both high PDE5 potency and selectivity over other PDE isoforms.

Keywords: PDE5 inhibitors, quinazoline derivatives, cardiovascular disease, erectile dysfunction





Determination of phenanthrene intermediate after degradation with tropical microorganisms by using HPLC

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Polycyclic aromatic hydrocarbons (PAHs) spontaneously occur by incomplete combustion of organic matter. Including automotive exhaust and cigarette smoke, which were toxic to the environment. Biodegradation processes are now emerging to transform PAHs to less hazardous or non-hazardous compounds. These processes are approaches to remove or reduce pollutants in an eco-friendly manner. Therefore, phenanthrene was studied to determine the intermediate after degradation with tropical microorganisms. Analysis of the intermediate during phenanthrene degradation using high performance liquid chromatography (HPLC). Dichloromethane was used as a solvent in the extraction of the intermediate. After degradation, 1-hydroxy-2-naphthol was found, which was identified using high performance liquid chromatography-mass spectrometry (HPLC-MS). Further study on other more intermediates is needed in order to know the mechanism of phenanthrene microdegradation.

Keyword: Phenanthrene, intermediate, HPLC, degradation





Determination of caffeine in aqueous matrix

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Caffeine ($C_8H_{10}N_4O_2$) is a central nervous system (CNS) stimulant that widely found in many kinds of beverage. Several methods have been used in quantitative measurement of caffeine; however, they are complex, inconvenient and expensive. The electrochemical technique is the technique that has been widely used in caffeine detection due to its selectivity and sensitivity. In this research, screen printed electrode (SPE) has been developed to use in quantitative measurement of caffeine. The surface of electrode was modified by nafion ($C_7HF_{13}O_5S.C_2F_4$) and PDDA ($C_8H_{16}NCl$)_n to improve selectivity and sensitivity of the electrode. It is found that nafion modified electrode shows the higher current than PDDA modified electrode. The nafion modified electrode was carried out in different concentrations of caffeine from 0.1 mM to 2.0 mM. The linear regression is $y = 22.779x - 2.8403$ with $R^2 = 0.9985$. The prepared electrode was used to detect caffeine in real samples of coffee and greentea.

Keywords: caffeine, nafion, screen printed electrode, modified





Synthesis ZnO@MOF by using ZnO as nucleating agent to synthesis MOF for study as photocatalyst degradation methylene blue

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Photocatalyst, ZnO, that have difference morphology was prepared by Thermaldecomposition of Metal Organic Frameworks (MOFs). It is used as a catalyst for the degradation of methylene blue and ZnO octahedral have highest efficiency for dye degradation. To increase dye degradation, take on ZnO octahedral coated with [Zn(2-aminotherephthalate)](MOF46) by using ZnO as a source of Zn(II) and combined with 2-aminopherephathalic acid by ultra sonicated give a ZnO@MOF. The morphological structure was characterized and confirmed by X-ray diffraction (XRD), Thermogravimetric analysis (TGA), Scanning electron microscopy (SEM) and Energy dispersive X-ray analysis (EDX). Test efficence of methylene blue degradation shown that ZnO@MOF have higher performance than ZnO only.

Keywords: Zinc oxide, metal organic framework, photocatalyst, dye degradation





Preparation, characterization and release study of caffeic acid-loaded chitosan/PVA hydrogel

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The physic-chemical properties of a polyvinyl alcohol (PVA)-based hydrogel, a chitosan (CS)-based hydrogel and a chitosan and polyvinyl alcohol (CS/PVA)-based hydrogel composite at 1:1 wt/wt, were investigated. A bioactive compound which is caffeic acid (CA) was loaded into those hydrogels at 10 and 20 wt%. Tetraethyl orthosilicate (TEOS) was employed as a crosslinking agent. The structural properties were evaluated using FTIR, showing the characteristic peaks of the crosslinking agent and the polymers. A SEM investigation revealed a compact and homogeneous structure of the hydrogels. The swelling behavior in DI water showed that the hydrogels consisting of chitosan presented a high %swelling. The release study of the CA-loaded hydrogels was investigated in PBS buffer pH 7.4 at 37 °C. The antioxidant properties of pure CA and CA-loaded hydrogel were also examined using DPPH assay. Our preliminary investigation could emphasize the benefit of using a bioactive a compound loaded hydrogel in pharmaceutical and cosmetic research.

Keywords: hydrogel, polyvinyl alcohol, chitosan, antioxidant





Synthesis of bioactive calcium phosphate composite organogel and its application for dental hypersensitivity treatment via dentine tubule occlusion

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Dentin hypersensitivity (DH) is one of the most regular dental symptoms caused by the erosion of enamel. Exposed dental tubules occlusion is the most effective and long-term way to relieve the pain induced by dental sensitivity. One of the potential material to occlude dental tubules and induce apatite deposition is calcium phosphate composite organogel, which can be synthesized by emulsion method. In this work, the water-in-oil emulsion was formulated using eucalyptus oil and sodium dodecyl sulfate (SDS) as a surfactant to form emulsion nanodroplets which served as a defined nanoreactor for calcium phosphate nanoparticles growth. Poly(ethylene glycol)-poly(propylene glycol)-poly(ethylene glycol), pluronic F127, and pluronic P123 were also introduced to the system as a template for the growth of nanoparticle and the gel formation. The structures and sizes for calcium phosphate nanoparticles was studied by varying the ratio of SDS and polymer, and its effectiveness on dentine tubule occlusion is also investigated. The results showed that the calcium phosphate nanoparticles was formed in spherical-shape and could partially occlude the dentine tubules after 1 day of application.

Keywords: Calcium phosphate, organogels, emulsion, dentine tubule occlusion





Isolation and structure elucidation of bioactive compounds from the fungus *Menisporopsis theobromae* BCC 4162

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Menisporopsis theobromae BCC 4162 is a seed fungus producing two major bioactive compounds, menisporopsins A and B. However, the genomic data of this fungus revealed that there are a large number of cryptic natural product biosynthetic gene clusters. In order to obtain novel bioactive compounds from this fungus, a new culture medium consisting of D-mannitol, KNO₃, KH₂PO₄ and various minerals was used for metabolite production. The fungus was grown in this new medium at 28 °C with shaking at 220 rpm for 14 days. Subsequently, the mycelia were isolated from the production medium. Both mycelia and medium were extracted with hexane and ethyl acetate, respectively. The crude extracts were further isolated using sephadex LH-20 column. Several fractions of compounds were obtained and will be further purified using high performance liquid chromatography (HPLC). The structures of isolated compounds will be elucidated by mass spectrometry and NMR spectroscopy techniques. Moreover, these compounds will be tested for their biological activities.

Keywords: *Menisporopsis theobromae* BCC 4162, menisporopsins A, menisporopsins B





The aggregation-induced emission enhancement (AIEE) of thiophene based chalcone materials: Synthesis, photophysical properties and DFT studies for selective sensing of nitro aromatic compounds

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Three Thiophene base chalcone Base derivative 1-3 with 2,4,5 methoxy(1),2,4,6 methoxy(2)and 3,4,5 methoxy (3) as terminal group. Thiophene (ThCh)-based chalcone bases that exhibit different aggregation-induced emission enhancement (AIEE) or aggregation-caused quenching (ACQ) behavior in ethanol (EtOH)/water mixtures have been synthesized and characterized. The photophysical properties in solution, aqueous suspension and film state along with their relationships were comparatively investigated. The DFT structures of 1-3 indicate that compact $\pi \cdots \pi$ stacking or excimers induce fluorescence quenching of 1 and 3. However, the existence of aggregates or multiple intra- and intermolecular interactions restrict the intramolecular vibration and rotation, enabling compounds 2 to exhibit good AIEE character. The size of particles with different water fractions were studied, which demonstrated that smaller uniformly dispersed nanoparticles in the EtOH/water mixtures favor fluorescence emission. The above results suggest that the combined effects of multiple forces caused by structural variation have a great influence on their molecular packing, electronic structure, and aggregation-induced fluorescence properties. In demonstration of the potential application of the thiophene based chalcone that are capable of unique detecting nitro aromatic compounds in water media is also reported.

Keywords: Aggregation-induced emission enhancement (AIEE), Chalcone derivatives, Nitro aromatic compounds, Density functional theory (DFT)





Applications of Cobalt Doped High Internal Phase Emulsions Polymers (polyHIPEs) as an Absorbent for Triethylamine and Formalin

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High Internal Phase Emulsions polymers (polyHIPEs) is a class of high porosity material. The anomalous small cavities found inside the structure make polyHIPEs suitable for gas absorption. This property depends mainly on the side-chain of polymers. However, there are evidences that introducing traces of metal into polyHIPEs can enhance affinity toward certain compounds. In this work, we try to investigate a capability of cobalt doped polyHIPEs in absorptions of triethylamine and formalin, undesired odor and prohibited preservative found fresh seafood. Analysis of surface structure and porosity indicate that the cobalt-polyHIPEs has higher porosity and smaller cavity sizes as compared to the polyHIPEs prepared without cobalt added. The cobalt-polyHIPEs showed the considerably high efficiency in triethylamine and formalin absorption.

Keywords: triethylamine, formalin, High Internal Phase Emulsions polymers, polyHIPEs, absorption.





Detection of dopamine by Ni/PDDA/rGO modified glassy carbon electrode

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This work studied the detection of dopamine (DA) by using a Ni/PDDA/rGO modified glassy carbon electrode. The cyclic voltammetry method was used to study both sensitivity and selectivity of the prepared catalyst. The experiments were carried out in 0.1 M phosphate buffer (pH = 7.0) with the concentration of DA from 0.1 to 20 μM . The oxidation peak of DA is at 0.20 V. The current increases as a function of DA concentrations. The linear range is obtained between 3 to 20 μM of DA concentration. The linear regression is $y = 0.11138x - 0.04981$. The limit of detection (LOD) is 0.6251 μM . The prepared electrode was used to analyse DA in real samples. The effects of accumulation time and scan rate were also studied.

Keywords: dopamine, nickel, reduced graphene oxide





Search for NS3pro dengue virus inhibitors from Thai traditional medicine using computational techniques

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Dengue fever is a kind of infectious disease caused by dengue virus (DENV). Dengue antiviral drugs are not currently available and the treatment is based on the patient's symptoms. In 2005, Thai petty patent with the title of "Thai drug for dengue fever" has been reported with the list of 16 Thai herbs. In this study, the chemical structures of plant extracts are searched from the literature. 134 chemical structures are constructed and optimized. Then, virtual screening technique based on molecular docking is applied in order to search for the potent compound against NS3pro DENV which is an important enzyme in DENV. The best docked compound obeyed the drug-like property is selected and performed molecular dynamics simulations (MD) in order to investigate in the details of the binding. From the MD results, the selected compound reveals the H-bond interactions to amino acids (i.e. VAL36, HIS51, VAL52, PRO132 and SER135) in the binding pocket. The obtained results will be helpful for the guideline to use Thai herbs as dengue inhibitors.

Keywords: Dengue virus, molecular docking, NS3pro, molecular dynamics simulations





Electrochemical detection of ascorbic acid by modified electrode

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Ascorbic acid (AA) also known as vitamin C, is found widely in several vegetables, fruits and also in a biological system. Ascorbic acid plays a critical role in human's body, namely, it optimizes body's immune function and also expedite wound healing. To determine the amount of ascorbic acid (AA), various techniques were presented in the literatures. Electrochemistry is one of the techniques that can easily and quantitatively analyze ascorbic acid in samples. In this research presentation, we modify the working electrode with copper compound, Copper-phthalocyanine (CuPc), and screen-printed on the flexible materials. Scanning electron microscopy (SEM), Energy-dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) were used to characterize the modified electrode. This modification proves to yield better sensitivity of ascorbic acid (AA) detection. We reason that copper complexes facilitate oxidative reaction of ascorbic acid, resulting in a signal enhancement from both cyclic voltammetry and amperometry measurement. We expect that this developed technique could provide benefits for the food and drug industry in the foreseeable future.

Keyword: ascorbic acid, screen printed electrode, Copper-phthalocyanine (CuPc)





Synthesis of MOF-Hybrid Materials for Methane Adsorption

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Biogas is widely used as substitute for coal and crude oil. Methane is main component of biogas. In order to use biogas as vehicle fuel, the biogas has to be purified and compressed in the form of compressed biomethane gas (CBG). However, the storage efficiency of CBG is still a problem that needs to be improved. Highly porous materials have been employed as an adsorbent to increase methane storage capability, so that methane can be compressed into a storage tank using lower pressure. The properties of the materials which can effectively absorb methane are high porosity, i.e. high surface area and pore volume, and having pores with the size suitable for methane adsorption. In this work, high porosity MIL-101(Cr) were synthesized. Method for purification were studied. Moreover, the pore size of MIL-101(Cr) were adjust by adding activated carbon into MIL-101(Cr). The samples were characterized with various techniques including X-ray diffraction (XRD), Scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), and thermo-gravimetric analysis (TGA), surface area analysis (SA). The results have suggested that methane adsorption capability of AC@MIL-101(Cr) was higher than MIL-101 due to the proper pore size of AC@MIL101(Cr).

Keyword: Methane adsorption, Metal-organic Framework, porous





Solvent Extraction Study of Antioxidants from *Zanthoxylum limonella*

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Zanthoxylum limonella, Ma-Kwaen, is aromatic deciduous trees and shrubs in Rutaceae family. Various parts of *Z. limonella* are used as the traditional medicine for the treatment of dental caries, febrifugal, sudorific, rheumatism, diuretic, stomach ache and diarrhea. The plant contained a variety of active secondary metabolites such as alkaloids, amides, lignins, coumarins and terpenoids and exhibited a wide variety of biological activities, for example, mosquito repellent, antimicrobial, antioxidant and antitumour activities. In this work, effects of solvent extraction are focused on searching for antioxidants because they are necessary *in vivo* by helping resist radical mechanism in body. Therefore, this study aimed at assessing the potential of antioxidant activity of *Z. limonella* extracts with various solvents. Five parts of *Z. limonella* including fruit, flower, stick, stem and seed were extracted with hexane, dichloromethane, ethyl acetate and ethanol, respectively. All crude extracts were examined their radical scavenging activities using spectrophotometric DPPH assay. The results are in progress.

Keyword: *Zanthoxylum limonella*, Antioxidants, scavenging activity, DPPH assay





A One-pot Synthesis of Benzo[*b*]naphtho[2,3-*f*]oxepine-6,11-dione

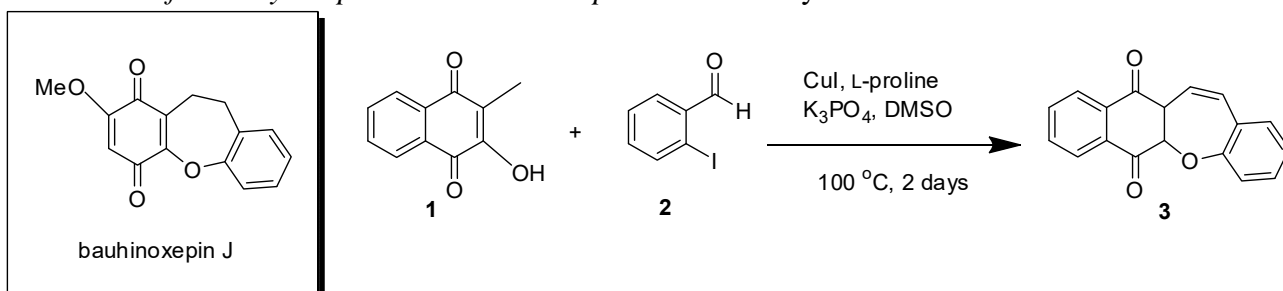
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Bauhinoxepin J is a natural product isolated from *Bauhinia purpurea L.* found in Thailand. This compound possesses anti-cancer and anti-malaria activities. Our objective is to synthesize benzo[*b*]naphtho[2,3-*f*]oxepine-6,11-dione (**3**) whose structure is similar to that of bauhinoxepin J. The desired product was synthesized from 2-hydroxy-3-methylnaphthalene-1,4-dione (**1**) and 2-iodobenzaldehyde (**2**) by Ullmann reaction followed by Knoevenagel condensation reaction. This reaction employed CuI as a catalyst, L-proline as a ligand, K₃PO₄ as a base and DMSO as a solvent and was carried out at 100°C for 2 days to provide the desired product in 90% yield.



Keyword: Bauhinoxepin J, Ullmann reaction, Knoevenagel condensation reaction, Benzo[*b*]naphtho[2,3-*f*]oxepine-6,11-dione





Biological activities from persimmon leaves extract

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Persimmon leaves extracts have been reported that abundant of natural sources and contained high level of flavonoids, which have many biological properties such as anti-wrinkle, antioxidant, anti-elastase and anti-tyrosinase. In this work persimmon leaves from three kinds of cultivars, Fuyu (F), Shizu (C) and Hong Mei (H) have been extracted with 95% ethanol. The crude extracts were formed the inclusion complexes with β -cyclodextrin (bCD) and 2-hydroxypropyl- β -cyclodextrin (HP-bCD). The amounts of active compounds in the inclusion complexes were determined by using UV-Vis spectrometry, Total phenolic contents have been investigated by using the Folin Ciocalteu method, The anti-oxidant, anti-tyrosinase, anti-elastase and anti-collagenase of the crude extracts and inclusion complexes have been studied. The results potentially show that ethanol extract from Persimmon leaves can be used as natural materials in cosmetic applications.

Keywords: Persimmon leaves, β -cyclodextrin, Anti-wrinkle, cosmetics





Encapsulation of retinoids in porous silicon

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Encapsulation of unstable and low aqueous solubility substances has attracted a great deal of attention over the past several years. Retinoids, derivatives of vitamin A, lipid soluble molecules, have gained great interest in pharmaceutical and cosmetic industry due to their beneficial properties such as powerful antioxidant, bone developer, maintaining healthy clear skin, facilitating cell differentiation and supporting immune function. However, vitamin A is unstable and easily degrades in sunlight; therefore, encapsulation is the interested way to store vitamin A for long term periods. In this work, Porous silicon nanoparticles (pSi-NPs) were utilized as an encapsulator for 3 types of retinoids (retinal, retinol and retinoic acid). The pSi-NPs, a biocompatible and biodegradable material, were synthesized by electrochemical etching. Their pore sizes of about 10 nanometers were determined by Brunauer–Emmett–Teller (BET) technique. The quantity of retinoids loaded into the pSi-NPs, by using organic solvents (ethanol and methanol), was measured by UV-VIS spectroscopy. The quantity of retinoids released in phosphate buffer saline (PBS) of different pH was investigated by a microplate reader. The results show that the retinoids have different loading and releasing efficiency in different solvents.

Keywords: porous silicon, electrochemical etching, vitamin A, retinoid, retinol, retinal, encapsulation.





Production of ethyl ester biodiesel using calcium oxide as catalyst for transesterification

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Biodiesel is derived from vegetable oil or animal fat by transesterification with methanol or ethanol using acid or base as catalyst. In this study, the biodiesel production of used frying oil using calcium oxide as solid base catalyst was investigated. The calcium oxide catalyst was characterized by X-ray diffraction (XRD) and scanning electron microscopy (SEM). The strength of catalyst was examined on the transesterification reaction of used frying oil and ethanol. The variable effecting on transesterification such as ethanol to oil molar ratio, amount of catalyst and reaction time on biodiesel conversion that determined by proton nuclear magnetic resonance ($^1\text{H-NMR}$) were investigated. The results showed the optimum condition on biodiesel conversion were 10% wt. of catalyst amount, 14:1 of ethanol to oil molar ratio, 75 °C of reaction temperature and 6 h of reaction time. In addition, the important fuel properties of biodiesel were further investigated followed the ASTM Standard and the results were in accordance with the standard.

Keywords : Calcium oxide, Use frying oil, Biodiesel Transesterification.





Development of sponge rubber formula by varying content of CaCO_3 filler and potassium oleate to apply in human model for practice procedure.

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This research studied the development of sponge rubber formula by varying the concentration of CaCO_3 filler and potassium oleate to apply in human model by using Dunlop processing to produce the latex foam. The contents of CaCO_3 used were 0, 10, 20, 30 and 40 phr. It was found that the optimum content of CaCO_3 used was at 30 phr. The collapse of the bubble, density, indentation force and compression set of CaCO_3 filled natural rubber latex foam (NRLF) increased with increasing amount of CaCO_3 . Moreover, it was observed that the content of K-oleate affected the properties of the natural rubber latex foam (NRLF). At a particular 20 phr of CaCO_3 , the increase in the amount of K-oleate from 1 phr to 2, 3 and 4 phr has influenced on the physical properties of NRLF as a result of giving more bubbles, leading to the decrease in density, indentation force and compression set with increasing amount of K-oleate.

Keywords: natural rubber latex foam, CaCO_3 , potassium oleate





Study of ethyl ester biodiesel production and study of biodiesel separation with glycerol by adding crude and purified glycerol

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The transesterification of the triglycerides present in the oil can be also conducted with ethanol to give fatty acid ethyl ester (FAEE) that is also considered as biodiesel. It is also of interest that ethanol can be obtained from renewable sources, but we found the problem about layer separation of glycerol from biodiesel layer. Therefore, this research studies of ethyl ester biodiesel production and biodiesel separation with glycerol by adding crude and purified glycerol. The biodiesel preparation involved transesterification reaction and followed with purification. The variable effects of the mass ratio of NaOH to oil (0.25, 0.50, 0.75, 1.00, 1.25% wt/wt), the molar ratio of ethanol to oil (4:1, 6:1, 8:1, 10:1, 12:1), the reaction time (15, 30, 45, 60, 90, 120, 150 min) and the reaction temperature (40, 50, 60, 70, 80 °C) were studied for the conversion of waste cooking oil for optimize conditions. The optimum conditions that made 100% FAEE conversion determined by ^1H NMR were an ethanol:oil molar ratio of 8:1, NaOH amount 0.75% wt/wt, 45 min reaction time and temperature of reaction at 40°C. Biodiesel were analyzed according to ASTM standards and the results were within standards limit. In addition, we add different volumes of glycerol (2.44, 4.76, 6.98, 9.09, 11.11% v/v) to find the optimum condition for layer separation and make it easy to purify. The results showed that the optimum condition for layer separation were adding 2.44% v/v purified glycerol. It took 14.38 min for layer separation that shorter than 4 h of adding crude glycerol.

Keywords: biodiesel, glycerol, ethanol, sodium hydroxide





Preparation of promoted manganese dioxide as a catalytic electrode for micro direct methanol fuel cells

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This research focused on the synthesis of Cu-promoted MnO_2 catalysts used in micro direct methanol fuel cells. Two methods of preparation were impregnation and hydrothermal. For impregnation process, MnO_2 was impregnated by $\text{Cu}(\text{NO}_3)_2$, then baked at $80\text{ }^\circ\text{C}$ for 12 h, then calcined at $300\text{ }^\circ\text{C}$ for 2 h. And for hydrothermal process, $\text{MnCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$ were mixed and urea, ethylene glycol, ethanol, and oleylamine were added into the mixture, transferred to the stainless steel teflon liner autoclave, and then baked at $200\text{ }^\circ\text{C}$ for 24 h, before filtered and calcined at $500\text{ }^\circ\text{C}$ for 20 min. The selected mole ratios of Mn : Cu were 1 : 0.1, 0.15, 0.2 and 0.25. The prepared catalysts were characterized by XRD and XAS, including XANES and EXAFS. The electrochemical testing was also performed to investigate the oxidation-reduction reaction.





Design of an optical modulator using germanium on silicon chips

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Controlling optical properties by using an optical modulator can be adopted in various applications such as transmitting signal through fiber optics, screen display and metrology. There are several types of optical modulators depending on the modulation mechanism. An optical modulator using germanium on silicon chip can be achieved by employing the electro-absorption effect to control light intensities by using external electric fields. An efficient optical modulator would give a significant difference in light intensity with a slight change in electric fields. The Extinction Ratio (ER), which is the ratio of light transmission between two values of electric fields, should be high. In contrast, the Insertion Loss (IL), which represents the loss of optical intensity, should be low. In this paper, optical simulation by Eigenmode method is used to simulate and analyze optical modulator models to obtain a low-loss waveguide-integrated optical modulator. From optical simulation, we have identified the most suitable condition to couple light from a silicon waveguide, that supports a single mode propagation with realistic etching depth and waveguide width, to a germanium modulator. Furthermore, well-selected dimensions of a coupling structure between the silicon waveguide and the germanium modulator are reported. Finally, the performance of the waveguide-integrated modulator is evaluated at a particular working wavelength.

Keywords: optical modulator, Eigenmode method, Extinction Ratio (ER), Insertion Loss (IL)





Experimental and Computational study of Cordycepin-encapsulated liposome

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Cordycepin can be found in *Cordyceps militaris* and exhibits several pharmaceutical activities such as anticancer (e.g. colon cancer), antibacterial, antiviral and immune regulation. Unfortunately, cordycepin is less stable and resulting in low therapeutic efficiency. To solve this limitation, the nanocarriers were used to improve drug properties and selectively deliver drug to specific targets. Liposomes are one of the most well-advanced drug nanocarriers and various types of liposome have been approved and used in market. The nanoscale size of liposomes plays an important role in the tumor cell selectivity. This study aims to improve the stability and subsequently anticancer activity of cordycepin by using liposome encapsulation. Both theoretical and experimental techniques were used to investigate the loading mechanism of cordycepin in liposome and its anticancer activity. Firstly, the atomistic molecular dynamics (MD) simulation was performed to explore the interaction of cordycepin and lipid bilayer. The lipid bilayer represented a part of liposome. To simulate the large-scale model of cordycepin-loaded liposome, the coarse-grained MD was used. Our simulations suggested that cordycepin could be loaded into liposome. The results of atomistic MD and coarse-grained MD showed that cordycepin was preferably interacted with lipid molecules and stably located at lipids' head group. Secondly, the anticancer activity test of cordycepin-loaded liposome was determined by cell viability of human colon cancer cells lines (HT29). The result showed that cordycepin-loaded liposome selectively killed cancer cells. The percentage of cell viability of cordycepin-loaded liposome was lower than free cordycepin and free liposome. This study indicated that the cordycepin-loaded liposome had the potential to be used as anticancer agents with high efficiency and low toxicity.

Keywords: Cordycepin, Cordycepin-encapsulated liposome, molecular dynamics (MD) simulation, human colon cancer cell line (HT29)





Rotation Mechanism of Chiral Nematic Droplets Induced by Heat Flux

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This research is an extension from the research published in 2016 by Ignés-Mullol et al on the topic of Continuous rotation of achiral nematic liquid crystal droplets driven by heat flux. Their research observed rotation in droplets of achiral molecules hence we adapted the method to be used in chiral liquid crystal. The behavior of droplets of chiral molecules under heat flux was the question we are interested in. In our experiment, small amount of S-MHPOBC chiral liquid crystals was doped into 5CB-CTAB mixture with DI water added. In the mixture, we found both radial and bipolar configurations of the droplets. Rotation of droplets was observed under polarized microscope in the temperature gradient of 20°C. Only bipolar configuration rotated under heat flux, non was observed in radial droplets. Here we report rotation characteristic of chiral bipolar droplets studied under heat flux.





Determination of Birefringence dispersion in nematic liquid crystal electro-optic cell

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We present an experimental approach for the determination of birefringence dispersion in nematic liquid crystal (LC) electro-optic cell. The method is based on the spectral measurement of light transmitted through the optical system composing of a polarizer, a quarter wave plate, LC cell, an analyzer and an Ocean-Optics HR4000CG-UV-NIR spectrometer. 5CB liquid crystal cell was used as a sample in our experiment at room temperature of 25°C, which is the temperature of 5CB nematic phase. Jones matrix calculation was employed to analyze the spectrum recorded. The method allowed determination of the rubbing angle, the twist angle and its sense, and the spectral dispersion of the LC cell retardation, simultaneously, with few measurements and without the need of applying voltage or any specific analytical conditions.

Keyword: birefringence dispersion, nematic liquid crystal (LC), spectrometer, 5CB





Measurement of the growth of microalgae by optical method

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Microalgae are currently interesting in industry because it can generate many useful products, such as supplementary food, cosmetic and biomass energy. During the cultivation, the growth of microalgae is followed by cell counting with a microscope and a calculation of the cell density –the traditional method. To obtain a precise value of the cell density, the measurement should be performed by ones with good laboratory skills and it takes a long time. We develop a photometer to determine the cell density of microalgae. The photometer consists of a light dependent resistor (LDR) as the sensor, a light emitting diode (LED) as the light source, and a microcontroller which controls all components as well as the cell density calculation using a calibration equation. To test the performance of our device, we cultivate microalgae with different aerations and measure the cell density during 18-day cultivation period by using the photometer and the cell counting with a microscope. The results show that the cell density values obtained from both measurement methods increase with day of cultivation in a similar manner. Thus, the photometer is a good alternative device to follow the growth of microalgae since it is relatively inexpensive, quick and *easy* for the *operator* to use.

Keywords: microalgae, cell density, photometer





Study of Environmental Radioactivity of Water Around Nuclear Research Reactor TRR-1/1

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This research study about the amount of specific radioactivity of Potassium-40, Caesium-137, Thorium-232 and Uranium-238 by gamma spectrometry analysis system with high-purity germanium (HPGe) detector, around Nuclear Research Reactor TRR-1/1 within 10-km radius consist of Kasetsart University Laboratory School, Bangbua canal after the Yakult, Wat Thawa Sunthon canal, Wat Don Muang canal and canal in front of the Office of atoms for peace for five samples of surface water since June to October 2017. We found, from our analysis, that the amount of specific radioactivity is around 7.98 Bq/l, 1.21 Bq/l, 0.20 Bq/l and 0.43 Bq/l for Potassium-40, Caesium-137, Thorium-232 and Uranium-238, respectively.

Keywords: High-purity Germanium (HPGe) detector, specific radioactivity, gamma spectrometry, surface water





Uncertainty Analysis of the Distance Measurement by Parallax Laser Range Finder

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We examine the error of distance measurements by a parallax laser range finder. As a part of the eucalyptus wood product evaluation project, we have developed a laser range finder to measure the tree height. The distance from the user to the tree and the elevation angle to the top of the tree are used to calculate the height. To make it simple we base our range finder on the parallax method. A laser beam is pointed on a tree and the image of the laser point on the tree is captured. The distance of an object is inversely proportional to the distance from the laser point to the center of the image. As a normal procedure, we perform linearization to the data sets, both by inverse and logarithmic function, to obtain a fitted calibration curve. The fitting goes well and we get the curve with R-squared very closed to one. However, the accuracy of actual measurements are poor, especially at large distances. We perform uncertainty analyses and realize that this due to the linearization that enhance the uncertainty of the fitted parameters. We then experiment with various non-linear fitting and find that the high degree polynomial fitting is a good choice. In our case, the fifth-degree polynomial gives less than one percent error on the actual measurements.

Keywords: Uncertainty analysis, Laser range finder, Parallax method, Curve fitting.





Effect of partially replaced sugar cane fly ash into ordinary portland cement: structural and physical investigation

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This article presents a study on the influence of fly ash and Na_2SiO_3 blended Portland Cement (PC) in cementitious composites like mortar with replacing 60% by weight of PC. The dependence of physical proportion of Na_2SiO_3 contents on PC in the presence of FA were investigated. Na_2SiO_3 were incorporated at a concentration of 0, 2, 4, 6, 8, 10 and 30wt% as partial replacement by weight of FA. The experimental results revealed that in the presence of FA and Na_2SiO_3 the cementitious composites significantly increased the average mechanical proportion. A cement substitution by 30wt% Na_2SiO_3 results in a mechanical proportion of 23.23 MPa. In addition, the heat curing at room temperature, 40°C and 60°C are reported. The markedly increased by 7.22 MPa for curing at 25°C was obtained. This positive effect is attributed to the formation of calcium silicate hydrate (C-S-H). Through this work, the microstructural proportion of partial replacement Na_2SiO_3 by weight of FA bended PC lead to noticeable improvement of the hardened cementitious composites like mortars.

Keywords: Cement replacement, Fly Ash, Na_2SiO_3 , Cementitious composited, Geopolymers





Diffusion of Magnetic Field Lines by Using Random Ballistic Decorrelation

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An event of solar energetic particles (SEPs) can cause damages on human utility systems, i.e., satellite failures, long-distant communication error and pipeline corrosion. These particles originate or are accelerated at the solar corona and move along the turbulent magnetic field toward the earth. Previous studies have shown that these particles greatly depend on the magnetic structures between the sun and the earth therefore studying the turbulent magnetic structures have been giving us better understanding of SEPs. In this work, we focus on one property of the turbulent magnetic field that is the diffusion of magnetic field lines. We use the model consists of a uniform magnetic field with 2D+slab magnetic fields to generate the turbulent field. The 2D+slab field is perpendicular to the uniform field and has its power spectrum consistent with the data from observation. We solve for the analytic expression of the diffusion coefficient of field-line separation by using random ballistic decorrelation (RBD) instead of the previously used diffusion decorrelation (DD). The result from this new assumption is compared with the result from the previous study and it leads to the better understanding on turbulent magnetic field and also the transportation of SEPs.

Keyword: energetic particle, turbulence, diffusion, magnetic field lines





Eucalyptus Tree Growth Modeling by Image Analysis

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We develop an image analysis system to measure dimensions of eucalyptus wood disks. The eucalyptus trees are marked at several height. Thin wood disks are then cut at the marking points. The cross-sectional images are taken by a digital camera. We write a Mathematica code to analyze these images. Each wood disk is placed on a plain A4 paper, which is used as a reference area. Several morphological parameters, such as, length and width of the fitted rectangular box, effective radius, circularity, effective lengths of major and minor axes, and number of pixels on the images, are measured. As a part of the eucalyptus wood product evaluation project, we cooperate these data with the growth model analysis team. Our results agree well with the prediction of the allometric model. We expect to use our results, together with the allometric model, in the regression analysis to identify the correlation between the clones and dimensions of eucalyptus trees.

Keywords: Image processing, Eucalyptus trees, Product evaluation.





A FRET-based biosensor for BRCA1 detection

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This research aims to develop FRET-based biosensor that could detect BRCA1 gene based on the principle of Forster Resonance Energy Transfer (FRET) with a catalyzed hairpin assembly (CHA). This process uses The BRCA1 gene as catalyst for CHA. When the CHA system is in place, both types of fluorescent are close enough to transfer the energy. The experiment was started by determining the range of sample concentrations from 0-1000 nM to study the linearity of sensor. Next, optimize concentration of sodium chloride that affects the CHA during 100-1500 mM. The result was found to be the response of the FRET signal in the linear range at 800 mM. Then, the calibration curve was determined at the final concentration of 800 mM sodium chloride and finally tested for specificity of sensor. Conclusively, the sensor is specific for the BRCA1 gene.

Keywords: BRCA1 , catalytic hairpin assembly (CHA) , Forster Resonance Energy Transfer (FRET)





Flywheel foe energy storage

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Flywheel energy storage is a renewable electrical power using an inert force of flywheel for produce electricity. The purpose of the project is to study flywheel energy storage system. The motor is operated by an external energy source to rotate the flywheel. Flywheel would store a rotational energy and then, rotate the generator to produce electricity. Electrical energy from generator would be returned to the motor to continue to rotate flywheel. The remaining energy would be transferred to the electrical devices. In addition, two scenarios, i.e. load and no-load resistor scenarios, are used to test the flywheel energy storage system. In load resistor scenario, a Light-Emitting Diode (LED) is used as load to check whether the remaining energy from flywheel energy storage system is sufficient for an electrical device (LED). As for no-load resistor scenario, the generating current and voltage and the rotational speed of the flywheel are measured and then, graph showing the relationship between current, voltage, power and rotational speed of the flywheel is plotted. The result of electrical power from the rotation of the flywheel is sufficient per LED size 3 volts but not enough energy to start the motor.

Keyword: Flywheel, electrical power, electrical energy, energy storage





To measure the resistance of composite Ne and Fe

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We investigate properties of conductivity which depend on surface roughness and grain size, of $\text{Ni}_x\text{Fe}_{1-x}$ substrate. We use Kubo formula theory to analyze the effect of surface roughness and grain size for surface structure of $\text{Ni}_x\text{Fe}_{1-x}$ substrate and compare with measurements. Then we can expand the effect of surface roughness and grain size on the conductivity for each composite of $\text{Ni}_x\text{Fe}_{1-x}$ substrate.

Keywords: $\text{Ni}_x\text{Fe}_{1-x}$ substrate, Kubo formula theory, Surface roughness, Grain size





Photodegradation performance of Dye on TiO₂ decorated activated Fly Ash blended cement

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The development of photocatalytic cementitious materials have been attracted much attention. In present study, a TiO₂ photocatalyst is coated on the surface of a Fly ash (TiO₂@FA) to improve its dispersability and blending with commercial cement (CC) was prepared for photocatalytic performances. Various cementitious specimens with different TiO₂@FA loading (0, 1, 5, 10, 20 and 30 wt%) exhibited well dispersed particles with the sizes of around 1-5 μm . The photocatalytic degradation activities on methylene blue (MB) solution under visible light were studied. The TiO₂@FA loading cement showed increased degradation of MB with increasing dosage of catalyst in the cementitious material. The high-efficiency photocatalytic activity under visible light on MB was obtained when the loading ratio was 30wt% of TiO₂@FA in cement. The degradation efficiency was around 99% in 3 h light irradiation. The superior photoactivities of these composites under visible light were mainly attributed to the separation of charge carriers. This results offer a promising way to provide an insight into the design and construction of catalyst for photocatalytic building materials.

