The Science Society of Thailand
Under the Patronage of His Majesty the King
and Faculty of Science, Chiang Mai University

CHIANG MAI 2024
STT 50

STT50

The 50th International Congress on Science, Technology and Technology-based Innovation

25th - 27th November 2024

The Empress Hotel, Chiang Mai, Thailand

https://stt50.scisoc.or.th

Science x Creativity

Crafting the World

Abstract book

TABLE OF CONTENTS

A-PHYSICS / APPLIED PHYSICS

B-BIOLOGICAL SCIENCES

C-CHEMISTRY (INORGANIC CHEMISTRY)

C-CHEMISTRY (ORGANIC & MEDICINAL CHEMISTRY)

C-CHEMISTRY (PHYSICAL & THEORETICAL CHEMISTRY)

D-MATHEMATICS / STATISTICS / COMPUTER SCIENCE / DATA SCIENCE / AI

E-ENERGY / ENVIRONMENTAL & EARTH SCIENCE / MATERIALS SCIENCE / CHEMICAL TECHNOLOGY

F-FOOD SCIENCE AND TECHNOLOGY/AGRICULTURAL SCIENCE

SP4-CHALLENGES AND OPPORTUNITIES IN CLIMATE AND ENVIRONMENTAL CHANGES

SP5-DATA SCIENCE AND DATA PRIVACY

SP9-GENERATIVE AI: AN EMERGING AI TECHNOLOGY

SP10-UNIVERSITY - INDUSTRY RESEARCH COLLABORATION

SP11-X-RAY CRYSTALLOGRAPHY

A-PHYSICS / APPLIED PHYSICS

COMPARISON OF CIRCULAR SHAPE AND SQUARE SHAPE LIGHT GUIDE PLATE ATTACHED WITH THE SAME NUMBER OF LIGHT EMITTING DIODE AS THE ARTIFICIAL LIGHTING FOR WHEATGRASS SPROUT GROWING

Pakorn Prajuabwan*

Department of Physics, Faculty of Science and Technology, Kanchanaburi Rajabhat University, Kanchanaburi, 71190, Thailand

*e-mail: pakorn@kru.ac.th

Abstract:

Growing wheatgrass sprouts for juicing always use fluorescent lighting which consume more electricity for illumination. Light Guide Plate(LGP) attached with Light Emitting Diode(LED) is proposed as the artificial lighting for wheatgrass instead of fluorescent lighting. LGP is an acrylic panel typically made from pure Polymethyl methacrylate (PPMA) resin. LGP are used as backlight light in LCD screen backlight module, LED panel lighting for decoration and advertising display panel. The simple technique to scatter the light from the light source through LGP by making a matrix of drilling holes as a concave lens all over LGP panel is proposed. This technique with LGP can be used to mix red and blue LED light source with appropriate ratio between red and blue colour to be artificial lighting for plants illumination. Surface mounted red color and blue color LEDs are attached at all 4 sides edge of square shape LGP (30cm.×30cm.) The appropriate 3 mm. diameter drilling holes and 5 mm. distance will scatter the mixed light out the front of the panel. In order to obtain the most production results of wheatgrass, The circular shape LGP with the same length of circumference of 120 cm. as same as 120 cm.(4 sides) of square shape LGP is fabricated and used in wheatgrass illumination experiment compared to square shape LGP counterpart. The effect of blue light on plants is directly related to chlorophyll production. Plants that receive plenty of blue light will have strong, healthy stems and leaves. Red light is responsible for making plants flower and produce fruit. It's also essential to a plant's early life for seed germination, root growth, and bulb development. In artificial LED lighting for plant illumination, The ratio between red and blue color is always fixed by the manufacturer of LED panel. The user cannot adjust the fixed red and blue ratio. With LGP technique, the user can design the ratio of red and blue color LED by selecting the number of red LED and blue LED to attach at all 4 edges of square LGP or circumference of circular LGP. Normally, the number of red LED is always higher than the number of blue LED, because the light intensity of red LED is lower than the light intensity of blue LED. In this experiment, The light intensity of various ratios of red color and blue color are measured with light spectrum instrument compared to the light intensity of unmixed red color and unmixed blue color in both square shape LGP and circular shape LGP. Red:Blue(2:1) ratio LED lighting give more weight of wheatgrass sprouts compare to Red:Blue(1:1) ratio counterpart (12 hours illumination). Because of the more area of the circular shape LGP(area=πr^2=1,146 cm^2) compared to the area of square shape LGP(area =30cm.×30cm.= 900 cm^2), the circular shape LGP for wheatgrass illumination will give more wheatgrass production in weight. The chlorophyll extraction results in various ratio of red and blue mixed color LED lighting are examined to confirm the possibility in using this technique.

INSIGHTS TO BALL VERTICAL DYNAMICS RELATIVELY BOUNCING ON PULSE VIBRATED SURFACE UPON IMPACTION UNDER AIR-RESISTANCE CONSIDERATION

Wiwat Chumai,[1] Kanjana Ongkasin,[2*]
[1]Royal English Program School, Rayong Thailand, 21130
[2]Department of physics, Ubon-Ratchathani University, Ubon-Ratchathani Thailand, 34190
*e-mail: kanjana.o@ubu.ac.th

Abstract:

Bouncing ball is a well-known problem in physics, involving a ball dropped from height to ground. Despite the simplicity, a ball may exhibit various fascinating behaviors upon surface impaction. In this research will delve into the bouncing ball problem under different surface condition by allowing surface to vibrate freely due to external impulse. The experiment was conducted to study a ball's impact an elastic surface upon presence of air-damping –four types of ball were included in the examination consists of steel ball, marble, tennis ball, and ping-pong ball. The consideration to ball dynamics was taken in two parts including ball bouncing and oscillating. However, the complexity occurs during ball oscillating in contact with surface. To understand to chaotic, Finite Element Analysis and Python Computing were employed to form the simulations while predicting the surface behaviors that affect the ball motion. Moreover, RDI high-speed camera were used to motion amplification and analyze the surface vibration more precisely. Our discovery revealed the relationship between damping ratio, peak to peak displacement, oscillation frequency, and amplitudes upon different kinds of mass. Finally, this research contributes to development in facets of spray research such improvement in spray nozzle in colling tower.

DEVELOPMENT OF HNT INCORPORATED POLYMER/MINERAL-COMPOSITE HAP COATING ON TITANUM SUBSTRATE

S. Sivasakthi[a], Anushiya Manickam[a], M. Jeevadharani[a], and M. Surendiran[a]*

Department of Chemistry, School of Arts and Science, Vinayaka Mission's Chennai Campus, Vinayaka Mission's Research Foundation, Paiyanoor, Chennai – 603 104.

E-mail: sschemsurender@gmail.com

ABSTRACT:

One promising approach in the field of biomedical research the use of composite materials, which combine different components to achieve desirable properties that are not attainable by a single material alone. Metal-based composites have shown great potential because to their osteogenesis-stimulating ability, biocompatibility, and mechanical strength. Ti-metal is often utilized in dental and orthopaedic implants; nevertheless, because of its bioinert nature, surface changes are necessary to increase bioactivity and prevent bone integration. Enhancing bioactivity is essential for better implant integration with bone tissue. HNTs are included into this composite as nano-reinforcements to enhance the polymer matrix's mechanical qualities and add more places for bone cells to adhere. While the HAP coating, which has been developed using the sol-gel process, resembles the mineral phase of bone and promotes better integration between the implant and surrounding bone tissue, the inclusion of minerals into the composite aids in the stimulation of bone regeneration. The homogeneous morphology and structural integrity of the composite coatings were confirmed by advanced characterisation techniques such as Fourier-transform infrared spectroscopy (FT-IR), scanning electron microscopy (SEM) with EDAX spectrum, transmission electron microscopy (TEM), and X-ray diffraction (XRD). With its greater mechanical strength, biocompatibility, and bioactivity, this material combination overcomes the constraints of conventional bone regeneration. It therefore fosters bone regeneration and restoration.

Development of THz Free Electron Laser Beamline at PBP-CMU Electron Linac Laboratory, Chiang Mai University

K. Damminsek*, N. Chaisueb, W. Jaikla, W. Jaipang, N. Khangrang, E. Kongmon, J. Saisut, C. Thongbai, S. Rimjaem
Chiang Mai University, Chiang Mai, Thailand, 50200
*email : sakhorn.rimjaem@cmu.ac.th

Abstract

The THz Free-Electron Laser (THz-FEL) beamline has been developed at the PBP-CMU Electron Linac Laboratory (PCELL), Faculty of Science, Chiang Mai University, Thailand. It aims to generate the super-radiant THz FEL for THz spectroscopy and high-field irradiation, which has the advantage properties such as coherent and high brightness radiation and tunable frequency. The accelerator system and the beamline consist of a thermionic cathode radio-frequency electron gun (RF-gun), a linear accelerator (linac), a magnetic bunch compressors system, focusing and bending magnets, an electromagnetic undulator-based radiation source, electron beam diagnostic devices and a THz radiation extraction chamber equipped with a characterization station. The optimized electron beams based on beam dynamics simulation have an energy in a range of 10 – 16 MeV, a duration pulse length of 200 – 300 fs and a bunch charge of 50 pC. These electron beams can be used to generate the radiation with frequencies covering the regions between 1 and 3 THz corresponding to wavelengths between 300 and 100 µm. Magnetic field profiles of the undulator have been optimized to properly generate the THz radiations, which will be transported to the radiation characterization and the experimental stations. In addition, magnetic field profiles of the source have been employed to evaluate the properties of the THz radiations via the SPECTRA code. This contribution reports the development progress of the THz FEL beamline, the results of magnetic characterization of the THz undulator and preliminary results of the THz radiation evaluations. Furthermore, the radiation extraction chamber and the designed diagnostics including associated optics to investigate properties of the THz radiations such as total pulse energy, energy spectrum, spatial and temporal pulse length as well as measuring methods for radiation properties will be presented in this contribution.

Keywords: Free Electron Laser, THz FEL, undulator radiation, photon diagnostic

Efficient oil/water separation on stainless steel mesh coated by spraying nanoparticles

Sawanya Ngamrung[a], Natda Wetchakun[a,b], Khatcharin Wetchakun[c], Sumet Sakulsermsuk[a,b*]

[a]Photocatalysts and 2D materials Research Laboratory, Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand

[b]Center of Excellence in Materials Science and Technology, Chiang Mai University, Chiang Mai, 50200, Thailand

[c]Program of Physics, Faculty of Science, Ubon Ratchathani Rajabhat Universtiy, Ubon Ratchathani, 34000, Thailand

Abstract:

Hydrophobic stainless steel meshes were prepared by coating candle soot (CS) and silica (SiO_2) nanoparticles with different weight ratios via spraying. From SEM images, it can be seen that the stainless-steel mesh was covered with CS/SiO_2 nanoparticles on the mesh wires. By using water contact angle measurements, the water contact angles of candle soot/SiO_2 composites immobilized on stainless steel mesh were 104.82°±6.12 to 136.17°±0.76°, which is characteristic of hydrophobicity. The separation efficiencies of oil hexane, toluene, and petroleum ether from water of the coated CS/SiO_2 meshes were 91.337%, 92.622%, and 75.302%, respectively. This work provides a simple, cost-effective procedure for oily wastewater treatment.

ELECTRICAL RESISTIVITY TEACHING USING GRAPHITE PENCIL LINE EXPERIMENT TO ENHANCE SCIENCE COMPETENCIES

Pranee Disrattakit
Department of Physics, Mahidol Wittayanusorn School, Nakhon Pathom, 73170 Thailand
*e-mail: pranee.dis@mwit.ac.th

Abstract:
Electrical resistivity and resistance are important topics in secondary and high school classrooms. Typically, the teacher uses the lecture and experiment to discuss the relationship between the conductor's length, cross-sectional area, and resistivity. In this study, a graphite pencil line was used to study and design a hands-on activity to investigate the relationship between the length and resistance of a pencil line on paper. The results show that a pencil line on paper can be used well to explore the relationship between length and resistivity. In addition, pencil line hands-on activity can promote the scientific competencies of the high school student. The feedback from the twenty expert teachers who have used this hands-on activity indicated that this activity enhances scientific competencies that are applying scientific knowledge to create reasonable explanations, identifying, using, and creating explanatory models and representations, predicting scientific changes using logical reasoning, proposing hypotheses for explanations, identifying issues for investigation from specified scientific studies, proposing methods for investigating specified scientific issues, evaluating methods for investigating specified scientific issues, describing and evaluating methods scientists use to verify the reliability of data, converting data from one form to another, analyzing and interpreting scientific data and drawing conclusions, identifying assumptions, evidence, and reasoning in scientific matters.

ENHANCING DATA ANALYSIS SKILLS FOR ASTRONOMY OLYMPIAD COMPETITORS THROUGH TEAM-BASED LEARNING: A CASE STUDY FROM THAILAND

Thanyanan Somnam,* Phanuphat Srisukhawasu
Department of Physics, Mahidol Wittayanusorn School, Nakhon Pathom, 73170 Thailand
*e-mail: thanyanan.phu@mwit.ac.th

Abstract:
International Science Olympiads have garnered significant interest from young students around the world. These annual competitions aim to challenge the brightest students from participating countries and to develop curricula and teaching methods that meet international standards. In Thailand, Mahidol Wittayanusorn School, a specialized high school, has been assigned the mission of providing advanced academic content and practical skills for students by organizing olympiad camps and selecting representatives for national olympiad competitions. In this study, we developed a team-based learning approach in data analysis in astronomy to prepare eight selected students for the twenty-first Thailand Astronomy Olympiad. Using a one-group pretest-posttest design, we prepared two parallel practice exams as pretest and posttest assessments, each with a total score of 75 points. The students were given one hour to complete the pretest exam. They were then divided into two groups of four to share and discuss their processes and results. Each group selected the best solutions for all questions to present to the class. After corrections, the students took the posttest exam under the same conditions and repeated the methodology. We found that the mean score of the posttest (67.88 points) was higher than that of the pretest (58.95 points), with a better standard deviation. The pretest scores displayed a left-skewed distribution, while the posttest scores, following our intervention, converged towards a normal distribution. Although some negative differences were observed, the related-samples Wilcoxon signed-rank test indicated a statistically significant improvement at the 0.05 significance level. In summary, our study highlights an alternative approach to improving data analysis skills and could pave the way for better preparation of representative students in other astronomy olympiad centers in Thailand.

Enhancing Quantum Communication Efficiency through Wave Properties

Sorrawit Sangngern *[1], Sirachat Kaewkongtham[2] , Pruet Kalasuwan[3]
[1] Science Classroom in University Affiliated School Project(SCiUS) ,Thailand
[2,3] Department of Physics , Prince of Songkla University ,Thailand
e-mail: mbb4935@gmail.com

Abstract:
In transmitting light from one location to another, there is often a problem of light power reduction over distance, which affects the accuracy and efficiency of data transmission to the other side. This experiment focuses on improving the efficiency of quantum communication between two parties by reducing the impact of light power loss that occurs when light travels long distances, through the use of polarization principles and appropriate wavefront and phase adjustments of light, along with suitable algorithms.
The experiment involves designing a data transmission system using a photon source, where light is subjected to polarization and appropriate wavefront adjustments before it travels through optical fibers to enhance data transmission efficiency and reduce light power attenuation over long distances. Upon reaching the other end, photon detectors are used to measure and analyze the arriving photons. This data transmission experiment was conducted over various distances to assess the system's performance based on distance.
The results indicate that using polarization principles and appropriate wavefront and phase adjustments can reduce light power attenuation and data loss, but it performs better when tested at shorter distances. This communication system design can be further developed into a high-efficiency and secure communication system or applied in conjunction with Quantum Key Distribution protocols.

EXCELLENT PHOTOVOLTAIC PERFORMANCE OF ORGANIC SMALL MOLECULE PASSIVATED CARBON-BASED PEROVSKITE SOLAR CELL

Sukhanidhan Singh[1], Chukwuebuka Emmanuel Usulor[1], Pattanasak Tipparak[2], Warunee Khampa[2], Wongsathon Musikpan[2], Woraprom Passatorntaschakorn[1], Atcharawon Gardchareon[1], Pipat Ruankham[1,3], Duangmanee Wongratanaphisan[1,3*]

[1]*Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand*

[2]*Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand*

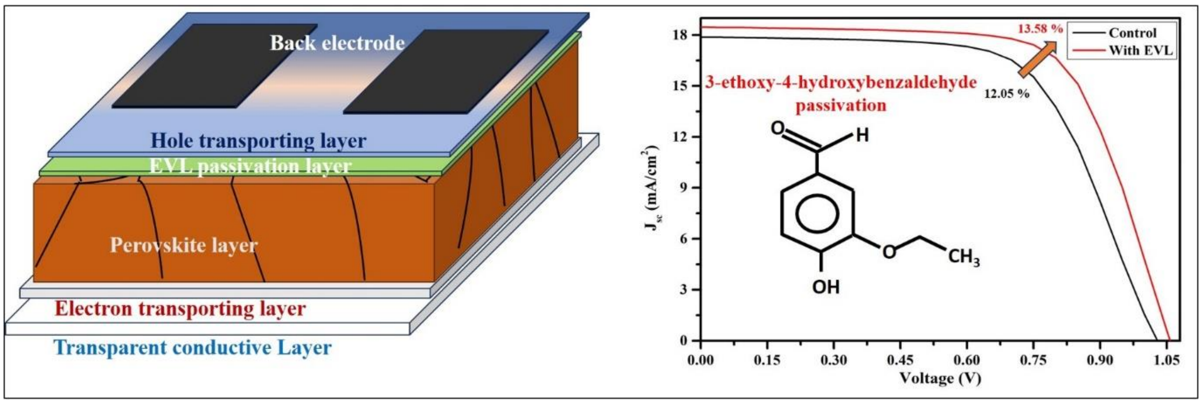
[3]*Thailand Center of Excellence in Physics (ThEP Center), Ministry of Higher Education, Science, Research and Innovation, Bangkok 10400, Thailand*

[*]*email: duangmanee.wong@cmu.ac.th*

Abstract:

Organic-inorganic halide perovskite solar cells (OIHPSCs) with carbon as back electrode have emerged as one of the most attractive PSCs due to their feasible synthesis process, low-cost fabrication and remarkable optoelectronic properties in ambient conditions. But still perovskite film is facing an issue related to defects, hydrophobicity, and various kinds of defects. These issues affect the performance of the PSCs as nonradiative recombination process recombination of photogenerated charge carriers occurs. Surface passivation is one of the most acceptable techniques to improve the perovskite film quality. Herein a small organic molecule 3-ethoxy-4-hydroxybenzadehyde is used as a passivation layer at the perovskite absorbing layer. In this molecule aldehyde (−CHO), hydroxyl (-OH), and alkoxy (-O-CH_2) functional groups are available to mitigate the defects and enhance the device performance, which passivates under-coordinated (Pb^{+2}) and impedes the migration of FA^+ and I^-, respectively on the perovskite film via hydrogen binding. The EVL passivation layer reduces defect density, suppresses the nonradiative recombination, and facilitates the movement of holes from the active layer to the hole transporting layer (HTL).

Keywords: *Non-radiative recombination, 3-ethoxy-4-hydroxybenzadehyde, Perovskite solar cells, Surface passivation*



Back electrode
Hole transporting layer
EVL passivation layer
Perovskite layer
Electron transporting layer
Transparent conductive Layer
13.58 %
Control
With EVL
3-ethoxy-4-hydroxybenzaldehyde passivation
12.05 %
J_{sc} (mA/cm^2)
Voltage (V)

FINITE ACTION FOR A SINGULAR INSTANTON

Vicharit Yingcharoenrat[1,*]
[1] Department of Physics, Faculty of Science, Chulalongkorn University
*e-mail: vicharit.y@chula.ac.th

Abstract:

In this talk, I will first briefly review the false vacuum decay in flat Euclidean space using the semiclassical approximation. In particular, the typical false vacuum decay follows the so-called Coleman condition, i.e. the instanton is regular at the center of the bubble, and the solution is O(4) symmetric. It was proven that such an instanton leads to the lowest on-shell action; therefore, its corresponding decay process is most probable. Then, I will explain the possibilities of extending such a situation to the case where the O(4)-symmetric instanton is singular, provided that the action is still finite. Specifically, I will show a general form of the potential around the origin, which realizes the singular instanton with finite action. Moreover, I will provide a concrete example, in which this situation is realized. Finally, I will discuss the possibilities of relaxing the O(4) symmetry of the instanton solution by considering a small deformation around the singular O(4)-symmetric instanton.

FORCED CONVECTION HEAT TRANSFER DUE TO HOT AIR FOR THE REFLOW SOLDERING PROCESS IN A HARD DISK DRIVE FACTORY INVESTIGATED BY COMPUTATIONAL FLUID DYNAMICS

Natcha Kanjad, Chanapat Chanbandit and Jatuporn Thongsri*
Computer Simulation in Engineering Research Group, College of Advanced Manufacturing Innovation, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
*e-mail: Jatuporn.th@kmitl.ac.th

Abstract:
In a reflow soldering process (RSP) of a hard disk drive (HDD) factory, hot air was supplied to the welding tip (WT), generating a high temperature based on a forced convection heat transfer to melt solder balls and bond small electrical components to assembly HDD. This research employed computational fluid dynamics (CFD) to investigate the parameters that affect the force convection heat transfer due to hot air. CFD revealed that hot air velocity (v), hot air temperature (T), and hot air supply time (t) were the mentioned parameters. Since the RSP preferred a uniformly distributed temperature at the welding tip, CFD indicated the supplied hot air should be slow v, low T, and long t. Otherwise, the temperature at the WT was non-uniformly distributed, which was improper for the RSP. CFD results were consistent with the experimental results, confirming the CFD results' credibility. Using a factory operating condition with v of 10 m/s and T of 230 °C, the WT temperature was non-uniform distributed for the t less than 45 s. In contrast, supplying hot air continuously for longer than 45 s would provide a more uniformly distributed temperature at the WT than was supplied shortly, which is suitable for the RSP.

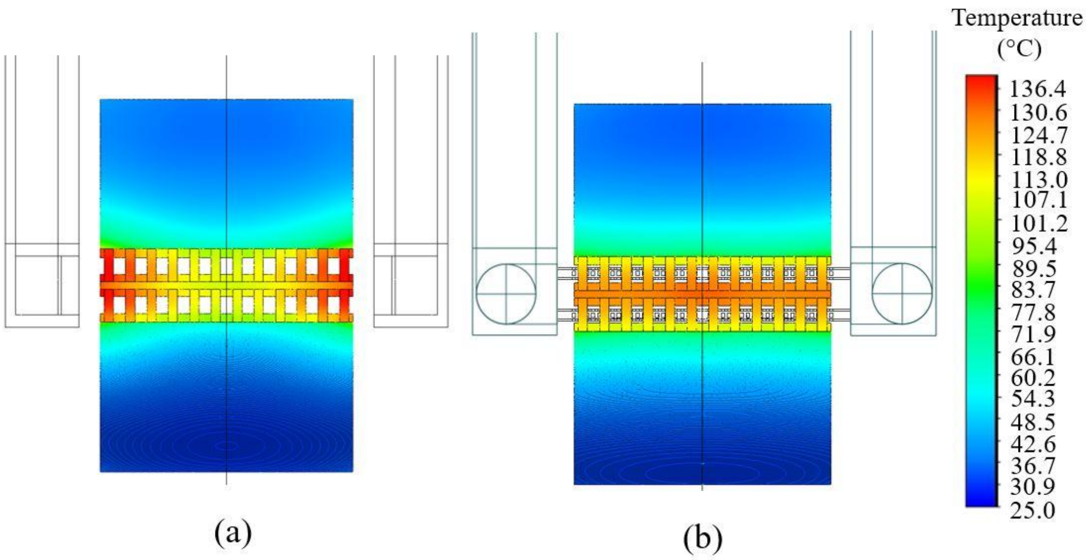


Figure 1.
The welding tip temperature due to hot air: (a) non-uniformly distributed and (b) uniformly distributed

HEAT KERNEL COMPUTATION FOR ONE-LOOP EFFECTIVE ACTION OF eV-SCALE STERILE NEUTRINOS IN JUNO EXPERIMENT

Apimook Watcharangkool[1,*]
[1] National Astronomical Research Institute of Thailand

*e-mail: apimook@narit.or.th

Abstract:

Sterile neutrino is one of the most anticipated beyond standard model particle. As it is postulated to interact only with neutrinos, its existence cannot be confirmed with current technology. The sensitivity of JUNO experiment provides a possibility of detecting eV-scale sterile neutrino. Theoretical predictions of sterile neutrinos were made by studying one-loop effective action of see-saw models, which provides corrections to that of standard model interaction. This can be calculated using heat kernel technique, which is systematic and geometrical meaningful. We demonstrate the technique on type I see-saw model, and compute the interaction up to 8 dimensional operators.

HIGH ORDER CUMULANT RATIOS OF NET-PROTON NUMBLE IN Au+Au COLLISION AT 7.7 AND 11.5 GeV BY USING UrQMD MODEL

Nitikorn Jaingarm[1], Krittaporn Anukulkich[1], Sukanya Sombun[2], Pornrad Srisawad[1]*

[1]Department of Physics, Naresuan University, Phitsanulok 65000, Thailand
[2] School of Physics and Center of Excellence in High Energy Physics & Astrophysics, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
*e-mail: pornrads@nu.ac.th

Abstract:

We studied fluctuations in conserved quantities to analyze the QCD phase structure and identify the first-order phase transition, with a critical point predicted by lattice QCD near the end of the first-order phase boundary. We studied the cumulant ratios up to the fourth order as a function of centrality for Au-Au collisions at mid-rapidity $|y| < 0.5$ and transverse momentum $0.4 < p_T < 2.0$ GeV/c at 7.7 and 11.5 GeV. We then compared our results with STAR data. We observed significant variations in the C_3/C_2 and C_4/C_2 ratios, which we attributed to statistical errors. At 7.7 GeV and 0-5% centrality, the C_4/C_2 ratio is greater than 1, indicating that protons and antiprotons are in the hadronic gas phase. In contrast, at 11.5 GeV, the C_4/C_2 ratio drops below 1, suggesting that protons and antiprotons are in the quark-gluon plasma state.

HIGH ORDER CUMULANTS OF NET-PROTON NUMBLE IN Au+Au COLLISION AT 14.5 , 16.5 AND 19.6 GeV BY USING UrQMD MODEL

Krittaporn Anukulkich[1], Sukanya Sombun[2], Pornrad Srisawad[1]*

[1] Department of Physics, Naresuan University, Phitsanulok 65000, Thailand
[2] School of Physics and Center of Excellence in High Energy Physics & Astrophysics, Suranaree University of Technology, Nakhon Ratchasima 30000, Thailand
*e-mail: pornrads@nu.ac.th

Abstract:
To explore the QCD phase structure and identify the first-order phase transition, with a critical point at the end of the first-order phase boundary predicted by lattice QCD, we analyzed fluctuations of conserved quantities. We investigated the cumulants of net-proton number as a function centrality in Au+Au collisions at 14.5 GeV and 19.6 GeV using the UrQMD model, within rapidity $|y| < 0.5$ and transverse momentum $0.4 < p_T < 2.0$ GeV/c. We computed the net-proton number cumulants of various orders and compared them with experimental data from the STAR collaboration. The results show that the values of the cumulant ratios at different orders are consistent with the STAR data. Additionally, the fluctuation behavior of the fourth-to-second-order cumulant ratio of net-proton number at 14.5 GeV suggests a phase transition from hadron gas to quark-gluon plasma, indicating the presence of a critical point. This study also predicts cumulants of net-proton numbers in various orders at 16.5 GeV. While the observed behavior was similar to that at 14.5 and 19.6 GeV, we noted interesting differences in the fourth-to-second-order cumulant ratio at 16.5 GeV.

HIGH-PERFORMANCE MID-INFRARED SUPERCONTINUUM GENERATION USING ALL-ANOMALOUS-DISPERSION $AsSe_5$-As_2S_5 CHALCOGENIDE HYBRID MICROSTRUCTURED OPTICAL FIBERS

Amphon Lukboon,[1,2] Panatcha Anusasananan,[1] Mongkol Wannaprapa,[3] Suksan Suwanarat[1,*]
[1] Department of Physics, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand, 10240
[2] Valaya Alongkorn Rajabhat University Demonstration School No. 1, Village No. 20, Phahonyothin Road, Khlong Nueng Subdistrict, Khlong Luang District, Pathum Thani Province 13180
[3] Department of Electronics Technology, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand, 10240
*e-mail: suksan@ru.ac.th

Abstract:
We numerically investigated Mid-infrared supercontinuum (Mid-IR SC) generation using all-anomalous dispersion $AsSe_5$-As_2S_5 chalcogenide (ChG) hybrid microstructured optical fibers (HMOFs). Our fibers are made from $AsSe_5$ ChG as core radius *r* and from As_2S_5 ChG as cladding radius *R*. The fibers are suitably designed to exhibit all-anomalous dispersion with a small value over the wide wavelength range to support the optical mode over the wavelengths in the Mid-IR regime. By pumping different peak powers, ranging from 100 W to 3000 W, a 4.0 mm-long $AsSe_5$-As_2S_5 ChG HMOF in all-anomalous dispersion with R = 4.4 μm and r = 1.9 μm can generate the widest Mid-IR SC spectra extending from 1.7 μm to 9.3 μm, with a −40 dB bandwidth of 7600 nm, using a 200-fs pulse with a peak power of 3000 W at the wavelength of 3.4 μm. Moreover, by varying the input pulse duration, the widest spectra can cover the wavelength range of 1.7 μm to 10.2 μm, producing a −40 dB bandwidth of 7850 nm at the 5.8 mm length, using a 300-fs pulse at the same power. The nonlinear process propagation behind the high-performance Mid-IR SC generation is related to self-phase modulation, and four-wave mixing. As ultra-broadband Mid-IR SC generation with low-energy (< 1 pJ) pulses and the simple structure are sufficient for on-chip Mid-IR SC sources, this proposed work should prove useful for practical applications.

JT GRAVITY FROM NON-ABELIAN T-DUALITY

Daniele Bielli[1,*]
[1] Chulalongkorn University

*e-mail: d.bielli4@gmail.com

Abstract:

We study the geometries obtained by performing super non-Abelian T-duality of the Principal Chiral Model on OSp(1|2). While the initial model represents an appropriate 3D supergravity background, interpretable as the superspace version of AdS3, the T-dual model fails solving the 3D supergravity torsion constraints. We argue that this has to do with a factorisation pattern taking place under dualisation: the dual 3D geometry can be rewritten as the supersymmetric version of AdS2, satisfying the supergravity constraints, fibered over what we interpret as the superspace equivalent of the standard bosonic line. We discuss an interesting connection between T-duals of generic Principal Chiral Models and Poisson sigma models. We exploit it to show that in a suitable limit the dual action studied in this work gives rise to JT (super)gravity.

Measurement of radon concentration in Phasavan and Tham Phra Caves in Nakhon Sawan Province using CR-39 Plastic Track Detectors

Thawatchai Itthipunthanakorn,[1] Saroh Niyomdecha,[1] Phachirarat Sola,[2] Thaentawan Saesueng,[3] Pornrad srisawad,[3*]
[1] Office of Atoms for Peace
[2] Thailand Institute of Nuclear Technology (Public Organization)
[3] Department of Physics, Faculty of Science, Naresuan University

*e-mail: thawatchai.i@oap.go.th, Saroh.n@oap.go.th, phachirarats@tint.or.th, thaentawan.s@gmail.com, pornrads@nu.ac.th

Abstract:

Radon in caves in Thailand is poorly documented, particularly the granite cave. where it is likely accumulate radon in high concentration. This study aims to investigate radon concentration within Phasavan and Tham Phra caves in Muang district, Nakhon Sawan province. We left a total of 25 CR-39 Plastic Track Detectors inside and outside both caves for a month. Following the chemical etching process, we counted the alpha tracks and calculated their radioactivity concentration. The results suggest that radon concentrations inside and outside of both caves are not significantly different. The range of radon concentrations is 1.43 - 24.49 Bq/m3 for Phasavan cave and 1.43 - 24.49 Bq/m3 for Tham Phra cave, which is below the United States Environmental Protection Agency (USEPA) standard for indoor radon at 148 Bq/m3. The annual effective dose of radon inhalation in Phasavan and Tham Phra caves ranges from 0.05 – 0.77 mSv/y and 0.44-0.85 mSv/y which is lower than the reference level of United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), with radiation exposure not exceeding 1.15 mSv/y.

MONOTONIC MANIPULATION OF ATOMIC DENSITY IN AN ISOVOLUMETRIC FOCUSED-BEAM TRAP FOR QUANTUM ATOM EXPERIMENTS

Nuttanan Tanasanchai[1,3], Kritsana Srakeaw[1], Parinya Udommai[1,2,*], Waranont Anukool[1]
[1]Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, 239 Huay Keaw Road, Muang, Chiang Mai, 50200, Thailand
[2]Office of Research Administration, Chiang Mai University, 239 Huay Keaw Road, Muang, Chiang Mai, 50200, Thailand
[3]Thailand Center of Excellence in Physics, Commission on Higher Education, 328 Si Ayutthaya Road, Bangkok 10400, Thailand
*e-mail: Parinya.udommai@cmu.ac.th

Abstract:
We present an asymmetric focused-beam trap (FBT) of cold rubidium-85 atoms, which is an alternative technique for preparing the cold atoms for quantum atom related experiments. With the path of the cooling beam occupying only one axis, the experiments on these cold atoms using additional laser beams or other atom interacting sources can be implemented more conveniently due to the more independent optical access. In our experiment, the cold atom cloud's volume only varied with the trap laser intensity. By repumping on F=2 to F'=2 D2 transition, the Stokes Raman scattering has strongly affected the population ratio in the two hyperfine ground states. With the volume and atom number simultaneously and separately controlled, we have shown that the cloud density can be monotonically manipulated from zero to the maximum value limited by the cooling power. By solely varying the intensity of repump laser, the scheme for precision loading of 1-6 atoms in the far-off-resonance optical dipole trap (FORT), which is beyond the practical loading limit of the blue-detuned light-assisted collision, is described. This work allows an alternative way to extend towards quantum simulation and quantum information experiments utilizing arrays of the FORTs.

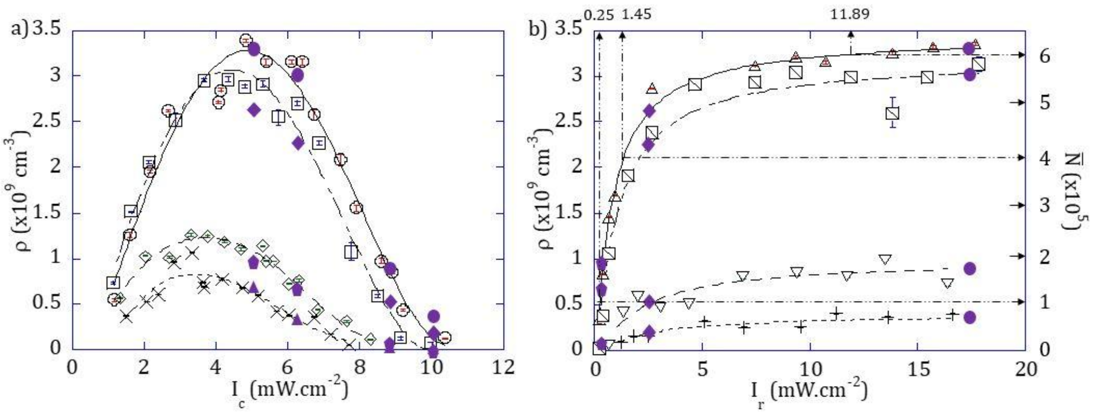


Figure 1. illustrates the dependences of the cloud density (ρ) on the intensities of a) the trap laser (I_c) and b) the repump laser (I_r). The same filled symbols indicate the cloud densities at constant I_r while a set of four different filled symbols manifests a constant cloud volume within the same trap regime. All filled symbols were marked on the fit curves in Figure 1b then linked back to Figure 1a for consistency checking. The polynomial fits are for guidance. The rightmost axis shows average number of trapped atoms (N_{FORT}) expected in the FORT with beam waist of 1.2 μm at the center of the FBT.

NUMERICAL AND EXPERIMENTAL STUDY OF THE WILBERFORCE PENDULUM BEHAVIOR WITH MAGNETIC INTERACTIONS

Nuththawat Kitchongcharoenying, Apiwit Triwatana, Adis Khetubol,* Natthawin Cho,*
Kamnoetvidya Science Academy
*e-mail: Adis.K@kvis.ac.th, Natthawin.C@kvis.ac.th

Abstract:
This research aims to study the behavior of a Wilberforce pendulum composed of a spring and an asymmetrical bob. Suspended and oscillating at the end of the spring, the pendulum exhibits coupled oscillations involving rotational motion around and linear oscillations along the vertical axis. The motion of the pendulum is numerically simulated using the Lagrangian method and verified by comparing the results with experimental data. The study investigates the relationships between key variables, such as mass, spring constant, initial displacement, asymmetrical characteristics (shape and mass distribution), damping force, and variations in the pendulum motion, primarily based on the constructed model. Additionally, the pendulum's motion under an applied magnetic interaction is explored by aligning magnetic dipoles at different configurations around the bob, leading to unusual behaviors such as additional degrees of freedom and prolonged oscillation times.

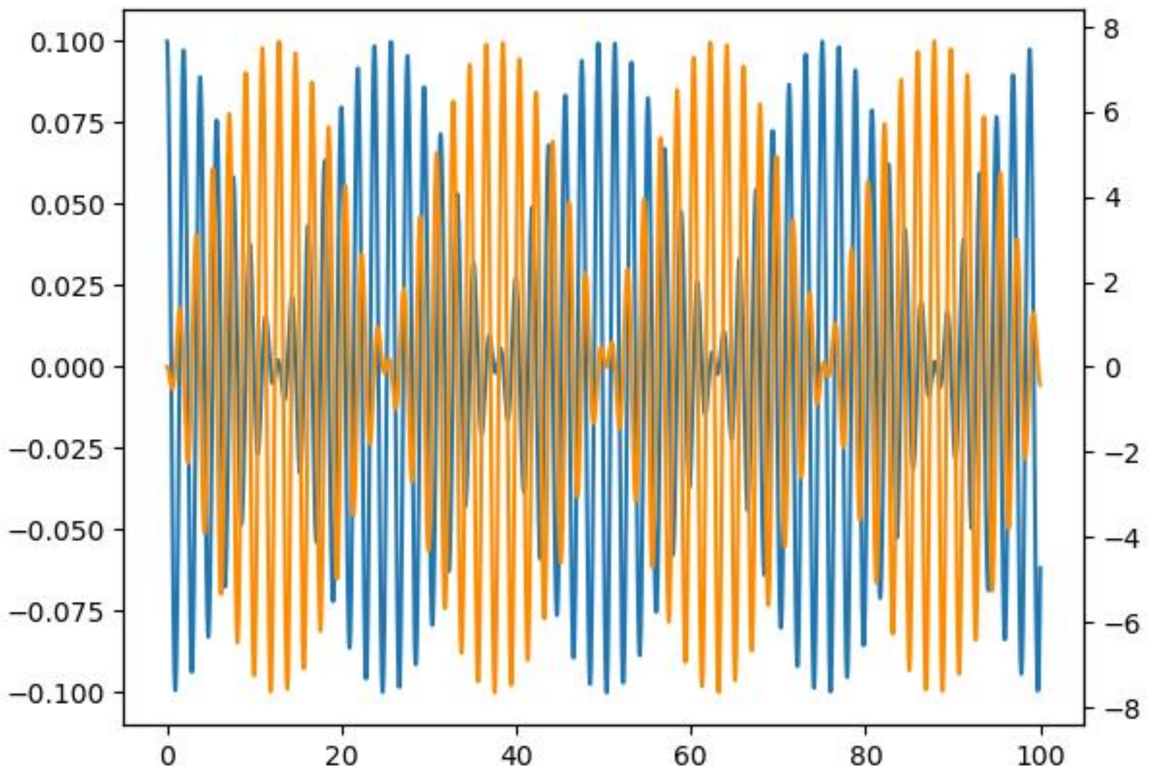


Figure 1.
Wilberforce pendulum motion in longitudinal (Blue line) and rotational (Orange line) motions in the system without damping force.

OPTIMIZING LIGHT ABSORPTION IN PEROVSKITE SOLAR CELL THROUGH IODED SALT PASSIVATION

Duangmanee Wongratanaphisan*[1,2,3], Chukwuebuka Emmanuel Usulor[1,4], Woraprom Passatorntaschakorn[1], Warunee Khampa[5], Wongsathon Musikpan[5], Sadeq Abbasi[1,6], Pattanasak Tipparak[5], Saowalak Homnan[2], Atcharawon Gardchareon[1], Athipong Ngamjarurojana[1], Watcharapong Pudkon[1], Pongsakorn Kanjanaboos[7], Pipat Ruankham[1,2,3]

[1]*Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand*

[2]*Research Unit for Development and Utilization of Electron Linear Accelerator and Ultrafast Infrared/ Terahertz Laser, Chiang Mai University, Chiang Mai, 50200, Thailand*

[3]*Thailand Center of Excellence in Physics (ThEP Center), Ministry of Higher Education, Science, Research and Innovation, Bangkok 10400, Thailand*

[4]*Graduate Doctoral Degree Program in Physics, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand*

[5]*Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand*

[6]*Key Laboratory of Artificial Structures and Quantum Control (Ministry of Education), Institute of Solar Energy, School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240, PR China*

[7]*School of Materials Science and Innovation, Faculty of Science, Mahidol University, Nakhon Pathom 73170, Thailand*

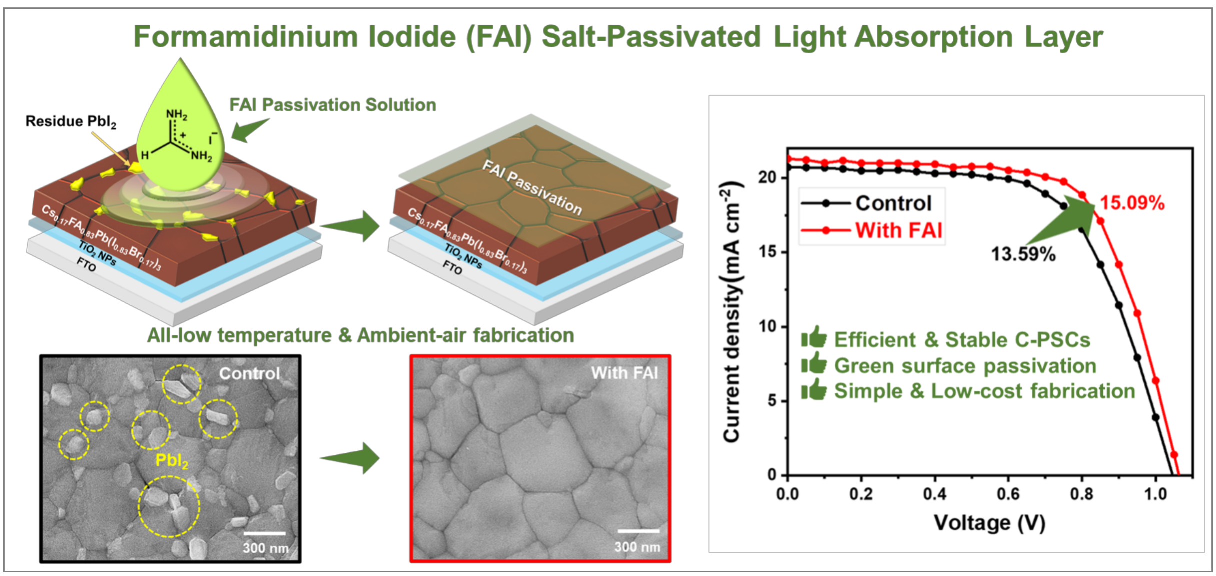
**email: duangmanee.wong@cmu.ac.th*

D. Wongratanaphisan and C.E. Usulor contributed equality to this work

Abstract:

Metal-halide perovskite is a promising photovoltaic renewable energy generation solar cell. The quality of the perovskite crystalline film and the interfaces between the perovskite and transport layers are crucial for maximizing both solar performance and device stability. During preparation and exposure to air, perovskite films tend to accumulate numerous defects on their surfaces, which significantly impainium iodide (FAI) dissolved in an eco-friendly isopropanol (IPA) antisolvent is used to treat perovskite surfaces. The FAI exhibits a strong interaction with the Pb^{2+} ions present on the surface of the perovskite film and grain boundaries. This interaction facilitates the passivation of defects within the film, consequently reducing interfacial recombination processes. Its functionality on different hole transport layers (HTL) was evaluated. The treatment enhances the stability of the perovskite solar cells (PSCs) and boosts power conversion efficiency under 1 sun (AM1.5G) incident light at 100 mW cm^{-2} measured with an active area of 0.09 cm^2. Similarly, under indoor illumination measurement (6500 K LED), efficiency improved. The study introduces a cost-effective and low-temperature approach utilizing carbon electrodes for the fabrication of highly efficient planar perovskite solar cells in ambient air conditions and paves the way for both indoor and outdoor applications, with the results providing new perspectives for its commercialization.

Keyword*: Formamidinium iodide, Ambient air fabrication, Grain boundary, Low temperature, Perovskite solar cells, Surface passivation*



Particle manipulation in solution with focused optical vortex beam

Supasilp Fuengfung, Sitti Buathong, Sarayut Deachapunya*
Department of Physics, Faculty of Science, Burapha University, Chonburi, 20131, Thailand
*e-mail: sarayut@buu.ac.th

Abstract:
We here present the demonstration of using an optical vortex beam to trap particles. Our trap particles are fluorescent dye molecules, which can absorb a light source with 780 nm wavelength. We show that the dyes can be trapped and rotated with helical motion of the vortex beam. Both positive and negative charges are used to test the idea. With this kind of manipulation, the production of particle patterning in solution can be achieved.

PHASE CHARACTERIZATION OF AMORPHOUS TIN OXIDES MICRO/NANOPARTICLES BY RAMAN SPECTROSCOPY

Suparoek Yarin,[1] Vasan Yarangsi,[1] Kritsada Hongsith,[2] Wakul Bumrungsan,[2] Sukrit Sucharitakul,[1] Surachet Phadungdhitidhada,[1] Supab Choopun,[1,*]
[1]Department of Physics and Materials Science, Faculty of Science, Chiangmai, 50200, Thailand
[2]Office of Research Administration, Chiangmai University, Chiangmai, 50200, Thailand
*e-mail: supab99@gmail.com

Abstract:
Raman spectroscopy is a beneficial technique for demonstrating the phase evolution of mixed-phase amorphous tin oxides due to their complex and low crystallinity properties. In our research, the mixed phase of amorphous tin oxides was synthesized via the electrochemical process. The as-prepared tin oxides were annealed with temperatures of 100 to 500 ˚C in Nitrogen (N_2) and air environments to study the phase changing of amorphous tin oxides. The properties of tin oxides were investigated using X-ray diffraction analysis (XRD), Raman spectroscopy, scanning electron microscopy, X-ray photoelectron spectroscopy, and photoluminescence spectroscopy. The XRD patterns show silent and broad peaks of the temperature below 300 ˚C in both environments. However, the Raman spectroscopy technique can reveal tin oxide phases below 300 ˚C by detecting the chemical bond vibrations. For rich oxygen ambient, amorphous SnO_2/SnO micro/nanoparticles completely transform to Sn_2O_3/Sn_3O_4 and SnO_2 at 500 ˚C. However, the annealing at 500 ˚C under lacking oxygen ambient (N_2) exhibits SnO combine with Sn_2O_3, Sn_3O_4 and SnO_2. Therefore, the Raman spectroscopy technique is a crucial procedure for revealing the phase of amorphous tin micro/nanoparticle oxides. Moreover, the phase evolution information can suggest the selection of the hybrid tin oxide phases for correct applications in p-n junction devices.

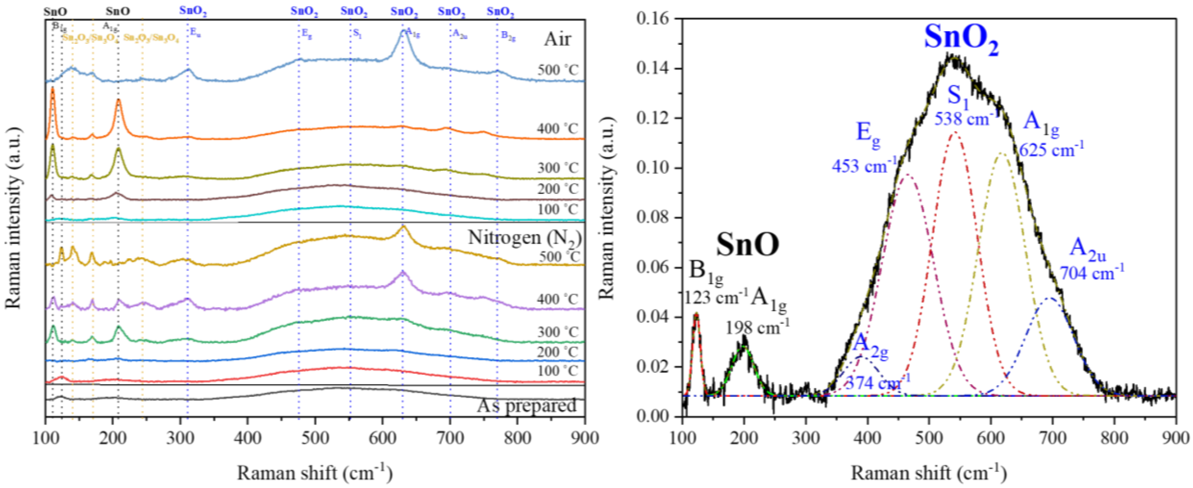


Figure 1.
The Raman spectra of tin oxides in various temperatures in nitrogen and air environment (left) and curve fitting of the Raman spectrum of as-prepared amorphous tin oxides at 50 ˚C in air ambient (right).

SIMPLE HYDROTHERMAL-MICROWAVE METHOD TO SYNTHESIZE MANGANESE PYROPHOSPHATE AND ELECTROCHEMICAL PERFORMANCE

Ratchadaporn Puntharod[1,*], Pattraporn Surin[1], Weerinrada Tapala[1], Nattapol Laorodphan[2]
[1]Department of Chemistry, Faculty of Science, Mae Jo University, Chiangmai, 50290, Thailand
[2]Department of Innovation of Industrial Chemistry, Faculty of Science, Mae Jo University, Chiangmai, 50290, Thailand
*e-mail: ratchadaporn_p@mju.ac.th

Abstract:
Manganese pyrophosphate as chemical formula $Mn_2P_2O_7$, was synthesized by hydrothermal-microwave method at 400, 600 and 800 watt for 5 and 10 min. The powders were calcined at 500 °C for 5 hr. The starting materials were Na_2HPO_4 and $MnSO_4$ with deionized water as solvent and without any surfactant and without acid or base. The watt and heating time affected the morphology and particle size. Fourier transform infrared spectroscopy was analyzed the stretching vibration of P–O of $(P_2O_7)^{4-}$. The X-ray diffraction was confirmed the phase of manganese pyrophosphate as monoclinic. The manganese pyrophosphate with smallest particle and agglomerate show the highest electrochemical properties with specific capacitance was 47 $F.g^{-1}$.

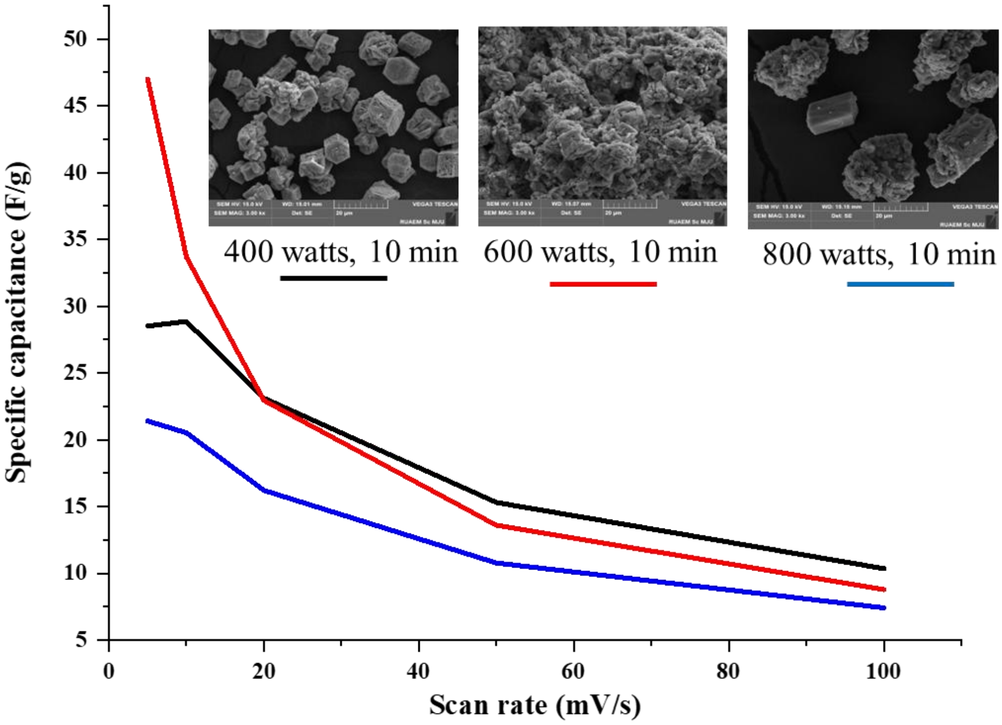


Figure 1. SEM and specific capacitance of $Mn_2P_2O_7$

STATISTICS OF PRIMORDIAL RANDOM FIELDS

Spyros Sypsas[1,*]
[1]Chulalongkorn University, Thailand
[1]National Astronomical Research Institute of Thailand (Public Organization)
*e-mail: s.sypsas@gmail.com

Abstract:
The structure that we observe in the universe can be traced back to a primordial, nearly Gaussian, scalar random process. Starting from an interacting scalar field in the early universe, I will use perturbation theory to derive the probability density function that underlies the primordial random process and study its implications.

STUDY OF TEMPERATURE AND TOTAL DEFORMATION OF HARD DISK DRIVE COMPONENTS IN A REFLOW SOLDERING PROCESS USING MULTIPHYSICS

Napatsorn Kimaporn, Chawit Samakkarn and Jatuporn Thongsri*
Computer Simulation in Engineering Research Group, College of Advanced Manufacturing Innovation, King Mongkut's Institute of Technology Ladkrabang, Bangkok 10520, Thailand
*e-mail: Jatuporn.th@kmitl.ac.th

Abstract:
In a reflow soldering process (RSP), heat and force were applied to melt solder balls for joining hard disk drive (HDD) components: flexible printed circuit (FPC) and printed circuit cable (PCC), leading to temperature (T) and total deformation (δ) in the HDD components. The PCC comprises stainless steel, polyimide, glue, and copper layers. This research employed multiphysics, consisting of steady-state thermal analysis and structural analysis, to study the T and δ in the HDD components. Based on the factory operating condition, the thermal analysis revealed that the T is unevenly distributed and decreased from the top to the bottom layers. As expected, the highest T of 410 °C was in the stainless steel layer, while the lowest T of 350 °C was in the PCC layer, consistent with the heat transfer principle, confirming the multiphysics credibility. Significantly, the T at the solder ball was 382 – 390 °C, near the melting point, suitable for melting solder balls, as intended. The structural analysis indicated that the maximum δ was near the edge of each layer. The higher the heat, the greater the T and the δ. Multiphysics results can be as fundamental information applied to improve the RSP in HDD manufacturing.

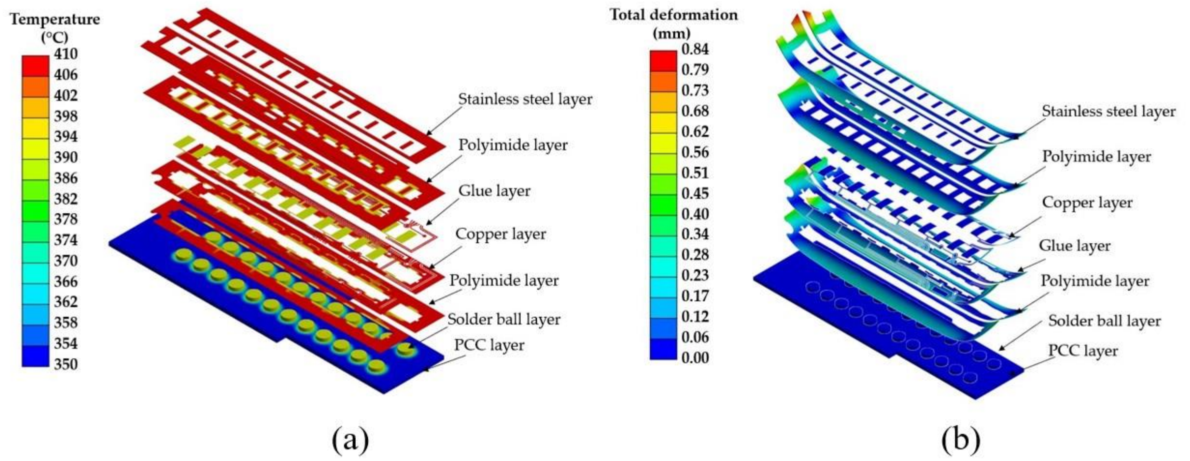


Figure 1.
Multiphysics results: (a) T and (b) δ distributions.

SUPERCONDUCTING AND VORTEX DYNAMICS IN YBCO|BNT|YBCO JOSEPHSON JUNCTIONS

Muthukkumaran Karthikeyan[1,2*], Geoffrey Chanda[4,5], Kattaliya Chaipisan[2], Thanayut Kaewmaraya[6,7], Pairot Moontragoon[6,7], Guoxing Sun[8], Zongjin Li[9], Anucha Watcharapasorn[1,2,3**]

[1]Center of Excellence in Quantum Technology, Faculty of Engineering, Chiang Mai University, Chiang Mai, 50200, Thailand

[2]Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

[3]Center of Excellence in Materials Science and Technology, Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

[4]Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany

[5]Department of Physics, University of Zambia, P.O Box 32379, Lusaka, Zambia

[6]Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen, 40002, Thailand

[7]Institute of Nanomaterials Research and Innovation for Energy (IN-RIE), Research Network of NANOTEC- KKU (RNN), Khon Kaen University, Khon Kaen 40002, Thailand

[8]Joint Key Laboratory of the Ministry of Education, Institute of Applied Physics and Materials Engineering, University of Macau, Avenida da Universidade, Taipa, Macau, SAR China

[9]Faculty of Innovation Engineering, Macau University of Science and Technology, Avenida Wai Long, Taipa, Macau, SAR China

*e-mail: muthuk29@gmail.com (Muthukkumaran Karthikeyan), anucha@stanfordalumni.org (Anucha Watcharapasorn)

Abstract:

This study explores the critical tunneling current and vortex behavior within a pulse-laser deposited $YBa_2Cu_3O_{7-x}|Bi_{0.5}Na_{0.5}TiO_3|YBa_2Cu_3O_{7-x}$ (YBCO|BNT|YBCO) Josephson junction. The ferroelectric $Bi_{0.5}Na_{0.5}TiO_3$ (BNT) barrier is expected to introduce tunable dielectric characteristics and enhance the proximity effect between YBCO layers. The temperature-dependent coherence lengths of the BNT barrier reduce from 5 nm to 2 nm when the temperature increase from 10°C to 90°C. The modulation of critical current by a magnetic field shows a Fraunhofer-like pattern within -5 and 5 Tesla, which is completely suppressed at higher fields. A maximum critical current of 1.25 µA and a peak current density of 0.48 A/mm² are observed under lower magnetic field conditions. The current-voltage (I-V) curve at 50 K indicates a critical current of 0.65 µA and resistively shunted junction behavior with a normal-state resistance of 2 ohms. Scanning tunneling microscopy (STM) provides insights into the electronic structure of vortex cores within the junction, elucidating the interplay between superconductivity and vortex dynamics. This comprehensive study enhances understanding of the superconductor-ferroelectric insulator interface, with implications for quantum electronics and condensed matter physics.

Thin-wall vacuum decay in the presence of a compact dimension

Ignatios Antoniadis,[1,2] Daniele Bielli,[1] Auttakit Chatrabhuti,[1] Hiroshi Isono,[1]*

[1]Chulalongkorn University
[2]LPTHE, Sorbonne Université, CNRS

*e-mail:
hiroshi.isono81@gmail.com

Abstract:
I introduce our recent study on the problem of false vacuum decay in arbitrary dimensions, in the presence of gravity, and compute the transition probability within the thin-wall approximation, generalising the results of Coleman and de Luccia. In the particular case of one compact dimension, we present explicit formulae for the Euclidean Bounce configuration that drives the transition from a de Sitter to Minkowski or from a Minkowski to anti-de Sitter vacua. This talk is based on arXiv:2405.16920, which has been accepted to JHEP.

B-BIOLOGICAL SCIENCES

Aerococcus sp. **ISOLATED FROM NATIVE INDONESIAN FROG SKIN *Sumaterana crassiovis* AS A POTENT BIOCONTROL AGENT AGAINST CHILI ANTHRACNOSE DISEASE**

Lela Susilawati,[1]* Arifah Khusnuryani[1], Sipriyadi[2], Dewi Atika Suri[1], Adelia Stevanie[1], Misbahul Munir[3]

[1]Department of Biology, Faculty of Science and Technology. UIN Sunan Kalijaga Yogyakarta, Jl. Marsda Adisutjipto No.1 Yogyakarta, 55281 Indonesia
[2]Department of Biology, Universitas Bengkulu, Jl. W.R. Supratman, Kandang Limun, Bengkulu, 38371 Indonesia
[3]Herpetological Society of Indonesia, Jl. Ulin, Kampus Darmaga, Bogor, Jawa Barat 16680 Indonesia

*e-mail: lela.susilawati@uin-suka.ac.id

Abstract:
Amphibian skin (e.g. frogs) carry microbial symbionts on their skin, which protect the host (frog) from pathogenic microbial invasions such as bacteria, viruses and fungi. These bacteria have been known to produce several remarkable antimicrobial substances that effectively inhibit the growth of pathogenic microbes, including fungi. This study aimed to isolate cultivable bacteria from adult Indonesian endemic frog skin *Sumaterana crassiovis* collected from West Sumatra and to evaluate their antifungal activity against plant pathogenic fungi. Thirteen bacterial isolates were obtained, three of which were ScV9, ScV11 and ScV12, showed high bacterial antagonistic ability in inhibiting the growth of phytopathogen *Colletotrichum* sp. Col1, which is an anthracnose-causing agent using a dual culture method. These three isolates were also able to inhibit the growth of fungal mycelium and reduce the ability of conidial germination. Based on the biocontrol test on chili pepper fruit and chili seed, isolates ScV9 showed a high antifungal ability to inhibit the growth of *Colletotrichum* with a low severity incidence value compared to the control. Based on molecular identification with 16S rDNA sequence analysis, isolate ScV9 is closest to the genus of *Aerococcus* sp. HT9 (99.89%).