Keywords: Photocatalytic cement, Fly Ash, Titanium dioxide, Smart multifunctional cement-based composite





Microwave Drying for Eucalyptus Wood Kernel

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We investigate the suitable heating procedure for microwave drying of eucalyptus wood. The drying process is very importance in the studying wood properties, e.g., density and hardness. A home-use microwave oven is used for a heating device. We assume that the device approximately radiates a constant rate of energy, in which for our case it gives the maximum output of 800 W. With an external timer device we can generate pulses of microwave radiation in the oven. We adjust the ON and OFF time durations to make the shortest drying time while make smallest crack on the wood. We found that, for our samples, 5 minutes ON and 10 minutes OFF sequence for total 2 hours heating makes the best result. This reduces the drying time a lot, comparing to the conventional hot air drying, which usually takes 24 hours or more to dry the wooden disks. In addition, pretreating the wood disks by put them into the water for a few minutes before drying makes it easier to remove the bark from the disks when they are dried. This should be very useful since we need to remove the bark before measuring the kernel properties, which in case of hot air drying is very hard to do.

Keywords: Wood drying, Microwave, Heating model





Synthesis and characterization of silver nanoparticles based on *Brassica oleracea capitta* Recucion

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Silver nanoparticle is one of the most popular metal nanostructures that can be applied in products such as anti-bacterial agents, water treatment, biomedicine, biological and chemical sensors due to its unique optical, electrical and catalytic characteristics. Silver nanoparticles have been widely synthesized by using chemical routes. Most chemical agents have hazard, toxics and high relative cost. To overcome these problems, green synthesis based on reducing agents from plants has attracted tremendous attention in recent years. In this paper, we report green synthesis of silver nanoparticles using *Brassica oleracea capitta* (cabbage), as reducing agent mixed with silver nitrate. Silver nanoparticles were characterized by ultraviolet-visible spectrophotometer (UV-vis) and transmission electron microscope (TEM). The primary results show that the formation of silver nanostructures can be confirmed with a changed color from none to brown color about 15 min. The surface plasmon resonance (SPR) peak occurs at 410 nm.

Keywords: Silver nanoparticles, Green synthesis, *Brassica oleracea capitta*





Fabrication of low cost electronic tongue for salinity measurement

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Most Thai people love to eat meals with strong flavors. Department of Health under the Ministry of Public Health reports that Thai people consume sodium/salt more than twice as much as they need. In general, a healthy adult shouldn't exceed 2,300 mg (5.5 grams of salt) daily. Too high salt consumption causes high blood pressure that is a risk factor for problems with the kidneys, the heart and the brain. Therefore, a portable small device with ease of use is necessary to evaluate amount of salt in foods before consumption for good healthy. In this study, electronic tongue and multivariate analysis methods were fabricated and used to examine the salinity quantity from electrical conductivity. The primary results indicate that sour and temperature strongly affect the electrical conductivity in estimation of the salinity quantity in foods. Electrical conductivity in foods increases with increasing of sour and temperature. To correct the electrical conductivity, the set of mathematical equations will be proposed. The electronic tongue based on conductivity sensors, pH sensor and temperature sensor with the set of mathematical equations will be presented to estimate salt quantity with high accuracy in foods.

Keywords: electronic tongue, electronic conductivity, salinity detection





Single Slit Diffraction Pattern Produced by Reflection from Thin Stripes

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We investigate the reflected rays from the sub-millimeter thin stripes. A collimated laser beam is incident on an edge of the thin stripe. Part of the beam is reflected back and projected on a CCD sensor. We find a diffraction pattern. When change stripes size, image size will change. We measure the intensity distribution of the images and find that it is similar to the diffraction pattern from a single slit.

Keywords: Single Slit, Diffraction pattern, Reflection





The Portable Access Counting System

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The Portable Access Counting System is used to count number of people entering or exiting the specific gate. The main controller of the system is built on the Arduino UNO R3. Two infrared sensors are used to detect whether the person is entering or exiting the gate. The main board can be programmed using C/C++ programming language. The system is also equipped with LCD screen that is used to show the result of system. The system can count number of person at the maximum speed of 30 persons per minute. The Portable Access Counting System comes in a compact size. It is easy to set up, energy saving as well as cost saving.

Keyword: Access Counting System, Entrance/Exit counter machine, Portable counting





Characteristics of mantle xenoliths enclosed in alkali basalt at Khao Lun Tom, Bo Phloi District, Kanchanaburi Province

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The peridotite xenoliths enclosed in alkali basalt were collected from Khao Lun Tom, Bo Phloi District, Kanchanaburi Province. Mineralogy, texture, and mineral chemistry of these samples were characterized under polarized microscope and EPMA (Electron probe micro-analyzer). The petrographic results show that the samples are equigranular texture and mainly consist of an assemblage olivine + orthopyroxene + clinopyroxene + spinel, however, plagioclase presents in some xenolith samples. Based on modal percentage of minerals, xenolith samples were classified to be spinel lherzolite and harzburgite. Note that some samples contain both spinel and plagioclase which might indicate that such xenoliths originated at the transition zone between stability fields of spinel and plagioclase at the depth of approximately 50 km then were brought to surface as xenoliths in alkali basalt. The mineral chemistry of olivine grains show that the Fosterite contents are in the very narrow range with Fo_{89.31-90.88}. Spinel grains have a Cr# in the range of 0.13-0.14. Orthopyroxene with En_{87.79-89.36}-Wo_{1.03-2.46}-Fs_{8.62-10.41} and clinopyroxene with En_{45.63-48.55}-Wo_{46.91-49.64}-Fs_{4.35-5.10}. Temperature and pressure were estimated based on the Ca partitioning between olivine and clinopyroxene which are about 1113.54-1232.46 °C and 25.57 kbar on the other hands two-pyroxene method yields approximately 1035.83-1050.91 °C. Both methods indicate the condition of crust-upper mantle boundary which is consistent with the result from petrographic observation.

Keywords: Mantle xenoliths, Alkali basalt, Bo Phloi





Petrology of Petrified Wood in Petrified Forest, Tak Province, Thailand

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The fossilized woods in petrified forest, Tak Province, Thailand. The petrified wood of pits 1, 3, 4, 6 and 7 are classified as *Koompassioxylon malaccensis*, while the pits 2 and 5 are closely to *Afzelia xylocarpa*. The fossilized wood is preserved in fluvial sediment unit in Ban Tak - Sam Ngao basin of Pleistocene age. The fossilized woods are distributed on both side of the Ping and Wang Rivers. Seventeen samples were examination. Petrified woods samples are composed of a large amount of fine grain to medium grain of quartz and chalcedony more than 80% with small amount of hematite, kaolinite, pyrite and iron oxide. Silica solution consists of quartz, chalcedony and opal-A that are precipitated in vessel, pore and ray fiber. Based on the geology and mineral assemblage, it suggests that the petrified wood was permineralization by weathering minerals from base rock and burial of subsurface water.

Keywords: Fossilized wood, Silica, Weathering minerals, Subsurface water





Petrographic Study and Geochemistry of Corundum-Bearing Marble of Skallevikshalsen, Lützow-Holm Complex, East Antarctica

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Two huge marble layers in the Skallevikshalsen area occur parallel to other high temperature metamorphic rock units i.e. metagranodiorite, garnet-bearing charnockite, chondalite, gneisses and quartzite. In some parts of the area, a narrow band, approximately 5-10 cm., of marble cut through the nearby gneisses with a sharp contact. This field relationship is very rare and could be interpreted as a result of high plasticity property of calcite compare to silicates. Therefore it could intrude along the fractures of gneiss during a deformation event. Both marble layers are approximately 500 meters wide. However, the length is not possible to be estimated since the rest part is covered by ice. Marble usually encloses a number of mica-rich pockets that contain corundum and spinel. Here we describe the petrographic characteristics of the marble. In general, it is very coarse-grained, white color and contains silicate phases homogeneously. Based on the observation under polarizing microscope and carbonate staining using Alizarin Red S (ARS) solution, the marble in Skallevikshalsen is composed of an assemblage calcite + dolomite + diopside + clinohumite + phlogopite \pm spinel \pm paptite. Opaque minerals are also scattered throughout the marble. Some samples show the phase transformation texture of phlogopite to be corundum. According to the literatures and petrographic observation, it could be concluded that the marble in study area has been metamorphosed under high temperature (>900 °C) which is a granulite facies. Corundum in this area is most likely formed by the phase transformation reaction from phlogopite as same as the West Ongul Island.

Keywords: Marble, Corundum, Skallevikshalsen, Antarctica





Integrated Electromagnetic and Resistivity Measurement for Effective Infiltration Management

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Water supply management for agriculture use at drought region is needed by new challenge approach of groundwater bank technique with initiate surface water infiltrate into shallow sand/gravel layer during rainy season. The study area is located at about central part of Thung Kula Rong Hai area, Suwan Phum district, Roi Et province, covering the area of 4.5 km. x 3 km. (2 village; Ban Nong I Khem and Ban Tang Mong). Electromagnetic and 2D resistivity are applied to identify aspect of aquifer layer and locate appropriate zone (with high potential shallow groundwater) for groundwater bank construction. An electromagnetic survey was conducted as regional scale area with N-S and E-W direction of survey lines (with 500-2,000 meters long) applying frequencies (5,000, 10,000 and 15,000 kHz). Then, 6 2D resistivity survey lines and location were made according to electromagnetic result (high resistivity zone) using Schlumberger array technique (with a spacing of 10 meters). 2D resistivity analysis was based on two purposes; first, shallow groundwater (with a spacing <40 meters depth) for groundwater bank design, and deep aquifer potential (fracture in bedrock and depth up to >100 meters). The electromagnetic result displays high resistivity (which can be interpreted as fresh groundwater zone) and low resistivity (which can be interpreted as salty groundwater zone). The resistivity result; shallow groundwater (about 10 meters depth) and bedrock at 60-100 meters depth were considered that area was suitable for marking a groundwater bank. The result of both electromagnetic and 2D resistivity method can help to select suitable location of design effectively covering the research are groundwater bank.

Keyword: Groundwater bank, 2D resistivity, Electromagnetic





The Influences of Indian Ocean Dipole (IOD) on Rainfall of Thailand

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The study of the influences of Indian Ocean Dipole (IOD) on rainfall of Thailand is presented to express the relationship between IOD and monthly rainfall by comparing Dipole Mode Index (DMI) with monthly rainfall data sets spanning the period 1987-2016 of 11 Southern meteorological stations and each 5 station Northern Region, Northeastern Region, Central Region and Eastern Region were examined using percentile of rainfall. The DMI value is between -0.3 to 0.3, it indicate that events are normal IOD, and if DMI value is >0.3 , it indicate that events are positive IOD and all rainfall is less than normal year, whereas if DMI is <0.3 , it indicate that events are negative IOD and all rainfall is more than normal year. The result show DMI during 1987-2016 obtained from National Oceanic and Atmospheric Administration (NOAA) shows 62% of normal IOD, 33% of positive IOD and 5% of negative IOD, which is rainfall in Thailand is normal and lower than normal. The reliability of relationship between DMI and rainfall 38-44% in Southern Region, 38-42% in Eastern Region, 38-43% in Central Region, 41-45% in Northeastern Region and 39-45% in Northern region of Thailand. In conclusion, the relationship between IOD and rainfall annual in Thailand show distinctly consistent relationship in positive IOD but the relationship between negative IOD and rainfall is absent.

Keywords: Indian Ocean Dipole, Rainfall, Dipole Mode Index





Modified Ground Electromagnetic and Magnetic Instrument for Marine Measurement to Locate Buried Electric Cable Offshore.

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Water pipeline undersea project performed under of Provincial Waterworks Authority (PWA) has been constructed, that from coast of Khanom District to samui island since 16 March 2015. Water pipe line is almost install completely undersea except at crossing zone between pipe line location and the main electric cable, which need more detail investigation to locate buried electric cable under sea floor precisely by marine geophysical equipment. The study area is located offshore between Don Sak District, Surat Thani province away from main land coast 8 km and away from Samui island 12 km (and sea depth 20 m). The ground electromagnetic and magnetic instruments i.e. multi frequency electromagnetic (EMP 400 profiler) and two magnetic were consisted Mag 1 (G-856 magnetometer), Mag 2 (WCZ-2 Proton Magnetometer) were modified as marine function. EM is installed on fiberglass boat (non-metallic). Mag 1 was set on same boat for automatic measurement. Mag 2 is designed for undersea measurement by sealed sensor and control until was use to take read data on main boat. Survey planning for testing instrument efficiently and offshore work, marine measurement were taken in two area, i.e. site A for instrument testing at known cable location and site B at the crossing zone where 3 main electric cable line for measurement at three existing cable location. In data processing background is removed by convert regional data to residual data. The result of EM is both site has high back ground data ≈ 3600 mS/cm affect from seawater and changeable level of boat. Conductivity has vary data around ± 50 mS/cm and anomaly value due to cable around $+150$ mS/cm. Mag 1 values background is stable vary data around ± 20 nT and anomaly value due to cable around $+300-500$ nT. Mag 2 data is vary data around ± 2000 nT and value due to cable around $\pm 10000-15000$ nT, Therefore EM data unclearly identified cable location while Magnetic can identified cable location clearly.

Keyword: marine geophysics, underseafloor cable, electromagnetic, magnetic





Cause of Flash Flood in Kasetsart University Bangkok Branch

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Cause of Flash Flood in Kasetsart University Bangkok Branch lead to traffic jams in the university. To plan the flood management, it is necessary to know the causes of flash flood. Methodology of this project are using the 5-minute rainfall data for 4 years (2014 - 2017), data of drain diameters and drainage routes, land use information and drainage plan of Kasetsart University. The result of the study showed that the daily rainfall is moderate rain (>10 mm. – 35 mm.) to violent rain (> 90 mm.) that cause of drainage floods. The potential of drainage channel of Kasetsart University is depending on size of dimensions, which include 0.3, 0.5, 0.6, 0.8 and 1 meter. The discharge is 0.177, 0.491, 0.707, 1.256 and 1.963 m^3/min respectively. The highest of drainage potential is 90 m^3/min when it works with 8 inches propeller pumps and pumps at the female dormitory and 30 m^3/min propeller pumps and pumps behind the Kasetsart University Golden Jubilee Administration and Information Center. It can support the average rainfall intensity is about 41.45 mm/hr. and 12.75 mm/hr. respectively.

Keywords: Flash Flood, Rainfall, Intensity, Drainage Potential





Comparison of Storm Surge intensity caused by Tropical Storm Linda in 1997 and Tropical Depression 30W (Wilma) in 2013 in the Gulf of Thailand, Thailand.

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Prachuap Khiri Khan is a province in the upper southern Gulf of Thailand, which located in western part of the South China Sea in the Pacific Ocean. Therefore, the tropical cyclones often cause landfall in the area and damage to coastal area, along with strong winds, heavy rainfall, surge penetration, coastal flooding and storm surges. This study brings the samples of tropical cyclones, between Tropical Storm Linda in 1997 and Tropical Depression 30W (Wilma) in 2013, to compare storm surge intensity. This study employs 4 data namely pressure, wind speed, wave height and predicted tide. This study finds that Tropical Storm Linda had lower pressure and a higher wind speed than Tropical Depression 30W (Wilma), so Tropical Storm Linda should have a higher wave height. However, that depends on other factors that affect the wave height such as storm track, bathymetry and predicted tide. The wider relevance of this study extends to understanding the phenomenon of storm surge, which can then help us to prevent damage in future cyclones.

Keywords: Tropical Storm Linda, Tropical Depression 30W (Wilma), Storm surge, Wave heights





Geology of Huai Yuak, Sukhothai Province, Northern Thailand.

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Huai Yuak area is located in the southern part of the Sukhothai fold belt. The Sukhothai fold belt extend from the Lincang, Jinghong of southern China to Chiang Khong, Lampang, Tak and Sukhothai of northern Thailand.

Geology of the Huai Yuak area is composed of Permian shale, Permo -Triassic tuff and covered by Quaternary sediments. 37 drilling core samples were examined. It can be separated into 2 units. Unit 1 is siltstone intercalated with sandstone. It mainly covered the south of the area. Unit 2 is shale intercalated with metasandstone. The shale also shows folding lamination. Moreover, shear rocks were observed in this area. Quartz veins are hosted by unit 1 siltstone and unit 2 shale. Based on the characteristics of pyrite, it can be classified into 3 types such as cubic pyrite (P1), pyrite veinlets (P2) and disseminated pyrite (P3). Cubic pyrite (P1) is characterized by 0.5 to 2.0 mm. that is composed of chalcopyrite, galena and sphalerite. Pyrite veinlets (P2) is 0.2 to 0.5 mm. of grain size with quartz veinlets. Disseminated pyrite (P3) is 0.1 to 0.2 mm. of grain size that occurs with galena.

Keywords: Huai Yuak, Sukhothai Province, Geology





Shallow seismic reflection survey of the landslide area in Banhui-King, Moo.6, Mae-Moh district, Lampang province, Thailand.

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On October 16, 2017, the area of Ban Huai King, Mae Moh district, Lampang province, northern Thailand had an incident of land subsidence that cover distance over 50 meters with 2 m in depth and covering 20,000 square meters, resulting in a total of 8 houses damaged and affect 22 residents. The cause of the land subsidence is thought to be a misuse of the land and torrential rain in previous days.

This incident led to the this research work that uses a shallow seismic reflection survey (5 lines) to explore subsurface of the landslide area in Huai King , Mae Moh district, Lampang province, northern Thailand. The results of the survey shows at least 2 subsurface layers which reflect their soil characteristics of the study area, the depth of the subsoil. The first layer consists of the road construction fill nearby. The second layer is assumed to be the natural soil lying underneath the first layer. This observation can be used for future landslide hazard management in the affected area.

Keywords : Shallow seismic reflection, Landslide





Heat Treatment of Amethyst Samples Using Alcohol Burner

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The cause of purple color in amethyst depends on the defect of Fe^{3+} that replaced Si^{4+} in quartz (SiO_2) structure. The goal of this research is to investigate the effect of heat treatment by alcohol burner in amethyst. The advanced scientific instruments were used in this research consisting of Raman spectrophotometer, UV-Visible spectrophotometer, Fourier-transform infrared spectrophotometer and Energy Dispersive X-ray Fluorescence spectrophotometer. For the brief result, the amethyst samples changed their colors from light purple and medium purple to very light purple and almost colorless when heating by alcohol burner at high temperature about $450\text{ }^\circ\text{C}$ for 30-45 minutes. It could be suggested that the intensity of purple color in amethyst samples will be decreased by heat treatment using alcohol burner.

Keywords: Amethyst, Heat treatment





The Multichannel Analysis of Surface Waves survey at the landslide area in Ban Huai King, Mae Moh district, Lampang province, Northern Thailand.

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This study investigates the subsurface structure at the landslide area in Ban Huai King, Mae Moh district, Lampang province, Thailand using geophysical survey. The landslide occurred in the residential area and caused moderate damages to houses due to inappropriate landuse and heavy rain. This work uses the Multichannel Analysis of Surface Wave (MASW), a non-invasive method developed to estimate shear wave velocity profile from surface wave energy, to obtain the subsurface condition. According to the study, the geophysical results reflect an overview of S-velocity model to determine the subsurface structure in the landslide area. The results show that S-wave velocities (V_s) are lower in the artificial soil layers compared to those of the natural soil layers at the various depth. Moreover, the results can be applied for the area planning and development of infrastructures in the area.

Keywords: MASW, Landslide, S-wave velocity, Seismic survey, Surface wave





Mineral paragenesis sequence related to gold mineralization of Huai Kham On, Phrae Province, Northern Thailand

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The Huai Kham On gold deposit is located in the Sukhothai Fold Belt, Northern Thailand. Quartz veins at the Huai Kham On gold deposit are hosted by monomictic andesitic breccia, polymictic andesitic breccia, volcanic sedimentary rock and andesitic tuff of Permo-Triassic age. Quartz veins are characterized by veins, veinlets and stockworks. Quartz veins can be classified into five stages based on the cross-cutting relationship and mineral assemblages. Quartz veins of Stage I consist of large amount of quartz associated with pyrite, sphalerite and small amounts of adularia, calcite, chalcopyrite, galena and trace amounts of illite. Quartz veins of Stage II consist of large amount of quartz associated with small amounts of adularia, calcite, pyrite, sphalerite, chalcopyrite, galena and trace amounts of illite and hematite. Quartz veins and veinlets of Stage III consist of large amount of quartz with small amounts of calcite, pyrite and trace amounts of sphalerite, chalcopyrite and galena. Quartz veins and veinlets of Stage IV consist of large amount of quartz with small amounts of dolomite, laumontite and trace amounts of chlorite, chalcopyrite and galena. Dolomite-quartz veins and veinlets of Stage V consist of large amounts of dolomite, quartz with small amount of calcite. Au and Ag contents of stages I and II range from 23 to 75 ppm and 33 to 125 ppm, respectively. Base on Fluid inclusions and sulfur isotopic values, temperature of ore fluid around 300°C-350 °C. Oxygen isotopic values of quartz of stage I to III range from 12.9 to 13.3 ‰. The estimation of hydrothermal fluid of Huai Kham On are 6.0-6.4 ‰ and 7.6-8.0 ‰ at temperature 300°C and 350 °C, respectively. It suggests that the ore-forming fluid was magmatic fluid mixing with meteoric water or magmatic fluid mixing with sea water.

Keywords: Gold, Huai Kham On gold deposit, Mineral paragenesis





The ground penetrating radar survey at landslide area in Ban Huai King, Mae Moh District, Lampang Province, Thailand.

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Landslide is a natural disaster that can causes damages to lives and properties. Especially in the northern Thailand where the terrain is flat alternating with the high slope which can induce the landslides to occur very often. This study was carried out using ground penetrating radar (GPR) survey to investigate the subsurface structure of landslides area at Ban Huai King, Mae Moh District, Lampang Province, Thailand. The survey area consisting of 20 gridded lines, using the 100 MHz and 400 MHz GPR antennas. The GPR profiles show that the soil layers slope down from northwest to southeast and part of the ground collapsed which affect the land use in the area. In addition, we found that the high frequencies antenna (400 MHz) provide higher resolution of subsurface images with penetration depth about 3 meters, but the low frequencies antenna (100 MHz), although has lower resolution and noisier data, provides better penetration depth down to about 10 meter. The results of this survey can be used for sustainable land use management.

Keywords: Ground penetrating radar, Landslide, Lampang, Thailand





Dyeing Cotton with Malachite and Goethite

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In the ancient times, human used mineral for providing natural colors in many activities. The aim of this research is to study the optimal pH for dyeing cotton with malachite and goethite solution. This experiment was used hydrochloric acid (HCl) as solvent, and added sodium hydroxide (NaOH) for varying pH values (pH4, pH7, and pH12) of mineral solution. Malachite and goethite mineral specimen was clearly identified by Raman Spectroscopy. The potential of coloring attachment on cotton were observed by Scanning electron microscopy with Energy dispersive spectroscopy (SEM-EDS) and UV-Vis spectrophotometry. The results showed that SEM images with EDS data mentioned that the pH12 of malachite cotton and pH4 of goethite cotton had high copper and iron quantity. UV-Vis spectra showed the absorption of malachite cotton with pH12 around 480 - 700 nm producing the blue color, and the absorption of goethite cotton with pH4 around 450 - 550 nm relating to the brown color. UV-Vis results are concerned with color index value from Colorimeter. It could be concluded that pH12 of a malachite solution and pH4 of a goethite solution are optimal pH for dyeing cotton.

Keywords: dyeing cotton, goethite, malachite





Petrography and mineral chemistry of Cal-silicate at Akarui Point, Lützom-Holm Complex, East Antarctica

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The Akarui Point, Lützow-Holm Complex, East Antarctica, is underlain by dominant rocks including garnet-biotite, biotite-hornblende, and hornblende-biotite gneiss. Mineral foliation in rock layers show that strike positions NW-SE and dips toward either NE or NW. Fold structures are both anticline and syncline in the western part of the area. Calc-silicate rock from the Akarui Point occurs as a lens in hornblende-biotite gneiss with the width of 20-50 cm and the length of 20 m. Within the calcsilicate body itself could be recognized as three zones including (I) amphibole-rich calcsilicate zone, (II) garnet-rich calcsilicate zone, and (III) diopside-garnet calcsilicate zone. Though the main mineral varies zone by zone but the main mineral assemblage is amphibole + clinopyroxene + garnet + plagioclase ± epidote ± mica ± chlorite ± quartz ± K-feldspar ± wollastonite ± calcite. While sphene, apatite and zircon occur as accessory mineral. Apatite in this calcsilicate lens has distinctive bluish green color and very transparent. All samples show granoblastic texture (polygonal texture) and their grain size range from 0.25 – 2.5 mm. Some sample that collected from the center of this calcsilicate lens preserved a crucial texture that a relict grain clino-pyroxene is partially replaced by calcicamphiboles. Based on previous literatures, the Akarui Point was denoted to be metagranodiorite which has experienced the last metamorphic condition of amphibolites. This interpretation is consistent with the mineral assemblage of calcsilicate. Moreover, such replacement texture indicates that the protolith of calcsilicate lens was retrograde metamorphosed simultaneously with granodiorite. This protolith could occurred as mafic dike cut through the granodiorite. However, the presence of trace amount of calcite and sphene might suggest that this mafic dike was mafic carbonatite.

Keywords: Calc-silicate, Garnet, Akarui Point, Antarctica





Petrology and geochemistry of volcanic rock in Huai Kham On, Phrae province, Northern Thailand

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Huai Kham On area is located in the Sukhothai fold belt that extend from SW China to NW Laos through northern Thailand. The distribution of volcanic rocks of Sukhothai fold belt areas such as Doi Ton and Doi Luang were called Lampang-Phrae volcanic belt where Huai Kham On area is located. There consist of volcanic rock, limestone of Kang Pla Formation and clastic rocks of Wang Chin Formation. Geology of Huai Kham On area consist of 4 units such as unit 1 andesitic tuff is characterized by andesite clast, K-feldspar, plagioclase and pyroxene with groundmass of fine-grained plagioclase, pyroxene, pyrite, magnetite, ilmenite and hematite. Unit 2 volcanic sedimentary rock is characterized by pebble to silt size, rounded shape, poor sorted to well sorted and consist of andesite clast, fragment of K-feldspar, plagioclase, quartz, pyrite and hematite. Unit 3 polymitic andesitic breccia consist of andesite clast and volcanic sedimentary clast with groundmass of fine-grained plagioclase, pyrite, magnetite and hematite. Unit 4 andesite is characterized by flow texture and porphyritic texture of K-feldspar, plagioclase and pyroxene with groundmass of fine-grained plagioclase, pyrite, magnetite, illmenite and hematite. Quartz-carbonate-sulfide vein are hosted by units 1, 2, 3 and 4. Geochemical composition of unit 1 andesitic tuff is composed of SiO₂ range from 45.32-54.27% with Al₂O₃ (16.01-21.33%) and Na₂O (3.25-5.41%). Unit 3 polymitic andesitic breccia is composed of SiO₂ range from 46.77-64.26% with Al₂O₃ (12.92-20.7%). Unit 4 andesite flow is composed of SiO₂ range from 43.02-43.31% with CaO (8.92-9.98%), MgO (15.32-15.83%) and K₂O (0.1-0.29%). Geochemical data suggest that units 1, 3 and 4 are alkali basalt. Units 1 and 3 are characterized by enrichment in LREE and depletion in HREE, suggest that there were formed in subduction zone. Therefore the volcanic rock in Huai Kham On area was formed in continental arc in middle-Triassic.

Keywords: Huai Khan On, Petrology, Geochemistry, Sukhothai fold belt





Environmental Risk Assessment of Heavy Metals by Pollution Indicators in Agriculture Soil, near Khonkean Municipal Landfill, Khonkean Province, Thailand

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Khonkean province has high economic growing, such as increasing of industrial plants, and high population density. Thus, industrial, and municipal waste have been increasing. In Khonkean province, the municipal and industrial waste have been collected to dumping site, Khonkean municipal landfill. This landfill site was poor waste management, such as improper disposal of waste. Thus, the poor waste management in study area causes environmental contamination, especially soil environment around landfill site. For example, soil in the crop around Khonkean municipal landfill may contaminated by heavy metal. The aims of this study were; (I) to analyze the heavy metal concentration; (II) to assess the pollution status of heavy metal (As, Cd, Cr, Fe, Mn, Ni, Pb and Zn) in 37 agriculture soil samples, by using pollution indicators (geo-accumulation index (I_{geo}), enrichment factor (EF), contamination factor (CF) and pollution load index (PLI)). For the methodology, soil samples from this area were air-dried and digested by nitric acid (HNO_3), hydrochloric acid (HCl) and hydrogen peroxide (H_2O_2), as a following by USEPA 3050B method. Sample solutions were analyzed by Inductive Coupled Plasma Optical Emission Spectrometer (ICP-OES). The results of this study could be concluded as follow; First, the result of geo-accumulation index (I_{geo}) shew that the soil quality was indicated to unpolluted (Class 0). Second, the extremely severe enrichment of enrichment factor (EF) was in As and Cd. Third, the contamination factor (CF) also indicated in low contamination level for Cr, Fe, Mn, Ni, Pb and Zn, while the values of As and Cd suggested to moderate contamination level. Fourth, the pollution load index (PLI) indicated that all samples have no metal pollution. Finally, because of high value of EF, source of heavy metal in study area was generated from human activities.

Keywords: Geo-accumulation index, Enrichment factor, Contamination factor, Pollution load index





Contouring map of As, Cr, Fe and Mn distribution in agricultural top soil, near Khonkaen municipal landfill, Khonkaen province, Thailand

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Heavy metals are contaminated in the soil environment from many sources, such as landfill. In Khonkaen province, there are many landfill site, as Khonkaen municipal landfill, Cheaoyean municipal landfill, and etc. For the Khonkaen municipal landfill received the waste, industrial, and municipal waste from Khonkaen district. Thus, the landfill can be generated huge volume of leachate and the uncollected leachate may contaminate to a crop around landfill. Thus, leachate discharge to an agricultural area, such as cassava crop, around landfill. The cassava absorbs the toxic substances, as heavy metals in leachate. If the people had been consumed the cassava product from this crop, it may be affected to human health. The purposes of this study was: (I) to study the concentration of heavy metals in soil and compare with the standard of Pollution Control Department: (II) to create the map of heavy metals distribution in soil. For the methodology, soil samples were collected in the dry season (December, 2016). The samples were air dried and digested with HNO₃, H₂O₂ and HCl. 4 heavy metals, including arsenic, iron, manganese, and chromium were analyzed by the Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). Comparing with a national standard, the results show that all samples were lower than the standard of the Pollution Control Department, except arsenic in samples number 23. For a heavy metals distribution pattern, the contouring map of heavy metals concentration shown that; First, iron and chromium were high accumulated in a south of a field. Second, arsenic dispersed from north-east to the south-west. Finally, manganese had not a distribution pattern in present study because it had the same concentration around the study area.

Keywords: Heavy metals, Agricultural soil, Contouring map, Thailand





Application of GIS to locate shallow groundwater at the margin of Chao Phraya basin.

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GIS has been applied for management of shallow groundwater by determine Potential Shallow Groundwater (PSG) zone. The investigation area is located at between 2 districts (Hankha and Wat Sing), Chai Nat province, margin of Chao Phraya basin where high demand for water in agriculture use during dry season. Shallow groundwater was chosen for support demand. GIS technique is to analyst spatial data for making PSG. Interpretation and weighting data to produce GIS database consist of soil group, water resource, land use, slop gradient and topography. With GIS spatial analysis, all data have been inputted in Arc GIS 10.3 program that calculate weighting data to produce PSG map. The result shows high, moderate, low and very low potential of shallow groundwater zone. High potential zone of shallow groundwater presents at center of investigation area due to sandy soil, low slope gradient and many water resources. PSG map can be support shallow groundwater information which may help to increase water supply in dry season.

Keyword: GIS, Shallow Groundwater, The margin of Chao Phra Eya basin





Petrography and mineral chemistry of ruby-bearing calc-silicate at West Ongul Island, Lützow-Holm Complex, East Antarctica

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Ruby-bearing calc-silicate rocks at the West Ongul Island in Lützow-Holm Complex of East Antarctica occur as lens within charnockitic rocks. Previous works point out that the area has been metamorphosed under amphibolite to granulite facies. Calc-silicate lens is approximately 1 m. wide and 100 m. long. Corundum formed as a narrow band at the middle of this calc-silicate lens with various thicknesses ranging from few mm. up to 20 cm. The grain size of corundum also varies from less than 1 mm. in the southern part up to approximately 5 cm. in the northern side. This calc-silicate body shows quite symmetric variation of lithology that could be defined as 3 zones. The outermost rims of calc-silicate lens are characterized by very coarse-grained, elongate wollastonite crystals which align perpendicular to the contact of charnockite. This outermost zone will be named as wollastonite zone herein. The second zone is marked by garnet-rich band that is relatively finer-grained compared to the former one. The last zone is corundum-bearing zone which mentioned earlier situates at the middle of the calc-silicate lens. Based on petrographic observation using polarizing microscope, the corundum-bearing zone is made up of an assemblage clinopyroxene + biotite + phlogopite + corundum + calcite \pm amphibole. Phase transformation of phlogopite to be corundum is obviously preserved in this zone. The outermost zone is characterized by an assemblage clinopyroxene + wollastonite + biotite + phlogopite + scapolite. The presences of wollastonite along both edges indicate metasomatism between charnockite and calc-silicate body during the peak metamorphism. Meanwhile the phase transformation reaction of phlogopite to be corundum at the middle part of the lens possibly took place at the same event.

Keywords: Calc-silicate, Ruby, West Ongul Island, Antarctica





Modeling of cadmium, nickel, lead, and zinc distribution in agricultural top soil, near Khonkaen municipal landfill, Khonkaen province, Thailand.

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Landfill can cause the effect on environment, especially soil environment. In developing country, solid waste management system is not effective. Thus, landfill may affect to surrounding area. One of the most important problem issue is leachate distribution from landfill. The leachate contains many toxicants, as heavy metals. Heavy metal contamination in plant, water, and especially in the soil will be affected by landfill. Hence, the level of heavy metals contamination should be monitored. This study was aimed; (I) to measure the level of heavy metals, as cadmium, nickel, lead and zinc in soil near Khonkaen municipal landfill, Khonkaen province; (II) to identify the distribution pattern of heavy metals in soil by Surfer11. The 37 soil samples were collected from agricultural top soil, near Khonkaen municipal landfill in December 2017. After that, the samples were dried in room temperature for 7 days and digested with nitric acid, hydrochloric acid, and hydrogenperoxide. Then, the solution samples were analyzed the concentration of 4 heavy metals by ICP-OES (Inductively Couple Plasma Optical Emission Spectrometer). Finally, concentration of 4 heavy metals were used to create the modeling of heavy metal distribution by Surfer11. According to results of this study, it found that leachate was not the primary source of 4 heavy metals , because the concentration of heavy metals in leachate was low concentration to undetected concentration, Thus, the heavy metals may accumulate from other sources,such as the natural of parent soil material, and runoff of rainwater during the wet season. For the suggestion, first, it should be considered to build the channel around the agricultural area because it can prevent the flow of leachate to cassava field. Second, heavy metals in the landfill should be regularly monitored. Finally, the landfill management system should be improved.

Keywords: Heavy metal, Soil pollution, Landfill, Contamination





Apply Multi Frequency Electromagnetic Technique for Shallow Groundwater Map at Nong Ya Sai – Dan Chang Area

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The margin of Chao Phra Ya basin is found as high terrace zone where as most of land use is agriculture: sugarcane, rice and cassava. Water supply use in agriculture in this zone is highly needed during dry season, which normally take water from irrigation and shallow groundwater in some particular area. Study area is located at Nong Ya Sai – Dan Chang area, Nong Ya Sai and Dan Chang Districts, Suphanburi Province, covering the area of about 50km x 50km. Shallow groundwater can normally be found within to old sand channel deposit zone with lineament in East – West. Multi Frequency Electromagnetic (Multi FEM) technique is applied to locate the boundary of high potential shallow groundwater by differentiate the different of conductivity in sand channel change and clay background. More than ten survey lines are design in North – South direction with length of 5 to 10 km and line spacing of 1 to 2 km. Apply frequency of 1, 5 and 10 kHz for this study area can be selected by calibrations all frequency (1 – 16 kHz) with repeats reading at same survey lines. Then applied frequency of 1, 5 and 10 kHz were used for all reading simultaneously to obtain vary different depth target. Background of conductivity reading is quite stable value with value about 60 mS/m (at 1 kHz), 50 mS/m (at 5 kHz), 40 mS/m (at 10 kHz). As a result of 5 kHz, old sand channel deposit zone with 50 m wide can be identified with low conductivity (20 mS/m), which different from general environment area filling with dominance clay layers. Multi FEM measurement is an effective shallow groundwater mapping which may be useful for local farmer

Keywords: shallow groundwater, FEM, Nong Ya Sai – Dan Chang





Hydrogeology of Muaeng Paeng hot spring, Pai district, Mae Hong Son province.

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The purpose of this research was to characterize hydrogeology of Muaeng Paeng hot spring, Pai district, Mae Hong Son Province, in terms of geology, hydrogeology and groundwater quality. The results reported that, geology of the study area consists of various rock of Ordovician to Quaternary in age. In the western part of the study area, limestone of Ordovician in age is found along the Pai River whereas in the central part, it is overlain by sandstone and shale of Silurian-Devonian-Carboniferous in age. In the eastern part, granite intrusion of Triassic in age is observed. The physical and chemical properties of Muaeng Paeng hot spring were found out that the temperature of hot spring was 92.5°C, the content of pH, electrical conductivity, total dissolved solids, sulfate and total hardness were 8.02, 501 $\mu\text{S}/\text{cm}$, 224 mg/l, 9 mg/l and 29.6 mg/l, respectively. Moreover, Piper diagram pointed out that the water type of hot spring was Na-HCO₃ (Carbonate alkaline facies) indicating soft water which can be used in consumer without treatment. The Muaeng Paeng hot spring has a potential to be a healthy-tourism place by using the hot energy in boiling eggs, bamboo shooting or bathing for health. However, the Muaeng Paeng hot spring water is inappropriate for drinking water due to the rotten egg gas smell of sulfur.

Keyword: Muaeng Paeng, Pai, Mae Hong Son, Hot spring, Physical, Chemical





2D Resistivity Imaging Survey of Landslide location at Ban Huai King, Mae Moh, Lampang Province, Thailand

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Ban Huai King, Mae Moh district, Lampang Province is characterized by low steep terrain. In the past, the soil was reclaimed as a residential area. At present, Ban Huai King has been damaged by landslide phenomenon. Due to heavy rain for long periods of time, the water penetrates the soil and accumulates a large amount. Soil on top cannot support water. Water flows through the joints of the soil layer. Slipping into low areas causes massive damage to the area. In this survey to study the shallow geological structure by 2D resistivity imaging survey by the way of Dipole-Dipole array and Wenner-Schlum array. All 8 surveys were collected. The resistance to readability is quite high. It may be due to the top layer of clay that cannot be attached to the ground clay. The research aims to study the structure of soil in the area and to provide information to prevent and respond to the occurrence of landslides to vulnerable communities.

Keywords: 2D resistivity imaging survey, Landslide, Dipole-Dipole array, Wenner-Schlum array





Accumulation of heavy metals in cassava near Khonkaen municipal landfill, Khonkaen province, Thailand

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Khonkaen municipal landfill is located in Khonkaen province, Thailand. Around the landfill, there are many agricultural activities, such as cassava crop. The leachate from landfill may be leak into the cassava field. Thus, toxic substances in leachate might be accumulated by farm plants, such as heavy metals. This research aimed; (I) to study the accumulation of heavy metals, including iron (Fe), manganese (Mn), zinc (Zn), nickel (Ni), cadmium (Cd), lead (Pb), arsenic (As) and chromium (Cr) by cassava plant; (II) to compare the concentration of heavy metals in cassava with WHO standard. For the methodology, the 15 cassava samples (roots, leaves and stems) were sampled in dry season (December, 2016). The cassava samples were air dried, pulverized and digested organic matter by Acid Digestion (USEPA method 3050B, 1996) and analyzed the concentration of heavy metals by Inductively Coupled Plasma - Optical Emission Spectroscopy (ICP-OES).

The results showed that the concentration of heavy metals, including As, Pb, Cr and Ni, exceeds the WHO standard in all parts of cassava, as roots, leaves and stems. All kinds of heavy metals was highly accumulated in leaves, except As in roots, Ni and Cr in all part. Comparison the concentration of heavy metals in cassava with elevation, the heavy metals tend to accumulate in lowest elevations, including Fe, Cd, Cr, As, and Zn. Heavy metal concentration in soils related to the concentration in plants. In conclusion, the landfill causes the effect to cassava. People who consume the cassava may be affected by heavy metals in cassava from food chain. Thus, the solid waste management system would be segregated hazardous waste and prevented the leaching of leachate to the environment.

Keywords: Heavy Metals, Accumulation, Cassava, WHO





Shallow Resistivity Analysis to Locate Appropriate Infiltration Construction

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Groundwater bank construction at Ban Non Samran, Sirindhorn District, Ubon Ratchathani Province, is to support sustainable groundwater management for agriculture and human activities. Pond construction function as surface water storage and infiltrated water into shallow sand/gravel layer presents as shallow groundwater. With groundwater bank concept, establish appropriate pond can be two functions as surface water storage and water infiltration into shallow sand/gravel layer where shallow groundwater storage. 2D resistivity imaging was applied to investigate subsurface feature for supporting high efficiency of pond construction. There are two stage of data acquisition in field work. First, large scale of 2D resistivity measurement with 10-meter electrode spacing and for >30-meter depth covering Ban Non Samran area with 6 survey lines. As a result of initial 2D resistivity measurement, there are 3 positions which selected and confirm more detail by 2D resistivity measurement with 2-meter electrode spacing. The result show low resistivity zone $< 10 \Omega \cdot m$. and deep > 10 m at the position of pond construction which may indicate shallow sediment and weathered rock layer. This may appropriate for pond. 2D Resistivity imaging method can be planed and designed groundwater bank infiltration construction efficiently.

Keyword: 2D Resistivity, Groundwater bank, Schlumberger





Hydrological Characteristics on Upper and Lower of PaSak Watershed

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The objective of the hydrological characteristics on the upper and lower of Pasak watershed to study the influence of the Pasak Jolasid Dam on water management. Gage high and discharge data of 6 water level stations were used during the period from 2007 to 2016. There are 3 stations (S.3, S.4B and S.33) at upper watershed (natural watershed area) and 3 stations (S.9, S.26 and S.5) in lower watershed (water management area). The result show that the Pasak watershed has annual rainfall in between 1,004.65 - 1,454.7 mm. In the upper Pasak watershed, average annual runoff between 191.3 to 538 million cubic meters (mcm). The runoff yield is 4.34 - 11.74 l/s/km². The ratio of runoff during rainy season to dry season is 87.07 : 12.93. The lower Pasak watershed has an average annual runoff between 2,464.6 - 9,847.9 mcm. The runoff yield is 5.34 - 16.67 l/s/km². The ratio of runoff during rainy season to dry season is 68.25 : 31.75. Pasak Jolasid Dam was built to help water management, the discharge in the rainy season would be reduced and discharge in dry season will increase.

Keywords: hydrological characteristics, Pa Sak watershed





Mineral paragenesis sequence related to gold mineralization of Huai Yuak, Sukhothai province, Northern Thailand

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Huai Yuak area is located in Sukhothai province southern part of Sukhothai Fold belt which is extended from Lincang, Jinghong, Chiang Khong, Lampang, Phrae and Sukhothai. The gold deposits are distributed from Phrae to Lampang (northern part) and Sukhothai (southern part) such as Long, Wang Chin (Phare Province), Sop Prap, Thoen (Lampang Province) and Sisatchanalai, Thung Saliam (Sukhothai province). Quartz veins in the Huai Yuak gold deposit are hosted by unit 1 siltstone and unit 2 shale. Quartz vein is characterized by veins and veinlets. Veins are trending NE and west dipping of 70-80 degree. Veins length are 25 to 150 m, and width around 1 to 3 m. Base on cross-cutting relationships and mineral assemblages, it can be divided into 3 stages. Quartz veins of stage I is composed of large amount of microcrystalline quartz with small amount of arsenopyrite, galena, calcite, pyrite and trace of hematite, chalcopyrite and electrum. Quartz veins of stage II consists of quartz. Quartz veins of stage III is comprised of large amount of dolomite with small amount of quartz and trace of arsenopyrite and illite. Electrum occurs in quartz veins of stage I that is related with arsenopyrite, galena, pyrite and chalcopyrite.

Keywords: Gold deposit, Huai Yuak, Quartz vein, Sukhothai fold belt





The Comparison Efficiency of Classification Methods for Precipitations in Bangkok

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The concerned factors of study affecting the precipitation in Bangkok by two classification methods were composed of discriminant analysis and logistic regression. The Apparent Error Rate (APER) for efficiency comparison was considered, The Apparent Error Rate method showed less error with correct and more precise data which proves it was more effective. The monthly average data from the Thai Meteorological Department for the past 11 years (2006-2016) was used in this study. The dependent variable was rainfall which divided into two groups, namely the occurrence of rain event and the absence of rain event. The independent variables were humidity, temperature, wind direction and wind speed. The result of this study indicated that the discriminant analysis of factors affecting the precipitation was humidity and Apparent Error Rate was 0.1212%. The logistic regression analysis of factors affecting the precipitation were humidity, wind direction, and wind speed and Apparent Error Rate was 0.1212%. Therefore, the logistic regression analysis was effectively similar to the discriminant analysis.

Keywords: Discriminant Analysis, Logistic Regression, Precipitations, Classification





A Comparison of Missing Data Estimation Methods in Multiple Regression Analysis

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The objectives of the research are to study and compare the four missing data estimation methods: Stochastic regression imputation (SRI), Regression-ratio quartile 1 imputation (RQ1), Multiple imputation (MI), and Weighted nearest neighbor regression imputation (WNR). The data comprise of Simulation data, in line with assumption, the real data with non-normal distribution of error, and the real data with multicollinearity. The dependent variables are missing in 3 rates: low (5%), medium (10%), and high (20%). The criteria of efficiency are AMAPE for simulation data and MAPE for the real data. The results are shown that WNR is the most suitable method for simulation data, except when missing rate is low. In case of non-normal distribution of error, MI is suitable method when sample size is small ($n \leq 100$) and medium ($101 \leq n \leq 150$); missing rate is low, RQ1 is suitable when sample size is medium and medium rate of missing. WNR is suitable in the same case when sample size is small and large ($n \geq 151$) in every missing rate. In case of multicollinearity, MI is suitable method while the RQ1 is suitable for small sample size, low and medium rate of missing.

Keywords: Stochastic regression imputation, Regression-ratio quartile 1 imputation, Multiple imputation, Weighted nearest neighbor regression imputation





A Comparison of test for Heteroscedasticity in Simple Linear Regression

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The objective of this research was to compare heteroscedasticity tests in simple linear regression which were Goldfeld-Quandt test, Brown-Forsythe test and Szroeter's Statistics test. They consider on estimated probability value of Type I Error and estimated power of test value when an error is at normal distribution. The sample sizes are 10, 20, 30, 60, 90 and 120 by setting these heteroscedasticity when an independent variable increases in two cases. There are decreased error variance and increased error variance. The determined significant level is on 0.05 and 0.01. This data were generated from Monte Carlo simulation and repeated in 1000 times. The results indicated that Goldfeld-Quandt test was controlled probability of Type I Error and had the most power of tests.

Keywords: heteroscedasticity, Brown-Forsythe test, Goldfeld-Quandt, Szroeter's Statistics test





Comparison of Gold Bar Price Forecasting with ARIMA model and GARCH model

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This study aimed to compare the best ARIMA and GARCH models for gold price prediction. It was based on the time series of daily gold bar trading prices from January 2, 2014 to December 30, 2016 covering 901 observations. Then using the best model made 50 days forward forecast from January 3, 2017 to March 2, 2017. The suitable forecasting method was chosen by considering the smallest value of Mean Square Error (MSE) and Mean Absolute Percentage Error (MAPE). The most appropriate ARIMA model was found to be ARIMA (0, 2, 1), while the best GARCH model was GARCH (3, 1) developed from ARIMA (0, 2, 1). Upon the MSE and MAPE values, it can be concluded that the model having the most accurate predicting power was GARCH, followed by ARIMA.

Keywords: gold price, forecasting, ARIMA, GARCH





A comparison of Two-phase Sampling and Inverse Sampling

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To estimate the population proportions in rare populations, two-phase sampling, inverse sampling, network sampling and snowball sampling were widely used. The objective of this research was to study and compare the efficiencies of two-phase sampling and inverse sampling. In inverse sampling, each sampling unit was taken by using simple random sampling without replacement until obtaining the pre-determined number of units of interest m . The sample size, n , was the number of all units sampled until the sample contains m units of interest.

In two-phase sampling, the sample selection was performed in two phases. For the first phase, a sample of units was selected for obtaining auxiliary information, then in phase two, a second sample was selected in which the study variable was observed.

In this research, the efficiency comparison of inverse sampling and two-phase sampling was performed by simulation study using R program. From the simulation study results, it was found that two-phase sampling was more efficient than inverse sampling under two generated rare populations.

Keywords: Probability sampling, Two-phase sampling, Inverse sampling





A Comparison of Factor Analysis by Orthogonal Rotation That Affects Prices of Jasmine Rice

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The purpose of this research is to solve the multicollinearity problem of multi regression by factor analysis via investigating method. The samples used in this research were the prices of Jasmine rice with other 44 variable factors. The data was collected monthly from 2011 to 2015. Test the relationship of independent variables and dependent variable. Cutting off the independent variables that have a relationship with the variable based on the least out to make the rest of the independent variables 37 variable

The results of the study indicated that the samples which were carried out can be divided into 7 elements. 3 axis rotations were implemented; Varimax, Quartimax, and Equamax rotation. It revealed that Quatimax rotation gave the lowest MAPE of 14.3869% which was the best among other axis-rotation methods.

Keywords: Multicollinearity, Factor Analysis, Orthogonal Rotation, Jasmine Rice





Performance Comparison of the Multivariate Cumulative Sum Control Charts

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Multivariate cumulative sum (MCUSUM) control chart is one type of multivariate control charts which is widely used to simultaneously monitor several quality characteristics for detecting the mean changes in manufacturing industries, especially for detecting small changes. In this research, we study the performance of two methods of MCUSUM, Crosier I and Crosier II, which are proposed by Crosier (1988). The reference values (k) 0.5, 1.0, and 1.5 are specified and the number of variables are 2, 3, and 5. Matlab Version R2017a is used to perform the simulations and to generate the random vectors. Each simulation is replicated 50,000 times to provide accurate results.

The average run length (ARL) and standard deviation of run length (SDRL) of MCUSUMs are calculated and compared. The numerical results indicate that Crosier II has the best performance for detecting small changes in mean.

Key Word: multivariate cumulative sum control chart, average run length, standard deviation of run length





A Study of the Number of Rounds of Kasetsart University's Welfare Bus Route (Bangkhen Campus) by using Queueing Theory

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This research aims to study round of providing appropriate services of Bangkhen Campus, Kasetsart University's welfare bus using M/M/s queueing system classified by bus line number and duration. We studied case of waiting and received customers are Poisson distribution at the significant level is 0.01. We used QM program for analyzing data. The results of round of providing appropriate services in 15 minutes were as follows. Round of bus 1st line in the afternoon should service at least one round or $s = 30$ seats. 2nd line in the morning should service at least one round and in the afternoon should service at least two rounds or $s = 60$ seats. 3rd line in the morning should service at least one round and at the evening should service at least two rounds. Finally, 4th line in the morning should service at least two rounds and in the afternoon should service at least two rounds.

Keywords: Poisson distribution, Exponential distribution, M/M/s queueing system, Kolmogorov-Smirnov test





Efficiency Comparison of the Standard Deviation Estimation Methods for a Normal Distribution

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The objective of this research was to compare the efficiency of five standard deviation estimation methods—sample standard deviation (SD), mean absolute deviation (MAD), adjusted range (AR), percentile tab-standard deviation (PSD) and adjusted standard deviation (ASD) methods—for a normal distribution. The simulation data in the form of normal distribution with mean (μ) equals 30 and the population standard deviation (σ) equals 1, 5, 10, 15 and 20 were generated by SAS programming. In addition, the sample size (n) in this study were determined at 10, 20, 30, 50, 70 and 100. The totals of 40 situations were studied. The experiment was repeated 2,000 times for each situation. The criteria for efficiency comparison were absolute bias (ABS) and mean square error (MSE). The conclusions of this research were as follows: based on considering the amount of ABS, the adjusted standard deviation (ASD) method was the most efficient estimator for all situations. However, if the amount of MSE was considered, it was found that the sample standard deviation (SD) method was the most efficient estimator for all situations.

Keywords: standard deviation, normal distribution, absolute bias, mean square error





Performance Comparison of Forecasting by Theil's Validation of Forecasts for Various Time Series Forms

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The objective of research aims to study and compare the appropriated forecasting methods into 3 aspects and each aspect consists 50 sets; 1) stationary time series data in each data set can be used forecasting methods such as Single Exponential Smoothing method, Moving Average, and Box-Jenkins method. 2) trend time series data in each data set can be used forecasting methods include Double Exponential Smoothing method, Double Moving Average, and Box-Jenkins method. 3) seasonal and trend time series data can be used forecasting methods such as Holt– Winter Smoothing method, Decomposition method, and Box-Jenkins method. For this research, the forecasting equation is created by Minitab program and used Solver tool in Microsoft Excel. The suitable forecasting methods were chosen by considering the measurement accuracy 3 values; 1) Theil's U statistic: U 2) Mean Square Error: MSE, and 3) Mean Absolute Percentage Error: MAPE.

The measurement accuracy was Theil's U statistic. The result were as follows: when consider stationary time series data show that Box-Jenkins method is the appropriated method. When consider trend time series show that Double Exponential Smoothing method with Optimization Technique is the appropriate method. Finally, when consider trend and seasonal time series show that Box-Jenkins method is the appropriated method.

Keywords : Exponential Smoothing, Box-Jenkins Method, Optimization, Theil's U statistic





Comparison of Power of Non-Parametric Tests for Two Dependent Populations

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The purpose of this research is studying the ability to control the type I error and comparing the power of Wilcoxon signed rank, Permutation, and Rank difference tests about the median difference for two dependent populations at the 0.05 level of significance. The data are generated from uniform and logistic distributions. The sample sizes (n) are as follows: the small sample sizes which are $n = 10$ and 20 , the medium sample sizes which are $n = 50$ and 60 , and the large sample sizes which are $n = 80$ and 100 . The Monte Carlo technique is used to simulate data with 1,000 repetitions.

The results of this research are as follows: when the data are uniform and logistic distributions, Wilcoxon signed rank Test controls the probability of type I error for all sample sizes. Permutation test controls the probability of type I error when the sample sizes are greater than and equal 60. Rank difference test controls the probability of type I error only when $n = 10$.

In terms of power, when the data is uniform distribution, Wilcoxon Signed Rank test is the most powerful at $n = 20, 50$ and 60 . Permutation test is the most powerful at $n = 60, 80$ and 100 . Rank Difference test is the most powerful at $n = 10$. When the data is logistic distribution, Wilcoxon Signed Rank test is the most powerful at $n = 20, 50, 60,$ and 80 . Rank difference test is the most powerful at $n = 10$. Permutation test is as powerful as Wilcoxon signed rank test at $n = 100$.

Keywords: Wilcoxon Signed Rank test, Permutation test, Rank Difference test, Power of the test, Type I error





A Comparison of Nonparametric Statistics for Multiple Comparisons

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The objective of this research is to compare the three of nonparametric statistics for testing the difference of mean population in three groups: Brunner and Munzel test, Bootstrap Rank Welch test and Fitted test. These methods are compared by considering the ability to control the probability of type I error at 0.05 and 0.01 level of significance and power of the test. Data were simulated by using program SAS 9.4 with the normal distribution, t-distribution and lognormal distribution with the equal sample sizes $(n_1, n_2, n_3) = (10, 10, 10), (30, 30, 30), (50, 50, 50)$ with 1,000 replications

The results show that the Bootstrap Rank Welch test has the highest power of the test and can control the probability of type I error for all sample sizes when data has the t-distribution and lognormal distribution. When data is normal distribution, the Fitted test has the highest power of the test for almost all the cases, but it can't control the probability of type I error for large sample sizes. Brunner and Munzel test can control the probability of type I error in almost all cases and the power of the test close to Bootstrap Rank Welch test.

Keywords: Multiple Comparisons, Brunner and Munzel test, Bootstrap Rank Welch test, Fitted test





Analysis of Factors Affecting the Success in Education of Kasetsart University, Bangkok campus by Using Logistic Regression Analysis

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The purposes of this research were to study factors affecting the success of graduate students in Kasetsart University, Bangkok campus and to perform a logistic regression model. 400 students from each faculty were randomized by stratified random sampling and randomly distributed a questionnaire by convenience sampling. Afterward, the data were analyzed by using frequency, percentage, factor analysis and logistic regression analysis.

The questionnaire of this research was divided into 2 parts. The first part which consisted of 11 factors were general information for graduate students and the second part which consisted of 17 factors were satisfaction associated with the educational success. The researcher classified the second part by factor analysis. The result showed that 17 factors is classified into 3 factor groups. Then, the logistic regression was performed logistic regression model. The significance factors by using logistic regression are 3 factors and 2 factor groups consisting of sex (X_1), age (X_2), grades obtained from high school (X_4) and behavior factors of students about the environment around campus (F_1), negative factors from the surrounding environment (F_2). The final logistic regression model was performed as follows:

$$\hat{P}(y = 1) = \frac{1}{1 + e^{-[-15.955 + 0.602(F_1) - 0.960(F_2) - 0.800(X_1) + 0.275(X_2) + 3.109(X_4)]}}$$

Summarized of 400 students from questionnaire, it was found that there were 192 graduate students who got a recently average grade more than or equal to 3.00 and there were 208 graduate students who got a recently average grade lower than 3.00. When the logistic regression model was used to predict the opportunity of 400 graduate students who got a recent average grade more than or equal to 3.00 was 163 accuracies of this model was 78.4 percent and the graduate student who get a recently average grade lower than 3.00 was 147 accuracies of this model was 76.6 percent. Then, the overall accuracy of the logistic regression was 77.5 percent.

Keywords: Logistic Regression Analysis, Factor Analysis, Analysis of Factors, Affecting the Success in Education





Time series Analysis and neural network to forecast export quantity and value of rubber

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The purpose of this study were to find the optimal model of quantity and the value forecasting of rubber. There were three methods for forecasting which were Holt and winter, Box-Jenkins and Neural Network. It used Sum Square Error (SSE), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) for comparative criterion. Information on export data, quantity and value of rubber since January 1998 to July 2017. The results indicated that Holt and winter method is appropriate method for rubber export quantity data and Neural network method is appropriate method for rubber export value data.

Keywords:Holt-Winter exponential smoothing, Box-jenkins, Neural network





Forecasting Models For BTS Passengers

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The objective of this research is to find the suitable forecasting model for BTS passengers. Three methods are considered which are the Double Moving Average, Double Exponential Smoothing and Box-Jenkins methods. The efficiencies of forecasting models are compared by the mean square error and mean absolute percentage error. The data is divided into two parts. The first part consists of forty eight months from January 2013 to December 2016 for determining the forecasting models. The second part consists of seven months from January 2017 to July 2017 in order model accuracy checking. The results show that the Box-Jenkins method is the appropriate method because of the lowest in mean square error and mean absolute percentage error. The suitable model is ARIMA(2,1,0) with no constant term.

Keywords: Double Moving Average, Double Exponential Smoothing, Box-Jenkins Method





Comparison of time series forecasting method for produce energy power of Thailand Electricity Generating Authority

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This research aim to study and compare the methods of time series forecasting for electricity productivity capacity of Thailand Electricity Generating Authority. 2 method are applied to this research, Exponential smoothing of Holt's and Winter method and Box and Jenkins methods for using in forecasting the electricity productivity capacity of Thailand Electricity Generating Authority. The study determine the best method for such a kind of data by considering from the lowest value of Mean Square Error and Mean Absolute Percentage Error. According to the 60 observations in the research from January 2012 to December 2016 , it shown that Holt's and Winter method is more appropriate than Box and Jenkins method for the data. This method uses multiplicative that has α (alpha) equal to 0.1, β (beta) equal to 0.1 and λ (grammar) equal to 0.4. It gives the lower results of Mean Square Error(MSE) and Mean Absolute Percentage Error(MAPE) which are 376555.8145 and 3.4032 respectively, than Box and Jenkins method gives Mean Square Error(MSE) and Mean Absolute Percentage Error(MAPE) which are 478100.7680 and 3.9245.

Key words: Box and Jenkins, Exponential smoothing, Holt's and winter, Forecasting





Efficiency Comparison of Population Ratio Estimators in Simple Random Sampling

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The objective of this research is to compare the efficiencies four population ratio estimators in simple random sampling. including a ratio of mean (r_1) given by Thompson et. al. (1992), a mean of ratio (r_2) given by Salas and Gregoire (2008), a simple ratio estimator based on \bar{x}^* (r_3) given by Onyeka et. al. (2013), and a ratio-type estimator based on both \bar{x} and \bar{x}^* (r_4) proposed by Onyeka et. al. (2004). Using simulated population of size 1000, two variables X and Y having three distributions such as bivariate normal distribution, bivariate Poisson lognormal distribution, and bivariate Cauchy distribution. Population correlation coefficient (ρ) between X and Y variables were $\pm 0.25, \pm 0.50$ and ± 0.75 . Sample of size $n = 10, 15, 30,$ and 100 were drawn by simple random sampling. Simulation were repeated 1000 times in each population and by using mean square error (MSE), efficiencies of the estimators were compared.

The results from study indicated that when population is distributed as bivariate normal, the ratio estimators r_1, r_2 and r_3 are more efficient than r_4 . For bivariate Poisson lognormal distribution resulting that estimators r_1 and r_2 are more efficient than r_3 and r_4 for bivariate Cauchy distribution, ratio estimators r_3 and r_4 are more efficient than r_1 and r_2 .

Keywords: Population ratio estimator, Mean square error, bivariate normal distribution, bivariate Poisson lognormal distribution, bivariate Cauchy distribution





A Comparison on Detecting Outlier Method in Simple Linear Regression

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The purpose of this research is to compare the ability to control the estimate of type I error and power of the test of three methods for detection outliers; Marasinghe (MM), Standardized residual and Internally Studentized Residual. The simple linear regression analysis is analyzed by data simulation with program SAS 9.4 with 1000 replications at significance level 0.05. The error distributions are normal distribution, Gamma distribution and Lognormal distribution.

Simple linear regression coefficient β_0 and β_1 are 1 and 3.5 respectively and sample size are 20, 50 and 100. The number of outlier in data are 1 and 2. The results show that Marasinghe (MM) and Standardized residual can control type I error for all three distributions of error. Internally Studentized Residual cannot control type I error in any cases and Marasinghe (MM) cannot control type I error when $k=5$.

For the power of the test all three methods provide the same result in three distributions of error. In case of the number of outlier is 1, power of the test in detection outliers by Marasinghe (MM) and Standardized residual are similar. When the number of outlier is 2, Marasinghe has the maximum power of the test.

Keywords: Power of the test, Simple Linear Regression, Outlier, Type I error, Marasinghe (MM), Standardized Residual, Internally Studentized Residual





Efficiency Comparisons of DEWMA, GWMA and DEWMA-TUKEY Control Charts for Normal Process

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The purpose of this research is to compare the efficiency of change detection of three control charts; Double Exponentially Weighted Moving Average (DEWMA), Generally Weighted Moving Average (GWMA) and Double Exponentially Weighted Moving Average-Tukey (DEWMA-TUKEY) at the variation of parameter levels. The criterion used to examine efficiency is an average run length (ARL_1). A simulation study is conducted by Monte Carlo technique with 5,000 repetitions. The factors consist of sample size (n) which are equal to 2, 4, 8, 10, 20, and 50, sizes of process mean shift (δ) which are set at 0.05, 0.25, 0.45, 0.75, 1.5, 3 and 5, weighted parameters which are $\lambda = 0.1, 0.2, 0.3, 0.4, 0.5$ and $\alpha = 0.55, 0.65, 0.75, 0.85$ and 0.95 and shape parameter (q) which are 0.55, 0.65, 0.75, 0.85 and 0.95. The result shows that, for all sample size, when process mean shift is equal to 0.05, the most efficiency control chart is DEWMA-TUKEY. In case of levels of process mean shift is greater than or equal to 0.25, the efficiency of three control charts seems not to be different at all situations.

Keywords: Average run length; DEWMA-TUKEY; GWMA; DEWMA; control chart





Efficiency Comparison for the Different Types of Exponentially Weighted Moving Average Control Charts

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The objective of this research was to compare the efficiency for process mean shift detection of three control charts—exponentially weighted moving average control chart (EWMA), exponentially weighted moving average sign control chart (EWMA Sign) and double exponentially weighted moving average control chart (DEWMA)—when data were normally distributed. For our study we focused on the following two studied factors. The first one was a sample size for each subgroup (n) which equals 3, 5, 7, 10 and 20. The second was the size of process mean shift ($\delta\sigma$) which equals 0.1σ , 0.3σ , 0.5σ , 0.7σ , 0.9σ , 1.5σ , 3σ , 5σ . In addition, a data simulation was conducted with 10,000 repetitions for each situation by SAS 9.4 programming to compare the efficiency in term of the out-of-control average run length (ARL_1) for each control chart. The results of this study were as follows: DEWMA control chart tended to have efficiency for mean shift detection of process was better than those of EWMA and EWMA Sign control charts for all situations. Furthermore, the efficiency of three control charts tended to have slightly difference for all sample size n . That is, when the amounts of mean shift were large, all three control charts tended to have no difference efficiency for mean shift detection of process. Therefore, all three control charts can be used for this situation.

Keyword: exponentially weighted moving average control chart, exponentially weighted moving average sign control chart, double exponentially weighted moving average control chart, normal distribution





An Accuracy Comparison of Some Statistical Procedures Based on Selected Statistical Platforms

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The objective of this research is to estimate the accuracy of statistical calculation by using R, Minitab, Google docs and MS Excel. The statistical procedures include arithmetic mean, standard deviation, F-test of the one-way analysis of variance (ANOVA), regression coefficient. All procedures of calculation are using StRD data from the National Institute of Standards and Technology (NIST). The calculated results are compared to the standard certified values provided by NIST based on the log relative error (LRE). The finding results show that the arithmetic mean procedure of R, Google docs, Minitab and MS Excel provide high accuracy of calculation. R and Minitab provide equally high accuracy of standard deviation calculation but also there are some errors of calculation base on some datasets. R, Minitab and MS Excel provide high accuracy of F statistic calculations in low difficulty level datasets, but they provide some errors with high difficulty level datasets. R, Google docs, Minitab and MS Excel provide high accuracy of regression coefficient calculations at low difficulty level datasets, but there are some errors when they are employed to high difficulty level datasets, excluded Google docs cannot produce the expected results. In addition, Minitab provided the highest reliability of regression coefficient calculations.

Keyword: R, Microsoft Excel, Minitab, Google Docs, Software accuracy





A Study of Regression Analysis Using Weka Program

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This objective of the research aims to study Regression Analysis with WEKA program, and also study several factors which caused flooding, by using regression analysis, Artificial Neural Networks, and support vector regression analysis. The data that is used for analysis is accumulated rainfall of Khlong Toei district, Benjasiri, and Khlong Toei station, the level of water in Chao Phaya river at Khlong Toei station, the level of water in the canal at Phra Khanong Station. All of them are independent variables for 16 variables. The dependent variable is duration of flood from 2011-2016, totally 6 years. The data collected each day, totally 74,528 records. The data is separated into two groups: 70% of data is used to create the predicting model, 30% of data is used to test such predicting model.

By using stepwise technique to select variables for Percentage Split 70% test, with regression analysis technique, the result was found that $R^2 = 0.0528$, correlation coefficient = 0.2208, and RMSE = 20.5152.

By using artificial neural networks, the result was found that correlation coefficient = 0.0888, and RMSE = 22.2699.

By using support vector regression analysis, the result was found that correlation coefficient = 0.024, and RMSE = 21.1351.

Keywords : regression analysis, artificial neural networks, support vector regression, WEKA program





Study on Influence of Fertilizer Affection of Arabica Coffee Yields

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The objective of this research is to study the effect of fertilizer on the yields of Arabica Coffee at Phetchabun Research Station, Phetchabun. The experimental design was split plot in Randomized Complete Block design with 4 replication 2 main plots and 4 sub plots. The main plots factor were pruning and non-pruning. The sub plots were non-fertilizer (NF) and fertilizer ratio 15-15-15 (10g/pt) applied in June, 8-24-24 in July and August (250g/pt) (CF12), fertilizer manure and compost (3kg/pt) and (5kg/pt), respectively in June (MF2), 8-24-24 about (250g/pt) applied on July and August (MCF2). The test shown that followed the assumption and results of study found pruning and fertilizer, there were no interaction, especially considering which pruning factor shown there no different in Arabica coffee yield that were pruning and non-pruning. Fertilizer method was considered, the results indicated fertilizer ratio 15-15-15 (10g/pt) applied in June, 8-24-24 in July and August (250g/pt) (CF12). This method can increase of highest the productivity of Arabica coffee yields about 5,331g/pt. In part of other fertilizer methods of Arabica coffee yield there are no different at $\alpha=0.05$

Keywords: Split plot design, Arabica Coffee, Analysis of Variance





Artificial Neural Network for Prediction the Amount of Rain in the Next Three Hours of a Day in Summer for Nakhon Ratchasima and Khon Kaen Provinces

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This study aimed to develop forecasting model for the amount of rain in the next three hours each day in summer season in Nakhon Ratchasima (NR) and Khon Kaen (KK) provinces. The data on meteorological features came from Department of Meteorology, including a three hour period of the amount of rain, wind speed, relative humidity, vapor pressure, visibility, clouds, sea level pressure, dew point temperature, wind direction, and average daily temperature. These data were retrieved for a period of March – June during 2014 – 2016 and provided a total of 2885 and 2882 observations for NR and KK, respectively. The method of Artificial Neural Network (ANN) was applied using feature selection and 10 fold cross-validation procedures in modeling.

The results showed that the appropriate ANN model for NR consisted of an input layer of 11 nodes, represent for 11 feature from stepwise feature selection, including rain amount at lagged time 3 and 21 hours; wind speed at lagged time 3, 12, and 15 hours; relative humidity at lagged time 12 and 18 hours; vapor pressure at lagged time 9 hours; visibility of the ground at lagged time 15 hours; and cloud at lagged time 9 hours, and 1 hidden layer of 6 nodes, yielding the RMSE forecast error of 2.53. For KK province, the appropriate ANN model consisted of an input layer of 5 nodes, for 5 features from forward feature selection, including the amount of rain at lagged time 3 and 6 hours; wind speed at lagged time 3 hour; visibility of the ground at lagged time 3 hours; and cloud at lagged time 9 hours, and 2 hidden layers with 3 nodes for the first hidden layer and 2 nodes for the second hidden layer, yielding the RMSE forecast error of 2.65.

Keyword: Artificial Neural Network, The amount of rain, Root mean Squared Error





A Comparative Optimal Model for Temperature Forecasting of Southwest Region in Thailand using ARIMA and ARIMAX Model

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The objective of this research was to study a comparison between ARIMA model and the application of ARIMAX model for temperature forecasting in Ranong and Phuket stations. The mean monthly temperature, relative humidity and rainfall were used in this research. These data were obtained from Thai Meteorological Department for the past 11 years from January 2006 to December 2016. Relative Root Mean Square Error (RRMSE) criterion was considered for comparison effectiveness. The optimal ARIMAX model result of the Ranong station was ARIMAX (1,0,0) (0,1,0)₁₂ and Relative Root Mean square error (RRMSE) value was 0.874. Factors affecting the temperature change was relative humidity and rainfall. The optimal ARIMA model result of the Phuket station was ARIMA (3,0,2) (0,1,0)₁₂ and Relative Root Mean Square Error (RRMSE) value was 1.113.

Keywords: Forecasting, ARIMA model, ARIMAX model, Temperature





Ethanol Production from Cellulosic Material by Thermotolerant Yeast *Kluyveromyces marxianus* DMKU 3-1042 Using Simultaneous Saccharification and Fermentation Process

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Cellulose is found in nature as a long chain polymer of glucose. It is used as a component of the diaper. Disposable diapers are usually discarded once used. Nowadays, the demand of diapers has continuously increased and generates more waste to affect the environment. In this study, the potential of cellulose from the used diapers as a raw material for ethanol production was studied through the simultaneous saccharification and fermentation (SSF) process using thermotolerant yeast *Kluyveromyces marxianus* DMKU 3-1042. The conversion of cellulose to glucose was performed using the cellulase enzyme complex (ACCELLERASE[®] 1500). First different amount of ACCELLERASE[®] 1500 was varied ranging from 0.1 - 0.5 mL/g cellulose with fixed cellulose content of 100 g/L and the amount of glucose released was measured. The optimal enzyme used for cellulosic hydrolysis was found to be 0.25 mL/g cellulose, which release glucose of 46.36 g/L at 72 h. Next, the SSF process using 100 g/L cellulose with optimal cellulase was performed until 72 h. The maximum ethanol concentration was found to be 11.6 g/L at 48 h. The two factors, solid loading and ammonium sulfate, which affect the ethanol production using SSF process were optimized by central composite design (CCD) response surface methodology (RSM). The optimized condition for the maximum ethanol concentration will be achieved. The parameters for ethanol yield and productivity will be calculated and reported.

Keywords: bioethanol, cellulosic biomass, disposable diapers, enzyme hydrolysis, SSF





Antimicrobial Properties of Lactic Acid Bacteria Isolated from Small Intestine and Feces of Chicken Broiler

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In this study, Lactic Acid Bacteria (LAB) was screened from small intestine and feces of chicken broiler in order to evaluate antimicrobial properties against Intestinal pathogens in chicken. By using spread plate technique on de Man Rogosa and Sharpe agar (MRS agar) supplemented with bromocresol purple 1.6% and incubated at 42°C for 24-48 hours. Selected colonies surrounded by yellow zone due to acid production. A total of 93 isolates were collected which are 12 from small intestine and 81 from feces. Among these, 48 isolates (51.61%) were coccus shape and 45 isolates (48.39%) were rod shape. For antimicrobial activity, direct agar spot test were conducted against 3 pathogenic bacteria. Of 93 isolates, 15, 19, 32 isolates showed inhibition zone against *Salmonella Typhimurium*, *Listeria monocytogenes*, and *Escherichia coli*, respectively. Only 6 isolates (6.45%) exhibited antimicrobial against all three indicator tested which are BI1-1 (coccus shape) and KC2-8, KC2-14, KC2-17, DC1-3 and IC1-3 (rod shapes). These isolates were further studied on probiotics properties on acid and bile salt tolerance. Also mode of action will be conducted in dual culture study.

Keywords: lactic acid bacteria, probiotics, antimicrobial





The Isolated Yeasts from Wild Mushrooms, and their Ability to Increase Mushrooms Yield

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Yeast is a microorganism that is classified in the group of Fungi. It can be found in nature, such as soil, water, plants and mushrooms. Therefore, the growth of yeasts associated with mushrooms may be an important factors that affect the growth of mushrooms. The objective of this research is to isolate yeasts from wild mushrooms and study for their ability to increase mushrooms yield. Yeasts were isolated by put 1 gram of wild mushrooms into 9 ml of YM broth then diluted and cultured on YM agar supplemented with 0.025% sodium propionate and 0.02% chloramphenicol by spread plate technique. Thirty-six strains of yeast were isolated. All yeast strains were tested for their ability to promote the mushrooms growth by the dual culture method with 5 strains of commercial mushrooms; *Pleurotus ostreatus*, *Pleurotus* sp. from Hungary, *Pleurotus* sp. from Bhutan, *Pleurotus flabellatus* and *Pleurotus cystidiosus*. As the result, the isolated yeasts strain Y102, Y201, Y203, Y302, Y503 and Y1001 could promotes the growth of *Pleurotus ostreatus* ; the isolated yeasts strain Y102, Y103, Y203, Y205, Y208, Y301, Y502 and Y503 could promotes the growth of *Pleurotus* sp. from Hungary; the isolated yeasts strain Y104, Y203, Y205, Y207, Y301, Y501, Y702 and Y1001 could promotes the growth of *Pleurotus* sp. from Bhutan; the isolated yeasts strain Y101, Y102, Y203, Y205, Y807 and Y1101 could promotes the growth of *Pleurotus flabellatus*; the isolated yeasts strain Y101, Y102, Y201, Y203, Y205, Y207, Y208, Y503, Y1001 and Y1101 could promotes the growth of *Pleurotus cystidiosus*. The ability to increase mushrooms yield by the isolated yeasts will be perform by put the yeasts cells into para rubber substrate to grow the mushrooms and check for the mushrooms yield.