ANTIBACTERIAL ACTIVITIES OF SEVEN HERBAL EXTRACTS AGAINST *Staphylococcus aureus, Pseudomonas aeruginosa* AND *Escherichia coli.*

Pabhada Asawakarn[1*], Punama Chulamokha Suchato[1], Phimphitcha Aemnawachat[1], Siriwan Saehlee[2], Tomroh Maya[2], Kiattawee Choowongkomon[2]
[1]Grade11th student, Chulalongkorn University Demonstration Secondary School, Bangkok, 10330 Thailand
[2]Department of Biochemistry, Faculty of Science, Kasetsart University, Bangkok, Thailand 10900
*e-mail: Praepabhada@gmail.com

Abstract:
The aim of this study is to investigate the antibacterial activities of seven types of herbal extracts against skin and enteric pathogens. These seven herbal extracts consist of galangal (*Alpinia galanga*), turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), red holy basil (*Ocimum tenuiflorum*), neem (*Azadirachta indica*), Cantella (*Cantalla asiatica*) and betel leaf (*Piper betle)*. These medicinal plants are affordable and, extensively utilized in Thai cuisine, highly favored, and readily available at fresh markets or supermarkets. The extraction was performed using 70% ethanol as a solvent. The seven single and five mixtures of herbal extracts were examined for their antibacterial properties against skin and enteric pathogens (*Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli,*) using the disc diffusion method. Mixture-1 consisted of red holy basil and betel leaf extract (ratio 1:1), while mixture-2 contained galangal and ginger extracts (ratio 1:1). Mixture-3 contained turmeric and neem extracts (ratio 1:1), whereas mixture-4 contained Cantella and betel leaf extracts (ratio 1:1). Finally, mixture-5 contained galangal, turmeric, ginger, red holy basil, and betel leaf extracts (ratio 1:1:1:1:1). The results showed that single betel leaf extract and all five mixtures could inhibit growth of bacterial pathogens. In terms of the single extract, the betel leaf extract showed the widest inhibition zone diameter against all tested pathogens. The single extracts of galangal, turmeric, ginger, and red holy basil was found to inhibit the growth of *S. aureus* and *P. aeruginosa,* while neem and Cantalla could only affect *S. aureus*. All five mixtures exhibited antibacterial activity, specifically mixture-5 which showed the widest inhibition zone against all tested pathogens. In conclusion, these seven herbal extracts exhibit antibacterial activities and could be applied as anti-bacterial agent against skin and enteric pathogens.

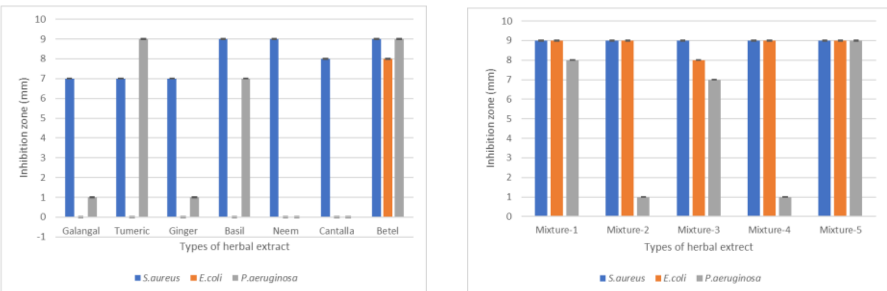


Figure 1. The inhibition zone of single (left) and mixture (right) herbal extracts.

ASSESSING THE SAFETY OF DRINKING WATER IN URBAN SLUM VS. RURAL CAMBODIA: *Escherichia coli* DETECTION USING H_2S TEST KITS

Keanseng Peung,[1] Sokkeang Be[1,]* Sreynich Chhun,[1] Sreyly Heng,[1] Sinith Say,[2] Vuthy Yem,[2] Chanvatanak Hem,[2] Lanyra Toem,[2]
[1]Department of Science Research, Faculty of Health Sciences and Biotechnology, University of Puthisastra, Phnom Penh 12211, Cambodia
[2]Department of Laboratory Science, Faculty of Health Sciences and Biotechnology, University of Puthisastra, Phnom Penh 12211, Cambodia
*e-mail: bsokkeang@puthisastra.edu.kh

Abstract:
This study investigates *Escherichia coli* (*E. coli*) contamination in drinking water in rural Prey Tom District, Kampot Province, and urban railway communities in Phnom Penh, Cambodia. Utilizing Hydrogen Sulfite (H_2S) test kits, water samples were collected from 39 urban households and 75 rural households. In urban areas, 71.80% of surveyed participants were female, with 41% aged 35-55, and 46.15% lacking formal education. There are two main sources of drinking water, most relied on tap water (64.10%), while 35.9% used bottled water. In addition, the treatment methods varied: 41% boiled their water, and 18% did not treat before drinking. Although 84.62% of water samples were free of coliform bacteria, 15.38% were contaminated, indicating inadequate water treatment practices. In contrast, in the rural area show that 63.38% of participants were female, 39.44% were aged 35-55 and 13.89% are lack of education. Only 40.85% used tap water, while 50.70% filtered it. *E. coli* contamination was found in 36.07% of water sources, which increased to 63.93% in stored drinking water, and then reduced to 44.26% after storage. This indicates that contamination likely occurs during storage because most people store water in kettles, plastic tanks, and cement tanks that are not properly cleaned. The study revealed significantly higher contamination levels in rural areas (44.26%) compared to urban areas (15.38%). Factors such as inadequate sanitation infrastructure and proximity to pollution were identified as key contributors to contamination. The findings emphasize the need for targeted public health interventions and recommend integrating H_2S test kits into routine water quality monitoring to ensure safe drinking water and protect public health.

BIOAUGMENTATION OF A CONSTRUCTED CONSORTIUM IN SOIL FOR DEGRADATION OF LOW-DENSITY POLYETHYLENE (LDPE)

Chanokporn Muangchinda,[1, 2] Onruthai Pinyakong,[1, 3,*]
[1]Center of Excellence in Microbial Technology for Marine Pollution Treatment (MiTMaPT), Department of Microbiology, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[2]International Postgraduate Programs in Hazardous Substance and Environmental Management, Graduate School, Chulalongkorn University, Bangkok, 10330, Thailand
[3]Research Program on Remediation Technologies for Petroleum Contamination, Center of Excellence on Hazardous Substance Management (HSM), Bangkok, 10330, Thailand
*e-mail: onruthai.p@chula.ac.th

Abstract:
Low-density polyethylene (LDPE) is one of the most widely used synthetic polymers, and contamination from LDPE waste has become a health and environmental hazard. The use of microorganisms is an alternative method for degrading plastic waste due to its cost-effectiveness and environmental friendliness. Therefore, this study aimed to construct a bacterial consortium for the remediation of LDPE-contaminated soil and to investigate changes in the bacterial community throughout the bioremediation process. Three nonpathogenic bacterial strains, including *Gordonia sihwensis* LS1, *Amycolatopsis thermoflava* 3B14, and *Mesorhizobium* sp. 1B3, previously isolated from LDPE-degrading consortia, were used to construct a consortium designated as GAM. Consortium GAM demonstrated a higher biodegradation rate on UV-treated LDPE film compared to the individual strains. Consortium GAM consumed 0.0007 g of LDPE per day, while the individual strains consumed between 0.0005–0.0006 g per day. Subsequently, consortium GAM was used for bioaugmentation treatment to remediate LDPE in soil microcosms. After 60 days of incubation, bioaugmentation with consortium GAM achieved the highest LDPE film removal efficiency (5.87%) compared to microcosms without consortium GAM (1.85%). Scanning electron microscope (SEM) analysis revealed that the LDPE surface from bioaugmentation treatment exhibited greater erosion than the treatment film without consortium GAM. In terms of bacterial community structure during LDPE degradation, the addition of consortium GAM did not alter the indigenous bacterial community. The relative abundance of *Gordonia*, *Amycolatopsis*, and *Mesorhizobium* remained evident in the bacterial profile. These results suggest that bioaugmentation with consortium GAM could enhance the bioremediation of LDPE-contaminated environments.

BIOENGINEERED CORTICAL NEURONAL NETWORK – A STEM-CELL DERIVED NEURONAL ARRAY WITH DEFINED CIRCUITRY ARCHITECTURE TO RECREATE THE HUMAN CORTEX IN VITRO

Pacharaporn Suklai*, Andrea Serio

The Francis Crick Institute, London, UK
UK Dementia Research Institute at King's College London, London, UK
Department of Basic and Clinical Neuroscience, Institute of Psychiatry, Psychology and Neuroscience, King's College London, London, UK
*e-mail: pacharaporn.suklai@gmail.com

Abstract:

Neurons in the brain are organised into functional circuits by connecting specific neuron types across various brain regions. Understanding how these neural circuits form is essential for understanding the mechanisms behind circuit-related dysfunction in brain diseases. The advent of human-induced pluripotent stem cell (iPSC) technology has allowed the creation of simplified experimental models to study the fundamental functions of neuronal networks. However, these models often lack precise network architecture, leading to randomly arranged neuronal connections. This randomness can result in significant variability in the maturation of neurons, as their development is closely tied to network connectivity. To address this, we have developed a new cortical network platform that integrates iPSC-derived cortical neurons with bioengineering techniques. Using photolithography, we created a polydimethylsiloxane (PDMS)-based microgroove topography to direct neurite growth. In combination with a temporally placed cell plating guide device, fabricated via SLA 3D printing, we constructed a platform that allows precise control over cell positioning, forming 'cortical nodes' that enable flexible circuit-building in an open system. This platform facilitates the creation of controlled network architectures, including node geometry, neurite directionality, and predictable sites for synapse formation, with live imaging to observe axon growth and synapse formation. Additionally, the absence of physical barriers provides easy access to neuronal materials and the potential for multi-level analyses of cortical circuits, such as transcriptomics and proteomics. Future direction will focus on validating the platform for proteomics studies and exploring molecular changes during neural circuit formation. However, the platform still exhibits immature functional phenotypes, such as spontaneous activity and rare occurrences of bursting and synchronous activity, probably due to delayed maturation of human iPSC-derived cortical neurons, a common challenge in the field. Further improvements could integrate optogenetic systems to mimic functional cortical circuits, opening new avenues for studying activity-dependent circuit functions in culture. Overall, this platform offers a valuable tool for investigating the molecular mechanisms driving neuronal network development and function in both health and disease.

CHITIN-BASED BIOSTIMULANT EFFECT ON RICE PRODUCTIVITY, STARCH PROPERTIES PROTEIN CONTENT AND ANTIOXIDANT ACTIVITIES OF 'RD43' RICE CULTIVAR

Ratchata Chokwiwatkul,[1,] Thanin Chantarachote[1], Supaporn Junbuathong[2], Rath Pichyangura[3] Supachitra Chadchawan,[1]*
[1]Center of Excellence in Environment and Plant Physiology, Department of Botany, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2] Pathum Thani Rice Research Center, Ministry of Agriculture and Cooperatives, Thanyaburi, Pathum Thani 12110, Thailand.
[3] Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
*e-mail: Supachitra.c@chula.ac.th

Abstract:

'RD43' cultivar (*Oryza sativa* L.) is the white rice with the consumers' concern as the rice for good health due to its starch properties, which are medium to low levels of apparent amylose content (AAC) and rapidly available glucose (RAG). In this research, we aim to investigate the effects of chitin-based bio-stimulants (CB) on plant growth, yield components, starch properties, total protein content, and antioxidant ability of 'RD43' rice. Two types of CB were developed. Type I CB was fermented chitin by *Bacillus lichenifomis* and Type II CB was the fermented chitin with rice husk (RH). The experiment was performed on pot-grown plants. Type I and Type II CB were applied in soil at the concentrations of 0.01%, 0.1%, and 0.2% (w/w). The general practice without soil supplements was used as a control. The application of Type II CB at the concentration of 0.2% resulted in the maximum tiller number at 11.69 tillers per plant and the rice yield was enhanced by 69.8%, while 0.2% Type I CB application increased rice yield by 56.8%. The increase in yield was due to the increase in the number of spikelets/panicle and filled grains/panicles without the increase in panicle number per plant. This suggested that RH was an important component for rice yield enhancement. Both Type I and Type II CB showed no significant effects on starch properties and protein content. Interestingly, 0.2% Type II CB application could significantly enhance the antioxidant activity of the brown seeds of 'RD43' by 29% when detected by the DPPH method and 24% when detected by the ABTS method. These data demonstrated that CB could be used to enhance 'RD43' rice yield efficiently without affecting starch quality and total protein content in the seeds. Moreover, the antioxidant capacity of brown rice was also increased by the application of CB. This method can be applied to produce rice for good health in the future.

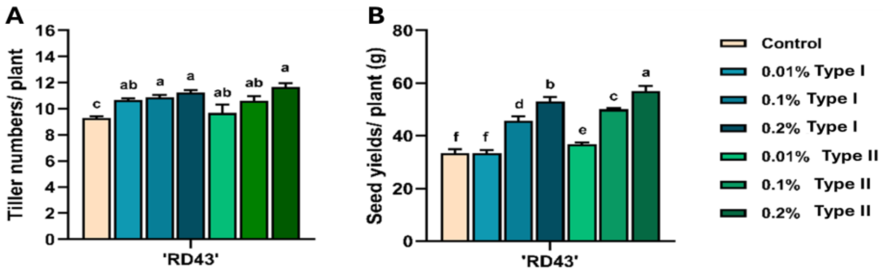


Figure 1. Tiller number/plant (A) and seed yield/plant (B) when Type I and Type II chitin-based bio-stimulant (CB) were applied in soil

CO-OCCURRENCE OF DI-(2-ETHYLHEXYL) PHTHALATE AND MICROPLASTICS IN AGRICULTURAL SOIL AND THEIR IMPACT ON BACTERIAL COMMUNITY AND DEGRADATION EFFICIENCY

Sakaoduoen Bunsangiam[1], Chatsuda Sakdapetsiri[2] and Onruthai Pinyakong[1,3,*]
[1]Center of Excellence in Microbial Technology for Marine Pollution Treatment (MiTMaPT), Department of Microbiology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
[2]Faculty of Agricultural at Kamphaengsaen, Kasetsart University Kamphaengsaen campus, Nakhonpathom, Thailand
[3]Research Program on Remediation Technologies for Petroleum Contamination, Center of Excellence on Hazardous Substances Management (HSM), Bangkok, Thailand
*e-mail: onruthai.p@chula.ac.th

Abstract:
The harmful effects of phthalate esters (PAEs) and microplastics (MPs) in soil have attracted considerable attention. Despite a theoretical link between the occurrence of plastics and plasticizers in agricultural areas, there are few studies on the relationship between their co-occurrence and the effects on bacteria in soils. In this study, the effects of di-(2-ethylhexyl) phthalate (DEHP), a commonly used plasticizer, and polyethylene microplastics (PE-MPs) on the bacterial community and degradation efficiency were investigated. We carried out a microcosm study to assess the co-occurrence of DEHP and PE-MPs in agricultural soil. The results showed that the concentration of DEHP remained at 37.3% after the addition of 500 mg/kg DEHP at 7 days, while the abiotic control remained at 78.5% of the initial DEHP concentration. Similarly, 32.3% of DEHP remained when co-substrates of DEHP and PE-MP were employed. However, PE-MP residues gradually reduced, with a 0.94% weight loss in the co-substrates treatment, whereas a 4.1% weight loss was observed when DEHP was omitted after 15 days of incubation. High-throughput sequencing revealed no significant change in microbial diversity in the phylum level within the microcosm containing both DEHP and PE-MPs compared to the treatment with DEHP/PE-MPs alone. Actinobacteria dominated the bacterial communities in the microcosm across all treatment groups. The genus *Nocardioides* was observed as the main actinobacterium in this study. Specifically, the genera *Agromyces* and *Nocardia* showed a significant increase in the presence of PE-MPs, whereas only DEHP alone led to the detection of *Gordonia*. This research reveals the potential bacterial strains to degrade DEHP and PE-MPs, contributing to the removal of toxic substance risks by sustainable eco-friendly.

COFFEE PULP PECTIN AS A POTENTIAL PREBIOTIC SOURCE

Kunakorn Deesophon,[1,2] Jutamat Nacha, [1,2] Amorn Owatworakit, [1,2] Natsaran Saichana, [1,2] Yin Quan Tang, [3] Sunita Chamyuang[1,2,]*
[1]School of Science, Mae Fah Luang University, Chaing Rai 57100, Thailand
[2]Microbial Products and Innovation Research Group, Mae Fah Luang University, Chaing Rai 57100, Thailand
[3]School of Biosciences, Faculty of Health & Medical Sciences, Taylor's University, 47500 Selangor, Malaysia
*e-mail: sunita@mfu.ac.th

Abstract:
The largest Arabica coffee plantation in Thailand is located in Chiang Rai, producing over 3,400 tons of coffee annually. Coffee pulp, constituting 45% of the total green bean production, is often discarded as a waste product, posing an environmental concern. However, this pulp is a valuable source of polysaccharides, including pectin. While traditionally used as a gelling agent, thickener, and stabilizer in the food industry, pectin has recently gained attention for its potential to improve gut microbiota composition. This study aimed to investigate the prebiotic properties of pectin extracted from coffee pulp. Using a previously established double extraction method, pectin was extracted from coffee pulp with a yield of 5.62%. The extracted pectin was determined to be low methoxy with a degree of esterification of 27.15%. The prebiotic activities of coffee pulp pectin (CP) were evaluated on the probiotic bacteria *Pediococcus* sp., *Lactococcus lactis*, and *Lactobacillus acidophilus*. Results were compared with inulin (In) and three commercial pectins: high methoxy apple pectin (HMP), low methoxy citrus pectin (L20), and low methoxy apple pectin (L40). The treatments were also used to evaluate the growth of the pathogen *Escherichia coli*. The prebiotic index was calculated by comparing probiotic growth with lactose as a control medium, and a prebiotic activity score was calculated by comparing probiotic growth with *Escherichia coli*. A prebiotic index over 1.00 indicates that the compound is considered a prebiotic. Evaluation of the prebiotic properties of coffee pectin and commercial standards revealed that CP exhibited prebiotic indices of 0.95, 3.88, and 3.73 for *Pediococcus* sp., *Lactococcus lactis*, and *Lactobacillus acidophilus*, respectively. In contrast, inulin, a commonly used prebiotic, only promoted the growth of *Pediococcus* sp. and *Lactobacillus acidophilus* with prebiotic indices of 1.14 and 15.34, respectively. Commercial pectins showed prebiotic indices lower than 1 in all treatments. Furthermore, the prebiotic activity score of CP on *Pediococcus* sp., *Lactococcus lactis*, and *Lactobacillus acidophilus* was observed to be 0.25, 0.40, and 0.72, respectively. Only inulin and HMP were able to promote *Pediococcus* sp. and *Lactobacillus acidophilus* with positive scores, while the prebiotic activity scores for commercial pectins were negative, indicating that they promoted the growth of pathogens more than probiotic bacteria. Our findings suggest that coffee pulp pectin can be used as an alternative prebiotic substance in the food industry, promoting a more sustainable and environmentally friendly approach to food production.

DECIPHERING BACTERIOPHAGE INFECTION THROUGH THEIR STRUCTURES AND NANOMECHANICS

Udom Sae-Ueng,[1,*] Chooseel Bunsuwansakul,[1] Kittiya Showpanish,[1] Michael Kolbe,[2,3]
[1]National Science and Technology Development Agency (NSTDA), Pathum Thani 12120, Thailand
[2]Department for Structural Infection Biology, Centre for Structural Systems Biology (CSSB) & Helmholtz Centre for Infection Research, 22607 Hamburg, Germany
[3]Faculty of Mathematics, Informatics and Natural Sciences, University of Hamburg, 20148 Hamburg, Germany
*e-mail: udom.sae@biotec.or.th

Abstract:
Excessive usage of pesticides urges us to seek safe and sustainable alternatives for eliminating and controlling crop diseases caused by bacterial pathogens. One of the emerging choices is bacterial viruses or bacteriophages (phages). However, phage usage for agricultural applications is still limited due to the low stability as phages must experience external fluctuations, causing degradation of phage structures and unsuccessful infection to host cells. Our works aim to understand phage stability by examining the phage structure and nanomechanics. A novel soilborne C19 phage isolated from a soil sample in Chiang Mai was studied. The C19 phage lyses *Ralstonia solanacearum*, causing bacterial wilt disease in chili and tomato. The phage structure with an icosahedral capsid and short tail examined by transmission electron microscope (TEM) showed that the C19 phage belongs to either *Autographiviridae* or *Podoviridae* family. The nanomechanics or phage stiffness was measured using an atomic force microscope (AFM). Our results showed that when the C19 phage was exposed to 40 °C for ten hours, the phage was degraded and lost infectivity. The phage stiffness of the “surviving” C19 phage decreased by 83%. The decrease in stiffness may indicate a nanomechanical adaption of the phage structure in high-temperature environments, which is common in tropical regions like Thailand. Understanding phage infection and stability through its nanomechanics structure can provide insights into the phage stabilizing mechanisms, such as steric adaptation of protein subunits.

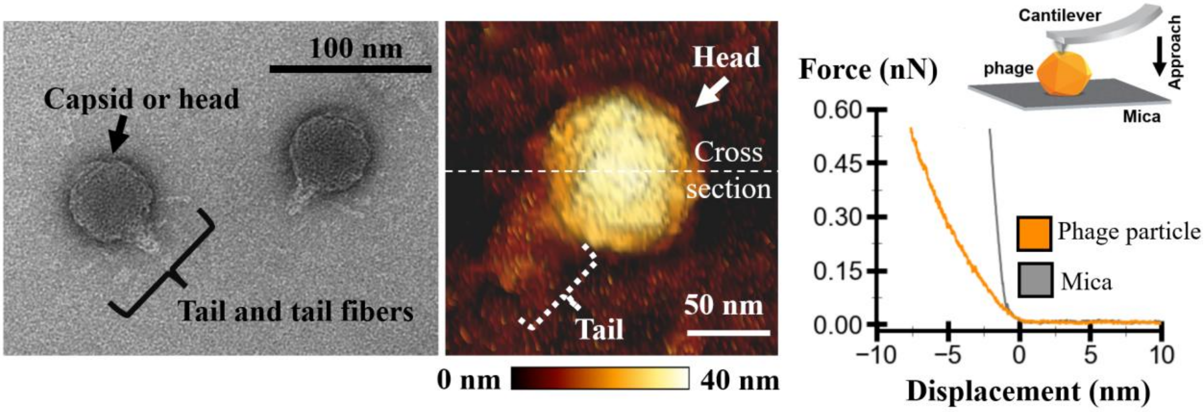


Figure 1. TEM micrographs (left) of the C19 phage. The scale bar is 100 nm. Phage tail and tail fibers were observed. AFM micrograph (middle) and indentation (right) of the C19 phage in SM buffer. The underneath color gradient scale bar indicates the height. The white scale bar indicates the lateral dimensions. An AFM tip indents into the particle and exerts a small force, yielding force-distance curves. The phage stiffness can be calculated.

DETECTION OF TOUCH DNA ON SHOELACES

Patima Thongphu, Piyamas Petchroen*
School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, Thailand
*e-mail: piyamas@sut.ac.th

Abstract:
The increasing complexity of criminal activities in Thailand, including homicide and robbery, underscores the need for effective forensic techniques. Detecting DNA on items like shoelaces, often used in crimes, remains a significant challenge. Previous research has introduced Diamond Dye (DD) fluorescence staining combined with portable fluorescence microscopy for latent DNA detection on various surfaces. However, its application to shoelaces—a common piece of evidence—has not been thoroughly explored.

This study aims to assess the efficacy of Diamond Dye fluorescence staining in detecting latent DNA on six popular types of polyester shoelaces commonly used today: flat red, flat black, flat white, round red, round black, and round white. These colors represent a significant portion of the shoelace market, reflecting current trends in footwear accessories. Volunteers were asked to handle each type of shoelace, after which the laces were stained with Diamond Dye and examined under the portable fluorescence microscope to detect the presence of latent touch DNA. The results indicate that three types of shoelaces (flat black, round red, and round black) demonstrated successful detection of latent DNA when using this method by observing the cellular material for DNA analysis clearly. Conversely, the other three types (flat red, flat white, and round white) did not yield detectable DNA. These findings suggest that the effectiveness of latent DNA detection on shoelaces may be influenced by both the type and color of the shoelace, with implications for forensic practices to help them find latent touch DNA when the shoelaces are submission as the evidence in criminal investigations.

This study provides critical insights into the applicability of Diamond Dye fluorescence staining for forensic analysis and emphasizes the need for further research to optimize DNA detection techniques on various types of evidence commonly encountered in crime scenes.

DETERMINATION OF CAPE OF THAI PROPOLIS AND ITS PROOXIDANT AND ANTIOXIDANT ACTIVITIES

Thanyarat Chuesaard,[1] Pattraporn Pukklay[2,*]
[1] Crop production Technology Program, Maejo University Phrae campus, Thailand
[2] Program in Forestry, the Established Project of College of Forestry, Maejo University Phrae campus, Thailand
*e-mail: pattraporn@mju.ac.th

Abstract:

Propolis is naturally resinous substance which is produced by *Apis mellifera.* The compounds from propolis extract are composed of polyphenolic compounds and flavonoids. Caffeic acid phenethyl ester (CAPE) belongs to red and green propolis which are the product of Brazil. Thailand locates geographical area that *A. mellifera* produces active compounds. The biological activities of CAPE are interesting as a promising drug for anticancer activity. The gathering of propolis from Chiang Mai province was extracted by using ethyl acetate and 70 % ethanol. The objectives of this study were to examine the antioxidant effects of CAPE with hydroxyl radical and superoxide anion. Prooxidant effects of CAPE was determined by observation of pUC19 plasmid DNA fragmentation on agarose gel electrophoresis. The results showed that the highest inhibition of superoxide anion was 41.2 percent at concentration 10 µM of CAPE. The dose-dependent inhibition was presented in xanthine-xanthine oxidase system. However, hydroxyl radical in fenton reaction could inhibit 60 percent by 10 µM of CAPE in comparing with 1 mM ascorbic acid. Plasmid DNA was protected from hydrogen peroxide but linear form was occurred at low concentration of CAPE. The protection of CAPE confirms the antioxidative and prooxidative roles in cellular protection. Thus, CAPE is an active substance for cellular antioxidant and the further research might be used as ingredients in drugs and cosmetics.

DETERMINATION OF EXTRACTED DNA FROM HUMAN BLOOD CELLS USING QIAAMP® DNA BLOOD MINI KIT

Sreylin Leng,[1] Kalyansethyroat Men,[1] Rotha Penh,[1] Sokkeang Be,[1] Sreyly Heng[1,*]

[1] Department of Science research, Faculty of Health Sciences and Biotechnology, University of Puthisastra, Phnom Penh 12211, Cambodia

*email: hsreyly@puthisastra.edu.kh

Abstract

Previous research has highlighted that many DNA extraction techniques have failed to consistently provide high-quality DNA. The challenge lies in the fact that DNA extraction is a critical primary step that any degradation, contamination, and low yield in the extracted DNA can adversely affect downstream applications. This study aims to determine the quality and quantity of extracted DNA from human blood cells using QIAamp® DNA blood mini kit to obtain high quality DNA for further applications. The limitation of this study is only focus on DNA quality and quantity of extracted DNA. Twenty samples were randomly collected from participants inside the University of Puthisastra using Systematic random sampling formula. DNA extraction was performed with 200uL of each blood sample using QIAamp® DNA Blood Mini Kit. The quality of the DNA was identified based on fragments size by Gel electrophoresis, while the quantity of DNA was measured using Nanodrop spectrophotometry at absorbance ratio (260/280) nm. Gel electrophoresis results showed that the DNA fragments size excessed 1kb when compared to the DNA ladder, while the purity of the DNA ranges from 1.40 to 2.27 (1.9 ± 0.24), with concentration between 5.40 ng/uL to 22.57 ng/uL (10.58 ng/uL ± 4.84). In addition, there is no significant different by using One-way ANOVA with Turkey comparison at confidence level 95%. Overall, QIAamp® DNA blood mini kit provided good quality and quantity of DNA and recovery efficiency up to 94.5% compared to salting out method that have 80% to 90%. The findings from both the Nanodrop spectrophotometer and Gel electrophoresis confirm that the QIAamp® DNA Blood Mini Kit is an effective technique for DNA extraction. This result can lead to future application successful such as PCR amplification, sequencing and genetic analysis. Therefore, the future applications can be identifying the genetic disease from DNA extracted.

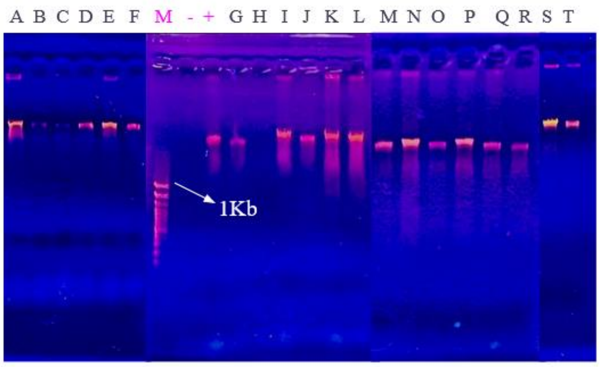


Figure1. Gel electrophoresis result of DNA extracted. The letter A to T refer to sample code, M is marker, (-) is control negative and (+) is control positive

DUAL FOLATE/BIOTIN-DECORATED LIPOSOMES MEDIATED DELIVERY OF METHYLNAPHTHAZARIN FOR ANTI-CANCER ACTIVITY

Pirun Mikled,[1,2] Mattaka Khongkow,[3,*] Warinthorn Chavasiri[2,*]
[1]Program in Biotechnology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[2]Center of Excellence in Natural Products Chemistry, Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[3]National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani 12120, Thailand

*e-mail: warinthorn.c@chula.ac.th

Abstract:
Methylnaphthazarin (MNZ), a promising anti-cancer agent, encounters restricted systemic bioavailability and adverse effects due to its poor aqueous solubility and selectivity. This study aims to minimize these limitations by developing novel MNZ-loaded liposomes targeting dual folate and biotin receptors (F/B-LP-MNZ). The optimized liposomal formulations exhibited favorable physicochemical properties, with particle sizes ranging from 110 to 140 nm, narrow size distribution, positive zeta potential (45 to 46 mV), high encapsulation efficiency, and long-term stability. *In vitro* studies demonstrated the preferable controlled drug release of F/B-LP-MNZ under tumor microenvironment-simulating condition. F/B-LP-MNZ significantly improved cytotoxicity against high folate/biotin receptor-expressing HeLa cells (IC_{50}: 1.58±0.04 μM) compared to non-targeted liposomes (IC_{50}: 5.76±0.34 μM). Enhanced cellular uptake and dynamic flow attachment further validated the superior cancer-targeting facilitation of F/B-LP compared to non-targeted LP. Additionally, F/B-LP-MNZ significantly inhibited HeLa cell migration and adhesion, suggesting potential in preventing cancer metastasis. These results highlighted the potential of folate/biotin-decorated liposomes for MNZ delivery, with promising implications for *in vivo* tumor suppression and future clinical studies in cancer therapy.

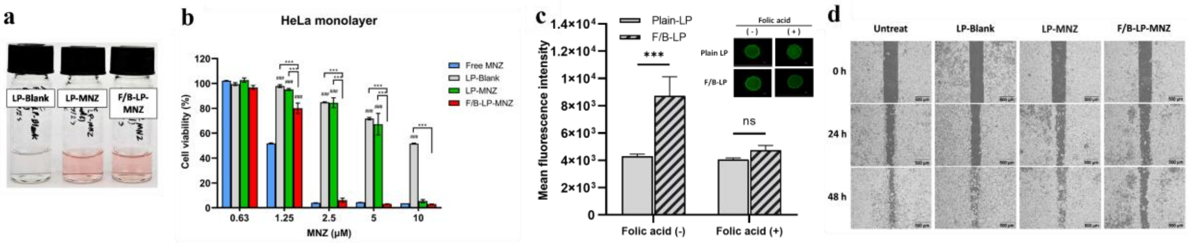


Figure 1. Dual folate/biotin-decorated liposomes loaded with MNZ enhance drug uptake and anti-cancer activities against HeLa cells. (**a**) Formulations of folate/biotin-decorated liposomes loaded with MNZ. (**b**) The effects of free MNZ and its liposome formulations on cell viability in HeLa monolayers. (**c**) Cellular uptake of non-targeted and folate/biotin-targeted liposomes loaded with fluorescent substance in the conditions of blocked and unblocked folate receptors. (**d**) Anti-migration effects of folate/biotin-decorated liposomes loaded with MNZ. Data is represented as mean ± sd (n ≤ 3). Statistical significances: $^{***}p < 0.001$; $^{\#\#\#}p < 0.001$ vs free MNZ; ns, not significant.

EFFCIENCY OF MEDIA ON GROWTH MYCELIUM OF *Phlebopus* sp. IN VITRO

Thanyaporn Tangjaroenchai,[1]* Suphunsa Phetphoon,[2] Alisa Oiuphuang[3] and Phonsuda Srathongwaen[4]
[1]Demonstration School University of Phayao
Division of Biology School of Science, University of Phayao, Phayao 56000, Thailand
[2]Division of Biology School of Science, University of Phayao, Phayao 56000, Thailand
[3]Division of Biology School of Science, University of Phayao, Phayao 56000, Thailand
[4]Division of Biology School of Science, University of Phayao, Phayao 56000, Thailand
*e-mail: thanyaporn.bo@up.ac.th

Abstract:

The research aims to study the effects of different media, specifically carbon and nitrogen sources, on the growth of *Phlebopus* sp. mycelium. Select mature and good quality fruiting bodies for the isolation. Tear the mushroom carefully and take the inner tissue; then place it on the PDA petri plate. Cut the piece of mycelium tested in synthetic media along with various carbon sources across seven media types: Potato Agar (PA), Potato Agar with Sucrose (PSA), Potato Agar with lactose (PLA), Potato Agar with glucose (PGA), Potato Agar with dextrose (PDA), Potato Agar with trehalose (PTA), and Potato Agar with molasses (PMA). Tested in synthetic media with various 6 nitrogen sources, including 1% malt extract, 0.05% ammonium chloride, 0.05% ammonium sulfate, 1% peptone, 0.05% urea and 1% yeast extract at 28 ± 3 °C for one month. The highest mycelium colony diameters of *Phlebopus* sp. were obtained in Potato dextrose agar (PDA) and Potato sucrose agar (PSA) media, measuring 7.96 ± 0.10 cm and 7.84 ± 0.26 cm, respectively which were signifcantly different ($P \leq 0.05$). The highest mycelium growth on peptone medium was 8.52 ± 0.13 cm which was significantly different ($P \leq 0.05$). Carbon sources for the growth of *Phlebopus* sp. mycelium were obtained in PGA, PSA, PDA and PMA. Meanwhile, the nitrogen source peptone resulted in a much higher mycelium density. The efficiency of the media on the growth of *Phlebopus* sp. mycelium can increase the quantity available for planting out of season. It can be transplanted into host plants, increasing opportunities and income for entrepreneurs and cultivators in the future.

Keywords: Media Growth Mycelium *Phlebopus* sp.

EFFECT OF *Centella asiatica* EXTRACT ON DELAYING ASSOCIATIVE MEMORY DEFICITS FROM AGING IN *Caenorhabditis elegans*

Wirulphat Sriola, Mattaya Hunsreesagul, Tanawan Leeboonngam*
Kamnoetvidya Science Academy, Rayong, Thailand
*e-mail: tanawan.l@kvis.ac.th

Abstract:

An aging society is a major problem around the world. Nowadays, the proportion of elderly people in societies is increasing. These elders often experience the degeneration of organ systems, including brain degeneration. This affects crucial daily memory functions, including associative memory, such as remembering names paired with faces. According to previous studies, *Centella asiatica* (CA) is a local herb that has the potential to reduce neurodegeneration and retain memory. CA extract contains Asiatic acid and Madecassic acid which help with neuroprotection against cognitive decline by aging. Therefore, this research aims to study the effect of CA on age-dependent associative memory deficits by using *Caenorhabditis elegans* (*C. elegans*), a small nematode with well-studied nervous systems, as a model. The CA extract was prepared using *Centella asiatica* dried leaves soaked in 95% ethanol at 60 degrees Celsius for 24 hours. The CA extract was dissolved in 2% DMSO solution with concentration 0.01 mg/mL, 0.1 mg/mL, and 1 mg/mL. These diluted CA solutions were then mix with *E. coli* as the food for *C. elegans*. Then, different concentrations of CA-treated and untreated *C. elegans* in young and aged groups were induced for associative learning by using 1-propanol and HCl as the conditioned and unconditioned stimuli, respectively. After that, the *C. elegans* were tested for chemotaxis behavior after different learning periods, calculating the Chemotaxis Index (C.I.), Learning Index (L.I.), and their statistics using ANOVA with Fisher's LSD to analyze the results. From the experiment, aged *C. elegans* showed lower learning ability compared to adult *C. elegans*. The results indicated that CA has the potential to improve learning efficiency, with the best concentration being 0.1 mg/mL in 2% DMSO solution. In conclusion, this study confirms the properties of CA extract on delaying memory deficits and suggests its potential to be developed into a treatment for age-related memory impairment in the future.

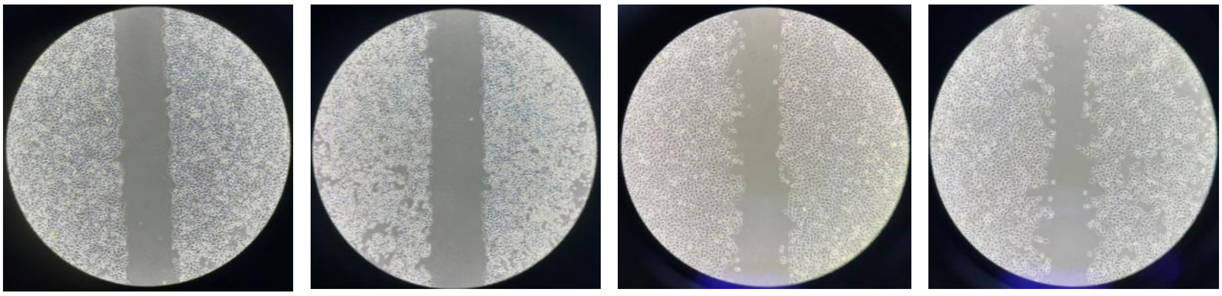
EFFECT OF PIPER RIBESIOIDES WALL. STEM EXTRACT ON INHIBITION OF CHOLANGIOCARCINOMA CELLS LINE IN VITRO

Kantika Sensed[1], Naiyana Phonpituk[1], Ratchadawan Aukkanimart[1], and Pranee Sriraj[1]*

[1]Department of Thai Traditional Medicine, Faculty of Natural Resources, Rajamangala University of Technology Isan Sakon Nakhon Campus, Sakon Nakhon, 47160 Thailand
*Corresponding Author, E-mail: srirajp11@gmail.com

Abstract:

Cholangiocarcinoma (CCA) is a commonly encountered disease in Thailand, especially in the northern and northeastern regions along the Mekong River basin. Which is associated with infection by the liver fluke *Opisthorchis viverrini*. Current treatments for CCA have not been highly successful, the focus is on using herbal medicines to develop treatments for this cancer. Piperine, a compound found in the Piper ribesioides Wall. has been reported to anti-inflammatory and antioxidant properties. Therefore, this study aims to investigate the effects of 95% ethanol extract obtained using a maceration extraction method at a 1:5 (w/v) ratio, fermented for 7 days, and concentrated using a rotary evaporator under 100-250 mbar pressure, 60 rpm, and 60°C of Piper ribesioides Wall. stem in inhibiting the growth and migration of KKU-M156 cholangiocarcinoma cells line. The results revealed that the Piper ribesioides Wall. extract exhibited cytotoxicity against cholangiocarcinoma cells line, with IC_{50} values of 76.34 ± 16.44, 59.35 ± 1.46, and 18.20 ± 2.02 µg/mL at 24, 48, and 72 hours, respectively. Additionally, the extract significantly inhibited the migration of cholangiocarcinoma cells as assessed by the wound healing assay, with inhibition rates of 6.46 ± 2.89%, 21.12 ± 3.91%, and 34.05 ± 8.43% at 12, 24, and 48 hours, respectively ($p<0.05$). These findings suggest that the ethanol extract of Piper ribesioides Wall. stem contains bioactive compounds with antioxidant and anti-inflammatory properties that effectively inhibit both the growth and migration of KKU-M156 cholangiocarcinoma cells, indicating its potential as a therapeutic candidate for the treatment of cholangiocarcinoma.



0 HR 12 HR 24 HR 48 HR

Figure 1.

Cell migration of cholangiocarcinoma cells treated with herbal extracts for 12, 24, and 48 hours, observed under a 10X magnification microscope.

Effects of pH on growth and anatomical characters of Tape seagrass (*Enhalus acoroides* (L.f.) Royle)

Yurachat Meksuwan[1]*, Nuttariya Sikeawpong[1], Panida Sukchan[1] and Phuripong Meksuwan[2]
[1]Faculty of Technology and Environment, Prince of Songkla University, Phuket Campus, Phuket, 83120
[2]Science and Mathematics Program (Biology), Faculty of Science and Technology, Phuket Rajabhat University, Phuket, 83000
*e-mail: yurachat.y@phuket.psu.ac.th

Abstract:
Enhalus acoroides, commonly known as tape seagrass, plays a crucial role in coastal ecosystems and is a dominant species in tropical seagrass meadows, particularly in Thailand. While ocean acidification is generally detrimental to calcifying marine species, it may benefit tropical seagrasses. However, the impact of varying pH levels on the growth and morphological traits of *E. acoroides* remains unclear. This study aimed to examine the effects of different pH levels on *E. acoroides* seedlings under controlled laboratory conditions, focusing on pH values ranging from 6 to 9. The experiment involved four pH treatments (6, 7, 8, and 9) conducted in aquarium tanks, with seedlings cultivated over eight weeks. During the first week, all treatments exhibited 100% seed germination. However, differences in seedling growth became apparent in the following weeks. Although there were no significant variations in fresh and dry biomass at week 2, substantial differences emerged by week 8. Seedlings exposed to pH 6 showed the highest fresh weight, as well as the greatest leaf number, length, and width, with growth differences becoming pronounced by week 8. The results suggest that lower pH levels enhance both shoot and root growth, whereas higher pH levels promote root development with reduced overall biomass. Chlorophyll content analysis revealed no significant correlation between pH and the measured parameters, including chlorophyll a, chlorophyll b, and total chlorophyll after 8 weeks. Anatomical examination highlighted the presence of tannin cells and starch granules with thick cell walls in the mesophyll across all treatments. Additionally, at lower pH levels, an enlarged exodermis was observed, indicating an adaptive response in *E. acoroides* for stabilizing in muddy substrates under acidic conditions. These findings suggest that pH influences the growth dynamics and structural adaptations of *E. acoroides* seedlings, providing insights into the resilience mechanisms of this species in response to environmental changes.

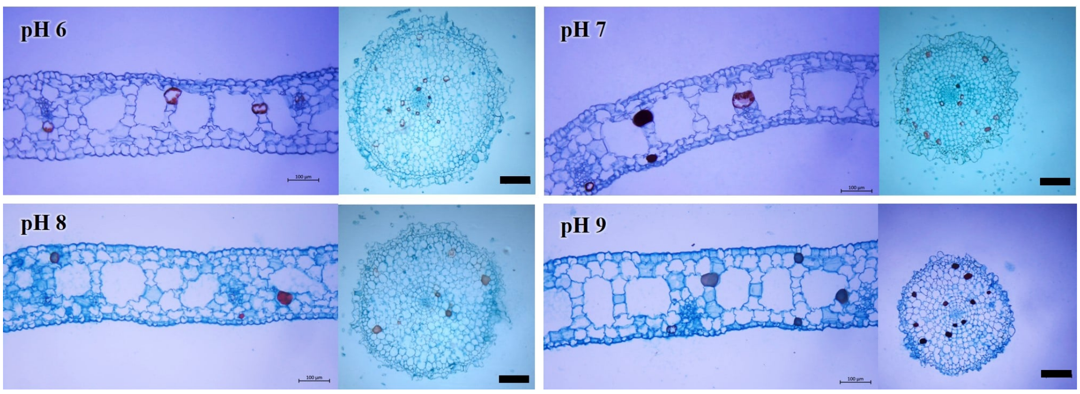


Figure 1 Anatomical observations in the leaves and roots of *E. acoroides* growing in pH 6-9

EFFICACY OF BOTANICAL EXTRACTS AGAINST LARVAL STAGE OF HOUSE FLY, *Musca domestica* (DIPTERA: MUSCIDAE)

Waranya Ardburai, Duangrat Thongphak, Ubon Tangkawanit*
Department of Entomology and Plant Pathology, Khon Kaen University, Thailand
*e-mail: ubonta@kku.ac.th

Abstract:

Chemical methods for controlling house flies have led to the persistence of toxic residues in the environment. The purpose of this study was to identify native plants that are effective in controlling house fly populations in urban and livestock areas at the larval stage. Seven indigenous Thai plants were examined: *Alstonia scholaris* (L.) R.Br., *Murraya paniculata* (L.) Jack, *Citrus aurantium* L., *Colocasia esculenta* (L.) Schott, *Limnophila aromatica* (Lam.) Merr., *Persicaria odorata* (Lour.), and *Manihot esculenta* Crantz. These plants were selected based on reports of their toxicity. A sequence of solvents with varying polarity was used for extraction, including hexane, ethyl acetate, acetone, and ethanol. Non-polar solvents were dissolved using a co-solvent (4% acetone). Both 4% acetone and distilled water were used as negative controls. The effects of the extracts on larval stages were evaluated independently *in vitro* with five replications, using a completely randomized design. The concentrations used in the experiment were 100 mg/ml. Each plant extract had a different effect on house fly larvae depending on the solvent utilized. Extracts with low-polarity solvents (hexane) showed strong larvicidal activity. Hexane extracts of *M. paniculata* and both hexane and ethyl acetate extracts of *C. aurantium* induced the highest percentage (100%) of larval mortality. Therefore, these solvents were used for further bioassays. Phytochemical compounds from hexane extracts of *M. paniculata* and ethyl acetate extracts of *C. aurantium* were expected as terpenoids and flavonoids. Although other plant extracts had less impact on mortality, they affected the growth and development of house fly larvae. The hatching percentage of adult females was lower than that of adult males when specific plant extracts were applied during the larval stage. The LC_{50} values of *M. paniculata* (hexane) and *C. aurantium* (hexane and ethyl acetate) were 4.865, 11.587, and 13.365, respectively. Hexane-extracted *M. paniculata* was the most effective for house fly control in the larval stage.

Table 1 Mortality rate of house fly larvae tested with seven plant extracts by feeding method.

Treatment		Cumulative mortality rate	% Total mortality	Corrected mortality
Solvents	Plants	72 h		
Hexane	*A. scholaris*	8.6±2.19^{abc}	86	85.61
	M. paniculata	10±0^{a}	100	100
	C. aurantium	10±0^{a}	100	100
	Co. esculenta	9.4±0.89^{ab}	94	93.87
	L. aromatica	8.4±2.19^{abcd}	84	83.67
	P. odorata	8.4±0.89^{abcd}	84	83.67
	Ma. esculenta	8±0^{bcd}	80	79.59
Ethyl acetate	*A. scholaris*	7.6±0.54^{cde}	76	75.51
	M. paniculata	9.6±0.54^{ab}	96	95.91
	C. aurantium	10±0^{a}	100	100
	Co. esculenta	7.6±0.54^{bcd}	76	75.51
	L. aromatica	8±1.41^{bcd}	80	79.59
	P. odorata	7.4±1.34^{cde}	74	73.46
	Ma. esculenta	8.2±1.78^{bcd}	82	80
Acetone	*A. scholaris*	8.4±2.30^{abcd}	84	83.67
	M. paniculata	9.4±1.34^{ab}	94	93.87
	C. aurantium	9.6±0.54^{ab}	96	95.91
	Co. esculenta	6.2±1.30^{efg}	62	61.22
	L. aromatica	2.6±0.54^{l}	26	24.48
	P. odorata	2.8±1.78^{l}	28	26.53
	Ma. esculenta	9.6±0.54^{ab}	96	95.91
Ethanol	*A. scholaris*	7.4±1.34^{cde}	74	73.46
	M. paniculata	6.8±0.44^{def}	68	67.34
	C. aurantium	5.4±0.89^{fgh}	54	53.06
	Co. esculenta	9.4±1.34^{ab}	94	93.87
	L. aromatica	3.2±1.09^{jkl}	32	30.61
	P. odorata	4.8±1.64^{ghij}	48	46.93
	Ma. esculenta	6.2±2.68^{efg}	62	61.22
Water	*A. scholaris*	3.6±0.89^{ijkl}	36	34.69
	M. paniculata	5.6±0.89^{fg}	56	55.10
	C. aurantium	4.6±1.94^{ghijk}	46	44.89
	Co. esculenta	7±2.82^{cdef}	70	69.38
	L. aromatica	3.8±0.44^{hijkl}	38	36.73
	P. odorata	3±1.73^{kl}	30	28.57
	Ma. esculenta	5±1.41^{ghi}	50	48.97
Control (4% acetone)		0.2±0.44^{m}	2	0
Control (water)		0.2±0.44^{m}	2	0

[1/]n=10, [2/]Mean±SD, [3/] Within each column, Mean±SD followed by the same small letter indicate not significantly different (P>0.05).

Elephant rehabilitation by native tree species in Kui Buri National Park

Khwankhao Sinhaseni[1,*], Ave Owen[1], Antoinette van de Water[1]

[1] Bring the Elephant Home

Email: khwankhao@bteh.org

Abstract:

Kui Buri National Park in Thailand has one of the highest elephant populations in the country, which has led to conflicts between humans and elephants, particularly because pineapple is a major crop grown near the park's boundaries. To reduce this conflict, Bring the Elephant Home (BTEH) aims to restore elephant habitats in degraded areas within the park that are mixed with timber plantations, such as eucalyptus. The goal is to attract elephants back into the protected area and to test which tree species can thrive under eucalyptus. Eight native tree species were planted under eucalyptus trees, with some receiving fertilizer and others not, to see how they would fare. The results showed that while some species could survive in these conditions, some seedlings were damaged by the elephants.

ENGINEERING OF β-OXIDATION PATHWAY TO INCREASE POLYHYDROXYALKANOATE (PHA) PRODUCTION IN *BACILLUS THERMOAMYLOVORANS*

Atitiya Kruaejun[1], Thanaphorn Rakkan[1,2] Nisa Paichid[3] Kanokphorn Sangkharak[4,*]
[1]Biotechnology Program, Department of Biological, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung Thailand 93210
[2]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai Thailand 50200
[3]Department of Chemistry, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung Thailand 93210
[4]Innovative Material Chemistry for Environment Center, Department of Chemistry, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung Thailand 93210
*e-mail: skanokphorn@yahoo.com

Abstract:
Polyhydroxyalkanoate (PHA), a class of microbial polyesters, accumulate intracellularly under stressful conditions as a reserve of carbon and energy. In this study, knockout gene mutation was used to increase the PHA production in *Bacillus thermoamylovorans*. Gene *fad*B and *fad*A encoding 3-ketoacyl-CoA thiolase and 3-hydroxyacyl-CoA dehydrogenase in *B. thermoamylovorans* were knocked out to weaken the β-oxidation pathway. Afterward, the potential of mutant to produce PHA under various fatty acids was studied. However, the highest biomass (4.5±0.3 g/L) and PHA (41.4±1.0%) was observed by wild type in sodium octanoate. In addition, heterogeneous PHA were also detected from both wild type and mutant strain. The result showed that *fad*B and *fad*A played a more important role in fatty acid degradation. The result indicated that β-oxidation was not completely blocked when only *fad*B and *fad*A genes were deleted. Furthermore, the production of PHA was scaled up in 3L fermenter. A huge value of specific growth rate (μ), biomass productivity and R_m were detected in wild type. Therefore, the deletion of *fad*B and *fad*A had no negative effect on biomass and PHA production. Interestingly, the composition of PHA by mutant showed the presence medium-co-long chain length (mcl-co-lcl) PHA while short chain length (scl) PHA was observed in wild type. By comparison, mcl-PHA are more desirable than scl-PHA because of high elasticity with low crystallinity and tensile strength as well as a high melting point. This is the first report on the improve PHA production in *B. thermoamylovorans* using *fad*B and *fad*A knockout gene method.

EVALUATION OF ANTI-CANCER PROPERTIES OF CRUDE EXTRACTS FROM THE PILUS OF THAI-ISOLATED BAMBOO MUSHROOM (*DICTYOPHORA* SPP.) ON THE HEPATOBLASTOMA CELL LINE (HEPG2)

Sirilak Chumkiew*
School of Biology, Institute of Science, Suranaree University of Technology, Muang, Nakhon Ratchasima, Thailand
*e-mail: s.chumkiew@g.sut.ac.th

Abstract:
Liver cancer is a major health challenge in Thailand and a leading cause of cancer deaths due to high rates of hepatitis B and C infections. Current treatments, including surgery, chemotherapy, and targeted therapies, are often limited and specific to certain cases, highlighting the need for alternative options. This study aimed to evaluate the anti-cancer properties of crude extracts from the pilus of two Thai-isolated bamboo mushrooms (*Dictyophora* spp.) on the hepatoblastoma cell line (HepG2). Two bamboo mushrooms were used in this study: short white skirt and long white skirt, both isolated in Thailand. The dry pilus of the mushrooms was ground into powder and then extracted using 70% ethanol (1:10 ratio) for 7 days. These extracts are thought to contain bioactive compounds such as polysaccharides and terpenoids, which may offer therapeutic benefits. An MTT assay was used to assess cytotoxicity in the HepG2 cell line compared with fibroblasts, which represent normal cells. The results of the study showed that both extracts exhibited anti-liver cancer properties with no toxicity to the normal cell line. The half-maximal inhibitory concentration (IC_{50}) values for liver cancer indicated that the extract from the short white skirt bamboo mushroom was significantly (p<0.05) more effective than that from the long white skirt, with IC_{50} values of 502.900±88.596 µg/ml and 676.567±113.823 µg/ml, respectively. In contrast, the IC_{50} values for the normal cell line (fibroblasts) were higher than 2,500 µg/ml. These findings suggest potential for further studies into anti-cancer mechanisms such as induction of apoptosis, inhibition of cell proliferation, etc. or the identification of bioactive compounds in the extracts.

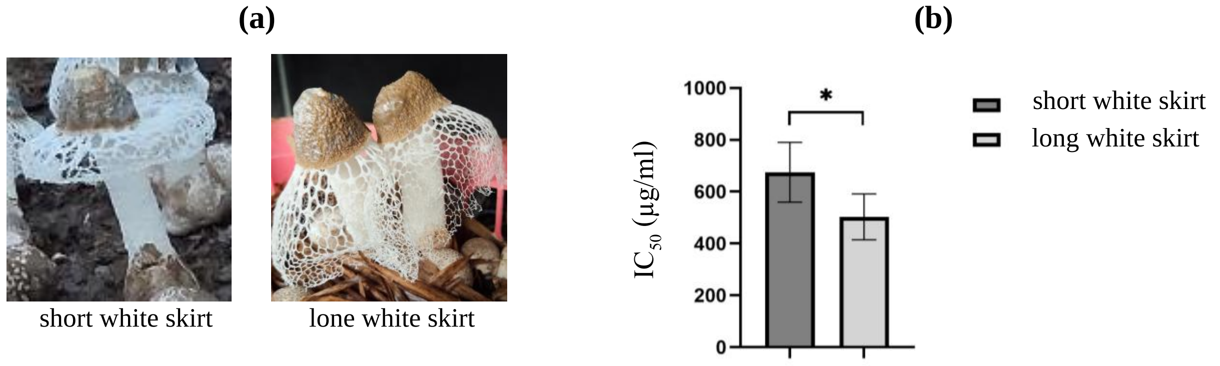


Figure 1. Bamboo Mushroom Characteristics and IC_{50} Values: (a) characteristics of short and long white skirt bamboo mushrooms and (b) IC_{50} values for liver cancer from crude extracts of short and long white skirt bamboo mushrooms.

EVALUATION OF ANTIOXIDANT AND ANTIBACTERIAL ACTIVITIES OF ESSENTIAL OILS FORM FRESH FRUIT of *Zanthoxylum rhetsa* (Roxb.) DC. IN NORTHERN THAILAND

Weeranoot Chaiysing[1,2] and Jantrararuk Tovaranonte[1,2,3*]

[1] Plant Genetic Conservation Project Under the Royal Initiation of Her Royal Highness Princess Maha Chakri Sirindhorn, Mae Fah Luang University, Thailand
[2] Mae Fah Luang University Botanical Garden, Mae Fah Luang University, Thailand
[3] School of Science, Mae Fah Luang University, Thailand
*email: jantrararuk@mfu.ac.th

Abstract:

Zanthoxylum rhetsa (Roxb.) DC. is a deciduous tree commonly found in the monsoonal forests of tropical regions worldwide. It is a native species and an important spice in Northern Thailand, predominantly distributed in the upper northern provinces. This study aims to evaluate the antioxidant and antibacterial properties of essential oils extracted from the fresh fruits. Fourteen samples were collected from five provinces in Northern Thailand including Chiang Mai, Chiang Rai, Lampang, Lamphun, Phayao, Phrae, and Nan. Essential oils were extracted range from 110 to 2,300 g of fresh fruit from each sample using distillation. The antioxidant activity of the essential oils was investigated using the DPPH assay, while the antimicrobial activity was evaluated through an agar diffusion assay at concentration of 90, 45, 30, 15 % (v/v) concentrations across 6 bacterial pathogens (*Bacillus cereus* TISTR 687, *Bacillus subtilis* TISTR 1248, *Staphylococcus aureus* TISTR 746, *Pseudomonas aeruginosa* DMST 4739, *Salmonella typhimurium* TISTR 2519, and *Escherichia coli* DMST 4212). The results showed that essential oils from all samples effectively inhibited all 6 tested bacterial pathogens. A total phenolic content across all samples ranged from 0.062 to 0.194 mg GAE/mL of oil, the flavonoid content ranged from 0.004 to 0.054 mg QE/mL of oil, and the antioxidant activity ranged from 0.145 to 1.449 mg TEAC/mL of oil. The antimicrobial activity of *Zanthoxylum rhetsa* essential oil was evaluated by determining the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) against bacterial pathogens. The essential oils exhibited inhibitory effects with minimum inhibitory concentration (MIC) values ranging from 45.00% to 0.17% (v/v) and bactericidal effects with minimum bactericidal concentration (MBC) values ranging from 90.00% to 0.35% (v/v). Among the five provinces, the Lampang samples exhibited the lowest MIC and MBC values, at 0.17% (v/v) and 0.35% (v/v), respectively. These results suggest that *Z. rhetsa* provides initial evidence of a novel and alternative source of medicinally valuable compounds. This potential can be utilized to develop alternative therapeutic products, offering promising applications in medicine and related industries.

EVALUATION OF BACTERIOPHAGE ECPW09 AS A POTENTIAL THERAPEUTIC AGAINST ANTIBIOTIC-RESISTANT *ESCHERICHIA COLI*

Phitchayapak Wintachai[1,2,3]*

[1] Bacteriophage Laboratory, Walailak University, Thasala, Nakhon Si Thammarat 80161, Thailand
[2] School of Science, Walailak University, Thasala, Nakhon Si Thammarat 80161, Thailand
[3] Functional Materials and Nanotechnology Center of Excellence, Walailak University, Thasala, Nakhon Si Thammarat 80161, Thailand
*e-mail: phitchayapak.wi@wu.ac.th.

Abstract:
The global rise of antibiotic-resistant bacteria in humans, animals, and the environment has become a critical issue. This study focuses on *Escherichia coli* infections in swine and the environmental conditions of swine farms. The occurrence of antibiotic-resistant *E. coli* in swine farms has been reported worldwide, including in Thailand, where intestinal *E. coli* infections are a significant cause of disease and economic loss in swine. The overuse and misuse of antibiotics have been strongly correlated with the development of antibiotic resistance, making it a major concern. Despite extensive research, there are currently no effective alternative or supplementary treatments for *E. coli* infections in swine and swine farm environments. This study aimed to address this gap by isolating and evaluating the efficacy of bacteriophage ECPW09 as a treatment against *E. coli*. Bacteriophage ECPW09, which exhibits broad activity against *E. coli*, was isolated from a water sample following activated sludge treatment. Whole genome sequencing was performed to further characterize the bacteriophage. The bacteriophage demonstrated a strong ability to reduce established biofilms and inhibit biofilm formation. Scanning electron microscopy revealed that bacteriophage ECPW09 caused membrane damage to bacterial cells, leading to cell lysis. These findings suggest that bacteriophage ECPW09 represents a novel and promising therapeutic tool against emerging *E. coli* infections.

EVALUATION OF BENEFICIAL BACTERIA INHIBITION *Pyricularia oryzae* CAUSING RICE BLAST DISEASE AND ENHANCE SEED GERMINATION AND VIGOR

Pholpipat Srisuwan[1], Warit Tantanis[1], Ananya Kewbumrung[1] and Wilawan Chuaboon[2*]
[1]Science Classrooms in University - Affiliated School Project, Thammasat University - Suankularb Wittayalai Rangsit School Center (SCiUS TU-SKR), Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand
[2]Department of Agricultural and Technology, Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand
*e-mail: cwilawan@tu.ac.th

Abstract:

Rice blast disease, caused by the fungus *Pyricularia oryzae*, leads to significant damage to rice yields. As a result, farmers often resort to using large quantities of chemical treatments to manage the disease, a method that is not environmentally friendly, poses potential risks to consumers, and increases production costs. Employing biological control methods to inhibit the pathogenic fungus presents an effective and safer alternative. This study aimed to isolate beneficial bacteria from various parts of rice plants to inhibit the growth of the fungus causing rice blast and to promote rice plant growth. The research began with isolating *P. oryzae* from infected rice plant parts and testing its pathogenicity. The results revealed that a total of 12 isolates of *P. oryzae* were obtained from 10 rice plants exhibiting symptoms of rice blast. Pathogenicity tests revealed that isolate F-scius02 caused the most severe rice blast disease within 5 days on the resistant rice varieties KB43, Pathum Thani 1, and Hompuang 20.

Concurrently, beneficial bacteria were isolated from disease-free parts of rice plants—including leaves, stems, roots, and the surrounding soil—resulting in a total of 170 bacterial isolates. These isolates were classified into 8 groups based on their colony morphology observed on NGA agar after 48 hours of incubation. The effectiveness of these beneficial bacteria in inhibiting the mycelial growth of F-scius02 was assessed using a dual culture method within a completely randomized design. The results revealed that the bacterial isolate B-tu02 exhibited the highest inhibition efficacy ($p \leq 0.05$), reducing the fungal colony size to 1.29 ± 0.09 cm. This was followed by isolates B-tu03, B-tu01, B-tu04 and B-tu05, with fungal colony sizes of 1.35 ± 0.10 cm, 1.42 ± 0.10 cm, 1.44 ± 0.25 cm, and 1.77 ± 0.25 cm, respectively, as measured by the fungal mycelium radius. Additionally, the potential of these beneficial bacteria to promote plant growth was evaluated using F-scius02-infected seeds of rice varieties RD4, Pathum Thani, and Hompuang 20. Among the isolates, B-tu04 proved to be the most effective, achieving an average germination rate of 89.7%. In comparison, B-tu01, B-tu02, B-tu05, and B-tu03 achieved germination rates of 84.0%, 83.6%, 82.3%, and 79.3%, respectively. Seeds treated with sterile water had a germination rate of 75.6%.

EXPLORING THE POTENT ANTI-CANCER PROPERTIES OF THAI *Dictyophora indusiate*: A STUDY ON EXTRACTS FROM DIFFERENT MUSHROOM PARTS

Kanyapak Sakheatkarn,[1] Pathanin Chantree,[2] Pongsakorn Martviset,[3] Sirilak Chumkiew[1,]*

[1] School of Biology, Institute of Science, 111 Suranaree University of Technology, Suranari, Muang, Nakhon Ratchasima, 30000, Thailand
[2] Division of Anatomy, Department of Preclinical Sciences, Faculty of Medicine, 99/209 Thammasat University, Phaholyothin Road Klongluang, Pathumthani, 12120, Thailand
[3] Division of Parasitology, Department of Preclinical Sciences, Faculty of Medicine, 99/209 Thammasat University, Phaholyothin Road Klongluang, Pathumthani, 12120, Thailand
*e-mail: s.chumkiew@g.sut.ac.th

Abstract:
There is growing interest in more effective and less harmful natural extracts for treating cancers. *Dictyophora indusiata*, or bamboo mushroom, has shown promise in anti-cancer studies. However, most research has focused on the Chinese species, while the Thai variety, which is native to region, remains relatively unexplored. This study investigates the anti-cancer activity of different parts of bamboo mushroom extracts and will explore their mechanisms in future research. Using a previously established protocol from our research group, we performed ethanol extraction (1:10 ratio) for 7 days, followed by filtration and evaporation. Extracts were obtained from the fruiting body, cap, and egg of the mushroom. Cytotoxicity was evaluated using the MTT assay, revealing that all three bamboo mushroom extracts effectively reduced cell viability in colon and liver cancer cells in a concentration-dependent manner. The extracts were especially effective against liver cancer cells compared with colon cancer cells, with no cytotoxic effects observed on normal fibroblasts. The half-maximal inhibitory concentration (IC_{50}) values for liver cancer cells were 2983.33±2753.63 μg/ml for the fruiting body extract, 1714.71±653.34 μg/ml for the cap extract, and 486.61±129.42 μg/ml for the egg extract, with the egg extract demonstrating the highest potency. Future research will explore the specific mechanisms of cell cycle arrest and apoptotic protein expression induced by these extracts.

EXPLORING THE POTENTIAL OF SOIL-DERIVED BACTERIA IN LIGNIN DEGRADATION AND SUSTAINABLE BIOMASS UTILIZATION

Esther Amosu, Phurt Harnvoravongchai and Thitinun Sumranwanich*

Department of Biology, Faculty of Science, Mahidol University, 272 Rama 6th Rd, Ratchathewi, Bangkok 10400, Thailand

*e-mail: thitinun.sum@mahidol.ac.th

Abstract:

Lignin is the second most abundant polymer in plant biomass. Its complex and resistant structure is a major barrier to efficient biofuel production. This study aims to overcome this challenge by isolating and characterizing bacterial strains capable of degrading lignin, thus enabling its conversion into valuable resources for sustainable applications. We isolated potential ligninolytic bacteria from 16 soil samples and assessed their ability to grow on minimal media containing alkali lignin as the sole carbon source at 40°C under microaerophilic conditions. Additional screening with model lignin compounds i.e. guaiacol, veratryl alcohol and dyes i.e. aniline blue, methylene blue, and Congo red identified strains with significant lignin-degrading capabilities.

Through 16S rDNA sequence analysis, the isolates were identified as belonging to *Burkholderia* spp., *Pseudomonas* spp., and *Klebsiella* spp. We detected a gene encoding a laccase-like multicopper oxidase in *Burkholderia* spp., and genome analysis revealed the presence of genes involved in lignin degradation, such as peroxidases and glutathione, along with pathways like gentisate and protocatechuate in *Klebsiella* and *Pseudomonas* species. The addition of Cu^{2+} significantly enhanced guaiacol oxidation in *Klebsiella* sp. LEA1 and *Pseudomonas* sp. LEA2.

Gas chromatography-mass spectrometry (GC-MS) analysis detected lignin-related monomers and intermediates, including 2,6-dimethoxyphenol, 4-vinyl guaiacol, 4-hydroxybenzoic acid, benzoic acid, catechol, and succinic acid, at the late stage of incubation in lignin minimal salt media. These intermediates suggest that lignin conversion and utilization occurred through the β-ketoadipate (ortho-cleavage) pathway under limited oxygen conditions.

The ability of these bacteria to degrade lignin and produce valuable intermediates under aerobic and microaerophilic conditions has significant implications for sustainability. By enhancing biofuel production from plant biomass, these bacteria could help reduce reliance on fossil fuels and contribute to the development of renewable energy sources. Furthermore, their potential for bioremediating lignin-contaminated environments and producing valuable renewable chemicals aligns with efforts to develop sustainable bioprocesses and advance the circular bioeconomy. Identifying specific ligninolytic enzymes and pathways provides a foundation for future studies aimed at improving lignin degradation and promoting the sustainable utilization of lignocellulosic biomass.

GENETIC FOOTPRINTS OF TAI YUAN MIGRANTS FROM LAN NA TO SUVARNABHUMI

Suwapat Sathupak[1], Metawee Srikummool[2], Wibhu Kutanan[3], Jatupol Kampuansai[1,*]
[1]Department of Biology, Faculty of Science, Chiang Mai University, Chaing Mai, Thailand.
[2]Department of Biochemistry, Faculty of Medical Science, Naresuan University, Phitsanulok, Thailand.
[3]Department of Biology, Faculty of Science, Naresuan University, Phitsanulok, Thailand.
*e-mail: Jatupol.K@cmu.ac.th

Abstract:

The Tai Yuan were the primary founders and inhabitants of the Lan Na Kingdom, established in the 13th century in what is now northern Thailand. Throughout history, the Tai Yuan migrated to various regions, both voluntarily and through forced migration. Their communities in Suvarnabhumi, predominantly in central Thailand, are historically documented as the result of migrations over the past few centuries. The significance of studying the Tai Yuan lies in understanding their historical migrations and genetic heritage, which sheds light on the broader genetic landscape of Southeast Asia. To systematically explore the genetic heritage of the Tai Yuan population in Southeast Asia, we collected biological samples from 94 contemporary individuals of Tai Yuan descent from Saraburi, Nakorn Ratchasima, and Uttaradit, Thailand. Genome-wide SNP data, covering around 600,000 loci, were generated using the Affymetrix Human Origins array and compared with previously published data on East and Southeast Asian populations. Population genetic structures were determined using principal component analysis (PCA), ADMIXTURE, pairwise Fst genetic distance, f-statistics, and AdmixtureGraph. The results showed that the Tai Yuan share a close relationship with their Tai-Kadai-speaking relatives in northern and northeastern Thailand, as well as southern China. Despite this close relationship, we observed varying proportions of genetic sources among Tai Yuan populations in different regions, influenced by founder effects and admixture with local populations. This study highlights the continuity of lineage from Lan Na to Suvarnabhumi and illustrates the impact of migration on the genetic structure of ethnic groups in Thailand. However, the analysis is constrained by the limited genetic data available from central Thailand. Expanding the dataset to include more genetic information from other local populations across Thailand and Southeast Asia would provide a more comprehensive understanding of the genetic landscape, offering deeper insights into regional migration patterns and cultural exchanges.

IDENTIFICATION OF *Coffea arabica* L. VARIETIES USING START CODON TARGETED (SCoT) MARKERS

Nattaporn Klin-on[1,2], Plaipol Dedvisitsakul[1,2], Kanchana Watla-iad[1], Siraprapa Mahanil[1], Somrudee Nilthong[1], Pattana Kakumyan[1,2] and Natsaran Saichana[1,2,*]

[1]School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand
[2]Microbial Product and Innovation Research Group, Mae Fah Luang University, Chiang Rai 57100, Thailand
*e-mail: natsaran.sai@mfu.ac.th

Abstract:
Coffea arabica or arabica coffee is a high-value commercial crop that is predominantly grown in northern part of Thailand. Since the first introduction in Thailand, there were some arabica coffee varieties that have been cross-bred with other varieties. Due to analogous morphological features, the identification of *C. arabica* varieties requires efficient molecular tools. In this study, Start Codon Targeted (SCoT) markers were used to distinguish 15 accessions of *C. arabica* varieties or hybrids and compared to other standard species that were maintained at the Royal Agricultural Station Mae Lord, Chiang Mai, Thailand. Thirty SCoT primers were tested and they produced highly informative results with an average of 88.04% polymorphism and a mean PIC of 0.42. Clustering using the unweighted pair-group method with arithmetic averages (UPGMA) and the Principal Coordinate Analysis (PCoA) using SCoT polymorphisms demonstrated the efficiency to identify the varieties of *C. arabica*. Moreover, an analysis of minimized test using a set of primers for SCoT marker (SC2, SC3, SC4, SC17, SC21, SC22, SC24 and SC32) has a potential to identify *C. arabica* in the variety level. This study demonstrated that SCoT marker is an efficient molecular tool for identification of *C. arabica* varieties.

IDENTIFICATION OF LICHENS USING ARTIFICIAL INTELLIGENCE

Phornnuchcha Anurak[1], Phimnaphat Sriphatphiriyakun[1]*, Vasun Poengsungnoen[2], Wetchasart Polyiam[2], Patsavipich Rungrojtrakool[1]
[1]Mahidol Wittayanusorn School, Nakhonpathom, Thailand
[2]Lichen Research Unit, Ramkhamhaeng University, Bangkok, Thailand
*e-mail: phimnapha.sri_g32@mwit.ac.th

Abstract:

Lichen represents a stable symbiotic association between at least one fungus and either an alga or a cyanobacterium. This organism is susceptible to air pollution. Each lichen species thrives in different air qualities, thus serving as an indicator of air quality. However, identifying lichen species can be challenging for the general public. In this study, we aim to simplify lichen identification by developing an Artificial Intelligence model that is suitable for the general public.

Five species of lichens such as *Dirinaria picta*, *Pyxine cocoes*, *Physcia undulata*, *Trypethelium eluteriae* and *Nigrovothelium tropicum* found in urban areas of Thailand are chosen. Lichen identification was rechecked by specialists from the Lichen Research Unit at Ramkhamhaeng University. Pictures of each selected lichen were captured to make a large dataset for the model training. Roboflow was used to annotate and label species in each image. The picture dataset was split into three sets; train set, valid set, and test set. Dataset was sent to the selected model YOLO version 8 run on Google Colab. YOLO version 8 is the most efficient model among widely used CNN models (Dillon et al.,2024). The augmentation including flipping, cropping, shearing, increasing and decreasing brightness was applied to escalate training performance by multiplying pictures in dataset and training model with variation dataset. Model accuracy was evaluated using parameters including the Mean Average Precision (mAP), Confusion matrix, Precision, Recall and F1-score.

Our best-performing model achieved the Mean Average Precision (mAP) of approximately 0.61149, with Precision, Recall and F1-score as 0.63789, 0.73180 and 0.71899 respectively. Confusion Matrix evince that model has ambivalent identification between *Trypethelium eluteriae* and background since *T. eluteriae* are analogous to background. Additionally, the model had difficulty identifying lichens in the foliose group, as species in this group closely resemble each other. Although the model's performance was not as high as anticipated compared with similar models for detecting objects like algae and fungi as mAPs in the range of 0.490 to 0.898 (Dan et al., 2022; Jungsu et al., 2022; Henu, 2022). To improve lichen identification accuracy, future developments would focus on using a larger model and expanding the dataset with more images. This AI model has the potential to assist beginners and enthusiasts in identifying lichens. A user-friendly platform should be further developed to display the model's results, making it more accessible to the general public and enhancing the ease of lichen identification in urban environments.

Identifying the target-directed miRNA degradation and the potential of decayed miRNAs during WSSV infection in *P. vannamei*

Chantaka Wongdontri and Kunlaya Somboonwiwat*
Center of Excellence for Molecular Biology and Genomics of Shrimp, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
*e-mail: Kunlaya.S@chula.ac.th

Abstract:

It has been demonstrated that miRNAs are essential for regulating antiviral innate immune responses, particularly in invertebrates. Besides being produced through the biogenesis pathway, target-directed miRNA degradation (TDMD) is a known mechanism for controlling miRNA levels in living cells, as it causes miRNAs that bind to specialized targets with high complementarity to quickly decay. However, the biogenesis and decay of miRNAs in invertebrates remain poorly understood, which limits the application of basic miRNA knowledge to the development of miRNA-based antiviral therapeutics.Given the availability of genome and transcriptome databases, we used the shrimp *Penaeus vannamei* as a model organism to investigate the biogenesis and degradation of miRNAs in invertebrates. Specifically, we identified miRNA-mRNA base-pairing interactions in the hemocytes of WSSV-infected shrimp using data from PARIS (Psoralen Analysis of RNA Interactions and Structures) analysis. We analyzed shrimp miRNAs that bind to target RNAs from either WSSV or the host, focusing on their secondary structures to identify potential miRNA/TDMD trigger pairs. Additionally, we examined the biogenesis of miRNAs potentially regulated by TDMD, such as miR-117, miR-novel-1, and miR-100, which are downregulated following WSSV infection. Furthermore, we investigated which TDMD machinery is crucial for miRNA degradation, specifically looking at ZWIM8, which has been reported as an adapter protein in the degradation process of miRNAs in humans, *Drosophila*, and *Caenorhabditis elegans*. However, the silencing of *PvZSWIM8* will be further investigated, and its effects on miRNA degradation will be explored in shrimp.

KUNINGAN BOTANICAL GARDEN AS AN EX-SITU CONSERVATION RESOURCE AND MINI SEED BANK FOR MOUNT CIREMAI VEGETATION, INDONESIA

Indriani Ekasari[1]*, Dian Latifah[2], Dedi Kurniawan[3], Satrya Permana[3], Sumarno[3], Yuga Priandana[3], Doni Nurpriatna[3], Ramdani[3], Rizal Rusdiantoro[3], Epi Hadipratiwi[3], Hendra Helmanto[1], Aulia Hasan Widjaya[2], Yayan Wahyu Candra Kusuma[1], Rizmoon Nurul Zulkarnaen[1], Muhammad Imam Surya[2], Ratih Damayanti[4], Ade Yusup Yuswandi[4], Kate Hardwick[5]

[1]Research Center of Ecology and Ethnobiology- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[2]Research Center of Applied Botany -National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[3]Kuningan Botanical Garden- Environmental Service of Kuningan Regency, Padabeunghar, Pasawahan, Kuningan Regency, West Java, Indonesia
[4]Directorate of Scientific Collection Management- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[5]Millennium Seed Bank Partnership- Royal Botanic Gardens Kew, Ardingly, Haywards Heath, Sussex, RH17 6TN, United Kingdom

*e-mail: indriani.ekasari@brin.go.id

Abstract:

Kuningan Botanical Garden (KBG) covers 154.90 ha and was established in 2015 under the management authority of the Environmental Service of Kuningan Regency, West Java, Indonesia. KBG is located in northern Kuningan Regency, about 4.5 hours from Jakarta. KBG has 1876 plant specimens planted in the garden spread across thematic parks dominated by specimens in rock habitats and flora habitats. KBG is located next to Mount Ciremai National Park (TNMC) and is considered ideal to become a centre for ex-situ plant conservation research as a reflection of in-situ conservation of Java's mountain forests whose ecosystem functions are currently declining due to fires, poaching, and illegal farming. KBG is expected to be of great value to Mount Ciremai. Seed germination and seedling maintenance facilities for native species are being developed as part of this initiative. The seeds from target species have been collected from exploration activities carried out since 2021 in MCNP and its surroundings. A total of 25 species (16 families) and 2,160 individual seedlings are currently being maintained until planting in demonstration and research plot in late 2024. A mini seed bank will also be built at KBG, adjacent to the natural forest to store seeds of selected native species from Mount Ciremai. The mini seed bank contains viable seeds for restoration, reintroduction and research to conserve and enhance MCNP's natural ecosystem. Furthermore, this ex-situ resource will support restoration activities and community needs in other strategic areas (seeds that have the potential for bioprospecting) of Kuningan Regency.

Keywords: Kuningan Botanical Garden, Mini Seed Bank, Mount Ciremai

Figure 1. Seedling maintenance in Kuningan Botanical Gardens nursery (left) and future mini seed hub in Kuningan Botanical Gardens (right).

LARGE-SCALE PRODUCTION, PURIFICATION AND BIOACTIVITY ASSAY OF ADENOSINE FROM *Cordyceps miliataris*

Kitiphong Khongpinitbunjung[1,2], Sunita Chamyuang[1,2], Thanyarat puttika[1,2], Tang Yin Quan[3], and Amorn Owatworakit [1,2,*]
[1]School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand.
[2]Microbial Product and Innovation Research Group (MP&I), Mae Fah Luang University, Chiang Rai 57100, Thailand.
[3]School of Biosciences, Faculty of Health and Medical Sciences, Taylor's University, 47500 Selangor, Malaysia
*e-mail: amorn@mfu.ac.th

Abstract:
Adenosine is the major active compound of Cordyceps mushroom (*Cordyceps militaris*) with therapeutic potential. It has been optimized to produce using submerged fermentation in small scale for biomass and main active compounds. In this work, we scaled up to culture this fungus using submerged culture, with a working volume of 100 L of PDB grown under 20 °C (maintain pH at 6, and aeration at 1 VVM) for 14 days. This system was capable of producing adenosine with productivity from intracellular (mycelia) and extracellular (medium) crude extract at levels of 3.04 ± 0.024 mg/L and 24.51±7.520 µg/L on days 3 and 5, respectively. The crude extract was subsequently purified on a large scale using Flash Chromatography System. HPLC was employed to identify the fractions that were collected. The adenosine was retrieved and yielded 5.94 mg of adenosine with purities exceeding 95% for a 400 mg crude extraction. Functional analysis of the purified and crude adenosine was tested with the human fibroblast (BJ) cell proliferation by MTT assay. The IC_{50} of purified adenosine and the crude extract was 100 µM and 530.9 µg/ml, respectively. In summary, we have successfully produced adenosine and allows us to obtain a large amount of purified adenosine from *C. militaris*. This purified adenosine has demonstrated the potential to be used as an active ingredient in health care products.

MATERNAL GENETIC HISTORY OF LOLOISH SPEAKING HILL-TRIBES IN NORTHERN THAILAND

Dhammawit Haemanwichian[1], Wirunchana Kaweela[2], Tanapon Seetaraso[2], Natcha Chaisoung[2], Suwapat Sathupak[2], Jatupol Kampuansai[2,*]
[1]Chiang Mai University Demonstration School, Chaing Mai, Thailand
[2]Department of Biology, Faculty of Science, Chiang Mai University, Chaing Mai, Thailand
*e-mail: Jatupol.K@cmu.ac.th

Abstract:
The Akha and Lahu are recognized as hill-tribe ethnic groups in Thailand. They speak languages belonging to the Sino-Tibetan linguistic family: Southern Loloish for the Akha and Central Loloish for the Lahu. Historical records indicate that these people migrated from their homeland on the Tibetan plateau over the last millennium, moving through southwestern China and northern Myanmar into northern Thailand. Despite their well-known unique cultures and languages, the genetic relationships between the Akha and Lahu remain unclear. This study investigates the maternal history of the Akha and Lahu in Chiang Mai and Chiang Rai provinces. Mitochondrial DNA control region analyses were conducted on 90 unrelated individuals from two Akha villages and two Lahu villages. Population pairwise differences (Fst) revealed significant genetic distinctions between the Akha and Lahu. A strong founder effect was observed in the Lahu village from Chiang Mai, with the lowest haplotype diversity at 0.7508±0.0710. The predominant mitochondrial lineages, haplogroup D4j in the Akha and D4e in the Lahu, suggest northern Asian ancestry. These findings enhance our understanding of the genetic differences, maternal lineage, and historical migrations of the Akha and Lahu populations in northern Thailand.

OPTIMIZING BIOMASS AND LUTEIN PRODUCTION IN *ACUTODESMUS OBLIQUUS*: EFFECTS OF GROWTH MEDIA, CULTIVATION METHODS, AND ENVIRONMENTAL STRESSORS

Theera Thurakit,[1,*] Wanida Pan-utai,[1] Ratchaneeporn Poonpanit,[2] Nipat Limsangouan,[3]
[1]Department of Applied Microbiology, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
[2]Food Quality Assurance Services Center, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
[3]Food Processing and Preservation, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
*e-mail: ifrtet@ku.ac.th

Abstract:
Currently, microalgae are acknowledged as an eco-friendly reservoir of significant chemicals, specifically pigments highly esteemed for their exceptional antioxidant attributes. Lutein, a renowned pigment, possesses the capacity to protect against ocular harm and is particularly distinguished for its potent antioxidant properties. This research project aimed to study the cultivation of *Acutodesmus obliquus* in a laboratory setting. The main objective was to examine the effects of three different growth media (Jaworski’s medium, CA medium, and Bold basal medium) on biomass and lutein production. The study also examined different cultivation methods, such as photoautotrophic, mixotrophic, and heterotrophic, using varying initial concentrations and organic carbon sources. In addition, the study investigated the promotion of lutein accumulation through the application of stressors, such as variations in light intensity and pH levels. The findings revealed that microalgae exhibited the greatest accumulation of lutein at concentrations of 6.08 mg/g and 24.35 mg/L when cultivated with Jaworski's medium in mixotrophic mode, having 10 g/L of glucose as a carbon source, maintained at a pH of 7.5, and exposed to light at 200 µmol photons/m²/s. Moreover, under these culture conditions, the microalgae attained a peak biomass production of 4.00 g/L, with a biomass productivity of 443.97 mg/L/d, representing a 1.86-fold increase compared to the control group.

PLANT DIVERSITY AND ETHNIC TRADITIONAL KNOWLEDGE OF PLANT USE AT DOI MAE SALONG, CHIANG RAI PROVINCE

Wipawan Kioasanthie [1,2] and Jantrararuk Tovaranonte[1,2,3*]

[1] Plant Genetic Conservation Project Under the Royal Initiation of Her Royal Highness Princess Maha Chakri Sirindhorn, Mae Fah Luang University, Thailand
[2] Mae Fah Luang University Botanical Garden, Mae Fah Luang University, Thailand
[3] School of Science, Mae Fah Luang University, Thailand
*email: jantrararuk@mfu.ac.th

Abstract:
Doi Mae Salong, characterized by over 50% forest cover, is inhabited by seven ethnic groups (Akha, Lahu, Lisu, Lawa, Shan, Mien, and Yunnan Chinese). These communities have historically coexisted with the natural environment, utilizing forest resources in a sustainable manner while preserving their cultural practices. This study focuses on examining the ethnobotanical uses of plants among various ethnic groups. Plant diversity in the villages and surrounding forests of Doi Mae Salong, Chiang Rai Province, was surveyed from 2021 to 2023 to assess plant species used by local communities and their traditional knowledge. The plants were identified by their scientific name using taxonomic keys from Flora of Thailand and other taxonomic literature publications, and plant specimens were collected in MFLU. The results showed that there were 418 species belonging to 316 genera and 107 families of wild plants and home garden plants. The use of these plants was investigated by 158 informants, who are aged 20-85 years (49 males and 109 females). The plants were categorized based on their uses into nine groups: medicine (287 species), food (238 species), beliefs and rituals (58), cultural traditions (18 species), equipment (51 species), building materials (39 species), animal medicine (18), fodder (11), and miscellaneous (66 species). The relative importance of each plant was quantified using the use value index (UV). The top five plants with the highest use value were *Dendrocalamus membranaceus* Munro, *D. asper* (Schult.f.) Backer, *D. giganteus* Munro, *Gigantochloa hosseusii* (Pilg.) T.Q.Nguyen, and *D. hamiltonii* Nees & Arn. ex Munro with UV of 2.09, 1.96, 1.81, 1.77 and 1.75 respectively.

Plants with the highest use value demonstrate significant utility and importance to local communities, reflecting their integral role in traditional practices and resource management. These plants are crucial for understanding ethnobotanical knowledge and guiding conservation and sustainable use strategies.

POTENTIAL OF ASPP 049, A NATURAL DIARYLHEPTANOID DERIVATIVE ENHANCING THE PORCINE MUSCLE SATELLITE CELL PROLIFERATION: IMPLICATIONS FOR CULTURED MEAT PRODUCTION

Utid Suriya[1], Ratchakrit Srikuea[2], Tanida Chokpanuwat[2], Kanoknetr Suksen[2], Wasina Watcharanapapan[2], Dusit Laohasinnarong[3], Apichart Suksamrarn[4], Tavan Janvilisri[1], Arthit Chairoungdua[2], and Kanit Bhukhai[2*]

[1]Department of Biochemistry, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
[2]Department of Physiology, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
[3]Department of Clinical Sciences and Public Health, Faculty of Veterinary Science, Mahidol University, Nakhon Pathom, 73170, Thailand
[4]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Ramkhamhaeng University, Bangkok 10240, Thailand

*Correspondence: kanit.bhu@mahidol.ac.th

Abstract:

Skeletal muscle stem cells, known as satellite cells, are essential for the production of cultured meat, as they drive the processes of proliferation and differentiation required to form muscle fibers *in vitro*. However, the ability of these cells to proliferate and differentiate is often decreased after extended periods of *in vitro* culture, due to the loss of their stemness properties. Consequently, there is a need for effective pharmacological agents that can enhance satellite cell proliferation while preserving their stemness, thereby supporting optimal cell growth for cultured meat production. In this study, we investigated the effects of ASPP 049, a diarylheptanoid derivative isolated from *Curcuma comosa* rhizomes as a glycogen synthase kinase 3β (GSK3β) inhibitor on the proliferation of porcine muscle satellite cells (PMSCs) and the Wnt/β-catenin signaling pathway. Our findings demonstrate that ASPP 049 improved cell viability and proliferation while maintaining the expression of the skeletal muscle stem cell marker, Pax7. Molecular dynamics simulations revealed that ASPP 049 could form a stable complex, primarily driven by hydrophobic interactions. This study underscores the potential of ASPP 049 in promoting PMSC proliferation and maintaining stemness, presenting a promising approach for advancing cultured meat production.

Potential of *Clinacanthus nutans* and *Barleria prionitis* Extracts in Reducing Pathogenic Factors Contributing to Periodontitis

Sirintip Pechroj[1,2,*], Yingmanee Tragoolpua[2], Angkhana Inta[2], Itthayakorn Promputtha[2]
[1] Multidisciplinary and Interdisciplinary School, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
*Email: Sirintip253771@gmail.com

Abstract:
Periodontitis is a condition characterized by the overgrowth and imbalance of specific bacterial populations in the oral cavity, leading to the formation of biofilms that trigger inflammatory responses, ultimately resulting in the degradation of the tooth-supporting structures. Furthermore, periodontitis has been associated with exacerbating insulin resistance and disrupting glycemic control. Plant extracts are known for their diverse pharmacological properties. In this study, the antibacterial, antibiofilm, and antidiabetic effects of *Clinacanthus nutans* and *Barleria prionitis* were evaluated. The leaf powder of *C. nutans* and *B. prionitis* was extracted using 95% methanol, 95% ethanol, 70% ethanol, and water. These extracts were tested against oral pathogenic bacteria contribute to dental caries, which can subsequently lead to the development of periodontitis, including *Klebsiella pneumoniae, Staphylococcus aureus, Streptococcus mutans*, and *Streptococcus pyogenes*, using agar well diffusion and minimum bactericidal concentration (MBC) assays. The antidiabetic potential was assessed by their ability to inhibit the α-glucosidase enzyme. The results revealed that *C. nutans* and *B. prionitis* extracts demonstrated inhibitory effects on all tested bacterial growth, biofilm formation, and biofilm degradation, as well as the ability to lower blood glucose levels by inhibiting the α-glucosidase enzyme. *B. prionitis* extracts demonstrated superior bactericidal activity compared to *C. nutans* extracts, as indicated by their lower MBC values. Among the various extraction solvents, 95% ethanolic extract exhibited the most effective performance in these activities. Specifically, *C. nutans* extract significantly reduced biofilm formation and encouraged biofilm degradation by over 80%, while *B. prionitis* extract displayed a slightly less pronounced effect. Conversely, *B. prionitis* extract displayed statistically significantly stronger inhibitory activity against α-glucosidase compared to *C. nutans* extract, with IC_{50} values of 13.90 ± 0.07 and 17.01 ± 0.30 mg/mL, respectively. These findings proffer valuable insights into the potential utility of *C. nutans* and *B. prionitis* extracts as active ingredients in products targeted for the prevention or treatment of periodontal disease. Future research will focus on comprehensive toxicity and safety evaluations to ensure the safe use of these extracts in oral care formulations.

PREDICTION MODEL FOR CLASSIFYING BACTERIAL SPECIES CONTAMINATION IN MEAT

Tadsakamon Loima, Jirapat Pongprayoon, Kattika Kaarj*

School of Biology, Institute of Science, Suranaree University of Technology, Nakhon Ratchasima, Thailand 30000
*e-mail: kattika.k@g.sut.ac.th

Abstract:

The widespread demand for meat consumption is accompanied by significant food waste due to consumer uncertainty about meat safety. Many people throw away meat once it reaches its best-by date, even when there are no actual safety concerns, contributing to substantial waste. Therefore, promptly evaluation method of potential bacterial contamination in meat is required to ensure the safety of meat. Traditionally, detecting bacterial contamination in meat products involves complex laboratory analyses that are time-consuming and costly. In this research project, we aim to identify common bacteria species found in meat which are *Bacillus cereus* and *Staphylococcus aureus* contaminating in meat, such as poultries, beef, and pork, by analyzing coloration patterns created by the reaction between volatile organic compounds (VOCs) released by bacteria and arrays of seven pH indicators. We developed a model using images of these coloration patterns and image processing libraries. We compared two modeling techniques: the Support Vector Machine (SVM) method, which represents supervised learning, and the Principal Component Analysis (PCA) method, which represents unsupervised learning. The bacterial classification model was developed in Python using Jupyter Notebook on the Google Colaboratory platform. Experimental results showed that the SVM model achieved an accuracy of 0.78, a precision of 0.87, a recall of 0.78, and an F1-score of 0.78. Similarly, the PCA method also achieved an accuracy of 0.78, a precision of 0.87, a recall of 0.78, and an F1-score of 0.78. Therefore, it can be concluded that the SVM method performs comparably to the PCA method. The bacteria species classification will be confirmed and compared with the traditional PCR. Future works include the improvement of classification model performance by increasing the number of datasets and selecting different pH indicators that may interact with VOCs more specifically. Finally, this classification model can be further refined to help consumers and merchants manage meat products more effectively.

PREPARATION OF PROTEIN HYDROLYSATES FROM *Schizophyllum commune* AND ITS BIOACTIVITIES

Kyaw Htet Hein,[1,2] Natsaran Saichana,[1,2] Plaipol Dedvisitsakul,[1,2] Orawan Suwantong,[1] Pattana Kakumyan[1,2,*]

[1]School of Science, Mae Fah Luang University, Chiang Rai, 57100, Thailand
[2]Microbial Products and Innovations Research Group, Mae Fah Luang University, Chiang Rai, 57100, Thailand
*e-mail: pattana.kak@mfu.ac.th

Abstract:
Schizophyllum commune, commonly known as the split gill mushroom, is an established source of bioactive compounds for beneficial-promoting human health. However, many studies have widely focused on polysaccharides and other extracts from fruiting bodies and mycelia. There is limited research on the potential contributions of protein hydrolysates and the optimal conditions for their preparation. Hence, this study aimed to investigate the optimal conditions for preparing protein hydrolysates from *S. commune* and its biological activities including anti-inflammatory, anti-cancer, anti-bacterial, and anti-oxidant properties, in comparison to non-hydrolyzed proteins. The proteins obtained from *S. commune* were hydrolyzed using proteases (80 mU of Alcalase/g of protein powder). The optimal conditions for producing protein hydrolysates with the desired molecular weight were established at 37 ℃ for 60 minutes. The antioxidant activity of protein hydrolysates in 10-50 kDa fraction showed the 50% inhibitory concentration (IC_{50}) values of 0.78±0.02 mg/mL and 1.98±0.07 mg/mL by ABTS and DPPH radical scavenging assay, respectively. These protein hydrolysates were found to inhibit nitric oxide production in RAW 264.7 macrophage cells, with IC_{50} values of 3.31 mg/mL. The cell viability of hydrolyzed proteins in 10-50 kDa fractions have IC_{50} of 1.5 mg/mL on human colon cancer SW480 cell line. The 50% cytotoxic concentration (CC_{50}) on L929 cells was 0.32 mg/mL of non-digested protein, while the protein hydrolysate was 7.04 mg/mL. These findings have suggested that protein hydrolysates from fruiting body of *S. commune* exhibited multiple beneficial properties and potentials as a functional food ingredient. Further large-scale studies on *S. commune* protein hydrolysates will be necessary to receive a significant role of the various factors in influencing biological activities.

QUERCETIN STIMULATES THE EXPRESSION OF DUAL SPECIFICITY PHOSPHATASE 5 THROUGH THE MODULATION OF SERUM RESPONSE FACTOR

Kanokkan Boonruang1,[1] Ilju Kim,[1] Chaeyoung Kwag,[1] Junsun Ryu,[2] Seung Joon Baek[1,*]
[1] College of Veterinary Medicine and Research Institute for Veterinary Science, Seoul National University, Seoul 08826, Republic of Korea
[2] Department of Otolaryngology-Head and Neck Surgery, Center for Thyroid Cancer, Research Institute and Hospital, National Cancer Center, Goyang 10408, Republic of Korea
*e-mail:
baeksj@snu.ac.kr

Abstract:
Quercetin has gained attention for its ability to reduce inflammation and inhibit tumor growth in various cancers. Dysregulated kinase and phosphatase activities contribute to cancer development, highlighting the importance of cellular balance. Specifically, Dual Specificity Phosphatases (DUSPs) play a pivotal role in modulating ERK phosphorylation. This study aimed to explore how quercetin affects the expression of DUSP5, a gene crucial for maintaining this balance in cancer. The results showed that quercetin stimulates DUSP5 expression, linked to a specific binding site for serum response factor (SRF) in the DUSP5 promoter. The removal of this binding site eliminated the quercetin-induced increase in DUSP5 expression, highlighting its essential role. SRF, acting as a transcription factor, likely contributes to the quercetin-induced transcriptional activation of DUSP5. These findings shed light on how quercetin may combat colorectal tumorigenesis by enhancing SRF activity, thereby increasing DUSP5 expression at the transcriptional level. This underscores the importance of further investigating quercetin's molecular mechanisms and its potential as a cancer therapy.

SARATOPIA: A BOARD GAME FOR LEARNING ABOUT FOREST SUCCESSION AND SPECIES DIVERSITY IN SARABURI PROVINCE

Suthinee Onuam,[1] Satayu Panjinda,[1] Noppadon Kitana,[2,3] Pongchai Dumrongrojwatthana[2,*]
[1] M.Sc. Interdisciplinary Program in Environmental Science, Graduate School, Chulalongkorn University, Bangkok 10330, Thailand
[2] Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[3] Center of Learning Network for the Region, Chulalongkorn University, Bangkok 10330, Thailand
*e-mail: pongchai.d@chula.ac.th

Abstract:
The Plant Genetic Conservation Project under the Royal Initiative of Her Royal Highness Princess Maha Chakri Sirindhorn (RSPG) emphasizes the importance of youth education in ecology, biodiversity, and natural resource conservation for sustainable development. However, it is necessary to create an active learning tool for young learners. Therefore, this research aimed to develop a board game for shared learning about diversity of plants and animals, ecological succession driven by both natural processes and human-induced changes, and conservation techniques. Data from previous research conducted in Saraburi province under RSPG projects was used to create a game. The popular Monopoly format was adopted due to its simple rules. Various renewable natural resources which are resources that are constantly replenished were provided, including herbs, shrubs, trees, and birds. The game incorporates scenarios, in the form of event cards, that support and delay ecological succession, such as patrolling, firebreak creation, invasive species, and drought from climate. The objective for each player is to create a highly diverse forest on their own gameboard. The player who receives the highest score along the succession process will be the winner. Pretest, posttest and guidebook were prepared for teachers to use. This educational tool has been implemented in various events, such as “Enhanced Teaching Skill in Biology Camp” for primary and secondary school teachers, “Biology Camps” for secondary school and university students, and ‘STEM Camp’ with secondary school students. Currently, it is used in the “Modeling for Natural Resource Management” course. After various testing sessions, we concluded that the game could support learning about local resources and forest conservation. It could be used as a gaming prototype for universities and schools engaging in the RSPG program in the other provinces to develop their own game.

Figure 1.
Game feature (left), game setting (middle), and game play with students (right)

STRESS-INDUCED FORMATION OF L-FORM *Clostridioides difficile*

Anchuleerat Maleehuan[1], Jiranan Apikusalophakorn[2], Puey Ounjai[2], Phurt Harnvoravongchai[2], Tavan Janvilisri[1], and Surang Chankhamhaengdecha[2]*

[1]Department of Biochemistry, Faculty of Science, Mahidol University, Bangkok, Thailand
[2]Department of Biology, Faculty of Science, Mahidol University, Bangkok, Thailand
*e-mail: surang.cha@mahidol.ac.th

Abstract:

L-forms are cell wall-deficient variants of conventional bacteria that retain proliferative ability. Although L-forms were discovered several decades ago, many aspects of their biology remain poorly understood, largely due to unreliable methods for generating them. This study aims to induce and characterize *Clostridioides difficile* L-forms using cell wall-interfering agents, including penicillin G, vancomycin, and lysozyme, on osmoprotective brain heart infusion agar. *C. difficile* L-forms were successfully induced by treatment with 100 µg/mL of penicillin G and 250 µg/mL of vancomycin, with induction rates of approximately 50% and 60%, respectively. Induced L-forms exhibited a distinct water drop-like morphology on agar plates. Phase contrast microscopy confirmed the presence of pleomorphic, cell wall-deficient shapes under these conditions. A muramic acid assay revealed a significant reduction in peptidoglycan content, particularly in L-forms treated with penicillin G. Fluorescent staining confirmed these findings, showing a decrease in the red-fluorescent signal indicative of peptidoglycan in cell wall-deficient L-forms. This research provides new insights into the generation and characterization of *C. difficile* L-forms and lays the groundwork for future applications in gene delivery and biotechnology, offering a tool for research and biotechnological applications in *Clostridioides* species.

THE EFFECT OF MONOSODIUM GLUTAMTE AND THE COMBINATION OF SODIUM TETRABORATE AND POTASSIUM NITRATE ON HUMAN LUNG CARCINOMA EPITHELIAL CELL VIABILITY.

Pabhada Asawakarn[1], Sarawut Kumphune[2], Sirakarnt Dhitavat[3], Sujin Sirisawadi[3], Nanthida Kunnasut[3], Sariya Asawakarn[3]*
[1]Grade11th student, Chulalongkorn University Demonstration Secondary School, Bangkok, 10330 Thailand
[2]Biomedical Engineering and Innovation Research Centre, Chiang Mai University, Muang, Chiang Mai, 50200, Thailand
[3]Biochemistry unit, Department of Physiology, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, Thailand
*e-mail: Sariya.a@chula.ac.th

Abstract:

Monosodium glutamate (MSG) is a well-known flavoring agent that has been widely used globally. MSG consumption has significantly increased over the past 30 years. MSG consumption contributes to the development and progression of metabolic disorders such as obesity, which increase the risk of other metabolic syndromes and hypertension, diabetes mellitus, and cancer initiation. Not only MSG but also other food additives, such as sodium tetraborate and potassium nitrate, are used and may cause health problems. In previous studies, it was shown that MSG could induce thymocyte apoptosis due to change of Bcl-2/Bax protein ratio and reduced cell viability in other cell line Wi38, Caco-3 and MCF-7. Sodium tetraborate and potassium nitrate in HepG2 have been proposed to involve several processes, such as inhibiting enzyme production, cell division, cell proliferation, cell cycle arrest, and induction cell apoptosis. The purpose of this study was to investigate the effect of MSG, sodium tetraborate, potassium nitrate, and their combinations on the viability of lung cancer cell lines. In this study, A549 human lung carcinoma epithelial cells were treated with MSG and the combinations at various concentrations (0.16-10 mg/ml) for 24 and 48 hours. The cell cytotoxicity was determined by MTT assay. The results showed that MSG and the combinations reduced cell viability in dose-dependent manner. In conclusion, MSG and the combinations of sodium tetraborate and potassium nitrate could cause cellular toxicity in human lung carcinoma epithelial cell viability. These findings provide a platform for further investigation into the physiological and mechanistic aspects of toxicity associated with these food additives.

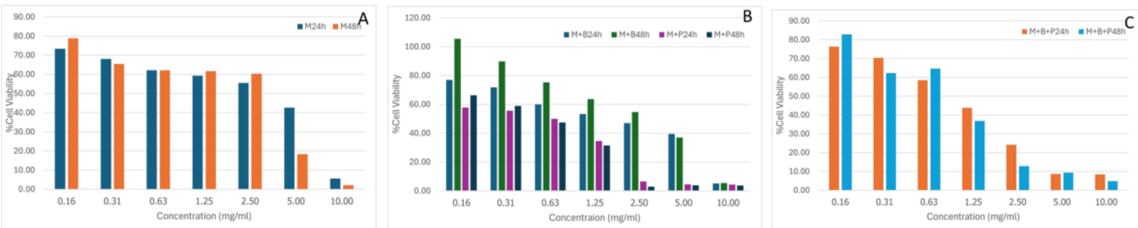


Figure 1.
A549 cells were treated with monosodium glutamate (A), monosodium glutamate and sodium tetraborate (B), monosodium glutamate and potassium nitrate (B) and combination of three food additives(C) for 24 and 48hours.

THE FUNCTION OF circRNA in miRNA REGULATION AND BIOGENESIS IN HEAT-STRESSED SHRIMP

Supitcha Wanvimonsuk,[1] Qian Cao,[2] Peter Sarnow,[2] Pakpoom Boonchuen,[3] Kunlaya Somboonwiwat[1,*]

[1]Center of Excellence for Molecular Biology and Genomics of Shrimp, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[2]Department of Microbiology and Immunology, Stanford University SOM, Stanford, CA 94305, USA
[3]School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand

*e-mail: kunlaya.s@chula.ac.th

Abstract:

Disease outbreaks can have a very destructive impact on any organism and have become a primary constraint to shrimp aquaculture. Previous studies have shown that non-lethal heat shock (NLHS) can promote an immune response in shrimp that leads to resistance against pathogenic infection. The NLHS-induced immunity relies on several mechanisms in addition to gene expression regulation via non-coding RNAs (ncRNAs). In this study, we found that NLHS-responsive miRNAs could bind various circRNAs, which likely act as miRNA sponges. circRNAs are a newly identified class of ncRNAs that regulate various biological processes. However, circRNA biogenesis in shrimp remains unknown. We identified a RNA-binding protein (RBP), zinc finger RNA-binding protein-like from *P. vannamei* (*Lv*ZnF) that have RNA-binding motifs and potential to interfere with circRNA production. In this study, we found that *Lv*ZnF was responsive to NLHS treatment and could promote the expression of circRNAs associated with its RNA-binding activity. Overexpressed *Lv*ZnF in NF90/110 knockdown cell confirms that *Lv*ZnF directly promotes circRNA production. Our research therefore firstly implicates regulation of circRNA biogenesis in shrimp via an NLHS-responsive *Lv*ZnF.

THE IMPACT OF BRASS BOTANICAL GARDEN MANAGEMENT ON THE SOCIO-ECONOMY OF THE COMMUNITY

Dedi Kurniawan[1], Ika Candra Destiyanti [2]

[1] Kuningan Botanical Garden

[2] Universitas Islam Al Ihya Kuningan

Abstract:

Kuningan Botanical Garden functions as a conservation with the function of preserving plant diversity outside its natural habitat. Kuningan Botanical Garden also has the function of tourism services where its regulation will affect the socio-economy of the surrounding community. Economic growth and political stabilization in the Kuningan Botanical Garden area are the focus of this research. This research aims to reflect the impact of the surrounding socio-economic community on the management of tourism services in the brass botanical garden. The community network in the development of the botanical garden is a research participant consisting of farming communities and community communities that for 5 consecutive years have utilized sustainable plantation land so that alternatives to stop land degradation in the brass botanical garden area. The limitations of this research only focus on two communities that have used brass botanical garden land as agricultural land and economic sources. This qualitative research uses triangulation data where interviews and observations to the socio-economic community become the primary data of this research. preliminary findings report that land utilization to the farming community makes a positive contribution to the economic and social between the brass botanical garden manager and the surrounding community where tourism services are supported by the community with the sale of typical brass botanical garden produce being a positive support for the community towards the progress of brass botanical garden management.

Keyword: Botanical garden, qualitative, triangulation, community of people

INCREASING AREA OF BANLAEM MANGROVE FOREST AT NAKHON SI THAMMARAT IN SOUTHERN THAILAND: LAND COVER CHANGES AND PREDICTIVE MODELS

Sinlapachat Pungpa[1], Sirilak Chumkiew[1,*]
[1] School of Biology, Institute of Science, Suranaree University of Technology, Muang Nakhon Ratchasima, Thailand
*e-mail: s.chumkiew@g.sut.ac.th

Abstract:
Land cover changes significantly impact mangroves forests, reducing their effectiveness as carbon sinks. The Banlaem mangrove in Nakhon Si Thammarat, Thailand, supports numerous mangrove plantation projects but lacks comprehensive assessments and monitoring related to land cover changes and carbon sink capacity. This study aimed to 1) investigate land cover changes in the Banlaem mangrove from 2016 to 2023, and 2) generate a predictive model for future land cover changes. For land cover assessment, we used level 2A satellite imagery from Sentinel-2, applying supervised classification with the maximum likelihood algorithm. Various regression models were analyzed to develop a predictive model based on area size and time. The findings revealed an overall increase in mangrove extent. In 2016, the mangrove area was 427.32 hectares (ha), which expanded to 527.55 ha by 2023, a 1.23-fold increase. Throughout the tested models, the polynomial model shows the highest coefficient of determination with an R-squared of 0.95. These results are expected to foster greater community engagement in the monitoring and management of the Banlaem mangrove. Specifically, we recommend establishing a community monitoring network to involve local residents in tracking mangrove cover changes, supported by training and resources. Additionally, the predictive model offers a valuable tool for forecasting future mangrove changes, which can enhance strategies for carbon management and conservation.

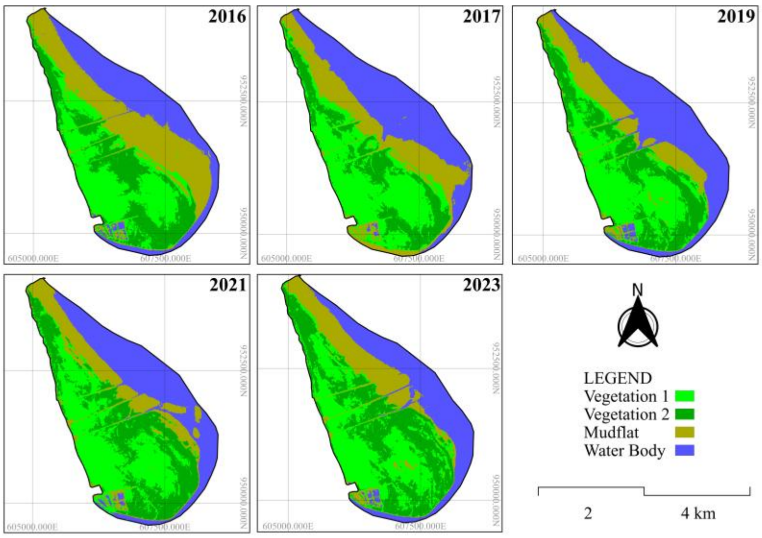


Figure 1.
The land cover changes of the Banlaem mangrove forest from 2016 to 2023, where vegetation type 1 represents *Avicennia marina*, and vegetation type 2 represents a combination of *Avicennia marina* and *Rhizophora* spp.

C-CHEMISTRY (ANALYTICAL CHEMISTRY)

AMINOPHENYLBORONIC ACID FUNCTIONALIZED GOLD NANOPARTICLES FOR SENSING OF MERCURY(II)

Voraluck Soasuab,[1,2] Asmah Kuno,[1,2] Nuryanee Hama,[1,2] Thitima Rujiralai[1,2,*]
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environment Research Unit, Division of Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Mercury (Hg^{2+}) is highly toxic and causes severe problems for human health such as kidney damage, central nervous system impairment, and long-term consequences of Minamata disease. Mercury is introduced into the environment through anthropogenic sources such as industry, mining, and agriculture, leading to mercury accumulation in water, soil, and air. Additionally, mercury is applied in some skin-lightening cosmetics. Thus, human exposure can be from the consumption of mercury-contaminated seafood and use of certain products that contain mercury. This research developed the novel colorimetric detection based on aminophenyl boronic acid functionalized gold nanoparticles (AuNPs@APBA) for Hg^{2+}. The probe specifically binds Hg^{2+} through boronic acid groups of APBA, causing the AuNPs@APBA to aggregate. The red-to-purple colored change is easily visible to the naked eye and can be measured using UV-Visible spectrophotometry. The absorbance ratio at 575 nm and 520 nm was applied to quantify Hg^{2+} concentration. The optimal detection condition used 15 mM of Britton-Robinson buffer (pH 7), with a detection temperature of 80 °C for 20 min. The probe demonstrated a linear response with the equation of $y = 0.0879x + 0.4022$ ($R^2 = 0.9961$) and the limit of detection (LOD) was 0.22 mg/L. Moreover, only Hg^{2+} caused substantial color and spectrum alterations, according to selectivity tests against Cr^{6+}, Cr^{3+}, Zn^{2+}, Al^{3+}, Pb^{2+}, Cu^{2+}, Co^{2+}, Ni^{2+}, Cd^{2+}, Fe^{3+}, and Fe^{2+}.

A PORTABLE SENSOR FOR SIMULTANEOUS DETERMINATION OF CADMIUM AND LEAD BASED ON BIOMASS-DERIVED CARBON COMPOSITES MODIFIED BISMUTH ELECTRODE

Tharinee Sridara,[1,*] Jaroon Junsomboon,[2] Pijika Mool-am-kha,[2] Jaroon Jakmunee,[3] Jantima Upan[4]
[1]Community Technology Division, Department of Science Service, Bangkok, Thailand
[2]Engineering Materials Division, Department of Science Service, Bangkok, Thailand
[3]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[4]Department of Chemistry, Faculty of Science, Mahasarakham University, Maha Sarakham, Thailand
*e-mail: tharinee@dss.go.th

Abstract:
In this work, carbon-based materials prepared from biomass were mixed with carbon black (CB-biomass) and utilized to modify the surface of a screen-printed carbon electrode (SPCE). This modification enhanced the electrode's electrical conductivity and surface area. Additionally, a bismuth film (Bi) was in-situ electrodeposited on the CB-biomass SPCE to improve the sensitivity for the simultaneous determination of cadmium and lead ions using differential pulse voltammetry (DPV). The electrochemical response and the morphology of the developed sensor were characterized using cyclic voltammetry and scanning electron microscopy. The optimum conditions were investigated including amount of CB-biomass, deposition time and potential, and DPV parameters. The developed electrochemical sensor demonstrated high sensitivity and ease of use for the simultaneous determination of trace cadmium and lead. The Bi/CB-biomass/SPCE was further applied to the analysis of real samples, such as glazed ceramic foodware, using acetic acid as the extractant. The results were compared with those obtained from graphite furnace atomic absorption spectrometry (GFAAS).

DETERMINATION OF CANNABIDIOL IN PRODUCT SAMPLES BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY

Palita Phunsap,[1] Patcharee Taenglek,[1] Rapeepat Rungmanee,[1] Suteekan Singyom,[2] Muhammad Niyomdecha,[1] Nichanan Thepsuparungsikul[1,*]
[1]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
[2]Scientific and Technological Equipment Centre, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
*e-mail: tepsuparungsiku_n@su.ac.th

Abstract:
Recently, the use of cannabis has become widespread in various applications, including food, beverages, relaxation aids, cosmetics, and medical treatments. The main active compounds found in cannabis are delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD). This study aims to determine the concentration of CBD in products that claim to contain cannabis, hemp, or CBD, using high-performance liquid chromatography coupled with a diode array detector (HPLC-DAD). The study investigated optimal conditions for analyzing CBD, including the concentration of acetic acid, the ratio of mobile phase solvents, and the flow rate. The results indicated that the optimal conditions were a mobile phase ratio of 80:20 acetonitrile to 0.5%(v/v) acetic acid and a 1.000 mL/min flow rate. The linearity range was between 1.0 and 100.0 ppm, with a Limit of Detection (LOD) of 0.73 ppm and a Limit of Quantification (LOQ) of 1.0 ppm. The %Relative Standard Deviation (%RSD) of the peak area at a concentration of 25.0 ppm ranged from 7.0% to 8.0%, at 50.0 ppm ranged from 0.2% to 0.9%, and at 100.0 ppm ranged from 0.2% to 0.4%. The %Recovery at three concentrations ranged from 80% to 120%. Analysis of 15 samples revealed that two contained CBD at concentrations of 18.8 ppm from acne aqua mask, and 92.6 ppm from hemp full spectrum oil.

DETERMINATION OF IRON, MANGANESE, AND ZINC IN INCENSE SAMPLES BY FLAME-ATOMIC ABSORPTION SPECTROMETRY

Panalee Ngamchomjun,[1] Banyai Sakuldejphaisarn,[1] Wanwisa Prajongtaeng,[1] Suteekan Singyom,[2] Pannaporn Pusomjit,[3] Nichanan Thepsuparungsikul[1,]*
[1]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
[2]Scientific and Technological Equipment Centre, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
[3]Safety Research and Development Section, Regulatory Technical Support Division, Office of Atoms for Peace, Bangkok 10900, Thailand
*e-mail: tepsuparungsiku_n@su.ac.th

Abstract:

In Thailand, incense holds significant cultural and religious importance. This study aims to determine the concentrations of iron, manganese, and zinc in two types of incense samples: incense stick material and incense ash. The study investigates the types and ratios of acids used for sample digestion using a Microwave Digestion System, followed by analysis using Flame Atomic Absorption Spectrometry (Flame-AAS) and comparison with analysis using Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). The results indicate that the optimal conditions for digesting incense samples were a HNO_3: H_2O_2: H_2O ratio of 1:1:2. The linear ranges for iron, manganese, and zinc were 0.3–12.0 ppm. The method's precision was verified by the %RSD for iron, manganese, and zinc, which was less than 10%. The percent recovery of incense stick material ranged from 72-83% for iron, 78-80% for manganese, and 78-100% for zinc. Additionally, the concentrations of these metals in five incense stick samples were as follows: iron at 0.218-6.146 ppm, manganese at 0.314-0.658 ppm, and zinc at 0.018-0.057 ppm, all of which comply with the limits established by the Industrial Product Standard of Thailand for Incense (TIS 2282-2005).

DEVELOPMENT OF A COLORIMETRIC DETECTION FOR ARSENIC(III) BASED ON AN AGGREGATION OF GOLD NANOPARTICLES

Wimonsiri Pongsawadan,[1,2] Saowanit Saithong,[1] Thitima Rujiralai[1,2,*]
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environment Research Unit, Division of Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Arsenic (As) is one of the highly toxic elements which contamination of arsenic can cause acute and chronic health problems including carcinogenicity. Arsenic primarily occurs as inorganic salts in forms of As^{3+} and As^{5+}, with As^{3+} being the most toxic. Exposure to arsenic exceeding WHO's guideline value of 10 μg/L through drinking water endangers people's lives. In the present work, we have developed a novel and simple colorimetric method for the detection of As^{3+} in water samples. The colorimetric sensing is based on the aggregation of citrate capped gold nanoparticles (AuNPs). The color of the solution changes from red to blue based on the concentration of As^{3+}due to the aggregation of AuNPs. The presence of As^{3+} can be detected by observing the color change and measuring the visible absorption spectrum in the wavelength range between 400 and 800 nm. To achieve the highest sensitivity, the concentration of sodium chloride (NaCl) and the reaction time were investigated. The absorbance ratio between 700 nm (aggregation state) and 523 nm (dispersion state) (A_{700}/A_{523}) was used as the optimized response. The results demonstrated that a concentration of 7 mM of NaCl and a reaction time of 15 min were the best conditions. The proposed method provided a linear calibration plot in the range of 10–100 μg/L, with an equation of y = 0.0017x + 0.0976 (R^2 = 0.9963). The limit of detection (LOD) was 7.8 μg/L. Furthermore, the proposed method had high selectivity for As^{3+} compared to studied other ions, *i.e.* Fe^{2+}, Fe^{3+}, Hg^{2+}, Cr^{6+}, Cr^{3+}, Cd^{3+}, Co^{2+}, Ni^{2+}, Al^{3+}, Pb^{2+}, Zn^{2+}, Cu^{2+} and As^{5+},

DEVELOPMENT OF A NOVEL ELECTROCHEMICAL IMMUNOSENSOR FOR DETECTION OF TILAPIA LAKE VIRUS

Kunlanat Boonhuad,[1] Anchalee Namsri,[1] Jutarat Sonjai,[1] Pakin Noppawan,[1]
Eakapol Wangkahart,[2] Jantima Upan[1,]*
[1]Department of Chemistry, Faculty of Science, Mahasarakham university, Maha Sarakham 44150, Thailand
[2]Department of Agricultural Technology, Faculty of Technology, Mahasarakham university, Maha Sarakham 44150, Thailand
*e-mail: Jantima.u@msu.ac.th

Abstract:
The outbreak of Tilapia Lake Virus (TiLV) in tilapia causes significant damage to farmers and affects exports. It has been reported that tilapia infected with TiLV can have a mortality rate of up to 90%. Therefore, early detection of TiLV is crucial. In this work, we proposed a new method for TiLV detection using a lab made screen-printed carbon electrode (SPCE) modified with carbon nanotubes and carbon materials prepared from rice straw. The results showed that the modified electrode had higher electrical conductivity than a bare SPCE. Immunosensor was prepared by immobilizing the modified SPCE surface with TiLV antibody. To detect TiLV, the immunosensor was incubated with TiLV, and the current change was investigated using potassium ferri-ferro cyanide as an electrochemical probe. The morphologies of the modified SPCEs were characterized by scanning electron microscopy. The immunosensor preparation was electrochemically characterized using cyclic voltammetry and electrochemical impedance spectroscopy. As a result, the optimum conditions were an antibody volume of 5 µl, an immobilization time of 45 minutes, and an incubation time of 30 minutes for TiLV. The proposed sensor demonstrated a wide linear range, good stability, and satisfactory reproducibility.

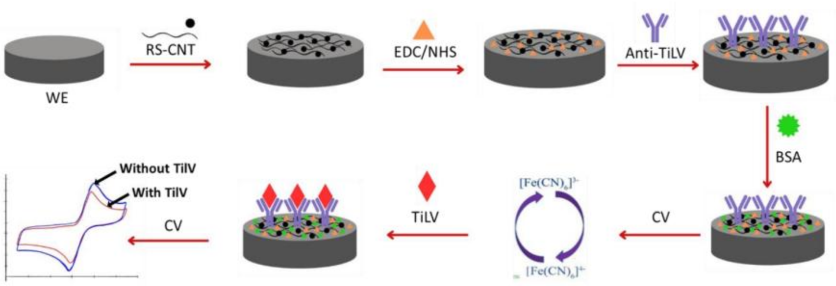


Figure 1.
Fabrication of the electrochemical immunosensor.

DEVELOPMENT OF CHITOSAN MOLECULARLY IMPRINTED POLYMER AS ADSORBENT FOR SELECTIVE EXTRACTION OF QUERCETIN

Rawisara Rakwongthai,[1,2] Thitima Rujiralai[1,2,*]
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science,
Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environmental Research Unit, Division of Science,
Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Quercetin is one of flavonoid groups widely found in fruits, vegetables, leaves, seeds, and grains. Quercetin has attracted considerable attention due to its highly biological activity. Moreover, it is used as an ingredient in dietary supplements, beverages, and food. At present, excessive dosage has not been reported; however, an effective extraction method for quercetin is still required for medicinal or food applications. In this work, we developed the dispersive solid phase extraction (DSPE) for extraction of quercetin coupled with high performance liquid chromatography-diode array detector (HPLC-DAD). Chitosan molecularly imprinted polymer as an adsorbent was applied in conjunction with DSPE for quercetin. An adsorbent was synthesized using chitosan, quercetin as a template, methacrylic acid as a monomer, ethylene glycol dimethacrylate as a cross-linker and azobisisobutyronitrile as a radical initiator. The adsorption of quercetin is due to hydrogen bonding between adsorbent and quercetin. It was found that 20 mg of adsorbent and extraction time of 20 min were the best condition of extraction. The method gave the limit of detection of 0.025 mg/L for quercetin. Furthermore, the linear calibration plot was found to be in the concentration range of 0.025-2.00 mg/L of quercetin, with a coefficient of determination (R^2) of 0.9989.