Keyword: yeast, mushroom yield





Ability to Produce Indole-3-acetic acid (IAA) by Actinomycetes Isolated from Kantulee Swamp Forest

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Kantulee swamp forest is one of the most important wetland located in Surat Thani province. It is a habitat of valuable plants, animals and microorganisms including actinomycetes. In this study, 142 actinomycetes which were isolated from Kantulee swamp forest were investigated. These isolates were observed for their ability to produce Indole-3-acetic acid (IAA) in Glucose yeast extract broth supplemented with 0.2% tryptophan and incubated for 7 days. The result of primary screening showed that all isolates were able to produce IAA within the range of 5.35 to 160.05 $\mu\text{g/ml}$. The highest IAA producing isolate was found in strain K7PN18 at 160.05 $\mu\text{g/ml}$. The effect of culture period of the isolate to produce IAA was performed. The result showed that the highest amount of IAA production in strain K7PN18 reached the maximum after incubation for 5 days. The result indicated that Kantulee swamp forest is good source for IAA producing actinomycetes that could be a promising candidate for agriculture.

Keywords: IAA, Actinomycetes, swamp forest





Effect of Lingzhi Mushroom Extract against Cancer Cells

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Cancer is a group of diseases that are associated with abnormal cell growth. The disease has a high mortality rate in Thailand and other countries. It is reported that a variety of mushroom extracts can help prevent cancer cells. The purpose of this research is to study the effect of *Ganoderma lucidum* extract on cancer cells. This mushroom will be extracted with pure ethanol and dried with a vacuum evaporator. Then, its effect was tested in cancer cells. In this study, five cancer cells including intestinal cancer cells (SW480), breast cancer cells (MCF7), lung cancer cells (A549), liver cancer cell (HepG2) and cervical cancer cell (Hela) were cultured in 96 well culture plates (3×10^5 cells/well) with different concentrations of 62.5, 125, 250, 500, 1000, 2000 and 4000 $\mu\text{g/ml}$, respectively, and then incubated for 24, 48 and 72 hours. The MTS assay was performed to detect cell proliferation. The results showed that at 24, 48, 72 hours, *Ganoderma* extract was able to inhibit HT29, Hela and MCF7 cells at 1000 $\mu\text{g/ml}$, 62.5 $\mu\text{g/ml}$ and 1,000 $\mu\text{g/ml}$, respectively. LDH assay can be used to confirm these results in future study.

Keywords: cancer, *Ganoderma lucidum*, mushroom extract, cell proliferation





Screening and Identification of Phytase-producing Fungi

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Forty-five soil samples were screened for phytase-producing filamentous fungi. The soil samples were collected from community area, forestry area, agriculture area, Kasetsart University area and other places in Thailand. A phytase-screening medium supplemented with chloramphenicol (antibiotic) was used to isolate phytase-producing filamentous fungi. The chloramphenicol could inhibit the growth of bacteria but did not affect the growth of fungi. The phytase-producing fungi can degrade phytate which was used as an ingredient in the screening medium resulting in a clear zone formation around the colony. Ninety-nine mold isolates producing phytase and forming clear zone around the colony were selected. After identified the highest phytase-producing fungi strains by morphological study under microscope using slide culture technique found that most of isolated mold were identified as *Aspergillus* sp. and *Penicillium* sp.

Keywords: phytase, phytate, chloramphenicol, *Aspergillus* sp.





Yeast Diversity in Grease Trap of Kasetsart University Canteens

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Lipases catalyze the hydrolysis and esterification of oil and fats. They have potentials for industrial applications. Lipases are found in widely source such as plants, animals and microorganisms. Many microorganisms have potential to produce extracellular lipases especially, yeast because yeast is easy to grow and handle. This research was aimed to study yeast diversity in grease trap of Kasetsart University canteens and screening for lipase producing yeasts. Eleven samples were collected from grease trap of 9 canteens for yeast isolation and 129 yeast isolates were obtained. Identification of the yeast strain was carried out using the D1/D2 region of the large subunit rRNA gene sequence analysis. Screening of lipase producing yeast was done by the appearance of turbid zone surrounding colony on Tween 80 agar. Thirty-five yeast isolates showed lipolytic activity. Eight of them were shown to produce large and quick turbid zone surrounding the colony. These isolates were inoculated into Yeast extract-Malt extract broth and incubated in an orbital shaker at 30 °C and 200 rpm for 120 h. The lipase activity in the culture supernatant was determined using *p*-nitrophenylpalmitate (*p*-NPP) as substrate. *Candida sp.* strain DMKU-JMGT1-24 showed maximum lipase activity of 25.61 U_{mL}⁻¹.

Keywords: yeast diversity, grease trap, lipases





Cultivation of *Ganoderma lucidum* Mycelia for Hydrophobin Extraction for Studying Antitumor Activity on Breast Cancer Cell

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In this study, we aimed to use hydrophobins extracted from cultivate *Ganoderma lucidum* mycelia for assay of their antitumor activity against breast cancer cells. Hydrophobins are small proteins, molecules weight about 7 -15 kDa, produced only in mushrooms and filamentous fungi. They are able to self-assemble into amphipathic monolayer at hydrophobic/hydrophilic interfaces. Previous research has found that the hydrophobin SC3 from *Schizophyllum commune* showed an antitumor activity against sarcoma and melanoma. First, the optimal conditions for the cultivation of *Ganoderma lucidum* mycelia were studied by measuring colony size on Potato dextrose agar (PDA) and the dried weight of mycelia on static cultivation in Potato dextrose broth (PDB) incubated at 25 and 30°C under light and dark condition, including uncontrolled condition. The result showed that the highest colony growth rate of 14.0 mm/day on Potato dextrose agar (PDA) was observed when incubated at 30°C under dark condition. In static cultivation, the highest dried weight of mycelia of 0.380 g was obtained when incubated at 25°C under dark condition for 20 days. Crude hydrophobin extracted from *Ganoderma lucidum* with trifluoroacetic acid (TFA) were examined for antitumor activity against breast cancer cells. Breast cancer cells were cultivated in a 96-well plate at the initial concentration of 3,000 cells per well. The MTS assay was used to determine the effects of hydrophobin crude extracts on the growth of breast cancer cells after 24, 48, and 72 hours of incubation.

Keywords: *Ganoderma lucidum* mycelia, hydrophobin, breast cancer cells.





Production of Tempe Starter in Laboratory Scale from Rice Germ Treated by Autoclave and Tyndallization

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Tempe is originally traditional fermented food in Indonesia, produce by fermentation of cooked soybean with *Rhizopus oligosporus*. Until now, Tempe is widely available at every wet market and supermarket in Indonesia. It is still not well-known in Thailand. However, consumers are gradually increase especially among vegetarian groups. As commercial tempe starter is still not available in Thailand, so we intend to introduce the easy method to make good quality tempe starter in household level. Study of bacterial contamination in commercial Tempe starter and how to make Tempe starter by sterile substrate with tyndallization technique were focused. Samples of commercial Tempe starter from Indonesia were examined fungal population and bacterial contamination as the same time by plating on PDA supplemented with 0.0013% Rose Bengal and PCA, respectively. In addition, endospore forming bacteria was detected by heat shock 100°C 5 minutes treated suspension of sample before plating on PCA and number of enterobacteria was evaluated by selective medium. We found that fungal populations were in the level of $6.7 - 6.9 \times 10^5$ cfu/g. Furthermore, $3.9 \times 10^2 - 6.85 \times 10^4$ cfu/g of endospore forming bacteria and only small number of enterobacteria (13-39 cfu/g) were detected. Those EFB isolates were identified as *B. thuringiensis*, *B. subtilis*, *B. megaterium* and *Bacillus* sp., respectively. Whereas enterobacteria isolates were identified as *Enterobacter aerogenes*. Production of Tempeh starter in laboratory scale from rice germ treated by autoclave at 121°C 15 minutes and steaming at 100°C for 1 hour for 3 days were comparative studied. The results showed that we could sterilize germ rice by both heat treatment. Anyway, fungal spore yield treated by autoclave and tyndallization were $3.5 - 5.1 \times 10^4$ cfu/g and $1.8 \times 10^3 - 1.54 \times 10^4$ cfu/g, respectively. Physical factor requirement to increase amount of fungal spore is under investigation.

Keywords: tempe starter, *Rhizopus oligosporus*, rice germ, tyndallization





Microbiological Quality of Crushed/Cube Ice from Drinking Shop in Kasetsart University, Bangkhen Campus

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The aim of this study was to investigate microbiological quality of crushed ice and ice cube according to the *World Health Organization* (WHO) standard of drinking water. Thirty ice samples were collected from 30 drinking shops in Kasetsart university area. Total count using dilution plate count method, coliforms and faecal coliforms using MPN method, and pathogens; *Staphylococcus aureus*, *Clostridium perfringens* and *Salmonella* spp. using membrane filtration technique with specific media, were analyses.

The results revealed that all ice samples were contaminated with total counts between 50 to $> 3 \times 10^3$ cfu/mL. Coliforms and faecal coliforms were < 2 to > 2400 MPN/100mL and < 2 to > 2400 MPN/100mL, respectively. Nine of 30 ice samples were contaminated with presumptive *S. aureus* colonies on Baird Parker agar. Nine and 4 of 30 ice samples were contaminated with presumptive *Cl. perfringens* colonies and *Salmonella* colonies on TSC and XLD agar, respectively. *E. coli* which WHO allows none in drinking water was found in 12 of 30 samples.

In conclusion, this study indicated that all ice samples from drinking shop in Kasetsart university area were contaminated with types and numbers of bacteria much higher than the WHO standard. These bacteria may cause adverse effect to consumer health. Improvement of good manufacturing and sanitation are urgently needed.

Keywords: crushed ice, ice cube, coliforms, faecal coliforms *Staphylococcus aureus*, *Salmonella* sp., *Clostridium perfringens*





Improvement of Rice and Coconut Water Vinegar Fermentation by Static Culture of *Acetobacter pasteurianus* SKU1108 G40 and Its Adapted Strain

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Acetobacter pasteurianus is widely used for submerged-industrial vinegar fermentation due to its strong abilities to oxidize ethanol and resistance to acetic acid. Thermotolerant *A. pasteurianus* SKU1108 is one of the most prominent strain that could grow and produce high amount of acetic acid at 37°C. However, vinegar fermentation produced by this strain was obtained in the medium or raw material supplemented with yeast extract which is expensive and also provides unfavorable smell. From our previous study, *Acetobacter pasteurianus* G40 was obtained from *A. pasteurianus* 7E-13 strain (ethanol-thermal adapted strain of SKU1108) by sequential cultivation in a low-nutrient (jasmine rice moromi containing 6% ethanol) medium. The G40 strain was shown to be useful for submerged-industrial vinegar fermentation at high temperature. Nevertheless, traditional static surface fermentation provides a low-cost production in terms of plant investment, and the good quality product. In this study, we attempted to improve G40 strain for the traditional static surface vinegar fermentation by repeating static cultivation for 31 generations (1,608 hours) in jasmine rice moromi containing 6% ethanol without yeast extract supplementation at 37°C. The adapted strains, M15 and M31, were selected from 15th and 31st generation, respectively. Both strains were characterized for the efficiency of traditional vinegar fermentation compared to 7E-13 and G40 strains in low-nutrient media (jasmine rice moromi containing 6 or 8% ethanol, coconut water containing 6 or 8% ethanol) at 37°C. The result confirmed that the low-nutrient adapted strains (G40, M15 and M31) exhibited better growth and acetic acid production than the 7E-13 strain in all tested media. However, both adapted strains, M15 and M31, could produce the higher amount of acetic acid (6.42 and 6.54%) than G40 strain (5.88%) in jasmine rice moromi containing the high concentration of 8% ethanol under static condition. Therefore, it was suggested that the elevated ability of both adapted strains is required for low-cost production of traditional vinegar fermentation.

Keywords: thermotolerant *Acetobacter pasteurianus*, adaptation, vinegar fermentation, low-cost fermentation





Study on Antimicrobial Activity of Piperaceous Plant Extracts against Acne-inducing Bacteria

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The genus *Piper* (Piperaceae) or Sa Kan (Thai name) is distributed mainly in tropical regions of the world, including in Thailand. Many common species of *Piper* has been regarded as medicinal plants and antimicrobial agents. *Propionibacterium acnes*, *Staphylococcus epidermidis* and *S. aureus* have been recognized as acne-inducing bacteria. Medicinal plants have been studied as alternative acne treatment to overcome the problem of antibiotic resistance. In the present study, 27 species of *Piper* collected from various locations in Thailand were examined for antimicrobial activity against the acne-inducing bacteria. The efficiency of different solvents for the extraction of antibacterial agents from leaf and stem of the *Piper* were also investigated. The antibacterial activity was determined by disc diffusion method. Minimal inhibitory concentration (MIC) and minimal bactericidal concentration (MBC) were evaluated by broth dilution method. The crude extracts of *Piper griffithii*, *P. leptostachyum* and *P. caninum* exhibited antibacterial activity against the tested bacterial strains, a tetracycline resistant strain. Ethyl acetate leaf extract of the tested plants exhibited greater antibacterial activity. The leaf and stem extracts of *Piper griffithii* had a strong inhibitory effect on *P. acnes*, *S. epidermidis* and *S. aureus*. This report suggests that the test plants may had potential for using as anti-acne agents.

Keywords: acne-inducing bacteria, antimicrobial activity, medicinal plant, *Piper*, *Propionibacterium acnes*





Detection of *Listeria monocytogenes*, *Salmonella* spp. and *Shigella* spp. by Multiplex Polymerase Chain Reaction (Multiplex PCR) Technique

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The incidence of foodborne infections caused by *Salmonella* spp., *Shigella* spp. and *Listeria monocytogenes* are poses a great potential threat to public health. Simultaneous rapid detection of these three pathogens by using multiplex PCR technique was developed in this study. Specific primers used to detect target genes include *isp* gene for *Listeria monocytogenes*, *ompC* gene for *Salmonella* spp. and *ipaH* gene for *Shigella* spp. After DNA amplification, bands of each pathogen, *Salmonella* spp. with 204 base pair, *Shigella* spp. with 162 base pair and *Listeria monocytogenes* with 713 base pair were detected. Multiplex PCR used for detection of *Listeria monocytogenes*, *Salmonella* spp. and *Shigella* spp. is highly specific, showed no cross reaction with different templates tested, and highly sensitive, can detect 10²CFU/ml of bacteria. Multiplex PCR is promising rapid test for identification pathogens in the samples simultaneously.

Keywords: multiplex PCR, foodborne pathogen, *Salmonella* spp., *Shigella* spp., *Listeria monocytogenes*





Comparative Study of Soybean Tempe Production by 1 Times and 2 Times Boiling Process

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There are many different methods to make Tempe from soybean. Comparative study of soybean Tempe made by boiling 1 times (B1) and boiling 2 times (B2) was our purpose. B1 and B2 are distinctively different on the step of spontaneous acidification by soaking with raw soybean and cooked soybean, respectively. Tempe quality was evaluated by NH_3 level and microbiological properties, including, Total Bacteria Count (TBC), Lactic Acid Bacteria (LAB), Enterobacteria (ETB) and Endospore Forming Bacteria (EFB) of Tempe products from each treatments. The study of populations of microbe from Tempe B1 after 48 and 96 hrs incubation showed that numbers of ETB were greater than LAB. On the other hand, from Tempe B2 after 48 hrs incubation, numbers of LAB were higher than ETB but appeared in the opposite way after 96 hrs incubation. Whereas NH_3 level detected by Nessler's reagent from both treatments were quite similar on 48 hrs. However, after 96 hrs incubation, higher of NH_3 quantities was detected from Tempe B2. The population of EFB normally found in Tempe less than ETB and $\text{LAB} \geq 2\text{-}3 \log \text{CFU}$, in addition, we found that numbers of EFB from B1 were greater than from B2 at least 1 log CFU. Based on conventional method, most dominated ETB was identified as *Enterobactor cloacae*, *Enterobactor aerogenes* and *Klebiella pneumoniae* subsp. *pneumonia*. Dominated LAB was identified as *Enterococcus* sp. and EFB was identified as *Bacillus thuringiensis*. Moveover, we noticed that *Klebiella pneumoniae* subsp. *pneumoniae* was most dominated in Tempe B1 whereas *Enterobactor cloacae* was dominated in Tempe B2. These results suggested that ETB might play important role in NH_3 odor in Tempe.

Keywords: tempe, soybean





Extraction of Lipopolysaccharide of *Brucella abortus* Using n-butanol Method

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Brucella abortus (*B. abortus*), an intracellular gram-negative bacteria, causes of brucellosis a highly contagious zoonosis and livestock disease related to a significant economic loss in livestock industry of developing countries. *B. abortus* cells are covered by lipid and polysaccharide called lipopolysaccharide (LPS) or endotoxin an essential structural component of outer cell membrane complex. LPS is responsible of bacterial virulence and pathogenesis. Phenol has been used commonly for *B. abortus* LPS extraction because of its beneficial effects as cell lysis and protein denaturing. However, phenol is highly poisoning and toxic to the environment. Moreover, *B. abortus* LPS held in phenol phase after phenol extraction is easily contaminated of the denature proteins.

The objective of this study is to extract *B. abortus* LPS using n-butanol, a low toxic alcohol, extraction method that the extraction process is carried out under cold temperature without lysis of bacterial cell to minimize protein contamination. The extracted LPS were characterized by dry weight measurement, SDS-PAGE, spectrophotometer, HPLC and Limulus Amebocyte Lysate (LAL) activity test. To extract *B. abortus* LPS by n-butanol method, PCR-identified *B. abortus* were cultured in tryptic soy broth (TSB). Afterward, bacterial suspension was mixed equally to water saturated n-butanol. Proteinase K was added to a reaction prior to water dialysis and lyophilization. Compared to bacterial dry weight, extracted LPS was equal to 0.2% of *B. abortus* dry weight. Extracted LPS was contaminated with proteins and nucleic acid as 5% and 3.7-4.7% respectively. Scanning spectrophotogram and HPLC chromatogram highest peak of extracted *B. abortus* LPS were at 201 nm and 1.638 minutes comparable to purified reference *E. coli* LPS. The highest activity of 0.056 ppm of extracted LPS was higher than 1 EU/ml after testing by LAL assay. Two dense SDS-PAGE bands approximately 18 and 45 kDa were observed that *B. abortus* LPS bands pattern was comparable to a band pattern of purified reference *E. coli* LPS.

Keywords: *Brucella abortus*, lipopolysaccharide, n-butanol extraction





A Study of *Ganoderma*, *Auricularia* and *Lentinus* from Forest in Thailand

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Mushroom are one of the most important decomposer for forest ecosystem. They take an important role by their enzymatic production ability. Moreover, mushroom can be used to cook and benefit to health because of the medicinal properties such as promoting beauty and anti-cancer effect as well. The aim of this study is to collect and identify *Ganoderma* spp., *Auricularia* spp. and *Lentinus* spp. from forest in Thailand. The fruiting bodies of mushrooms were collected and isolated to be pure cultures. The identification method was done using molecular method. The nucleotide sequences of the mushrooms were analyzed for internal transcribed spacer (ITS) and large-subunit (LSU) rDNA. DNA from the mushroom cultures were extracted using DNAsure Plant Kit and amplify for ITS and partial sequence of LSU rDNA using ITS5 and LR5 primers. The purified PCR products were subjected to sequence using ITS1, ITS3, ITS4, LR0R, LR3 and LR5 primers. The assembled sequence of each sample was compared with the database sequence in GenBank by Blast search. The result show that the fungal strains KU020, KU021, KU022, KU024, KU025, KU027 and KU028 revealed 95% similarity to *Auricularia auricula-judae* AFTOL ID 1681, KU015 and KU019 strains revealed 96% similarity to *Lentinus tigrinus* strain CZ463, KU016 and KU018 strains revealed 98% similarity to *Panis velutinus* strain VKRA1 and KU017 strain revealed 99% similarity to *Psathyrella trinitatensis* voucher TL9035.

Keywords: mushroom diversity, molecular method





Induction of Phenanthrene Biodegradation of Fungal-bacterial Co-culture by Using Phenanthrene Substitutes

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Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds containing two or more fused benzene rings. They are considered as pollutants found generally in the environment. In addition, they are carcinogenic and mutagenic. PAHs are mostly produced from organic incomplete combustion and petroleum contamination. Microbial bioremediation is the key for treatment of PAH contamination because it is environmental friendly. Usually, microbes have to be incubated with PAH compounds to induce the production of PAH-degrading enzymes prior to perform PAH bioremediation. This can increase the risk of additional pollutants when applied in nature. This research aimed to study the replacement of phenanthrene in induction of phenanthrene biodegradation by fungal-bacterial co-culture with other aromatic compounds such as methyl salicylate, vanilla and naphthalene, which are considered as less toxic. These compounds were applied for the retention of phenanthrene biodegradable capacity of fungal-bacterial co-cultures on wood meal agar which were once induced by phenanthrene. Use of phenanthrene as inducer was positive control whereas no inducer used was negative control. Interestingly, it seemed that fungal-bacterial co-culture was not required any inducer to maintain its phenanthrene degrading capability. The results showed that efficient phenanthrene biodegradation was obtained even with or without phenanthrene used as inducer. Within 14 days, the phenanthrene was decreased 87% when no induction or induced by phenanthrene or vanilla. The reduction of phenanthrene at 86% and 89% were obtained when induced by methyl salicylate and naphthalene, respectively. Next, use of phenanthrene substitutes in the first round of induction of fungal-bacterial co-cultivation for effective phenanthrene biodegradation was very challenging.

Keywords: polycyclic aromatic hydrocarbons (PAHs), phenanthrene biodegradation co-cultivation, phenanthrene, methyl salicylate, vanillin, naphthalene





Antimicrobial Properties of Probiotic Microorganisms and Growth of Probiotic Cultures in Fermented Soybean Meal

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In this study, we used 6 strains of microorganisms: *Lactobacillus plantarum* IG-3, *Lactobacillus plantarum* IFS-1, *Enterococcus faecium* PR-2, *Enterococcus faecium* MG-2, *Candida krusei* MB-1 and *Bacillus subtilis* C4 to study the properties of probiotic microorganisms and their ability to inhibit pathogenic microorganisms in order to develop feed supplement from fermented soybean meal. To study probiotic properties, acid tolerance at pH 2.5 for 3 hours was performed. It was found that all 6 strains showed varying degree of acid tolerance where PR-2 > IFS-1 > IG-3 > MB-1 and cell number was increased by 2.21, 1.50, 0.22, 0.14 %, respectively whereas MG-2 > C4 but cell count decreased by 2.29 and 4.66 %, respectively. When cultures the acid tolerance cells in condition of ox bile 0.3% (w/v) for 36 hours. MB-1 exhibited good survival by cell number increased 9.14% whereas the other strains, cell number were decreased to varying degree from 2.51, 4.02, 15.60, 19.24 and 21.41%, for IFS-1, MG-2, C4 and PR-2, respectively. All strains were also determined for enzyme activity including amylase (starch agar), protease (skimmed milk agar), lipase (tween 80 agar) and phytase (phytase screening medium). Results showed that only 3 strains exhibited amylase activity which are C4 > MB-1 > IG-3 with clear zone size of 29.5, 9 and 4 mm, respectively. For protease activity, C4 and MB-1 gave positive clear zone of 15.5, and 6.5 mm, respectively. For phytase activity, C4, MB-1 and IG-3 showed positive with clear zone of 9, 7.5 and 4 mm, respectively. However, all strains showed no lipase activity at all. Due to diverse enzyme activity of all strains tested, further study is also focused on possibility to use probiotic strains in soybean meal fermentation in order to develop feed supplement in the future.

Keywords: probiotics, antibacterial activity and fermented soybean meal





Studies on the Effect of Shiitake Extract against Cancer Cells

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Cancer is characterized by the rapid proliferation of abnormal cells containing mutations, which can affect any part of the body and spread to other parts of the body. It is one of the leading causes of death worldwide. Recently, many mushroom extracts have been reported as the source of health supplements and substances against several types of cancer in human. The objective is to study the effect of crude extracts of Shiitake mushroom (*Lentinula edodes*) on cancer cells. This mushroom was extracted with absolute ethanol and was dried by evaporation. The cytotoxicity of the extract against HeLa, HepG2, SW480, MCF7 and A549 was determined. These cell lines were cultured in 96-well plate, different concentrations of the extract (62.5, 125, 250, 500, 1,000, 2,000 and 4,000 $\mu\text{g/ml}$) were added and incubated for 24, 48 and 72 h. Cell viability was determined using the MTS assay. The results showed that the extract of Shiitake mushroom against HeLa cell at 24 h with the concentration of 125 $\mu\text{g/ml}$ and MCF7 at 72 h with the concentration of 4,000 $\mu\text{g/ml}$. LDH assay will be used to confirm this finding in the future.

Keywords: mushroom extract, shiitake, *Lentinula edodes*, HeLa, MCF7, cell viability





Study on Factors Affecting Phytase Production of *Aspergillus* sp.

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This research aimed to study on factors affecting phytase production of *Aspergillus* sp. cultivated in the modified phytase screening medium for 7 days. A study of suitable carbon sources for the production of fungal enzymes shows that rice flour is the best source of carbon in enzyme production. Using sugars as a source of carbon to produce enzymes does not increase the production of phytase enzyme more than the use of rice flour, glutinous rice flour, corn starch and tapioca starch. It was found that the activity of phytase enzyme in 4 percent rice flour had the highest activity of 2.82 units per milliliter. Nitrogen sources and phosphate content were studied by using 0.24 percent of nitrogen sources and 0.0005, 0.001, 0.01 and 0.1 percent of potassium hydrogen phosphate. It was found that *Aspergillus* sp. produced highest phytase when cultured with ammonium nitrate (3.28 units per milliliter.) as nitrogen source followed by peptone. The amount of potassium hydrogen phosphate affected the production of phytase enzyme and 0.0005 percent of potassium hydrogen phosphate promotes the enzyme production. However, the increased phosphate content resulted in an inhibition of enzyme synthesis. Increasing the amount of potassium hydrogen phosphate from 0.0005 to 0.1 percent resulted in a decrease in the activity of the enzyme from 1.35 to 0.99 units per milliliter.

Keywords: phytase, *Aspergillus* sp, nitrogen sources, carbon sources





Optimization of Succinic Acid Production from Hydrolysates of Sugarcane Bagasse as Carbon Sources by *Corynebacterium glutamicum* CS176 Isolated in Thailand

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Succinic acid is a dicarboxylic acid used as a precursor to produce many chemicals including biodegradable polymer such as polybutylene succinate (PBS). It has been reported that *Corynebacterium glutamicum* is one of the microorganisms used to produce succinic acid through the Reductive TCA cycle, basically. Previously, our laboratory isolated *Corynebacterium glutamicum* CS176 which can utilize L-arabinose -pentose sugar, from soil. Its characteristics based on glutamic acid and succinic acid productions has been investigated. In this study, the optimization of succinic production by *C. glutamicum* CS176 from fermentative sugars derived from hydrolysates of sugarcane bagasse was carried out. The production was observed under two-stage fermentation. The first stage with high oxygen is to increase cell mass and the second stage with oxygen deprivation is to produce succinic acid. The factors involved in succinic acid production were elucidated such as cell biomass (2, 5 and 10 g), sodium bicarbonate concentrations (0 – 400 mM), sugar as carbon sources (glucose, arabinose or mixed sugars at 5% each), sampling period (0 – 24 h) and total volume (17 or 100 ml). All the test production conditions were done in BT medium at room temperature under static culture. The results revealed that the condition with high bicarbonate and cell mass gave better yield of succinic acid with shorten production time. At 5 g wet-cell condition, the maximum glucose and arabinose consumption were observed at 12 h of 71.72% and 24 h of 68.62%, respectively. While at 10 g wet-cell condition, the maximum consumption of both glucose and arabinose were observed at 12 h with 84.84% and 75.24%, respectively. Qualitative analysis of succinic acid as visualized by TLC revealed the highest intensity spot could be detected from BT-glucose medium. The results indicated that the optimum condition of succinic acid production was in 100 ml BT-glucose medium supplemented with 400 mM bicarbonate at 12 h under static culture at room temperature. The production in sugar derived from hydrolysates of sugarcane bagasse was further studied by simulation of the same condition with BT-glucose.

Keywords: bio-based succinic acid production, *Corynebacterium glutamicum*, hydrolysis of sugarcane bagasse





Enzyme Production and Plant Material Degradation for Animal Feed Industry of *Bacillus* and *Paenibacillus* Isolated from Termite Guts

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This study investigated an ability of enzyme production and plant material degradation of bacteria isolated from the guts of various termite species collected from Sakaerat Environment Research Station, Wang Nam Kiew, Nakhon Ratchasima. Seven isolated bacteria were selected for the study and they were members of genus *Bacillus* and *Paenibacillus*. Molecular identification based on 16S rRNA gene showed that, 6 isolates were related to *Bacillus toyonensis* strain BCT-7112 (isolate MC-17-2 and GS-4-1), *B. cereus* strain ATCC 14579 (isolate Ps-10-3), *B. methylotrophic* strain CBMB205 (isolate Tp-8-1), *B. amyloliquefaciens* subsp. *Plantarum* strain FZB42 (isolate Hs-4-5 and Tp-6-2) and only the isolate Tp-10-2 was related to *Paenibacillus taichungensis* strain BCRC 17757, with 99-100% nucleotide identity. The isolates were tested their ability to produce various enzymes including cellulase, pectinase, amylase, lipase, caseinase, gelatinase and phytase. Moreover, soybean milk was used as substrate for test. All isolates showed the ability to produce cellulase, pectinase and amylase. Moreover all isolates except Tp-10-2 showed the ability to produce caseinase and gelatinase, as well as to degrade the soybean milk. Furthermore, there were 4 isolates showed the ability to produce phytase (Tp-8-1, Tp-6-2, Hs-4-5 and Tp-10-2). Some isolates especially the isolate Tp-6-2 presented high ability to produce proteolytic enzymes, as well as some other enzymes. The isolates were selected and tested their ability to grow by degradation of several types of plant materials, especially soybean meal. The soybean meal (whole substrate) contains high protein and it is extensively used in many types of animal feed. The results suggested that, the isolated bacteria and their producing enzymes were useful for biotechnology. This study was the first application using the bacteria isolated from termite guts to degrade the plant materials for animal feed industry.

Keywords : *Bacillus*, *Paenibacillus*, bacterial enzyme, soybean meal





Plant Growth Promotion of Heavy Metal Resistant Actinomycetes Isolated from Zinc Mine Soils

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Actinomycetes were isolated from different soil samples in a zinc mine located in Mae Sot district, Tak province, Thailand. More than a hundred of isolates were tested their heavy metal resistance (Zn^{2+} , Cd^{2+} , Cu^{2+} and Hg^{2+}). The isolates were characterized their siderophore production on Chrome azurol S agar. The results showed that, many isolates showed high siderophore production, such as isolates S1-122, S2-9, CO1-65, CO1-77, B3-87, B3-T, C1-25, C1-89, C1-92 and C1-109. Moreover, this study characterized an ability of phosphate solubilization on Pikovskaya agar medium and some phosphate solubilizing actinomycetes showed high decomposition rate, such as isolates S2-2, S2-9, S2-1 and S2-43. The actinomycetes isolated in this study can be used for the future study of plant growth promotion under heavy metal stress.

Keywords: Actinomycetes, Siderophore, phosphate solubilization, heavy metal





Xylanase Production from *Streptomyces*

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Xylanases are of great important applied in several industrial processes such as bio-bleaching in paper and pulp industry, biomass pretreatment in biofuel industry and in animal feed stock. Actinomycete is one of source for xylanase production. In this present study, 23 *Streptomyces* spp., isolated from paddy soil, were tested for their ability to produce xylanase on Minimal xylan agar plates. The results showed that 19 isolates were able to produce xylanase in which TY41-2, TY47-6, TY49-2 and TY68-3 exhibited the high xylanase production. Afterwards, enhancing the xylanase production growth in liquid medium was investigated and the result revealed that the medium of Nascimento and coworkers in 2002 was able to enhance the highest xylanase production in isolate TY41-2. Therefore, this isolate was selected for further medium optimization study using agricultural waste for higher economic feasibility. The media optimization was analyzed by the statistical software package Design Expert 11 using Box–Behnken design of response surface methodology. The results revealed that the maximum xylanase production obtained from the modified medium consisting of NaNO₃ (0.1 g/L), KH₂PO₄ (3 g/L), K₂HPO₄ (6 g/L), MgSO₄ · 7H₂O (0.3 g/L), CaCl₂ (0.05 g/L), MnSO₄ · 7H₂O (0.01 g/L), ZnSO₄ · 7H₂O (0.001 g/L), and wheat bran (30 g/L). The optimized media resulted in 2-fold increase of xylanase production compared to the control after 7 days of shaking incubation experiments. The crude *xylanase* was active at the pH range 4–6 and temperature at 50°C. In part of identification of *Streptomyces* sp., the analysis of 16S rRNA gene showed that TY41- 2 was similar to *Streptomyces castaneoglobisporus* (100%).

Keywords: xylanase, *Streptomyces*, medium optimization





Investigation of Thermotolerant Genes, *hspD* and *serA*, Expression on Growth, Acetic Acid and Bacterial Nanocellulose (BNC) Production in *Komagataeibacter* spp. at High Temperature

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Thermotolerant acetic acid bacteria (AAB) are an important group of bacteria in food and beverage industries such as vinegar and bacterial nanocellulose (BNC) production especially in tropical countries where the average temperature is higher than 30°C. Their thermotolerant mechanisms are of interest to be characterized and 24 thermotolerant genes have been previously reported in thermotolerant *Acetobacter tropicalis* SKU1100. From previous study, thermotolerant *Komagataeibacter* sp. MSKU9 was isolated from persimmon in Thailand. This strain can produce acetic acid and BNC at high temperature. Comparative genome sequences analysis revealed that *hspD* (483 bp) and *serA* (963 bp) genes, associated with thermotolerant mechanism, were observed in MSKU9 but not in the mesophilic type strain, *K. europaeus* DSM 6160^T. The *hspD* gene encoded small heat shock protein Hsp20 which is an ATP-independent molecular chaperone involved in protection of unfolding proteins from irreversible aggregation. Moreover, the *serA* gene encoded D-3-phosphoglycerate dehydrogenase involved in early steps of L-serine biosynthesis. To investigate the role of these two genes on growth, acetic acid and BNC production, both gene disruption and overexpression were carried out. The recombinant plasmid, pGEMThspD::Tc and pGEMTserA::Tc were separately introduced into MSKU9 by both conjugation and electroporation. None of disruptant colonies was isolated from homologous recombination of those two genes into genome of MSKU9. Moreover, overexpression of *hspD* and *serA* genes were performed by subcloning of individual genes into pCM62 (broad host range vector) and pMV24 (shutter vector *E. coli*-*Acetobacter* sp.) and introduced into MSKU9 and *K. medellinensis* NBRC 3288 (non-BNC producing strain), respectively. The results demonstrated that overexpression of *hspD* gene on pCMhspD in MSKU9 was not significantly affected on growth, acetic acid and BNC production. In contrast, MSKU9 carrying pCMserA produced the same amount of acetic acid but showed lower growth and BNC yield than wild type at 30 and 37°C. In addition, the growth of *K. medellinensis* NBRC 3288 harboring pMVhspD decreased at 33°C whereas *serA* gene was not significantly affected on the growth at high temperature.

Keywords: *hspD* gene, *serA* gene, *Komagataeibacter* spp., thermotolerant genes





Calcium Carbonate Precipitation by Urease Producing Bacteria Isolated from Soil

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Microbially induced calcium carbonate precipitation (MICCP) is biomineralization process and common phenomenon in nature. Microorganisms play roles in calcium carbonate formation in various mechanisms. Ureolytic bacteria were capable to hydrolyze urea to ammonia and induce alkalinity in an environment, resulting in calcium carbonate precipitation. The beneficial effect of MICCP has been researched to repair building materials and improve durability of soil structures. In this study, ureolytic bacteria were isolated from nine soil samples on Christensen's urea agar. Ten urease positive strains were gram-positive, long rod shape, spore-producing, and catalase positive. Primary screening for bacteria with high urease activity was performed on Stuart's urea broth (highly buffered medium). Seven strains were able to change pH of Stuart's urea broth from initial pH 7.0 to pH 10 within 72 hours. Urease activity was determined by measuring released ammonia from urea hydrolysis using phenol-hypochlorite assay method. Determination of calcium carbonate precipitation was performed by addition of 0.025 M and 0.4 M of calcium chloride to cultures grown on nutrient broth supplemented with 2% urea for 3 days. Precipitated calcium carbonate was measured by EDTA titration method. We found that all strains produced urease and were able to enhance calcium carbonate formation. Two strains, *Bacillus* sp. strain 5.1 and 2.2, effectively precipitated calcium carbonate on the addition of 0.025 M of calcium chloride (3.11 and 3.62 g/l) and 0.4 M of calcium chloride (15.97 and 8.82 g/l). All of the newly isolated strains in this study showed a potential of MICCP and possibility to apply in various engineered technology approaches.