DEVELOPMENT OF EXTRACTION FOR PARABENS USING MAGNETIC SORBENT BASED ON GRAPHENE OXIDE/C18/ALGINATE

Natthida Keawsanit,[1,2] Thitima Rujiralai[1,2,*]
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environment Research Unit, Division of Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Parabens are esters of *p*-hydroxybenzoic acid and have antimicrobial properties, preventing the effects of oxidation and bacterial contamination. As a result, it is widely used as a preservative in various products, including cosmetics and food. The common parabens used are methyl paraben (MP), ethyl paraben (EP), propyl paraben (PP) and butyl paraben (BP). Furthermore, parabens can enter the body via absorption. Direct paraben exposure can disrupt the human endocrine system and increase the chance of breast cancer. High use of parabens can lead to accumulation in the environment. Therefore, this work aimed to develop magnetic solid phase extraction (MSPE) for extraction of parabens (MP, EP, PP and BP) coupled with high performance liquid chromatography-diode array detection (HPLC-DAD). The MSPE sorbent was prepared by crosslinking sodium alginate, C18, graphene oxide (GO), and magnetic particles in calcium chloride to obtain granular beads (called Mag GO/C18/Alg). Further, the synthesized Mag GO/C18/Alg bead was applied to extract parabens from water samples. The adsorption of parabens was attributed to π-π stacking, hydrogen bonding and hydrophobic interaction. The best extraction conditions, 0.35 g of Mag GO/C18/Alg sorbent, extraction time of 10 min, 650 µL of GO, and acetonitrile as a desorption solvent were achieved. We found the linear calibration plot for MP, EP, PP and BP in the concentration ranges of 0.01-1.0 mg/L, with a coefficient of determination (R^2) greater than 0.9990. The limits of detections for parabens were found to be 0.01 mg/L.

DISPERSIVE LIQUID-LIQUID MICROEXTRACTION BASED ON SOLIDIFICATION OF FLOATING ORGANIC DROP FOR DETERMINATION OF LEAD(II) IN ENVIRONMENTAL SAMPLES BY FLAME ATOMIC ABSORPTION SPECTROMETRY

Sureerat Sangthai, Jakkarin Chomphuphuen, Bophit Khamjanwong, Wannaporn Saenghao, Siriluk Kanthala*
Department of Chemistry, Faculty of Science, Udon Thani Rajabhat University, Udon Thani 41000, Thailand
*e-mail: Sureerat.sang@udru.ac.th

Abstract:

In the present work, a method for Pb(II) determination in groundwater samples was developed by Dispersive liquid-liquid microextraction based on the solidification of floating organic drop (DLLME-SFO) using anthocyanin (extraction from Butterfly pea) as a chelating reagent and detected by Flame atomic absorption spectrometry (FAAS), due to the dispersed liquid phase micro-extraction technique. This method offers several advantages, including simplicity, cost-effectiveness, low solvent usage, and low toxicity. It provides good extraction efficiency, high recovery, and a high enrichment factor. Most importantly, it takes very little time to extract. The experimental conditions were studied and optimized, such as the effect of pH, the volume of the chelating reagent, and the volume of the disperser solvent. Its subsequent analytical signals were studied and optimized. Under optimized experimental conditions, the buffer solution with a pH of 8.00 was prepared from a mixed solution of Citric acid and Disodium Hydrogen Phosphate, and the volume of chelating reagent at 100 μL was prepared from extraction from Butterfly pea by using DI water as a solvent extraction, the volume of the disperser solvent at 45 μL using methanol. Therefore, we used the above conditions to study other conditions that affect the following experiment. Moreover, the concentration of surfactants, salt concentration, extraction time, and temperature are examined in the plans. The successful development of this method could have practical applications in the field of environmental science and analytical chemistry, particularly in the efficient and cost-effective analysis of Pb (II) in groundwater samples.

EFFECT OF VANADIUM ADDITION ON TIN OXIDE GAS SENSOR FOR IMPROVED ACETONE DETECTION

Yurino Yamasaki[1], Yusuke Inomata[2], and Tetsuya Kida[2]*

[1]Graduate School of Science and Technology, Kumamoto University, Kumamoto, 860-8555, Japan

[2]Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, 860-8555, Japan

*e-mail: tetsuya@kumamoto-u.ac.jp

Abstract:

Breath analysis has emerged as a non-invasive diagnostic tool for a variety of diseases, such as lung cancer, diabetes, and asthma. In particular, the detection of volatile organic compounds (VOCs) in exhaled breath has shown great potential as a biomarker for specific diseases. Semiconductor gas sensors using metal oxides are expected to be an ideal means of breath analysis because of their advantages of long-term stability and high sensitivity to low-concentration gases. On the other hand, they require operation at high temperatures and have poor gas selectivity due to the presence of ethanol as an interfering component in the breath. In this study, we investigated the effect of adding vanadium to tin oxide to improve acetone detection performance and to compare the oxidation mechanism, we conducted in situ diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) measurements in the presence of acetone and ethanol.

The V/SnO_2 was prepared by the hot soap method, and the material was applied to an alumina substrate by screen printing. The sensor responses to acetone were investigated from 100 °C to 300 °C. In situ DRIFTS measurements were conducted to investigate the adsorbed species on the sample surface in the presence of ethanol and acetone.

The sensor measurements of SnO_2 and V/SnO_2 (0.5, 1, and 3 mol%) against acetone showed that 1 mol% V/SnO_2 exhibited the largest response value (R_{air}/R_{gas} = 1527) at 150 °C, which was 7 times more sensitive than that of SnO_2. This value was also 1.8 times greater than the sensor response to ethanol (R_{air}/R_{gas} = 830). DRIFT spectra showed peaks derived from acetate species and peaks due to desorption of OH groups, and only 1 mol%V/SnO_2 showed peaks derived from the chemisorption of acetone (Figure 1). Therefore, it is suggested that the addition of vanadium to tin oxide promotes the chemisorption of acetone and increases the sensor response.

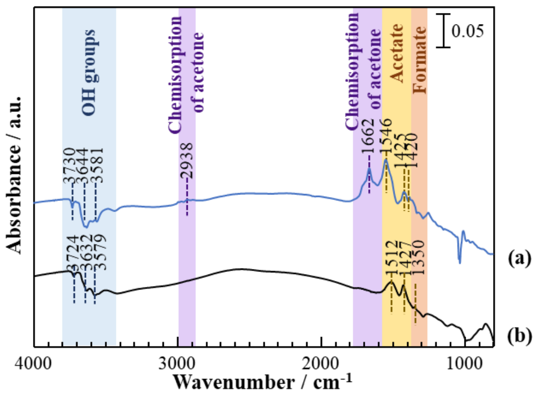


Figure 1. *Operando* DRIFT spectra of (a) 1 mol% V/SnO_2 at 150 °C and (b) SnO_2 at 250 °C during exposure to acetone gas.

EVALUATION OF XANTHINE OXIDASE INHIBITORY ACTIVITY BY ELECTROCHEMICAL SENSOR BASED ON CARBON BLACK AND GRAPHENE OXIDE MODIFIED SCREEN-PRINTED CARBON ELECTRODE

Supada Khonyoung,[1,*] Jiratchaya Moomsalee,[1] Preeyaporn Reanpang,[2] Jaroon Jakmunee[3]

[1]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathumthani, 12120, Thailand
[2]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Lampang, 52190, Thailand
[3]Research Laboratory for Analytical Instrument and Electrochemistry Innovation, Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
*e-mail: ksupa@tu.ac.th

Abstract:
Thai traditional herbal medicines for gout treatment are widely sold in local markets. There has been rapid growth in the medicinal plant product market and a broadening consumer base interested in herbal products from Thailand. In this study, the inhibition for the formation of uric acid by Thai traditional herbals were evaluated by electrochemical method. A simple flow injection amperometric sensor based on carbon black (CB) and graphene oxide (GO) modified screen-printed carbon electrode (SPCE) was developed for detection of uric acid (UA) that is produced from xanthine via the catalysis of xanthine oxidase (XOD). Uric acid is a marker of gout, and a high concentration lead of uric acid can cause gout. Allopurinol was used as a model inhibitor to evaluate the xanthine oxidase inhibitory activity. The proposed method exhibited a good linearity with a correlation coefficient of 0.9710 in a sample concentration range equivalent to allopurinol concentrations of 0 - 50 µM, rapid detection, and low cost for the evaluation of XOD inhibitory activity.

EXTRACTION AND PRECONCENTRATION OF SYNTHETIC PHENOLIC ANTIOXIDANTS FROM WATER BASED ON ALGINATE ADSORBENT

Watcharamon Jaichuen,[1,2] Panwadee Wattanasin[1] and Thitima Rujiralai[1,2,]*
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environment Research Unit, Division of Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Synthetic phenolic antioxidants, *e.g.* butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are preservatives and stabilizers used in lipsticks, moisturizers, cosmetics and food applications. Due to their possible health risks, they are strictly applied by well-defined limits for their usage in food products and pharmaceutical formulations. The U.S. Food and Drug Administration (FDA) has established the maximum permitted quantities of BHA and BHT at 0.02% (w/w) or 200 mg/L, and the CIR expert panel has set the maximum concentration limits in cosmetics for these compounds at 0.5%. In this work, an efficient dispersive solid phase extraction and preconcentration of antioxidants from water samples was developed with analysis of gas chromatography-flame ionization detection (FID). The composite adsorbent prepared by a mixture of sodium alginate, carbon 18 and graphene oxide was used to extract BHA and BHT at concentrations of 0.5 mg/L. Some preliminary parameters, desorption solvent and concentration of sodium alginate were investigated. The best extraction efficiency was achieved with ethyl acetate as desorption solvent and 2% of sodium alginate. The standard calibration curves of antioxidants were linear in the concentration range of 0.02-2.00 mg/L, with a coefficient of determination (R^2) of 0.9992 for BHA and 0.9991 for BHT. The preliminary study demonstrated that synthesized adsorbent can be used for the extraction of antioxidants in water samples. Further studies will be conducted to improve the high extraction efficiency.

FLEXIBLE GOLD MICRONEEDLE LIKE NANO DENDRITES MODIFIED ELECTRODE AS SENSITIVE AND SELECTIVE DETECTION OF NITRITE IN FOOD SAMPLES

Mani Arivazhagan[1] and Jaroon Jakmunee[1,2]*

[1]Research Laboratory for Analytical Instrument and Electrochemistry Innovation, Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200 Thailand

[2]Research Laboratory on Advanced Materials for Sensor and Biosensor Innovation, Materials Science Research Center, and Center of Excellence for Innovation in Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200 Thailand

*e-mail: jaroon.jakmunee@cmu.ac.th

Abstract: Effective detection of nitrite for food preservation is crucial in healthcare and the food industry. Conventional nitrite determination methods are often inaccurate and slow, necessitating sensitive electrochemical sensors based on nanostructured electrode materials [1]. These materials offer high surface-to-volume ratios, catalytic efficiency, and strong adsorption abilities that are beneficial to electrochemical sensors and biosensors [2]. In this work, we developed a novel sensor using gold nanodendrites (Au NDs) on flexible screen-printed carbon electrodes (FSPCEs) for efficient voltammetric and amperometric sensing of nitrite ions in food samples. The Au NDs@FSPCE, created via electrochemical deposition, demonstrated high activity and excellent direct electrocatalytic oxidation towards nitrite. The proposed electrochemical sensor platform offers high accuracy, sensitivity, selectivity, simple fabrication, and low cost. The sensor achieved a limit of detection (LOD) of ~1.0 nM with a high sensitivity of 52.529 $\mu A\ \mu M^{-1}\ cm^{-2}$ and a wide linear concentration range of 20.0 nM to 5.8 µM. The Au NDs@FSPCE-based sensor demonstrated good selectivity against potential interferences and showed high practicability for nitrite sensing in food samples such as tap water, drinking water, milk, and fruit juices.

References:

[1] M. Arivazhagan, B. Mohan, J. Jakmunee, *Green analytical chemistry, **2024***,10, 100127.

[2] M. Arivazhagan, P. Kannan, G. Maduraiveeran. *Biosensors.* 2022, 12 (12), 1128.

FORMALDEHYDE DETERMINATION IN *Hevea brasiliensis* LATEX BASED ON CASEIN/FERRIC CHLORIDE/POLYVINYL ALCOHOL COMPOSITE

Nuryanee Hama,[1,2] Wilairat Cheewasedtham,[2] Thitima Rujiralai[1,2,]*
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
[2]Analytical Chemistry and Environment Research Unit, Division of Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, 94000, Thailand
*e-mail: thitima.r@psu.ac.th

Abstract:
Casein/ferric chloride/polyvinyl alcohol (casein/$FeCl_3$/PVA) composite was used together with a modified Leach test to develop a simple and selective colorimetric detection of formaldehyde in *Hevea brasiliensis* latex. A purple product was formed with a maximum absorbance at 525 nm after formaldehyde reacted with 8% casein/0.1% $FeCl_3$/4.3% HCl prepared in 30% PVA packed in a syringe at 60±5 °C for 45 min. The %magenta value of color detection zone evaluated from RGB application was applied for formaldehyde response. The proposed method achieved a linear calibration plot between %magenta intensity and formaldehyde concentration ranging from 0.04–0.80% with a detection limit of 0.032%. The interday and intraday precisions ranged from 0.67 to 4.94%. The casein/$FeCl_3$/PVA composite was highly selective amongst other latex preservatives including phenol, ammonia and tetramethylthiuram disulfide. Furthermore, the proposed method was successfully applied to determine formaldehyde in ammonia latex samples with satisfactory recoveries of 81.55–99.51% (RSDs less than 5.42%).

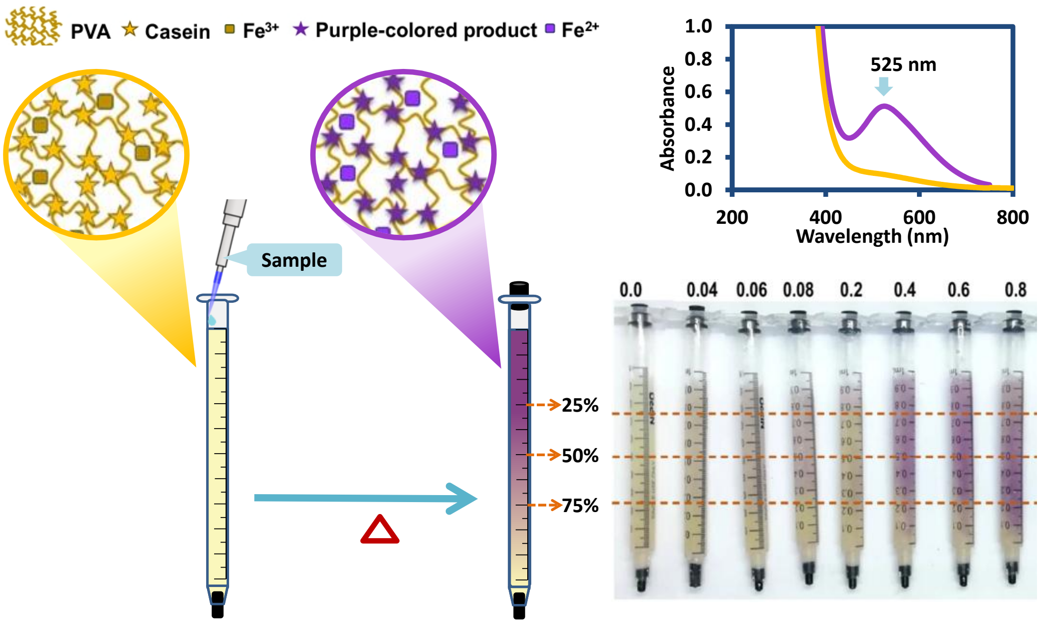


Figure 1.
The schematic of formaldehyde detection in *Hevea brasiliensis* latex.

HYBRID ELECTROCATALYTIC NANOCOMPOSITE BASED ON BIOMASS-NANOCELLULOSE/CARBON BLACK/GOLD NANOPARTICLES FOR A PORTABLE ELECTROCHEMICAL SENSOR TOWARD DETERMINATION OF CHROMIUM(VI) IN CONSTRUCTION PRODUCT

Pijika Mool-am-kha,[1,*] Tharinee Sridara,[2] Jaroon Jakmunee,[3] Jaroon Junsomboon[2]

[1]Engineering Materials Division, Department of Science Service, Bangkok, Thailand
[2]Community Technology Division, Department of Science Service, Bangkok, Thailand
[3]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
*e-mail: Pijika@dss.go.th, Pijika.m@hotmail.com

Abstract:

Hybrid electrocatalytic nanocomposite from a green nanomaterial (nanocellulose, NC), carbon black (CB) and gold nanoparticles (AuNPs) was modified onto a screen-printed carbon electrode (SPCE) for a portable electrochemical sensor of the determination of chromium(VI). Biomass-derived carbon as NC is an axial modulus rearrangement and presents OH groups that increase electrode conductivity and provide more binding sites for different analytes. CB was inexpensive, simply synthesized, and had a sphere shape that can increase the homogeneity of composite and electrode surface area. In addition, these carbon composites were mixed with AuNPs that provide to implement highly sensitive detection of Cr(VI). The NC-CB/AuNPs nanocomposites were modified on the working electrode surface to increase electrode conductivity and enhance the sensitivity of Cr(VI) determination. The structural, morphological, and electrochemical properties of the as-synthesized/fabricated materials and electrodes were thoroughly analyzed through appropriate instrumentations (scanning/transmission electron microscopy, cyclic voltammetry, X-ray photoelectron spectroscopy, etc.). The developed portable electrochemical sensor has a low detection limit, dynamic range, good reproducibility, and stability sensitivity and can be applied to the analysis of real samples, such as construction products.

MECHANISTIC INVESTIGATION OF THE ACETONE DETECTION WITH Pt-ZnO SENSOR USING DRIFT SPECTROSCOPY

Yuto Ohata,[1] Yusuke Inomata[2], Tetsuya Kida[2],
[1]Department of Materials Science and Applied Chemistry, Kumamoto University
[2]Faculty of Advanced Science and Technology, Kumamoto University
Kumamoto, 860-8555, Japan
*Tetsuya@kumamoto-u.ac.jp

Abstract:

ZnO, known for its wide band gap, strong exciton binding energy, and high electron mobility, is utilized in many devices, with a low detection limit for acetone, enabling the detection of trace amounts. Acetone detection using ZnO sensors is significant in numerous applications in various fields. This study aims to investigate the combustion mechanism of acetone on ZnO crystals using in-situ Diffuse Reflectance Infrared Fourier Transform Spectroscopy (DRIFTS) and to measure the decomposition products of acetone using online FTIR gas cell measurements.

ZnO and Pt-loaded ZnO crystals were synthesized using the hot soap method. The amount of Pt was varied to check the activity, resulting in different doping concentrations of 0.1wt%, 1wt%, and 5wt%. Gas sensor elements were fabricated by depositing the synthesized samples onto alumina substrates with gold comb electrodes, followed by heating at 450°C for 30 minutes. The X-ray diffraction (XRD) patterns of all samples were consistent with the theoretical pattern of cubic ZnO, with an additional peak attributed to cubic Pt observed around 40° in 5wt% Pt/ZnO. Transmission Electron Microscopy (TEM) images indicated average particle sizes of 12.5 nm for ZnO, 24.6 nm for 0.1wt%Pt/ZnO, 27.1 nm for 1wt%Pt/ZnO, and 48.4 nm for 5wt%Pt/ZnO suggesting enhanced crystal growth of ZnO nanocrystals in the presence of a significant amount of Pt precursor.

The sensor sensitivity was calculated by measuring the electrical resistance at 250°C~400°C in a dry atmosphere. ZnO loaded with 0.1 wt% Pt showed the highest sensitivity to acetone and ethanol at 350 and 400°C in a dry atmosphere, as shown in Fig 1.

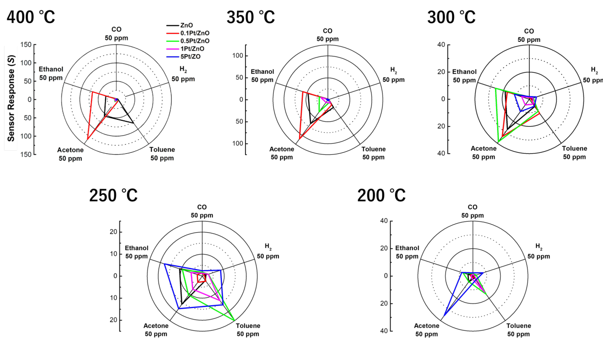


Figure 1. Sensor response to five different test gases under dry atmosphere at various Temperatures

This study provides insights into the enhanced sensitivity and catalytic behavior of Pt-loaded ZnO sensors, highlighting their potential for detecting low acetone concentrations in various applications.

MINIATURIZED COLORIMETER BASED ON A PAIR OF LED DEVICES: APPLICATION TO SEQUENTIAL INJECTION ANALYSIS OF COPPER ION WITH A NATURAL REAGENT

Petcharat Sirisakwisut[1], Nutnicha Janthon[1], Benjaporn Theerawutthisart[1], Jitnapa Sirirak[1], Apisake Hongwitayakorn[2], Sumonmarn Chaneam[1,3]*
[1]Silpakorn University, Faculty of Science, Department of Chemistry, Nakhon Pathom, Thailand
[2]Silpakorn University, Faculty of Science, Department of Computing, Nakhon Pathom, Thailand
[3]Flow Innovation Research for Science and Technology Laboratories (FIRST Labs), Bangkok, Thailand
*e-mail: chaneam_s@su.ac.th

Abstract:
A UV-Visible spectrophotometer is commonly employed as a detector in analytical chemistry; however, it has some limitations, such as its large benchtop size, high cost of the instrument and maintenance, and difficulty in adaptation or redesign. In this work, a colorimeter, comprising a pair of light emitting diodes (LED), one for light emission and the other for light detection, has been constructed and used as a detection device. A constant voltage of 5.0 V was applied to the emitter LED using a power supply, with a 100 Ω resistor as a current-limiting load. A digital multimeter was used to monitor the output from the detector LED. The detected signal is directly proportional to the analytical concentration of a solution. Here, the miniaturized colorimeter was combined with a sequential injection analysis (SIA) in order to potentially determine copper ion. This method was investigated by measuring the color of the anthocyanin-copper complex using the laboratory-made colorimeter. For the SIA on-line measurement, the effect of LED color and physical parameters including zone sequence, reagent volume, and flow rate to detector, were investigated. Under optimal conditions, the proposed method is acceptable for copper content analysis with a rapid sample throughput of 42 samples per hour, a limit of detection (LOD) 87.0 µM, and a relative standard deviation (%RSD) of 1.31% within a linear range of 100 – 3000 µM. Moreover, orchid reagent is cheap, easily obtainable, and safe making it a green reagent. Finally, the amount of copper in dietary supplement and surface water was determined using our method and the results were compared with those obtained using standard flame atomic absorption spectroscopy (flame-AAS).

PAPER-BASED ANALYTICAL DEVICE FOR MONITORING MINOR MARKERS OF KIDNEY STONES

Manassawee Janrod, Monpichar Srisa-Art*
Electrochemistry and Optical Spectroscopy Center of Excellence, Department of Chemistry, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok, 10330, Thailand
*e-mail: monpichar.s@chula.ac.th

Abstract:
A microfluidic paper-based analytical device (µPAD) coupled with colorimetric detection was developed for simultaneous detection of minor biomarkers (Ca^{2+}, Mg^{2+} and PO_4^{3-}) of kidney stones. Reactions used for each analyte detection were based on chemical reactions. Murexide and xylidyl blue were used to complex with Ca^{2+} and Mg^{2+}, respectively, resulting in the color change. Ammonium molybdate potassium antimony (III) tartrate (the molybdenum blue method) was employed to react with PO_4^{3-}, resulting in the formation of antimony-phosphomolybdate complex, which is a blue color. Linearities for Ca^{2+}, Mg^{2+} and PO_4^{3-} detections were in the concentration ranges of 5-180, 5-50, and 5-80 mg L^{-1}, with the detection limits of 10.2, 5.2, and 13.1 mg L^{-1}, respectively. The developed µPAD holds a great promise to be a simple, inexpensive, low-sample and reagent volume, reliable and portable tool for simultaneous detection of minor biomarkers of kidney stones in urine samples. Information obtained from the individual determination of minor biomarkers could be used as supporting information to refine the diagnosis of the stone type which exhibits the daily habits and diets of the patients. These are very important for assessing the risk of kidney stone formation, medical treatment, and prevention of kidney stones.

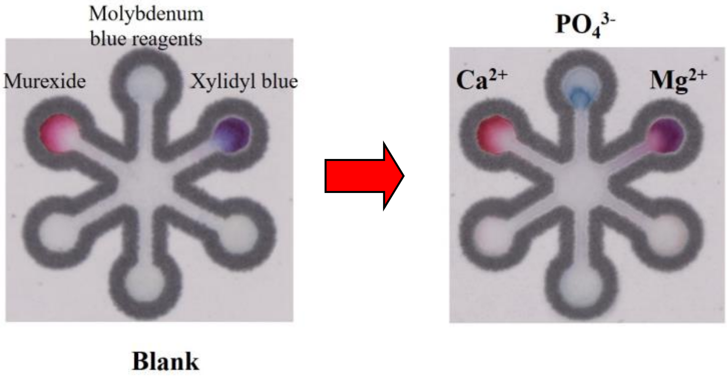


Figure 1. A microfluidic paper-based analytical device coupled with colourimetry for simultaneous determination of minor biomarkers (Ca^{2+}, Mg^{2+} and PO_4^{3-}) of kidney stone.

QUANTIFICATION OF SODIUM DITHIONITE IN BEAN SPROUTS FROM MARKETS LOCATED IN PHNOM PENH, CAMBODIA

Linheng Pek, Seihakpanha Makara, Seakleang Soknea, Seavmean Phally, Tha Chea Buthra Chao, Bunrong Phal, Sreynich Chhun*
Department of Science Research, Faculty of Health Science and Biotechnology, University of Puthisastra, Phnom Penh, 12211, Cambodia
*e-mail: csreynich@puthisastra.edu.kh

Abstract:
Bean sprout (*Vigna radiata*) is a type of vegetable that provides significant sources of nutrition, but it can be damaged and rotten. To prevent this, a chemical substance, sodium dithionite is added. However, this chemical is toxic to human health, especially to the metabolism and digestive system. This study aimed to determine sodium dithionite contents in bean sprouts, from three different markets located in Phnom Penh, Cambodia namely, Daeum Kor, Chouk Meas, and Toul Kork markets. Two different conditions, unrinsed and rinsed, bean sprouts were analyzed using the UV spectrophotometry and Naphthol Yellow S as reagent, where the absorbance of sodium dithionite was detected at 504 nm. The result shows that sodium dithionite contained in unrinsed was higher than in rinsed bean sprouts, with a concentration range of 3.713-3.056 mg/kg, and 3.206-2.906 mg/kg, respectively. The sodium dithionite concentrations of these two conditions were significantly different ($p < 0.05$). Therefore, sodium dithionite contents found in unrinsed and rinsed conditions were lower than FSANZ (Food Standard Australian New Zealand) which is 10 mg/kg ($p < 0.05$). A good linearity was obtained for sodium dithionite detection between concentrations of 50.0-250.0 mg/L, R^2 = 0.9916, and limit of detection (LOD) = 0.338 mg/L. Samples were spiked with sodium dithionite at levels of 150.0 and 200.0 mg/L which was used to validate the method. The recovery percentage value was between 91.708-95.667% and the relative standard deviation (%RSD) was less than 5%, which demonstrated the good accuracy and precision of the method. In conclusion, the presence of sodium dithionite in vegetables, and other foods should be properly investigated, and monitored to ensure the safe level of this chemical.

SAMPLE PREPARATION-FREE COLORIMETRIC DEVICE FOR SALIVARY ETHANOL AND TETRAHYDROCANNABINOL DETECTION USING A CAPILLARY-DRIVEN MICROFLUIDIC INTEGRATED WITH A PAPER-BASED DEVICE

Chawin Srisomwat,[1,*] Nattawat Bawornnithichaiyakul ,[1] Orawon Chailapakul[2]
[1]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani, Thailand
[2]Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
*e-mail: chawinsr@tu.ac.th

Abstract:

A capillary-driven microfluidic device has been widely used for the sensing application since it can improve the flow rate of the solution, which makes it possible for rapid analysis. In this work, we proposed a capillary-driven microfluidic integrated with a paper-based device, or µCD-PAD for salivary detection. The flow behavior of a synthetic saliva solution with varying viscosity on the proposed device was studied. The results demonstrated that a capillary-driven microfluidic device could minimize the viscosity effect of saliva solution, enabling all the saliva solution to flow seamlessly to the detection zone without the need for a sample preparation step. Also, we applied the proposed device for colorimetric detection of ethanol and tetrahydrocannabinol, providing a comprehensive screening tool for alcohol and cannabis exposure. Ethanol and tetrahydrocannabinol (THC) are particularly interesting due to their widespread use and potential societal implications. Hence, the µCD-PAD with two detection zones was designed for simultaneous detection of ethanol and THC. After the sample (125 µL) was loaded and waited for 30 min, the color change onto the detection zone was observed using potassium dichromate and fast blue B salt as colorimetric reagents for ethanol and THC, respectively. The color intensity was analyzed using a smartphone camera. A linear range of ethanol and THC was established between 0.1–5% v/v and 0.1–10 ppm, respectively. Also, the detection limits of 0.08% v/v (ethanol) and 0.06 ppm (THC) were achieved. With the performance of the sensing platform, this innovative device holds great promise for roadside testing application.

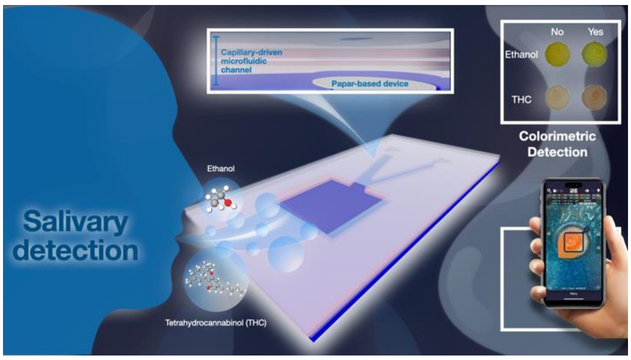


Figure 1. Conceptual idea of the µCD-PAD for salivary detection

SELECTING *Camellia sinensis* UTILIZING CHEMICAL PROFILE DATA

Kanchana Watla-iad,[1,2,*] Jitlada Pongphattranit,[1] Somrudee Nilthong,[1] Rungrote Nilthong[1]
[1]School of Science, Mae Fah Luang University, Thailand
[2]Center of Chemical Innovation for Sustainability (CIS), Mae Fah Luang University, Thailand
*e-mail: Kanchana.wat@mfu.ac.th

Abstract:
Camellia sinensis leaf extract, rich in bioactive compounds like catechins, caffeine, and L-theanine, is renowned for its health benefits. The bioactive chemical composition must be identified to select the potential cultivars for future cultivation. In this study, antioxidant activity, total phenolic content, and total flavonoid content were compared among *Camellia sinensis* extracts from various countries cultivated in Singha Park, Chiang Rai, Thailand, for variety selection. Thirty-four samples of *Camelia sinensis* leaves originating from China (7 samples), Japan (12 samples), and Taiwan (15 samples) were collected and extracted using the supercritical fluid extraction (SFE) method. Ethanol was used as a co-solvent in a 2:40 ratio with the dried tea leaves, at a pressure of 30 MPa and 48 °C. The extraction solution was evaporated before extraction yield analysis. The Folin-Ciocalteu assay is a method for determining total phenolic content. The absorbance was measured at 765 nm using a spectrophotometer. The 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical assay is the method used to evaluate the antioxidant activity of compounds or extracts. Absorbance was measured at 517 nm using a spectrophotometer. It was found that China Mingxuan 311 had the highest yield at 9.82 %w/w, while China Zhenong 117 had the lowest at 2.41 %w/w. The highest antioxidant activity (12.58 mg ascorbic acid equivalent AAE/g dried sample) was found in the Japan 08-00108 sample. Tea leaf samples from Japan and Taiwan exhibited significantly higher antioxidant activity compared to those from China at a 95% confidence level. The Taiwan sample exhibited the highest total flavonoid content with 12.04 mg catechin equivalent CE/g sample, while some China samples had the highest phenolic content at 3.26 mg gallic acid equivalent/g sample. Tea from Japan and Taiwan had higher antioxidant activity and flavonoid content compared to Chinese tea. Taiwanese tea had the highest phenolic content compared to Chinese and Japanese tea, which had similar levels. Based on these findings, the study recommends tea from Taiwan and Japan for further variety selection.

SUSTAINABLE SYNTHESIS OF NITROGEN-DOPED CARBON DOTS FOR FORMALIN DETECTION AND HYDROCHAR FOR DYE REMOVAL FROM CASSAVA WASTE

Nirinthana Ungudonpakdee,[1]Rawisara Chokdeepanich,[1] Suranan Anantachaisilp,[1,*]
Kanokorn Wechakorn[2,*]
[1]Kamnoetvidya Science Academy, Rayong, Thailand
[2]Department of Chemistry, Faculty of Science and Technology, Rajamangala University of Technology Thanyaburi, Pathum Thani, Thailand
*e-mail: suranan.a@kvis.ac.th, kanokorn_w@rmutt.ac.th

Abstract:
Cassava or *Manihot esculenta* is an agricultural plant produced in a high amount due to its consumption rate. Its high demands lead to excessive waste from inedible parts, such as the pulps, to be left out after processing. Such waste can disturb its surroundings and pollute the environment if not properly taken care of. Advantageously, cassava pulps are rich in carbon, with over 56% of their composition being starch. In this research, cassava pulp was utilized as a precursor for a zero-waste synthesis of nitrogen-doped carbon dots (N-CDs) and hydrochar (HC) via a hydrothermal carbonization method. The N-CDs were applied as a formalin-detecting sensor via a small-scale silver mirror reaction, while the black residue of HC was further studied to be used as an adsorbent for organic dyes in aqueous solutions. The N-CD sensor showed high sensitivity and selectivity towards formalin with the limit of detection of 96.5 and 83.6 µg/L for UV-Vis and Fluorescence spectroscopy, accordingly. Additionally, HC showed excellent adsorption abilities towards methylene blue (MB), methyl violet (MV) and crystal violet (CV) with the maximum adsorption capacity at 96.5, 99.7 and 99.8%, accordingly, entering equilibrium within 10 minutes. The reusability of HC was studied, showing the ability to adsorb dyes above 50% after 9 cycles of reusing. The mechanisms of formalin detection and dye adsorption were investigated as well.

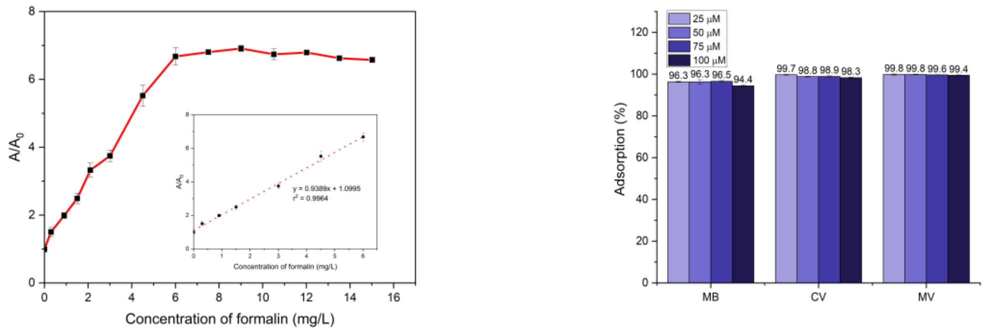


Figure 1.
The correlation between absorbance value and formalin concentration of N-CDs (left) and the adsorption capacity of HC towards MB, CV and MV (right)

ULTRASENSITIVE FLUORESCENCE PROBE BASED ON MOLECULARLY IMPRINTED POLYMER COMPOSITED WITH CARBON DOTS FOR THE DETERMINATION OF ANTIBIOTIC

Nanthicha Chodchoy,[1] Opas Bunkoed[1]*
[1]Center of Excellence for Innovation in Chemistry and Division of Physical Science, Faculty of Science, Prince of Songkla University, Songkhla, 90110, Thailand
*e-mail: opas.b@psu.ac.th

Abstract:
A sensitive and rapid detection of antibiotic residues in food is essential for safeguarding human health. A fluorescence sensor based on nitrogen dope graphene quantum dots incorporated into molecularly imprinted polymer (N-GQDs@MIP) was developed for the determination of piperacillin (PIP). The analysis was performed by measuring the fluorescence quenching of the nanocomposite probe when the target analyte rebinds with the specific recognition sites. Under optimal conditions, the fluorescence sensor demonstrated a good linearity in the range of 0.10 to 20.0 μg L^{-1}, with a low limit of detection (LOD) of 0.10 μg L^{-1}. The nanocomposite probe exhibited high specificity, with an imprinting factor of 3.48. Moreover, the fluorescence sensor achieved satisfactory recoveries in the range of 90.4 to 99.3% with RSD less than 5%. The analysis results of real sample were also agreed well with the results obtained using a chromatographic method, but the developed method offers lower cost, higher sensitivity and a faster determination process. Additionally, a portable device based on smartphone-integrated N-GQDs@MIP was utilized for on-site detection of piperacillin, providing a distinct color change for easy identification of piperacillin.

C-CHEMISTRY (INORGANIC CHEMISTRY)

EVALUATION OF EtOH GAS DETECTION CHARACTORISTICS OF SnO_2 AND Pt-SnO_2

Shotaro Kubo[1], Keigo Masumoto[2], Yusuke Inomata[3], Tetsuya Kida[3*],
[1]Department of Materials Science and applied chemistry, Kumamoto University,
[2]Graduate School of science and Technology, Kumamoto University,
[3]Faculty of Advanced science and technology, Kumamoto University
Kumamoto, 860-8555, Japan
*Tetsuya@kumamoto-u.ac.jp

Abstract:

Currently, airborne particulate matter and photochemical oxides are known to have adverse effects on the human body. A typical example of these are volatile organic compounds (VOCs). Semiconductor metal oxide (SMOx) is used as a gas sensor to detect these gases. Metal oxide gas sensors have the advantages of high stability and sensitivity, long life, and low cost, but they have the disadvantages of high operating temperatures, fire and gas explosion hazards, and a tendency to degrade due to sintering effects. In this study, we aim to achieve low-temperature operation and high sensitivity in EtOH gas detection by doping Pt to SnO_2, a typical material for semiconductor gas sensors.

SnO_2 and Pt-SnO_2 (1 wt%, 5 wt%, and 10 wt%) were prepared by the hot soap method. The prepared metal oxides were characterized by XRD and scanning transmission electron microscopy (STEM) measurements. Sensor response values for 25 ppm EtOH gas at each measurement temperature are shown (Figure 1a). The results show that the addition of 5 and 10 wt% Pt shifts the maximum response value of SnO_2 to EtOH to lower temperatures. At low temperatures (<150°C), Pt-SnO_2 showed a high response value to 25 ppm EtOH gas, suggesting that the addition of Pt enhances the EtOH gas response of SnO_2 at low temperatures. In addition, the *operando* DRIFT spectrum after 15 minutes of 25 ppm EtOH ventilation at 200°C confirmed the formation of acetate and carbonate species derived from the EtOH partial oxidation reaction on the Pt-SnO_2 surface (Figure 1b). These peaks were not observed for SnO_2, indicating that the EtOH surface reaction was activated by the addition of Pt.

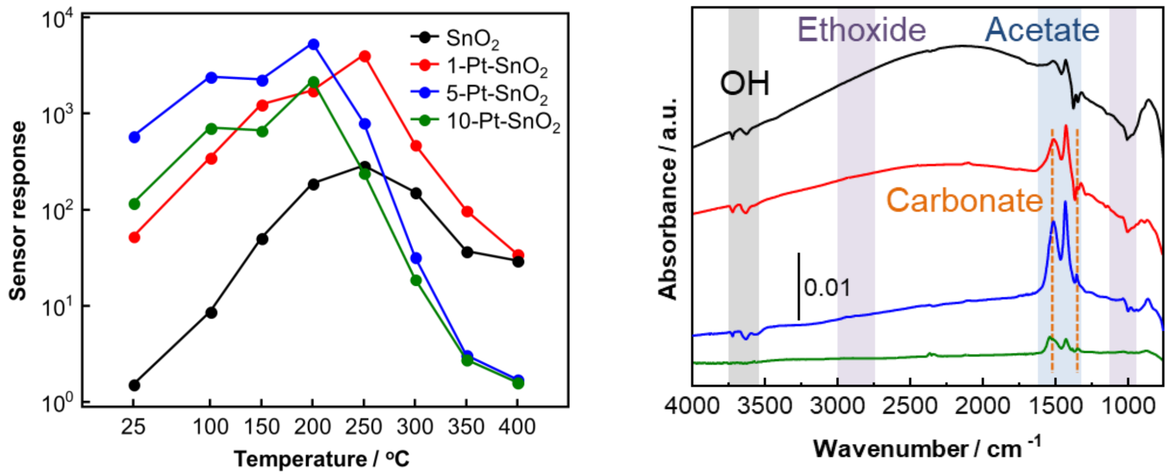


Figure 1. (a) Sensor response values of Pt-SnO_2 to 5 ppm EtOH gas. (b)*Operando* DRIFT spectra of SnO_2 and Pt-SnO_2 (1,5,10 wt%).

FORMATION OF COBALT (II) COMPLEX N4S2 COORDINATES WITH SCHIFF BASE TYPE LIGAND AND ITS IMPREGNATED MCM 41 MATERIALS AS THE CATALYSTS FOR DEGRADATION OF METHYLENE BLUE DYE

Manikandan Palaniappan [1], Manogaran Tamiliniyaa[1], Arumugam Selvi[1], Rajavel Rangappan [1],*

[1]Department of Chemistry, Bio-Inorganic Lab, Periyar University, Salem 636 011,

Tamil Nadu, India.
*e-mail: drrajavel@periyaruniversity.ac.in

Abstract:

Water pollution, a pressing global issue caused by hazardous organic and inorganic pollutants, seriously threatens human health and development. The urgent need for effective remediation methods is underscored by their detrimental effects on social, economic, and health aspects of life and aquatic and marine life forms. This study introduces a novel Schiff base cobalt (II) mobile composite matter 41 heterojunction (MCM41@ AQSMDTC@Co(II) complex) and its application in the photocatalytic breakdown of methylene blue (MB). Various contemporary physical techniques have been employed to characterize the photocatalyst, and this paper discusses the rationale behind their beneficial intervention. The functional, structural, morphological, and optical properties were studied using FTIR, XRD, FE-SEM, EDX Analysis, HR-TEM, UV–visible/UV-Drs absorption, and XPS Analysis. Testing the photocatalytic abilities of MCM 41 and MCM41@AQSMDTC@Co(II) complex by degrading MB under natural sunlight demonstrated a rapid degradation rate with the MCM41@AQSMDTC@Co(II) complex on MCM 41. The best performance was achieved with a 10 mg concentration of MCM41@AQSMDTC@Co(II) complex, displaying an impressive efficiency of up to 92% within 2 hours, surpassing the other concentrations. This work highlights the enormous potential of photo-catalytic activity-based Schiff base materials as a platform for sunlight catalysts, paving the way for the future design and functionalization of related materials.

LIGHT ENERGY STORAGE USING $CsPbBr_3$ NANOCRYSTALS COUPPLED WITH POLYOXOMETALATES FOR PHOTOCAPACITOR DEVICES

Kona Sumi,[1] Gimpei Yoshimura,[1] Yuji Akaishi,[2] Yusuke Inomata,[3] Tetsuya Kida[3*]
[1] Department of Materials Science and Applied Chemistry, Kumamoto University, Japan
[2] Institute of Industrial Nanomaterials, Kumamoto University, Japan
[3] Faculty of Advanced Science and Technology, Kumamoto University, Japan
*tetsuya@kumamoto-u.ac.jp

Abstract:

Solar cells convert light energy into electrical energy but cannot store it. This study aims to develop photoelectrochemical capacitors that can store electrical energy using polyoxometalates (POMs), which are known for their excellent reversible redox activity and stability in the reduced state. Despite their potential, POMs have a wide band gap, which limits their photoelectrochemical applications. To overcome this limitation, we have used perovskite $CsPbBr_3$ nanocrystals (NCs) as photosensitizers due to their strong absorption in the visible light region. When visible light irradiates these NCs, it excites electrons, that are subsequently transferred to the POMs, thereby charging them. Furthermore, when connected to an external circuit, the stored electrons are transferred and discharged.

In this study, we demonstrate a visible-light-driven photoelectrochemical capacitor using $CsPbBr_3$ NCs and POMs. Decatungstate $[W_{10}O_{32}]^{4-}$ as the POM was hybridized with tetra-n-butylammonium cations to solubilize it in organic solvents. Then, $CsPbBr_3$ NCs were synthesized by hot-injection method and covered with TiO_2 layer to improve durability. These materials were then dispersed in acetonitrile, and the change in absorbance of tetra-n-butylammonium decatungstate (TBADT) under visible light irradiation ($\lambda \geq 422$ nm) was evaluated from UV-vis absorption spectra. The absorption band at 500–800 nm gradually increased upon visible-light irradiation, indicating that TBADT was photoreduced by the $CsPbBr_3/TiO_2$ NCs (**Figure 1**). Finally, we demonstrated that the system could store and discharge electrical energy, with $TBADT^-$ storing electrons that were extracted as an electrical current using TEMPO in a photoelectrochemical cell.

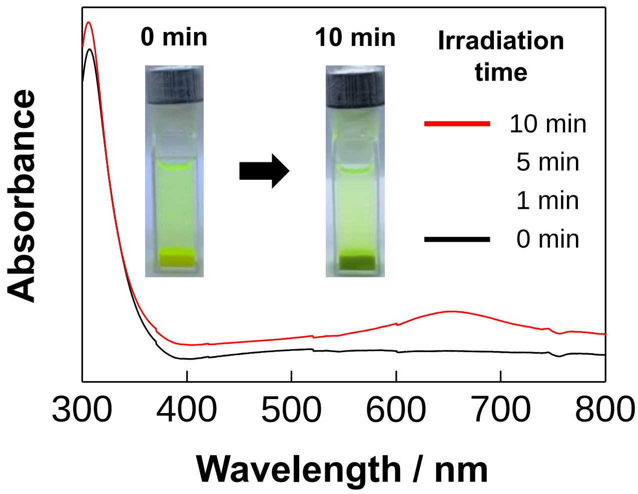


Figure 1. UV-vis. absorption spectra of $CsPbBr_3/TiO_2$ NCs in acetonitrile under the visible light irradiation ($\lambda \geq 422$ nm). The system was purged with Ar gas before measurements. The inset shows photographs of the solution before and after the visible light irradiation.

PHOTOLUMINESCENCE CONTROL OF $CsPbX_3$ QUANTUM DOTS COUPLED WITH PHOTOCHROMIC MOLECULES; MECHANISTIC STUDY BY ULTRAFAST TIME-RESOLVED ABSORPTION SPECTROSCOPY

Yuki Suenari,[1] Yuji Akaishi,[2] Ashkan Mokhtar,[1] Yusuke Inomata,[3] Daisuke Kosumi,[2] Tuyoshi Fukaminato,[3] Tetsuya Kida[3,] *
[1] Graduate School of Science and Technology, Kumamoto University, Japan
[2] Institute of Industrial Nanomaterials, Kumamoto University, Japan
[3] Faculty of Advanced Science and Technology, Kumamoto University, Japan
*tetsuya@kumamoto-u.ac.jp

Abstract:

$CsPbX_3$ (X=Cl, Br, or I) quantum dots (QDs) have attracted much attention as new luminescent materials due to their strong photoluminescence (PL) with high quantum efficiency. Recently, we discovered that the PL intensity of these QDs can be photo-reversibly switched by mixing diarylethene, a photochromic molecule, with a dispersion of $CsPbBr_3$ QDs. Femtosecond pump-probe spectroscopy measurements revealed that the PL quenching mechanisms involved photoinduced electron transfer (PET) and Förster resonance energy transfer (FRET). PET generates strong oxidative holes inside the quantum dots, leading to their degradation, which is unfavorable for stable fluorescence switching (Y. Akaishi et al., Small. 2022, 18, 2205046). Therefore, switching based on pure FRET is desirable for stable PL switching over long cycles. In this study, we synthesized $CsPbX_3$ QDs with a tuned band gap to prevent PET generation and adsorbed diarylethene ligands to investigated their PL switching properties. The mechanism was analyzed using femtosecond pump and probe spectroscopy measurements.

$CsPbX_3$ QDs were synthesized using the hot injection method and dispersed in toluene. These dispersions were mixed with a predetermined amount of diarylethene ligands, and the resulting mixture was alternately irradiated with 365 nm UV light and visible light (white LED). The PL spectra after light irradiation were measured over multiple cycles to track changes in PL intensity. Our results showed that the red-emitting $CsPbI_3$ QDs/diarylethene solutions exhibited promising PL switching properties. Figure 1 demonstrates the change in PL intensity when $CsPbI_3$ QDs/diarylethene solution was alternately irradiated with UV/visible light. ON/OFF switching of PL intensity was observed with alternating UV/visible light irradiation, achieving a quenching efficiency approximately 90%. Moreover, stable ON/OFF PL switching behavior was maintained throughout 10 cycles. Femtosecond pump-probe spectroscopy measurements confirmed that this quenching was caused by FRET rather than PET ensuring stable PL switching overextended cycles.

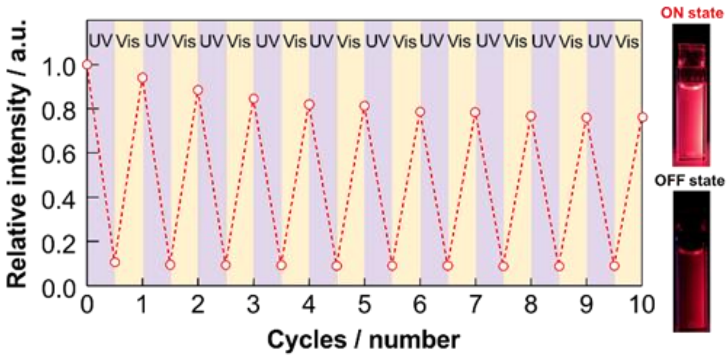


Figure 1. Changes in the PL intensity for the $CsPbI_3$ QDs/diarylethene solution irradiated with alternating UV/visible light.

SELECTIVE COUPLING OF $CsPbBr_3$ QUANTUM DOTS AND CdS NANORODS BY CLICK REACTION

Fuko Shiga,[1] Yuji Akaishi,[2] Yusuke Inomata,[3] Tsuyoshi Fukaminato, [3] Tetsuya Kida[3,*]
[1]Graduate School of Science and Technology, Kumamoto University, Japan
[2] Institute of Industrial Nanomaterials, Kumamoto University, Japan
[3] Faculty of Advanced Science and Technology, Kumamoto University, Japan
*e-mail: tetsuya@kumamoto-u.ac.jp

Abstract:

Three-dimensional structures in which individual quantum dots (QDs) are regularly arranged and organized are called quantum dot superlattices. These structures have gained significant interest due to their unique properties, which differ from those of isolated QDs. This study focused on $CsPbX_3$ (X = Cl, Br, or I) QDs, known for their high wavelength-tunability, luminescence efficiency, and narrow emission half-width. We aimed to create novel electrical and optical properties by constructing superlattices combined with heterogeneous metallic nanomaterials. The formation of strong bonds between quantum dots and hetero-metallic nanomaterials is crucial for constructing quantum dots superlattices. One promising bonding technique is the formation of strong triazole rings via the click reaction, a cycloaddition reaction between an azide and an alkyne. The reaction is highly reactive and selective and proceeds irreversibly. In this study, we coupled CdS nanorods (NRs) with $CsPbBr_3$ QDs using the click reaction.

We used 4-azidobenzoic acid with terminal azide groups and 3,5-diethynylbenzoic acid with terminal alkynyl groups as azido and alkyne ligands. $CsPbBr_3$ QDs and CdS NRs were synthesized by hot injection method. Azide and alkyne ligands were introduced into the materials by a solution process ligand exchange method, providing reaction points on the surface of the materials. The complexation of $CsPbBr_3$ QDs with CdS NRs incorporating these terminal reaction points was achieved by click reaction under copper catalyst.

The introduction of azide and alkyne ligands into the QDs and NRs surfaces was confirmed by FT-IR measurements. Furthermore, the XRD patterns and TEM images indicated no significant change in the structure of QDs and NRs after ligand exchange and click reaction. Figure. 1 shows the TEM images of the $CsPbBr_3$ QDs/CdS NRs mixture before and after the click reaction. After the click reaction, the results reveal multiple $CsPbBr_3$ QDs are bonded to the surface of CdS NRs, suggesting that 1,2,3-triazoles effectively link QDs and NRs, and that the click reaction successfully brings QDs and NRs into close proximity.

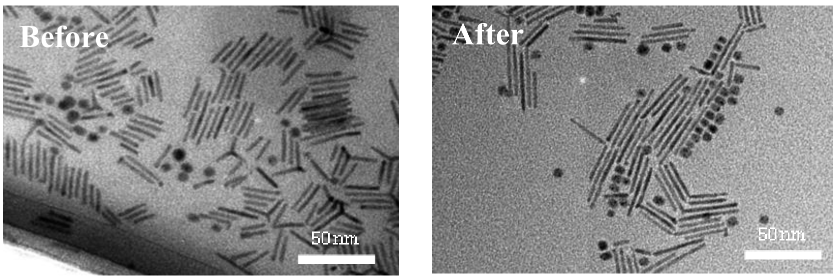


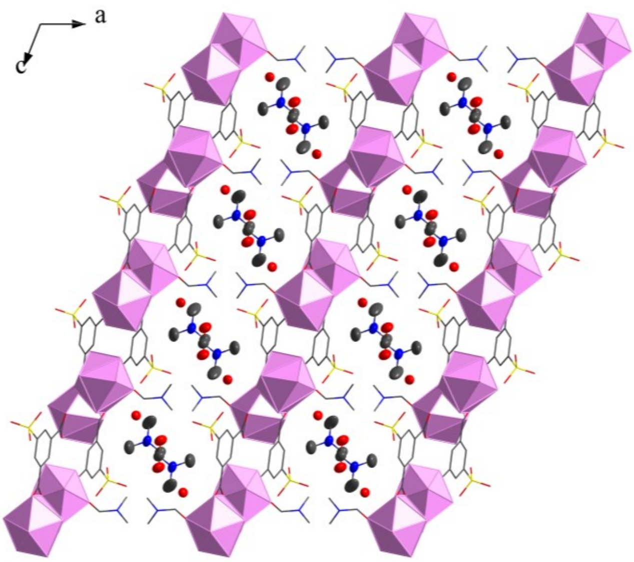
Figure. 1
TEM image of $CsPbBr_3$ QDs/CdS NRs composites before and after the click reaction.

Single Crystal Structure and Photophysical Property of [Eu(bdc-SO_3)(DMF)(H_2O)$_4$]·DMF·H_2O

Phraepan Konsom,[1] Malee Sinchow,[1,2] Thammanoon Chuasaard,[1,2] Athipong Ngamjarurojana,[3] Apinpus Rujiwatra [1,4,*]
[1]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Office of Research Administration, Chiang Mai University, Chiang Mai 50200, Thailand; Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3]Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[4]Department of Chemistry, Faculty of Science and Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: apinpus.rujiwatra@cmu.ac.th

Abstract:

A new lanthanide coordination polymer, *i.e.* [Eu(bdc-SO_3^-)(DMF)(H_2O)$_4$]·DMF·H_2O (**I**), where H_2bdc-SO_3Na = 5-sulfoisophthalic acid sodium salt and DMF = dimethylformamide, has been synthesized and characterized. The crystal structure of [Eu(bdc-SO_3)(DMF)(H_2O)$_4$]·DMF·H_2O was elucidated in the monoclinic space group $P2_1/c$ with refined cell parameters a = 13.47 Å, b = 10.75 Å, c = 17.94 Å, β = 111.5°, V = 2417 Å^3, and Z = 4. The structure features a hydrogen-bond driven supramolecular assembly of the one-dimensional [Eu(bdc-SO_3^-)(DMF)(H_2O)$_4$]$_n$ polymeric chain. The other characterizations were also carried out to evaluate its purity: elemental analysis, powder X-ray diffraction and Fourier transform-infrared spectroscopy. Its thermogravimetric behavior and the room-temperature solid-state photoluminescence were also examined.



C-CHEMISTRY (ORGANIC & MEDICINAL CHEMISTRY)

AN EFFICIENT PHOSPHORUS-BASED ORGANOCATALYTIC SYSTEM FOR AMINATION REACTIONS OF ALCOHOLS

Lalita Radtanajiravong*
Department of Chemistry, School of Science, University of Phayao, Phayao 56000, Thailand
*e-mail: lalita.ra@up.ac.th

Abstract:
Unsaturated amines, such as allylamines and propargylic amines, are versatile synthons for the formation of various biologically active heterocyclic compounds. The direct amination of alcohols, which produces water as the sole by-product, is an atom-economic reaction that leads to the synthesis of these amines. Remarkably, this reaction has been identified as a research priority by the ACS Green Chemistry Institute Pharmaceutical Roundtable. Despite its potential, the hydroxyl group in alcohols is a poor leaving group, posing a significant challenge in finding effective catalysts for this reaction. Brønsted acid organocatalysts are particularly attractive due to their low cost, stability in air and moisture, and ease of separation from organic products. However, a major limitation is that amine starting materials can degrade the catalyst through common acid-base reactions. In this poster presentation, we explain how phosphorus-based compounds can overcome these limitations and serve as potential Brønsted acid catalysts in the amination reactions of propargylic and allylic alcohols. The reaction scope has been expanded to include nucleophilic substitutions of alcohols with *C*-, *O*-, and *S*-nucleophiles. Our study focuses on commercially available phosphorus-based catalysts, including those derived from naturally occurring sources. We hope that this presentation will inspire innovative approaches to the design of new organocatalysts.

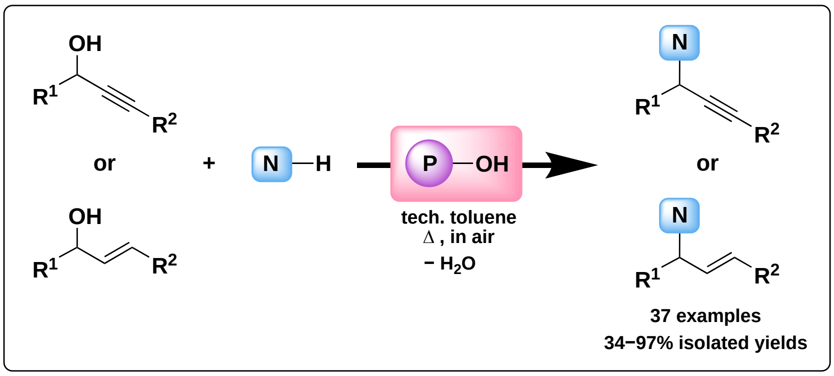


Figure 1. Phosphorus-based catalysed amination reactions of alcohols

CHIRAL PYRIMIDINYL-PIPERAZINE CARBOXAMIDE DERIVATIVES AS POTENT YEAST α-GLUCOSIDASE INHIBITORS

Noval Herfindo,[1] Pirun Mikled,[2] Neni Frimayanti,[3] Thanyada Rungrotmongkol,[4] Emmanuel Theodorakis,[5] Warinthorn Chavasiri[1,*]
[1] Department of Chemistry, Faculty of Science, Center of Excellence in Natural Products Chemistry, Chulalongkorn University, Pathum Wan, Bangkok, 10330, Thailand
[2] Program in Biotechnology, Faculty of Science, Chulalongkorn University, Pathum Wan, Bangkok, 10330, Thailand
[3] Sekolah Tinggi Ilmu Farmasi (STIFAR), Pekanbaru, Riau, 28293, Indonesia
[4] Center of Excellence in Biocatalyst and Sustainable Biotechnology, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[5] Department of Chemistry and Biochemistry, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA, 92093-0358, USA
*e-mail: warinthorn.c@chula.ac.th

Abstract:
α-Glucosidase is responsible for the breakdown complex carbohydrates into sugar, increasing blood sugar levels. Inhibition of α-glucosidase has become an important target for treating type 2 diabetes. It slows sugar absorption and prevents postprandial hyperglycemia. Drug development toward this target is still important to carry out to increase efficacy. Pyrimidine, piperazine and carboxamide are some of potential pharmacophores in developing antidiabetic drugs as indicated by previous reports. In this context, we synthesized a series of pyrimidinyl-piperazine carboxamide **(6-22)** containing chiral centers and evaluated their inhibitory potency toward α-glucosidase from *Saccharomyces cerevisiae*. All compounds in the series showed excellent inhibitory activity with IC_{50} values lower than 20 μM, significantly better than positive control, acarbose. The structure-activity relationships analyses indicated that halogen substituents enhanced the activity. The study revealed that, chirality affected the selectivity of the compounds as (*S*)-pyrimidinyl-piperazine carboxamide showed three times more potency than (*R*)-configuration. Molecular docking results illustrated that the compound predominantly formed hydrophobic interactions including halogen bonding within the active site. Furthermore, the binding modes of enantiomer **21** were in opposite direction, explaining the activity difference. Molecular dynamics simulations and MM-GBSA calculations demonstrated (*S*)-4-(2-((4-chloro-3-hydroxyphenyl)amino)pyrimidin-4-yl)-3-methyl-*N*-(4-(trifluoromethyl)phenyl)piperazine-1-carboxamide **(21c)** complex with α-glucosidase was more stable than its enantiomer counterpart. Moreover, cytotoxicity test indicated the compounds were not toxic to normal cells. Thus, these compounds are promising candidates in the development of α-glucosidase inhibitors.

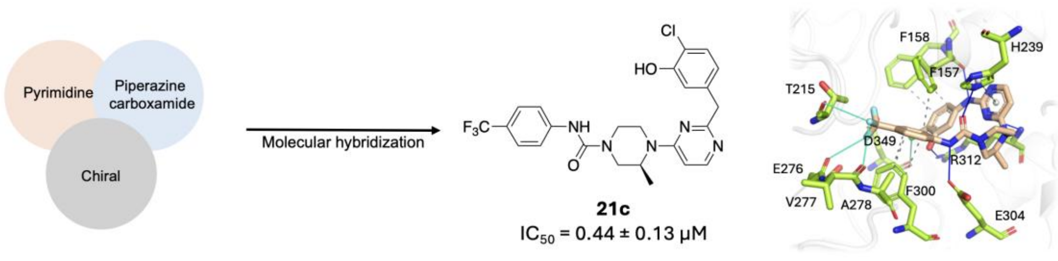


Figure 1. Rational and docking result of compound **21c**.

FABRICATION AND CHARACTERIZATIONS OF SILK FIBROIN/ CALCIUM PHOSPHATE HYDROGEL FOR DENTAL FILLING MATERIAL

Bussabongkot Hoipetch,[1] Pawetida Fungfuang,[1,*] Atsadaporn thangprasert,[2] Saranyoo Klaiklay[2]
[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand
[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand
*e-mail: ezbebear@gmail.com

Abstract:
There are many types of dental filling materials available today. Amalgam is made from a mixture of mercury and other metals and can have adverse health effects with long-term use. Composite resin and Porcelain ceramic materials can be colored to match the natural tooth color but have the disadvantages of material strength and high maintenance costs. The research team realized this problem. Therefore, there is interest in constructing bio-adhesive hydrogels derived from silk fibroin (SF), tannic acid (TA), and calcium phosphate ($Ca_3(PO_4)_2$). The resulting hydrogel will be prepared into 4 groups are SF, SF2CP, SF4CP, and SF6CP with a different amount of $Ca_3(PO_4)_2$ added 0 g, 0.2 g, 0.4 g, and 0.6 g respectively and will be tested the properties as follows: structural analysis (FT-IR), swelling behavior, degradation, water leakage, and adhesive testing. Then, the properties of hydrogels in each group were compared to find a suitable experimental group to use as a prototype for application as dental filling materials and medical biomaterials in the future.