Keywords: microbially induced calcium carbonate precipitation, ureolytic bacteria, biogrout





Adaptation of Raw Material to Enhance the Nutritional Value of *Hericium erinaceus*

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Hericium erinaceus is known as medicinal mushroom. Research on *Hericium erinaceus* also provides a guideline for research that may affect the beneficial addition of mushrooms such as proteins and other active ingredients. The research report on most mushroom species indicated that mushroom are nutritional values change due to raw material used. Therefore, this is research proposed to modify the raw material use for *Hericium erinaceus* cultivation compared with the conventional methods to test whether the test material affects the amount of protein and active ingredient in the mushroom yield. To replace the conventional material (para rubber sawdust) by using eucalyptus sawdust, the experiment was done by divided the proportion para rubber sawdust : eucalyptus sawdust as 100:0, 0:100, 60:40, 50:50 and 40:60. The result show that the higher yield of mushroom product has got from the ratio 60:40. The active ingredient in the mushrooms was analyzed by HPLC-MS and indicated that the ratio 100:0, 0:100 and 60:40 could detect erinacine 29%, 3% and 3%, respectively.

Keywords: *Hericium erinaceus*, Eucalyptus sawdust, Erinacine





Comparative Study of Tempe Production from Splitted Soybean by 1 Time and 2 Times Boiling Process

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Tempe made from soybean is most popular than other kind of beans or cereal. In Indonesia soybean is generally more favorable for making Tempe inspite of more time and labor need for peeling step. On this study, we selected splitted soybean for Tempe production and conducted by 2 treatments; Boiling 1 time (B1) and boiling 2 times (B2). B1 and B2 are distinctively different on the step of spontaneous acidification by soaking with raw soybean and cooked soybean, respectively. Tempe quality was evaluated by NH_3 level and microbiological properties of Total Bacteria Count (TBC), Enterobacteria (ETB), Lactic Acid Bacteria (LAB) and Endospore Forming Bacteria (EFB). The study of populations of microbe from Tempe B1 showed that numbers of LAB were greater than ETB both after incubation 48 and 96 hrs. Whereas populations of LAB from Tempe B2 were not different from ETB after 48 and 96 hrs incubation. Moreover, populations of EFB from Tempe B1 were less than from Tempe B2. In addition, we founded that NH_3 level detected by Nessler's reagent from Tempe B1 was always less than from Tempe B2 both after 48 and 96 hrs incubation. Based on conventional method, dominated LAB (10^7 - 10^8 CFU/g) found in Tempe B1 was identified as *Enterococcus* sp. next group was ETB (10^7 - 10^8 CFU/g), which were mostly identified as *Enterobacter cloacae*, *Klebsiella pneumoniae* subsp. *pneumoniae*, whereas *Bacillus thuringiensis* was most abundant among EFB (10^4 - 10^5 CFU/g). The results suggested that quality of Tempe made from splitted soybean boiling 1 time was superior than boiling 2 times not only less NH_3 odor but also microbiological properties.

Keywords: tempe, splitted soybean





Microbiological studies of bacteria in vermicompost and selection of starter culture for vermicompost fermentation

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A total of 75 isolates were isolated from 6 samples of vermicompost and 1 sample of worm tea. Among them, 93.33% were Gram positive and 6.67% were Gram negative. All isolates were determined for their ability to produce 3 enzymes: Amylase, Caseinase and Lipase on Starch Agar, Skimmed milk Agar and Tween 80 Agar, respectively. Results shown that isolate TB 1/3 exhibited highest amylase activity whereas isolate TB1/9 gave highest caseinase activity and isolate TB4/3 gave highest lipase activity. On the other hand, isolate TB1/13 exhibited all three enzymes activity. These enzymes properties would be a key role in organic matter digestion in the soil. Therefore, further study was conducted on vermicompost fermentation for 3 weeks and samples were determined every week for total count, pH, Inhibition of *B. cereus*, *E coli*, *P. aeruginosa*, and *S. aureus* by Spot on lawn method. At the beginning, total count of vermicompost fermentation with TB1/3, TB1/9, TB4/3 and TB1/13 were 1.65×10^4 , 7.6×10^5 , 8.7×10^3 and 6.3×10^5 CFU/ml, respectively whereas the pH closed to neutral as 6.30, 6.19, 6.17 and 6.33, respectively. After 7 days of fermentation, total count of TB1/3, TB1/9 and TB4/3 were increased to 1.65×10^7 , 1.53×10^8 , 9.0×10^6 CFU/ml, except for TB1/13 total count were slightly decreased to 1.43×10^5 CFU/ml. However, the pH values were increased to 6.73, 6.83, 7.02 and 7.55, respectively. For antibacterial activity, no any sample showed inhibition against *B. cereus*, *E coli*, *P. aeruginosa*, and *S. aureus*. However, the experiment had to be continued until clearly state.

Keywords: vermicompost, worm tea, fermentation, antibacterial





Improvement of Bacterial Nanocellulose Production by Adapted Strain of *Komagataeibacter xylinus* MSKU 12

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Komagataeibacter xylinus is well known as a model for bacterial nanocellulose (BNC) production. The BNC is a biopolymer of β -(1, 4) glucose, which possesses unique properties such as high purity, high crystallinity, high degree of polymerization and high water holding capacity. Thus, it has been used in various fields of application such as food, cosmetic and biomedical devices. However, industrial BNC production and its application are still limited due to high-cost medium and low yield production. Thermotolerant *K. xylinus* MSKU 12, a promising strain for BNC production was previously isolated from rose apple in Thailand. The adapted C 37-10 strain was obtained from MSKU 12 by a repeating static cultivation for 10 generations (70 days) at 37°C in a low-cost medium, coconut water containing 1% acetic acid and 2% ethanol (CW-1A2E). The adapted C 37-10 strain showed higher and lower BNC production ability than the parental strain at 37°C and 30°C, respectively. In this study, we attempted to improve the C 37-10 strain to produce higher yield of BNC for industrial applications. The C 37-10 strain was sequentially cultivated under static culture for 20 generations (140 days) in CW-1A2E medium containing 0, 0.5 and 1.0% sucrose at 30°C. The adapted strains were selected as C 30-10, C0.5S 30-10 and C1S 30-10 from 10th generation, and as C 30-20, C0.5S 30-20 and C1S 30-20 from 20th generation. The efficiency of BNC production of the adapted strains were further determined and compared to C 37-10 and MSKU 12 in 50 ml of CW-1A2E medium containing 0.5% sucrose at 30°C for 7 days. The result showed that C 30-10 produced the highest amount of BNC of 12.74±0.5 g/L dry weight which was 6 and 3.8 fold higher than that of C 37-10 and MSKU 12, respectively. This result suggested that the effective-adapted strain was obtained, and it is worthwhile to be useful for high yield with low-cost production of BNC.

Keywords: *Komagataeibacter xylinus*, bacterial nanocellulose production, low-nutrient adaptation, coconut water





Screening of Phytase-producing Yeasts

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Forty eight soil samples were collected from agriculture area, community area, forestry area and other places in Thailand. They are screened for phytase-producing yeasts by using a phytase-screening medium supplemented with sodium propionate to inhibit filamentous fungi and chloramphenicol to inhibit bacteria and the phytase-producing yeasts were selected by observing clear zone formation around the colony. Twenty five isolates which can degrade phytate and form clear zone around the colony were selected. Further studies are carried on to isolate a wide variety of phytase-producing yeasts from other soils and evaluate their ability to degrade phytate in order to find the most promising yeast strain for phytase production.

Keywords: yeasts, soil sample, phytate





Detection of *Vibrio parahaemolyticus*, *Vibrio cholerae* and *Escherichia coli* O157:H7 by Multiplex Polymerase Chain Reaction (Multiplex PCR) Technique

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Vibrio parahaemolyticus, *Vibrio cholerae* and *Escherichia coli* O157: H7 are important foodborne pathogens. *Vibrio parahaemolyticus* causes food poisoning and enterocolitis, *Vibrio cholerae* produces cholera toxin that cause cholera while *Escherichia coli* O157: H7 produces toxin that cause diarrhea and hemolytic uremic syndrome. The objective of this study is to detect these three pathogens simultaneously by multiplex PCR. Three pairs of primers specific to target genes including *collagenase* gene for *Vibrio parahaemolyticus* which give DNA product size of 271 bp, *ompW* gene for *Vibrio cholerae* which give DNA product size of 427 bp and *rfbE* gene for *Escherichia coli* O157: H7 which give DNA product size of 193 bp. The optimal condition for multiplex PCR was determined. The result showed that the primers used were highly specific for each bacterium with no cross-reactivity. Sensitivity test for the detection of *Vibrio parahaemolyticus* and *Escherichia coli* O157: H7 were 10^2 CFU/ml and sensitivity for detection of *Vibrio cholerae* was 10^5 CFU/ml. In conclusion, multiplex PCR is a specific, sensitive, time-saving technique for simultaneous detection of *Vibrio parahaemolyticus*, *Vibrio cholerae* and *Escherichia coli* O157:H7.

Keywords: multiplex PCR, foodborne pathogen, *Vibrio parahaemolyticus*, *Vibrio cholerae*, *Escherichia coli* O157: H7





Antimicrobial Efficiency of Piperaceous Plant Extracts against Food-spoilage Microorganisms

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Growing consumer demand for natural preservatives to replace chemical substances, thus antimicrobial compounds from plants must be investigated for their potential to serve as biopreservatives. The member of piperaceous plants (*Piper*) or Sa Kan (Thai name) have long been regarded as a medicinal plants. In this research twenty-seven species of *Piper* from Thailand, which have been traditionally used as anti-inflammatory agents were examined for antimicrobial activities against food-spoilage microorganisms frequently found in food products (*Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* sp., *Shigella* sp. and *Serratia marscescens*). Antimicrobial properties of these piperaceous plants have not been studied. Out of 71 plant extracts of the species tested, an ethyl acetate extract of *Piper griffithii*, *Piper leptostachyum* and *Piper porphyrophyllum* showed antibacterial activity against Gram-positive bacteria, including *Bacillus cereus* and *Staphylococcus aureus*. The *Piper griffithii* leaf extract have the highest antimicrobial power against endospore-forming bacteria, *Bacillus cereus*, in a paper disc agar diffusion assay. Potential application of the *Piper* extract emulsion as a natural food preservative was evaluated. *Piper griffithii* has potential for developing and using as natural antimicrobial agents in food preservation.

Keywords: antibacterial activity, antimicrobial activity, food-spoilage microorganisms, *Piper*, preservative,





Quantification of Melittin and Histamine in Crude Bee Venom Extracts by Reverse-phase HPLC

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Bee stings can cause a severe allergic reaction, especially anaphylaxis, in human. Many components, including melittin and histamine, of bee venom have been shown to associate with allergic reactions. Melittin, a 26-amino-acid peptide, is a major component found in bee venom. Histamine, the only biogenic amine in bee venom, was reported to contribute to allergic reaction. In this study, we are interested in quantifying the amount of melittin and histamine in crude bee venom extracts. Here, crude protein content was evaluated by Bradford assay. Then, crude bee venom extracts were analyzed by glycine-sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and tricine-SDS-PAGE. The result of glycine-SDS-PAGE and tricine-SDS-PAGE showed a protein band at 3 kDa, the expected size of melittin. Total amount of melittin and histamine in crude bee venom extracts were examined by reversed-phase high-performance liquid chromatography (RP-HPLC) using silica-based C18 column. The HPLC conditions were optimized for quantification of melittin and histamine. In addition, derivatization of histamine with dansyl chloride at different histamine concentrations were modified to generate a standard curve. The identities of proteins were confirmed by liquid chromatography – mass spectrometry (LC-MS). This study can further be applied for quantification of melittin and histamine from different species of bee and wasp.

Keywords: bee venom, melittin, histamine, RP-HPLC





Functional Study of the *OsSALI* on Drought Tolerance Mechanism in Rice by RNA Interference

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Rice (*Oryza sativa* L.) is an economic crop that is important to Thailand and Khao Dawk Mali 105 (KDML) 105 is the most popular rice varieties. Currently, due to the drought situations, plants are under stress leading to a significant loss in productivity. Previous study reported that *SALI* is involved in drought tolerance in Arabidopsis. When *SALI* expression is decreased, the plants are more drought tolerant. In addition, two *SALI* homologues were found in rice, namely *OsSALI-1* and *OsSALI-2*. Therefore, this research aimed to study the function of *OsSALI-2* in KDML 105 rice by RNA interference (RNAi). Firstly, the *OsSALI-2::RNAi* plasmid was constructed, transformed into *Agrobacterium* prior to rice callus transformation. Then, plant regeneration was successfully obtained using a combination of 2,4-D and BA. Total RNA were extracted from rice plants, converted to cDNA and the expression of *SALI* was examined by semi-quantitative RT-PCR. The result showed that *OsSALI-2* expression is down-regulated in transgenic plants, compared to wild-types and the controls. These transgenic plants were next subjected to drought stress using different concentrations of mannitol (0mM, 100mM and 200mM). The shoot and root growth were measured at 0, 1, 3, 5, 7 and 10 days. Taken together, the results obtained from this work would be useful for drought tolerance improvement in rice in the future.

Keywords: drought, *SALI*, rice, RNAi





Expression and Purification of Antigenic Protein from Bacterial Disease in Nile Tilapia (*Oreochromis niloticus*)

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Nile tilapia (*Oreochromis niloticus*) is an important freshwater fish species in Thailand aquaculture. It provides a high protein source with less fat content. Tilapia consumption and exportation of tilapia is drastically increased in past few years. Due to several reasons, tilapia aquaculture is raising throughout the Country because of huge economic value. This fish species is classified as an omnivorous with easiness in handling, fast growing and rapid reproduction with few months after hatching. Recently production loss of tilapia culture was mentioned in many Countries including Thailand which lead to profits loss and cause several economically problems for local farmers. Currently, columnaris disease, an external or systemic infection, caused by *Flavobacterium columnare* and Aeromonad disease, caused by *Aeromonas spp.*, are predominantly epidemic disease effect on tilapia which difficult to control. Columnaris disease causes skin lesions, fin erosion and gill necrosis to the infected fish whereas Aeromonad disease causes an intestinal hemorrhage in which both diseases leading mass mortality of tilapia aquaculture. Therefore, to control both diseases, the combination of subunit vaccines is being used to control the dominant diseases in tilapia. In this study, antigenic proteins from both *F.columnare* and *Aeromonas spp.* were chosen to produce subunit vaccine. Only *Gliding motility lipoprotein J* gene (*Gldj*) from *F. columnare* were successfully amplified by polymerase chain reaction (PCR), then ligated to TA cloning vector for sequencing. Corrected DNAs were shuffled from TA vector to *Escherichia coli* (*E. coli*) expression vector for recombinant protein production, then transformed to *E. coli* BL21. IPTG was used to induce protein expression demonstrated overexpressed proteins of 65 kDa in size which confirmed by Western blot analysis. Affinity column was brought up for protein purification showing approximately 65 kDa. The purified protein will use in vaccine development against the bacterial infection from both *F.columnare* and *Aeromonas spp.* to reduce the problem which causing the production loss in tilapia aquaculture.

Keywords: aeromonad, antigenic protein, Columnaris, Nile Tilapia





Development of Vaccine Delivery System for Fish

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Oral vaccination has known for their easiness in manipulation, less stress compared to injection vaccine. Within the past decade, a lot of study shown that oral vaccine falls short in building up protective immunity compared with the injection vaccine. Biodegradable polymeric nanoparticles such as chitosan have a lot of potential to serve as antigen delivery system for oral vaccines. In this study, natural polysaccharide with biodegradability, non-toxic and biocompatibility such as chitosan was brought up to use as material with unique poly-cation characteristic which could bind to proteins in stomach with electrostatic interaction.

In this study, SIP protein, previously used as subunit vaccine against Steptococcosis disease in fish, was encapsulated in chitosan nanoparticles to be use as oral vaccines for Nile Tilapia via ionic gelation of tripolyphosphate (TPP) and chitosan. The optimum entrapment efficiency obtained was 65.20% by using 1 mg/ml of chitosan with 91% deacetylation and 1 mg/ml of TPP with mass ratio 3:1. *In vitro* release shown 69.93% of SIP protein was released over 72 h post incubation with phosphate buffer saline (PBS) pH 7.4. The releasing of SIP protein shown to burst out with in the first 12 h with 54.23%, followed by slow releasing which raised approximately 16%. These studies suggest that chitosan nanoparticles might serve as an alternative way of oral vaccination which can provide greater efficacy than traditional way of oral vaccines and might be huge change for disease therapeutic in aquaculture.

Keywords: oral vaccination, cChitosan, nanoparticles, antigen delivery system





Development of Detection Kit for Feline Immunodeficiency Virus

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Feline immunodeficiency virus (FIV) is a member of lentivirus group in the family *Retroviridae*. It's worldwide infection in domestic cat which can cause of chronic diseases. The FIV-infected Cats may not show any symptom until after years of infection. However, their immune system are weak, this makes that cat susceptible to secondary infection and opportunistic infection. Therefore, this study aimed to develop a rapid and convenient method for detecting FIV antibodies based on the specific antigen and antibodies binding, by detecting antibodies to p15 (matrix protein) and p24 (capsid protein).

In this study we generate the viral proteins, p15 and p24 in bacterial system by transform the constructed plasmid to *Escherichia coli*. (BL21). From the optimization, 0.2 mM of isopropyl β -D-1-thiogalactopyranoside (IPTG) were used for expression the viral protein. Protein purification was done by Ni^{2+} -column chromatography, and confirmed the band of protein by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). The result showed that the size of purified p15 and p24 were 15 and 24 kDa, respectively. The purified proteins (p15 and p24) were used for detected IgG antibodies from the FIV-infected cats by enzyme-linked immunosorbent assay (ELISA). The concentration of proteins and serum dilution by observing the absorbance at 450 nm were optimized. 10 $\mu\text{g/ml}$ of protein and 1:100 of serum dilution were found to be the optimum condition for ELISA. For detecting FIV antibodies in the cat serum, the result indicated that the amounts of IgG antibodies are response to p15 and p24 different in each cat. Then both proteins were mixed together for ELISA experiment. The same positive results were confirmed. The quantity of antibodies and specificity were finally confirmed by Western blot analysis by using anti-cat IgG antibodies. In conclusion, our result indicated that the bacterially expressed p15 and p24 bind specifically to cat FIV antibodies in serum and the amount of IgG are different in each cat.

Keywords: Feline immunodeficiency virus (FIV), FIV detection kit, p15 and p24





Effect of Temperature on the Anthocyanin Content in Mulberry

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Mulberry (*Morus spp.*) is a medium-sized shrub, growing well in tropical countries, especially in Thailand. The mulberry fruits are filled with important nutrients, including vitamins, minerals and anthocyanins. Anthocyanins are group of compounds with some biological activities such as antioxidant, anti-microbial, neuroprotective, cytoprotective agents and lowering the risk of cardiovascular disease. This research therefore aimed to investigate the effect of low-temperature stress on anthocyanin content in mulberry fruits. Firstly, the fruit samples were harvested and stored at -80°C , -20°C , 0°C and 4°C . Then, the anthocyanin content was determined using High Performance Liquid Chromatography (HPLC) method. The results showed that the samples kept at -80°C have increased cyanidin-3-glucoside and malvidin-3-glucoside, major anthocyanins found in plants, when compared to other temperatures. Next, *Anthocyanin synthase* (*ANS*), a gene involved in anthocyanin biosynthesis was cloned and characterized. Furthermore, cell suspension culture has been established for mulberry plants using callus grown on Murashige and Skoog (MS) media supplemented with 6-benzylaminopurine (BAP) and 2, 4-dichlorophenoxyacetic acid (2,4-D) in a ratio of 1:1. This cell suspension culture can be used as a model system to study anthocyanin biosynthesis and for production of secondary metabolites of interest.

Keywords: mulberry, anthocyanin, *ANS* gene, cell suspension





Site-directed Mutagenesis of Beta-glucosidase to Release Isoflavones in Soybean

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β -Glucosidases are enzymes that catalyze the hydrolysis of a β -glucosidic bond linking between glucose with other compounds. β -Glucosidases from different species show different specificities to various substrates. In this study, we compared hydrolytic properties of 3 types of β -glucosidases, which are Dnbglu2 from *Dalbergia nigrescens* Kurz (blackwood), dalcocinase from *D. cochinchinensis* Pierre (Thai rosewood) and GmICHG from *Glycine max* (soybean), which are all from leguminous plants and share between 60-80% amino acid sequence identities. GmICHG was most efficient in hydrolysis of isoflavone glucosides with a modifying group, while Dnbglu2 was most efficient in hydrolysis of isoflavone glucosides without a modifying group. The abilities of these enzymes in hydrolysis of soybean isoflavone glucosides to release free isoflavones can be used to improve nutritional values of soybean food products, because free isoflavones are better absorbed in the small intestine and exhibit greater bioactivity than the glucoside forms. So, human can gain more health benefits from consumption of isoflavones from soybean food products. In this study, we generated new β -glucosidases by changing the amino acids located in the substrate binding pocket of Dnbglu2 to the corresponding residues of GmICHG. These amino acids had been shown to be important for hydrolysis of soybean isoflavone glucosides. Thus, single and double mutants, D400N and D400N/S454F, respectively, of Dnbglu2, were constructed. These mutant constructs were transformed into *Escherichia coli* (DH5 α), confirmed by DNA sequencing, and then transformed into *Pichia pastoris*. Both mutant β -glucosidases were expressed when induced with 0.5% (w/v) methanol, and purified by hydrophobic interaction chromatography and immobilized metal affinity chromatography. The purified enzymes exhibited an apparent molecular weight of 66 kDa. We hope that replacement of amino acid residues of Dnbglu2 with the corresponding residues of GmICHG, would help enhance their efficiencies in hydrolysis of soybean isoflavone glucosides with a modifying group.

Keywords: β -glucosidase, isoflavone glucoside, isoflavone, soybean, Dnbglu2





Expression and Purification of Single-stranded DNA Binding Protein from *Sulfolobus solfataricus* for Application in Long Range PCR.

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DNA polymerase is an enzyme that is most important for the synthesis of DNA *in vivo*. The thermostable forms of DNA polymerase derived from thermophilic organisms have been used in polymerase chain reaction (PCR). The limitation of *Taq* DNA polymerase in PCR is that the enzyme fails to amplify DNA fragment greater than 5 kb because this enzyme lacks of the 3' to 5' exonuclease activity (proofreading). This project is interested in the application of single-stranded DNA binding protein (SSB) isolated from the Archaeon *Sulfolobus solfataricus* (Sso) in improving the size of DNA that can be amplified in PCR. Therefore, *Taq* DNA polymerase and single-stranded DNA binding protein were purified. *Taq* DNA polymerase was purified from 12 liters of BL21 carrying *pTaq* by heat treatment, ammonium sulfate fraction, and DEAE-cellulose chromatography. This purification protocol resulted in 80 mg of sufficiently pure enzyme. Similarly, single-stranded DNA binding protein was purified from 6 liters of BL21 (DE3) + RIL carrying pET-ssDNA binding protein by heat treatment, ammonium sulfate fraction, and DEAE- cellulose chromatography. The effect of single-stranded binding protein on the length of DNA fragment that can be amplified by *Taq* DNA polymerase will be examined.

Keywords: DNA polymerase, long and accurate PCR





Optimization for Recombinant Ribosome Inactivating Protein (RIP) Production from *Jatropha* in *E. coli*

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Ribosome inactivating protein (RIP) is classified as a toxic protein because it can inhibit the synthesis of proteins within the cell by cleaving the glycosidic bonds on the ribosomal RNA at specific residue. RIPs are proteins with several of biological activities such as enzyme, antibacterial activity, antifungal activity, inhibition of viral replication, and anti-insect activity. It can also prevent the growth of cancer cells. RIP proteins are found in many plants, including *Jatropha*. It is found in seed kernel, seed coat and leaves. Because this protein has many bioactive properties, it is of interested to develop this proteins for further applications. However, the preparation of RIP protein from the tissues of *Jatropha* is difficult due to its low recovery yield. Thus, the production of recombinant proteins using *E. coli* as a host is an alternative choice for preparation of the RIP protein. Recombinant protein production in *E. coli* host requires optimization of the induction process. Therefore the aim of this study is to optimized the induction conditions to produce RIP protein in *E. coli*. In this study, the attempts were made to produce 2 RIP proteins, 28 SK and 34.7 (A) SK. The induction conditions were varied including IPTG concentrations and induction temperature. Concentration of IPTG were 0.1, 0.2, and 0.5 mM and the induction temperatures were 25, 30, 37°C. All of the induction conditions were carried out for 3 hours. We found that the suitable induction condition for 34.7 (A) SK was 0.2 mM IPTG at 25 and 30°C. However we were unable to induce the protein of 28 SK protein in all tested conditions. From this study, we were successfully produced recombinant RIP protein which would be feasible us for further large-scale protein production.

Keywords: ribosome inactivating protein (RIP), *Jatropha*, recombinant protein production





Biological Activities of Protein Extracts from Silkworm Pupae against NCDs

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Non-communicable diseases or NCDs, such as cancers, diabetes, hypertension and Alzheimer's disease, are public health issues of our country and lead increasingly cause of deaths. However, NCDs can be prevented. Previous studies have shown that silkworm pupae which are a waste product after silk drawing, contain high quality proteins and can be used in medicine. This research is interested in studying biological activities of protein extracts from silkworm pupae against NCDs. Two species of silkworm pupae were used; Thai-multivoltine silkworm pupae, *Bombyx mori* (Nanglai strain) and Wild silkworm pupae, *Samia ricini* (Eri). The following *in vitro tests* were designed to determine the *biological activities of protein extracts from silkworm pupae* including anti-inflammation by inhibition of albumin degradation, anti-diabetic properties by α -amylase and α -glucosidase inhibition tests, antioxidant activities by 2,2-diphenyl-1-picryl hydrazyl (DPPH) and ferrous ion chelating, and anti-cholinesterase activity by quantifying the acetylcholinesterase (AChE) inhibitory activity. All assays were evaluated using inhibitory concentration (IC_{50}) value. The results indicated that protein extracts from Nanglai and also Eri showed all inhibitory activities. Anti-inflammatory assay showed that Nanglai ($IC_{50} = 65.63 \pm 5.99 \mu\text{g/ml}$) had stronger activity than Eri ($IC_{50} = 121.45 \pm 5.81 \mu\text{g/ml}$). Nanglai and Eri exhibited relative high anti-diabetic activities to α -amylase with IC_{50} values of $36.15 \pm 7.29 \mu\text{g/ml}$ and $42.69 \pm 5.42 \mu\text{g/ml}$, and to α -glucosidase with IC_{50} values of $14.11 \pm 9.41 \mu\text{g/ml}$ and $11.96 \pm 7.42 \mu\text{g/ml}$, respectively. Further evaluation of antioxidant activities to ferrous ion chelating and DPPH showed that Nanglai ($IC_{50} = 10.24 \pm 3.53 \mu\text{g/ml}$ and $335.58 \pm 4.98 \mu\text{g/ml}$, respectively) revealed better activities than Eri ($IC_{50} = 14.97 \pm 3.92 \mu\text{g/ml}$ and $340.15 \pm 6.07 \mu\text{g/ml}$, respectively). Finally, determination of acetylcholinesterase inhibitory activity shows that Nanglai had lower IC_{50} value ($74.88 \pm 9.85 \mu\text{g/ml}$) than Eri ($110.45 \pm 11.13 \mu\text{g/ml}$). The results of this study indicated that protein extracts from silkworm pupae had biological activities against most causes of NCDs, offering a possibility of prevention and treatment of NCDs in the future.

Keywords: Silkworm pupae, Biological activities, NCDs





Evaluation of Antioxidative Properties of Protein Hydrolysate from Thai Rice

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Rice is a staple food for Thai people. It is rich in nutrients such as carbohydrates, vitamins, and proteins. The proteins in rice are digested in stomach and duodenum of small intestine by pepsin and trypsin, respectively, giving protein hydrolysate. The rice protein hydrolysate has recently been reported to have antioxidant activities. Thus, this study aims to investigate and compare the antioxidant activities of rice protein hydrolysates that were prepared from two different methods which are sodium dodecyl sulfate (SDS) and alkali protein extraction. Five different varieties of rice in this study are Hom Lao, Hom Surin, Nok khao, Khao Rhi, and Hom Mali. The protein hydrolysates were prepared by digestion of proteins with pepsin and trypsin, respectively according to a digestive system. Then, the antioxidant activities including DPPH, ORAC, and DNA damage assays were determined. The alkali extraction yielded higher amount of total proteins than the SDS extraction evaluated by Lowry method. Also, a PAGE technique revealed that proteins that were extracted from both methods rendered different protein patterns. Moreover, based on the DPPH assay of protein hydrolysate from SDS extraction, Hom Mali demonstrated the highest percentage of scavenging activity followed by Hom Lao, Hom Surin, Nok khao and Khao Rhi, respectively. ORAC and DNA damage assays are currently being investigated.

Keywords: rice, protein hydrolysate, antioxidative peptide, antioxidant activity





The Simulation of Tyrosine Kinase Protein in EGFR Cause of Drug Resistant by Computational Program

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Epidermal growth factor receptor (EGFR) is a protein receptors that belongs to the transmembrane receptor tyrosine kinase (RTK). Which have the important roll about cell signaling. The functions of the EGFR associated with cell growth, cell survival, and cell multiplication. When EGFR abnormal it causes of cancer. So EGFR is a target of drug for therapy in cancer. Currently there are several drugs that can bind to specific EGFR but they loses the capacity for inhibit the functional of EGFR because the mutation of EGFR at the binding site of drug. The drug does not effective to treatment so have to change the drug for further treatment.

In this experiment want to study about the mutation of EGFR at binding site of many drugs which EGFR target. So in this study focus on the important amino acid at the binding site of drugs (Afatinib, Erlotinib, Gefitinib and Lapatinib) by the computational method. We used the EGFR template from PROTEIN DATA BANK PDB) for simulation at the binding site of EGFR and drugs by protein MODELLING TECHNIQUE and MODELLER TECHNIQUE. And then we used GOLD 5.5 program for simulation the binding of EGFR mutation with each of drugs. The result from this study will present important data for develop drug that target with EGFR and prevent the lose function of drug if EGFR will mutant in patient have cancer.

Keywords: epidermal growth factor receptor (EGFR), MODELLER, cancer and gold 5.5





Characterisation of Titin Isoforms and their Localisations in Side-specific Aortic Valve Endothelial Cells.

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Titin protein presents in many cells such as cardiac cells and epithelial cells. Mutations of titin have been found in dilated cardiomyopathy (DCM) and hypertrophic cardiomyopathy (HCM). Titin in different organelles such as cytoplasm and nucleus has its own specific function. In addition, titin has several isoforms in the cells. For example, human cardiac titin contains N2BA and N2B isoforms. However, whether specific isoform of titin is presented in specific organelle has not been studied yet. Therefore, this study aimed to investigate titin isoforms in cytoplasm and nucleus of valve endothelial cells on the aortic side (aVEC) and the ventricular side (vVEC) of the porcine aortic valves. The cells were side-specifically isolated from each side of the valves by frozen-plate technique. Subsequently, cytoplasmic and nuclear protein extraction was performed by using Nuclear Extraction kit. Protein concentration from each organelle was quantitated by Proteoquant™ Proteome Quantification Assay Kit followed by Western blot analysis of titin isoforms. The results showed that the amounts of protein from pooled samples (3 aortic valves) of cytoplasm and nucleus of aVEC were 31.1 ± 2.6 and 48.4 ± 2 μg (2 replicates), respectively. The amounts of protein from cytoplasm and nucleus of vVEC were 37.9 ± 6.6 and 40.1 ± 0.8 μg (2 replicates), respectively, which was not much different from those of aVEC. These amounts of organelle-specific proteins from minimum 3 aortic valves were sufficient to carry out the further investigation of titin isoforms by Western blot.

Keywords: titin, isoforms, organelle specific, aortic valve endothelial cells





Characterization of Proteins in Response to Hydrophobic Substrate in *Yarrowia lipolytica*

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Yarrowia lipolytica is yeast that can grow in media containing lipid and *n*-alkanes. However, the controls of lipid metabolism and alkane degradation in yeast have not been completely revealed. From previous studies, fatty acid metabolism of *Y. lipolytica* is controlled by the major transcription factors Por1p and Cfu1p. Moreover, Snf1p is recently known as a regulator of lipid accumulation in this yeast. First, to investigate the other functions of Snf1p in lipid metabolism and alkane degradation, the growth of $\Delta snf1::ADE$ was analyzed on media containing different hydrophobic substrates. The results showed that $\Delta snf1::ADE$ was unable to grow on decane, dodecane, tetradecane, hexadecane, while having the partially defective growth on media containing lauric acid, myristic acid, palmitic acid. Next, to investigate the association of Snf1p in the transcriptional regulation of genes in β -oxidation pathway, the expression of *LacZ* under the control of promoter of *PAT1*, a gene encoding enzyme in the final step of β -oxidation pathway, was analyzed by β -galactosidase assay. The result showed that β -galactosidase activity of $\Delta snf1::ADE1$ was lower than that of CXAU/AI in media containing oleic acid and decane, thereby suggesting that Snf1p is possibly involved in the control of *PAT1* expression.

Keywords: *Yarrowia lipolytica*, Snf1p, lipid metabolism, alkane degradation





Study of Salt-responsive Proteins in Salt Tolerant Rice Strains

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Thailand is an agricultural country where rice is a main crops exported worldwide. Saline soil is one of the major problem which effects the growth and yield of rice. There are many ways to overcome this problem. One way is to develop salt-tolerant rice varieties. To understand the salinity responses in the tolerant lines, four rice varieties were selected. Thai jasmine rice 105 (KDML 105), Pokkali, CSSL16 and CSSL106. The latter two strains are the chromosome substitution lines of rice with KDML105 genetic background. The rice were screened for salt tolerance at seedling stage by planting in hydroponic solution with 150 mM sodium chloride for eight days. Under salt treatment, all of the varieties displayed the stress symptoms where the tips of the leaves turn white or curled. The growth were severely retarded whereas no leaf symptoms was observed in an absence of salt. Leaf protein was extracted before analyzing by sodium dodecyl sulfate polyacrylamide gel electrophoresis. We found that under the control treatment without NaCl, there are differential protein patterns in all samples examined. But the changes of protein expression was clearly observed in the Pokkali under salt treatment which might indicate the alteration of the salt-responsive proteins in the salt tolerant strain. The data obtained from this study preliminary indicate the difference in the protein profiles of the salt-tolerant rice compared to that of the salt-sensitive one.

Keywords: salt tolerance rice, KDML105, seedling stage, Pokkali





Effect of Garden Balsam (*Impatiens balsamina* L.) Extracts on Fungal Infection of Rice

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Garden balsam (*Impatiens balsamina* L.) is widely used as an ornamental plant in landscaping. Different parts of this plant are used traditionally to treat skin diseases. The objective of this study is to determine the total phenolic content and effect on ethanol crude extract of garden balsam on rice disease. There are many rice diseases in Thailand caused by fungi; i.e dirty panicle disease (*Curvularia lunata*), brown spot disease (*Bipolaris oryzae*) and rice blast disease (*Pyricularia oryzae*). The screening of the antifungal activity of extracts from six parts of this plant was conducted by a disc diffusion test. The most active extracts was the extract from the pericarp of garden balsam that can inhibit *Curvularia lunata*. The inhibition diameter is equal to 46 mm. The pericarp extract concentrations are 11.3, 8.5 and 6.8 mg/ μ l which showed the total phenolic compound 157.31, 126.48 and 97.72 ppm GAE respectively.

Keywords: fungal infect rice, garden balsam, phenolic compound, rice disease





Water Limitation Affects Photosynthesis and Yield of Aged Chili Plants

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Chili (*Capsicum frutescens* L.) is an important economical plant used as a component of many foods. Normally, yield of chili plant increases in 3-6 months after planting and then decreases later. In order to improve yields in the aged plants, a good maintenance is required including irrigation. To assess whether deficit irrigation treatments affect aged chili plants, we investigated the effects of water limitation on some physiological parameters and yield of aged chili plants. In this study, 5-month-old TVRC 758 plants were regrown and subjected to different watering periods including everyday (control), 3 days and 5 days for 36 days. The results showed that various water limitations decreased the relative water content (RWC), especially 5 days watering treatment on 36 days which had the lowest trend; however, they are not significantly different as compare to the control. The chlorophyll contents (chlorophyll a,b and total chlorophyll) in plants grown under water limitations were reduced faster than that of the control. Furthermore, the water limitations decreased the number of flower but they are not significantly different as compare to the control. Number of fruit and percentage of fruit set of the 5 days watering treatment which had the lowest different as compare to the control. However, the fruit weight did not influence by water treatments. In conclusion, 5 days-watering treatment decreased chlorophyll concentration, number of fruit and percentage of fruit set, while yield of plants under 3 days-watering period was not different as compare to the control. Accordingly, water limitation for 3 days can be performed in aged chili plants.

Keywords: chili, aged plant, water limitation, chlorophyll content, yield





Comparative Phytochemistry of *Polyalthia debilis* (Pierre) Finet & Gagnep. and Its Antifungal Activity against Fungi Cause Diseases in Agricultural Products

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Comparative phytochemical analysis of *Polyalthia debilis* (Pierre) Finet & Gagnep. has been done during March 2017 to March 2018. The aim of this research is to make the chemical profiles of each plant parts and use them as chemical characters of *P. debilis*, in order to support the taxonomy of this plant. Moreover, it is interesting to look for potential of this plant which may be source of antifungal substances for fungi cause diseases in agriculture products. Three plant samples were collected from Kasetsart University, Sriracha campus and each individual was separated into two parts, stem bark and leaves. All plant parts were extracted and separated into lipophilic and hydrophilic extracts between chloroform and distilled water respectively. The lipophilic extracts were analysed by mean of chromatographic methods i.e. Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC). The results showed chemical profiles from TLC and HPLC which were specific to each plant parts (stem bark and leaves). From TLC analysis some groups of compounds could be detected by using specific reagents and observed the colour appearance and also colour changing. Terpenes, phenols, steroids, sterols, sugar and coumarins could be detected in the extracts from stem bark and leaves, no appearance of alkaloids. All lipophilic plant extracts were tested for antifungal activity using bioautography technique. It was shown that all plant extracts at the concentration 10 mg/ml were inactive against all tested fungi: *Aspergillus flavus*, *A. flumigatus*, *A. parasiticus*, *Lasiodiplodia* sp. and *Colletotrichum* sp. In conclusion, lipophilic extracts from *P. debilis* showed specific chemical character of each plant part (stem bark and leaves) and this information will support plant identification.

Keywords: *Polyalthia debilis*, comparative phytochemistry, antifungal activity





Morphology and Anatomy of the Genus *Peltophorum* (Vogel) Benth. (Fabaceae, Caesalpinioideae) in Thailand

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A morphological study of the genus *Peltophorum* (Vogel) Benth. (Fabaceae, Caesalpinioideae) in Thailand was conducted from July 2017 to May 2018. Two species are enumerated, *Peltophorum dasyrachis* (Miq.) Kurz and *P. pterocarpum* (DC.) Back. ex Heyne. Morphological descriptions, distributions and ecological information are provided. A key to the species was constructed based on stipule, type and character of inflorescence, hairs on the base of petal, filament and style, shape of fruit and seed, length of pedicel, the presence or absence of petaloid stamen. *P. dasyrachis* has many-branched stipule, pendulous raceme, creamy white hairs on the base of petal, filament and style, elliptic fruit and lanceolate seed. Pedicels are 2.3–3 cm long and petaloid stamen is absent. While *P. pterocarpum* has bifid stipule, erect panicle, brown hairs on the base of petal, filament and style, ovate fruit or fusiform-like fruit with constriction between the seed and oblong seed. Pedicels are approximately 6 mm long and petaloid stamen is present. The distribution of 2 species are different; *P. dasyrachis* occurs in the North-eastern, Eastern, Central and South-eastern regions in dry evergreen forest and mixed deciduous forest, up to 400 m. elevation, whereas *P. pterocarpum* occurs in the Southeast and Southern regions along the coastal area or behind the mangrove forest, up to 100 m. elevation. According to anatomical characteristics, *P. dasyrachis* has two-layered palisade mesophyll cell. Its wood has 1–2-celled adjacent vessel and vasicentric parenchyma. While *P. pterocarpum* has one-layered palisade mesophyll. Its wood has 2–4-celled of adjacent vessel and aliform parenchyma.

Keywords: *Peltophorum*, Fabaceae, morphology, anatomy





Anatomical Characters of *Thespesia populnea* (L.) Soland ex. Correa and *Talipariti tiliaceum* (L.) Fryxel

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The anatomy of *Thespesia populnea* (L.) Soland ex. Correa and *Talipariti tiliaceum* (L.) Fryxel was studied. The primary growth and secondary growth stages of stems, leaves and petioles were collected. Permanent slides of the specimens were made using the paraffin method and observed under a light microscope. The results showed that the cortex of primary growth stems of *Thespesia populnea* and *Talipariti tiliaceum* deposit tannin and starch grains. Epidermis of *Thespesia populnea* modifies to peltate hairs. Secondary growth stems of *Thespesia populnea* and *Talipariti tiliaceum* contain collateral bundles. Typical stomata were observed on epidermis of both species. Hypodermis was found only in *Talipariti tiliaceum*. While mucilaginous cells were found only in *Thespesia populnea*. Angular collenchyma were observed in petioles of both species.

Keywords: anatomy, *Thespesia populnea*, *Talipariti tiliaceum*





Effect of Sunflower Pericarp Aqueous Extract on *Mimosa pigra* L.

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The use of synthetic chemicals for long-term weed control affect many aspects of the environment. Nowadays, biological substances from plants are used for weed control. In nature, sunflower release biological substances into the environment. These substances affect on growth of other plants. In this study, the effects of sunflower pericarp aqueous extract were investigated on seed germination, seedling growth of *Mimosa pigra* L. and mode of action of the extract, *Mimosa pigra* L. seed treated with the 10, 20 and 30% (w/v) of the extract for 5 days. The results showed that the extract didn't inhibit seed germination but delayed germination and inhibited seedling growth, especially root growth. Root length were 3.26, 2.32 and 1.56 centimeter, which were significantly different from the control (used distilled water as control). Mode of action of the extract was examined using *Mimosa pigra* L. as the tested plant. The result showed that the extract induced lipid peroxidation in *Mimosa pigra* L. seedling. The ultrastructure changes were determined by Scanning Electron Microscope (SEM). The result showed swollen root tip, epidermis peeled off and damaged root cap cells. From the result, the extract might be developed as bioherbicide for weed control.

Keywords: aqueous extract, delayed germination, *Mimosa pigra* L., sunflower pericarp





Comparative Phytochemistry of *Oldenlandia corymbosa* L. (Rubiaceae) and Its Antifungal Activity against Fungi Cause Diseases in Agricultural Products.

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Comparative Phytochemistry of *Oldenlandia corymbosa* L. (Rubiaceae) has been done during August 2017 to March 2018 by using chromatographic technique i.e. High Performance Liquid Chromatography (HPLC) and Thin Layer Chromatography (TLC). The aim of this research is to make the chemical profile of *O.corymbosa* (whole plant) and use it as chemical character in order to support the taxonomy of this plant. Moreover, it is interesting to look for potential of this plant which may be source of antifungal substances for fungi cause diseases in agriculture products. In this research plant samples were collected from three different habitats: Kasetsart University (Bangkhaen campus), Wat Khao Ban Dai It (Phetchaburi province) and Amphoe Phanom (Surat Thani province). The HPLC profiles of whole plant lipophilic extracts from *O.corymbosa* collected from three different habitats were similar. From TLC analysis some groups of compounds could be detected by using specific reagents and observed the colour appearance and colour changing. Terpenes, phenols, steroids, sterols, sugar and coumarins could be detected in all extracts except alkaloids. Antifungal activity of lipophilic extracts from all samples were screened with five agricultural product fungal i.e. *Aspergillus flavus*, *A.parasiticus*, *A.fumigatus*, *Lasiodiplodia* sp. and *Colletotrichum* sp. All lipophilic extracts could not inhibit those five agricultural product fungi. Accordingly, *O.corymbosa* is not appropriate source of natural antifungal substances for agricultural products.

Keywords: *Oldenlandia corymbosa*, comparative phytochemistry, antifungal activity





Morphology and Anatomy of Leaves in Some Species of the Genus *Cycas* L.

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Cycas spp. are gymnosperm plants in the family Cycadaceae. They are distributed all regions of the world. The comparative study on morphology and anatomy of leaves of fourteen species in the genus *Cycas*; *C. macrocarpa* Griff., *C. ferruginae* F.N. Wei, *C. aculeate* K.D.Hill & T.H.Nguyen, *C. tanqingii* D.Yue Wang, *C. rumphii* Miq., *C. conferta* Chirgwin ex Chirgwin & Wigston, *C. multifrondis* D.Yue Wang, *C. micholitzii* Dyer, *C. silverstris* K.D.Hill, *C. glauca* Hort. ex Miq., *C. tropophylla* K.D.Hill & P.K.Loc, *C. thouarsii* R.Br. ex Gaudich., *C. szechuanensis* W.C.Cheng & L.K.Fu and *C. micronesica* K.D.Hil. were investigated. It was found that all species have once-pinnately compound leaves and leathery. The anatomical characters are similar in all species. There are thick cuticle layers covered epidermis on both upper and lower sides of leaflets. Hypodermis presents only on upper side. Mesophyll comprises of palisade and spongy layers. Palisade layer was found on the upper side, meanwhile spongy was found on the lower side. Vascular bundles of all species are collateral bundles. Sunken stomata were found only on the lower epidermis.

Keywords: anatomy, *Cycas*, leaf





CrLIP4* Expression Analysis in *Chlamydomonas reinhardtii

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Petroleum is a key factor to drive world's economy. However, due to its price, its unsustainable nature and its effect on environment, many attempts have been carried out for new energy sources. Among a few alternatives, biodiesel from microalgae is a promising option. For the cost-effective production, yield must be improved by either increasing the rate of oil synthesis or inhibiting oil degradation. While many researches focus on the former, the latter has not received much attention. Breakdown of oil or triacylglycerol (TAG) starts by an action of a TAG lipase yielding diacylglycerol and free fatty acid. In the model microalga *Chlamydomonas reinhardtii*, more than a hundred genes were predicted as lipases. However, no TAG lipase has been characterized. A transcriptomic study revealed a few lipases could function as TAG lipases. One of them named *CrLIP4* is a homologue of Arabidopsis's TAG lipase. In this research, transcript level of *CrLIP4* was compared to TAG concentration in different growth conditions. The results showed that transcription level of *CrLIP4* and TAG concentration are inversely correlated. During N starvation when TAG accumulated, *CrLIP4* was down regulated. After N was reintroduced into the culture, TAG decreased and *CrLIP4* transcript increased back. This result suggested that *CrLIP4* plays a role in TAG mobilization in the microalga and it could be a target for improving oil yield in biodiesel production.

Keywords: *Chlamydomonas reinhardtii*, microalgae, oil, triacylglycerol





Wood anatomy and properties of species in the Family Ebenaceae in Thailand

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The family Ebenaceae are mostly trees which distribute throughout Thailand. Many species are valuable timbers. In addition, bark and heart wood can be used as medicines. Eight species of Ebenaceae woods were collected and investigated using a sliding microtome and tissue maceration methods. The results showed that all species are porous woods with solitary and multiple pores. There are three patterns of intervessel-pit arrangement; scalariform, opposite and alternate. Axial parenchyma appear in apotracheal diffuse, diffuse-in-aggregates, boundary and banded. Rays are uniseriate and multiseriate. Fibers are libriform.

Keywords: anatomy, hard wood, Ebenaceae





Anatomy of *Lycopodium* s.l. Found in Thailand

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Lycophytes or fern allies are belong to the family Lycopodiaceae. They are distributed across all regions of Thailand, especially in the rainy zones of Southern and Northern Thailand. The comparative anatomy of 6 species in the genus *Lycopodium* was conducted. The plant parts including shoot tips, stems, leaves, strobiluses and spores were used in this study. The results showed that the anatomical characters were similar except cortex and stele. It was found that the cortex of *L. carinatum*, *L. phlegmaria*, *L. nummularifolium* and *L. squarrotum* consist of only parenchyma while the cortex of *L. cernuum* and *L. clavatum* consist of parenchyma and sclerenchyma. In addition, *L. carinatum*, *L. phlegmaria*, *L. cernuum* and *L. clavatum* have plectostele while *L. nummularifolium* and *L. squarrosus* have actinostele. The data from this study can be used for species identification of the genus *Lycopodium*. Furthermore, the results support genera discrimination of the recent classification.

Keywords: morphology, anatomy, *Lycopodium* s.l.





Host Tree Characters Affect Occurrences of Epiphytic Bryophytes

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Bryophytes are a group of small plants. They do not have real vascular tissue in leaves, stem and root. However, there are important to the ecosystem. Nowadays, most ecological studies are from the temperate zone. Most studies about bryophytes in Thailand focused on taxonomy and diversity of bryophytes in different areas. The ecological studies of epiphytic bryophytes in Thailand are rather limited. This study examined the relationship between species, size and elevation of host tree and the species richness and cover of epiphytic bryophytes. We surveyed and estimated the cover of epiphytic bryophytes on 5 species of 968 host trees. The survey found 16 morphospecies of bryophytes. From the analysis, the richness and cover of bryophytes increased with the size and elevation of the host trees. But this was the case only for some host species. The results indicated that the type of host tree was an important factor for the occurrence of the richness and cover of epiphytic bryophytes. The results of this study provide additional information for further ecological studies of epiphytic bryophyte.

Keywords: Bryophyte, host trees, ecology





Production of Recombinant ATG12 Protein for Checking Autophagic Activity

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Autophagy is a degradative process of the intracellular component under stress leads to nutrient recycle and cell survival. Autophagy-related (ATG) proteins are essential in this process. Autophagy occurs by forming autophagosomes to enclose cytoplasmic content for degradation. The autophagosome formation requires an ubiquitin-like conjugation pathway with the interaction of two related proteins, ATG8 and ATG12. ATG8, one of the key autophagic proteins, has been used as a molecular marker for autophagy process. Therefore, in this study, we produce the recombinant ATG12 protein for testing the use of ATG12 in checking autophagic activity. The *ATG12* gene (*CrATG12*), previously cloned from *Chlamydomonas reinhardtii*, was constructed into a vector to produce a recombinant ATG12 protein with GST- and HA-tagged at N-terminus and FLAG-tagged at C-terminus. In addition, a mutant CrATG12 recombinant protein with the last amino acid changed from glycine to alanine (CrATG12G/A) was also constructed. Both recombinant CrATG12 proteins (CrATG12 and CrATG12G/A) were expressed in *Escherichia coli* (BL21 strain) and purified using enzyme purification (GST fusion protein). The recombinant CrATG12 proteins can also be detected by antibodies specific to GST and HA. The conjugation activity of the recombinant CrATG12 to their target protein, ATG5, was checked using crude extract of *Chlamydomonas reinhardtii*. In summary, we can generate the recombinant CrATG12 protein as a tool for checking autophagy by monitoring the ATG12 conjugation to help better understand the autophagy process.

Keywords: autophagy





Detection and Genotyping of Dengue virus in *Aedes aegypti* Male Mosquitoes

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Dengue virus (DENV) is the cause of dengue diseases. Mosquitoes that carry dengue diseases are *Aedes* spp. especially *Aedes aegypti*. DENV is classified in the family *Flaviviridae*, the genus *Flavivirus* and there are four serotypes of DENV including DENV-1, DENV-2, DENV-3 and DENV-4. The DENV genome is consist of 5' UTR region, three structural (capsid (C), pre membrane (prM), and envelope (E)) and seven nonstructural (NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5) genes and ends with 3' UTR region. In this project, we aimed to detect the serotype of DENV in male *Aedes aegypti* from dengue epidemic areas. Mosquitoes were collected from Central (Bangkok, Pathum Thani, Nonthaburi, Lopburi and Suphan Buri), Eastern (Chanthaburi, Chachoengsao, Trat) and Southern (Songkhla) parts of Thailand. To determine DENV infection in male *Aedes aegypti*, we started by identifying sex and mosquito's species and extracting RNA from 13 pools of male mosquitoes. The RNA samples were converted into cDNA using reverse transcription polymerase chain reaction with Super Script®III First-strand synthesis and a dengue specific primer named D2RV5. Then polymerase chain reaction (PCR) technique was applied to amplify a C-prM gene junction. Agarose gel electrophoresis was used to separate DNA fragments according to their size. Then second PCR was performed to amplify fragments within the polyprotein gene. Agarose gel electrophoresis was used to separate DNA fragments and the PCR products were purified. Finally, DNA sequence of DENV was determined by Sanger sequencing method. Two samples from Songkhla; named Song1 and Song2 were achieved to get DENV sequences. The BLAST results showed that they were DENV-2 and their sequences were matched to DENV-2 from Laos.

Keywords: Dengue virus, *Aedes aegypti*, male mosquito





Population Structure of the Short Mackerel, *Rastrelliger brachysoma* (Bleeker, 1851) from Spawning Grounds in the Gulf of Thailand

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Rastrelliger brachysoma, short mackerel, is a highly economically important fish in Thailand. This is due to its highly nutritious and preferably consumed by Thais. At present the short mackerel resources in The Gulf of Thailand are noticeably declined. Conservation plan and resource monitoring are thus urgently required for sustainable fishery. This study was conducted to study fully mature short mackerel collected from spawning grounds in the Gulf of Thailand. The short mackerel individuals were analyzed for 10 microsatellite markers. The achieved genotypic data was then compared to the previous data of mackerel collection 2016. Genetic diversity and population structure are being analyzed and detail will be discussed. The achieved information will be added to the government fishery information to facilitate conservation plan of the short mackerel in the Gulf of Thailand.

Keywords: short mackerel, population structure, microsatellite marker, the Gulf of Thailand





Genetic Code on the Mitochondria of *Betta mahachaiensis*

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Betta mahachaiensis is freshwater fish endemic to Thailand. It was reported as a new species of the world in 2010 and was also classified as critically endangered for conservation status. This research was done to reveal genetic codes on mitochondrial genome. The laboratory process began with the genomic DNA extraction from the fish sample. Then, specific primers were designed to amplify mitochondrial fragments and nucleotide sequences were assembled to a long chain of mitochondria. The last step was to identify gene localization. To date, the mitochondrial genome of *B. mahachaiensis* is not yet complete. From the assembled mitochondrial fragment 6745 base pairs sequenced here (39.7% of expected complete mitochondrial length), 7 protein coding genes, 12 *t-RNA* genes and the *origin of replication* were found. Among these genes, *ND1* and *t-RNA_{gly}* genes were still partial sequences. The data from this study can be used for evolution study of fishes in Genus *Betta*.

Keywords: *Betta mahachaiensis*, mitochondria, genome, endemic





Genetic Diversity of Firefly, *Pteroptyx malacca* (Coleoptera; Lampyridae) in Thailand

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Fireflies are a member of the beetle family Lampyridae. They have long slender soft-body and bioluminescence abdomen. In some countries including Thailand, fireflies can be considered as one of the main ecotourism attractions. Fireflies can also be used as a biological indicator as they can only survive in relatively clean and undisturbed habitats. *Pteroptyx malacca* is one of the firefly species abundantly found in the tropical mangroves. This firefly species has a unique synchronous flashing behavior which can attract tourist attention. In this study, we aim to assess genetic diversity and population genetic structure of *P. malacca* distributed throughout Thailand. Mitochondrial *Cytochrome oxidase I (COI)* and *Cytochrome b (CytB)* genes were amplified from 79 *P. malacca* specimens. The DNA sequences were analyzed, and phylogenetic tree were constructed using neighbor-joining (NJ) and maximum likelihood (ML) methods. Genetic structures of population will be analyzed to identify the status of this *P. malacca* in Thailand.

Keywords: firefly, cytochrome oxidase I, cytochrome b





Evolution of Dictyostelids *mtcox1/2* Gene and its Relationship to *mtcox1* in other Amoebozoa

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Dictyostelids are unicellular eukaryotes belonging to supergroup Amoebozoa. They generally live in soil and eat bacteria. Their life cycle has both unicellular and multicellular state which these organisms enter the latter state when there is food shortage. In general, this group of organisms is classified based on their morphologies and/or nucleotide sequences of 18S rDNA. It is noteworthy that *mtcox1* gene has been widely used for species identification, especially in metazoans. For amoeba, nucleotide sequence of *mtcox1* gene has been proposed for identifying species belonging to a group of arcellinid testate and vannellid naked amoebae. Hence, this study aimed to examine whether the *mtcox1* gene sequence can be applied to identify Dictyostelids' species. In order to achieve this goal, we first attempted to understand the evolution of this gene in Dictyostelids. Because some Dictyostelids carry a fused *mtcox1/2* gene—a join *mtcox1* and *mtcox2* gene, *mtcox1/2*, *mtcox1* and *mtcox2* gene sequences of five Dictyostelids' species and five other amoebas were collected from GenBank database. The comparison of these genomic sequences showed that introns were observed only in Dictyostelids. No orthologous intron was observed between different subgroups and a few orthologous introns were observed within subgroup of Dictyostelids. The phylogenetic trees reconstructed based on amino acid alignments of *mtcox1/2*, *mtcox1* and *mtcox2* gene of all amoebas included in this study showed that these genes could be applied for species identification and *mtcox1* could be used for distinguishing Dictyostelids from other amoebas. These results suggested that the evolution of *mtcox1* and *mtcox2* genes in Dictyostelids are quite complicated and more sequences are required to completely understand the evolution of these genes in this group of eukaryote.





Co-evolution of Fungus-growing Termites and their Symbiotic Partners

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Fungus-growing termites in the subfamily Macrotermitinae have an obligate symbiosis with termite mushrooms in the genus *Termitomyces*. Fungus gets protection and maintain by termites while termites eat fungal spore for their food source. Fungal spores can form mushrooms for sexual reproduction. Nowadays, termite mushrooms are expensive because there are no mean of mushroom cultivation without termites. Despite its importance, little is known about the relationship between termites and termite mushroom in Thailand. Here, we study for the relationship between fungus-growing termites and their fungal symbionts of Thailand by using DNA barcoding technique for species identification. This study focused on identify species of *Termitomyces* in the gut of termites for revealing clear association between termite species and *Termitomyces* because one termite mound may have more than one pair of termite and termite mushroom species. From a total of 22 samples, we found ten species of fungus-growing termites cultured nine *Termitomyces* species. The relationship was found to be complicated because different *Termitomyces* species can be cultured by the same termite species, while the same *Termitomyces* species can be cultured by different termite species. Our result is in agreement with the process of the spreading of *Termitomyces* by termites via horizontal transfer.

Keywords: *Termitomyces*, DNA barcoding, termite mushrooms, ITS





Exploring New Targets from *Anopheles* to Inhibit Malaria Transmission

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Malaria is a serious disease caused by protozoa, *Plasmodium* spp. The *Plasmodium vivax* can survive in human's liver for many years. Human gets malaria by bites of an infected female *Anopheles* mosquitoes. Malaria is transmitted extremely in tropical and subtropical countries, for example Thailand. New target *Anopheles* genes that associated with *Plasmodium* development in the mosquitoes are required to find the drugs for blocking the malaria transmission. In previous study, the differential gene expression of the *P. vivax*-infected mosquito was performed. In this study, ten candidate *Anopheles* genes were selected from the transcriptome data. The expression levels of these genes were confirmed by qRT-PCR. The RNA was extracted from the infected *Anopheles* mosquitoes. The cDNA was synthesized and the qRT-PCR was performed using actin as a control. The qRT-PCR results of four genes were corresponded to the transcriptome data. These genes were assigned as the candidates to further characterize their functions whether they are important for *Plasmodium* development.

Keywords: malaria transmission





Molecular Cloning of Repetitive DNA Elements in the Genome of Snakes

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Vertebrate genomes are characterized by the presence of a large copy number of repetitive sequences. A large fraction of site-specific repetitive sequences is composed of tandem repeated sequences known as satellite DNA (stDNA), which was indicated that have an important role in structure and functional significant in genome. In addition, the accumulation of repetitive DNA sequence in genome makes diversity and evolution of each organism. Recently, PBI-Msp1 repetitive DNA sequences was isolated from the Burmese python (*Python bivittatus*, Pythonidae). To investigate and characterize the evolutionary process of PBI-Msp1 in forty snake species (Henophidian and Caenophidian groups), Polymerase Chain Reaction (PCR) using PBI-Msp1 specific conserved sequences was conducted to elucidate their genomic organization. The polymeric ladder DNA bands were found in the genome of *Bungarus candidus*, *Bungarus flaviceps*, *Boiga dendrophila* etc. Cloning and sequencing are needed to clarify their relative evolution.

Keywords: repetitive sequence, satellite DNA, snakes





Development of Recombinant ATG8 as a Marker for Studying Autophagy in *Cucumis sativus*

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Autophagy is a degradative process that is important for balancing sources of energy in response to nutrient stress. One of the important proteins in this process is Autophagy-related protein 8 (ATG8). This protein is incorporated into autophagy-related membrane and is required for the formation of autophagosome to engulf the target proteins and organelles for degradation. Therefore, ATG8 can be used as a molecular marker for autophagic membrane. In this study, we developed the recombinant ATG8 as a marker for studying autophagy in *Cucumis sativus* by producing two recombinant proteins; mCherry-GFP-CsATG8a and GFP-CsATG8a. The *CsATG8a* gene was previously cloned from *Cucumis sativus*, whereas mCherry gene and GFP gene were amplified from 810-m50 and p63 plasmid, accordingly. These two recombinant proteins were subcloned into a vector (pCXSN-HA) via Ligation Independent Cloning (LIC) and transform to *E. coli* (XL1-BLUE). The constructs were analyzed for the presence of insert by cutting with BamHI and EcoRI/HindIII restriction enzyme, producing the product of 12,308 bp and 11,600 bp compared to 10,526 bp of empty vector. By sequencing the candidate plasmids using 35s seq4 and seq NOS2 primers located in the vector, we found that the recombinant protein was correctly subcloned in the vector. The vector was then transformed into plants using *Agrobacterium*-mediated gene transformation and selected for transformants using Kanamycin as a selectable marker. In summary, we have developed the recombinant CsATG8a protein as a marker to study autophagy in *Cucumis*, with hope to improve plant performance in the future.

Keywords: autophagy-related protein





Expression of *Phytochrome Interacting Factor 4 (PIF4)* in Oil Palm

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Oil palm is an economic crop for consumption and plays an important alternative energy resource in the future. The way to propagate the oil palm is tissue culture that take longer time than the other economic plants. Previously, studied molecular mechanism during somatic embryogenesis that shown the expression levels of *LEAFY COTYLEDON1 (LEC1)* was high during somatic embryo tissues in oil palm especially in globular and plantlet stage suggested the idea that *LEC1* gene is the important regulator for the embryogenesis and *PHYTOCHROME INTERACTING FACTOR4 (PIF4)* was identified to interact with *LEC1* in controlling the hypocotyl elongation of *Arabidopsis* in the dark-dependent manner. Our research aims to study expression of *LEC1* and *PIF4* genes during each somatic embryo stages including callus, globular, torpedo, cotyledon and plantlet stage using reverse transcription PCR (RT-PCR) method in oil palm. The results from this study will help us to understand the mechanism controlling somatic embryogenesis in oil palm.

Keywords: oil palm, *PHYTOCHROME INTERACTING FACTOR4*, somatic embryogenesis





Gene Cloning and Protein Expression of *Anopheles* Proteins those are Important for *Plasmodium* Development

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Malaria infection is caused by *Plasmodium* parasites. This disease is transmitted by the bite of infected female *Anopheles* mosquitoes. In this study, three *Anopheles* genes encoded for carboxypeptidase B (CPB), skeletor (SkeI) and antennapedia homeotic protein (Antp) are focused. CPB is essential for the sexual development of *Plasmodium* in the mosquito. Antp is a transcription factor which is part of a developmental regulatory system that regulates segmental identity in the mid-gut of the mosquito. The function of SkeI is still unknown. This study aimed to clone these three *Anopheles* genes and express them as recombinant proteins in *E.coli*. These three genes were synthesized using *E.coli* codon optimization. All of them were cloned into pH6HTC which the resulting recombinant proteins will have the Halotag as a fusion protein at the C-terminal. The recombinant plasmids were transformed into *E.coli*. The automated DNA sequencing of these genes was performed. The results showed that the CPB, SkeI and Antp are successfully cloned. Next step is the recombinant proteins production which is still further investigated.

Keywords: malaria, *Plasmodium* parasites, *Anopheles* mosquito





Application of mtDNA Sequence of Ancient Pigs to Understand the Livelihood of the Log-coffin Culture Community Who Used to Live in the Highland Pang Mapha, Mae Hong Son province, Thailand

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Many evidences of prehistoric community, such as earthenware, wooden loom and log coffins, have been observed in the highland Pang Mapha, Mae Hong Son Province, Thailand. Many log coffins containing human bodies and some sacrificed objects including pig bones were observed in the Long Long Rak cave—one of important archeological sites located in this area. This study aimed to gain insight into the livelihood of the ancient community who had the log-coffin culture via the study of genetic features of pig bones observed as sacrifices in the Long Long Rak cave. Ten ancient pig remains were collected from Long Long Rak cave and Tham Lod rockshelter—the late Pleistocene archeological site located nearby. DNA of these samples were extracted by using ZymoBead Genomic DNA Kit. The quality of these DNA samples were evaluated by applying polymerase chain reaction (PCR) to amplify partial sequence of mitochondrial control region (*mtCR*). We could get PCR products from two out of ten samples; however, the amount of PCR products were inadequate for Sanger sequencing. Hence, no partial sequence of *mtCR* were obtained from this study. We also submitted genomic DNA of LLR11 and TL4 samples collected from Long Long Rak cave and Tham Lod rockshelter, respectively for sequencing by a high-throughput sequencing platform. The results showed that 934,175 and 178,256 reads were obtained from LLR11 and TL4, respectively. No reads were mapped to the *Sus scrofa* mitochondrial genome (NC_000845.1); however, 0.2% and 0.8% of reads were mapped to nuclear genome sequence of *Sus scrofa* (*susScr2*). These results suggested that methods for DNA extraction, quality evaluation and sample preparation for sequencing are needed to be adjusted for highly degraded ancient remains collected in Thailand.

Keywords: ancient DNA, pig, mtDNA





DNA Extraction and Nucleotide Sequence Analysis of Ancient Cattle

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Ancient DNA refers to DNA extracted from ancient specimens. DNA can be recovered from ancient skeletal remains such as bones or teeth. Sometimes both of them are the only accessible sources which preserve DNA comparatively well for a long time. Most of DNA in ancient samples are mitochondrial DNA. Cells contain many thousands of copies of mtDNA, so it is easier to extract mtDNA sequences than nuclear sequences from degraded samples. This makes mtDNA particularly useful in ancient DNA study. Cows are one of the most economically important of domesticated animals. They help several humans' activities and produce many products. The importance of ancient DNA study is to uncover evolution, anthropology and population genetics. In our project, we used cow teeth from Ban Non Wat (NW) archaeological site dated 3,600-2,400 YBP. The site is a large prehistoric site located in the Non Soong district, Nakhon Ratchasima Province, Northeastern of Thailand. The main objective of this project was to identify species of the ancient cow teeth and to investigate their genetic background which may gain insights into the history of cattle domestication in Thailand. We started by grinding the sample into powder then extracting DNA and using polymerase chain reaction technique to amplify copies of D-loop of mtDNA. Agarose gel electrophoresis was used to separate DNA fragments according to their size then PCR products were purified. DNA sequencing was the final process. Two from four samples; named NW8 and NW9 were achieved to get DNA sequences. The BLAST results showed that they were *Bos taurus*. Besides, the results also indicated that NW8 and NW9 had the close relationship to *B. taurus* from Ukraine and Colombia, respectively.

Keywords: ancient DNA, mitochondrial DNA, cattle





Meiotic Chromosome Behavior of the Seed Bugs, *Lygaeus pandurus* Scop.

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Seed bugs, *Lygaeus pandurus* Scop. (Heteroptera: Lygaeidae) is an insect feed on crown flower plant distributed in many parts of Thailand. It has a special type of chromosomes called holocentric chromosomes, allowing fragmented chromosomes to be able to move to a pole at anaphase and thus preventing chromosome loss. In this study, 30 males of the seed bugs collected from Chon Buri and Buri Ram provinces were studied for meiotic chromosome behavior and karyotype using aceto-orcein staining. The result revealed that the chromosome complement of *Lygaeus pandurus* Scop. was $2n=12+XY$. Meiotic chromosome behaviors showed that autosomes divided pre-reductionally while sex chromosomes divided post-reductionally (divide equationally at anaphase I but divide reductionally at anaphase II). At metaphase I, the sex chromosomes, X and Y, often formed a pseudobivalent at the center of ring, while the autosomal bivalents arrange in a circle. Meiosis cell division of this insect is similar to other species in the suborder Heteroptera such as family Pentatomidae.

Keywords: holocentric chromosome, karyotype, inverted meiosis





Effect of Non-polymorphic Residues to HIV1-Protease Activity and Drug Resistance

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HIV-1 protease is an enzyme for the maturation and assembly of infectious viral particles. This enzyme is a retroviral aspartic protease that is essential for the life-cycle of HIV. For controlling HIV replication, protease inhibitors (PIs) are one of the approaches to treat the HIV patients. However, the high mutation rates that changes to a few amino acids within HIV protease can render it much less visible to the inhibitors. Due to this problem we are interested in the effect of non-polymorphic residues of HIV-1 protease in terms of activity and drug resistance. Four non-polymorphic residues, L10, L24, M46 and G73 were selected to mutate. The site-directed mutagenesis was used to construct the mutant. Two mutants, L10R and G73V were successfully constructed. They were expressed as inclusion body in *E.coli* under IPTG induction. The large scale expression and purification will be further investigated. The function of these mutants will be compared to that wild type.

Keywords: HIV-1 protease, drug resistant, non-polymorphic, side-directed mutation





Genetic Variation of Circadian Clock Genes in *Anopheles scanloni*

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Anopheles scanloni belong to the Dirus species complex and is a second malaria vector distribute in western and southern Thailand. The endogenous circadian clock is the important factor in all organisms to synchronize normal biological rhythms including behavior, locomotor, and metabolic activity within approximately (circa) 24-hr cycles. Investigate the genetic variation of circadian clock in mosquito may help to understand the rhythmic behavior. This study aimed to estimate genetic variation in circadian clock genes of *An. scanloni* using single nucleotide polymorphisms (SNPs) marker. Four partial circadian clock genes (*timeless*, *period*, *cycle* and *clock*) were amplified and sequenced. Low level of nucleotide variation was detected in all fragment, with the average nucleotide diverity (π) = 0.005. Tajima's D showed non-significant deviation from the neutral equilibrium, suggested

Keywords : *Anopheles scanloni*, genetic variation, circadian clock, single nucleotide polymorphisms





Genetic Variation of VRI Gene in Malaria Mosquito (*Anopheles dirus*)

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Anopheles dirus is a highly anthropophilic mosquito and a main malaria vector in Thailand. The circadian clock is good candidate for investigating the effect of light on rhythmic behavior. *Vri* is one of the gene in circadian clock core mechanism which regulate the circadian clock to run in proper rhythm. In this study, we investigate sequence variation of the partial *vri* gene in *An. Dirus* collected inside and outside three caves in Kanchaburi province. low level of nucleotide variation was detected in all populations. Tajima's D value showed no signal of deviation from the neutrality. The Fst parameter was used to estimate the genetic differentiation, showing slightly different among three populations. The population clustering using STRUCTURE software give the highest likelihood at two clusters.

Keywords: *Anopheles dirus*, genetic variation, neutrality, population differentiation





Development of Lead-free Gamma Shielding Materials from EPDM Rubber

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In this work, gamma shielding, cure characteristics, and mechanical properties of ethylene propylene diene monomer (EPDM) rubber composites with the addition of metal oxides namely iron (II, III) oxide (Fe_3O_4), tungsten (III) oxide (W_2O_3), or bismuth (III) oxide (Bi_2O_3) were developed for potential replacement of lead (Pb)-containing rubbers used as gamma-shielding materials in order to minimize environmental and health risks associated with toxicity from lead. The results showed that increases in the contents of Fe_3O_4 , W_2O_3 , and Bi_2O_3 from 0 to 100, 300, and 500 part per hundred parts of rubber by weight (phr) increased the gamma attenuation coefficients, torque differences, tensile modulus at 100% elongation, and hardness (Shore A), while reduced tensile strength, tear strength and elongation-at-break of the composites. The EPDM rubber composites also underwent thermal aging tests at 100 °C for 96 h, which showed a slight reduction in the overall tensile properties. Specifically, the EPDM rubber composites with 500-phr Bi_2O_3 had the highest value of mass attenuation coefficients (μ_m) among other composites, implying great possibilities of replacing hazardous lead-containing gamma-shielding materials with the investigated composites, while still providing safe and efficient gamma-shielding properties for the radiation users.

Keywords: gamma ray, radiation shielding, metal oxide, rubber, mechanical properties





Application of Thermoluminescence Technique for Detection of Irradiated Spices and Herbs

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Thermoluminescence (TL) is a proven method used for detection of irradiated foods. The method is based on trapping energy of radiation by inorganic crystals in foods and then releasing energy after a proper heat stimulation. This technique is suitable for examining food samples containing minerals. This research aimed to apply thermoluminescence technique to detect irradiated spices and herbs according to the European standard EN 1788. Paprika and garlic powders were irradiated with gamma ray at the dose of 1, 2, 5 and 10 kGy. The inorganic minerals were extracted from samples by using high density potassium carbonate solution instead of the high cost sodium polytungstate solution. The mineral compositions were determined by X-ray diffraction technique (XRD). The morphology of the extracted minerals were examined by a scanning electron microscope (SEM). The measurement of thermoluminescence (TL) were done by determine the ratios (TL ratio) of first and second TL signal readings. The results showed that the TL ratios of irradiated dried paprika and garlic were higher than 0.5 whereas those of non-irradiated samples were lower than 0.1. The results obtained reveal that the inorganic minerals extracted from paprika and garlic have good properties to be used for identification of irradiated spices and herbs by thermoluminescence technique.

Keywords: irradiation foods, thermoluminescence (TL), mineral





Antioxidant Activity and Radioprotective Effect of Instant Green Tea in Human Lymphocytes

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The objectives of this study were to investigate antioxidant activity of instant green tea. Three brands of instant green tea including ITO EN BRAND, SEMBA TOHKA BRAND and NITTOM BRAND have been selected from commercial supermarket. Instant green tea extracts were studied total phenolic compound and antioxidant activity using DPPH, ABTS and FRAP assay. Determination of total phenolic compound were 72.25 ± 3.25 $\mu\text{g/ml}$, 44.97 ± 5.45 $\mu\text{g/ml}$ and 59.39 ± 6.14 $\mu\text{g/ml}$, respectively. The results of DPPH assay showed EC_{50} value as 14.17 ± 0.13 $\mu\text{g/ml}$, 44.78 ± 1.13 $\mu\text{g/ml}$ and 23.07 ± 1.15 $\mu\text{g/ml}$, respectively, ABTS assay showed EC_{50} value as 6.31 ± 0.69 $\mu\text{g/ml}$, 12.90 ± 0.43 $\mu\text{g/ml}$, and 10.55 ± 1.14 $\mu\text{g/ml}$, respectively. FRAP value exhibited 309.50 ± 22.82 $\mu\text{g/ml}$, 155.00 ± 30.52 $\mu\text{g/ml}$ and 180.83 ± 6.05 $\mu\text{g/ml}$, respectively. Therefore, the highest of total phenolic compound and antioxidation activity were found in ITO EN BRAND. Furthermore, all instant green tea extract have been shown to decrease dicentric chromosome at the concentration of 100 $\mu\text{g/ml}$ which exhibited their radioprotective effect in human lymphocytes. In conclusion three brands of instant green tea may exert antioxidant activity and radioprotective potential in human lymphocytes through decreasing the number of dicentric chromosome.