IN SILICO SCREENING OF MOLECULAR INTERACTIONS OF PHYCOCYANIN FROM *Spirulina platensis* IN AN INHIBITING OF ANTI-INFLAMMATORY PATHWAYS

Patipat Kamdenlek,[1] Komgrit Eawsakul,[2] Chawan Manaspon[1,]*
[1]Biomedical Engineering Institute Chiang Mai University, Chiang Mai, Thailand
[2]Thai Traditional Medicine Program School of Medicine, Walailak University
Nakhon Si Thammarat, Thailand
*e-mail: chawan.m@cmu.ac.th

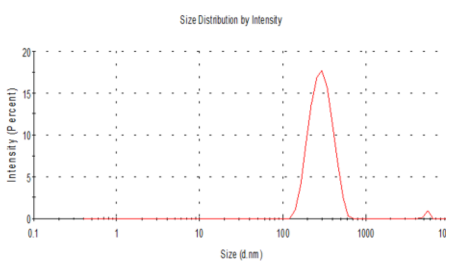
Abstract:

Phycocyanin (PC) is the main pigment within the total phenolic compound extracted from *Spirulina platensis*. Previous studies have indicated that PC possesses anti-inflammatory properties through multiple pathways. This study employed an *in silico* approach to predict molecular interactions between PC and proteins implicated in inflammatory pathways, including COX-1, COX-2, IL-1, IL-6, IL-8, TNF-α, and PGE2. Molecular docking simulations identified the inhibitor binding cavities of the inflammatory proteins (IPs), using quercetin-IPs as a control. Three freeware programs, ArgusLab, AutoDock, and AutoDock Vina, were employed to calculate binding energy (kcal/mol) and predict anti-inflammatory activity measured as IC_{50} values. The results indicated that PC is a promising candidate as a natural anti-inflammatory agent. Overall, PC exhibited lower IC_{50} values than quercetin against several targets: COX-1 (63.05 nM), COX-2 (1.6 mM), IL-1 (5.49 mM), IL-6 (35.8 nM), IL-8 (53.0 nM), TNF-α (160.5 nM), and PGE2 (6.9 nM). For comparison, quercetin's IC_{50} values were 2,200 nM, 6.1 mM, 607.5 mM, 48,800 nM, 9,290 nM, 3,660 nM, and 37,100 nM, respectively. These results could be valuable in elucidating the molecular mechanisms underlying PC's anti-inflammatory effects and facilitating its development as a therapeutic agent. Further *in vitro* studies will be conducted to confirm the efficacy and therapeutic potential of PC.

MINOXIDIL LOADED NANOPARTICLES

Suchanya Charoensin, Wittawat Keawsongsaeng, Rojrit Rojanathanes*
Department of Chemistry, Faculty of Science, Chulalongkorn University, Thailand
*e-mail: rojrit@hotmail.com

Abstract:
Minoxidil is one of the medicines used for androgenetic alopecia treatment. This work aimed to prepare minoxidil loaded nanoparticles to facilitate topical drug delivery. The minoxidil was successfully loaded in calcium carbonate and calcium citrate nanoparticles using co-precipitation. Both citrate and carbonate-based nanoparticles exhibited spherical shapes with 300 to 400 nm diameter. The carbonate nanoparticles showed a higher loading capacity at 11%.



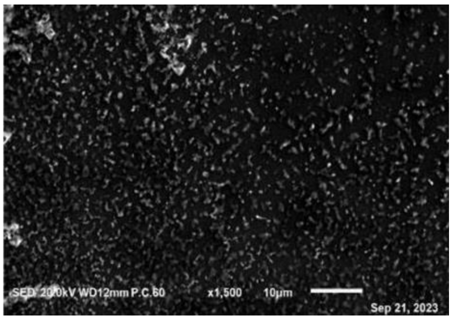


Figure 1. Size distribution from DLS (left) and morphology from SEM (right) of minoxidil-loaded citrate nanoparticles

OXIDATIVE COUPLING OF 2-NAPHTHOL USING IRON-COPPER COMPOSITE OXIDES AS SOLID CATALYST

Natsumi Ota,[1,*] Yusuke Inomata,[2] Tetsuya Kida[2]
[1]Graduate School of Science and Technology, Kumamoto University, Kumamoto, Japan
[2] Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, Japan
*e-mail: 232d8804@st.kumamoto-u.ac.jp

Abstract:
BINOL (1,1'-bi-2-naphthol) serves as a starting material for the synthesis of many chiral molecules, including BINAP (2,2′-bis(diphenylphosphino)-1,1′-binaphthyl), necessitating an efficient synthetic method. BINOL is typically synthesized using oxidants and homogeneous catalysts, but this approach leads to issues with waste generation and difficulty in catalyst reuse. To address these problems, it is necessary to develop a new heterogeneous catalyst (as solid catalyst) that can be easily separated from the product, reused, and does not generate waste. In this study, we investigated the synthesis of BINOL via the oxidative coupling reaction of 2-naphthol with molecular oxygen as an oxidant using iron-copper composite oxides, which can be synthesized at low cost, as solid catalysts.

Iron-copper composite oxides were synthesized using the organic acid salt method with $Fe(NO_3)_3{\bullet}9H_2O$ and $Cu(NO_3)_2{\bullet}3H_2O$ as precursors. To investigate the optimal catalyst, we synthesized catalysts with varying Fe/Cu ratios, types and amounts of organic acids and calcination temperatures, and then investigated their effects on BINOL yields. The Fe-Cu composite oxides were characterized by XRD and nitrogen adsorption measurements. The catalytic reaction was performed by adding 2-naphthol (1 mmol) and the catalyst (200 mg) to the solvent under air. After the reaction was complete, conversion, selectivity, and yield were calculated by NMR analysis.

XRD measurements revealed that spinel-type iron-copper composite oxides, $CuFe_2O_4$, were synthesized when 10, 20, and 33 mol% Cu was added. Comparing the organic acid salt method with other methods (such as the solvothermal method and sol-gel method) showed that $CuFe_2O_4$ (10 mol% Cu) with a high specific surface area of 154 m^2/g was obtained using oxalic acid as the organic acid at a lower calcination temperature than other synthetic methods (Table.1). Activity tests using composite oxides with various Cu/Fe ratios as catalysts (in aqueous solution at 80°C for 12 hours) demonstrated that $CuFe_2O_4$ (10 mol% Cu) produced the highest BINOL yield (90%).

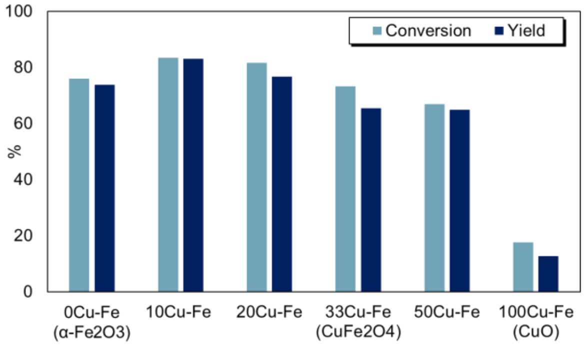


Figure 1. BINOL yields for various Cu/Fe ratio catalysts

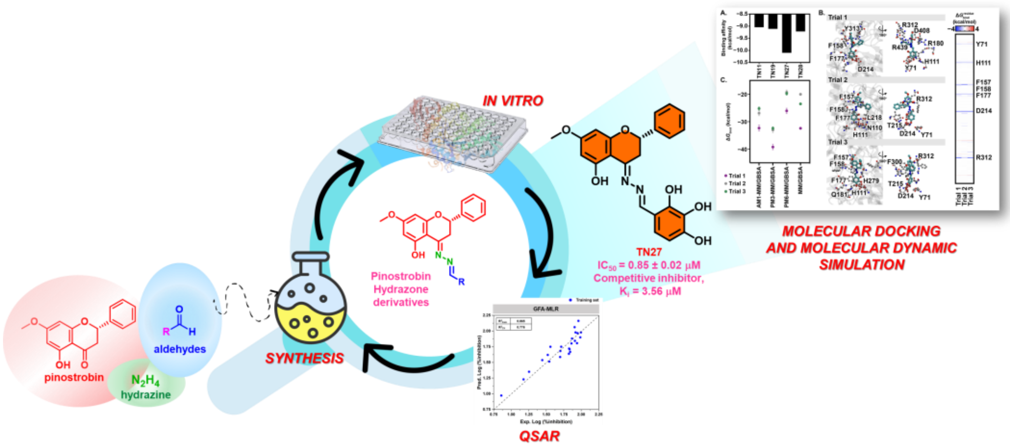
ENTRY	CATALYST	SOLVENT	CONVERSION (%)	YIELD (%)
1	10Cu-Fe	Water	100	90
2		Ethanol	20	6.7
3		THF	42	24
4		toluene	84	81

Table. 1 BINOL yields in various solvents

PINOSTROBIN HYDRAZONE DERIVATIVES AS NEW α-GLUCOSIDASE INHIBITORS

The Thanh Ngo,[1] Borwornlak Toopradab,[2,3] Kowit Hengphasatporn,[4] Maitarad Phornphimon,[5] Thanyada Rungrotmongkol,[2,3] Warinthorn Chavasiri[1,*]
[1] Center of Excellence in Natural Products Chemistry, Department of Chemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand.
[2] Center of Excellence in Structural and Computational Biology, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand.
[3] Program in Bioinformatics and Computational Biology, Graduate School, Chulalongkorn University, Bangkok 10330, Thailand.
[4] Centre for Computational Sciences, University of Tsukuba, Japan.
[5] Research Center of Nano Science and Technology, Shanghai University, China.
*e-mail: warinthorn.c@chula.ac.th

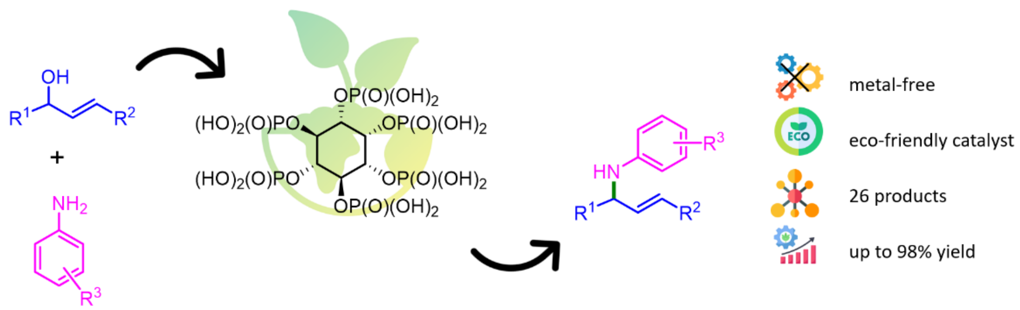
Abstract:
Flavonoid hydrazone derivatives have been reported to limit postprandial hyperglycemia through α-glucosidase inhibition by reducing glucose uptake. In this study, a series of pinostrobin hydrazones (**TN01-TN24**) were synthesized through two continuous steps from pinostrobin, hydrazine monohydrate, and selected aldehydes. These compounds were well characterized and screened for α-glucosidase inhibitory activity. Then, QSAR study was applied to predict more potential candidates (**TN25-TN28**). As a result, their IC_{50} values ranged from 0.85 to 11.81 μM, significantly better than acarbose (IC_{50} 817.38 μM), used as the standard compound.**TN27** which exhibited the most excellent activity was further investigated and disclosed that it bound to the active site with lower binding affinity score of -10.098 kcal/mol compared to acarbose (−8.47 kcal/mol). In addition, binding patterns, key binding residues, and the interaction's binding free energy between **TN27** and α-glucosidase were also clarified.



SYNTHESIS OF *N*-ALLYLANILINES VIA ALLYLIC AMINATION OF ALCOHOLS AND CATALYZED BY PHYTIC

Can Van Pham,[1] Lalita Radtanajiravong,[2] Warinthorn Chavasiri[1,*]
[1]Center of Excellence in Natural Products Chemistry, Department of Chemistry, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok 10330, Thailand
[2]Division of Chemistry, School of Science, University of Phayao, Maega, Muang Phayao, Phayao 56000, Thailand
*e-mail: warinthorn.c@chula.ac.th

Abstract:
Phytic acid is a unique natural substance found in plant seeds and is typically considered agricultural waste. This is the first report to effectively use this biogenic organophosphorus acid as a sustainable catalyst for direct amination of allylic alcohols affording allylamines with yields ranging from moderate to excellent. Challenging electron-rich aniline nucleophiles were tolerant, while shorter reaction time was achieved with less basic anilines. Their corresponding Friedel–Crafts side products could be minimized under the optimized reaction conditions. A variety of asymmetrically substituted allylic alcohols were accommodated, while the scope was extended to hetero-centered nucleophiles as C-, O- and S-nucleophiles.



THE DEVELOPMENT OF ANTI-BREAST CANCER DRUGS BY USING POLYPHENOLS FROM BERGAMOTS WITH CELLULOSE NANOCRYSTAL FROM DURIAN PEELS FOR DRUG DELIVERY SYSTEMS

Weerin Wutthijarernkij,[1] Sawitta Chuealee,[1] Kriengsak Lirdprapamonkol,[2] Janjira Maneesan[1,*]
[1]Kamnoetvidya Science Academy. 999, Payubnai Sub-district, Wangchan District, Rayong, Thailand, 21210
[2]Chulabhorn Research Institute. 54 Kamphaeng Phet 6 Road, Talat Bang Khen, Lak Si. Bangkok, Thailand, 10210
*e-mail: janjira.m@kvis.ac.th

Abstract:

Breast cancer has currently become a severe global health issue, with continuously increasing incidence rates every year. Many people suffer greatly due to the high cost and limited accessibility of treatments. This project aims to explore commonly available plants in Thailand as an alternative treatment for breast cancer, along with developing a drug delivery system that is innovative and promising. These plant-based treatments are cost-effective, non-toxic to normal cells, target-specific, preventing degradation through the body's various systems as they travel towards their targets. Bergamot in parts of peel, juice, and leaves were used. The peel and leaves were extracted with water and ethanol, while the juice was squeezed and dried for further use. These extracts were studied and processed into therapeutic drug, testing for their antioxidant properties using the DPPH technique and quantifying polyphenol content with the Folin-Ciocalteu method. The ethanol leave extracted showed the lowest IC_{50} value of 0.608 mg/mL, indicating the highest antioxidant activity, while the juice showed the lowest antioxidant activity. The drug delivery systems were tested for efficacy against cancer cells using in vitro cytotoxic assays such as the MTT assay. The result indicated that the peel and leaf ethanol crude extracts exhibited the cytotoxicity against cancer cells, though they were not significantly lower than that of doxorubicin. Subsequently, polyphenols were purified using thin-layer chromatography and cellulose nanocrystals were produced from durian peel as drug carriers through acid hydrolysis. This project aims to broaden treatment options for breast cancer and reduce the suffering and costs associated with the disease, providing patients with access to effective and affordable medications.

C-CHEMISTRY (PHYSICAL & THEORETICAL CHEMISTRY)

APPLICATION OF SIAM RUBY QUEEN CORN EXTRACT AS INDICATOR IN BIODEGRADABLE ACID-BASE INDICATOR FILM

Sarocha Lapate, Sutinee Girdthep, Jitnapa Sirirak*
Department of Chemistry, Faculty of Science, Silpakorn University Nakhon Pathom 73000, Thailand
*e-mail: sirirak_j@su.ac.th

Abstract:
Siam Ruby Queen corn, a purple corn in Thailand, is considered as the world's first variety of red sweet corn. It stands out in terms of its beautiful, bright colors and exotic flavor. Siam Ruby Queen corn also has a high amount of anthocyanin, a purple-red pigment that has a high ability to neutralize free radicals. Therefore, in this work, Siam Ruby Queen corn was utilized as indicator in biodegradable acid-base indicator film. The Siam Ruby Queen corn extract was prepared by aqueous extraction at 60 °C for 30 mins. Its pH sensitivity and UV–Vis spectra were then investigated. The results showed that Siam Ruby Queen corn extract was sensitive to pH, which was indicated by its color change from reddish pink to orange as pH increased. Additionally, the acid-base indicator film incorporated with Siam Ruby Queen corn extract based on gelatin was prepared using solvent-casting method and its pH sensitivity was explored. It was found that the color of film changed from purple red to dark red and dark green with respect to the vapor of hydrochloric and ammonia, respectively. Thus, Siam Ruby Queen corn extract could be utilized as indicator in acid-base indicator film.

ENHANCED SELECTIVE PHOTOCATALYTIC OXIDATION OF 5-HYDROXYMETHYLFURFURAL TO 2,5-FURANDICARBOXYLIC ACID USING A TEMPO-FREE $BiVO_4$/C ELECTRODE

Se Rin Jung, Myung Jong Kang*
Department Chemistry, Gangneung-Wonju National University, Gangneung, 25457, Republic of Korea
*e-mail: mjkang@gwnu.ac.kr

Abstract:
Selective photocatalytic oxidation of 5-hydroxymethylfurfural (HMF) to 2,5-furan-dicarboxylic acid (FDCA) is crucial for producing high-value-added products from biomass derivatives. Aerobic oxidation methods often require harsh conditions, and electrochemical methods are attractive alternatives due to their milder operating conditions. Among various photocatalysts, $BiVO_4$ have been reported to achieve FDCA yields of more than 99%. However, reported oxidation reaction mediated by 2,2,6,6-tetramethylpiperidine 1-oxyl (TEMPO), which has been utilized as a redox mediator as reducing the competing oxygen evolution reaction (OER) during HMF oxidation reaction. Although TEMPO is not classified as toxic chemicals, it causes severe skin burns and eye damage on human including an aquatic eco toxicant and expensive chemical in economic aspect. Therefore, 5-HMF oxidation into FDCA with TEMPO-free condition needed for environmental friendly system and economic feasibility. In this study, we developed a $BiVO_4$/C composite electrode that does not require TEMPO to overcome the limitation of the low electron transfer ability of $BiVO_4$. The $BiVO_4$ electrode was fabricated via electrodeposition, and the $BiVO_4$/C composite was synthesized through hydrothermal synthesis and precipitation techniques. The improved $BiVO_4$/C electrode shows enhanced electron transfer and catalytic performance, which were validated through comprehensive electrochemical analyses, including Linear Sweep Voltammetry (LSV) and Chronoamperometry (CA). Additionally, surface morphology and composition were characterized using X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), and Energy Dispersive X-ray Spectroscopy (EDS). The results indicate an improvement in the selective oxidation of HMF to FDCA without the use of toxic mediators, positioning the $BiVO_4$/C electrode as a promising candidate for sustainable and efficient biomass conversion.

MECHANISMS OF 2-PAM IN REACTIVATING HUMAN ACETYLCHOLINESTERASE

Thanyada Rungrotmongkol,[1,2,*] Nalinee Kongkaew,[1] Phiphob Naweephattana,[2] Kowit Hengphasatporn,[3] Ryuhei Harada,[3] and Alisa Vangnai[2]
[1]Program in Bioinformatics and Computational Biology, Graduate School, Chulalongkorn University, Bangkok 10330, Thailand
[2]Center of Excellence in Biocatalyst and Sustainable Biotechnology, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
[3]Center for Computational Sciences, University of Tsukuba, 1-1-1 Tennodai, Tsukuba, Ibaraki 305-8577, Japan
*e-mail: thanyada.r@chula.ac.th

Abstract:
Exposure to organophosphate pesticides (OPs) is common among agricultural workers in Thailand, leading to frequent poisoning due to their irreversible inhibition of acetylcholinesterase (AChE), which disrupts the nervous system. The FDA-approved antidote, 2-PAM, is limited by its ability to cross the blood-brain barrier and its efficacy in reactivating AChE. This study explores the binding pathway of 2-PAM and unbinding pathway of phosphorylated 2-PAM (the product from reactivation), as well as designs more effective antidotes using computational chemistry techniques. Based on LB-PaCS-MD, we found that 2-PAM effectively enters AChE's catalytic site through various pathways, with the acyl door allowing the most effective reactivation via an SN2 mechanism. The product phosphorylated 2-PAM is released through only the acyl door. This effective binding mode has been utilized in designing 2-PAM analogs by adding electron-donating groups on the para and/or ortho positions of the pyridinium core, which have shown enhanced binding energy, particularly with aromatic amino acids: Y124, W286, F297, W338, and Y341. These discoveries provide insights into the binding and unbinding pathways toward inhibited AChE and a rational guide for developing new antidotes to treat organophosphate insecticide toxicity.

THE EFFECT OF AN AQUEOUS-ORGANIC MEDIUM ON PAPAIN-SUBSTRATE BINDING AND PAPAIN ACTIVITY: MOLECULAR DYNAMICS SIMULATIONS STUDY

Poomipat Tamdee, Nichanun Sirasunthorn, Jitnapa Sirirak*
Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
*e-mail: sirirak_j@su.ac.th

Abstract:
Biosensors are devices that used for detecting various samples. In recent years, enzymes have been developed into enzyme-based biosensors, which offer high sensitivity and selectivity in detection. In this study, papain, a protease enzyme found in papaya, was investigated to understand the presence of organic solvent within aqueous-organic system to its structure and enzymatic reactions. N_{α}-benzoyl-arginine-*p*-nitroanilide (BAPNA) is a substrate hydrolyzed by papain to produce *p*-nitroaniline, which displays a yellow color, allowing the monitoring of papain activity. Herein, molecular dynamics (MD) simulations were performed to explore the effect of acetonitrile, as a co-organic solvent, with dimethyl sulfoxide (DMSO) and water on the activity of the papain bound to BAPNA for 300 ns using AMBER20. The results showed that when co-organic solvent contained high percentage of acetonitrile, the active site of papain was predominantly replaced by acetonitrile molecules which made BAPNA unbound from papain cavity. This indicates that acetonitrile affects the binding of the papain-BAPNA complex.

THE IMPACT OF NITROGEN DOPING ON Pt CLUSTER-DECORATED CARBON NANOCONES FOR CO_2 HYDROGENATION TO FORMIC ACID: A DFT STUDY

Yuwanda Injongkol,[1,2] Pimjai Pimbaotham,[3] Siriporn Jungsuttiwong,[3] Nuttapon Yodsin[4,*]
[1]Futuristic Science Research Center, School of Science, Walailak University, Nakhon Si Thammarat 80160, Thailand
[2]Functional Materials and Nanotechnology Center of Excellence, Walailak University, Nakhon Si Thammarat 80160, Thailand
[3]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Ubon Ratchathani University, Ubon Ratchathani 34190, Thailand
[4]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
*e-mail: yodsin_n@su.ac.th

Abstract:
The conversion of CO_2 into formic acid via hydrogenation is crucial for environmental catalysis, as it offers the dual benefits of reducing greenhouse gas emissions and generating valuable chemicals. Due to the expensive nature and limited supply of platinum, it is essential to investigate efficient catalysts based on platinum. In this study, we utilized density functional theory (DFT) calculations to investigate the reaction mechanism on defective carbon nanocones decorated with Pt_4 clusters (Pt_4/dCNC) and assessed the impact of N-doping (Pt_4/N_xdCNC; x = 1, 2, 3) on CO_2 hydrogenation. Based on previous studied, two distinct reaction pathways were examined: one involving co-adsorption and the other combining H spillover with co-adsorption. The latter pathway, proceeding through a formate intermediate, was identified as the most favorable. Additionally, the effects of varying nitrogen contents on Pt_4/dCNCs were compared. The findings revealed a substantial increase in active species on the catalyst surface with higher N-doping, particularly during the H-spillover step from Pt to the N atom of N_3dCNC, which requires a rate-determining formation barrier of 1.08 eV. Remarkably, statistical analysis revealed strong linear correlations between overall free energy barriers ($\Delta G^{\#}_{overall}$) and rate-determining step barriers ($\Delta G^{\#}_{RDS}$) and free energy differences of the key intermediate. Our findings highlight the significance of N-doping of Pt_4/dCNCs in enhancing catalytic activity and provide valuable insights for designing and optimizing catalysts for efficient CO_2 conversion processes, with implications for environmental remediation and chemical synthesis.

D-MATHEMATICS / STATISTICS / COMPUTER SCIENCE / DATA SCIENCE / AI

AN ALGORITHM FOR ILLUMINATING N NON-OVERLAPPING CIRCULAR DISC' BOUNDARIES ON THE PLANE

Phapaengmuang Sukkasem,[1,*] Supanut Chaidee,[2] Watit Khokthong[3]
[1]Program in Applied Mathematics, Department of Mathematics, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[2]Department of Mathematics, Faculty of Science, Chiang Mai University, Thailand
[3]Forest Restoration Research Unit (FORRU-CMU), Department of Biology, Faculty of Science, Chiang Mai University, Thailand
*e-mail: phapaengmuang_s@cmu.ac.th

Abstract:
Given a set of n non-overlapping circular discs on a plane, we aim to determine possible positions of points (referred to as cameras) that could fully illuminate all the circular discs' boundaries. This work presents a geometric approach for determining feasible camera positions that would provide total illumination of all circular discs. The Delaunay triangulation, coupled with the intersection of slabs formed by the boundaries of circular discs, is employed to form the region that satisfies the given conditions. The experiment is conducted using a set of randomly positioned circular discs on a plane. This study has the potential to address the issue of illumination in forests by utilizing a LiDAR camera to determine the possible number and placement of cameras that can effectively illuminate trees within a forest.

APPROXIMATING ENDPOINTS OF MULTI-VALUED NONEXPANSIVE MAPPINGS IN UNIFORMLY CONVEX HYPERBOLIC SPACES USING A NEW ITERATION PROCESS

Thanomsak Laokul*
Department of Mathematics and Computing Science, Mahidol Wittayanusorn School, Nakorn Pathom 73170, Thailand
*e-mail: thanom.kul@mwit.ac.th

Abstract:
Endpoint theory plays a significant role in mathematical science. In 1986, Corley showed that maximizing over a cone corresponds to finding an endpoint of a specific multi-valued mapping. Building on this, Makbule Kaplan Özekes, in 2022, introduced a new iteration process for approximating endpoints of multi-valued nonexpansive mappings in uniformly convex Banach spaces. This research extends her work by modifying the process to approximate endpoints in 2-uniformly convex hyperbolic spaces, a broader class of spaces. A Δ-convergence theorem is established for the new iterative sequence, and under condition J and the mapping's semicompactness, strong convergence to an endpoint is achieved. These findings improve upon the results of Özekes and others.

COMPARATIVE PERFORMANCE OF TRADITIONAL AND VISION TRANSFORMER MODELS IN MONONUCLEAR CELL CLASSIFICATION

Peempol Chokchaipernpoonphol,[1] Jermphiphut Jaruenpunyasak,[2,*]
[1]Department of Pathology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand
[2]Department of Biomedical Sciences and Biomedical Engineering, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand
*e-mail: jjermphi@medicine.psu.ac.th

Abstract:
Differentiating mononuclear cells is crucial in diagnosing various hematological conditions. However, due to their similar morphology, misclassification of monocytes, myelocytes, promyelocytes, and metamyelocytes often occurs in routine digital imaging. Accurate classification is essential for effective patient care. This study aimed to compare the outcomes of traditional and Vision Transformer (ViT) architecture in classifying mononuclear cell differentiation. An online dataset of microscopic peripheral blood cell images was selected, focusing on monocytes and immature granulocytes for this research (N=4,315). The dataset consisted of monocytes, myelocytes, metamyelocytes, promyelocytes, and immature granulocytes, with counts of 1,420, 1,137, 1,015, 592, and 151, respectively. All images were centered and resized to 180x180 pixels, which is half the size of the original dataset. Following this preprocessing step, we compared two primary frameworks. The first framework employed traditional classification methods based on texture features, including Local Binary Patterns (LBP), Histogram of Oriented Gradients (HOG), and Gray-Level Co-occurrence Matrix (GLCM). To address imbalanced datasets, we applied and compared two balancing techniques: Synthetic Minority Over-sampling Technique (SMOTE) and Adaptive Synthetic Sampling Approach (ADASYN). We trained 15 traditional classifiers using 5-fold cross-validation. The second framework employed the ViT architecture, featuring a pre-trained model with a base size, utilizing 16x16 patches and designed for input images of 224x224 pixels. This second framework was divided into training, validation, and testing sets in an 80:10:10 ratio. Both frameworks were evaluated based on their accuracy. According to our findings, the ViT stood out with the highest accuracy when trained on the original dataset, boasting a remarkable score of 95.37%. In contrast, the top-performing traditional method utilizing LBP-SMOTE augmentation and Light Gradient Boosting Machine (LightGBM) classifier achieved an accuracy of 76.12%. In conclusion, combining transfer learning models with ViT architecture has been demonstrated to significantly enhance the accuracy of mononuclear cell classification. This breakthrough offers a significant advantage over traditional approaches, allowing healthcare professionals to make data-driven decisions and deliver targeted treatments that improve patient care outcomes.

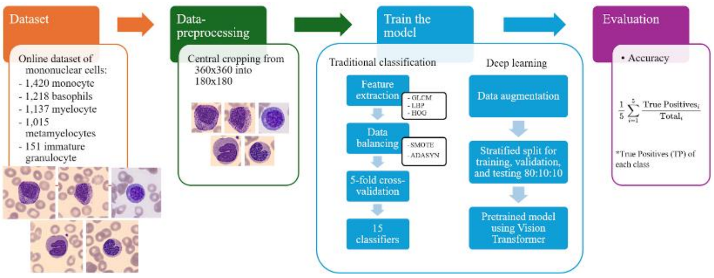


Figure 1. Process of this study

COMPARISON OF FORECASTING METHODS FOR DIGITAL MARKETING PLANNING: A CASE STUDY ON HEALTHY VEGETABLES

Suphannee Chueanun*
Department of Mathematics and Computing Science, Mahidol Wittayanusorn School, Nakhon Pathom, Thailand
*e-mail: suphannee.chu@mwit.ac.th

Abstract:
Forecasting in digital marketing involves predicting future trends and behaviors using historical data and analytics. This helps marketers plan effective strategies, allocate budgets, and optimize campaigns. Nowadays, interest in healthy vegetables continues to grow as consumers become more health-conscious and seek nutrient-dense foods. Key trends include an emphasis on sustainability, plant-based diets, and functional foods that offer specific health benefits. The aim of this work is to study forecasting methods for time series data, namely the simple moving average, weighted moving average, and exponential smoothing. These methods are used to predict future trends in the search term 'healthy vegetables' and are compared by considering the mean squared error (MSE) and mean absolute error (MAE). The model with the lowest MSE and MAE is considered the best model. In this case study, data on healthy vegetables from September 2019 to August 2024 were collected from Google Trends. Current trends in healthy vegetables are explored to identify the most appropriate forecasting method for predicting future trends. The best prediction model is expected to support marketing planning, raw material inventory, and customer demand.

DEVELOPMENT OF A SURGICAL PLANNING SYSTEM FOR MAXILLOFACIAL SURGERY USING ARTIFICIAL INTELLIGENCE

Krisda Tapracharoen,[1,*] Patcharapit Promoppatum[2]
[1]National Metal and Materials Technology Center (MTEC), National Science and Technology Development Agency (NSTDA), 111 Thailand Science Park, Phahonyothin Road, Khlong Nueng, Khlong Luang, Pathum Thani, 12120, Thailand
[2]Department of Mechanical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
*e-mail: krisda.tap@mtec.or.th

Abstract:
This project addresses the increasing demand for precise and personalized surgical solutions in maxillofacial surgery, driven by an aging population and global trends in aesthetic enhancement. Traditional planning methods, which rely on 2D approaches and non-customized tools, often impede the efficiency and accessibility of high-quality care. To overcome these limitations, a web-based platform has been developed that integrates advanced AI technology to streamline critical processes such as segmentation, device positioning, and surgical planning. The platform's inputs include 3D CT scan data, patient anatomical landmarks, and specific surgical requirements. These inputs are processed by an AI-driven segmentation model that automatically identifies key structures, such as the jawbone. The outputs are 3D visualizations of patient anatomy, along with customized surgical devices positioned according to precise parameters set by the user. Device positioning is optimized through AI algorithms based on anatomical features and user-defined surgical criteria. The effectiveness of the platform will be evaluated by measuring the accuracy of the segmentation and device positioning models using standard performance metrics, such as the Dice similarity coefficient for segmentation. Additionally, user satisfaction will be assessed through feedback from surgeons, focusing on ease of use, time savings, and clinical outcomes. The AI integration improves the accuracy and efficiency of surgical planning. The segmentation process employs deep learning algorithms trained on large datasets of maxillofacial anatomy, while device positioning uses optimization techniques to ensure precise surgical outcomes. By reducing planning time and enhancing surgical precision, the system contributes to improved patient outcomes and supports the domestic medical industry by reducing reliance on foreign technology and fostering local innovation within Thailand's healthcare sector.

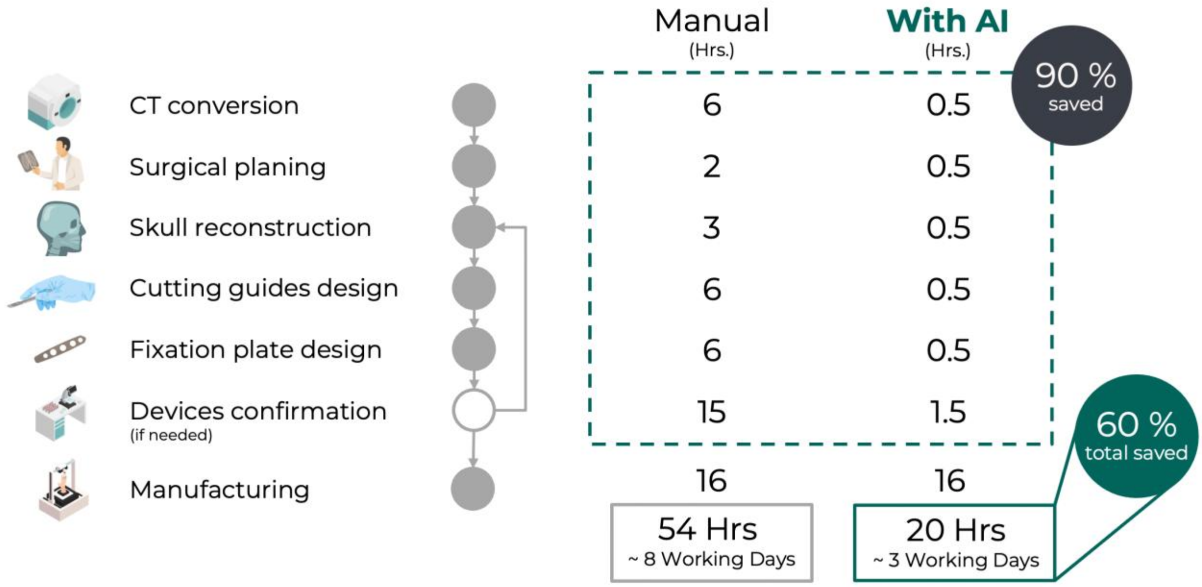


Figure 1. shows that incorporating AI into maxillofacial surgical planning reduces total time from 54 to 20 hours, achieving a 60% time reduction.

Development of a Web Application for Assessing Injury Risk in Running Using Posture and Motion Analysis

Terawee Chaijaroen,[1] Tipok Saemram,[1] Veerapatra Saejew,[1] * Kritsada Puangsuwan [2]
[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand
[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand
*e-mail: topthipok1043@gmail.com

Abstract:

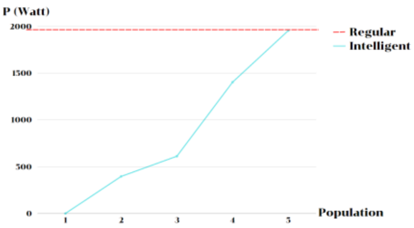
Running is a popular activity with health benefits accessible to all ages. However, improper running techniques can lead to injuries, potentially causing chronic pain and subsequent health issues, leading to medical expenses and other costs. To address these issues promptly and make injury prevention and treatment accessible to the general public, this project aims to develop a platform that can assess the risk of running injuries via smartphones using motion detection technology and biomechanical data processing. We utilize the MediaPipe system to identify body joint positions for real-time human body movement tracking. The obtained data is used to calculate average joint flexion angles, which are then compared with standard ranges of appropriate joint flexion angles for running based on scientific research. Additionally, machine learning techniques are employed to assess running posture risk accurately. By learning from video clip data frame-by-frame, we achieved an accuracy of 0.96 on the test dataset. From the analysis of the movement data, we can identify joints at risk of injury. Subsequently, the model was further developed into the software "Runagnos" which is aimed at enabling interested individuals to analyze running results through the system. This research not only benefits the improvement of running efficiency but also develops a tool with the potential to prevent and reduce injuries in runners, which could lead to sustainable and safe running development in the future.

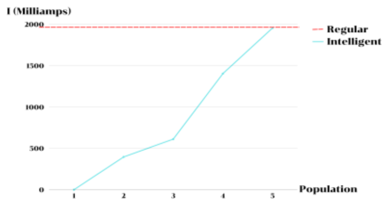
DEVELOPMENT OF AN INTELLIGENT TEMPERATURE CONTROL SYSTEM BASED ON POPULATION DENSITY IN THE AREA

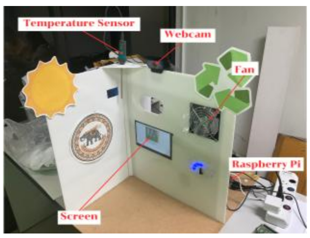
Nattapat Ueapitak, Phoomjai Sukkasem, Pirisa Didchan, Wanchalerm Chansong *
Affiliation
Naresuan University Secondary Demonstration School, Meung District, Phitsanulok
*e-mail:
Wanchalermj@nu.ac.th

Abstract:
This project introduces a smart temperature management system utilizing Raspberry Pi technology, which adjusts fan speed based on the number of occupants in a room. By integrating facial detection and occupancy analysis through a single camera, the system accurately counts the number of people and monitors the ambient temperature in real time, ensuring comfort without compromising energy efficiency. The camera tracks individuals entering and exiting the room, adjusting fan speed based on occupancy. However, the system requires a clear view of the face, as it will not recognize individuals if the eyebrows or nose are obstructed, such as when wearing certain accessories or due to other visual blockages. Increased occupancy results in higher fan speeds to maintain comfort, but even in these cases, the intelligent system demonstrates significant energy savings compared to a traditional system. For example, with one person in the room, the intelligent system uses 0 units of energy, while the regular system consumes 1956 units. Energy savings decrease slightly as more people enter the room, with reductions of 79.75%, 68.71%, and 27.60% for two, three, and four people, respectively. However, with no occupants, the system enters a low-power mode, conserving energy effectively. These results are based on multiple trials under controlled conditions to ensure reliability. While the system's efficiency decreases as occupancy rises, it still offers substantial savings, particularly in lower occupancy scenarios. This innovative solution is ideal for densely populated spaces like classrooms and offices, providing an energy-efficient and sustainable approach to maintaining comfort.

Figure 1.







People	P(Intelligent)	P(Regular)	Difference	%
1	0	1956	1956	100
2	396	1956	1560	79.75
3	612	1956	1344	68.71
4	1416	1956	540	27.60
5	1956	1956	0	0

Table indicates the usage of energy with the room temperature at 24 degrees celcius

TITLE IN ENGLISH

Generalization Equilibrium Mass Point Distribution in Structurally Fractal Configurations.

Perawit Boonsomchua[1,*], Papon Poramatthongchai[2]
[1]Engineer Science Classroom (ESC), Learning Institute, King Mongkut's University of Technology Thonburi, Bangkok, 10140, Thailand
[2]Bodindecha (Sing Singhaseni), Bangkok, 21130, Thailand
*e-mail: perawit.boon@mail.kmutt.ac.th

Abstract:

The mass point method is the classical problem-solving technique in Euclidean geometry, which applies the physical center of mass in a homogeneous coordinate system. This paper theoretically generalizes the mathematical relation that describes the mass point distribution underlying the fractal configurations. Additionally, we uncover the corresponding graph circuits that underlie the fractal shape. Our discoveries reveal the empirical recursive formulation that explains the correlation between mass point distribution patterns and any fractal layer. This knowledge contributes to our understanding of how mass point is applied to the modern geometry problem and potentially becomes a basis for further research within the discrete geometry domain.

GEODESICS ON THE RANDERS CYLINDER OF REVOLUTION OF NON-CONSTANT NAVIGATION DATA ALONG MERIDIAN

Pinyada Prakobsin,[1] Thunphitcha Koikim,[1,*] Phattaraphorn Hama,[1] Rattanasak Hama[2]

[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand

[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand

*e-mail: tpchakoikim@gmail.com

Abstract:
In this project, we explore the concept of Riemannian unit-speed geodesics on a Randers cylinder of revolution, focusing on meridians and parallels as solutions to Zermelo's navigation problem. Our study examines a scenario where the wind is modeled as non-constant and blows along the meridian direction. Our conclusions show that meridians are geodesics in Randers space, and a parallel is also a geodesic if and only if it is a critical point of the profile curve and wind. Finally, we compare the properties and behaviors of geodesics in both Riemannian and Randers spaces to better understand how wind affects these geodesic paths.

MACHINE LEARNING FOR IDENTIFICATION OF DNA METHYLATION BIOMARKERS FOR EARLY-STAGE LUNG CANCER DETECTION AND SUBTYPES CLASSIFICATION

Virakarn Boonfahpratan,[1] Chananrat Tiranumpongvanich,[1] Jiramet Kinchagawat,[2] Thanasan Nilsu,[1] Kanes Sumetpipat[1,*]
[1] Kamnoetvidya Science Academy, Rayong 21210, Thailand
[2] Cariva (Thailand) Company Ltd., Bangkok 10120, Thailand
*kanes.s@kvis.ac.th

Abstract:

Lung cancer is the second most common cancer type in which patients often get detected in metastatic stage. It is classified into 3 major subtypes: small cell lung cancer, lung adenocarcinoma, and lung squamous cell carcinoma. In this study, we identified cancer-specific DNA methylation sites to apply as biomarkers for lung cancer detection and subtypes classification. Machine learning models were trained on DNA methylation data from TCGA and GEO databases. The Random Forest Classifier was used as a baseline model, and it is compared to three additional algorithms: Naïve Bayes, Support Vector Machine, and XGBoost. To enhance model performance, different pre-processing and feature selection methods were investigated. The detection of lung cancer tumor shows the best F1 score of 0.99 after filter selection; meanwhile, the classification of three lung cancer subtypes shows the best F1 score of 0.97 after filter and embedded selections. RFC showed the highest performance compared to other algorithms. By tracking potential methylation sites back to original genes, we found that genes from lung cancer detection are associated with cancer cell suppression, proliferation, and metastasis pathways. Genes from subtypes classification also relate to specific subtypes, including RUNX3, SIX3, CMIP, and A2TML1.

MACHINE LEARNING-BASED PREDICTION OF THONG DEE POMELO SWEETNESS USING EXTERNAL PHYSICAL CHARACTERISTICS

Thanchanok Pinyamoon[1], Piyapoom Janpanmuang[1], Chainun Poraha[1], Limpapat Bussaban[1,2], Prondanai Kaskasem[1,2,]*,

[1]Department of Mathematics, Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand
[2]Research Center for Academic Excellence in Mathematics, Department of Mathematics Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand
*e-mail: prondanaik@nu.ac.th

Abstract:
This study investigates the application of various machine learning techniques to predict the sweetness of Thong Dee pomelo based on external physical characteristics. The attributes used for this study include weight, circumference, height, height from floor to circumference, and the diameter of the stalk. The dataset comprises 108 original pomelos and two synthetic datasets with 200 and 400 pomelos generated using REaLTabFormer. We employed several machine learning models, including Logistic Regression, Decision Tree, Support Vector Machine, k-nearest neighbors, Naïve Bayes, Random Forest, and XGBoost. Our findings revealed that Logistic Regression achieved the highest accuracy of 72% on the original dataset. In contrast, both Decision Tree and Random Forest demonstrated superior performance on the synthetic datasets, achieving an accuracy of 97.5%. This research underscores the potential of machine learning algorithms, particularly Decision Tree and Random Forest, in effectively predicting Thong Dee pomelo sweetness based on external physical characteristics, especially when leveraging synthetic data to enhance model training.

Predicting Boat Movement in Windy Conditions through Vector Field Analysis

Khonkaraponpan Rodpangwan,[1] Phatatcharee Udomsup,[1,*] Supanee Hnooheed,[1] Rattanasak Hama[2]

[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand

[2]Faculty of Science and Industrial Technology, Prince of Songkhla University, Surat Thani Campus, Surat Thani, 84000, Thailand

*e-mail: khotkaraponpan4698@gmail.com

Abstract:
This research aims to develop a method for predicting boat movements when facing different wind conditions by studying wind directions in various situations through the analysis of vector field flow. The objective is to understand how wind directions relate to or impact boat trajectories. We assume that the sea is a Euclidean plane and the boat is sailing with constant speed and consider four cases of the wind blowing directions in uv-plane, that is counterclockwise, clockwise, along the u-axis, and along the v-axis. We compute flow of vector filed φ (u, v) in each case, by solving system of differential equations, with initial conditions $u(0) = u0(t)$, $v(0) = v0(t)$, where $u0(t)$, $v0(t)$ are the direction of the boat in case of no wind. We give examples in specifics situation by using flow of vector field and use the boat route in the case there is no wind as initial condition and plot by using GeoGebra. The outcomes of this research or the derived equations are then utilized in information systems to enhances the efficiency of locating lost or rogue vessels, determining their approximate positions within a short timeframe Furthermore, this methodology can also be applied to finding suitable vessel routes during sudden strong wind conditions or adapted for the movement of other vehicles.

QUANTUM-ENHANCED DEEP LEARNING FOR PREDICTING PCSK9/NARC-1 INHIBITOR BIOACTIVITY: A NOVEL APPROACH TOWARDS CORONARY ARTERY DISEASE THERAPY

Nita Jongkraijak,[1,*] Chontiwa Chonchanokboon,[1] Kittiphop Khiansa,[1] Dr.Sarote Boonseng,[2] Thanatkrit Kaewtem[3]
[1]Mahidol Wittayanusorn School, Phutthamonthon, Nakhon Pathom, Thailand
[2]Department of Chemistry, Mahidol Wittayanusorn School, Phutthamonthon, Nakhon Pathom, Thailand
[3]Department of Mathematics and Computing Science, Mahidol Wittayanusorn School, Phutthamonthon, Nakhon Pathom, Thailand
*nita.jon_g32@mwit.ac.th:

Abstract:

According to the World Health Organization (WHO), coronary artery disease (CAD) is the leading cause of death worldwide. Unfortunately, the drugs currently available can only alleviate the symptoms initially, and the process of discovering new drugs for CAD requires significant time and resources. Deep learning has played an important role in the drug industry by decreasing the time and resources required during the drug discovery process. Focusing solely on the drug structure leads to reduced efficacy in the deep learning model, with a common challenge arising from the use of small datasets. This reason prompted the authors to develop a multi-input deep learning approach by integrating quantum energy data, specifically the highest occupied molecular orbital (HOMO) and the lowest unoccupied molecular orbital (LUMO) from quantum calculations, with drug molecule structures to predict the bioactivity of PCSK9/NARC-1 inhibitor drugs to address the limitation availability datasets. The molecular structures used in this study were sourced from three major databases: ChEMBL, PubChem, and BindingDB. The dataset was split into training, validation, and testing sets in a 70/20/10 ratio to ensure robust model evaluation. The quantum energy data were calculated by using B3LYP/6-31G(d,p) level of theory. The TensorFlow concatenate function was used to integrate HOMO/LUMO values with a Convolutional Neural Network (CNN) model. Then an attention mechanism was adopted to predict bioactivity (pIC_{50}). The results show that combining coupled HOMO/LUMO values with molecular structures, represented as Extended Connectivity Fingerprints (ECFP), achieves more accurate predictions, with an R^2 value of 0.8105 and a Mean Square Error (MSE) of 0.4629, compared to using only the CNN model, which yielded an R^2 value of 0.3995 and an MSE of 1.3913. The results indicate correlations between the HOMO/LUMO values of drugs with similar molecular structures and their bioactivity on the PCSK9/NARC-1 target protein, allowing for analysis of drug bioactivity on this target protein. The model's applicability is restricted due to its dependency on quantum energy data, which is time-consuming to obtain. Nevertheless, recent calculation methods such as semi-empirical approaches or quantum chemistry codes offer expedited alternatives. Therefore, in the future, the application of this technique holds potential for the design of pharmaceuticals targeting coronary artery disease, and its adaptation may extend to the development of medications for a range of other diseases.

SECURE DOMINATING SET OF SPLIT GRAPHS

Nuttapusit Keatipimol,[1,*] Nitithon Budnamphet,[1] Phattaraphorn Hama,[1] Apirat Wanichsombat[2]
[1]PSU Wittayanusorn Suratthani School, Thailand
[2] Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Thailand
*e-mail: nuttapusit.49@gmail.com

Abstract:
In Graph Theory, for any graph G = (V, E), we define a subset D of V as a dominating set of G if, for any u in V \ D, there exists a v in D such that {u, v} is edge in E. We further define a dominating subset S of V as a secure dominating set if, for any u in V \ S, there exists a v in S such that the union of (S \ {v}) and {u} is a dominating set. The secure domination number of a graph G is the minimum cardinality of a secure dominating set of G. A split graph is a graph whose vertex set can be partitioned into a clique and an independent vertex set. In this research, we first study the secure domination number of some split graphs. Finally, we examine the structure of secure dominating sets of split graphs where the cardinality of these sets equals the secure domination number of the split graphs.

Simulation of constellation deployment using Semi-parametric regression in celestial hemisphere

Hataipat Rakluangsakul,[1]Kavisara Jivarut,[1,*] Asst.Prof.Dr.Nathaphon Boonnam,[2,]Miss Suchanat Chupool,[1]

[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand

[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand

*e-mail: 2249@psuwitsurat.ac.th

Abstract:

This study presents a developed approach to simulate the deployment of constellations within the celestial hemisphere, employing semi-parametric regression techniques. Traditional deployment strategies often rely on deterministic models, which may not adequately capture orbital dynamics' complex and dynamic nature. This research introduces a semi-parametric regression that combines the flexibility of non-parametric methods with the interpretability of parametric models. By leveraging this hybrid approach, we aim to enhance the accuracy of constellation deployment predictions while providing insights into the underlying relationships between key deployment parameters and orbital characteristics. The study utilizes a comprehensive dataset of orbital parameters, historical deployment patterns, and celestial phenomena to train and validate the semi-parametric regression model. The results show the model's ability to adapt to various deployment scenarios, considering direction, magnitude, distance, right ascension, declination, azimuth, and altitude. We found that the highest R-squared in linear regression between azimuth and altitude factors of constellation, which are correlated, are Hamal, Libra, and Sagittarius with an accuracy of 0.9993, 0.9958, and 0.9935, respectively. As the demand for satellite-based services continues to increase, the findings in this study are significant for space agencies, satellite operators, and researchers involved in space systems engineering.

Some Properties of Geodesics on Minimal Surfaces

Porpach Phumsuwan,[1] Napatchol Somnakit,[1,*] Asst.Prof.Dr.Nathaphon Boonnam[2]
[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand
[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand
*e-mail: sporpiang@gmail.com

Abstract:

We analyzed the similarities and differences in the interplay between the fundamental shape, specifically the cylinder, and minimal surfaces, particularly the catenoid and helicoid. Following this, we delved into studying geodesic equations in theory and through implementation in Python code on Google Colab. Additionally, we elucidated the behaviors and connections of geodesics on the cylinder and catenoid, as well as on the cylinder and helicoid. We are concerned with the geodesic equations; each shape exhibits only two distinct forms. By substituting variables u' and v' into the geodesic equations within Google Colab, we could generate individual geodesic lines for each shape. The geodesic equations exhibit a similar relationship for a geodesic line around the parallel between a cylinder with $u'(0) = 1$, $v'(0) = 0$ and a catenoid with $u^{'}(0) = 1$, $v'(2) = 0$ and a helix between a cylinder with $u'(0) = 1$, $v'(0) = 0.5$ and a helicoid with $u'(1) = 0$, $v'(0) = 1$. Utilizing 3D printing technology to simulate complex shapes is a game-changer in surgical planning. By creating accurate models, surgeons could visualize and analyze anatomical structures with unparalleled precision, leading to better patient outcomes. With this innovative approach, we can predict and plan for the shortest wound and minimal scarring possible. The result is a faster and more efficient process that saves time and money and improves patient care

STOCHASTIC MODELLING OF TRAFFIC FLOW USING A MODIFIED TASEP INCORPORATING DRIVING BEHAVIOUR

Pongrawee Chumworathayee,[1] Watthanan Jatuviriyapornchai[2,*]
Department of Mathematics, Faculty of Science, Mahidol University, Bangkok 10400, Thailand
*e-mail: watthanan.jat@mahidol.ac.th

Abstract:

The classical traffic modelling approach usually relies on partial differential equations that describe overall traffic patterns, but it may overlook the interactions between individual vehicles. The Totally Asymmetric Simple Exclusion Process (TASEP), one of the most studied models in stochastic particle systems, has the advantage of providing the study of both microscopic interactions and macroscopic traffic dynamics. Despite its simplicity, it can reproduce many complicated traffic flow and congestion patterns.

In this study, we propose a modified version of TASEP with transition rates that reflect driving behaviours under various conditions. We use mean-field analysis to derive macroscopic properties from microscopic interactions to understand traffic dynamics across different scales. Monte Carlo simulations are performed under periodic and open boundary conditions to corroborate with the model. The modified TASEP is then compared against empirical traffic data from various urban environments, including Bangkok's Chalong Rat Expressway, Manchester's Inner Ring Road, and California's Interstate 405 (I405N, I405S).

The results show that the modified TASEP accurately captures key traffic phenomena and reproduces the influence of driving behaviour on traffic flow. By incorporating driving behaviour factors, we provide a more precise representation of traffic dynamics, offering a useful tool for analyzing traffic congestion in complex urban settings.

THE DEVELOPMENT OF FAILED PRINT DETECTION SYSTEM IN 3D PRINTER

Nada Jeana,[1,*] Punyapat Pumma,[1] Wanida Saetang[2]

[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand

[2]Faculty of Science and Industrial Technology, Prince of Songkhla University, Surat Thani Campus, Surat Thani, 84000, Thailand

*e-mail: nadajeana2550@gmail.com

Abstract:
3D Printing technology has gained significant attention due to its ability to create various objects conveniently meet user's needs. However, printing complex objects may fail and most failures are caused by Spaghetti printing, which costs time and materials. Therefore, this project developed a system for detecting failed prints in 3D printers by creating web application that can detect failed prints in real time and sent notifications to the users immediately by using Supervised Machine Learning with open-source library called OpenCV for image or video processing and use real time detection algorithm, YOLO Model. With dataset, normal printed 500 pictures and failed spaghetti printed 500 pictures and test the performance of this system using Confusion Matrix, that resulted the Accuracy to be 80.5%, Precision, Recall, F1-score of 0.93, 0.774, and 0.827, respectively and can notify to users after detecting failed print immediately. So, this system can be used in real situations and increase efficiency of 3D printers by decreasing wasted time and materials after detecting failed print.

THE GEOMETRIC ALGORITHM FOR IDENTIFYING THE CORNERS OF CONVEX BODIES COMPOSED BY CIRCULAR ARCS

Asama Jampeepan,[1,*] Supanut Chaidee,[2] Papangkorn Inkeaw[3]
[1]Program in Applied Mathematics, Department of Mathematics, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Department of Mathematics, Faculty of Science, Chiang Mai University, Thailand
[3]Data Science Research Center, Department of Computer Science, Faculty of Science, Chiang Mai University, Thailand
*e-mail: asama_ja@cmu.ac.th

Abstract:
This paper presents a mathematical approach for accurately identifying the iris boundaries in photographic pictures, specifically focusing on eye position detection. This issue is of significance for several applications, especially in the field of eye tracking. Suppose that the detected data of the iris combined with eyelids is given. We assumed that the shape of the detected data is represented by the boundary of a convex body composed of circular arcs that represent the boundaries of the iris, upper eyelid, and lower eyelid. The objective is to identify the iris boundary by generating points on the boundary of the convex body that correspond to the position of the eye. We investigate the geometric properties of convex bodies, specifically focusing on their corners, which are non-differentiable points. An algorithm is then established to classify points to the iris boundary or the eyelids. This is done by utilizing convex hull and exterior angle analysis. The set of finite points around the boundary of the iris can be used to approximate the center of the iris. The experiments were conducted using both ideally generated data and real data obtained from photographic images of eyes.

WIN-PROBABILITIES FOR COMPARING TWO NEGATIVE BINOMIAL RANDOM VARIABLES

Patcharapa Hanmungtham,[1] Aaron Nielsen,[2] Monchai Kooakachai[1,*]
[1]Department of Mathematics and Computer Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
[2]Department of Statistics, Colorado State University, Fort Collins, CO, United States
*e-mail: Monchai.K@chula.ac.th

Abstract:
Win-probabilities are defined as the probabilities that a future observation from one process will be better than, or at least as good as, a future observation from another process. Previous studies have focused on deriving point and interval estimates of win-probabilities for comparing processes generated from the same distribution with distinct parameters, such as Poisson, Binomial, and Weibull. In this work, we build on this concept and extend it to conduct statistical inference on the win-probability parameter when comparing two negative binomial processes with different success probabilities. We specifically examine both exact and approximate values of these win-probabilities. Numerical studies show that as the number of successes increases indefinitely, approximations using the normal distribution become increasingly accurate. Furthermore, a thorough comparison between the normal and Poisson approximations will be illustrated. The study also explores the construction of bootstrap confidence intervals for win-probabilities, with simulation results confirming the reliability of these intervals through coverage probability analysis.

E-ENERGY / ENVIRONMENTAL & EARTH SCIENCE / MATERIALS SCIENCE / CHEMICAL TECHNOLOGY

A STUDY ON THE POTENTIAL OF GREEN MUSSEL AND COCKLE SHELLS AS SUSTAINABLE ALTERNATIVES FOR RAW MATERIALS IN CERAMIC GLAZE PRODUCTION

Sureemas Meksawangwong*, Saijit Daosukho
Community Technology Division, Department of Science Service, Bangkok, Thailand
*e-mail: sureemasmek@gmail.com

Abstract:

This research investigated the potential of green mussel (MS) and cockle (CK) shells as sustainable alternatives to traditional raw materials in ceramic glaze production. Focusing on the W31 glaze formula, the study aimed to reduce the environmental impact of shell waste while exploring the feasibility of creating transparent glazes. Both mussel and cockle shells underwent chemical processing, grinding, and incorporation into the W31 glaze composition. Applied to different clay bodies, the resulting glazes were fired at 1230 °C for 30 minutes and exhibited varying levels of transparency, gloss, strength, and color. These differences were attributed to the unique chemical and structural properties of each shell type. X-ray diffraction (XRD) and X-ray fluorescence (XRF) analyses revealed that the calcium carbonate from both types of shells had a chemical composition similar to commercial products. The XRD analysis confirmed that the primary phase of the synthesized sample was aragonite. Color analysis using the International Commission on Illumination (CIE) system showed that the aragonite crystals present in the treated cockle shells contributed to increased glaze transparency, comparable to the W31 glaze formula. This study demonstrates the potential of transforming abundant shell waste into a valuable resource for the ceramic industry.

ACTIVATED CARBON DERIVED FROM RICE HUSKS ENHANCED BY METHYLENE BLUE AND GAMMA IRRADIATION FOR SUPERCAPACITORS

Thannithi Anusontiwong,[1] Jittiyada Surawattanawiset,[1] Natavoranun Suwattanapongched,[1] Suranan Anantachaisilp,[1,*], Tanagorn Sangtawesin,[2,*]
[1]Kamnoetvidya Science Academy, Rayong, Thailand
[2]Thailand Institute of Nuclear Technology (Public Organization), Nakorn Nayok 26120, Thailand
*e-mail: suranun.a@kvis.ac.th, tanagorn@tint.ac.th

Abstract:
Glutinous rice husk (GRH) was processed into activated carbon (GAC) for electrodes in supercapacitors. The production of activated carbon involved chemical activation (KOH), followed by carbonization at 800 °C for 2 hours under N_2 atmosphere. Furthermore, methylene blue was introduced to the activated carbon to enhance pseudocapacitive effects by allowing N/S to be adsorbed at the outer layer. Two post-treatment methods of methylene blue modification were employed: gamma irradiation at doses of 25 kGy (GAC-25), 50 kGy (GAC-50), and 100 kGy (GAC-100), and hydrothermal treatment (GAC-Hdt). Among samples subjected by gamma irradiation at vary doses, including GAC-25, GAC-50, and GAC-100, the GAC-25 exhibited the highest specific capacitance of 127.9 F g^{-1} at 0.5 A g^{-1}, enhancing up to 84.8% compared to GAC, which is attributed to pseudocapacitive effects. Meanwhile, GAC-Hdt demonstrated a specific capacitance of 242.1 F g^{-1} at 0.5 A g^{-1} with the highest specific surface area of 1846.9 m^2 g^{-1}. However, GAC-25 behaves like a pseudocapacitor, whereas GAC-Hdt results in EDLC characteristics which can be observed from increasing scan rate. This indicates the potential development of gamma irradiation as an alternative method for post treatment that does not require additional corrosive chemicals and heat.