Keywords: antioxidant activity, instant green tea, dicentric assay





Investigation on Properties of Gamma-irradiated Reduced Graphene Oxide (rGO)

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This research aimed to produce reduced graphene oxide (rGO) from graphene oxide (GO) using gamma irradiation at the accumulative doses of 0, 7, 14, 21, 28, 35, 42 kGy, respectively. This technique to synthesize rGO has considerably advantages to chemical synthesis including the absence of toxic chemicals as a reducing agent, more uniform distribution of reducing agent, and higher purity of rGO. Structural and physicochemical properties of GO and rGO were investigated with the help of various characterization techniques: ultraviolet-visible (UV-vis) spectrum and C=C aromatic stretching in the Fourier transform infrared (FT-IR) spectrum. The morphologies of the samples were also observed under scanning electron microscope (SEM). The success in rGO synthesis using gamma irradiation would not only enhance the utilization of gamma irradiation but also widen possible applications of rGO that require green and environmental friendliness during the synthesis.

Keywords: reduced graphene oxide, rGO, gamma irradiation, UV-vis





Enhancement of Cellulose Fiber Degradation from Water Hyacinth (*Eichornia crassipes*) by Gamma Radiation for Ethanol Production

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The main aim of this project is to study degradation of extracted cellulose fibers from water hyacinth by hydrolysis and gamma radiation to produce sugar. Water hyacinth was extensively recognized as one of the worst weeds because it could grow very fast in natural water resources, leading to block water ways, affecting both navigation and drainage, as well as increase siltation and flooding. In order to reduce or eliminate the fresh water weed, a management strategy was to turn the weed problem to be useful. The cellulose fibers could be extracted from the aquatic weed by hydrolysis with sulfuric acid and gamma irradiation. The degradation of cellulose material lead to from sugar compounds. The leaf samples were cut and dried at 80°C. The dried samples were ground and sieved by 325 meshes. The pure cellulosic fibers were extracted from the sample powder by methanol, 0.8% of sodium hypochlorite and 20% w/v hydrogen peroxide. The cellulose material was decomposed by hydrolysis using 3% sulfuric acid. The experiments could be divided into three experiments, control (without irradiation), irradiated powder samples and irradiated powder samples in 3% of sulfuric acid. The samples were irradiated at 25, 50 and 75 kGy by a Co-60 gamma irradiator with dose rate 40.0 ± 3.0 Gy/min. The hydrolysis processes were used 3% sulfuric acid at 121°C in 30 minutes. The results shown that the sugar concentration of control was 1.03% meanwhile the irradiated powder cellulose samples were 1.61%, 1.96% and 1.68% as a function of absorbed dose. In case of irradiated powder samples in 3% sulfuric acid, the sugar concentrations were 1.59%, 1.69% and 1.87%, respectively. These results demonstrate that gamma irradiation could be used to enhance the damage of cellulose fibers to produce sugar.

Keywords: cellulose, ethanol, water hyacinth, gamma radiation





Study of Genetic Variation of Canna Wild Type and Mutants through ISSR Marker

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Canna (Canna generalis) is a tropical ornamental plant with large, colorful flowers and interesting foliage. The canna breeding program of Kasetsart University conducted by induced mutation using gamma-rays as a mutagen. Mutation characters observed were changing in leaf colour, flower colour, flower size, flower form and plant type. However, genetic variation of those mutants are not investigated. In this study, derived genetic variation among 8 canna mutant varieties, namely, GISC10, Napavan, Pink Pannee, Red Viroch, GISC24, Orange Siranut, Wanwisa and Penphit were assessed based on ISSR marker. Thirteen selected ISSR primers amplified 75 bands ranging in size from 160-3,000 bp and all 75 bands were polymorphic (100%). The similarity index ranged from 0.0 to 0.49. Cluster analysis using Part3 program based on genetic similarity indexes indicated that the 8 canna mutant varieties were clustered into 3 major groups. The ISSR marker system is useful for identification and analysis of genetic variation of canna mutant varieties.

Keywords: canna, genetic variation, mutant variety, ISSR markers





Effects of Gamma Rays on Chemical Properties and Antinutrients of Mulberry Leaves

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Mulberry leaves (*Morus alba*) are used for silkworm cultivation. This plant grows well in both tropical and subtropical climates. Therefore, sericulture (mulberry tree plantation and silkworm cultivation) is an important occupation in many countries in both Asia and Europe such as China, Japan, France, Italy and Thailand. Silkworm farmers need to grow mulberry trees, they cannot cultivate only silkworms because mulberry leaves are the only feed for silkworms that used in silk production. Without mulberry tree cultivation, there will be not enough food for silkworms. However, during some seasons or some unsuitable conditions may result in reduced mulberry leaves yield and not enough for silkworms. In these situations, artificial feed is necessary as a replacement of mulberry leaves. The objectives of this study were to investigate chemical composition and antinutrients of mulberry leaves and to use the obtained data as basis for silkworm artificial feed. Mulberry leaves cv. Burirum 60 were irradiated with different doses of gamma rays at 0, 10, 40 and 60 kGy from Co-60. The chemical properties such as ash, crude protein, crude fat and crude fiber contents of irradiated mulberry leaves were determined. The amount of tannin which is a type of antinutrient found in mulberry leaves was also determined. Structural analysis was carried out by Fourier transform infrared spectroscopy (FT-IR). In addition, the comparisons between mulberry leaves with and without irradiation with gamma ray at different doses were also performed. The results showed that irradiation with gamma ray resulted in changes in chemical properties however the amounts of antinutrients of mulberry leaves were not affected. Therefore, gamma irradiation may be used as an alternative method for improving mulberry leaves quality and for producing artificial feed for silkworm.

Keywords: gamma ray, mulberry leaves, chemical properties, tannin





Measurement and Analysis of Radioactivity in Japanese Imported Sauce Products by Gamma Spectrometry with High Purity Germanium (HPGe) Detector

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This study aimed to determine the amount of radioactivity in Japanese imported sauce products which have been imported and distributed to the supermarket in Thailand. Japanese sauce are as follows Tonkatsu sauce, Sesame sauce calorie hanbun, Gyoza no tare, Takoyaki sauce, Okonomi sauce otana no karakuchi, Shin yakiniku no tare shoyu aji, Tsuyusanbai, Sushi su, Memmi sauce and Azazuke no moto konbu dashi. Ten samples were randomly chosen for measurement and analysis of their radionuclides by gamma spectrometry with high purity germanium detector. The result demonstrated that the specific activities of radionuclides, e.g. ^{40}K , ^{226}Ra , ^{131}I and ^{137}Cs in Japanese sauce exhibited in a range of 55.05 - 128.81 Bq/L, 36.47 - 59.87 Bq/L, 0 Bq/L and 3.87 - 6.19 Bq/L, respectively. These finding indicated that the specific activities of radionuclides in those Japanese sauce were lower than the standard of International Atomic Energy Agency (IAEA). In conclusion, these Japanese sauce might be safe for human consumption due to undetectable radioactive residue in these product.

Keywords: Japanese sauce, radioactivity, gamma spectrometry, high purity germanium detector





Measurement of Radionuclides in Thai Rice and Japanese Rice by Gamma Spectrometry with High Purity Germanium (HPGe) Detector

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This study was conducted to measuring the amount of radionuclides in 5 Thai rice samples including Jasmine rice (Roi Et), Jasmine rice (Surin), Jasmine rice (Yasothon), Jasmine rice (Burirum) and Jasmine rice (Chiang Rai) and 4 Japanese rice samples including Sasanishiki (Sun brand), Akitakomachi (Kikoto Akitakomachi Musenmai brand), Nigata Koshihikari (Kikoto Nigata Koshihikari Musenmai brand) and Iwate Hitomebore (Kikoto Iwate Hitomebore Musenmai brand). All samples were measured and analyzed by gamma spectrometry with high purity germanium (HPGe) detector. The results of this study showed that the specific activity of ^{40}K , ^{226}Ra , ^{232}Th and ^{137}Cs in Thai rice exhibited in a range of 38.46 - 43.01 Bq/Kg, 3.09 - 32.32 Bq/Kg, 0.32 - 0.36 Bq/Kg and 1.81 - 2.37 Bq/Kg, respectively. The specific activity of ^{40}K , ^{226}Ra , ^{232}Th and ^{137}Cs in Japanese rice exhibited in a range of 37.84 - 41.23 Bq/Kg, 3.36 - 29.01 Bq/Kg, 0.39 - 0.47 Bq/Kg and 1.71 - 2.15 Bq/Kg, respectively. These finding indicated that the specific activity of radionuclides in these samples was lower than the standard of International Atomic Energy Agency (IAEA). Therefore, these samples could be beneficial and safe for consumption.

Keywords : radionuclides, Thai Rice, Japanese Rice, high purity germanium detector





Antioxidant Activity and Radioprotective Effect of Leaves of Japanese Green Tea in Human Blood Lymphocytes

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This study aimed to investigate antioxidant activity and radioprotective effect of Japanese green tea leaves. Three brands of Japanese green tea leaves including Itoen brand, Bancha brand and Marutoyo brand have been selected to study. They were determined total phenolic compound and antioxidant activity using DPPH, ABTS and FRAP assay. Total phenolic compounds of them showed 54.75 ± 0.51 , 58.31 ± 0.10 and 54.48 ± 0.23 GAE μ g/ml, respectively. Antioxidant activity using DPPH assay showed EC₅₀ value as 47.94 ± 0.77 , 50.29 ± 0.55 and 63.28 ± 0.89 μ g/ml, respectively and ABTS as 30.14 ± 0.03 , 31.61 ± 0.80 and 30.45 ± 0.03 μ g/ml, respectively. FRAP value exhibited 770.09 ± 0.03 , 673.65 ± 0.26 and 640.70 ± 0.47 FeF μ g/ml, respectively. Therefore, the highest antioxidation activity was found in Itoen brand in all test methods. Their radioprotective effects were determined using dicentric chromosome assay. Whole blood was irradiated by 3 Gy of Co-60 (50 μ g/ml and 100 μ g/ml of Japanese green tea leaves concentration) which was found to decrease dicentric chromosome at the concentration of 100 μ g/ml. In conclusion, Japanese green tea leaves in this study may exert antioxidant activity and radioprotective potential in human lymphocytes through decreasing the number of dicentric chromosome.

Keywords: Japanese green tea, radioprotective effect, antioxidant activity, dicentric chromosome





Development of Neutron-shielding Particleboards Using B₂O₃ Powders

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This work aimed to investigate effects of boron trioxide (B₂O₃) contents on neutron-shielding and mechanical properties of particleboards that could be used as walls or partitions that effectively prevented neutron leakage. This work was possible because ¹⁰B in B₂O₃ had high neutron absorption cross section, thus significantly improve their ability to attenuate neutrons. Furthermore, ultra-high-molecular-weight polyethylene (UHMWPE) powders were also added to the particleboards due to their high hydrogen contents in UHMWPE, which could moderate or reduce energies of incoming neutrons to thermal neutrons and significantly increase probabilities of interactions with ¹⁰B. The contents of B₂O₃ in this work were varied between 0, 10, and 20%wt, while keeping UHMWPE constant at 10%wt. The results indicated that particleboards with 20%wt B₂O₃ could attenuate neutrons with the highest efficiency.

Keywords: boron trioxide, neutron absorption, neutron shielding, particleboa





Ability of Chitosan to Adsorb Radionuclides from Wastewater

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Iodine-131 is a radionuclide commonly used in medical diagnostic and treatment procedures, especially in thyroid cancer therapy. It is also used in many laboratories for research. Both types of activities result in the production of low-level radioactive waste. Safe management of radioactive waste generated is important to ensure that the radiation exposure to public and environment does not exceed the safe limits. Therefore, the proper treatment of radioactive waste is necessary. For this reason, this research investigated the possibility of using chitosan to absorb iodine-131 in aqueous solution. Chitosan solution with a concentration of 4.0 wt% in the total volume of 5.0 ml was mixed with 19.21 μCi iodine-131 solution at room temperature. The mixing time was varied from 30 minutes to 24 hours. The results showed that the ability of chitosan to absorb iodine-131 increased with mixing time from 1 to 24 hours. This finding is useful for further development as an absorber for radioactive waste treatment.

Keywords: iodine-131, chitosan, radiation absorption





Measurement of Radionuclides in Coffee Bean by Gamma Spectrometry with High-Purity Germanium (HPGe) Detector

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According to many more people trend to drink coffee nowadays than in the past. The objectives of this study aimed to measure the specific activity of radionuclide (^{40}K , ^{226}Ra , ^{137}Cs and ^{232}Th) in coffee beans. Six samples of coffee beans including NICHE coffee roasters, Casino (PUR BRESIL), Casino (Saveur'd Ailleurs), Wawee coffee (Lanna), Wawee coffee (espresso) and Doi Chang have been selected to investigate using gamma spectrometry with HPGe detector. The result demonstrated that the specific activity of radionuclide of ^{40}K , ^{226}Ra , ^{137}Cs and ^{232}Th in the selected coffee beans were ranged from 416.35 to 482.10 Bq/kg, 72.50 to 82.10 Bq/kg, 4.09 to 5.67 Bq/kg and 0.94 to 1.83 Bq/kg, respectively. Our results showed that the specific activity of radionuclides in coffee beans were lower than the value of international Standard from IAEA. Therefore, our findings could be beneficial for people who consume or drink coffee.

Keywords: coffee bean, gamma spectrometer, radionuclides





Effect of Gamma Radiation on Physical Properties of Mulberry Leaves

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Mulberry leaves (*Morus alba*) have been historically used as feed for silkworms. The quality of mulberry leaves for feeding the silkworms is a key factor in the successful production of cocoon which is made of one thread of raw silk from 300 to 900 meters long. Thai silk fabrics have brought good reputation to the country as well as have been accepted and recognized among national and international consumers. Sericulture is a traditional and cultural way of life of the Thai people. The sustainability of mulberry leaves supply is necessary for sericulture industry. However, the amount of mulberry leaves exceeds the requirements of silkworms in some seasons, whereas there is a shortage of mulberry leaves to be fed silkworms caused by insect pests in other seasons. Therefore, to be able to feed silkworms throughout the year, the production of an artificial diet for silkworms from mulberry leaves is essential.

In order to prepare artificial diet for silkworm with high quality, the cellulose accumulated in the cell wall of mulberry leaves should be degraded for easily digestion in silkworms. It is well-known that gamma radiation can induce the oxidative degradation of cellulose. The purpose of this study was to investigate the effect of gamma radiation on the physical properties of mulberry leaves var. Buriram 60. Mulberry leaves were irradiated at the dose of 10, 20, 40 and 60 kGy. The chemical composition of leaf samples was analyzed including their moisture, crude protein, crude lipid, ash, crude fiber and nitrogen free extract. The mulberry leaves were characterized by X-ray diffraction and the physical properties such as water solubility, swelling power and water absorption of irradiated leaves were analyzed and compared to non-irradiated leaves.

The results showed that gamma rays had the ability to change the molecular structure of mulberry leaves. As a result, the amount of chemical compositions including crude protein, crude lipid, ash, and NFE increased significantly ($p < 0.05$). On the other hand, total fiber content decreased with increasing radiation dose. The X-ray diffraction pattern showed that crystallinity and amorphous of irradiated mulberry leaves were different from non-irradiated ones. Water solubility and swelling power increased significantly ($p < 0.05$) that compared to non-irradiated leaves, whereas water absorption decreased non-significantly ($p > 0.05$). This can conclude that gamma radiation affects the chemical compositions, water solubility and swelling power properties of mulberry leaves. Therefore, gamma irradiation might be an alternative technology for improving the quality of mulberry leaves to be further developed for the production of artificial silkworm feeds.

Keywords: mulberry leaves, gamma radiation, physical properties





Effects of Gamma Radiation on Some Biochemical Change of Turmeric *in vitro* propagation

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Turmeric (*Curcuma longa* L.) belonging to the family Zingiberaceae is an economically important spice and medicinal plant cultivated widely in South-East Asian countries. To put the turmeric cultivation as an industry, it is therefore essential to develop turmeric genotypes with improved drug yielding potential and rhizome yield. Gamma radiation has been widely applied in agriculture for induced mutation in plant, however, it also induced stress response and free radical in plants cell. The objective of this research is therefore to investigate gamma radiation effects in turmeric on biochemical change by exposing 6-weeks-old seedling with acute and chronic gamma irradiation under *in vitro* propagation. Plantlets of turmeric cultured on MS medium were exposed to acute irradiation from Cs-137 at the doses of 0, 20, 40, 60 and 80 Gy. For chronic irradiation with a Co-60 source were exposed to 0, 20.69, 44.16, 64.87 and 81.38 Gy. Malondialdehyde (MDA) and proline were measured after irradiation. Free radicals generate the lipid peroxidation process in plant cell. An increase in free radicals causes overproduction of MDA. Malondialdehyde level is commonly known as a marker of oxidative stress and the antioxidant status. The highest MDA and proline accumulation of 0.01142 $\mu\text{M g}^{-1}\text{Fw}$ and 0.327 $\text{mg g}^{-1}\text{Fw}$ were found after acute irradiation at dose of 40 Gy. It was also found that after chronic irradiation at 80 Gy had the highest MDA and proline accumulation revealed 0.01089 $\mu\text{M g}^{-1}\text{Fw}$ and 0.5253 $\text{mg g}^{-1}\text{FW}$, respectively

Keywords: turmeric, gamma radiation, MDA, Proline, *In vitro* propagation





Production of Sugar from Cellulose Fibers Degradation of Incense Burner (*Typha angustifolia* L.) for Ethanol Production by Gamma Irradiation

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In this project, sugar compounds were produced by degradation of cellulose fiber of Incense Burner (*Typha angustifolia* L.). The aquatic weed could grow extremely fast in water resources and might be a serious environmental problem. In order to reduce or eliminate the fresh water weed, a management strategy was to turn the weed problem to be useful. This study planned to produce sugar from degradation of Incense Burner's leaves. There were a lot of cellulose fibers in the weed leaves. The leaf samples were cut and dried at 80°C. The dried samples were ground and sieved, using 325 meshes. The pure cellulosic fibers were extracted from the sample powder by methanol, 0.8% of sodium hypochlorite and 20% w/v hydrogen peroxide. The cellulose material was decomposed by hydrolysis using 3% sulfuric acid. The experiments could be divided into three experiments, control (without irradiation), irradiated powder samples and irradiated powder sample in 3% of sulfuric acid. The gamma irradiation was used to increase the efficiency of hydrolysis. The samples were irradiated at 25, 50 and 75 kGy by a Co-60 gamma irradiator with dose rate 40.0 ± 3.0 Gy/min. The sample solutions were measured concentration of sugar by a pocket refractometer, ATAGO PAL-1. The sugar in control was 1.42%. The concentrations of sugar in irradiated powder samples were 1.72%, 1.71% and 0.91% as a function of radiation doses meanwhile the irradiated power in sulfuric solutions were 0.77%, 1.02% and 1.36% respectively. The result show that the irradiation could enhanced the degradation of cellulose material in order to produce sugar.

Keywords: cellulose, ethanol, incense burne, gamma radiation





The Optimization of Chitosan Concentration for Radionuclide Adsorption in Aqueous Solution

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Iodine -131 is a common radionuclide used in the treatment of thyroid cancer. If iodine - 131 is contaminated to the environment, it is dangerous to the ecosystem. Therefore, the removal of iodine - 131 is needed before discharging into the environment. This research aimed to investigate the ability of chitosan at different concentration for radionuclide adsorption in aqueous solution. Chitosan solutions at concentrations of 2% and 4% with the volume of 200, 400, 600, 1000, 2000, 3000, 4000 and 5000 μl were used. There were mixed with iodine – 131 solution for 24 hours. The radioactivity of supernatant was determined by HPGe gamma spectrometry. The scanning electron microscope (SEM) was used to determine the appearance and texture of chitosan that was attached to iodine. The fourier transform infrared spectrometry (FTIR) was used to study the functional group of chitosan by determining the infrared absorption spectra at 550 - 2000 cm^{-1} . The results showed that 2% and 4% chitosan had same ability to adsorb radioactivity of iodine – 131 solution. This finding is useful for further development of an absorber for treatment of liquid radioactive waste.

Keywords: iodine – 131, chitosan, radiation absorption





Radiosensitivity of *Curcuma Longa L.* to Acute and Chronic Gamma Irradiation

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Nuclear technology has been greatly utilized for the global benefit of mankind, not only in the field of medical science, but also in agriculture for crop improvement. The present investigation was undertaken to study the effect of gamma radiation on the survival rate and plant growth of turmeric (*Curcuma Longa L.*) after acute and chronic radiation as well as to employ micro propagation to bypass the slow rate of multiplication of traditional methods. Estimates of the 50% lethal dose (LD₅₀) and 50% growth reduction dose (GR₅₀) were used as indicators for turmeric radiosensitivity. Plantlets of turmeric cultured on MS medium were exposed to acute irradiation from Cs-137 at the doses of 0, 20, 40, 60 and 80 Gy. For chronic irradiation with a Co-60 source were exposed to 0, 20.69, 44.16, 64.87 and 81.38 Gy. After irradiation, tissue cultures of turmeric were transferred to the fresh media (MS). The number of surviving plantlets and plant growth in M₁V₁ generation were recorded. The results showed that percent of survival plantlets and growth of turmeric seedling were decreased as radiation dose increased. Acute irradiation caused higher radiosensitivity of turmeric than chronic irradiation. At 21 days after irradiation, the GR₅₀ values to acute irradiation were estimated to 109.16 Gy. Whereas, the LD₅₀ values would be understood after prolonged period of plantlets observation. Some abnormalities observed in the M₁V₁ generation of the irradiated plantlets were variegated leaf and changed in leaf color from the dose of 20 and 80 Gy.

Keywords: radiosensitivity, gamma Irradiation, *Curcuma Longa L.*, LD₅₀%, GR₅₀%





The Use of Photostimulated Luminescence Technique to Identify Irradiated Spices and Herbs

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Photostimulated luminescence (PSL) has been used as a rapid screening method for various irradiated foods. The method is based on emission of light when the stored or trapped energy in the material is released upon infrared stimulation. This study aimed to apply PSL technique to identify irradiated spices and herbs. The paprika and garlic powders were irradiated by a cobalt-60 gamma source at the dose of 1, 2, 5 and 10 kGy. The PSL measurements were done with a pulsed photo-stimulated luminescence system. The photon counts /60 s were measured in the sample chamber as described in the European standard EN 13751. The samples with photon counts less than 700 were considered as negative (non-irradiated) and more than 5,000 were considered as positive (irradiated), whereas the values between these two limits were classified as intermediate requiring further investigation to confirm the results. The results showed that non-irradiated samples had negative PSL counts whereas all irradiated samples had positive PSL counts. The integrated values of PSL emission of irradiated samples increased compared with those of non-irradiated ones. Upon irradiation, the intensity of the PSL signal increased with the dose level. Therefore, it was suggested that PSL had possibility to be applied for detecting irradiated paprika and garlic powders.

Keywords: irradiated foods, identification, spice, photo-stimulated luminescence





Preliminary Study on *In Vitro* Phototoxicity for Safety Evaluation

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Phototoxicity assay was accepted in several countries for photosafety evaluation of pharmaceuticals, chemicals and cosmetic products. It is used to predict an acute phototoxicity effect in animals and human. The 3T3 Neutral Red Uptake Phototoxicity Test (3T3 NRU PT) is designed to detect the phototoxicity induced by the combined action of a chemical and light by using an *in vitro* cytotoxicity assay with the Balb/c 3T3 mouse fibroblast cell line. The test evaluates phototoxicity by the relative reduction in viability of cells exposed to the chemicals in the presence versus absence of light. In this experiment, we set up and tested the UVA device to adjust the distance for use in the study of phototoxicity assay. The cell was irradiated UVA of $1.7\text{mW}/\text{cm}^2$ at a dose of $1\text{J}/\text{cm}^2$ per 10 minutes in range of time from 10 to 90 minutes. We determined cell survival by Neutral Red Uptake (NRU) technique. The uptake of the vital dye is used as a quantitative indication of cell number and cell viability. At 540 nm using microplate reader. The results showed that the radiation time range from 10 to 50 minutes did not produce any toxic to the cell. The time at 90 minutes exhibited to reduced 50% of cell survival. Therefore, the suitable time for this test was 50 minutes whereas more radiation time could be toxic to the cell. In conclusion, our findings suggested the suitable time for phototoxicity evaluation under the condition.

Keywords: UVA, phototoxicity, cell survival, safety evaluation





Effects of Gamma Radiation on Physical Properties and Main Active Compounds of Garlic Bulb

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Garlic (*Allium sativum*) has been used as a food and medicine for more than 5,000 years to prevent and treat a wide range of diseases. It contains two active key compounds, allicin and ajoene, which are powerful natural antibiotic, anti-fungal and anti-viral properties. The purpose of this study was to investigate the effects of two different methods, heating and gamma irradiation, on physical properties and main active compounds of garlic. Garlic samples were irradiated at 0, 10, 20, 40 and 60 kGy by gamma rays. Another garlic samples were heated at 65-80 °C. The appearance of garlic was examined by Scanning Electron Microscope (SEM). The functional groups were analyzed by Fourier-Transform Infrared Spectroscopy (FT-IR). Heating and gamma radiation at 10 kGy resulted in the change of C-O functional group of allicin. However, heating caused color change. Our results suggest that gamma irradiation is a promising method for improvement of garlic without any physical changes.

Keywords: gamma rays, garlic, allicin





In Vitro Phototoxicity Study of Thai Gac Fruit Extracts

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Gac (*Momordica cochinchinensis* Spreng.) has been reported to contain high content of antioxidants and nutritional value. This study was conducted to investigate the phototoxicity of different fruit fraction (skin, pulp and arils of Thai gac fruit). In this study, each part of gac fruit was extracted by ethanolic extraction (EtOH) and accelerated solvent extraction (ASE). Phototoxicity is the result of direct cellular damage following the exposure to UV radiation or visible light in the presence of a phototoxic substance. The *in vitro* 3T3 NRU phototoxicity test is used to identify the phototoxic potential of gac fruit extracts induced by the excited chemical after exposure to UVA. The results showed that IC₅₀ values of skin, pulp and arils extracted by ASE with UVA light and non-UVA light were 822.69, 1,940.85, 3,523.79, 3,831.03, 5,989.61 and 9,148.40 µg/mL, respectively. Moreover, IC₅₀ values of skin, pulp and arils extracted by EtOH with UVA light and non-UVA light were 2,242.05, 880.08, 1,021.84, 2,261.19, 2,879.83, and 1,484.57 µg/mL, respectively. The Photo-Irritation-Factor (PIF) values of skin, pulp and arils extracted by ASE and EtOH were 4.66, 3.08, 2.59, 1.01, 3.27, and 1.45, respectively. Therefore, our findings suggested that skin and arils extracted by EtOH could be predicted no phototoxicity as PIF < 2 whereas other extracts could be predicted probable phototoxicity as 2 < PIF < 5. In conclusion, all extracts of gac fruit fraction could be safe to use as ingredient in cosmeceutical products. Other toxicity studies should be performed for further study.

Keywords: Thai gac fruit, *Momordica cochinchinensis*, phototoxicity





Fabrication of a Prototype PDMS-Based Microfluidic Device for Gamma H2AX Detection

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The objectives of this study were to develop microfluidic device for measuring gamma-H2AX in order to determine the exposure level of radiation in cells by using microfluidic technology based on PDMS mold. This device was a small operation system, therefore small amounts of substances were used in the measurements with shorter analysis duration. The experiment was started with the conventional gamma-H2AX technique. Blood samples from healthy subjects were irradiated with gamma rays at different doses. The levels of gamma-H2AX in blood samples were then measured in order to plot the calibration curve. After that, small scale experiment was performed using microchannel. The pattern of microchannel was designed as the prototype for PDMS mold by using AutoCAD 2016 software. The designed pattern was then used to prepare PDMS mold by using UV lithography technique. Fluid flow of the microfluidic chips were investigated with the help of pump system at flow rate of 0.001-5 mL/min. The results showed that the pattern design in the microfluidic device could be used to develop microfluidic device prototype for measuring gamma-H2AX in the subsequent experiment.

Keywords: gamma-H2AX, microfluidics, radiation





Indoor Radon Investigation Using a Solid State Alpha Track Detector Technique at Kasetsart University

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Radon ($Rn-222$) and Thoron ($Rn-220$) are radioactive gas with inert gas properties. There are no colors, no odors, and cannot be perceived by human senses due to the decay of the uranium series ($U-238$) and the thorium series ($Th-232$) in rocks, soil, earth crust and radium ($Ra-226$) in water, which these are all basic building materials. Therefore, there is a high probability that radon and thoron can be found in building materials. These materials are a good source of both gases if they are not managed properly, and when inhaled these gases for a long time. In addition, radon and thoron gases are also important causes that can induce lung cancer. The World Health Organization (WHO) has reported that radon is a second leading cause of lung cancer and the first cause is smoking. This project would focus on radon-thoron measurement in the school building as well as building activities, which is a place where students from various groups come together for activities and study every day for basic information. The results obtained from this project were used as a guide to the prevention of harm caused by radon and thoron gas. In the project, indoor radon and thoron concentration levels were estimated in Kasetsart University using a passive integrating discriminative radon-thoron monitor (Raduet) with a Solid State Nuclear Track Detector (CR-39). The monitors were installed in target rooms and were left for about 4 months for measuring the concentration levels. As the dangers of radon and thoron inhalations that accumulate in homes, offices or communities, are important to be aware of the annual effective dose to human health effects. Therefore, determining the concentration levels is necessary to assess the dose from inhalation in dwelling for radiation protection.

Keywords: radon, Solid State Nuclear Track Detector, radon concentration, CR-39





Design and Fabrication of Polydimethylsiloxane (PDMS)-Based Microchannel for a Microfluidic Device Used as a Radiation Biodosimeter

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The objectives of this experimental study were to design and produce micron-sized channel on PDMS mold to be used in the development of radiation biodosimeter. This research consisted of 2 main steps. The first step was the investigation of radiation dose from gamma-H2AX in lymphocyte cells by using Flow Cytometry. The obtained data was used in the designing of micron-sized pattern on PDMS mold by using AutoCAD computer software for 2D designing. The second step was the preparation of microfluidic chip by using UV lithography to create the pattern (mold) on silicon wafer. The mold plate with pattern was then assembled with PDMS mold. The preliminary results showed that the micron-sized pattern was successfully designed and created on 22 μm PDMS mold as the microchannel for lymphocyte cells with cell size of 7-21 μm . This microfluidic device could be further used in the development of radiation biodosimeter.

Keywords: microchannel, microfluidics, PDMS, biodosimeter





Study of Counter and Timer for Radioactive Measurement

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The purpose of this research was to produce the counter and timer instrument for measurement of radiation in laboratory. The Instrument has 3 systems, which are 1 MHz base timer, timer system, and counting system. There are controlled by switches. The timer could be adjust by switch separately from start/stop switch. The developed Timer and Counter module display radiation counting on seven segment display which has 6 digits with maximum of 999999 counts. The maximum radiation counting rate was 100 kcps. The timers could be selected between units of second and minute. The developed Timer and Counter from this research can be used as a Nuclear Instrumentation Module (NIM).

Keywords: timer and counter, radiation measurement, nuclear instrumentation





Effect of UHMWPE Powders on Neutron Attenuation Properties of Particleboards

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Neutrons are subatomic particles that are considered ionizing radiation and could be hazardous to radiation workers and the general public. In order to prevent risks associated with neutrons, effective neutron-shielding materials must be developed and used appropriately. In this work, we developed particleboards that contained B_2O_3 and UHMWPE powders and investigated effects of UHMWPE powders with different contents on mechanical and neutron-shielding properties of the particleboards. Since UHMWPE powders contains high hydrogen contents, the increases in UHMWPE contents from 0 to 10%wt and 20%wt could improve the ability to reduce neutron energy to thermal neutrons, leading to higher attenuation properties at fixed content of B_2O_3 . It was also interesting to investigate whether the increase in UHMWPE contents could improve mechanical properties of the particleboards. The results of this work would not only show effective shielding ability of the developed materials but also increase market values of regular particleboards.

Keywords: neutron, neutron attenuation, UHMWPE, wood particle, boron





Investigation on Anthropogenic in Infant Formula

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Infant formula has become one of the most important sources of energy for infants who take considerably large amounts in early years of their lifetime. However, anthropogenic radionuclides in infant formula could possibly affect the development of infants or even harm infants' health. In this work, we investigated radioactivity, annual effective doses, and possible risks associated with anthropogenic radionuclides, namely ^{137}Cs in 9 different infant formulas purchased from Thailand market. The activities of all samples were measured using a gamma spectrometer with the collective time of 60,000 sec. The results indicated that the annual effective doses in the infant formula designated for less than 1-year-old infants and for older than 1-year-old infants had the values between 0.781-2.624 $\mu\text{Sv}/\text{year}$ and 0.73-1.01 $\mu\text{Sv}/\text{year}$, respectively. These values of the annual effective doses were less than the recommendations issued by the World Health Organization (WHO) and, thus, are safe for consumption.

Keywords: Infant formula, anthropogenic radionuclides, annual effective dose, radioactivity, gamma spectrometer





Investigation on Natural Radionuclides in Infant Formula

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Infant formula has become one of the most important sources of energy for infants who take considerably large amounts in early years of their lifetime. However, natural radionuclides in infant formula could possibly affect the development of infants or even harm infants' health. In this work, we investigated radioactivity, annual effective doses, and possible risks associated with natural radionuclides, namely ^{226}Ra , ^{232}Th and ^{40}K , in 9 different infant formulas purchased from Thailand market. The activities of all samples were measured using a gamma spectrometer with the collective time of 60,000 sec. The results indicated that ^{40}K had the highest activities among all concerned radionuclides, while the annual effective doses in the infant formula designated for less than 1-year-old infants and for older than 1-year-old infants had the values between 600-700 $\mu\text{Sv}/\text{year}$ and 100-200 $\mu\text{Sv}/\text{year}$, respectively. These values of the annual effective doses were less than the recommendations issued by the World Health Organization (WHO) and, thus, are safe for consumption.

Keywords: Infant formula, natural radionuclides, annual effective dose, radioactivity, gamma spectrometer





Effects of Bi_2O_3 Particle Sizes on X-ray Attenuation Properties

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This research aimed to investigate effects of particle sizes of Bismuth (III) oxide (Bi_2O_3) used as an x-ray protective fillers in natural rubber composites. The properties investigated in this work included cure, mechanical, and x-ray shielding properties, and the particle sizes of Bi_2O_3 were in nanoscales (~ 80 nm) and microscales (~ 2 μm). The results showed that adding 700 parts per hundred parts of rubber by weight (phr) of Bi_2O_3 at 1-mm NR samples, the x-ray attenuation percentages for nano- Bi_2O_3 and micro- Bi_2O_3 were 76.10% and 71.96%, respectively. These implied that NR composites with nano- Bi_2O_3 could shield or attenuate x-ray with higher efficiency, indicating better shielding materials. The results could be due to the fact that nano- Bi_2O_3 could be better dispersed in the composites and also have much larger surface area than the NR composites with micro- Bi_2O_3 . This result is beneficial and intriguing to further x-ray shielding development and investigation.

Keywords: natural rubber, Bi_2O_3 , x-ray shielding, nanoparticles





Effects of Powdered Eggshell as Fillers on Mechanical Properties of Gamma-vulcanized Natural Rubber Composites

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This work investigated mechanical and physical properties using a Fourier Transform Infrared Spectrophotometer (FTIR) with the wave number between 450 – 4000 cm^{-1} and Scanning Electron Microscope equipped (SEM) with Energy Dispersive Spectrometer (SEM-EDS) of gamma-vulcanized natural rubber (NR) with additions of different contents of powdered eggshell in order to improve mechanical properties of the composites. The X-Ray Diffractometer (XRD) showed that the powdered eggshell used in this work contained high percentage of Calcium carbonate (CaCO_3). The natural rubber sheets were prepared using gamma vulcanizing method with the irradiation doses of 10, 20 and 30 kGy, respectively. All samples were then mixed with 0, 2, 4, and 6 parts per hundred parts of rubber by weight (phr) and left to completely cure. The samples were tested with the Universal Testing machine in order to investigate and to compare mechanical properties (tensile modulus, tensile strength, elongation at break, and hardness). This work would not only improve properties of NR composites but also reduce amounts of wasted eggshell that could possibly pose hazard to environment.

Keywords: CaCO_3 , gamma-vulcanized natural rubber (NR), powdered eggshell





Study of Process Synthesis for Plastic Scintillator

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This research study of process synthesis for the plastic scintillator. The research divided into 2 sections. The first section builds the synthesis stove that temperature up to 300 degrees Celsius and software developed with the Lab-View program to record and monitor temperature effects. The second section, synthesis the plastic is 120 degrees Celsius for 48 hours to make the plastic homogenous after that cool-down the plastic for 24 hours. The result of the research is synthesis stove that it can build the crystal 1-inch diameter.

Keywords: plastic scintillator, plastic synthesis stove





Wireless Radiation Detection and Measurement Robot

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This work designed and developed a robot with instruction set by ArduinoIDE for detection and radiation measurement. It used wireless communication for control and data transfer. The robot could be used to search radioactive sources instead of human. By using the Arduino board as a control board and wireless communication module (nRF24L01P) the robot could send the information to the control's LCD screen. Gas-filled detector was also installed to measure radiation and all devices were install on a 4WD Smart Car Chassis Kit motor drive, the robot could measure the amount of beta and gamma radiation. Control and data transfers range is about 50 meters. The results showed that the robot could detect radiation and send data effectively. The robot could move to the designated positions and could find the location of the radiation source in the designated area.

Keywords: survey robot, radiation measurement, wireless communication, microcontrollers





Background Radiations Estimation from Soil Sample in Kasetsart University

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According to many of radiation agencies are located within and around Kasetsart University, Bangkok Campus, including Gamma Irradiation Service and Nuclear Technology Research Center, Thailand Institute of Nuclear Technology (TINT), Office of Atoms for Peace (OAP), and the Department of Applied Radiation and Isotope. In order to monitor a natural background radiation level and estimating the external exposure from terrestrial gamma radiation. 15 soil samples around this area were collected for measurement and estimation. In experiment, the results were displayed using The a gamma spectrometry analysis system with HPGe detector that was installed in the standard laboratory at the Department of Applied Radiation and Isotopes, Faculty of Sciences, Kasetsart University, Bangkok Campus. The measuring time of each sample was set about 86,400 seconds. Natural radioactive elements such as K-40, Th-232, Ra-226, and U-238 from soil sample and background radiation levels were found from the spectrum peak and calculating the value of the measured count rates. Furthermore, the results obtained were also used to evaluate the absorbed dose rates in the air (D) and the annual effective dose (E) for dose assessment in this area and comparing with the dose limit by International Commission on Radiological Protection (ICRP). The experimental results can be used as soil background radiation data for confirming background radiation level of this area and radiation accidents in the future. Moreover, experimental results were also compared to the Office of Atoms for Peace (OAP) research data in Thailand, the global radioactivity measurement values, and the recommend values which were proposed by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR).

Keywords: radiation, background radiations estimation from soil sample





Comparative Properties of Natural Rubber (NR)/Bi₂O₃ Composites as X-ray Shielding Materials

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This research aimed to investigate x-ray shielding, cure characteristics, and mechanical properties of natural rubber (NR) with additions of Bismuth (III) Oxide (Bi₂O₃) for potential use as flexible, lead-free x-ray shielding materials. The investigated properties included radiation protection properties, cure times, torque differences, and mechanical properties. The results showed that the increases in contents of Bi₂O₃ from 700 to 1000, and 2000 parts per hundred of rubber by weight (phr) improved the shielding abilities as seen by the increases in the attenuation percentages. For example, the NR composites with 2000 phr of Bi₂O₃ and the thickness of 1.3 mm had the attenuation percentage of 85.52% for 100-keV x-rays, while the NR composites with 1000 phr and 700 phr of Bi₂O₃ had the values of 76.24% and 71.96%, respectively. When compare the ability to shield x-ray with lead (Pb), the results showed that 1.3-mm NR composites with 2000 phr of Bi₂O₃ were equivalent to 0.51 mm of lead sheet, while the NR composites with 1000 phr and 700 phr of Bi₂O₃ were equivalent to 0.36 mm and 0.31 of lead sheets, respectively, implying potentials to replace lead-containing materials with the developed materials.

Keywords: natural rubber, Bi₂O₃, x-ray shielding, lead equivalent





Development of Biodegradable PLA/B₂O₃ Composites for Neutron Shielding Applications

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The objective of the study was to develop a biodegradable poly(lactic) acid (PLA) derived from natural products such as corn, roots, cassava and sugar cane. Since PLA could be decomposed naturally, neutron shielding composites based on PLA would solve the increasing demands of spaces to store radioactive wastes. This work investigated mechanical (tensile modulus, tensile strength, elongation at break, and hardness), biodegradable, and neutron-shielding properties of PLA/B₂O₃ composites with the contents of B₂O₃ varied from 0 to 10%wt and 20%wt, respectively. The overall results showed that the increases in B₂O₃ contents decreased mechanical properties, while improved neutron-shielding abilities, implying great potential to utilize PLA/B₂O₃ composites as an effective and biodegradable neutron shielding materials.

Keywords: Biodegradable, poly(lactic) acid(PLA), Boron oxide, neutron shielding





Green and Environmental Friendly PLA/Sm₂O₃ Composites for Uas Neutron-shielding Materials.

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This research studied the development of neutron-shielding materials based on a biodegradable poly(lactic) acid (PLA) that was produced from renewable resources such as corn, cassava or sugarcane. In order to improve the neutron-shielding properties of the PLA composites, Samarium (III) oxide (Sm₂O₃) powders were added to PLA due to the high neutron absorption cross section of ¹⁴⁹Sm that could absorb thermal neutrons with high efficiency. In this work, PLA/Sm₂O₃ composite were produced using the solvent-casting technique, which used methylene chloride to dissolve PLA granules, and mixed with Sm₂O₃ powders at the contents of 0, 10%wt and 20%wt, respectively. These solvents were then formed using high pressure compression molds to produce 2-mm sheets for neutron-shielding, mechanical (tensile modulus, tensile strength, elongation at break, and hardness) and physical properties. The overall results implied that this developed material could effectively shield neutrons, which improve safety to radiation workers, while also posed environmental friendliness due to their biodegradable properties.

Keywords: samarium(III) oxide, poly(lactic) acid, neutron shielding materials, mechanical properties





Classification of Indochina Rice Varieties Using Insertion-Deletion Marker

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Rice is consumed by a large number of human populations. Understanding genetic relationship of rice cultivars is vital for rice breeding. Insertion-Deletion (InDel) polymorphisms have been widely applied as DNA marker to facilitate rice breeding with high accuracy and stability. So our study aims to classify rice varieties using InDel marker. Genetic relationship among rice group consisting of 50 cultivars in different geological origins of Indochina (Thailand, China, Laos and Vietnam) were evaluated with 133 InDel markers. A total of 99 loci were detected with 97 polymorphic loci. The observed polymorphism information content (PIC) ranged from 0.004 to 0.59 with an average of 0.26. RD0508 locus had the highest PIC value contributing to the potential investigation the genetic relationship of rice cultivars in Indochina. The results showed that rice was classified into three groups composing of the cultivars which are originated from the same region. The interesting result was that rice varieties from China were distributed in all groups, which suggested that China rice may be an ancestor of others.

Key words: genetic relationship, Indochina rice, insertion-deletion marker, polymorphism





Microscopic Structures of the Ovary and Female Genital Ducts of the Water Monitor *Varanus salvator* (Reptilia: Squamata: Varanidae)

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The water monitor, *Varanus salvator*, which is a member of the Family Varanidae, is commonly found in Thailand. As far as is known, the reproductive biology of this varanid lizard is poorly understood, including the anatomy and microanatomy of the reproductive system. This research aimed to investigate the microscopic structures of ovary and female genital ducts of *V. salvator*. Two *V. salvator* females were collected from Varanus Farm, Kasetsart University, Kamphaengsaen Campus, Nakhon Pathom Province. The animals were anesthetized by intramuscular injection of 5 mg/kg Zoletil® 100 (tiletamine-zolazepam), followed by intraperitoneal injection of 10 mg/kg Nembutal® (sodium pentobarbital). The ovaries and reproductive tracts were removed from the body cavity, preserved in Bouin's solution for 24 hours, processed for paraffin technique, cut into 5 µm thick and stained with hematoxylin and eosin, periodic acid-Schiff and Masson's trichrome. *V. salvator* have the paired, elongated, sac-like ovaries that are attached to the body wall by the mesovarium. The ovaries consist of various stages of developing germ cells and follicles, including primary oocytes, primordial follicles, previtellogenic follicles and atretic follicles. The primary oocytes are surrounded by an incomplete layer of prefollicular cells. Primordial follicles are characterized by the presence of unilaminar squamous follicular cells. Previtellogenic follicles measure 2.48 ± 0.90 mm in diameter and have pseudostratified columnar granulosa cells. The theca layers (theca interna and theca externa) and the zona pellucida are initially formed. The granulosa is composed of three follicular cell types: small, intermediate and pyriform cells. The oviduct is divided into four distinct histologic regions: infundibulum, uterine tube, uterus and vagina. The oviduct consists of three tissue layers: mucosa, muscularis and serosa. The cloaca is divided into three parts: coprodaeum, urodaeum and proctodaeum. The coprodaeum which is a part of the gastrointestinal tract is lined by a simple columnar epithelium. The urodaeum has urodeal glands in the mucosa. The proctodaeum has proctodeal glands in the lamina propia. In this study, corpora lutea and vitellogenic follicles were not found, likely because the animals were in the non-breeding season. In conclusion, the microscopic structures of the ovaries, oviducts and cloaca of *V. salvator* are similar to other lizards. This research can be used as the basis for the comparative anatomy and histology of the vertebrates.

Keywords: water monitor, *Varanus salvator*, histology, female reproductive system





Cladoceran Community in Different Macrophytes in Thale-Noi, Phattalung Province

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Cladoceran have the important role in aquatic ecosystem by being food for other organisms. Therefore, changes in cladoceran community structure could effect on changes of other aquatic organism communities. Thus, this research aims to study the relationship between cladoceran community and habitats covered with different species of macrophytes. Cladoceran samples were collected from habitats covered with *Hydrilla verticillata*, *Ceratophyllum demersum* and *Utricularia* sp. beds in Thale-Noi, Phattalung Province every two months during June 2014 to April 2015. A total of 19 cladoceran species was recorded. The most diverse habitat was *Utricularia* sp. beds (15 species) followed by *H. verticillata* beds and *C. demersum* beds (11 species), respectively. Chydoridae was the most diverse family in every macrophytes species both in term of species richness and abundance. However, there are two cladoceran species; *Coronatella monacantha* and *Ephemeroporus hybridus*, that were found only in *C. demersum* beds and four species; *Simocephalus serrulatus*, *Macrothrix odiosa*, *Macrothrix pholpunthini* and *Sida crystallina*, were found only in *Utricularia* sp. beds. Moreover, it was found that most dominant species showed the same distribution pattern in all macrophytes beds in a year round. In addition, community composition and habitat preference were mainly structured by depth, salinity and pH ($P=0.012$). Thus, it is possible to conclude that under similar environmental conditions but in different macrophyte species, the cladoceran communities may not change, yet under dissimilar conditions but with the same macrophyte species, the cladoceran communities may differ.

Keywords: cladoceran, macrophyte, environmental factors, distribution pattern





Insecticidal Efficacy of Widebetal Leafbush (*Piper sarmentosum* Roxb.) against *Nilaparvata lugens* (Hemiptera: Delphacidae)

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Brown planthopper (BPH, *Nilaparvata lugens*) is one of serious insect pests of rice cultivation, especially during reproductive stage of rice plants. Both nymphs and adults congregate at the base of rice plants to suck the plant sap, which severely affect rice productivity. During the BPH's outbreak, farmers need to use the large amount of chemical insecticides to control their population. Excessive use of insecticides leads to the development of chemical resistance. Alternatively, the use of plant extracts, which is less harmful, has been introduced to agricultural system. In this study, we focused on the insecticidal efficacy of widebetal leafbush (*Piper sarmentosum* Roxb.) extract against adult brown planthoppers. The dried leaf powder was extracted in 4 types of solvent in order: hexane, dichloromethane, ethyl acetate and ethanol. Each crude extract was diluted with 5% and 10% of dimethyl sulfoxide (DMSO) and 5%, 10% and 25% of ethanol (EtOH) to make 7 concentrations (625 ppm, 1,250 ppm, 2,500 ppm, 5,000 ppm, 10,000 ppm, 20,000 ppm and 40,000 ppm). Only the crude extract extracted in ethanol was used in this experiment, since other crude extracts could not be dissolved in the diluents. Adult brown planthoppers were tested and survival rate was recorded at 12, 24 and 48 hours. As a result, by using the highest concentration (40,000 ppm) of crude extract diluted with 10% of EtOH, survival rate was the lowest. Respectively, the survival rate was 77%, 25% and 33% at 12, 24, 48 hours. It can be concluded that the crude extract mentioned above had insecticidal efficacy against brown planthoppers.

Keywords: *Nilaparvata lugens*, *Piper sarmentosum*, plant extract, insecticidal efficacy





Larvicidal Activity of *Morinda citrifolia* Extract against *Aedes aegypti* (Diptera: Culicidae) and *Culex quiquefasciatus* (Diptera: Culicidae)

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Mosquitoes, common carrier, cause the effect on humans' and animals' health. At the present, the use of chemicals to control mosquito population is widespread. It causes residues in the environment and affects humans' health. Therefore, the use of natural extracts, especially ones from edible plants, is an alternative to control mosquito population. This study was aimed at investigating the effect of crude extracts from *Morinda citrifolia*. The dried leaf powder was extracted in 4 types of solvent in order: hexane, dichloromethane, ethyl acetate and methanol. Each crude extract was diluted with 1% dimethyl sulfoxide (DMSO) and 1% ethanol (EtOH) to make 5 concentrations (625, 1,250, 2,500, 5,000 and 10,000 ppm). Due to limitation of crude extracts' solubility, 3 crude extracts could not be dissolved in the diluents. In this preliminary experiment, we decided to use only the crude extract extracted in methanol. Third-stage larvae of *Aedes aegypti* and *Culex quiquefasciatus* were tested desperately and survival rates were recorded at 3, 6, 12, 24 and 48 hours. Water (control A), 1% DMSO (control B) and 1% EtOH (control C) were used as controls. After 48 hours of treatment, the results showed that the highest concentration (10,000 ppm) in both diluents (1% DMSO and 1% EtOH) could not kill any larvae of *A. aegypti*. In the experiments with *C. quiquefasciatus*, it cannot be concluded yet, since the mortality rates of larvae in control A and control B were high. Consequently, retests are needed to obtain reliable results.

Keywords: *Morinda citrifolia*, *Aedes aegypti*, *Culex quiquefasciatus*, survival rate





Physical Parameters in Tourism Effected and Pristine Areas: A Case Study in Don Hoi Lot, Samut Songkhram Province

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The study of physical parameters of water and sediment in Don Hoi Lot, Samut Songkhram Province was investigated by comparison between tourism effected and pristine areas. The study sites included 9 sites of tourism effected areas and 9 sites of pristine areas. Sampling in each station started from 500, 700 and 900 meters from shore line. The physical parameters of water and sediment were measured in October 2017, January 2018 and March 2018 using YSI EXO model. The physical parameters in tourism effected and pristine areas which were not significantly different ($p > 0.05$), were temperature, dissolved oxygen and pH. The temperatures range from 23-30 °C while average dissolved oxygen content was 5.08 mg/l and pH range from 7.11-7.19. Those parameters that areas significantly different ($p < 0.05$) in both areas were salinity, conductivity and nitrate concentration. The average salinity in tourism effected areas was 19.17 ppt while in pristine areas was 20.46 ppt. The average conductivity in pristine areas was 34161 us/cm while in tourism effected areas was 31566 us/cm and nitrate concentration in pristine areas was 17.17 mg/l while was 15.64 mg/l in tourism effected areas. These latter factors were influenced by human tourism activities, the length from the freshwater runoff and precipitation. Moreover, all parameters were significantly different ($p < 0.05$) by period of sampling due to the different weather effect. Most water parameters were not exceed the marine coastal water quality standard except the salinity and nitrate concentration which were higher than standard. In term of sediment, major component were sand in every station and all period of sampling and organic matter ranged from 2.32-3.79%. The highest organic matter was in January 2018 and lowest in March 2018 due to water runoff.

Keywords: physical parameters, pristine areas, tourism effected areas, Don Hoi Lot





Effect of *Tiliacora triandra* Leaf Extract on Glycogen Storage in Chronic High Glucose Intake Mice

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Chronic hyperglycemia is abnormally high blood glucose level for a long period of time and may lead to diabetes mellitus and diabetes complications in diabetics. In general, if it has high glucose level in bloodstream, it will change to glycogen and storage in liver and muscle. The present study investigated the effect of *Tiliacora triandra* leaf extract on glycogen storage in chronic high glucose intake mice. Nine-male ICR mice were divided in to 3 groups of control (10% tween 80), *T. triandra* 300 and 600 mg/kg. All animals were received 30% glucose in drink water and continue for 4 weeks. *T. triandra* leaf extract was given by daily oral administration for 4 weeks. Later, all animals were killed and liver tissue were collected for evaluation of liver glycogen by Periodic acid Schiff technique. The result revealed significant different in glycogen storage around central vein of liver ($P < 0.05$) by the treatment with *T. triandra* 300 mg/kg depicted significant reduction of glycogen storage but *T. triandra* 600 mg/kg was significantly increase. The present study conclude that *T. triandra* leaf extract 600 mg/kg increase glycogen storage and *T. triandra* leaf extract 300 mg/kg decrease glycogen storage around central vein of liver in chronic high glucose intake mice.

Keywords: hyperglycemia, Diabetes mellitus, glycogen storage





Tourism Effect in Distribution of Gammarid Amphipod in Don Hoi Lot, Samut Songkhram

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This study aims to evaluate the effects of tourism activity in Don Hoi Lot, Samut Songkhram on distribution of gammarid amphipods. Quantitative samplings were conducted bimonthly in November 2017, January and March 2018 by using Ekman grab and environmental factors including temperature, pH, conductivity and salinity were measured. The study sites included 18 sites which 9 sites of tourism activity areas (including restaurant and park area) and other 9 sites of mangrove forest areas. Sampling in each station started from 500, 700 and 900 meters from shore line. The study showed that the environmental factors (temperature, pH, conductivity and salinity.) in both areas were similar except for the pH in January 2018 and conductivity in March 2018 that were significant different ($p > 0.05$).

The macrobenthic fauna found in this study were classified into 3 major groups: crustaceans, mollusks and polychaetes represented the proportion of 4:2:4. In crustaceans group, gammarid amphipods are major composition. A total of 7 gammarid amphipod species belonged to 4 genera and 4 families was encountered. The most abundant species were *Kamaka appendiculatar* with the average density of 89 individual/m². The mangrove forest area contained higher species diversity but less amphipod density than tourism activity area. In the nearest shoreline area contain less species diversity but higher amphipod density than other 2 areas (500 m. and 900m.). However, the amphipod distribution and environmental factors between two areas were not significantly different ($p < 0.05$). Canonical correspondence analysis (CCA) show that most important factors that affected diversity of gammarid amphipods are pH and salinity. Only members of genus *Kamaka* distribution were affected by temperature. Thus, the environmental factors and gammarid amphipod distribution in these two areas were not different due to tidal and current effect that prevented the organic matter accumulation in both area.

Keywords: diversity, Gammarid amphipod, effect of tourism activity, mangrove forest





Antioxidant and Anticancer Peptide Screening From Giant African Snail (*Achatina fulica*) Genome

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Giant African snail (*Achatina fulica*) is one of several invasive species that widely spreads in Thailand causing damages on agricultural and ornamental plants. Mucus of this snail contains various bioactive glycoproteins and peptides, so it has been popularly added in cosmeceutical products. The *in vitro* bioassays for screening these bioactive molecules are costly, time consuming, and infeasible due to limited protein contents in the samples. This study aimed to develop a bioinformatic screening workflow for identification of antioxidant peptides (AOPs) and anticancer peptides (ACPs) from the *A. fulica* genome data. By mimicking the central dogma process, the python-written program could construct the *A. fulica* proteome data set from its genome, and predict possible pepsin-digested peptide fragments. AOPs and ACPs were predicted from these peptides using bioinformatics prediction programs and databases (e.g. AntiCP, APD, CancerPPD, and AOP-Pred). These AOPs and ACPs could be useful for further peptide design and modification to achieve the desired bioactivities.

Keywords: bioactive peptide, bioinformatics, antioxidant peptide, anticancer peptide, *Achatina fulica*.





An Ability of *Cordycepsmilitaris* Colon Cancer Cell Growth Inhibition Via *FOXMI* Suppression

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Nowadays, *Cordycepsmilitaris* has been used as traditional medicine in many countries. An extract of Cordyceps were reported that it plays many role with many physical pathways including an anti-cancer effect which involves in apoptosis and cell cycle process. This study aims to clarify the effect of *C. militaris* in 2 types which is CM (Chinese strain) and RU (Thai strain) in an inhibition of colorectal cancer cell lines progression which is HT-29 (Non metastasis) and SW620 (Metastasis) by interfering the cell cycle mechanism through the expression of *FOXMI* and *Cyclin B1*. In this study, we extracted total RNA from the cells, investigated expression of genes by RT-PCR and Quantitative analysis by Image J. The results showed that after we treat cells by extract of *C. militaris* in different concentration (100, 200, 400, 800 $\mu\text{g/ml}$), an expression of mRNA depended on concentration of *C. militaris*. For CM, the percentage of *FOXMI* expression in HT-29, decreased when the concentration of CM increased but in SW620 has no effect on *FOXMI* expression, compared with the control group. For RU, *FOXMI* expression in HT-29 decreased when treated with 200, 400, 800 $\mu\text{g/ml}$ but in SW620, it effect on the decreased the *FOXMI* expression only at two concentration which is 400 and 800 $\mu\text{g/ml}$. In addition, we studied the expression of *Cyclin B1* in HT-29 and SW620 as a downstream of *FOXMI* in cell cycle pathway. The trend of percent expression was also decreased similar to the expression of *FOXMI*. According to the results, we can conclude that the extract of Cordyceps, CM and RU, has a biological activity that reduces the expression of *FOXMI* of colorectal cancer at the proper concentration.

Keywords: colorectal cancer, apoptosis, RT-PCR





Annotation of Metabolic Transporters in *Cordyceps militaris* at a Genome-scale

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Cordyceps militaris is one of entomopathogenic fungus which is widely used for medicinal and industrial applications for a long time. In *C. militaris* metabolism, transporters appear to play an important roles in controlling the flux of molecules for nutrients delivery, energy generation, and waste elimination in the cell. Even though, a genome sequence of *C. militaris* is available, it is required for understating its functional annotation of transporter genes in terms of metabolic level. This study therefore aimed to annotate genome of *C. militaris* against other databases of transporter. Here, we performed pairwise BLASTP comparisons between *C. militaris* genome and three transporter databases i.e. transporter classification database (TCDB), TransportDB, and non-redundant protein sequence database (NR). Sequence-based analysis with manual curation showed that 133 genes out of 9,651 total genes in the *C. militaris* genome encoded metabolic transporters. Under consensus integrative databases, 133 unambiguous metabolic transporter genes were distributed into channels and pores (8 genes), electrochemical potential-driven transporters (82 genes), and primary active transporters (43 genes). This study serves as a basic data for understanding of the transporter genes of *C. militaris* which can be used for enhancing metabolic network reconstruction.

Keywords: *Cordyceps militaris*, metabolic transporter, genome annotation





Acute Effect of p-Coumaric Acid on Cerebral Cortex Neuron and Corpus Callosum in Ischemia Reperfusion Mice

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p-Coumaric acid (PC) or 4-hydroxycinnamic acid is a phenolic compound in plants and food stuffs which has antioxidant and anti-inflammatory properties. The present study aimed to investigate the acute effect of p-Coumaric acid on cerebral cortex neuron and corpus callosum in ischemia reperfusion (I/R) mice. Thirty-six male ICR mice were divided into 3 groups of Sham (10% tween80), Control-IR (10% tween80) and PC-IR (PC 100mg/kg) groups. The treatments were given 30 minutes before IR induction. I/R was induced by bilateral common carotid artery occlusion for 30 minutes followed by 45 minutes of reperfusion. After reperfusion, brains were collected for histological examination of cerebral cortex neuron by the using of 0.1% cresyl violet staining and histological examination of corpus callosum by the using of 0.1% Luxol fast blue staining. The results showed that acute PC pretreatment significantly decreased percentage of dead cells in cerebral cortex ($p < 0.05$) and prevented the decrease of white matter density in the corpus callosum ($p < 0.05$). The present study suggests that acute PC pretreatment exert neuroprotective effect on cerebral cortex neurons and white matter in I/R mice.

Keywords: p-Coumaric acid (PC), ischemia reperfusion (I/R), cerebral cortex neurons, corpus callosum





Habitat use of *Cyclemys oldhami* at Sakaerat Environmental Research Station, Nakhon Ratchasima Province

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Asian leaf turtle, *Cyclemys oldhami* is widely distributed from India, Cambodia, Myanmar, Nepal and Thailand, Biology of *C. oldhami* is little known and no intensive ecological study was conducted in Thailand. This study aimed to investigate habitat use of *Cyclemys oldhami* at Sakaerat Environmental Research Station, Nakhon Ratchasima Province. The surveys were carried between August 2017 to March 2018, and twenty individuals, consisting of six males, 11 females, and three juveniles were monitored using radio-telemetry technique. The turtles were found in two main habitat types i.e., natural stream (or Tham Jong Ang) and man-made pond. Seven microhabitat types were classified and the observations showed that the turtles were frequently found in ponds (52%), under rock boulder above ground (24%) and under rock boulder in ponds (17%) for all seasons. Moreover, adult males and females differed in microhabitat use, especially at the natural stream site. The results from this study provided the basic biology information on habitat use that can be used for turtle conservation in Thailand. However, the long-term study on ecology of this turtle is still needed.

Keywords: habitat, ecology, microhabitat, radio-telemetry





Species Diversity of Bdelloid Rotifer in Freshwater Habitats in Kasetsart University

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This research aims to study the species diversity of bdelloid rotifer in various types of 28 freshwater habitats in Kasetsart University, Bangkok Campus including ponds, swamps, lotus ponds, canals and fish ponds. Samples were collected by plankton net of 20 micrometer of mesh size between November 2017 and February 2018. A total of ten species was recorded including *Rotaria macrura*, *R. megarostris*, *R. mento*, *R. neptunia*, *R. neptunoida*, *R. cf. neptunoida*, *R. rotatoria*, *R. tardigrada*, *Rotaria* sp. and *Philodina megalotrocha*. Of which, *R. macrura* is a new record for Thailand and some morphological characters of *Rotaria* sp. are not present in other *Rotaria*. *R. neptunia* is the most widely distributed species which was found in 10 sampling sites and cover all types of habitats whereas *R. macrura* and *R. tardigrada* were found in only one sampling site. Moreover, six from seven *Rotaria* species recorded in Thailand were found in freshwater habitats in Kasetsart University. Thus, it is interesting to study more intensively on the distribution pattern of bdelloid rotifers in each type of habitats and each region. In addition, findings of more new record and more taxa that supposed to be a new species in these small study sites indicated that the present records of this microinvertebrate in Thailand are far of the actual species richness.

Keywords: bdelloid rotifers, new record, diversity, Thailand





Diversity of the Cladocera in Peat Swamp in Rayong Botanic Garden, Rayong Province

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Cladoceran is a zooplankton which important in freshwater ecosystem by being a primary consumer and food for other aquatic animals. Their distribution is different in each type of habitats which has different type of food and other environmental factors. This research aims to study the species diversity of cladoceran in peat swamp in Rayong Botanic Garden, Rayong Province. Samples were qualitatively collected from six stations between May and October 2017. A total of 23 cladoceran species in seven families was recorded. This number is account for about 21% of number recorded in Thailand. The most diverse family is Chydoridae (11 species) followed by Macrothricidae (4 species) Daphniidae (3 species) Sididae (2 species) and Bosminidae (1 species), Ilyocryptidae (1 species) and Moinidae (1 species). Number of species in each station ranges from 9-14 species. The most common species is *Chydorus reticulatus* and *Alonella excisa* which were found in every station whereas most of species (35% of total records) including *Alonella nana*, *Scapholeberis kingi*, *Kurzia longirostris*, *Euryalona orientalis*, *Guernella raphaelis*, *Simocephalus serrulatus*, *Chydorus cf. pubescens* and *Macrothrix spinosa* were found in only one station. These results indicated that there is relatively low diversity of cladoceran in peat swamp comparing with other freshwater habitats especially vegetated swamps which contain more than 20 species in each locality. However, this type of habitat contains a group of species which rarely found in other type of habitats.

Keywords: Cladoceran, peat swamp, zooplankton





Effects of Polyvinyl Alcohol-silver Nano Hydrofilm on Wound Healing in Mice

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This study sought to evaluate the wound healing activity of polyvinyl alcohol-silver nano hydrofilm in excisional model of skin in mice. Six week olds male ICR mice were used in this experiment. Round full thickness skin wounds were performed on the back of mice. All animals were divided into four groups: group 1 (control group) wound dressing with 0.9% normal saline, group 2 wound dressing with povidone-iodine, group 3 wound dressing with polyvinyl alcohol+0.4% silver nano hydrofilm and group 4 wound dressing with polyvinyl alcohol+ 0.8% silver nano hydrofilm. Wound healing was evaluated by wound contraction, wound closure and histopathological characteristics. Animals were sacrificed on 3,7 and 14 days after wound induction. The results show that polyvinyl alcohol- silver nano hydrofilm treated groups were greater reduced wound surface area and higher percentage of wound contraction as compare with control group in during the first 7 days. The histopathological study show that polyvinyl alcohol+0.4% silver nano hydrofilm had highly density of collagen fiber on 3 days after wound induction. Whenever polyvinyl alcohol+0.8% silver nano hydrofilm had highly density of collagen fiber and neovascularization on 7 days after wound induction. The present study confirms potential therapeutic benefit of polyvinyl alcohol-silver nano hydrofilm for management of wounds.

Keywords: wound healing, polyvinyl alcohol, silver nanoparticle, hydrofilm





Morphological Variation of *Sphenomorphus maculatus* in Thailand

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Common skink, *Sphenomorphus maculatus* is widely distributed in Thailand and little is known for its biology. This study aimed to explore morphological variation of *S. maculatus* in Thailand based on 16 morphometric and 12 meristic characters. Forty-four specimens were collected from 13 localities and classified into three groups i.e., adult male, female and immature. Body size of females is larger than that of male and immature skinks, respectively. The differences in morphometric characters were tested using Kruskal-Wallis test, and it was found that some head characters are different between adult and immature skinks, and tail depth and limb length differ between sexes, indicating sexual dimorphism. Some meristic characters e.g., supraciliaries, primary temporals, and lower labial show variations among individuals. However, the sample size in this study is small for determining variation among localities, and additional specimens from different localities in Thailand should be collected for further analysis.

Keyword: Scincidae, morphometrics, meristic, sexual dimorphism





Effects of Polyvinyl Alcohol-silver Nano Hydrogel on Wound Healing in Mice

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The present study was conducted to establish an excisional model of skin wound healing in polyvinyl polyvinyl alcohol-silver nano hydrogel in mice. Six week olds male ICR mice were used in this experiment. Round full thickness skin wounds were performed on the back of mice. All animals were divided into four groups: groups 1 (control group) wound dressing with 0.9% normal saline, group 2 wound dressing with povidone-iodine, group 3 wound dressing with polyvinyl alcohol+0.4% silver nano hydrogel and group 4 wound dressing with polyvinyl alcohol+0.8% silver nano hydrogel. Wound healing was evaluated by wound contraction, wound closure and histopathological characteristics. Animals were sacrificed on 3, 7 and 14 days after wound induction. As compared to the control group the wound surface area and wound contraction were greater in both polyvinyl alcohol- silver nano hydrogel treated groups on 7 day after wound in parameter of wound healing, both of polyvinyl alcohol- silver nano hydrogel groups were significant increase the Amount of collagen deposition and neovascularization when compared with control group and the povidone-iodine group. Nevertheless, both of polyvinyl alcohol- silver nano hydrogel groups were significant increase the amount of collagen deposition and insignificant increase neovascularization on day 14 after wound healing. The present study confirms potential therapeutic benefit of polyvinyl alcohol- silver nano hydrogel for management of wounds.

Keywords: wound healing, polyvinyl alcohol, silver nano, hydrogel





Daily Activity of Flat-headed Cat (*Prionailurus planiceps*) in Captivity at Songkhla Zoo

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This study focused on the daily activity of flat-headed cats (*Prionailurus planiceps*) which were recognized as an endanger species. Activities of male and female cats in captivity were observed during 8th - 15th June 2017 by using video cameras at the Small Cat Research Center, Songkhla Zoo, Songkla Province. The observation gathered on each individual by the *Ad libitum* sampling for 24 hours (daytime 0600- 1800 and nighttime 1800- 0600). The observed behavior and time budget were recorded and used for constructing the ethogram. Finally, the daily activities were analyzed and compared between male and female. The result revealed that activity patterns of the cats were classified into six categories as following; maintenance, feeding, resting, interaction, aggressive and vigilance. The cats were commonly active at the nighttime and rest during the daytime. Daily activities and time spend during the daytime of male and female were not significantly difference ($p>0.05$). However, vigilance time spend of the male was significantly longer than the female at night ($p=0.003$). In addition, compared with congeneric species, the activity pattern of flat-headed cats are similar to the natural activity of leopard cats (*P. bengalensis*) and fishing cats (*P. viverrinus*). As commonly known, fishing cats are nocturnal/crepuscular species, while leopard cats are known as a strictly nocturnal species. According to the result, the period of time spent on activities of flat-headed cats is more similar to the fishing cats rather than leopard cat.

Keywords: daily activity, Flat-headed cat, captivity, ethogram





Morphometric Analysis of Butterfly Lizard Genus *Leiolepis* in Thailand

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This study focuses on morphological variation among conspicuous geographic morphs of lizard in the genus *Leiolepis* in Thailand. The total of 84 specimens from 13 localities throughout Thailand, from Zoological Museum of Kasetsart University (ZMKU), Thailand National History Museum (THNHM) and Songkhla Zoo, were investigated. Morphological characters included mensural character, meristic character such as scales count and stripe patterns were used for clustering. Principal component analysis and cluster analysis were applied for discrimination of the taxa. The result revealed four distinct groups of *Leiolepis* in Thailand. Neck stripe patterns, dorsal spots pattern and their distribution were significant characters for distinguishing the geographic morphs in character analysis. Trang population is clearly separated from the other groups (distance = 62.5) with different body stripe pattern and might be the new distribution range of *L. triploida* outside their original published distribution at Phuket Province and Penang, Malaysia. Moreover, clustering of others population consisted with previous morphological identification and related with their distribution ranges. All of North-eastern populations correlated with *L. rubritaeniata*. The green morph population from Songkhla Province was compatible with *L. bohemei*. The last group composes of the Northern, Western, Eastern and some populations from Southern part, this group is a mix of *L. belliana* and *L. Ocellata*. In the past, these two species once were identified as the same species (*L. belliana*).

Keywords: *Leiolepis*, morphological characters, cluster analysis





The Isolation and Culture of the Pigment Producing Microalgae from Nature

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Carotenoids are colors ranging from yellow to red pigments that can be found in higher plants, microalgae, crustaceans and microbes. They also have a critical antioxidant function of scavenging free radicals together with other interesting biological properties. As this type of pigment has been getting more use in several ways by different industries such as food, cosmetics as well as poultry and aquaculture which they will be served as colorants in various food and cosmetics, hence the objectives of this study were to: 1) isolate the microalgae from nature. 2) investigate the stress conditions inducing the algae to produce high value pigments. First, the isolation of microalgae from a pond in rhino's zone at Songkhla Zoo, Mueang Songkhla District, Songkhla was performed by which the water samples was done with a four 10-fold serial dilution after that the samples then were cultured in different media as follows: TAP (enriched media), HSM (minimal media for photoautotroph) and BG11 (selective media for cyanobacteria) in order to select for the algae. The potential for pigment production of the algae colonies isolated were characterized by consequently culturing them under the following stress conditions: 1) heat stress (40°C) with light 2) heat stress (40°C) without light 3) nitrogen reduced stress (10%N) 4) salinity stress (+10g/L NaCl). Fourteen days under stress condition, the color of 9 algae colonies under heat stress (40°C) both with and without light changed from green to yellow-orange indicating the accumulation of some carotenoid pigments. The evidence of this might be used as a preliminary study for investigating the stress conditions that possibly induce the accumulation of yellow-orange pigment in microalgae.

Keywords: microalgae; carotenoid; stress condition; Songkhla Zoo





Effect of Antidepressants Fluoxetine to Non-target organism by Using *Artemia* sp. As a Study Model

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Fluoxetine is a drug used to treat depression. Some of the medicine that patients receive are excreted in the urine. If these wastes are released into the environment, they can have toxic effects on other organisms. So, we studied that effect by using *Artemia* sp. (Brine shrimp) as a study model. We divided the sample into 6 groups of about 100 each, each group received the drug at different concentrations for 24 hours, recorded the results by counting the number of survivors and deaths, reproducing all three times and then analyzing the data and calculating the statistics using TTEST. We found that the mortality rate of drug-treated groups was statistically significantly different with the non-treated group, and it was also found that the higher dosage was associated with higher mortality. This shows that Fluoxetine has a toxic effects on non-target organisms, especially in *Artemia* sp. which are living in water and are the primary consumer of the food chain, leading to the spread of toxins for a wide range. This research will implant a responsibility for waste management, water conservation, including awareness of food hazards in water resources that are at risk of contamination.

Keywords: antidepressant, Fluoxetine, *Artemia* sp., Brine shrimp





Comparative Genomics of *Mucor circinelloides* Strain WJ11 and the Closely Related Oleaginous Species

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Mucor circinelloides WJ11 is an oleaginous fungus, which is able to produce high content of lipid containing the nutritionally important fatty acid, γ -Linolenic acid (GLA). Even though a genome of *M. circinelloides* WJ11 is available, understanding of gene functions and how the difference between *M. circinelloides* WJ11 and other closely related species are required, particularly in terms of metabolic level and oleaginic feature. This study therefore aimed to annotate the genome of *M. circinelloides* WJ11 against other species of oleaginous fungi. Here, we performed pairwise BLASTP comparisons between *M. circinelloides* WJ11 genome and other related genomes, i.e. *M. circinelloides* strain CBS 277.49, *Mortierella alpina*, *Aspergillus oryzae* strain RIB40 and BCC7051. The results clearly showed that *Mucor* species have high number of orthologous genes (9,062 genes), which accounted for 96% genes similarity than the other species. Additionally, *M. circinelloides* WJ11 also had unique genes relevant to lipid biosynthesis and accumulation, for examples, genes encoding for fatty-acid-CoA ligase, lysophosphatidate acyltransferase, glycerol-3-phosphate acyltransferase, glycerol 3-phosphate dehydrogenase, and glycerol-3-phosphate dehydrogenase. This study serves as an informative data for further integrative study of the oleaginous strains, which would guide for development of over-production process of functional lipids and oleochemicals.

Keywords: *Mucor circinelloides*, lipid accumulation, oleaginic



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