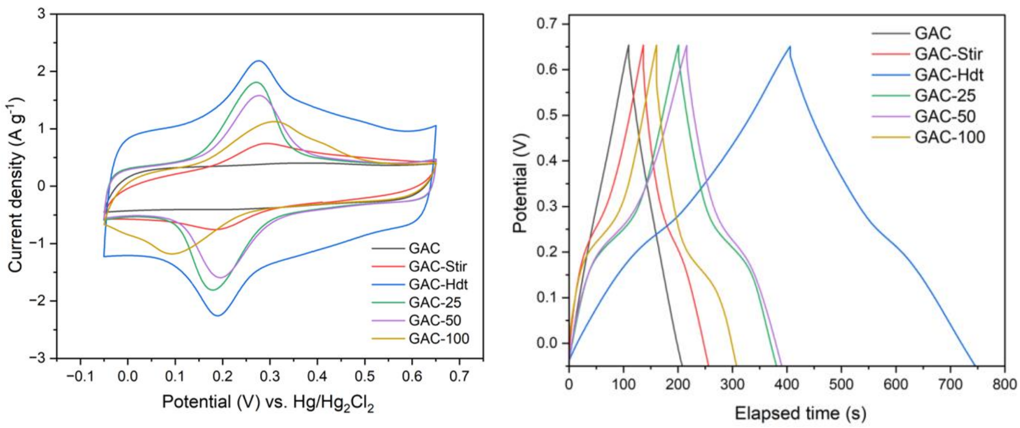


Figure 1.
Cyclic voltammetry curves of GACs at a scan rate of 5 mV s^{-1} (left) and galvanostatic charge-discharge curves of GACs at a current density of 0.5 A g^{-1} (right)

Ag-Cu CATALYSTS FOR THE EFFICIENT ELECTROCHEMICAL CONVERSION OF HMF TO BHMF

Geon Hyeong Park, Myung Jong Kang*
Department Chemistry, Gangneung-Wonju National University, Gangneung, 25457,

Republic of Korea

*e-mail: mjkang@gwnu.ac.kr

Abstract: HMF (5-Hydroxymethylfurfural) is a precursor for various value-added products, including biofuels, pharmaceuticals, and chemicals, through reduction reactions. Nonetheless, existing reduction processes for HMF necessitate high pressure and temperature, which limits their efficiency. An electrochemical reduction has attracted considerable attention due to its ability to operate under ambient temperature and pressure conditions.

In electrochemical reduction, noble metal catalysts demonstrate high efficiency in converting HMF to BHMF (2,5-Bis(hydroxymethyl)furan); however, their high cost presents challenges for practical applications. Thus, this study investigates the use of a relatively cost-efficient Ag-Cu catalyst for this reduction. While the individual application of Ag and Cu resulted in low selectivity and conversion rates for BHMF, the electrochemical deposition of Ag onto a Cu film significantly enhanced the overall efficiency of the process.

Herein, we studied on a highly selective Ag-Cu catalyst for the conversion of HMF to BHMF. The structural characteristics of the synthesized electrodes were characterized using X-ray diffraction (XRD), while surface and compositional analyses were conducted through scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDS).

Boosted Electrochemical Performance of High-Energy Lithium-Sulfur Batteries Using Synthesized MXene and Carbon Nitride

Young Soo Kim, Young Ho Park, Yiseul Yu, Insik In* and Seung Jun Lee*

Department of IT-Energy Convergence (Brain Korea 21(FOUR)), Korea National University of Transportation, Chungju 27469, Republic of Korea

*Email: juny9906@naver.com and sjlee@ut.ac.kr

Abstract:

Lithium-Sulfur batteries (LSBs) are emerging as promising storage devices for the post-Lithium era, offering six times the capacity of conventional Lithium-ion batteries. However, LSBs face challenges, particularly the shuttle effect, which hampers their performance. In this study, Carbon Nitride and MXene were employed to enhance cycle stability by preventing the shuttle effect. The synthesis of the CxNy phase via the hydrothermal method, confirmed by XRD analysis, plays a crucial role in this effort. By incorporating CxNy and MXene into the composite, steps were taken to coat the separator using the vacuum filtration, thereby mitigating the shuttle effect and improving electronic conductivity. Additionally, the use of 1 M LiTFSI in DME as the electrolyte enhances overall performance. Electrochemical analytical techniques, including cyclic voltammetry, electrochemical impedance spectroscopy, and galvanostatic charge-discharge studies, are employed to assess the assembled LSBs. The findings reveal a significant improvement in electrochemical performance, characterized by strong specific capacity retention and improved cycling stability even after rigorous C-rate analysis. This work makes a substantial contribution to advancing energy storage systems by providing valuable insights into the design and optimization.

CERAMIC MATERIAL $CaCu_3Ti_4O_{12}$ DOPED WITH Sr^{2+} and Al^{3+} IONS AT Ca^{2+} AND Ti^{4+} POSITIONS : STUDY AND DEVELOPMENT OF MATERIALS FOR APPLICATION AS CERAMIC CAPACITORS

Nattapong sukseangjaew [1] Jakkree Boonlakhorn [2,*] Pornjuk Srepusharawoot [3]

[1]Bachelor of Education Program in Physics, Faculty of Education, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[2]Department of Basic Science and Mathematics, Faculty of Science and Digital Innovation, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[3]Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand

*e-mail: jakkree.b@tsu.ac.th

Abstract:
This study conducted a detailed examination of the structure, electrical properties, and responses of the ceramic $Ca_{0.95}Sr_{0.05}Cu_3Ti_{4-x}Al_xO_{12}$ (x = 0.05, 0.10, and 0.15). X-ray diffraction analysis revealed that all the ceramics after firing exhibited the presence of the $CaCu_3Ti_4O_{12}$ phase. The incorporation of Sr^{2+} and Al^{3+} into the $CaCu_3Ti_4O_{12}$ structure caused changes in the microstructure. Adding Sr^{2+} and Al^{3+} into the $CaCu_3Ti_4O_{12}$ structure demonstrated the ability to maintain a high dielectric permittivity while simultaneously reducing the loss tangent . The $Ca_{0.95}Sr_{0.05}Cu_3Ti_{3.85}Al_{0.15}O_{12}$ ceramic showed a high dielectric permittivity of approximately 1.01×10^5 and a low tangent loss of about 0.0697. Impedance spectroscopy analysis indicated that the $Ca_{0.95}Sr_{0.05}Cu_3Ti_{4-x}Al_xO_{12}$ ceramic has a heterogeneous microstructure, displaying semiconductor grains and insulating grain boundaries. Thus, the high dielectric permittivity observed in the $Ca_{0.95}Sr_{0.05}Cu_3Ti_{4-x}Al_xO_{12}$ ceramic might be attributed to this heterogeneous microstructure.

CONVERSION OF GALACTOSE TO 5-HMF IN SUBCRITICAL WATER INTENSIFIED USING MICROWAVE-CARBOCATALYSIS

Risa Fukuda,[1] Armando T. Quitain,[2,]* Yusuke Inomata,[3] Tetsuya Kida[3]
[1]Department of Materials Science and Applied Chemistry, Kumamoto University, Japan
[2]Center for International Education, Kumamoto University, Japan
[3]Faculty of Advanced Science and Technology, Kumamoto University, Japan
*e-mail: quitain@kumamoto-u.ac.jp

Abstract:
Fossil fuels, such as coal, oil, and natural gas, remain as the primary resource in producing energy and essential chemicals. However, because of their dwindling reserves and negative environmental impact, research has focused on alternative sources. In recent years, there has been growing research on the conversion of biomass to 5-hydroxymethylfurfural (5-HMF), which is a versatile platform chemical that can be converted to fuels and plastics. In this study, we propose the use of galactose, which is a sugar commonly found in algal biomass, to produce 5-HMF. Subcritical water, which dissociates readily into the catalytically active H^+ and OH^- ions, was used as the reaction medium. Microwaves (MW) were used as the heating source coupled with a carbocatalyst: graphene oxide (GO), reduced graphene oxide (rGO), or silicon carbide (SiC). GO is a bifunctional catalyst with a graphitic region (MW absorptive, Lewis acidity) and oxygen functionalities (Bronsted acidity). Meanwhile, rGO is more stable derivative of GO at higher temperatures, but with fewer oxygen functionalities. Lastly, SiC possesses a higher MW absorptivity that allows for more efficient localized heating, thus promoting water dissociation on its surface. This feature of SiC prevents the degradation of HMF as it diffuses from the SiC surface where it is produced to the bulk solution that has a lower temperature. Figure 1 shows that all three catalysts exhibited similar performances in terms of galactose conversion and 5-HMF yield. Therefore, localized heating alone is an effective driving force to produce 5-HMF from galactose in the proposed system. Future studies will be focused on investigating the interaction between the catalysts and the substrates to determine the mechanism.

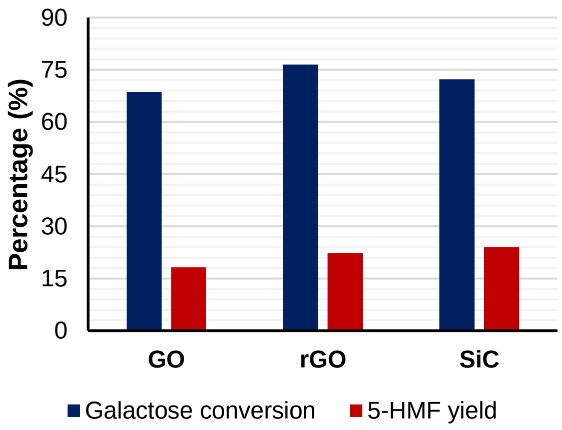


Figure 1. Catalytic performance of graphene oxide (GO), reduced graphene oxide (rGO), and silicon carbide (SiC) in the conversion of 5-hydroxymethylfurfural (5-HMF) from galactose. [Reaction conditions: 200 °C, 15 min, 250 mg galactose/25 mL H_2O, 10 mg catalyst]

DEVELOPMENT OF ECOFRIENDLY LIQUID SPRAYABLE MULCH FILMS BASED ON CASAVA STARCH/NATURAL RUBBER LATEX BLENDS CONTAINING RICE HUSK POWDER

Sarawut Prasertsri,[1,*] Chamaiphon Suriya,[1] Phinitnan Suphon,[1] Phanupong Pomsuwan,[1] Pranee Nuinu,[1] Sansanee Srichan,[1] Saowaluk Boonyod,[1] Chaiwute Vadjung,[1] Sayant Saengsuwan[1,2]

[1]Innovation and Sustainability in Advanced Natural Rubber and Polymers (ISANRAP) Research Group, Department of Chemistry, Faculty of Science, Ubon Ratchathani University, Warinchamrab, Ubon Ratchathani 34190, Thailand
[2]Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Ubon Ratchathani University, Warinchamrab, Ubon Ratchathani 34190, Thailand
*e-mail: sarawut.p@ubu.ac.th

Abstract:
Liquid mulch film, as novel biodegradable mulch, fabricated by spraying method is interesting because it effectively regulates soil temperature and moisture and has the advantages of being applied without terrain restriction and biodegradable. In this study, we formulated a liquid biopolymer from cassava starch (CS) and natural rubber latex (NRL) mixed with rice husk powder (RHP) to develop the sprayable mulch film. Firstly, the mixture of gelatinized CS and NRL was prepared at various CS/NRL ratios of 100/0, 90/10, 80/20 and 70/30 %wt/wt. In all formulations, 2.5 %wt glycerol was added as a plasticizer. Furthermore, the effect of RHP content at various amounts (0-20 %wt) on the properties of biopolymer films was studied. From the results, when increasing the amount of NRL in biopolymer film, the modulus reduced and tensile strength increased. As a result of the elasticity of NR and structural intrinsic linkages between CS and NR. The optimum formulation of CS/NRL is 80/20 %wt/wt. When RHP was added into CS/NRL mixture, the viscosity of liquid mixture, the tensile modulus and biodegradability with soil burial test of the film tended to increase, while the tensile strength of the film decreased. For the sprayable ability in trial fields, the liquid mulch film of 80/20 CS/NRL containing 10 %wt RHP having modulus, tensile strength of 0.25 and 2.09 MPa, respectively, and soil burial degradation at 60 day of 40%, can be applicable with the highest wicking depth and retaining moisture and temperature in the soil.

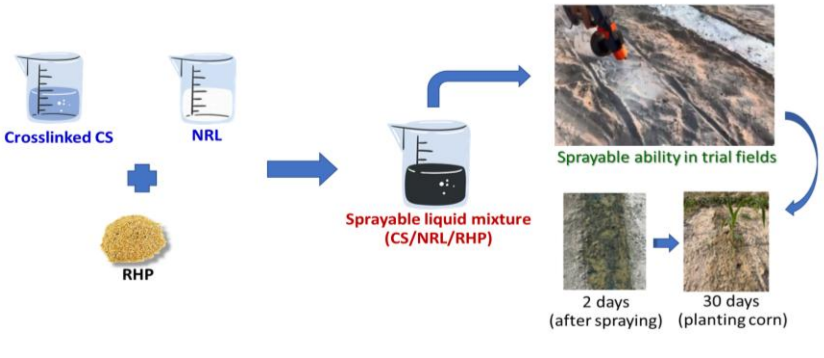


Figure 1.
The schematic procedure for preparing liquid mulch film and spraying test in trial fields

DEVELOPMENT OF POROUS CORDIERITE-BASED MOLD FOR GLASS SLUMPING PROCESS FROM INDUSTRIAL WASTE

Suneeporn Pokaew,[1,*] Thanakorn Wasanapiarnpong,[2] Nithiwach Nawaukkaratharnant[2,3]
[1]Construction Materials Group, Division of Engineering Materials, Department of Science Service, Bangkok, 10400, Thailand
[2] Upcycled Materials from Industrial and Agricultural Wastes Research Unit, Department of Materials Science, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[3] Metallurgy and Materials Science Research Institute (MMRI), Chulalongkorn University, Bangkok, 10330, Thailand
*e-mail: suneeporn@dss.go.th

Abstract:
Recently, recycling of industrial solid waste is focused due to environmental reasons. This research studied the utilization of cordierite waste obtained from a cordierite honeycomb ceramic production process as a raw material in mold preparation using mortar technique for glass slumping process. Phase compositions of the cordierite waste mainly consist of cordierite which has low thermal expansion coefficient ($1\text{-}3\times10^{-6}$ °C^{-1}, 25-800 °C), and high melting point (1460 °C). Therefore, this waste is suitable to use as a raw material for ceramic that can be operated at high temperature. The mold for the glass slumping process is used to transform the shape of a simple glass plate into a more complex shape at 600-800 °C. The waste was milled by wet ball-milling and then mixed with other raw materials including white Portland cement as a binder. The mortar mixtures were poured and shaped in metal mold and were then left at room temperature environment for setting. The formed samples were then dried and fired at 1150 °C for 2 h. The physical properties, phase composition, thermal expansion coefficient and compressive strength of fired samples will be presented.

DIVERSITY OF POTHOLE LANDFORM AT SAM SIB SANG HILL GEOSITE, SUNG NOEN, NAKHON RATCHASIMA

Rattanaphorn Hanta[1,]*, Chotima Yamee[2], Phawinee Maihorm[2], Wanthip Buasing[2], Boonrong Arsairai[1], Parichat Kruainok[3,4], Krongkaew Jenjitpaiboon[3,4]

[1]School of Geotechnology, Institute of Engineering, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand
[2]Mineral Resources Offices (Region 2), Department of Mineral Resources, Khon Kaen, 40000, Thailand
[3]The Northeastern Research Institute of Petrified Wood and Mineral Resources, Nakhon Ratchasima Rajabhat University, Mueang, Nakhon Ratchasima 30000, Thailand
[4]Khorat UNESCO Global Geopark, Nakhon Ratchasima, 30000, Thailand
*e-mail: hantar@sut.ac.th

Abstract:

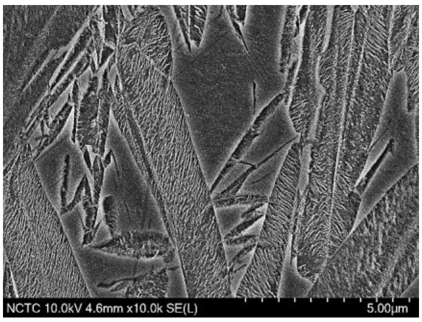
The Sam Sib Sang (SSS) Hill geoheritage, the geosite of the Khorat UNESCO global geopark, is a significant part of the inner row of the cuesta range within this renowned geopark. The SSS Hill is unique in its geological features, with a diverse range of potholes that provide a rich learning experience for tourists and public learners. Detailed geological information is needed to give geosite information. This study aims to explore the pothole landform features present at this geosite, potentially enhancing our understanding of the Khorat UNESCO Global Geopark. The potholes were found on a hilltop of the sandstone bedrock of the Phu Phan Formation, Khorat Group, early Cretaceous (120 Ma) at the elevation of 386 meters above mean sea level and 80meters above the ground, which raises the question of how and when these natural potholes were formed. During the investigation by field and drone surveying, a thrilling process of discovery, various forms of potholes were found according to the strength and direction of the stream current. Pothole sets were found from three principal elevations with different hole dimensions. The first group was the previously known SSS hill, which had a golf hole-like dimension, 20 to 30 centimeters in diameter and 80-100 centimeters in depth, and the bowl-like and earthen jar-like 80 centimeters in diameter and 50-60 and over 100 centimeters in depth at the elevation of 377-386 meter above MSL. The second group of potholes is found at the lower elevation and at the northeast dipping downslope of the hilltop bedrock, which yields the waterfall if the water is available. Its shape is unique: shallow, 40-50 centimeters in-depth, 2.4 meters in width, and 4.0 meters in length, which resembles a bathtub, technically called a Plunge pool'. The last set is near the foothills (306-308 meters above MSL), where the stream current hit the dipping bed and developed the lateral potholes on the bedding section, and contemporaneous flow over the bedrock ground, which has a joint fracture developed the elongated pothole along the joint fracture in the northwest-southeast direction. As these stream water, a distance of five kilometers is obtained from the rain shower, and all these potholes are named the potholes of the rainwater stream, which is a temporary stream. As the potholes were found from the hilltop, mid-hill, and foothill, the name "the Pothole Valley" is well-described the SSS Hill, which has only a significant stream flowing and draining the rainwater. The significance of this site is that various forms of potholes can be seen from a single site, and shall be promoted to be a learning site of the pothole development.

DUCTILITY ENHANCEMENT OF A SINTERED MULTIPHASE STEEL BY PARTITIONING PROCESS

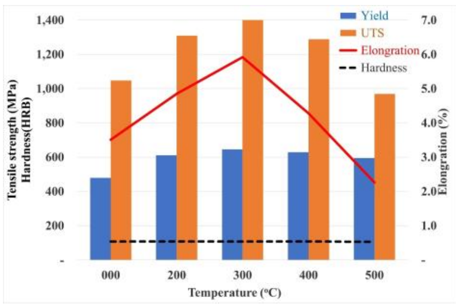
Prapas Kunnam*, Monnapas Morkotjinda, Nattaya Tosangthum, Thanyaporn Yotkaew, Ruangdaj Tongsri

Functional Materials for Novel Engineering Applications Research Team (FMAT), Metal and Manufacturing Process Research Group, National Metal and Materials Technology Center, 114 Paholyothin Road, Khlong Nueng, Klong Luang, Pathum Thani 12120, Thailand
*email: prapask@mtec.or.th

Abstract:
Sintered multiphase steels with strength and ductility synergy are ideally demanded as potential candidates for future applications. However, they have poor ductility with elongation values of 3.0-4.0 % due to high fraction of martensite. In this work, the approach to enhance ductility, known as partitioning process, was employed to improve sintered steel matrix. The experimental sintered steel, namely AFSiC steel, was produced from diffusion-bonded Fe-5.0Ni-1.0Mo-2.0Cu (Distaloy AF) powder mixed with 4.0 wt. % silicon carbide. The as-sintered AFSiC steel showed a microstructural feature consisting of a black particle enveloped with multiphase matrix consisting of bainitic ferrite (B/F) laths, retained austenite (A) blocks and films, and martensite (M) plates. Under different partitioning temperatures, microstructural evolution was observed as carbide precipitation and austenite fraction change. Carbide precipitation was clearly observed in plate components of AFSiC steel partitioned at 300 °C (Figure 1a). The austenite fraction was maximized at partitioning temperature of 300 °C, leading to the maximum elongation value (Figure 1b). With increasing partitioning temperature of up to 300 °C, the strength-ductility synergy was achieved in the as-partitioned AFSiC steel. The partitioning process with a proper condition was successfully applied to enhance both strength and ductility of a sintered multiphase steel.



(a)



(b)

Figure 1 (a) microstructure of AFSiC steel partitioned at 300 °C and (b) mechanical properties of sintered and partitioned AFSiC steel samples.

DYEING IMPROVEMENT AND UV PROTECTION PROPERTIES OF SAPPAN HEARTWOOD DYED COTTON USING CHITOSAN/NANOZINC OXIDE COMPOSITE

Panittra Patinyabandit[1], Waraporn Cheunsuwan[1], Chaipat Lapinee[1], Kanlaya Jumpatong[1], Chutikarn Junta[2], Sunsanee Komboonchoo[2,*]
[1]School of Science, University of Phayao, Phayao 56000, Thailand
[2] Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: sunsanee.k@cmu.ac.th

Abstract:
The interest in using natural dyes for textiles has gained momentum due to increased awareness of environmental and health aspects, as well as the benefits of sustainable resource utilization. Sappan heartwood is widely used as a natural dyeing agent for producing a red color; however, textiles dyed with sappan heartwood tend to fade easily due to various environmental factors. This research aims to improve the dyeing and UV protection properties of chitosan/nanozinc oxide composite-coated cotton fabrics dyed with sappan heartwood. The dyed cotton fabrics were characterized by the percentage of dye exhaustion, color coordinates, color strength, SEM analysis, and ultraviolet protection factor (UPF). The dyed cotton fabrics were tested for light and wash fastness using standard methods. The optimum dyeing conditions were found to be 75 °C for 120 minutes, using a liquor ratio of 1:30. The chitosan/nanozinc oxide composite-coated cotton fabrics dyed with sappan heartwood showed an increase in color strength. The dyed cotton fabrics exhibited a color strength of 1.64±0.03, while the color strength of chitosan/nanozinc oxide composite-coated cotton fabrics dyed with sappan heartwood increased to 9.66±1.08 and 7.48±1.46 when using commercial chitosan and analytical chitosan, respectively. Furthermore, chitosan/nanozinc oxide composite-coated cotton fabrics dyed with sappan heartwood showed improved color fastness to light and washing, achieving levels of 2-3 and 3, respectively. Additionally, these composite-coated cotton fabrics provided excellent UV protection, with a UPF of 2000 and UVA/UVB transmittance as low as 0.05%.

EARTHEN HOUSE WITH CROSS VENTILATION IMPROVING NATURAL COOLING PERFORMANCE

Waraporn Rattanongphisat* and Chirawat Thongkaemkaeo
Energy Technologies Building Laboratory, Department of Physics, Faculty of Science, Naresuan University, Phitsanulok, Thailand
*e-mail: warapornr@nu.ac.th

Abstract:
Construction materials of building envelope significantly contribute to indoor thermal comfortable especially in hot climate countries. Parameters affect the selection of these materials are physical and thermal properties including apparent density, thermal conductivity and thermal diffusivity. In addition, the environmental impact of these materials is as important as thermal properties. In this paper, a combination of natural and earth materials in the forms of adobe brick for building envelope was investigated by experimentation method. The adobe brick was constructed from sandy clay available in Wang Thong district, Phitsanulok, rice husk at the same area and tap water. The appropriate ratio of those combination was selected based on the stable formation of brick in the experiments. Low thermal conductivity of adobe brick confirmed its suitable choice as building structure. Several hundred pieces of adobe brick were manmade produced. In the production process the wet adobe brick were sun dried before build the cubical test house. Two identical, internal dimension, cubical house of 1 m were constructed using adobe brick and clay brick, conventional, materials. These two houses were tested outside at Naresuan University, Phitsanulok, Thailand for a tropical climate condition. Experimental data analysis displayed the thermal characteristics of temperature distribution during the day according to the variation of solar radiation. Overall heat transmission through north and west walls of an earthen house lower than a clay house by 1.2 W, in other words, heat reduction of 16 % was achieved by earthen house. Combining natural cross flow ventilation via house opening, the heat reduction of around 30 % can be obtained. In brief, earthen house made of adobe brick outperform conventional clay brick house in terms of heat reduction through building envelope thus could effectively be considered for energy conservation.

EFFECT OF COPPER ADDITION ON MICROSTRUCTURE AND PROPERTY OF SINTERED Fe-Cr-Mo-Si-C-(Cu) ALLOYS PRODUCED UNDER SLOW COOLING

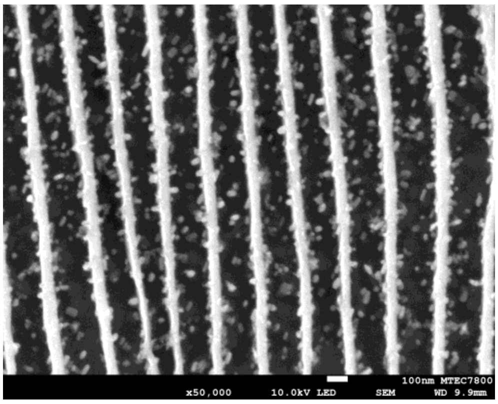
Arisara Wanalerkngam[1], Sarum Boonmee[1], Thanyaporn. Yotkaew[2], Pennapa Muthitamongkhol[2], Nattaya Tosangthum[2], Ruangdaj Tongsri[2]

[1]School of Metallurgical Engineering, Institute of Engineering, Suranaree University of Technology, Nakorn Ratchasima, 30000, Thailand
[2]Particulate Materials Processing Technology (PMPT), Metal and Manufacturing Process Research Group, National Metal and Materials Technology Center, 114 Paholyothin Road, Khlong Nueng, Klong Luang, Pathum Thani 12120, Thailand

*e-mail: arisara.jane@gmail.com

Abstract:
The sintered Fe-Cr-Mo-Si-C-alloys, produced by adding 4.0 wt. % silicon carbide to pre-alloyed Fe-1.5Cr-0.2Mo and Fe-3.0Cr-0.5Mo powders, showed a common microstructural feature resembling that of a fully pearlitic ductile iron, i.e., the microstructural feature comprised a black particle enveloped with ferrite halo and pearlite nodules. Copper additions, with varied content of 1.0, 2.0, 3.0 and 4.0 wt. %, led to changes of microstructural components, such as prior austenite grain size, black particle count, proeutectoid carbide thickness, abnormal ferrite thickness, pearlite colony size, and pearlite interlamellar spacing, in sintered Fe-Cr-Mo-Si-C-(Cu) alloys. Cu precipitates existed in both nano- and micro-particles (Figure 1) and contributed precipitation strengthening to sintered Fe-Cr-Mo-Si-C-(Cu) alloys. Tensile strength and elongation showed inverse relationships with microstructural factors, such as black particle count, proeutectoid carbide thickness, abnormal ferrite thickness, and pearlite interlamellar spacing. The sintered Fe-Cr-Mo-Si-C-(Cu) alloys, produced from pre-alloyed Fe-1.5Cr-0.2Mo and copper powders, showed better mechanical properties.

(a)



(b)

Figure 1 (a) nano Cu particle in a sintered Fe-Cr-Mo-Si-C-(Cu) alloy, with 1.0 wt. % Cu and (b) micro Cu particles in a sintered Fe-Cr-Mo-Si-C-(Cu) alloy, with 4.0 wt. % Cu.

EFFECT OF MOLYBDENUM AND SILICON CARBIDE ON MICROSTRUCTURES AND PROPERTIES OF SINTERED Fe-Mo-Mn-Si-C ALLOYS

Preeya Nakornkaew, Thanyaporn Yotkaew*, Rungtip Krataitong, Nattaya Tosangthum, Ruangdaj Tongsri

Particulate Materials Processing Technology (PMPT), Metal and Manufacturing Process Research Group, National Metal and Materials Technology Center, 114 Paholyothin Road, Khlong Nueng, Klong Luang, Pathum Thani 12120, Thailand

*e-mail: thanyy@mtec.or.th

Abstract:
Two sintered Fe-Mo-Mn-Si-C alloys with different molybdenum contents (0.50 and 0.85 wt. %) were produced by alloying silicon and carbon elements, via silicon carbide addition with varied amounts of 0.5-4.0 wt.% with 0.5 increment, to pre-alloyed Fe-0.5Mo-0.15Mn and Fe-0.85Mo-0.15Mn powders. The sintered alloys were slowly cooled in a sintering furnace. The microstructures of the sintered Fe-Mo-Mn-Si-C alloys changed with added silicon carbide content. With up to 2.0 wt. % silicon carbide additions (or up to 0.60 wt. % carbon), the sintered alloys exhibited hypoeutectoid steel microstructures consisting of polygonal ferrite plus eutectoid decomposition products consisting of ferrite and carbide mixtures formed by non-cooperative growth mode. The non-cooperative ferrite and carbide mixtures confirmed the pearlite suppression by molybdenum in Fe-Mo-Mn-Si-C alloys with silicon carbide contents of up to 2.0 wt. % (or carbon contents of up to 0.60 wt. %). The pearlite suppression by molybdenum became weaker when silicon carbide amounts of ≥ 2.5 wt.% (or ≥ 0.75 wt. % carbon) were added. Regarding the molybdenum effect, two different pearlite structures (ferrite + $M_{23}C_6$ and ferrite + M_3C lamellae) existed in sintered Fe-0.50Mo-0.15Mn-Si-C alloys with silicon carbide contents of 2.5-3.0 wt. % (0.75-0.90 wt. % carbon) whereas the ferrite + M_3C pearlite became dominant in the sintered alloys with silicon carbide contents of higher than 3.0 wt. % (or carbon contents of higher than 0.90 wt. %). When molybdenum content was increased to 0.85 wt. % it was observed that retained austenite existed in the form of ausferrite in sintered Fe-0.85Mo-0.15Mn-Si-C alloys with silicon carbide contents of 2.0-3.5 wt. % (or carbon contents of 0.60-1.05 wt. %) whereas the ferrite + M_3C pearlite dominated in the sintered alloy with 4.0 wt. % silicon carbide (carbon content of 1.2 wt. %). Tensile strengths of the sintered alloys increased with increasing added silicon carbide content. However, elongation values decreased with increasing added silicon carbide content of up to 2.0 wt. %, after which the elongation values increased.

EFFECTS OF Fe^{3+} DOPING ON STRUCTURE AND DIELECTRIC PROPERTIES OF $CaCu_3Ti_4O_{12}$ CERAMICS

Pariwat Dumnui [1] Jakkree Boonlakhorn [2,*] Pornjuk Srepusharawoot [3]

[1]Bachelor of Education Program in Physics, Faculty of Education, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[2]Department of Physical Science, Faculty of Science and Digital Innovation, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[3]Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand

*e-mail: jakkree.b@tsu.ac.th

Abstract:
The structure, dielectric properties, and electrical response of $CaCu_{3-x}Fe_xTi_4O_{12}$ (x=0, 0.05, 0.10, and 0.15) were all thoroughly investigated in this study. All of the sintered ceramics contain a $CaCu_3Ti_4O_{12}$ phase, according to the XRD analysis. Microstructural changes can be discerned after the addition of Fe^{3+} doping. Importantly, the doped samples exhibit a significant decrease in dielectric permittivity in comparison to the undoped sample. At 1 kHz, the dielectric permittivity of $CaCu_{3-x}Fe_xTi_4O_{12}$ decreases from 2.15×10^4 to 2.47×10^2 with increasing x from 0 to 0.15. In the dielectric results, it was found that the doped ceramics exhibited low-frequency dielectric relaxation. In $CaCu_{3-x}Fe_xTi_4O_{12}$ ceramics, an extrinsic factor, such as an internal barrier layer capacitor structure, can be the primary cause of the dielectric response. However, intrinsic factors such as charge compensation and oxygen vacancy, among others, also play a significant role in explaining the significant decrease in dielectric permittivity and low-frequency dielectric relaxation in the doped samples.

EFFECTS OF *EUCALYPTUS* WHITE CHARCOAL CONTENT ON ETHYLENE ABSORPTION PERFORMANCE OF NATURAL RUBBER FOAM BEADS IN PROLONGING THE RIPENING HOM THONG BANANA

Pranee Nuinu,[1]* Wachirapanee Saeheng,[1] Jandapetch Tolek,[1] Chaiwute Vudjung,[1] Sarawut Prasertsri,[1] Sansanee Srichan,[1] Sayant Saengsuwan,[1] Weerawate Utto[1,2]
[1]Innovation and Sustainability in Advanced Natural Rubber and Polymers (ISANRAP) Research Group, Department of Chemistry, Faculty of Science, Ubon Ratchathani University, Warinchamrab, Ubon Ratchathani 34190, Thailand
[2]Major in Agro-Industry, Faculty of Agriculture, Ubon Ratchathani University, Warinchamrab, Ubon Ratchathani 34190, Thailand
*E-mail: Pranee.n@ubu.ac.th

ABSTRACT:
The objective of this research was to study the preparation and properties of natural rubber foam beads for the application of ethylene absorption to delay the ripening of Hom Thong Bananas. The foam beads were prepared from natural rubber latex mixed with a curing agent, potassium permanganate-coated *eucalyptus* white charcoal (CZK), and a blowing agent via the reverse spherification technique. Different levels of CZK, 0, 10, 15, and 20 phr were investigated. The chemical structure, surface properties, morphological characteristics, physical properties, chemical properties, and mechanical properties of the natural rubber foam beads mixed with CZK were investigated. The efficiency of using ethylene-absorbent natural rubber foam beads to absorb ethylene from Hom Thong Banana was also tested. This includes analyzing physical changes in terms of weight loss, peel color, sweetness, and ethylene absorption capacity of Hom Thong Banana compared to commercially available ethylene-absorbing sachets. The findings indicate that the natural rubber foam beads with 20 phr CZK lowered the ambient ethylene levels considerably, allowing the storage of bananas at 31-34°C and 78% humidity for up to 11 days, which was more effective than commercial ethylene-absorbing sachets and extends the shelf life of bananas by 6 days. Therefore, the natural rubber foam beads with 20 phr of CZK may be used for fruit packaging applications.

Keywords: Ethylene Absorbent Foam; Natural Rubber Latex; *Eucalyptus* White Charcoal; Potassium Permanganate

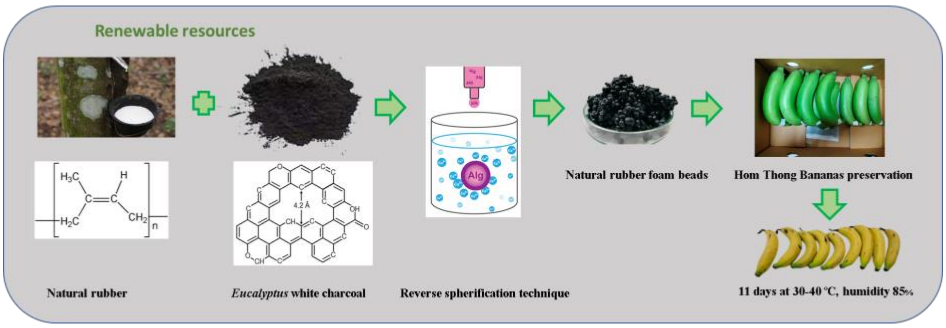


Figure 1.
The schematic procedure for preparing natural rubber foam beads and their effect on absorbing ethylene emitted by postharvest bananas

ELUCIDATING THE CO DETECTION MECHANISM OF Pd-LOADED SnO_2 GAS SENSOR VIA OPERANDO SPECTROSCOPY

Yuki Shimada,[1] Yusuke Inomata,[2] Tetsuya Kida[2,*]
[1]Graduate School of Science and Technology, Kumamoto University, Kumamoto, Japan
[2]Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, Japan
*tetsuya@kumamoto-u.ac.jp

Abstract:

SnO_2 is widely used in commercial gas sensors because of its wide band gap (E_g = 3.6 eV), and high thermal and chemical stability. However, its poor selectivity and high operating temperature requirement are its major disadvantages. To address these issues, doping with noble metals with excellent catalytic activity is a common approach. However, the sensing mechanism of doped SnO_2 remains not fully understood, thus limiting the development of gas sensors of better quality. In this study, we performed *operando* spectroscopic measurements to elucidate the role of Pd in improving the sensitivity of SnO_2 to carbon monoxide (CO).

Pristine SnO_2 (*p*-SnO_2) and Pd-doped SnO_2 (Pd-SnO_2) nanocrystals were synthesized using the liquid-phase method. From the gas performance measurements, the highest Sensitivity (S) to CO was achieved using 1 wt% Pd-SnO_2 (1Pd-SnO_2) at 100 °C with a value of S = 53.0, which was ca. 25 times higher than that of *p*-SnO_2. To determine the role of Pd in this improvement, the DRIFT spectra of *p*-SnO_2 and 1Pd-SnO_2 were recorded after 1 h of CO exposure. As shown in Fig. 1, CO chemisorbed on 1Pd-SnO_2 at 100 °C, as evidenced by the bands I_{CO} at 1850–2120 cm^{-1}. At the same temperature, I_{CO} was absent in the spectra of *p*-SnO_2. When the temperature was increased to 200 and 300 °C, the I_{CO} of 1Pd-SnO_2 disappeared with successive decreases in response. Thus, the higher sensitivity of 1Pd-SnO_2 compared to *p*-SnO_2 can be attributed to effectiveness of Pd as an adsorption site for CO, which diminishes at higher temperatures. Additional results from UV-vis spectroscopy under CO revealed that the both *p*-SnO_2 and 1Pd-SnO_2 exhibit an increase in absorbance with a corresponding decrease in electrical resistance. An increase in absorbance can be associated with the reduction of metal oxides. When the atmosphere was switched to air, the absorbance decreased while the resistance increased, suggesting the re-oxidation of the sensing layer by the O_2 from air. Since 1Pd-SnO_2 exhibited more significant changes in absorbance than *p*-SnO_2, the catalytic activity of Pd towards redox reactions plays a crucial role in the CO sensing mechanism of Pd- SnO_2.

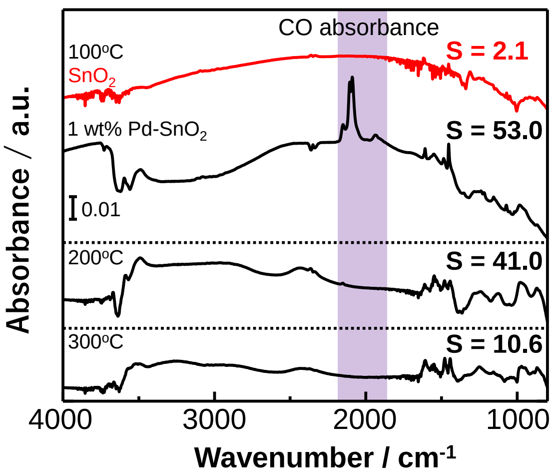


Fig. 1. DRIFT spectra of SnO_2 and 1 wt% Pd-SnO_2 under 50 ppm CO in air after 1 h.

ENHANCED PROPERTIES OF MULTISCALE RICE HUSK FIBER SHEET WITH BY USING THE CASSAVA STARCH/NATURAL

Saad Riyajan*
Department of Chemistry, Faculty of Science and Technology, Thammasat University
99 Moo 18 Paholyothin Road, Klong-Luang, Pathumthani, 12120, Thailand
*e-mail: saadriyajan@hotmail.commes

Abstract:

Rice husk (RH) fibers were obtained by submitting the industrial rice crop to lactic acid and bleaching treatments with maleic anhydride. RH was used to prepare the active packaging with antimicrobial properties that could impede the growth of bacteria and extend the storage life of packaged food items. Cassava starch (CS) blended with natural rubber (NR) presents an excellent alternative to conventional packaging materials. However, its usage is limited due to its high hydrophilicity and low mechanical properties. The impact of these variations on the mechanical properties, thermal properties, moisture content, moisture absorption, morphology, biodegradability optical properties of the biocomposite film was evaluated and analyzed. The maximum tensile strength and elongation at break of this composite was 16 MPa and 280% when using 7.5% NR/CS content, respectively. The lowest moisture content (5%) and moisture absorption (8%) were found when using 7.5 NR/CS. At 7.5% CS/NR blend, the biocomposite film showed 80% improvement in tensile strength, optimum moisture content, and water solubility. Moreover, the good thermal stability of sample containing 7.5% NR/CS was found at 250ºC. The good adhesion between RH and NR/CS was observed by SEM. Also, the MRH content was optimized to attain good antimicrobial properties against food-spoiling bacteria. The biocomposite film was found to increase the shelf life of packaged banana by more than 14 days. The degree of biodegradation was around 90-100% after buried in soil for 30 days. The biocomposite film with excellent properties could be a potential packaging material in food, health care, and food industries.

ENHANCING TEMPERATURE STABILITY OF DIELECTRIC PERMITTIVITY AND REDUCING LOSS TANGENT IN Ni^{2+}-DOPED CCTO CERAMICS

Atittaya Changchuea [1] Jakkree Boonlakhorn [1,] * Pornjuk Srepusharawoot [2]

[1]Department of Physical Science, Faculty of Science and Digital Innovation, Thaksin University, Songkhla 90000, Thailand
[2] Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand

*e-mail: jakkree.b@tsu.ac.th

Abstract:
The present investigation utilized solid-state reaction methodology to produce $CaCu_{3-x}Ni_xTi_4O_{12}$ ceramics, where *x* values were varied to 0, 0.05, and 0.10. An analysis of the phase evolution and crystal structure in the $CaCu_{3-x}Ni_xTi_4O_{12}$ ceramics revealed a body-centered cubic structure with a space group of *Im*3. It is worth mentioning that the microstructural investigation demonstrated a reduction in the average grain size after the addition of Ni^{2+} into the $CaCu_3Ti_4O_{12}$ system. A high dielectric permittivity ranging from 10395 to 20459, together with a very low loss tangent of 0.009 to 0.010, can be measured in $CaCu_{3-x}Ni_xTi_4O_{12}$ ceramics with *x* values ranging from 0.05 to 0.10. Moreover, the frequency and temperature stabilities of the dielectric permittivity of these ceramics can be quantified, meeting the standard requirements for utilization in X7R-type capacitors. The colossal dielectric response exhibited by these ceramics within the frequency range of 40-10^5 Hz is attributed to the grain boundary response. Additionally, the simultaneous observation of grain boundary effects and conduction mechanisms within this frequency range at relatively high temperatures has been confirmed. The obvious decrease in dielectric permittivity, coupled with a sharp increase in the total loss factor observed at high frequencies, indicates high-frequency dielectric relaxation attributable to the presence of bivalent-type oxygen vacancies. The collective findings indicate that the phenomenon of colossal dielectric permittivity exhibited in the $CaCu_{3-x}Ni_xTi_4O_{12}$ ceramics can be attributed to interfacial polarization resulting from their heterogeneous microstructure.

EXPERIMENTAL HEAT TREATING OF AMETHYST FROM BRAZIL

Natcha Rattana-anan, Kanyarat Kwansirikul,* Phisit Limtrakun
Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand 50200
*e-mail: kanyarat.k@cmu.ac.th

Abstract:
Amethyst is a variety of alpha-quartz which has been one of the gemstones commonly used in the gems and jewelry trade because of its distinct color and inexpensive price. However, citrine, a yellow variety, is also popular and more expensive in the trade. In this study, thirty natural rough amethysts from Brazil were experimentally heat treated to observe the change of their colors and characterized gemological properties using gemological standard methods, and some advanced techniques. Specific gravities and refractive indices of the samples are in the same range as those from other localities in the world. They were inert under short-wave and long-wave UV radiation. Uneven color distribution and fractures or healed fractures were found in every sample when viewed under a microscope. Some samples exhibited weak to strong color zoning to the unaided eyes. The samples were heated 6 times at a maximum temperature of 300, 350, 400, 450, 500 and 560°C in reducing conditions and soaking time for 1 hour at each maximum temperature. The result of the heating experiments revealed that the temperature at 400°C could change the initial color of the samples to yellow-green and the temperature over 450°C could change the violet color of amethysts to light yellow and greenish yellow but the transparency was decreased. Chemical composition analysis using micro EDXRF revealed the important trace elements detected relating to color causing were aluminum, titanium, manganese and iron. The UV-Visible-NIR absorption spectra exhibited a broad absorption between 300-400, 500-600 and 600-700 nm related to iron and aluminum elements in the crystals. After heating at the temperature reached 450 °C, the intensity of the absorption band between 500-600 nm decreased corresponding to the change of the violet color of amethyst turned to greenish yellow and light yellow.

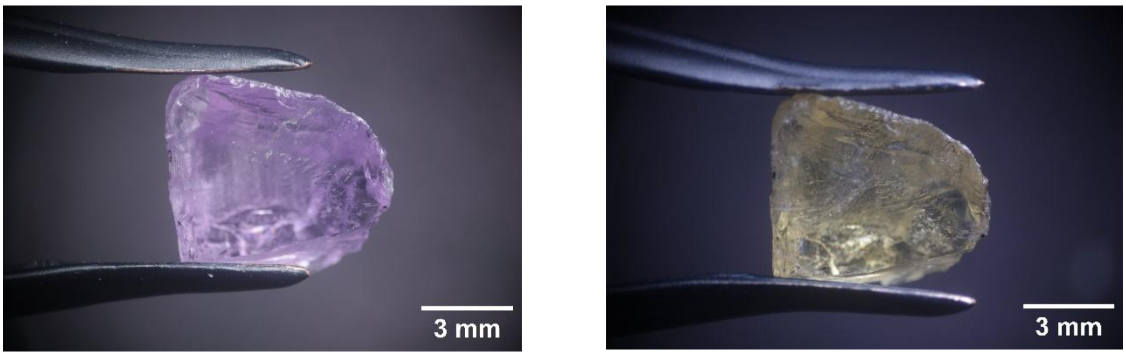


Figure 1.
Examples of the change of amethyst color before (left) and after heat treatment (right).

Fabrication and Characterization of Alginate – Gelatin Interpenetration Hydrogel in Application for Cartilage Tissue Engineering

Chalita Masung,[1]Pattida Aonpetch,[1,]* Atsadaporn Thangprasert[2]

[1]PSU. Wittayanusorn Surat Thani, Surat Thani, 84000, Thailand

[2]Faculty of Science and Industrial Technology, Prince of Songkla University, Surat Thani Campus, Surat Thani, 84000, Thailand

*e-mail: litainkorea@gmail.com

Abstract:

To increase Knee Osteoarthritis treatment options, researchers have applied tissue engineering knowledge to the above methods. Specifically, they used cell scaffolds to treat patients with Knee Osteoarthritis (OA). The polymers for cell scaffolds must have properties that promote the growth of cartilage and tissue. Researchers have used interpenetrating hydrogels with good water retention properties as polymers, because they have a similar flexibility to the cartilage in the knee joint of the body. Hydrogels studies using alginate and gelatin, polysaccharides that can form gels, to form the polymers. Calcium chloride ($CaCl_2$), which acts as a cross-linker with the ability to strengthen and toughen the hydrogel mesh structure. It has also been used to help form the hydrogels. Each experimental group was supplemented with calcium chloride at different concentrations. The concentrations of calcium chloride used were 1%, 3%, 5%, and 7%. After obtaining hydrogel samples at the specified concentrations, they were tested for physical and chemical properties. The following tests were performed: Structural analysis (FT-IR), Swelling testing, Degradation testing, Thermogravimetric analysis, Calcium release, Gelatin release. The properties of hydrogels made from alginate and gelatin were then compared to determine the optimal concentration of calcium chloride for use in hydrogels that would be applied in patients with Knee Osteoarthritis (OA).

FABRICATION OF COPPER BASED METAL ORGANIC FRAMEWORK USING RECOVERED TEREPHTHALIC ACID FROM WASTE PET WITH COPPER NITRATE FOR POTENTIAL ENERGY APPLICATIONS

Kaviya R[1], Loganathan M[1], and Murugesan A[1,*]

[1] Polymer Science Engineering Lab, Department of Chemistry, Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam- 603 110

*Email: murugesana@gmail.com

Abstract:

Polyethylene terephthalate (PET) bottles are the most abundant waste material in the current scenario, which could be an excellent resource to recover different value added products via effective thermocatalytic depolymerization (TCDP) reactions. In this research work, we have focused on the recovery of terephthalic acid effectively, which can be used as an organic source for the preparation of metal organic framework (MOF). Copper-based metal-organic framework (Cu-MOF) was prepared using recovered terephthalic acid (r-TPA) from waste PET with copper nitrate and dimethylformamide (DMF) as a solvent via the hydrothermal precipitation method. The resulting material underwent characterization through XRD, NMR, FT-IR, and SEM analyses. An electrochemical study of the supercapacitive behaviours of Cu-MOF investigated cyclic voltammetry (CV), galvanostatic charge–discharge (GCD) and electrochemical impedance spectroscopy (EIS) with an ambient 6M KOH aqueous alkaline as an electrolyte and a conductive Ni foam as a substrate and found effective high capacitance. Experimental results suggest that Cu-MOF is a promising material for supercapacitance, and other energy applications will be investigated.

FABRICATIONS OF BROWN CERAMIC PIGMENT USING LEATHER BUFFING DUST FROM TANNERY INDUSTRY

Pranee Junlar,[1,*] and Nithiwach Nawaukkaratharnant,[2,3]

[1]Division of Engineering Materials, Department of Science Service, Bangkok 10330, Thailand
[2]Metallurgy and Materials Science Research Institute, Chulalongkorn University, Bangkok 10330, Thailand
[3]Upcycled Materials from Industrial and Agricultural Wastes Research Unit, Department of material Science, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
*e-mail: pranee@dss.go.th

Abstract:
Environmental pollution remains a pressing issue due to the difficulties in managing solid waste from the tannery industry. Leather buffing dust is the solid waste generated in leather processing. The waste is composed of chromium compounds, which can have harmful effects on the environment. The alternative procedure to utilize the waste is to use it for ceramic pigment. The goal of this research is to prepare the brown ceramic pigment using leather buffing dust as a source of chromium. The phase content and chemical composition of the as-received waste were characterized by XRD and XRF, respectively. The waste was calcined at 1100 °C to obtained chromium powder. The XRD result indicated that the CrO_3 (chromium trioxide), a harmful component of the as-received waste, could be transformed into Cr_2O_3 (chromium oxide). The obtained chromium powder was mixed with zinc oxide (ZnO) and ferric oxide (Fe_2O_3) and was then calcined at 1200 °C to create the brown pigment (Zn-Fe-Cr system). The various contents of brown pigment powder (3, 5, 7 and 10 wt%) were added into the basic glaze composition and were then coated on the stoneware body samples before firing at 1200°C. The results showed that the brown glazed stoneware could be created by the adding of 10 wt% brown ceramic pigment. Additionally, the leaching of lead (Pb), cadmium (Cb) and chromium (Cr) from glazed stoneware was not detected.

GIANT DIELECTRIC PROPERTIES, ELECTRICAL RESPONSE, AND MICROSTRUCTURE OF $CaCu_3Ti_{4-x}Ga_xO_{12}$ CERAMICS

Natwara Tansungnern [1] Jakkree Boonlakhorn [2,] * Pornjuk Srepusharawoot [3]

[1]Bachelor of Education Program in Physics, Faculty of Education, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[2]Department of Physical Science, Faculty of Science and Digital Innovation, Thaksin University, Songkhla Campus, Songkhla 90000, Thailand
[3]Department of Physics, Faculty of Science, Khon Kaen University, Khon Kaen 40002, Thailand

*e-mail: jakkree.b@tsu.ac.th

Abstract:
The present study involved a comprehensive examination of the structure, dielectric properties, and electrical response of $CaCu_3Ti_{4-x}Ga_xO_{12}$ (x = 0, 0.05, and 0.10) ceramics. Based on the X-ray diffraction analysis, it has been determined that all of the sintered ceramics exhibit the presence of a $CaCu_3Ti_4O_{12}$ phase. The substitution of Ga^{3+} dopant into the $CaCu_3Ti_4O_{12}$ lattice leads to observable microstructural changes. Also, the doping of Ga^{3+} in the $CaCu_3Ti_4O_{12}$ lattice exhibits a remarkable ability to maintain high dielectric permittivity while simultaneously reducing the loss tangent. The $CaCu_3Ti_{3.95}Ga_{0.05}O_{12}$ ceramic exhibits a high dielectric permittivity of approximately $5.28x10^4$ and a low loss tangent of approximately 0.07. Impedance spectroscopy analysis indicates that the $CaCu_3Ti_{4-x}Ga_xO_{12}$ ceramics display a heterogeneous microstructure characterized by the presence of semiconducting grains and insulating grain boundaries. Thus, the observed high dielectric permittivity of $CaCu_3Ti_{4-x}Ga_xO_{12}$ ceramics could be attributed to their heterogeneous microstructure.

Green Synthesis of SiO_2/C Composites Derived from Rice Straw as High-Performance Anodes for Lithium-Ion Batteries

Pitchayanin Paiplod,[1] Saran Youngjan,[2] Jakkapop Phanthasri,[2] Pongthanawat Khemthong,[2] Sopon Butcha[1,*]

[1] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani, 12120, Thailand

[2] National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani, 12120, Thailand

*e-mail: soponb22@tu.ac.th

Abstract:

The green synthesis of silicon/carbon (SiO_2/C) composites derived from rice straw (RS), an agricultural waste, was developed by a one-step activation approach. This strategy was successfully done by applying zinc chloride ($ZnCl_2$) both as a reducing agent during hydrothermal carbonization (HTC) and as a chemical activator in subsequent thermal activation, instead of using the magnesium chloride ($MgCl_2$) or aluminum chloride ($AlCl_3$) in previous studies. The resulting SiO_2/C composites could be synthesized under mild condition, HTC at 180 ^{o}C for only 4 h and activation at 700 ^{o}C under nitrogen atmosphere, revealing high surface areas with hierarchical meso/microporous structures. When the SiO_2/C composites were also applied as an anode material in lithium-ion batteries (LIBs), they demonstrate their good electrochemical, evidenced by a capacity of 226 mAhg^{-1} at 1 Ag^{-1} with an excellent cycling stability even after charging/discharging for up to 500 cycles. These findings highlight their significant advantages such as low cost and environmental friendliness of material synthesis and applicability for energy storage devices.

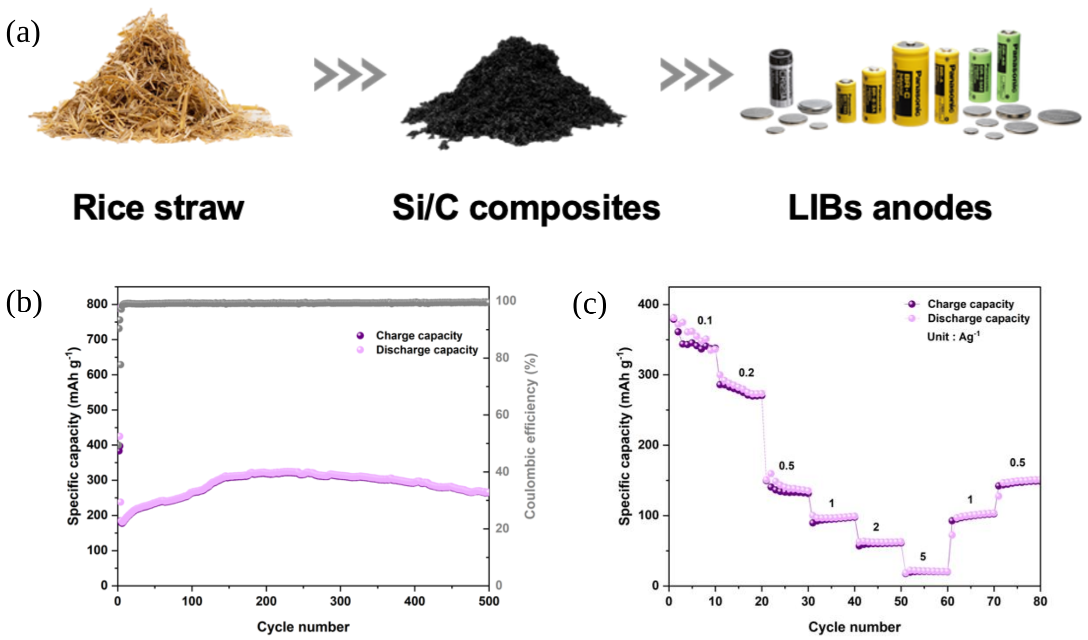


Figure 1. (a) Graphical illustration of the synthesis of SiO_2/C composites derived from rice straw as anodes for LIBs. (b) Cycling stability of the SiO_2/C composite at 1 A g^{-1}. (c) Rate capability of the SiO_2/C composite at various current densities.

HETEROJUNCTION TITANIUM DIOXIDE/HIERARCHICAL POROUS CARBON COMPOSITES FOR AZO DYE ROMOVAL VIA ADSORPTION AND PHOTOCATALYSIS

Saitharn Limsakul,[1,2] Chanchana Thanachayanont,[4] Adisak Siyasukh,[2] Manunchaya Jaideekard,[2,7] Saranphong Yimklan,[5] Pimluck Kijjanapanich,[6] Yothin Chimupala[2,3,]*
[1]Office of Research Administration, Chiang Mai University, Chiang Mai, 50200, Thailand
[2]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[3]Center of Excellence in Materials Science and Technology, Chiang Mai University, Chiang Mai, 50200, Thailand
[4]National Metal and Materials Technology Center, National Science and Technology Development Agency, Pathum Thani, 12120, Thailand
[5]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[6]Department of Environmental Engineering, Faculty of Engineering, Chiang Mai University, Chiang Mai, 50200, Thailand
[7]Graduate School, Chiang Mai University, Chiang Mai, 50200, Thailand
*e-mail: Yothin.chimupala@cmu.ac.th

Abstract:

With the rapid progress in the textile industry, wastewater issues are also emerging. Advanced materials for treating reactive black 5 dye through adsorption and photocatalysis have been developed using Titanium dioxide (TiO_2) nanoparticles supported on porous carbon media to address this. This study introduces a novel method involving the synthesis of spherical porous carbon using a water–in–oil emulsion technique combined with a sol–gel process, and the formation of TiO_2 nanoparticles via precipitation of Titanium isopropoxide followed by carbonization at 700–900°C for 2 hours. Characterization of these materials reveals that varying temperatures lead to different properties, such as increased surface porosity and changes in TiO_2 crystal structure. The results indicate that carbonized material at 900°C exhibits excellent dye adsorption, reaching up to 430 ppm in 1 hour, due to its high surface area and pore volume. Conversely, the material calcined at 700°C demonstrates superior photocatalytic efficiency due to the heterojunction band gap between anatase and rutile crystal structure. This mixed–phase structure reduces charge recombination, thereby enhancing photocatalytic performance.

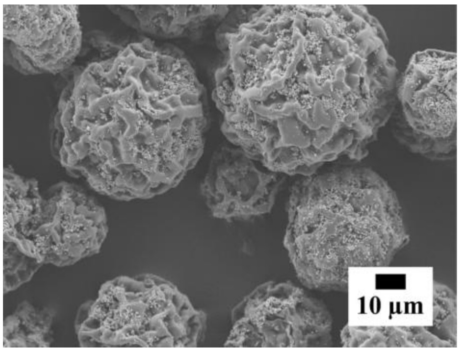


Figure 1.
Scanning electron microscope (SEM) image of Titanium dioxide nanoparticles on carbon media

IDENTIFYING EROSIONAL HOTSPOTS USING FLUVIAL MORPHOMETRIC ANALYSIS IN MAE CHAN RIVER WATERSHED, NORTHERN THAILAND

Pichapop Maneekiang[1], Pichawut Manopkawee[1,*]

[1]Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
*e-mail: pichawut.m@cmu.ac.th

Abstract:

Streambed and bank erosion is an environmental issue threatening socioeconomic impacts and damaging human lives and properties. As a climate change attributing extreme seasonal climatic patterns and inducing severe erosion along streambeds and banks, the development of morphometric analysis with a GIS-based model using a new, openly affordable, high-resolution remote dataset has proven to help identify erosional hotspots in a channel reach scale. Mae Chan River in Chiang Rai province is considered to be susceptible to streambank erosion where sediment and discharge are largely drained from high erodible topography in the west, and erosional susceptibility is present along the mainstem in the lower elevation. This research identified erosional hotspots along the Mae Chan River by combining geomorphic factors of the stream's driving forces: stream power-based erosion index, bend curvature and channel sinuosity indices, and land use and landcover index. Erosional hotspots derived by the GIS-based predictive model result from the morphometric analysis. The field erosion index was conducted to verify the prediction of erosional hotspots. Due to available multitemporal digital elevation models collected between 2014 and 2023, the approach of DEMs of difference also proceeded to calculate elevation and volumetric changes between successive surveyed times. Our preliminary findings reveal that 30% of whole analyzed channels were highly susceptible to streambank and bed erosion, particularly highly sinuous channel reaches with moderate-to-high FEI. The significant elevation change along the mainstem also corresponds to the high-to-very-high susceptible class obtained from the predictive model. Overall, the study and preliminary results suggest that morphometric analysis on channel morphology helps predict erosional hotspots and susceptible channel reaches along the mainstem. The study offers Mae Chan districts helpful data for community planning, mitigation, and stream restoration efforts.

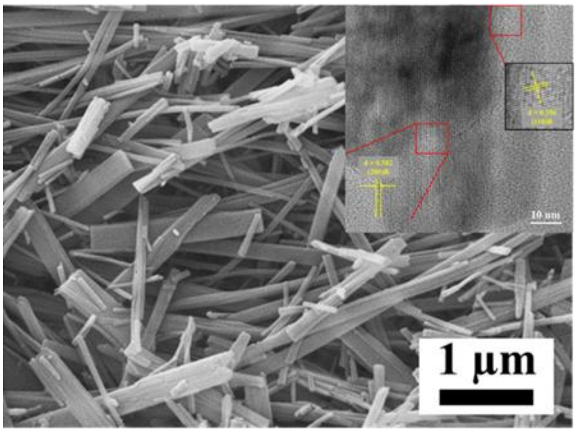
Influence of Hydrothermal Synthesis Condition on Physical Characterization and Electrochemical Properties of Bronze-Phase Titanium Dioxide as Fast-Charging Anode Materials in Lithium-Ion Batteries

Korawith Pimta,[1,3,4] Thanapat Autthawong,[2,3] Waewwow Yodying,[2] Chitsanupong Phromma,[1] Mitsutaka Haruta,[5] Hiroki Kurata,[5] Thapanee Sarakonsri,[2] Yothin Chimupala[1,4]*
[1]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand.
[2]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand.
[3]Office of Research Administration, Chiang Mai University, Chiang Mai, 50200, Thailand.
[4]Center of Excellence in Materials Science and Technology, Chiang Mai University, Chiang Mai, 50200, Thailand.
[5] Institute for Chemical Research, Kyoto University, Uji, Kyoto, 611-0011, Japan

*e-mail: yothin.chimupala@cmu.ac.th

Abstract:

The goal of this research is to develop bronze-phase titanium dioxide (TiO_2(B)) nanoparticles via hydrothermal process by using the influence of temperatures and reaction times in synthesis conditions. Hydrothermal temperatures and duration times directly influence on TiO_2(B) particle shape, crystallinity, and phase formation. An increase in hydrothermal temperature and duration elongated TiO_2(B) particles and formed nanorod and nanowire morphologies. The higher temperature and longer reaction time also produced higher crystallinity of the TiO_2(B) structure. In addition, hydrothermal temperatures and time affect the morphology and TiO_2(B) crystallinity, which are main factors in specific capacity and rate capability of the battery performance. The hydrothermally synthesized TiO_2(B) for 12 hours at 220°C showed the highest capacity at 348.8 mAh/g, when the current density was 100 mA/g. The ideal TiO_2(B) nanorod materials also had better cycling stability over 1000 cycles and outstanding fast charge ability at 15C.



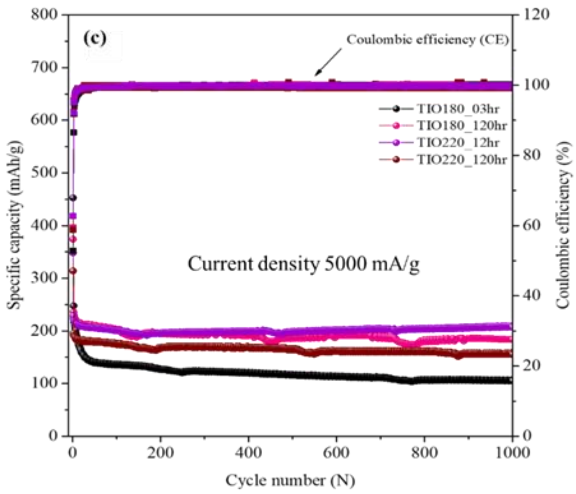


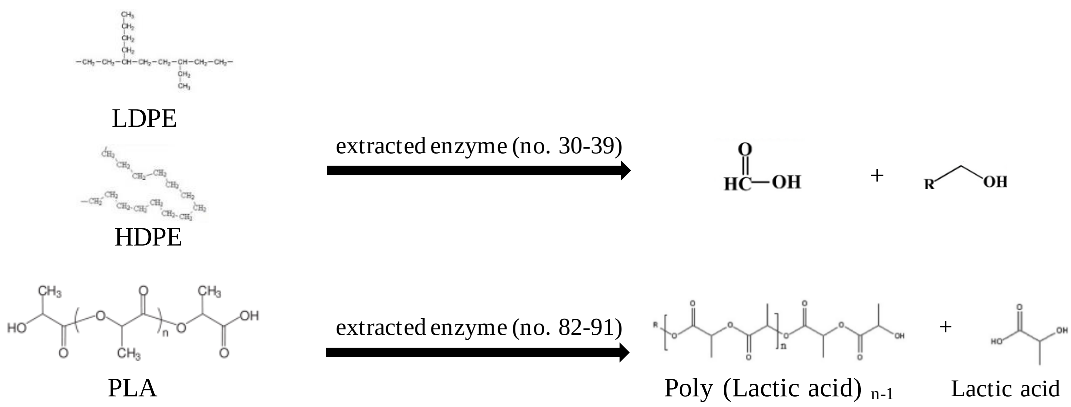
Figure 1. SEM and HRTEM images of the optimal TiO_2(B) (left) and Fast-charging performance of TiO_2(B) samples (right)

INNOVATIVE ENCAPSULATION OF PURIFIED ENZYME FROM *Bacillus subtilis* L. FOR POLYETHYLENE AND POLYLACTIC ACID BIODEGRADATION

Nongnapas Aenguthaiwat[1], Thanyalak Sanguanchit[1], Kerdsiri Somphong[1], Rujipas Varathikul[1], Piyakamon Bunkum[2], Janjira Maneesan[1*]
[1]Kamnoetvidya science academy, 999 Pa Yup Nai, Wang Chan, Rayong, 21210, Thailand
[2]Biomolecular Science and Engineering Vidyasirimedhi Institute of Science and Technology 555 Pa Yup Nai, Wang Chan, Rayong 21210, Thailand
*e-mail: janjira.m@kvis.ac.th

Abstract:

Plastics are widely used in households, stores, and industries due to their waterproof, light weight, good-insulator, and easy thermal forming abilities. However, this benefit led to the disposal of over 8 million tons of plastic into natural water sources, resulting in widespread contamination. Marine creatures ingest these plastics, resulting in pollution and accumulation in aquatic creatures. The most commonly used plastics are LDPE and HDPE, which take over 500 years to fully degrade. Currently, these plastics are managed through incineration, which leads to air pollution, and landfilling, which causes soil contamination. Therefore, this research aims to study and enhance the degradation rate of plastics, focusing on the most efficient and environmentally friendly methods. The procedure for biodegradation using an enzyme extracted from *Bacillus subtilis* L. involved purifying and identifying the enzyme and calculating its activity rate under optimal conditions (e.g., pH 5.0-9.0). Additionally, observing the work rate of enzyme by degrading HDPE, LDPE, and PLA for 14 days. Plastic grains were prepared by weight before reaction and weight after enzyme reaction. Plastic morphology was checked by SEM. As a result, the enzyme extracted from *Bacillus subtilis* L. at pH 7.0 achieved the highest degradation rates: 6.5% for HDPE, 1.8% for LDPE, and 2.3% for PLA. Purification was performed using gel filtration and ion exchange chromatography to increase the enzyme concentration to enhance the degradation rate. The purification system indicates 4 peaks, and there are 2 peaks that are suitable for plastics. HDPE and LDPE suit with fraction 30-39 and PLA at fraction 82-91, which is found from plastic degradable reactions for 10 days to find specific activity. In addition, encapsulation was conducted to improve the enzyme's tolerance and effectiveness in landfill conditions.



Proposed schematic mechanism of LDPE HDPE and PLA biodegradation

Keywords: Biodegradation, Plastic, *Bacillus subtilis*, Enzyme extraction, Degradation rate

INVESTIGATION OF OXYGEN EVOLUTION REACTION USING A CODOPED Ir/ Sb-SnO2 AS ELECTROCATALYTIC ELECTRODES MATERIALS

Supandee Maneelok[1,*], Chakkrapong Chaibury[2], Chontira Sangsubun[3] and Pierrot S. Attidekou[4]
[1] Department of Occupational Health and Safety, Faculty of Health and Sports Science, Thaksin University, Phatthalung 93210, Thailand
[2] Department of Chemistry, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung 93210, Thailand
[3] Department of Physic, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung 93210, Thailand
[4] School of Chemistry, University of Birmingham, Birmingham, B15 2TT, United Kingdom
*e-mail:: msupandee@tsu.ac.th

Abstract:
Iridium antimony doped tin oxide (Ir-ATO) is a suitable candidate as catalytic materials for anodic oxygen evolution reaction (OER), one of the great challenges in clean energy technology including energy storage, energy conversion and electrolysis. In this study, Ti/Ir-ATO electrodes were fabricated by dip coating method with various Ir concentration at different calcination temperature. Oxygen evolution reaction was evaluated. The material properties were characterised by X-ray diffraction (XRD), Scanning Electron Microscope (SEM), Energy Dispersive Spectrometer (EDS), X-ray Photoelectron Spectroscopy (XPS) and Cyclic voltammetry (CV). The dark blue catalyst obtained when increasing calcination temperature is indicative of conductive property. The Ir-ATO materials exhibit a single phase tetragonal structure with nano-sizes particles ranging between 8.2-24 nm as function of doping at 650 ^oC. The particles were spherical and EDS mapping show uniformly distributed Ir and Sb atoms over tin oxide with no agglomeration, indicating increased in the specific surface area. XPS spectra of Ir-ATO calcined at 650 ^oC showed presence of Sn^{4+} and both Sb^{3+} and Sb^{5+}. The highest Sb^{3+} peak area of 3%Ir-ATO suggested enhance kinetic due to substitution and increased electrochemical active sites. With regard to OER performance, the CV performed on 3%Ir-ATO catalyst exhibits a cathodic surface oxide reduction peak around ca. 0.47 V (vs Ag/AgCl) with a current density of 2.03 mA cm^{-2} and a surface oxidation onset around E = 0.8V. Furthermore, an onset potential for the oxygen evolution reaction (EOER) can be observed at ca.1.4 V indicating superior OER properties.

INVESTIGATION OF STRUCTURAL, OPTICAL, ELECTRICAL AND THERMOELECTRIC PROPERTIES OF Bi_2Te_3 DOPED WITH $SbCl_3$ THIN FILMS

Pensri Pramukkul[1], Pansa Nantawiang[1], Ekasiddh Wongrat[2,3], Auttasit Tubtimtae[4], and Panupat Chaiworn[1*]
[1] Department of Physics and General Science, Faculty of Science and Technology, Chiang Mai Rajabhat University Chiang Mai
[2]School of Science, University of Phayao, 56000, Thailand
[3]Unit of Excellence on Sensors Technology, University of Phayao, Phayao, 5600, Thailand
[4]Division of Physics, Department of Physical and Material Sciences, Faculty of Liberal Arts and Science, Kasetsart University Kamphaeng Saen Campus, Nakhon Pathom 73140, Thailand
*e-mail: Panupat_cha@g.cmru.ac.th

Abstract:

Thin films of bismuth telluride doped with antimony trichloride were deposited using a chemical deposition method with varying concentrations of 0.5, 1, 2, 3 and 4 wt%. The films were coated for 1.30 hr. at 70 °C on glass slides and then annealed at 120 °C for 5 min in furnace until the films dried. From the study, it was found that increasing concentration of antimony trichloride resulted in increased thickness and grain boundary of the film as observed in SEM images and XRD analysis. The films exhibited light transmittance of 70-83 % in the wavelength range of 400-1000 nm, with energy gaps ranging from 1.53 to 2.80 eV. Resistance measurement at various temperatures showed a maximum activation energy of 0.724 eV. The thermoelectric properties of Bi_2Te_3 thin films doped with 2 wt% $SbCl_3$ showed a maximum Seebeck coefficient of 152 μVK^{-1} and a maximum power factor of 0.218×10^{-3} $Wm^{-1}K^{-2}$ at a temperature of 195 °C.

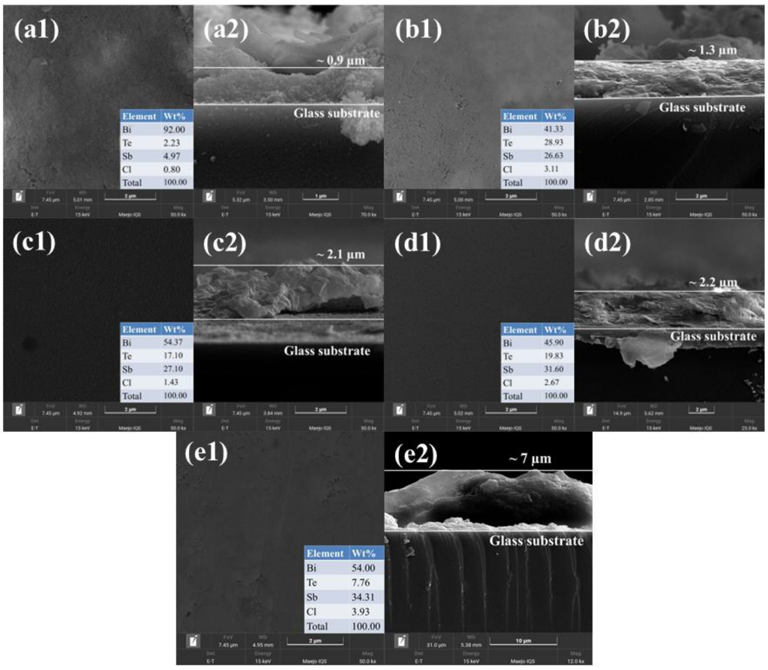


Figure 1. (a-e) Shown surface and cross-sectional micrographs of Bi_2Te_3 doped with $SbCl_3$ thin films at 0.5, 1, 2, 3 and 4 wt%.
(Inset: elemental percentages from EDS spectra).

INVESTIGATION OF THE ELECTROCATALYTIC INTERFACE BETWEEN FUNCTIONALIZED $Ti_3C_2T_x$ AND Pt NANOPARTICLE FOR ENHANCED HYDROGEN EVOLUTION

GA EUL SEO,[1] Yiseul Yu[1], Naga Vamsi Krishna bolisetti[1], Taewoong Lee[1], Seung Jun Lee[1*]
1Department of IT and Energy Convergence (BK21 Four), Korea National University of Transportation, Chungju 27469, Republic of Korea
*e-mail: sjlee@ut.ac.kr

Abstract:
Recently, many research groups have been extensively studying electrocatalyst materials, which can serve as alternatives to the traditional platinum-carbon (Pt/C)-based systems for efficient hydrogen evolution reactions. Among those innovations, the integration of platinum (Pt) with highly conductive two-dimensional (2D) nanomaterials presents a promising strategy to enhance hydrogen evolution efficiency while controlling the requisite amount of Pt. In this study, we utilized MXene, a 2D material distinguished by its unique surface functional groups and low work function, which allows for the direct reduction of Pt ions. However, one significant challenge with MXenes is the oxidation that occurs when noble metal nanoparticles are directly deposited onto its surface. To address this issue, we modified the MXene surface with organic ligands. The introduction of amine (NH_2) and carboxyl (COOH) groups facilitates the formation of coordination bonds with Pt ions, thereby preventing direct interaction between the MXene surface and the noble metal nanoparticles. This modification promotes the uniform growth of Pt nanoparticles, which are approximately 3 nm in size. The procured results demonstrate that the functionalized MXene/Pt nanoparticle composite exhibits exceptional hydrogen evolution performance, attributed to its large surface area and the uniform distribution of Pt nanoparticles.

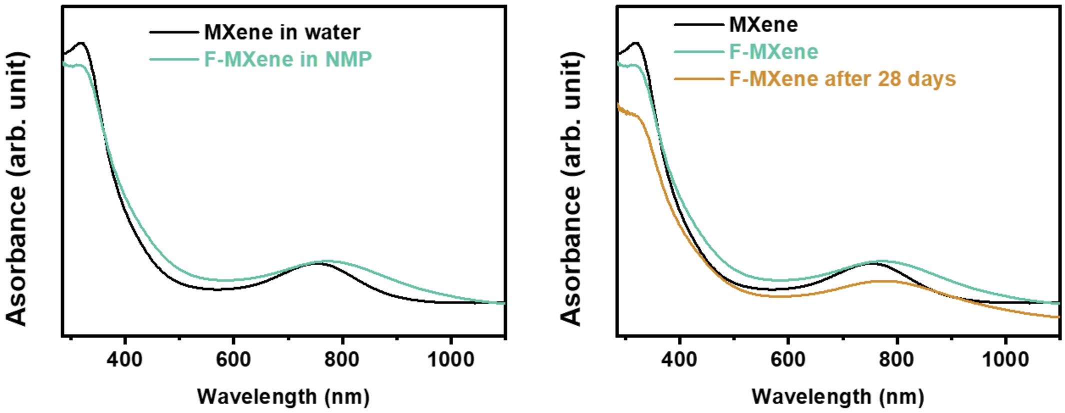


Figure 1. (a) UV-Vis spectroscopy of the MXene without surface modification (black line) and the F-MXene after surface modification (green line). (b) UV-Vis spectroscopy after 28 days.

MAGNETIC Fe_3O_4/Cu_2ZnSnS_4 COMPOSITE: ENHANCED ADSORPTION AND RECYCLABILITY IN DYE REMOVAL APPLICATIONS

Arthittaya Poungyu,[1] Maniwara Boonkam,[1] Pornthip Tongying[1,]*
[1]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
*e-mail: tongying_p@su.ac.th

Abstract:
Iron oxide-based adsorbent materials have attracted significant interest due to their dual function as efficient adsorbents and their magnetic properties, which allow for easy separation after use. This study focuses on developing a magnetic adsorbent by integrating Fe_3O_4 with Cu_2ZnSnS_4 to enhance the surface area for dye adsorption, specifically targeting Titan Yellow removal. Cu_2ZnSnS_4 was synthesized via a hydrothermal method, producing micrometer-sized particles with a kesterite crystal structure. Fe_3O_4 nanoparticles, ranging in size from 10 to 20 nm, were synthesized through co-precipitation, resulting in a magnetite structure. These particles were then combined using chitosan as a binder to form the composite material. The Fe_3O_4/Cu_2ZnSnS_4 composite exhibited a specific surface area of 61.16 m^2/g, approximately 12% higher than that of Fe_3O_4 alone. Magnetic property analysis using vibrating sample magnetometry revealed that Fe_3O_4 had a high saturation magnetization of 59.11 emu/g, indicating soft ferromagnetic behavior. Upon forming the Fe_3O_4/Cu_2ZnSnS_4 composite, the saturation magnetization decreased by about half but remained high enough to enable effective magnetic separation. The composite achieved an adsorption capacity of 46.55 mg/g for Titan Yellow at pH 6, nearly double that of Fe_3O_4 alone, and demonstrated excellent recyclability, retaining over 80% removal efficiency after three cycles. These findings underscore its potential for practical applications in wastewater treatment. Adsorption isotherm and kinetic studies suggest that the process follows the Langmuir adsorption model and pseudo-second-order kinetics.

MAGNETICALLY SEPARABLE ZnO/Fe_3O_4 BINARY PHOTOCATALYST FOR COMPLETE DEGRADATION OF TETRACYCLINE ANTIBIOTIC IN WASTEWATER

Atchawadee Panchakeaw, Sattra Nonthing, Khemika Wannakarn, Suwat Nanan*
Department of Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand.
*e-mail: suwatna@kku.ac.th

Abstract:
A magnetic separable ZnO/Fe_3O_4 binary photocatalyst, comprising about only 3 mol% of Fe_3O_4, was synthesized by using an ultrasonication route. The prepared photocatalyst was characterized by using various techniques and it was then used as photocatalytic material in wastewater treatment. The band gap energy of the bare hydrothermally grown ZnO was found to be 3.12 eV while that of the corresponding ZnO/Fe_3O_4 binary photocatalyst was about 3.04 eV. The XRD patterns of the samples showed the hexagonal phase of ZnO. The Zn–O bond was confirmed from vibrational spectra. The photoluminescence spectrum of the ZnO/Fe_3O_4 binary photocatalyst showed the lowest intensity in comparison to those of the pristine ZnO and Fe_3O_4. This indicates the lowest electron-hole recombination rate found in the binary photocatalyst, compared to the bare ZnO and Fe_3O_4. Consequently, the highest photocatalytic performance was expected to be detected in the ZnO/Fe_3O_4 binary photocatalyst. Under the optimal experimental conditions, the photodegradation efficiency of 100% toward degradation of both rhodamine B (RhB) dye and tetracycline (TC) antibiotic was observed. The results suggest that, after incorporation of Fe_3O_4, the surface structure of Fe_3O_4 gives a higher contact area for ZnO nanostructures. This facilitated the effective reduction of Fe^{3+} to Fe^{2+}, suppressed the charge carrier recombination rate, and finally increased the removal efficiency of the pollutants. It was also found that the prepared binary photocatalyst showed good reusability and chemical stability. High photoactivity of about 100% toward degradation of TC antibiotic was reported even after five times of use. Furthermore, the trapping experiment was performed to investigate the primary reactive species responsible for degradation of the pollutant. The result showed that hydroxyl radicals played an important role in degradation of TC antibiotic. The effect of experimental parameters such as solution pH, catalyst loading, and solution concentration on the resultant photoactivity is under investigation. The present research demonstrates the new avenue for fabrication of photocatalytic material with excellent magnetic separable property for complete detoxification of dye and antibiotic in wastewater.

Materials Study of Local Clay Tile in Mae Hia Subdistrict, Chiang Mai Province

Theerapol Thurakitseree,[1] Rattanakarn Khomson,[2] Ampika Rachakom[2,]*
[1]Program in Applied Physics, Maejo University, Chiang Mai, 50290, Thailand
[2] Faculty of Science and Agricultural Technology, Rajamangala University of Technology Lanna, 128 Huay Kaew Road, Muang Chiang Mai, 50300, Thailand
*e-mail: ampika_aom@rmutl.ac.th

Abstract:

In this study, we have investigated the material characteristics of clay roofing tiles produced by household industries in Ban Din Khor, Mea Hia Sub-district, Chiang Mai Province. By employing a systematic evaluation approach, the comprehensive assessment of local clay raw materials and the firing processes utilized by households were initially performed. The thermal properties of the raw materials were characterized by differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA), whereas X-ray diffractometer (XRD) and X-ray fluorescence (XRF) spectrometer were used to access phase and chemical compositions. The samples were categorized based on kiln levels: low (20 cm), medium (60 cm), and high (120 cm). They were subjected to the 10-day annealing process for humidity removal, followed by firing at 950°C for 30 hours. The key physical properties were measured, including density (1.91–1.93 g/cm³), apparent porosity (25.5%–27.2%), water absorption (12.56%–13.41%), and material strength. The sample morphologies were imaged by scanning electron microscopy (SEM) and X-ray tomography microscopy (XTM). In Addition, the thermal conductivity and X-ray attenuation properties of the Lanna clay roof tiles were also investigated. These findings highlight the potential of clay roof tiles to contribute to sustainable economic development within the community, promoting long-term viability, and elevating their production to reach the Thai Industrial Standard (TIS) for household-based enterprises.

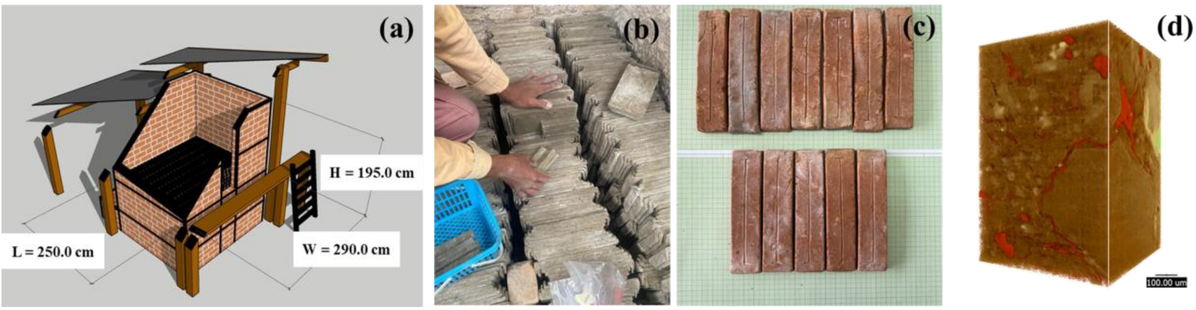


Figure 1. (a) A kiln model of Lanna clay roof tiles, (b) specimens undergoing the firing process, (c) post-firing specimens, and (d) X-ray tomography image of the specimen at a height of 120 cm in the kiln.

MECHANICAL PROPERTY PREDITION OF SEDIMENTARY ROCKS FROM ULTRASONIC VELOCETY IN MAE TAENG – MAE NGAT DAM – MAE KUANG DAM WATER TUNNEL AREA

Sathit Kanthata*, Kritsada Moonpa, Kannipa Motanated, Chanawut Sooksabai, Piyanat Arin, Phenchamat Thanadee, Nitipon Tipwarot
Department of Geological Sciences, Faculty of Science, Chiang Mai University, Thailand
*e-mail: sathit.k@cmu.ac.th

Abstract:
Mechanical properties used for estimating the quality of rocks such as rock mass rating (RMR) are critical for engineering design. Uniaxial compressive strength (UCS) is a parameter required to determine RMR. However, UCS test destroys rock samples and time-consuming. Thus, the purpose of this research is to use non-destructive ultrasonic techniques, which send ultrasonic waves through rock core samples and to infer the UCS as a mechanical parameter, RMR quality index, and physical parameters, such as density, porosity, and void ratio. The samples were collected from the water diversion tunnel construction project in the Mae Teang, Mae Ngat, and Mae Kuang Dams in Chiang Mai province, Thailand. The samples from the water diversion tunnel construction site between Mae Teang River and Mae Ngat Dam were petrographically classified as the clastic sedimentary rocks. The results show that the reliability of P-wave velocity (Vp) responding is greater than that of S-wave (Vs) when using only P-wave to estimate those parameters. The correlations between P-wave velocity and density are linear, with R^2 = 0.6601, but those between P-wave velocity and UCS, porosity, and void ratio are exponential, with R^2 = 0.2067, R^2 = 0.7356, and R^2 = 0.7311, respectively. The diagram developed by Uyanik et al. (2019) to determine RMR values from ultrasonic velocities can be utilized to identify the quality of these clastic sedimentary rocks with R^2 = 0.5103 as shown in Figure 1. The velocity ratio (Vp/Vs) of this study is 2.0 and spreads between the ratio lines of 2.4 and 1.7. The relationship between physical parameters and P-wave velocity is identified, and RMR values can be predicted from the Vp and Vs. Therefore, the physical quality of clastic sedimentary rocks in this study area can be quickly inferred from ultrasonic velocities. We also advise caution in using ultrasonic velocities to estimate UCS suggested by the previous studies, because lithological and structural factors can influence the rock's stability, necessitating further research.

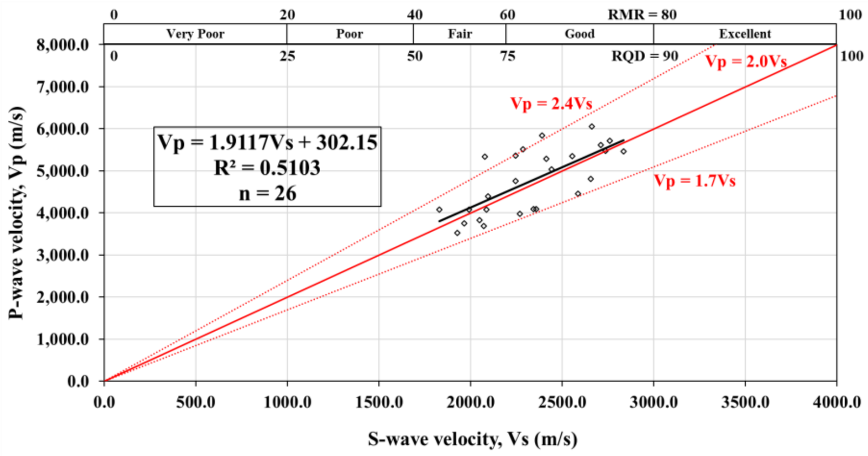


Figure 1. RMR values from ultrasonic velocity (modified from Uyanik et al., 2019)

METALLIC SILVER-DECORATED ON ZnO/Fe_3O_4 PHOTOCATALYST FOR DETOXIFICATION OF ANTIBIOTICS AND DYES IN AQUEOUS SOLOUTION

Sattra Nonthing, Atchawadee Panchakeaw, Khemika Wannakarn, Suwat Nanan*
Department of Chemistry, Faculty of Science, Khon Kaen University, Khon Kaen, Thailand.
*e-mail: suwatna@kku.ac.th

Abstract:
As an advanced oxidation material, Fe_3O_4-metal oxide photocatalysts have been widely used in wastewater treatment. However, Fe_3O_4 nanostructures suffer from the disadvantages of carrier recombination and aggregation, which seriously affect the resultant photocatalytic activity. In the present work, Fe_3O_4-ZnO photocatalyst with well dispersion of metallic silver was synthesized. The unique nanostructure of Fe_3O_4 facilitated the deposition of Ag/ZnO, resulting in Fe_3O_4/Ag/ZnO ternary photocatalyst with high photocatalytic performance. Under the optimal experimental conditions, the photocatalytic degradation rate of rhodamine B (RhB) dye in the photocatalytic synergistic Fenton-like system constructed with Fe_3O_4/Ag/ZnO reached 98. 7% within 120 min, significantly surpassing that of single ZnO photocatalysis and Fenton-like systems. It is assumed that the unique surface structure of Fe_3O_4 provided a larger contact area for ZnO nanoparticles. It facilitated the effective reduction of Fe^{3+} to Fe^{2+} by photogenerated electrons in ZnO, inhibited the recombination of photogenerated electron-hole pairs, and consequently enhanced the degradation rate of RhB dye. Furthermore, the magnetic separable photocatalyst exhibited excellent cycling ability and structural stability, with the recovery rate and degradation rate of RhB dye remaining above 90% even after five cycles. More importantly, the photocatalytic mechanism of the pollutants in the presence of the prepared photocatalyst was elucidated, and photogenerated electron was identified as the primary reactive species responsible for degradation of RhB dye. The photoactivity of about 100% toward degradation of levofloxacin (LVX) antibiotic was also obtained after 90 min of UV light illumination (a mercury lamp, 135W). This work provides a novel research direction for designing and preparing advanced catalytic degradation materials, offering a practical solution to the challenging issue of wastewater treatment. In addition, the degradation of pollutants under sunlight is under investigation.

METAMORPHOSED CALCAREOUS MUDSTONE INDUCED BY SHALLOW INTRUSIONS IN THE CHUN AREA, PHAYAO PROVINCE

Burapha Phajuy,[1,] * Vimoltip Singtuen,[2]

[1] Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai 50200 Thailand
[2] Department of Geotechnology, Faculty of Technology, Khon Kaen University, Khon Kaen 40002 Thailand

*e-mail: buraphaphj3@gmail.com

Abstract:
The Chun Area in Phayao Province is renowned for its geologically intricate landscape, characterized by a diverse array of rock types. This study investigates the effects of shallow intrusions on host rocks through comprehensive petrographic and geochemical analyses. The intrusions, classified as andesite/basalt, indicate a continental within-plate origin. These basalts display porphyritic and ophitic/subophitic textures, primarily composed of plagioclase, with lesser amounts of clinopyroxene and unidentified mafic minerals, as well as minor opaque minerals. Host rocks, identified petrographically, include siltstone, calcareous siltstone, and calcareous mudstone, with geochemical characteristics categorizing them as shale and Fe-shale. These fine-grained rocks consist of very fine silt-grade to clay-grade clasts, cemented by calcite and hematite/iron hydroxides. The temperature of the mafic dike exceeds 800°C, suggesting its intrusion into very fine-grained sedimentary rocks as a shallow intrusive body, leading to low-pressure, low-temperature metamorphism. The intrusion causes secondary replacement by chlorite and opaque minerals, along with recrystallized calcite cement in mudstone. As a result, chlorite formation and recrystallized calcite are observed in the sedimentary rocks. Chemical changes indicate that mafic intrusions lead to Fe^{2+} and Mg^{2+} gains, meanwhile K^{+} and Ca^{2+} loss in host rocks due to metasomatism.

METHYLENE BLUE REMOVAL FROM WASTEWATER USING THE HYDROGEL BEADS OF POLY(VINYL ALCOHOL)-SODIUM ALGINATE-CHITOSAN-ACTIVATED CARBON-FeO

Nutnicha Kumwung,[1] Kan Chuvutayakorn,[1] Pimmada Fakthong,[1] Jidapa Pimthong,[2] Sakdinun Nuntang[2,*]

[1]Montfort College, Chiang Mai, 50000, Thailand
[2]Industrial Chemistry Innovation Program, Faculty of Science, Maejo University, Chiang Mai 50290, Thailand
*e-mail: Sakdinun.nt@gmail.com

Abstract:
Poly(vinyl alcohol)-sodium alginate-chitosan-activated carbon and FeO hydrogel beads (CH-Act.C-FeO) with porous and steady structure were fabricated via hydrogen-bond and electrostatic interactions, and were characterized by FT-IR, BET surface area analyzer, XRD and SEM-EDS and effecting tests. The preparation of the CH-Act.C-FeO hydrogel bead using chitosan as a precursor, which then cooperated with polyvinyl alcohol (PVA), using trisodium citrate as crosslink agent and stimulating the polymerization reaction to encapsulate the activated carbon. The FeO was added to the mixture to enhance the strength of the chitosan-based hydrogel adsorbent. In addition, the composite material displayed an amorphous carbon structure and possessed a high BET surface area. Furthermore, it demonstrated higher stability in aqueous solutions than the composite hydrogel material without FeO but showed lower swelling in the aqueous solution. In addition, CH-Act.C-FeO hydrogel beads demonstrated high adsorption capacity of methylene blue (MB) from water > 75 mg/g, but lower than CH-Act.C hydrogel bead (> 98 mg/g). However, the CH-Act.C-FeO hydrogel bead had good stability, magnetic separation and reusability.

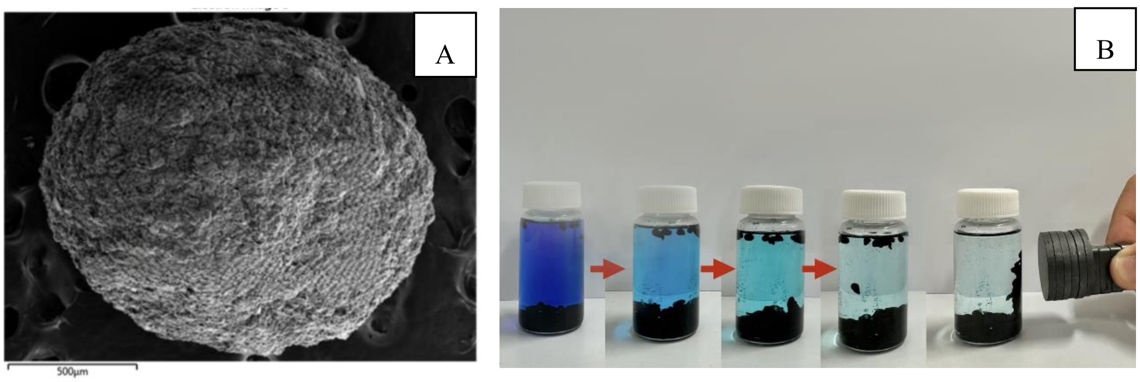


Figure 1.
(A) SEM images (1,000 x magnification) of the CH-Act.C-FeO hydrogel bead and (B) the adsorption of methyl blue on CH-Act.C-FeO hydrogel bead and magnetic separation.

MICROWAVE-SYNTHESIZED CU-ZN(BDC)-MOF: AN EFFICIENT CATALYST FOR DYE DEGRADATION

Seungwoo Choi,[1] Siwoo Jeong, [1] Duangkhae Srikun,[2] Eun-Young Choi[1,]*
[1]Korea Science Academy of KAIST, Busan, Republic of Korea
[2]Mahidol Wittayanusorn School, Nakhon Pathom, Thailand
*e-mail: cey@ksa.kaist.ac.kr

Abstract:
In this study, we investigate the catalytic efficiency of a Copper-Zinc Metal-Organic Framework (Cu-Zn(BDC)-MOF) synthesized via microwave heating for the degradation of dye such as methyl orange dye. The Cu-Zn(BDC)-MOF was characterized by its unique structural and compositional properties using X-ray powder diffraction (XRD), thermogravimetric analysis (TGA), infrared spectroscopy (IR), and other techniques. It was employed as a catalyst in the presence of sodium borohydride ($NaBH_4$) as a reductant. The synthesis of Cu-Zn(BDC)-MOF through microwave heating presents a significant advancement due to its rapid, energy-efficient, and environmentally friendly approach compared to traditional synthesis methods. The microwave reaction enabled the production of high-purity metal-organic frameworks quickly, enhancing their catalytic activity. The catalytic performance was evaluated by monitoring the degradation rate of methyl orange, and the results demonstrated a marked improvement in degradation efficiency, showcasing the potential of Cu-Zn(BDC)-MOF as a highly effective catalyst in wastewater treatment applications. This work underscores the dual benefits of employing microwave-assisted synthesis for MOFs and the catalytic prowess of Cu-Zn(BDC)-MOF in dye degradation, offering a promising avenue for sustainable environmental remediation.

PHYTOEXTRACTION AND PHYTOSTABILIZATION POTENTIAL OF COPPER BY *Neptunia plena* (L.) Benth

Prima Pipatnarapong[1], Pattanun Tangpairojvong[1], Toemthip Poolpak[2], Chomcheun Siripunkaw[3]*

[1]Kamnoetvidya Science Academy, Thailand

[2]Department of Biology, Faculty of Science, Mahidol University, Thailand

[3]Department of Biology and Environmental Science, Kamnoetvidya Science Academy, Thailand

*e-mail: chomcheun.s@kvis.ac.th

Abstract

Heavy metal pollution is an everlasting environmental issue that has been widely reported. Copper, a heavy metal with prominent levels of toxicity found in electronic wastes such as computers and batteries, can contaminate soil and water sources if not properly disposed. *Neptunia plena* (L.) Benth is a pioneer species that grows in desolate areas, both in terrestrial habitats and wetlands. The purpose of this study is to investigate the potential of *N. plena* as an alternative plant for copper remediation and heavy metal mitigation in diverse ecosystems. A laboratory-scale hydroponics system was set up, with Hoagland's solution containing 0, 5, 10, 20, 40 mg/L $Cu(NO_3)_2$, displaying a pH value of under 5.5. Copper was completely ionized, resulting in a significant ability to transport copper ions to above-ground plant tissue. The majority of copper ions were accumulated in the stems in high copper concentrations and translocation factors higher than one, which was analyzed by Atomic Absorption Spectroscopy (AAS). The experiment was followed by another laboratory-scale hydroponics system, with Hoagland's solution containing 0, 3, 5, 10, 15 mg/L $Cu(NO_3)_2$, where its pH was adjusted to be between 5.5 to 6.5. The results showed copper precipitation and accumulation within or near the roots, presenting translocation factors of under one. Furthermore, a stem diameter of more than 1.6 centimeters is an appropriate size for *N. plena* harvesting in order to properly remove copper and use as biomass fuel. These results indicate a possibility that *N. plena* possesses both phytoextraction and phytostabilization potential to remediate heavy metal contamination with low required maintenance of humans. Further studies and an improved management plan can lead to the use of *N. plena* as an alternative plant for copper remediation.

POTASSIUM SUPPORTED RICE HUSK SILICA AS LOW-COST SOLID BASIC HETEROGENEOUS CATALYST FOR SYNTHESIS OF DIBENZYLIDENEACETONE

Sophacha Sugkachiradej,[1] Nalin Dulyapraphant,[1] Paparda Tantisukumarl,[1] Jidapa Pimthong,[2] Sakdinun Nuntang[2,*]

[1]Montfort College, Chiang Mai, 50000, Thailand
[2]Industrial Chemistry Innovation Program, Faculty of Science, Maejo University, Chiang Mai 50290, Thailand
*e-mail: Sakdinun.nt@gmail.com

Abstract:
Investigation was conducted on potassium supported by rice husk silica (K/RHS) as basic catalysts for dibenzylideneacetone (DBA) production. The catalysts were prepared by an impregnation method of K_2CO_3 solution (10-30 wt.%) onto rice husk silica as support and calcined at 700 °C. The physicochemical and morphological characterization of the K/RHS catalyst were performed using X-ray diffraction, N_2 adsorption–desorption analysis and Fourier transform infrared spectroscopy and Scanning electron microscopy. The results of such analysis revealed that the catalyst obtained was associated with strong basicity. The aldol condensation reaction of acetone with benzaldehyde was studied using acetone: benzaldehyde molar ratio of 1:2, catalyst loading of 1 wt% at 80 °C for 1 h. The K/RHS exhibited the yield of DBA as 75%.

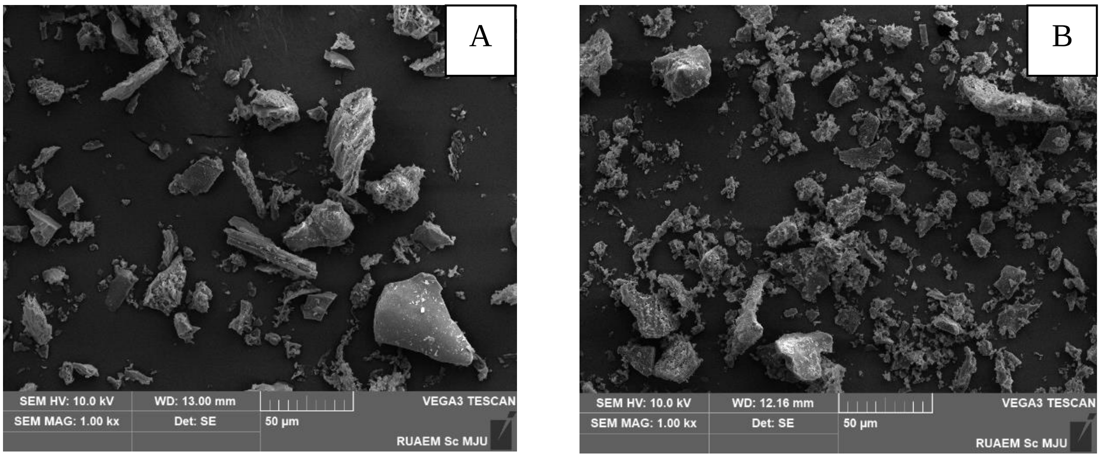


Figure 1.
SEM images (1,000 x magnification) of the (A) RHS and (B) K/RHS respectively.

PREPARATION AND CHARACTERIZATION OF MUNG BEAN-BASED FILMS FOR POTENTIAL ELECTROLYTIC APPLICATION

Nuengruethai Auekeng,[1] Manat Jaimasith,[2] Wanrudee Kaewmesri[2,*]
[1]Demonstration School, University of Phayao, 19 Moo 2 Tambon Maeka, Amphur Muang, Phayao 56000 Thailand
[2]Department of Chemistry, School of Science, University of Phayao, 19 Moo 2 Tambon Maeka, Amphur Muang, Phayao 56000 Thailand
*e-mail: wanrudee.ka@up.ac.th

Abstract:
Ion-conducting polymer electrolytes, primarily based on synthetic polymers, are indispensable components in electrochemical devices. However, growing environmental concerns have shifted towards exploring biodegradable, bio-based polymers as a sustainable alternative. This aims to reduce the ecological footprint of these devices while maintaining their performance. In this study, a polymeric matrix film was developed using mung bean, a commonly grown legume in Thailand. The films were made with 5% w/v mung bean flavor through a solution casting technique and dried at 45°C for 18 hours. To improve hydrophilicity, varying amounts of citric acid (1%, 5%, 15%, and 30%) were incorporated as a cross-linker. Additionally, 2% v/v glycerol was added as a plasticizer to enhance the film's flexibility and ion mobility. The impact of varying citric acid content on the properties of mung bean films was extensively studied and compared to neat films. Mung bean films with lower citric acid levels (1% and 5%) showed increased tensile strength, while higher concentrations (15% and 30%) negatively affected the mechanical properties, leading to reduced extension and tension. In all citric acid-treated films, FT-IR spectra showed the peak at 1714-1715 cm^{-1} indicated the stretching vibration of the C=O bond, confirming ester carbonyl formation from esterification between hydroxyl and carboxylic groups. The intensity of this peak increased with higher citric acid concentrations. Additionally, a peak at 1078 cm^{-1} corresponded to the C-O bond in starch and the C-O-H bond in glycerol.

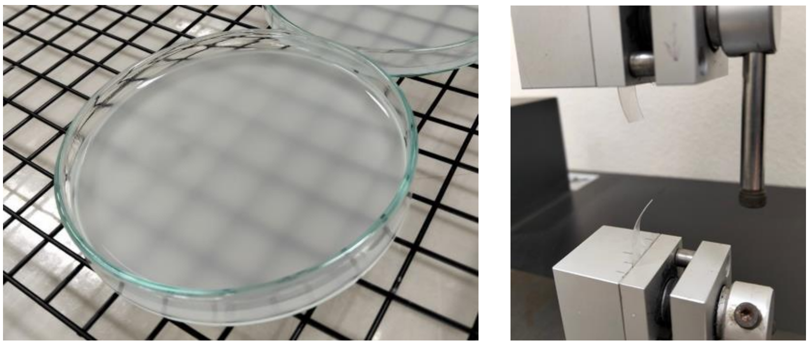


Figure 1.
Mung bean solution in the mold (left) and Fractured mung bean film (right)

PRODUCTION OF DEUTERIUM GAS FROM HEAVY WATER BY USING MIXED CONDUCTIVE GRAPHENE OXIDE MEMBRANE REACTOR

Toma Kiyozawa,[1] Muhammad Sohail Ahmad,[2] Yusuke Inomata,[3] Tetsuya Kida[3,*]
[1]Department of Materials Science and Applied Chemistry, Kumamoto University, Kumamoto, 860-8555, Japan
[2]Institute of Industrial Nanomaterials, Kumamoto University, Kumamoto 860-8555, Japan,
[3]Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, 860-8555, Japan
*tetsuya@kumamoto-u.ac.jp

Abstract:
Recently, the demand for deuterium gas, a raw fuel for nuclear fusion, has increased significantly. The conventional production method, electrolysis, is energy-intensive and expensive, highlighting the need for a new production approach. This study focuses on the graphene oxide (GO) based membrane reactor, an inexpensive and scalable carbon-based nanosheet material. GO was synthesized using Tour`s method, which involves the oxidation and exfoliation of the graphite. Further, Ce ions have been intercalated to enhance the proton conductivity and mechanical strength of the prepared GO, resulting in Ce-GO. The membrane was fabricated via a simple filtration method and then thermally reduced to a specific degree, producing partially reduced GO (Ce-prGO) with mixed proton and electron conductivity at room temperature. Proton and electron conductivities were measured using impedance spectroscopy and DC voltage methods. The Ce-prGO membrane was humidified with heavy water and exposed to hydrogen flow, facilitating the conduction of proton and electrons. The protons displaced the deuterium ions in the heavy water, which then combined with electrons to form deuterium gas, driven by the hydrogen partial pressure difference (Figure 1).

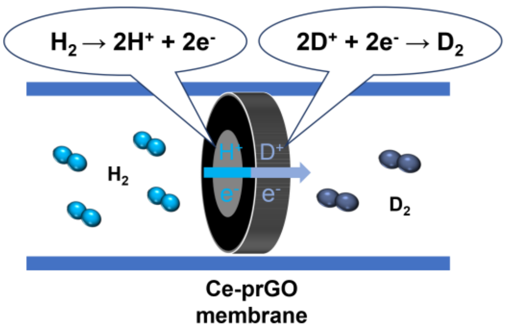


Figure 1. Schematic of the deuterium production using Ce-prGO membranes

Our findings confirm that the Ce-prGO membrane effectively produces deuterium gas from heavy water, substantiating the efficacy of our approach. This supports the unique properties of graphene oxide-based membranes, offering a more efficient method for deuterium production.

QUANTIFYING FRACTURE (JOINTS) CLUSTERING IN CHIANG MAI GRANITE: A METHODOLOGICAL APPROACH USING NORMALIZED CORRELATION COUNT

Natchanan Doungkaew
Department of Geological Sciences, Faculty of Science, Chiang Mai University, Thailand
e-mail: natchanan.d@cmu.ac.th

Abstract:

Fracture spatial distributions are crucial in controlling rock permeability, influencing fluid flow and potential resource storage. This study introduces a refined methodological approach to quantify fracture clustering and spatial distribution, with the goal of developing a robust technique for evaluating fracture distributions and connectivity in rocks. The research employs the Normalized Correlation Count (NCC) method within the CorrCount Program to analyze fractures in granitic outcrops at Huai Kaew, Wang Bua Ban, and Pha Ngoep waterfalls in Doi Suthep. The geomorphology of these waterfalls is linked to the Chiang Mai Low-Angle Normal Fault, which significantly influences the formation and spatial arrangement of fractures and slickenlines at the study areas. Preliminary findings reveal distinct fracture patterns: random distributions at Wang Bua Ban, regularly spaced clusters at Pha Ngoep, and log-periodic fractal clusters at Huai Kaew. Joint orientations show two dominant sets: a north-south set at Wang Bua Ban and Huai Kaew, parallel to the slickenlines, and a NW-SE set at Pha Ngoep. These variations likely result from localized stress reorientation associated with the uplift of the Doi Suthep metamorphic core complex. This research not only enhances the NCC framework for fracture analysis but also contributes to the broader application of these techniques in geological evaluations for CO_2 sequestration sites, providing a solid foundation for environmental conservation and carbon storage solutions —a key strategy in mitigating climate change.

RAPID SYNTHESIS AND CHARACTERIZATION OF UV-POLYMERIZED CASSAVA STARCH-GRAFTED-POLYACRYLIC ACID/ GRAPHENE OXIDE (GO) COMPOSITE HYDROGELS AS LOW-COST AND BIODEGRADABLE SUPERABSORBENT : EFFECT OF GO CONTENTS

Sayant Saengsuwan,[1*] Manmanut Srikaew,[1] Vinich Promarak[2]
[1]Innovation and Sustainability in Advanced Natural Rubber and Polymer (ISANRAP) Research Group, Department of Chemistry and Center of Excellence for Innovation in Chemistry, Faculty of Science, Ubon Ratchathani University, Warin Chamrap, Ubon Ratchathani, 34190, Thailand.
[2]Department of Materials Science and Engineering, School of Molecular Science and Engineering, Vidyasirimedhi Institute of Science and Technology, Wangchan, Rayong 21210, Thailand.
*e-mail: sayant.s@ubu.ac.th

Abstract:
Graphene oxide (GO) is widely known for enhancing both the mechanical strength and adsorption capacity of hydrogels, making it a promising material for wastewater treatment applications. This study explores the incorporation of GO into cassava starch-grafted-polyacrylic acid (CSt-g-PAA) hydrogels to improve mechanical properties and methylene blue (MB) dye adsorption. The hydrogels were synthesized through UV and free-radical polymerization with varying GO concentrations (1-10 mg). The chemical, physical, and morphological characteristics of the CSt-g-PAA/GO composite hydrogels were analyzed using FTIR, swelling behavior, tensile testing, and SEM. The results confirmed the successful formation of CSt-g-PAA/GO composite hydrogels. Swelling measurements showed that water swelling decreased with increasing GO content, from 35,645% for CSt-g-PAA without GO to 25,126% for the hydrogel containing 10 mg of GO. The swelling data followed zero-order kinetics, with diffusion constants (k) decreasing from 0.003 to 0.001 %/min as GO content increased, which correlated with reduced swelling ratios and less porous structures observed in SEM analysis. Conversely, the mechanical properties improved with higher GO content. Interestingly, the CSt-g-PAA hydrogel without GO exhibited the highest MB adsorption capacity (1,044 mg/g), while GO-reinforced hydrogels (1-10 mg GO) showed reduced dye adsorption capacity, decreasing from 1,037 mg/g to 779 mg/g. These findings suggest a complex trade-off between mechanical strength and adsorption efficiency in GO-reinforced hydrogels. The study provides valuable insights for optimizing bio-based adsorbents for industrial wastewater treatment and opens new opportunities for advancing water purification technologies.

Rational Design of Magnesium Silicate-based Nanocomposites to Enhance Electrochemical Effects for Hybrid Capacitor

Taewoong Lee, B. N. Vamsi Krishna, and Seung Jun Lee*
Department of IT-Energy Convergence (Brain Korea 21(FOUR)), Korea National University of Transportation, Chungju 27469, Republic of Korea
*e-mail: sjlee@ut.ac.kr

Abstract:
The rational design of nanostructures has garnered significant interest in enhancing the performance of energy storage devices. In this work, porous magnesium silicate template-based composites were prepared via a facile hydrothermal process, using magnesium silicate nanosphere as a template. The successful formation of the resulting composites is demonstrated via various spectroscopic techniques. By optimizing the process condition, it is demonstrated that the as-prepared composites maintain outstanding electrochemical performance in terms of specific capacity and retention. Additionally, the excellent electrocatalytic kinetics with lower overpotential is achieved. The prepared composite electrode is employed in a hybrid capacitor (HSC) and shows outstanding energy density and power density with remarkable cycling stability. These results highlight the promising strategies to prepare the composite electrodes for high performance HSC.

REMOVAL OF DIESEL OIL FROM WATER USING MAGNETIC BIOCHAR DERIVED FROM LONGAN PEEL AS ADSORBENT

Naphattra Pripwai,[1] Pitchayapon Mungthong,[1] Nuthatai Srichan,[1] Chanyanut Thammasit,[2] Sakdinun Nuntang[2,]*

[1]Montfort College, Chiang Mai, 50000, Thailand
[2]Industrial Chemistry Innovation Program, Faculty of Science, Maejo University, Chiang Mai 50290, Thailand
*e-mail: Sakdinun.nt@gmail.com

Abstract:
Oil spills may be extremely dangerous to marine life. The objective of this study is to evaluate the adsorption capacity of magnetic biochar from longan peel (M-BLP) prepared in difference pyrolysis temperature of $FeCl_3$ treated longan peel as an adsorbent for removing the diesel oil from water. The M-BLP was synthesized using a slow pyrolysis method (400-600 °C) and characterized using SEM-EDX, FTIR, BET surface area analyzer and XRD. The results showed that M-BLP exhibited high porosity, thermal stability, and hydrophobic character, making it a promising adsorbent for oil-water separation and environmental remediation. The adsorption capacity of M-BLP for diesel oil removal was examined in terms of adsorbent dose, pH level, salinity, and contact time. Increasing the M-BLP dosage, contact time, and salinity significantly enhanced the sorption capacity, however, pH variations had no significant effect on adsorption. Moreover, the M-BLP adsorbent had a good stability and magnetic separation.

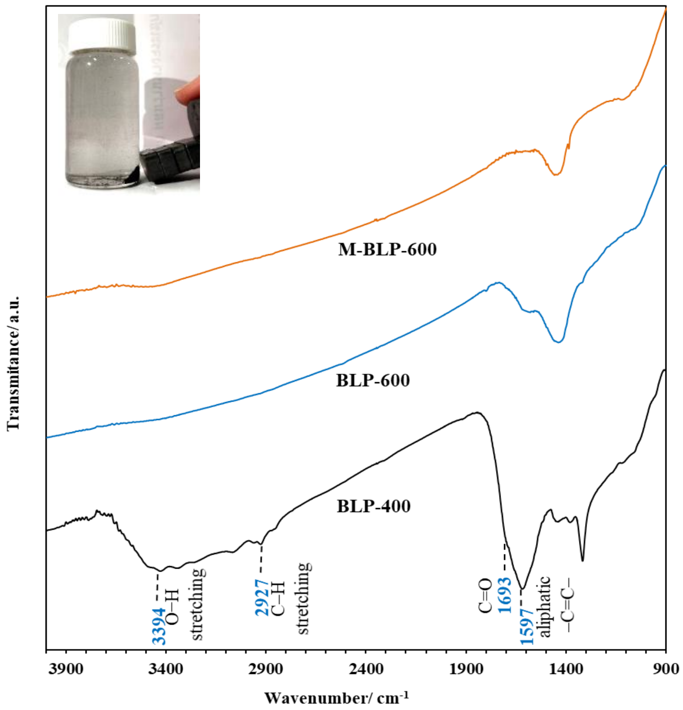


Figure 1.
FTIR spectra of biochar from longan peel and magnetic separation.

SELECTIVE ACETIC ACID FORMATION BY ELECTROCHEMICAL CO_2 REDUCTION USING AgCu NANOPARTICLES

Yuya Watase,[1] Satoko Takase,[2] Yusuke Inomata,[3] Yoichi Shimizu,[2] Tetsuya Kida,[3*]
[1] Graduate School of Science and Technology, Kumamoto University, Kumamoto, Japan
[2] Faculty of Engineering, Kyushu Institute of Technology, Fukuoka, Japan
[3] Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, Japan
*e-mail: 231d8836@st.kumamoto-u.ac.jp

Abstract:

Electrochemical CO_2 reduction is a technology for electrochemically converting CO_2 into valuable chemicals, and it's considered an effective method of becoming carbon neutral because of its simple and mild condition. Among the catalysts used in electrodes, Ag-Cu bimetal catalysts are known to be highly selective in the production of C_2 substances such as ethylene and ethanol, but there are few reports of successful selective production of acetic acid. Acetic acid derivatives are widely used as industrial chemicals such as pharmaceuticals and polymer raw materials, and their demand is expected to increase in the future. In this study, I investigated various conditions for the selective acetic acid production using AgCu alloy nanoparticles / Nitrogen doped reduced Graphene Oxide (NrGO) composite catalysts.

AgCu alloy nanoparticles (AgCu NPs) were synthesized by a solvothermal method using copper(II) acetylacetonate and silver acetate as metal precursors, and AgCu NPs were mixed with graphene oxide (GO) and urea, freeze-dried, and calcined in a reducing atmosphere to form a catalyst for electrodes. A gas diffusion electrode (GDE) was prepared from this catalyst and carbon black. Electrochemical measurements were performed in a three-electrode system using a two-tank cell separated by an anion exchange membrane and the prepared GDE as the working electrode. The catalytic performance was evaluated by calculating the Faradic Efficiency (FE) of the CO_2 electrolysis products from the samples under various conditioning conditions, including copper and silver compositions.

AgCu NPs transformed from a homogeneous mixture of Cu and Ag into Janus particles via calcination (Fig. 1(a)) and exhibited acetogenic activity. 30 mol% - AgCu NPs synthesized at 180°C achieved FE = 21% for acetic acid formation at -1.6 V vs. Ag/AgCl (Fig. 1(b)). TEM observations showed that AgCu NPs were uniformly dispersed on NrGO, and no agglomeration of particles was observed during the calcination process; when AgCu NPs and GO were heat-dried before calcination, no Janus particles were formed due to agglomeration and melting of particles and no activity against acetic acid formation was observed. This suggests that the Janus structure of AgCu is effective against acetic acid formation. Furthermore, the XRD results suggest that the formation of Janus particles and the presence of Cu(111) are effective for acetic acid formation.

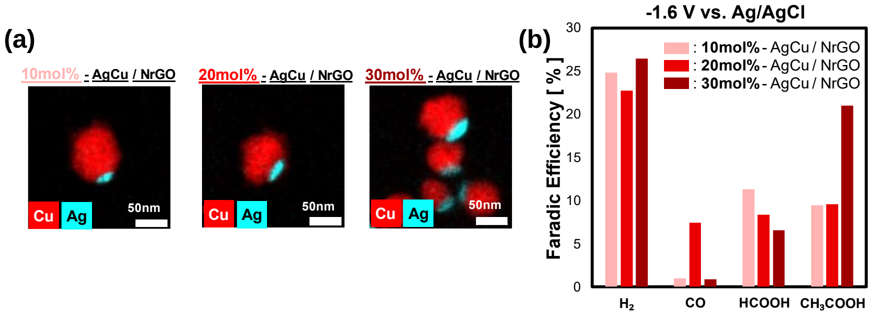


Figure 1. (a) EDX images of AgCu NPs for each composition and (b) FE for each product (-1.6V vs Ag/AgCl).

STUDY OF THE OPTIMAL CONDITIONS FOR ALCOHOL FERMENTATION FROM TROPICAL CARPET GRASS (*Axonopus compressus*)

Emiley Kettunen,[1] Khomkrit Arunchaipong,[2]*
[1] Khonkaen Wittayayon, Khon Kaen, Thailand
[2]Department of Chemistry, Faculty of Engineering, Rajamankala University of Technology Isan, Khon Kaen Campus, Khon Kaen, Thailand
*e-mail: khomkrit.ar@rmuti.ac.th

Abstract:

Tropical carpet grass (*Axonopus compressus*) is commonly used for landscaping and home decoration in many countries. Unfortunately, when the grass is cut, it is often burned or discarded. As the issue of global warming becomes increasingly severe, the demand for alternative energy sources also rises as well. This study aims to assess the possibility of using tropical carpet grass for ethanol production, providing foundational data for the development of alternative energy sources. Hydrochloric acid (HCl), sulfuric acid (H_2SO_4), or nitric acid (HNO_3) at various concentrations and time intervals were used in the study to investigate the hydrolysis of lignocellulose from the grass. The results showed that a concentration of 1.00 mol/dm^3 of HCl and 7 hours of incubation time at 80°C yielded the highest concentration of reducing sugar, which was 2.667×10^{-3} mol/dm^3, as detected by the dinitrosalicylic acid colorimetric method. The hydrolyzed grass was then used for alcohol fermentation studies with yeast (*Saccharomyces cerevisiae*) under conditions both with and without additional nitrogen sources. The results showed that the optimal fermentation period for ethanol under anaerobic conditions was 5 days, yielding an ethanol concentration of 11.68% (v/v) as detected by gas chromatography. When a nitrogen source was added to the fermentation process, the highest ethanol concentration of 6.52% (v/v) was achieved by adding 0.1 % (w/w) ammonium sulfate after 3 days of fermentation. Additionally, the addition of 0.1 % (w/w) of the amino acid leucine resulted in an ethanol concentration of 11.03% (v/v) after 5 days of fermentation.

SUPERCRITICAL CO_2-MEDIATED HYDROTHERMAL LIQUEFACTION OF MICROALGAE PRETREATED WITH MICROWAVE

Nagamine Taisei[1], Armando T. Quitain[2,3], Yusuke Inomata[4], Tetsuya Kida[3,4]

[1]Department of Materials Science and Applied Chemistry, Kumamoto University, Kumamoto, 860-8555, Japan
[2]Center for International Education, Kumamoto University, Kumamoto, 860-8555, Japan
[3]International Research Organization for Advanced Science and Technology, Kumamoto University, Kumamoto, 860-8555, Japan
[4]Faculty of Advanced Science and Technology, Kumamoto University, Kumamoto, 860-8555, Japan
*e-mail: 237d8824@st.kumamoto-u.ac.jp

Abstract:
The use of fossil-derived fuels has been an integral part of our daily lives. However, they are finite substances and will steadily be depleted. In addition, they emit large amount of carbon dioxide, a greenhouse gas, that is the main cause of global warming. As an alternative, biofuels have attracted a lot of attention. Among them, microalgae-derived biofuels have been extensively investigated worldwide. One advantage of microalgae is that they do not require large areas of cultivated land. They also have a very high oil and fat production per unit area, making them useful as next-generation biomass resource. However, existing processes using this raw material are not cost-effective. Besides, the products still contain unwanted nitrogen-containing compounds. In this study, we propose the use of hydrothermal liquefaction (HTL) for conversion of microalgae to bio-oil. HTL does not require pre-drying of the feedstock and has low pre-treatment costs. As an intensification strategy to HTL, supercritical carbon dioxide was added into the system to generate a more acidic condition required for the liquefaction. Moreover, microwaves were used to pre-treat the microalgae. These intensification strategies are thought to have positive effect on deamination, thus avoiding conventional expensive process of hydrogenation for upgrading of the resulting bio-oil.
The main products in the bio-oil produced by HTL treatment with microalgae were found to be long-chain alkenes and nitrogen-containing heterocyclic compounds. Results also showed that pretreatment of sample with microwave could further suppress the formation of nitrogen-containing heterocyclic compounds in a supercritical CO_2-aided hydrothermal liquefaction of microalgae, thus selectively producing long-chain alkenes. This means that deamination of the bio-oil is accelerated, resulting to the reduction of the nitrogen content in the bio-oil. Optimization was also performed, as well as qualitative analysis of the obtained bio-oil.

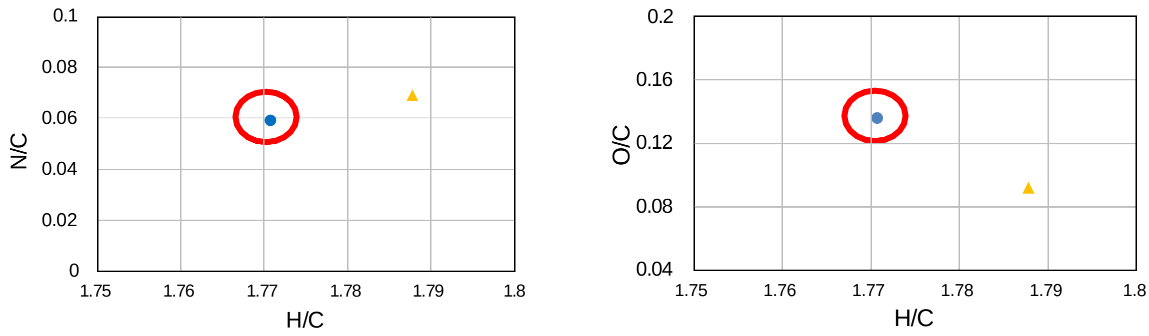


Figure 1. Degree of deamination using microwave pretreatment
(red circles represent results with microwave pretreatment)

SYNERGISTIC EFFECT OF NiCoOx AND FUNCTIONALIZED MXENE FOR HIGH-PERFORMANCE SUPERCAPACITORS

Han Su Kim[1], Astakala Anil Kumar[1], Yiseul Yu[1], Young Ho Park[1], Insik In[1]*, Seung Jun Lee[1]*
Department of IT and Energy Convergence (BK21 Four), Korea National University of Transportation, Chungju 27469, Republic of Korea
*e-mail: sjlee@ut.ac.kr

Abstract:
Nickel Cobalt Oxalate (NiCoOx) has garnered significant attention as a promising electrode material for supercapacitors due to its high specific capacitance. However, its performance is often hindered by low conductivity and limited ion accessibility. In this study, we introduce a novel approach to enhance the electrochemical properties of NiCoOx by incorporating two-dimensional transition metal carbides, MXenes, as a conductive additive. NiCoOx/MXene composites were synthesized via a low-temperature KOH-assisted method. Structural and morphological analyses confirmed the successful integration of MXene into the NiCoOx matrix, resulting in increased surface area, porosity, and conductivity. Electrochemical evaluations demonstrated that the composite electrode exhibited significantly higher specific capacitance compared to conventional NiCoOx-based supercapacitors. Moreover, we further enhanced the electrochemical performance by utilizing functionalized MXene(L-MXene), which exhibits a synergistic effect with NiCoOx, leading to improved interactions with the electrolyte compared to pristine MXene. The synthesized NiCoOx/L-MXene composite presents a promising avenue for developing high-performance supercapacitors with enhanced electrochemical properties.

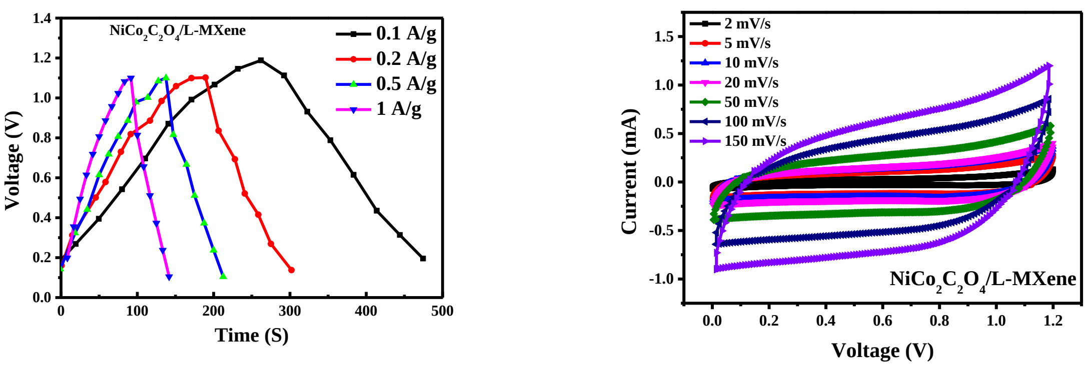


Figure 1. Galvanostatic Charge Discharge analysis of $NiCo_2C_2O_4$ interfaced L-MXene in the KOH aqueous electrolyte and Cyclic voltammetry analysis of $NiCo_2C_2O_4$ interfaced L-MXene in the KOH aqueous electrolyte.

Synthesis and Optimization of Phase-Pure $NaCoPO_4$ for Enhanced Electrochemical Performance as a Cathode Material in Sodium-Ion Batteries

Jaturon Kumchompoo[1], Jyh-Tsung Lee[1*]

[2] Department of Chemistry, National Sun Yat-Sen University, Kaohsiung, 80424, Taiwan.

*e-mail: Jyh-Tsung Lee: jtlee@faculty.nsysu.edu.tw

Abstract: $NaMPO_4$ (where M = transition metal) compounds often tend to transition into the electrochemically inactive maricite phase when synthesized using conventional methods. The advancement of sodium-ion batteries (SIBs) is crucial for their widespread commercial production. In this study, phase-pure $NaCoPO_4$ was synthesized using solvothermal and hydrothermal methods. Variations in the crystallinity of $NaCoPO_4$ were observed due to different pH values and temperatures employed during synthesis. Specifically, $NaCoPO_4$ synthesized at pH 9.70 using hydrothermal at 180°C for 2 h exhibited a starfish-like morphology (NCP-1). In contrast, $NaCoPO_4$ synthesized at pH 8.0 under hydrothermal conditions at 180°C for 5 h (NCP-2) and at pH 9.80 at 150°C for 5 h (NCP-3) displayed disc-like morphologies. Electrochemical characterization revealed that NCP-1 demonstrated superior charge-discharge performance, with a more pronounced and stable capacity compared to NCP-2 and NCP-3. Notably, NCP-1 achieved a capacity of 20.2 to15.2 mAh g^{-1} after 200 cycles at a rate of 0.2C, exhibiting excellent capacity retention of 60.39%. Structural and morphological analyses were conducted using powder X-ray diffraction (XRD) and scanning electron microscopy (SEM). Electrochemical performance was assessed through cyclic voltammetry (CV) and charge-discharge tests. The results indicate that variations in solvent conditions and heating durations lead to significant differences in particle size and electrochemical properties.

Keywords: Sodium-ion battery; cathode material; $NaCoPo_4$; solvothermal synthesis; hydrothermal synthesis.

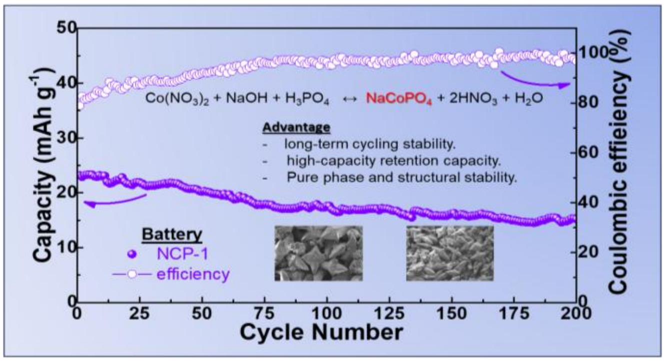


Figure 1. Cycle performance of $NaCoPO_4$ cathode material in sodium-ion battery.

References

[1] Gutierrez A, Kim S, Fister T-T, Johnson C-S. ACS Appl. Mater. Interfaces 2017;9; 4391−4396.
[2] Chen Y-T, Li C-C. Mater. Chem. Phys. 2023;205;127998.
[3] Kumar S, Ranjeeth R, Mishra N-K, Prakash R, Singh P. Dalton Trans. 2022;51;5834-5840.

SYNTHESIS OF g-C_3N_4-BASED PHOTOCATALYST WITH ENHANCED PHOTO CATALYTIC PERFORMANCE AND THEIR APPLICATION TO PHOTOELECTROCHEMICAL WATER SPLITTIING

Kyung Suh Kim, Myung Jong Kang*
Department Chemistry, Gangneung-Wonju National University, Gangneung, 25457, Republic of Korea
*e-mail: mjkang@gwnu.ac.kr

Abstract:

g-C_3N_4 (graphitic carbon nitride) is a promising photocatalytic material that is easy to synthesize using inexpensive precursors such as urea, melamine, and dicyandiamide. It has excellent thermal and chemical stability, and has a band gap that absorbs sunlight, so it is used in various areas such as sensors, water purification, and water splitting.

However, it has limitations on poor photocatalytic efficiency due to the low surface area, rapid electron-hole recombination, and can only absorb light of a specific wavelength. Several methods for modifying pristine g-C_3N_4 are being studied to overcome these limitations and improve photocatalytic efficiency, including surface, morphology-engineering, metal doping etc. In this reason, we studied the transition metal doping method among several methods. In case of transition metal doping, it is expected that the photocatalytic efficiency will be improved by reducing the band gap of the pristine photocatalyst materials and solving problems such as rapid electron-hole recombination.

The photocatalysts were synthesized through a facile thermal treatment process. Each photocatalyst was named CN 0, CN Fe, and CN Co according to the type of metal. To confirm the photocatalytic efficiency, Methyl Orange (MO) photodegradation and photoelectrochemical water splitting were performed. For MO photodegradation, the concentration change of MO was confirmed through UV-vis, and for photoelectrochemical water splitting, LSV and CA measurements were performed. This study suggests that doping transition metals into g-C_3N_4 can help improve the photocatalytic efficiency.

SYNTHESIS OF MAGNETIC-Ag/BIOCHAR COMPOSITE DERIVED FROM CORN HUSK AND THEIR ANTIBACTERIAL ACTIVITY AGAINST *Escherichia coli*

Paphada Pathomnatikul,[1] Chottiwaad Siriprachote,[1] Gulsara Panyam,[1] Chanyanut Thammasit,[2] Sakdinun Nuntang[2,]*

[1]Montfort College, Chiang Mai, 50000, Thailand
[2]Industrial Chemistry Innovation Program, Faculty of Science, Maejo University, Chiang Mai 50290, Thailand
*e-mail: Sakdinun.nt@gmail.com

Abstract:
Corn husk (CH) was utilized for the multifunctional magnetic-silver/biochar material (M-Ag/CHB). A magnetic corn husk biochar with colloidal Fe_2O_3 particles embedded in porous biochar matrix was fabricated via thermal pyrolysis of $FeCl_3$ treated biomass. Then, the synthesis of magnetic silver-biochar material using $AgNO_3$ solution as silver source and polyphenol extracted from green tea as a reducing agent. Their structure and morphology were characterized by X-ray diffraction (XRD), Scanning electron microscope (SEM), and brunauer-emmett-teller (BET) specific surface area and Fourier transform infrared spectroscopy (FTIR). The results showed that the magnetic-silver nanoparticles were loaded onto the biochar successfully have larger specific surface area than initial biochar. Their antibacterial activity against *Escherichia coli* (*E. coli*) was examined by tablet colony counting method and optical density (OD) method. The results showed that the magnetic-silver/biochar composites were more effective and had superior antibacterial performance than initial biochar which indicated that magnetic-silver/biochar composites have good application prospect in antibacterial field.

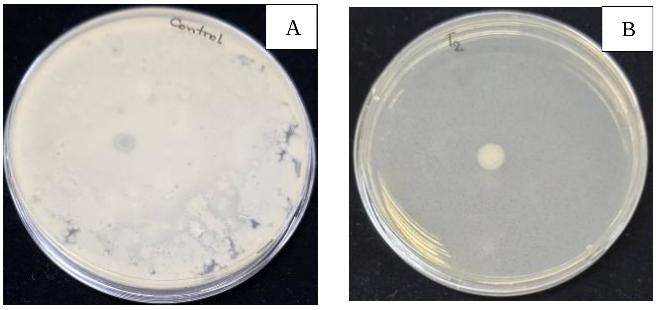


Figure 1.
The comparison of antibacterial activity of (A) Blank and (B) Ag/CHB composite.

SYNTHESIS OF S-DOPED CARBON DOTS FOR PHOTOCATALYTIC DEGRADATION OF DYE

Ganyaporn Wongwaen,[1] Cheewita Suwanchawalit,[1,*]
[1]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom, 73000, Thailand.

*e-mail: suwanchawalit_c@silpakorn.edu

Abstract: In this work, we are interested in the designed synthesis of carbon dots for wastewater treatment. Sulfur-doped carbon dots (S-CDs) were synthesized via a solvothermal method using various amounts of sulfur, with using caffeine and sodium sulfide as precursors. The microstructure and optical properties of the synthesized S-CDs were characterized using X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), Transmission Electron Microscopy (TEM), Ultraviolet-visible (UV-Vis) spectroscopy, a zeta potential analyzer, and Photoluminescence (PL) spectroscopy. The synthesized S-CDs showed main absorption bands at approximately 210 and 280 nm, corresponding to the C=C bonds in the graphitic structure and the C-N/C-S bonds, respectively. The PL spectra of the synthesized S-CDs exhibited strong emission peaks at 425 nm when excited at a wavelength of 365 nm. The photocatalytic properties of the synthesized S-CD suspensions were investigated by studying indigo carmine decolorization under UV irradiation. The S-CDs with a higher sulfur content demonstrated better photocatalytic performance under UV irradiation compared to those with lower sulfur content. Additionally, the mechanism of dye degradation was explored using various charge-carrier scavengers.

TAILORING ANION COMPOSITION IN COPPER-BASED LEAD-FREE HALIDE PEROVSKITES FOR ENHANCED PHOTO ELECTROCATALYTIC PERFORMANCE

Dibyendu Dutta,[1] Anil Kumar Astakala,[2] Yiseul Yu [3], Young Ho park [1], Insik In [1,*], Seung Jun Lee [1,*]
Department of IT and Energy Convergence (BK21 Four), Korea National University of Transportation, Chungju 27469, Republic of Korea
*e-mail: sjlee@ut.ac.kr

Abstract:
Perovskite materials, particularly lead halide perovskites, are recognized for their exceptional optoelectronic properties but face environmental challenges due to lead toxicity. This has led to a growing interest in lead-free alternatives, with copper-based perovskites emerging as promising candidates. The anion exchange process, such as the transformation from $CsCuBr_3$ to $CsCuCl_3$, enables fine-tuning of material properties while retaining the cationic framework. This exchange results in significant shifts in electronic and optical properties, including bandgap widening and enhanced stability. The present study investigates the anion exchange process from $CsCuBr_3$ to $CsCuCl_3$ to enhance the photo electrocatalytic performance of copper based halide perovskites. We have synthesized a series of cesium copper halide compounds and evaluated their structural, optical, and electrochemical properties. X-ray diffraction (XRD) analysis confirmed the successful exchange and structural integrity of the resulting materials, while field emission scanning electron microscopy (FE-SEM) provided insights into their morphology. Optical characterization revealed that the materials exhibit tunable band gaps and strong photoluminescence, with $CsCuCl_3$ showing a prominent green emission peak at 530 nm, Zeta potential measurements indicated good colloidal stability across the series, with particle size distributions and surface charges favorably influenced by solvent choice. Photo electrocatalytic tests, including electrochemical impedance spectroscopy (EIS), cyclic voltammetry (CV), and Tafel analysis, highlighted $CsCuBr_3$ as the most efficient catalyst with the lowest charge transfer resistance, highest current density, and smallest Tafel slope. The results suggest that anion exchange from Br- to CI- can modulate the electronic and catalytic properties of cesium copper halides, making $CsCuX_3$ compounds promising candidates for photo electrocatalytic applications.

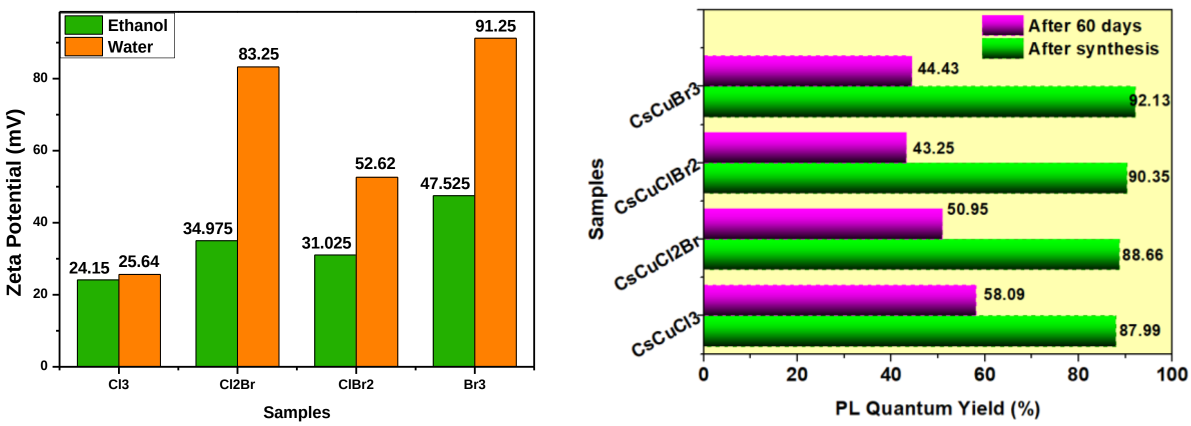


Figure 1. : (a) PL Quantum Yield (%) data for $CsCuCl_3$, $CsCuCl_2Br$, $CsCuClBr_2$, and $CsCuBr_3$; (b) PLQY comparison over time (60 days)

The Development of IoT for Automatic Cat Food Feeder Using Hybrid Energy

Ittipat Lohalaksnadech[1,*] Tharathep Sripet[1] Weerayuth Nillaor[1] and Phapatchakorn Areekul[2]
[1] Saparachinee School, 142 Visadekul Alley, Tambon Thap Thiang, Mueang Trang District, Trang 92000 Thailand
[2] Faculty of Engineering and Technology, Rajamangala University of Technology, Srivijaya, Trang, 92000 Thailand
e-mail: Ittipatrx@gmail.com

Abstract:

Raising cats as pets at home is very popular, and the number of cat owners tends to increase. However, feeding cats is an important matter in taking care of them, both in terms of the amount of food and the time of feeding. When the owners feed their cats by leaving a large amount of food for them in advance, especially during the rainy season, mold will occur on the food due to humidity, which causes loss of valuable nutrition and harms the cat's health. Therefore, the researchers are interested in using technology to help with feeding by developing an automatic cat feeder using a hybrid energy system (Solar Energy and 220 V AC electricity) which has developed an automatic system with IoT technology on a small embedded computer that can control the working process (Figure 1) showing the conceptual diagram and principle of this project. From the experiment, the outstanding features are the ability to set the amount of food needed by calculating the weight of the food and the automatic feeding system at a specified time using the control system via an application called Blynk, which can display data and process status on a smartphone. The automatic cat feeder uses solar energy and 220 V AC electricity, because the power supply has a sensor control system and can be used with a household power supply. The automatic cat feeder can also store energy in the battery. The results of the study show that the food can be dispensed to cats according to the food containers. Therefore, users can plan and set the time as well as the amount of food to be fed. Moreover, they can control and adjust the system remotely and efficiently using a hybrid energy system.

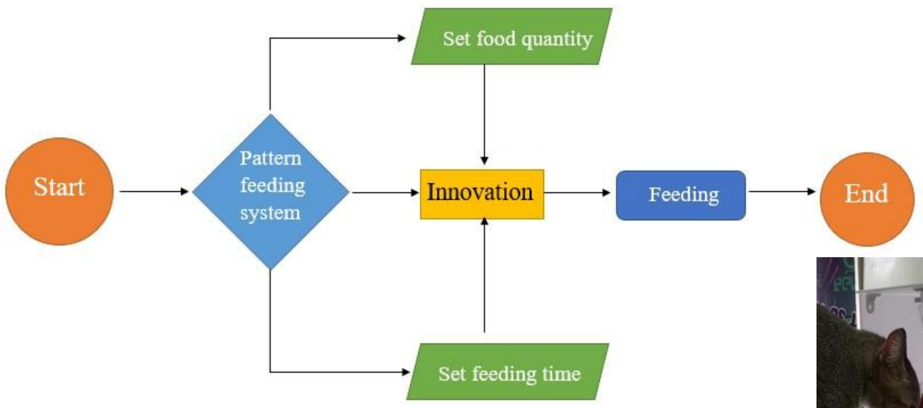


Figure 1 Automatic cat food feeder

THE PETROCHEMISTRY OF MAE CHAN IGNEOUS ROCK, EAST MAE CHAN, CHIANG RAI, THAILAND

Patcharin Kosuwan Jundee[1,*] Burapha Phajuy,[1] Yuenyong Panjasawatwong,[1] Prinya Phutthaphibal,[2] Panjai Saraphanchotwitthaya,[3] Panawat Watthanapond,[4] Ekkachak Chandon,[2] and Piyanut Arin[1]

[1]Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand, 50200

[2]Geoscience program, Mahidol University, Kanchanaburi campus, Kanchanaburi, Thailand, 71150

[3]Department of Mineral Resources, Bangkok, Thailand, 10400

[4]Department of Geology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand, 10330

*e-mail: patcharinkosuwan.j@cmu.ac.th

Abstract: The Mae Chan igneous rock is crop out at Doi Pha Rua and Doi Pa Sak area, Tha Khao Pluek sub-district, Mae Chan district, Chiang Rai province that is the eastern part of Mae Chan Pluton, the northern part of the east granitic belt of Thailand. The Mae Chan igneous rock is composed mainly of granite, with minor granodiorite, gabbro, and andesite dike. Twenty samples are collected from outcrop and core sampling for petrochemistry analyses. The igneous rock samples are classified into four groups. Group I is porphyritic hornblende-biotite monzogranite with high-K calc-alkaline rhyolite to dacite with hybridized I- and S-type magma series. Group II is garnet-bearing diorite, monzodiorite and granodiorite with low-K tholeiitic magma series. Group III is cumulate gabbro with low-K tholeiitic basalt magma series. Group IV is a porphyritic andesitic dike with medium-K calc-alkaline andesite to dacite magma series. Based on the tectonic discrimination diagram and rare earth element pattern, The Mae Chan igneous rocks are identified as Group I, II and IV rocks are related to continental margin volcanic arc whereas Group III rock is formed in trench-proximal mid-ocean ridges. The relationship between monzogranite and granodiorite-gabbro is fault contact because they do not have a geochemical data correlation. The Mae Chan igneous rock was originated by the magmatism along the boundary between the Sukhothai Arc and Inthanon Zone.

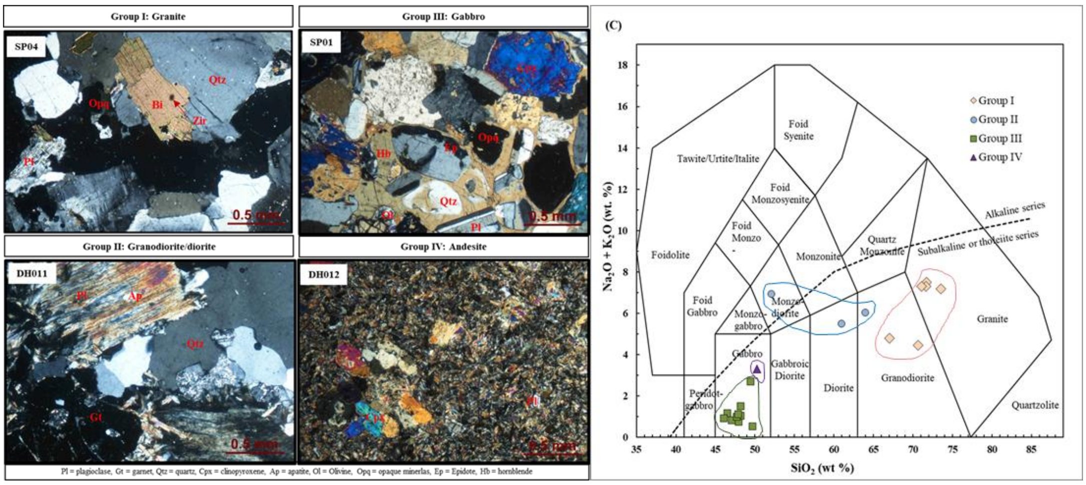


Figure 1.
The petrography (left) and TAS diagram plot (right) of samples

THE POTENTIAL OF THE BUATONG WATERFALL - CHET SRI FOUNTAIN NATIONAL PARK, CHIANG MAI, THAILAND FOR GEOTURISM

Yupa Thasod, Natchanan Doungkaew*, Phatcharin Kosuwan Chandee, Chanawut Suksabai
Department of Geological Sciences, Faculty of Science, Chiang Mai University, Thailand

*e-mail: natchanan.d@cmu.ac.th

Abstract:

Buatong Waterfall-Chet Si Fountain National Park, located in Mae Taeng District, Chiang Mai (Figure 1), is notable for its distinctive beige carbonate waterfall and vibrant greenish-blue fountain. Geological assessments, including fieldwork and polarizing microscope studies, reveal that the area is composed of mafic igneous rocks (gabbro), sedimentary rocks (sandstone, siltstone, and fossiliferous limestone), and fossils such as fusulinids, crinoids, and coral (Figures 2 and 3). These characteristics align with the Permian Kiew Lom Formation. Structural evidence exposed shearing, faulting, sheared veins, slip-fiber lineation, slickensides, and offset veins, suggesting multiple tectonic events. The first occurred during the Permian-Triassic when the Sibumatsu and Indochina plates subducted, closing the paleo-ocean and forming mountains. The second event, during the Cenozoic, involved the India-Eurasia collision, leading to the deformation and development of Cenozoic fault-bound basins. The step-like topography of Buatong Waterfall is a clear indicator of fault activity. These geological features highlight the area's potential for future geo-tourism development in Chiang Mai.

Figure 1

The location of the Buatong Waterfall-Chet Si Fountain National Park, northeast of Chiang Mai City, is a one-hour drive by car. The park is located at 19.08206N, 99.08037E.

Figure 2

1. Buatong Waterfall with step-like topography and tufa, 2. Mafic igneous rock (gabbro) covered by tufa, 3. Bua Thong Limestone cave with faults and fractures, 4. Sandstone bed with faults

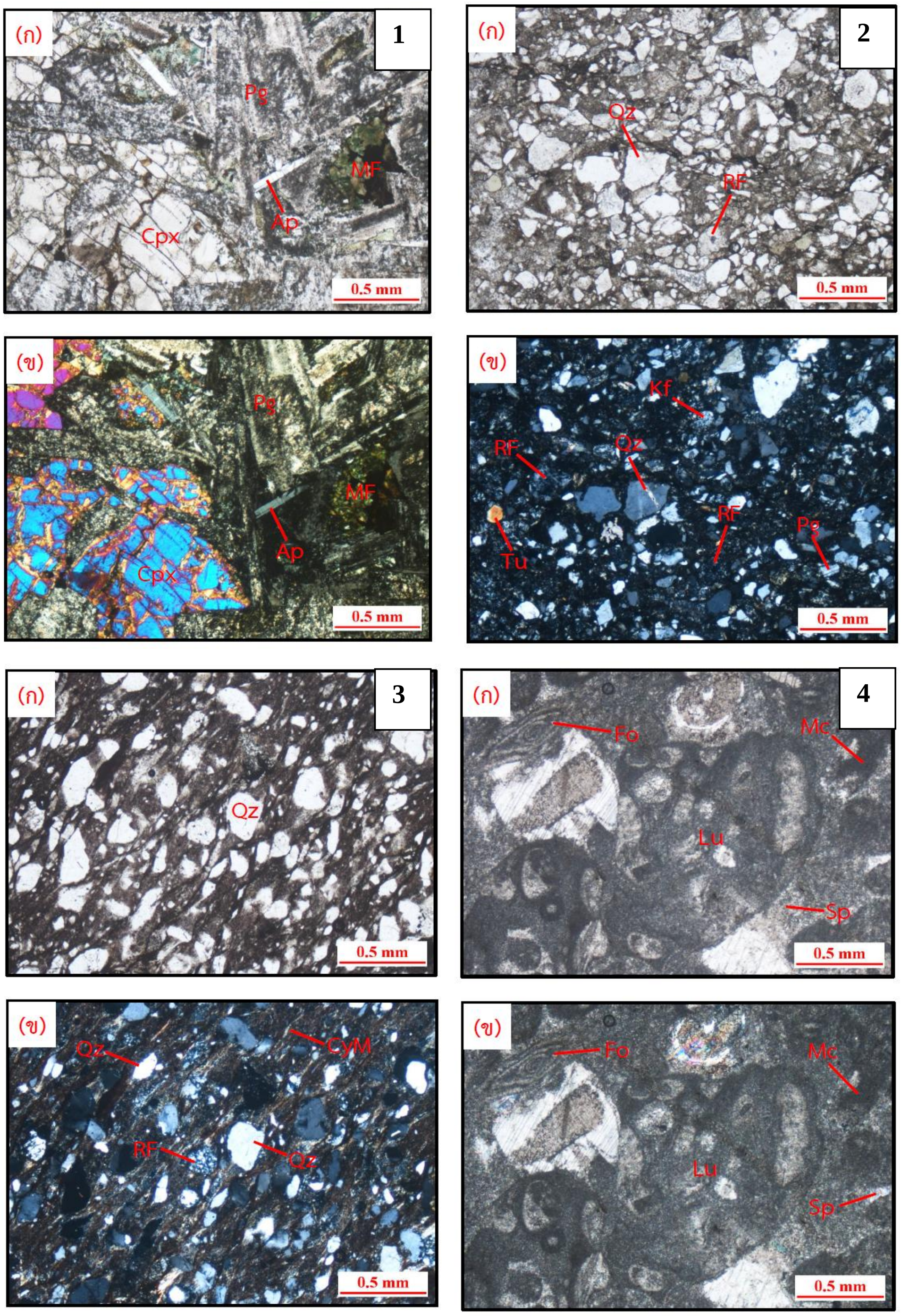


Figure 3

Photomicrograph of rocks at the Buatong Waterfall-Chet Si Fountain National Park and nearby areas, 1. Gabbro (Pg=plagioclase, Cpx=clinopyroxene, Mg=magnetite, MF=mafic mineral altered to chorite), 2. Sub-angular poorly sorted sandstone (Qz=quartz, Rf=rock fragment, Pg=plagioclase, Kf=K-feldspar, Tu=tourmarine), 3. Sheared Sandstone (Qz=quartz, RF=rock fragment, CyM=clay matrix), 4. Fossiliferous Limestone with foraminifera (Fo=foraminifera, Lu=lump, Mc=micrite, Sp=sparite)

THE PREPARATION OF GREEN POLYLACTIDE FOAMS: EFFECT OF ENVIRONMENTALLY FRIENDLY FOAMING AGENTS

Tunsuda Suparanon,[1,2,*] Worasak Phetwarotai[1,2]
[1]A Division of Physical Science, Faculty of Science, Prince of Songkla University, Hatyai, Songkhla 90112, Thailand
[2]Energy and Materials for Sustainability (EMS) Laboratory, Faculty of Science, Prince of Songkla University, Hatyai, Songkhla 90112, Thailand

*e-mail: tunsuda68@gmail.com

Abstract:

The Bio-Circular-Green (BCG) model offers a promising solution to the issue of plastic waste by minimizing the use of petrochemical-based foams and instead employing biodegradable polymers, such as polylactide (PLA) foam. The preparation of PLA foams using environmentally friendly foaming agents is essential in this process. In this study, citric acid (CA) and sodium bicarbonate (SB) were investigated as a combined foaming agent (CS) for PLA foam production. PLA foams with varying ratios and contents of CA and SB were prepared via melt extrusion and characterized using scanning electron microscopy (SEM) and differential scanning calorimetry (DSC). SEM analysis and physical appearance studies revealed that the optimal CA ratio was 1:4, which showed the best cell dispersion and distribution, with a closed-cell structure compared to other ratios. This ratio was selected for further investigation. The addition of 1 phr of CS decreased the glass transition temperature (Tg) to 47.3°C and the cold crystallization temperature (Tcc) to 111.5°C. Furthermore, the crystallinity of PLA foam increased significantly to 41.28% with the inclusion of 1 phr CS. These findings demonstrate that the combination of CA and SB serves as an effective, environmentally friendly foaming agent for producing green PLA foams with improved crystallization properties.
Keywords: foam, polylactide, foaming agent

THE RELATIONSHIP BETWEEN MICROSTRUCTURE AND EROSION-CORROSION BEHAVIOR OF HIGH CHROMIUM CAST IRONS

Amporn Wiengmoon[1,*], John T.H Pearce[2], Torranin Chairuangsri[2], Kittikhun Ruangchai[1]
[1]Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand
[2]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: ampornw@nu.ac.th

Abstract:
The objective of this work is to study the effects of destabilization heat treatment on the microstructure, hardness, corrosion resistance and erosion-corrosion behavior of 28wt.%Cr iron with (1-6)wt.%Mo and (1-4)wt.%W addition. As-cast irons were destabilized at 1000°C for 4 hours, and then air-cooling to room temperature. Microstructural investigation and phase identification were studied by optical microscopy, scanning electron microscopy, and X-ray diffraction. Vickers macro-hardness, potentiodynamic testing, and erosion-corrosion testing were tested. The 28wt.%Cr iron (R iron) with 1 and 6wt.%Mo (Mo1 and Mo6) promoted the formation of M_6C and $M_{23}C_6$, while the irons with 1 and 4wt.%W (W1 and W4) promoted the formation of primary M_7C_3 and eutectic M_6C. After destabilization, the precipitation of secondary carbides within the martensite matrix was found in all irons. The addition of Mo or W led to finer secondary carbides. Vickers macro-hardness of all irons in the as-cast condition and after destabilization increased with increasing Mo or W addition. The R iron in as-cast condition gave the best corrosion resistance. Destabilization heat treatment did not significantly improve the corrosion resistance of all irons. The erosion-corrosion resistance was increased by the Mo/W additions both as-cast and after destabilization, as shown in Figure 1(a). The highest erosion-corrosion resistance was obtained in the as-cast Mo6 iron. As seen in Figure 1(b), the Mo6 iron showed a less damaged surface and less M_6C carbide cracking. Mo6 iron has a large amount of M_6C carbide, which is more resistant to SiO_2 particle penetration.

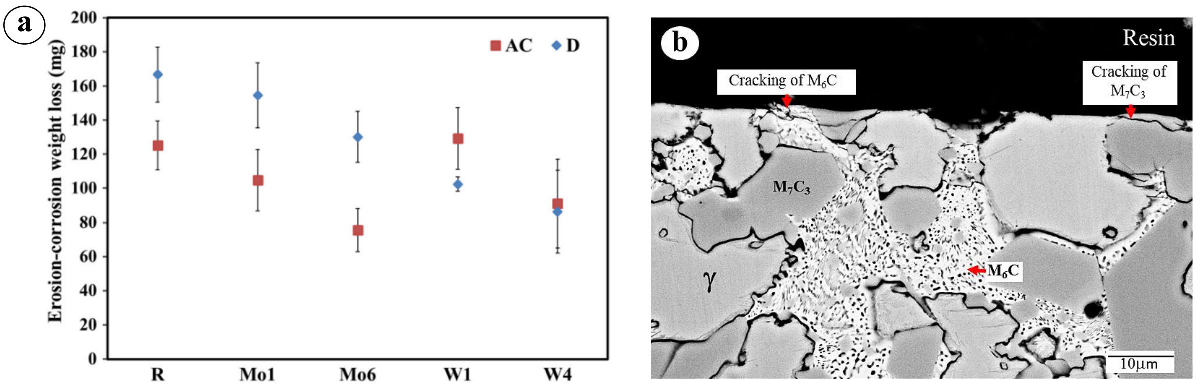


Figure 1. (a) The weight loss during erosion testing and (b) SEM-BEI shows cross section of the eroded surfaces in as-cast Mo6 iron. AC = as-cast, D = destabilization

THE STUDY OF MISMATCHED STRINGS IN A PV MODULE

Buntoon Wiengmoon*, Sirinuch Chindaruksa, Chatchai Sirisamphanwong
Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand
*e-mail: buntoonw@nu.ac.th

Abstract:
This work aims to study the mismatch of a 20 W_p solar module divided into 3 strings. Each string consists of 12 cells connected in series, divided into left string (L), middle string (M), and right string (R). Measure electrical characteristics using the PV Analyzer I-V curve tracers. From the electrical measurements of each string within the PV module, under irradiance levels of approximately 400 W/m², 600 W/m², and 800 W/m², it was found that string R exhibited a significant anomaly regardless of the irradiance level, as shown in Figure 1 (a). The data at 600 W/m² is not shown here to avoid data overlap, however, its electrical characteristics would be intermediate. Considering the FF value of string R, it is around 0.4. Therefore, when the strings L, M, and R are parallel and series, it will affect the occurrence of the module mismatch phenomenon When arranged in parallel and series, the strings L and M which have good electrical properties, will display typical electrical properties. At low or high intensity, the electrical power will double. The abnormal string R is paralleled with strings L and M, and the electrical characteristics will be abnormally reduced along the abnormal string R. The short-circuit current (I_{SC}) will also double, but the electrical power will not double, it will decrease along the string R. According to the results of connecting strings L, M, and R in series and parallel, the FF value at low light levels is higher when the strings are connected in parallel than it is at high light levels. This is because at high light levels, the electrical characteristics of string R cause the maximum electric power (Pmax) to be lower than usual, which lowers the FF value. Furthermore, as Figure 1 (b) illustrates, the graph's slope will be substantially smaller than typical when connected in series, leading to a lower FF value. When connected in series, the slope of the graph is reduced more than normal, resulting in a lower FF value as well, as shown in Figure 1 (b). Therefore, mismatches are a problem that can affect the performance of solar power systems. Selecting solar panels of equal quality and installing them together can help reduce system mismatches.

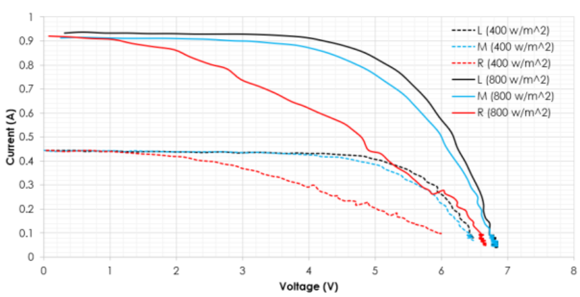
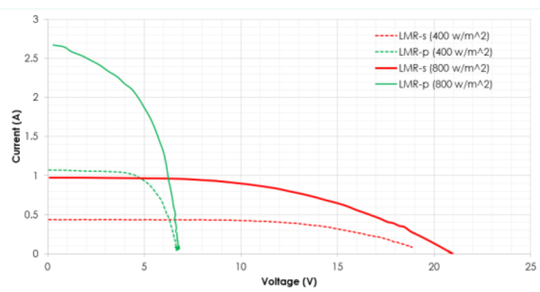


Figure 1 (a) The electrical characteristics of the left (L), middle (M), and right (R) strings at irradiance levels of 400 W/m² and 800 W/m².



(b) The electrical characteristics of parallel and series LMR strings at light intensities of 400 W/m^2 and 800 W/m^2.

F-FOOD SCIENCE AND TECHNOLOGY/AGRICULTURAL SCIENCE

ANTIOXIDANT ACTIVITIES OF BIOCALCIUM CAPSULES FROM THREADFIN BREAM BONES (*Nemipterus hexodon*): EFFECT OF PACKING CONDITIONS DURING A LONG TERM SRORAGE

Patchanee Petrat,[1] Sappasith Klomklao,[2,*] Jarurat Panyo[3] Wonnop Visessanguan[4]
[1] Biotechnology Program, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[2] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[3] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[4] National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency, Pathum Thani, 12120, Thailand
*e-mail: sappasith@tsu.ac.th

Abstract:

The impact of different packing conditions on antioxidant stability in biocalcium capsules made from threadfin bream (*Nemipterus hexodon*) bones was studied. The capsules were stored at room temperature (28–30°C) for 6 months. The factors examined were packaging material (clear PET bottle vs. amber PET bottle), storage time, and the presence or absence of a silica gel sachet. The biocalcium capsule consisted of 400 mg of biocalcium powder and 100 mg of maltodextrin. Every container had a total of 60 capsules. The antioxidative activities, as determined by ABTS (2,2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) and DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activities, as well as ferric reducing antioxidant power (FRAP) and metal chelating activity were quite stable for all samples during 6 months of storage at room temperature. The antioxidant activity of all samples, as measured by all assays, remained constant within the first 3 months ($P>0.05$). Thereafter, only slight decreases in activities were noticeable. After being stored at room temperature for 6 months, the biocalcium capsule packed in an amber PET bottle with a silica gel sachet showed the highest levels of antioxidant activity. Therefore, the use of an amber PET bottle along with a silica gel sachet is an efficient method for packing biocalcium capsules, resulting in enhanced antioxidant stability during storage.

ANTIOXIDANT ACTIVITY OF FOOD PLANTS AND APPLICATION IN SOY-BASED PROBIOTIC BEVERAGES

Suree Nanasombat[1,*]
[1]Department of Biology, School of Science, King Mongkut's Institute of Technology Ladkrabang, Bangkok, Thailand
*e-mail: Suree.na@kmitl.ac.th

Abstract:
This study aimed to investigate antioxidant activity and other phytochemical properties of eight of fruit and vegetable juices, including orange, pomelo, guava, carrot, cilantro, celery, kitcken mint and sweet pepper, and five plant-based beverages including soybean, kidney bean, mixed rice, green tea, and cocoa for the development of probiotic beverages. Among all fruit and vegetable juices, guava juice possessed the highest antioxidant activity, 4.36 mmol Fe(II)/100 ml by FRAP method and 222.43 mg Trolox/100 ml by DPPH method. Kitcken mint juice contained the highest total phenolics and flavonoids, 168.10 mg gallic acid equivalent (GAE)/ 100 ml and 102.98 mg catechin equivalent (CE)/100 ml, respectively. Among all plant-based drinks, soybean milk had the highest phenolics and flavonoids, 218.81 mg GAE/100 ml and 350.01 mg CE/100 ml, respectively. Therefore, soybean, cocoa, orange and guava juice with strong phytochemical properties were selected to develop probiotic beverages using probiotic ABT-5 starter culture. The fermented soybean-cocoa beverage had strong antioxidant activity of 41.01 mg Trolox/100 mL by the DPPH method. This beverage contained the highest total phenolics (978.81 mg GAE/100 ml) and flavonoids (347.42 mg CE/100 ml). After 14 days of storage at 4°C, the lowest reduction in viable total lactic acid bacteria (3.19 log CFU/ml) was found in the fermented soybean-cocoa beverage when comparing to fermented soybean-orange and soybean-guava beverages. Among all beverages, this soybean-cocoa beverage received the highest overall acceptability score of 7.47.

BIODEGRADABLE STARCH FOOD PACKAGING WITH FISH BIOWASTE FILLER

Kwansuda Kongthong, Kaewta Kaewtatip*
Division of Physical Science, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand
*e-mail: kaewta.k@psu.ac.th

Abstract:
Polystyrene-based products have excellent heat-shielding properties, water resistance and mechanical strength. Due to the ease of processing these products, they have been widely used in the food packaging industry. However, when disposed of as waste, polystyrene (PS) pollutes the environment. Starch-based plastics are attractive alternatives to non-biodegradable petroleum-derived plastics. They are inexpensive, harmless to humans and biodegradable in the environment. Starch-based foam is an attractive material for the production of food trays. The white sea bass is an important economic fish and is consumed in large quantities. Most of the fish scales from the sale of white seabass are disposed of in landfills or used for small-scale applications. The use of fish scale as a filler in starch foam trays can improve some properties of starch foam and increase the value of waste fish scale. The density, hardness, and color of starch-based foam were evaluated, revealing that an increase in fish scale content resulted in a reduction in foam density. Especially, incorporating 20% fish scale meal increased the foam's hardness to a Shore OO value of 95, without affecting its whiteness. These mechanical, physical, and thermal characterization results provide a foundation for further development in starch-based foam production.

CHEMICAL COMPOSITION AND *IN VITRO* ANTIOXIDANT PROPERTES OF LOW-GRADE FRESH CACAO FRUIT (*Theobroma cacao* L.)

Montita Kamwisaet,[1] Jarurat Panyo,[2] Sappasith Klomklao[3,*]
[1] Biotechnology Program, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[2] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[3] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
*e-mail: sappasith@tsu.ac.th

Abstract:

Large amounts of low-grade fresh cacao fruit (pod weigh <250 g) as a by-product are left over from cocoa processing. However, they are a potential source of nutrients and bioactive compounds. The objective of this work was to evaluate the proximate composition and antioxidant activity as determined by the total phenolic content (TPC) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) scavenging activity of different parts of low-grade fresh cacao fruit obtained from a CoCoa Ton Nga Chang Community Enterprise in Songkhla province, Thailand in May 2024. The fruit was divided into four parts for analysis: the whole fruit, the pod husk, the pulp and the beans. The samples were washed with water, dried at 50 °C until the moisture content was below 10%, and then finely powdered for analysis. The proximate compositions varied with the portions tested. All portions had moisture (38.78–84.55%) and carbohydrate (12.58–41.09%) as the major components. Protein (0.72–5.44%), fat (0.30-12.29%), and ash (0.74–2.40%) were also found at various levels, dependent upon portions. The TPC in all parts varied from 110.45 to 207.23 mg GAE/g dry extract. All samples analyzed exhibited good antioxidant activity in the DPPH assay, with values ranging from 155.00 to 886.20 mmol TE/g dry extract. Among all the portions tested, cacao beans showed the highest TPC and antioxidant activity ($P<0.05$). The results of this study indicate that low-grade fresh cacao fruit may be considered a good source of natural compounds with significant antioxidant activity.

CHEMICAL COMPOSITION AND PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF KOMBUCHA FROM TORCH GINGER

Panatda Machaui,[1] Villailak Klompong[2*]
[1] Biotechnology Program, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung Campus, Phapayom, Phatthalung, 93210, Thailand
[2] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Phapayom, Phatthalung, 93210, Thailand
*e-mail: vilailak@tsu.ac.th

Abstract:

Kombuchas are a trend in the fermented beverage field and Torch ginger (*Etlingera elatior*) is a southernmost local plant and rich in active compound that might provide unique characteristics. The study aimed to evaluate the features of torch ginger kombucha. Kombucha was prepared using torch ginger flower extracted with water by boiling, scoby (symbiotic culture of bacteria and yeast) as microbial starter and sugar as carbon source and then allowed to ferment at ambience temperature for 7 days. The changes in physicochemical properties during fermentation were monitored. Sensory profile and chemical constituents using Gc-Ms of finished product were also investigated. pH and total soluble solid of torch ginger kombucha decreased throughout the fermentation time, while no alcohol content was detected. For the color, L* increased, while a* and b* decreased during fermentation. Sensory profile, including sourness, sweetness, umami, flavor and overall liking were acceptable with more than like moderately. The main compounds detected in torch ginger kombucha were acetic acid and D-limonene with 87.90 and 18.31 %Area, respectively. Thus, physicochemical characteristics of torch ginger kombucha were governed by fermentation time and torch ginger could be used as promising raw material for producing kombucha with sensory acceptance.

Chitosan nanoparticle encapsulated Pva-pre-mir-11881 mixed in shrimp feed improves shrimp survival rate against WSSV infection

Pun Sangchai and Kunlaya Somboonwiwat*
Center of Excellence for Molecular Biology and Genomics of Shrimp, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
*e-mail: Kunlaya.S@chula.ac.th

Abstract:

White spot syndrome virus (WSSV) is a major viral pathogen causing massive losses in shrimp production. Numerous studies have revealed a diverse role of microRNAs (miRNAs), a class of small non-coding RNA, in shrimp antiviral immunity. The precursor miRNA (pre-miR) plays a crucial part in generating functional miRNAs, which regulate gene expression at the post-transcriptional level. Nevertheless, the information obtained from shrimp miRNAs regulating the viral genes is still limited. Previously, we identified a novel shrimp miRNA, pva-miR-11881, as a key antiviral agent against WSSV. When shrimp were treated with its precursor (pva-pre-miR-11881), it reduced viral load, improved survival, and suppressed key WSSV genes. In this study, to enhance stability, we encapsulated pva-pre-miR-11881 in chitosan nanoparticles (CNP) called 'pva-pre-miR-11881 CNP' and found that it further improved antiviral efficacy and shrimp survival when co-injected with WSSV or used as a feed supplement. This nanoparticle formulation shows great promise as a therapeutic against WSSV in shrimp, offering an effective RNA-based antiviral treatment.

COMPARATIVE STUDY OF PROPERTIES OF STARCH FOAM WITH BEESWAX AND ALGINATE COATINGS

Jutamas Trongnit, Kaewta Kaewtatip*
Division of Physical Science, Faculty of Science, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand.
*e-mail: kaewta.k@psu.ac.th

Abstract:
Polystyrene foams are used in many industries. However, used polystyrene foam products cause serious environmental problems since they are not compostable or recyclable. Foam prepared from starch, on the other hand, is totally biodegradable in a wide variety of environmental conditions and the use of starch foam packaging is one possible solution to some of the problems created by waste polystyrene foam. The major drawback of starch foam is its hydrophilic character which causes it to degrade easily in the presence of moisture. Consequently, cassava starch foam is considered suitable only for packaging dry products. However, an appropriate coating can protect starch foam from moisture. We coated the starch foam with pure beeswax and 1% alginate solution because the beeswax has hydrophobic property, and the coating with 1% alginate solution based on previous study, after spraying with calcium chloride, formed a solid gel coating the foam surface. The coating enhanced the water resistance of the starch foam. Due to and studied the effect of the coating on the water resistance, physical, mechanical and thermal properties of the starch foam. The results showed that the starch foam coated with 1% alginate exhibited better water resistance, thermal stability and mechanical properties than uncoated starch foam, and starch foam coated with beeswax. Moreover, the 1% alginate coating completely adhered to the entire surface of the starch foam whereas the beeswax did not, and the cavities present allowed water to migrate easily into the starch foam. Therefore, alginate can be used to develop 'green' starch foam composites, and is a suitable coating material for applications that require enhanced properties.

COMPARISON OF THE AMOUNT OF ACTIVE COMPOUNDS AND ANTI-INFLAMMATORY EFFICACY OF UMBRELLA MOSS (*Rhodobryum giganteum*) EXTRACTS FROM FOREST AND TISSUE CULTURE

Hataichanok Pandith*, Kullanun Mekawan, Witthawin Baiubol, Nipitpawn Limpanich, Rujipas Yongsawas, Narin Printarakul*
Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
*e-mail: hataichanok064@gmail.com, hataichanok.p@cmu.ac.th
kamenpcobtor@gmail.com, narin.printarakul@cmu.ac.th

Abstract: *Rhodobryum giganteum* (umbrella moss) is used in traditional Chinese medicine to cure mainly heart disease through anti-inflammatory mechanisms. Its major bioactive compounds are 7,8-dihydroxycoumarin and *p*-hydroxycinnamic acid. Umbrella moss normally grows on high humid mountains. The over collecting for commercial scale is a risk of the extinction of natural population and heavy metal contamination. To avoid these problems, the tissue culture technique was developed. However, the biological activity of forest moss and tissue culture moss is necessary to be compared. Both moss samples were extracted with 60% ethanol by maceration and then analyzed the active compounds using high performance liquid chromatography (HPLC). After that, the extracts were further determined for anti-inflammation using enzyme-linked immunosorbent (ELISA) cyclooxygenase 2 (COX-2) inhibition screening assay. The HPLC results revealed that quantities of 7,8-dihydroxycoumarin in *R. giganteum* extracted from the forest and tissue culture system were 0.41±0.03 and 6.16±1.25 µg/mL, respectively. Quantities of *p*-hydroxycinnamic acid were 5.15±0.08 and 24.59±0.65 µg/mL, respectively. Therefore, the extracts from the tissue culture system had higher amounts of these two substances than from its natural habitat, approximately 5 and 14 times, respectively. Furthermore, the anti-inflammation activity confirmed that the extract from tissue culture exhibited higher efficacy than the forest sample. The forest moss extract, tissue culture moss extract, 7,8-dihydroxycoumarin and *p*-hydroxycinnamic acid from 500-5,000 µg/mL showed high efficacy on percent inhibition of COX-2, with 81.42-90.00%, 90.25-98.18%, 77.50-81.01% and 83.39-87.90%, respectively. Our results reveals that the tissue culture technique can propagate of *R. giganteum* and also induces the higher amount of active compounds and anti-inflammatory property. These findings may serve for future studies of pharmaceutical products derived from *R. giganteum* and conservation.

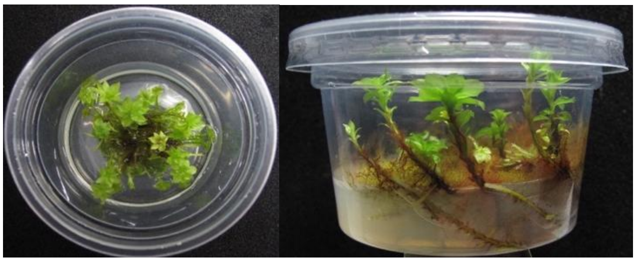


Figure 1.
Rhodobryum giganteum tissue culture from top view (left) and side view (right)

Development of meat spoilage real-time sensor using organic fluorescent compounds

Thanwa Srinoi, Thanetphon Nakbumrung, Ananya Pongpattananuruk
Darunsikkhalai Science School, King Mongkut's University of Technology Thonburi, Thailand
e-mail: 23thanwa.tc@gmail.com

Abstract: Choosing fresh meat is vital for maximizing its nutritional benefits. However, assessing meat spoilage remains challenging during purchasing. The absence of convenient tools to differentiate between fresh and spoiled meat poses health risks for consumers. To address this, researchers have developed a glowing molecule capable of sensing volatile substances like ammonia and amines emitted during decay. When exposed to these compounds, fluorescent compounds undergo color or signal changes due to modifications in their structure. This study aims to create a real-time meat spoilage detection sensor using organic fluorescent compounds (OFCs). Two experiments were conducted: evaluating five OFCs' efficiency in detecting ammonia and amines and assessing selected OFCs' ability to detect meat spoilage under various conditions. Performance was evaluated by measuring changes in red, green, and blue values under black light. OFC1, OFC3, and OFC5 accurately detected ammonia and amines in the screening test. Paper-based sensors using OFC1 and OFC5 showed the most significant color changes in response to these compounds. OFC5-based sensors displayed reliable responses to gas emissions during meat spoilage at both room (33°C) and refrigerated (4°C) temperatures This study offers preliminary evidence that OFC5-based paper sensors demonstrate significant reliability in detecting meat spoilage, suggesting the potential for further exploration in real-time meat sensor applications.

Development of polydiacetylene-silica nanocomposite carboxymethylcellulose-based as sulfur compound indicator label for durian produce

Piyapong Sonkaew, Amporn Sane, Panuwat Suppakul*
Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University 50 Ngamwongwan Road, Ladyao, Chatuchak, Bangkok, Thailand
*e-mail: fagipas@ku.ac.th

Abstract:

Polydiacetylene/silicon dioxide nanocomposite in carboxymethylcellulose-based film label (PDA/SiO_2 NC) for detecting volatile sulfur compounds in durian was developed. Ethanethiol, a volatile sulfur compound, acts as a precursor to secondary sulfide compounds in durian. The presence of ethanethiol in Monthong durian was confirmed using headspace gas chromatography-mass spectrometry (GC-MS) and two-dimensional gas chromatography-mass spectrometry (GCGC-MS). The results of GCGC-MS indicated that ethanethiol is retained in the column close to ethanol and ester compounds, rending it difficult to detect and quantify. Nevertheless, in one-dimensional GC-MS, cound be detected and quantified using selected ion monitoring (SIM mode) with mass-to-charge ratio (m/z) of 62 m/z at 1.724 minutes. Ethanethiol was found in the range 5-50,000 $\mu g \cdot Kg^{-1}$ fresh weight of Monthong durian pulp. The development of PDA/SiO_2 NC carboxymethylcellulose-based indicator label was aimed at producing an indicator label for detecting sulfur compounds in Monthong durian. The PDA/SiO_2 label had a detection limit at 5 µg, causing the label to change color from blue to violet at 10 µg, and also can be detectable by the unaided eyes. Therefore, this label enables to indicate the quality of Monthong durian pulp shelf storage.

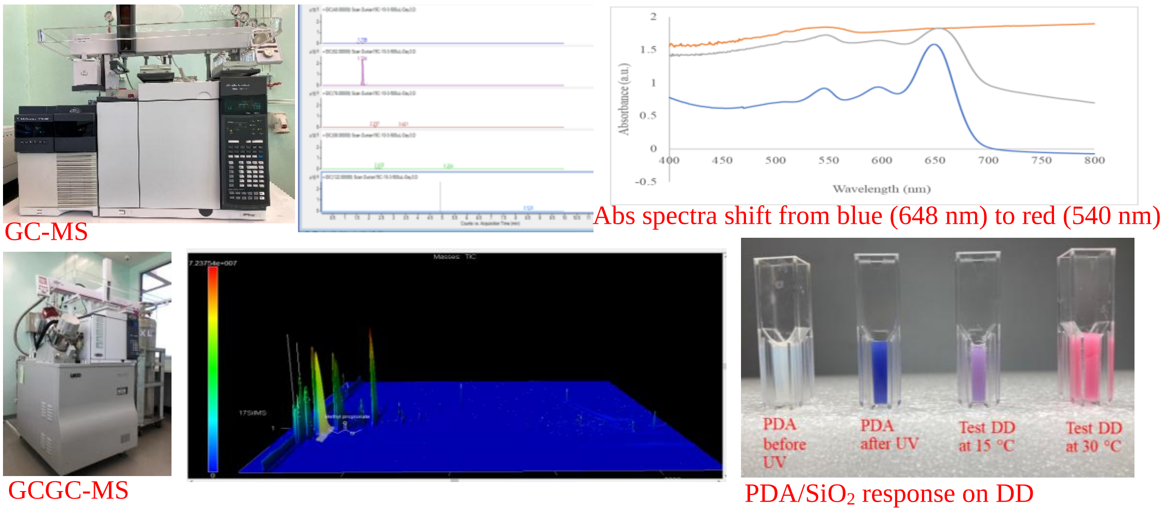


Figure 1. Detection sulfur compounds in durian pulp and development of PDA/SiO_2 label

EFFECT OF TEMPERATURE AND STORAGE DURATION ON VITAMIN C CONTENT IN PURSAT ORANGE JUICE (*Citrus sinensis* (L.) Osbeck)

Sreyneath Orn, Chanvita Horn, Bya Kaosuon, Sokkeang Be, and Sreynich Chhun*
Department of Science Research, Faculty of Health Sciences and Biotechnology, University of Puthisastra, Phnom Penh, 12211, Cambodia
*e-mail: csreynich@puthisastra.edu.kh

Abstract:
Citrus sinensis (L.) Osbeck is a well-known fruit in Cambodia as Pursat orange, consumed as juice. It contains vitamin C as a nutrient necessary for the body's numerous metabolic processes however, vitamin C is temperature-sensitive and can be degraded over a long period in unsuitable storage conditions. This study aims to determine the vitamin C content, and best storage condition and assess the Pearson correlation coefficient (PCC) between temperatures and storage duration on vitamin C contents in Pursat orange juice (*Citrus sinensis* (L.) Osbeck). The sample juices were stored at 4 levels of temperatures (freezer -18°C, refrigerator 4°C, room temperature 25°C, outdoor 35–40°C) and 8 levels of storage duration (0h, 4h, 8h, 16h, 1d, 3d, 5d, and 7d) by using high-performance liquid chromatography (HPLC) as quantification method. The studied storage conditions were chosen based on real-life consumption of Pursat orange juice, which is typically consumed in no more than 7 days at various available storage temperatures. The results showed that vitamin C content in Pursat orange juice at 0h in all storage conditions was between 37.256 - 38.263 mg/100 mL. From 0 days to 7 days, the vitamin C content decreased by 100%, 40.96%, 40.40%, and 40.47% at 35–40°C, 25°C, 4°C, and -18°C, respectively. The PCC value revealed a significantly negative correlation between temperature and storage duration with the values as follows: -0.821, -0.747, -0.758, and -0.663 at 35–40°C, -18°C, 25°C, and 4°C, respectively. The findings suggest that a refrigerator (4°C) is the most suitable storage condition, and Pursat orange juice should be drunk freshly to get the highest Vitamin C content and other nutrients. Importantly, when it is stored at a higher temperature for a longer period, its vitamin C content decreases significantly.

Effects of natural fiber waste and commercial fiber on the properties of starch-based bioplastics

Benjamat Phonsing and Keawta keawtatip*
Division of Physical Science, Faculty of Science, Prince of Songkla University, Hatyai, Songkla, 90110, Thailand
*e-mail: kaewta.k@psu.ac.th

Abstract:
Starch-based bioplastics offer several advantages over petroleum-based plastics. They are made from inexpensive, abundant, renewable and biodegradable materials, and can be processed using conventional techniques. However, some properties of starch-based bioplastics must be improved to position them as competitors to petroleum-based plastics. Some of these properties can be improved by incorporating filler materials such as natural fiber waste. In this work, we used two fiber materials as fillers in starch-based bioplastic and investigated their effects on the morphology and water resistance of starch-based bioplastic. Split gill mushrooms are processed to obtain polysaccharides and the process leaves waste residues. Since the waste fiber residues have similar chemical structures to starch, good interactions can be obtained between a starch matrix and this material. The natural compatibility of the components can result in highly effective performances. The effects of split gill mushroom waste (MS) and commercial carboxymethylcellulose (CMC) fiber on the morphology and water resistance of starch-based bioplastic were compared. The addition of MS reduced the mass loss of starch-based bioplastic in water (15.93%), and increased the contact angle (93^{o}) more than the addition of CMC. The improvements were due to the better dispersion and embedding of MS in the starch matrix. Moreover, the addition of MS did not affect the degradation rate of the starch-based bioplastic. The proposed composite bioplastic could be used to make biodegradable flower pots to replace flower pots made from non-degradable petroleum-based plastics. The use of natural fiber waste could also bring economic benefits to certain parts of the world, increase the value of the waste and reduce the volume of landfill.

ENHANCEMENT OF ANTIOXIDANT DEFENSE SYSTEM IN POSTHARVEST LONGAN FRUIT BY GASEOUS SO_2 AND ClO_2 FUMIGATION: ROLE OF ATP AND MAPK CASCADE

Sitthisak Intarasit,[1,*] Atinut Joradol,[2] Kobkiat Saengnil[1]
[1]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2]Department of Biology, Faculty of Science and Technology, Chiang Mai Rajabhat University, Chiang Mai, 50300, Thailand
*e-mail: sitthisak.inta@cmu.ac.th

Abstract:

Adenosine triphosphate (ATP) plays a pivotal role in driving cellular processes and activating signaling pathways. The reduction of ATP pool initiates senescence plant. This study aimed to explore the role of sulfur dioxide (SO_2) and chlorine dioxide (ClO_2) fumigation in inducing endogenous ATP production, which subsequently triggers the MAPK cascade. This cascade activates the cellular antioxidant system, thereby enhancing its efficiency in scavenging reactive oxygen species (ROS) and reducing longan senescence. Longan (*Dimocarpus longan* Lour. cv. Daw) fruit were fumigated with either 1000 mg L^{-1} sulphur dioxide (SO_2) or 10 mg L^{-1} chlorine dioxide (ClO_2), or combination of both (fumigated with SO_2 followed by ClO_2), and then stored for 8 days. Fumigation with SO_2 or ClO_2 or their combination reduced senescence and maintained fruit quality for up to 3, 5 or 7 days, respectively, compared to a shelf life of only 2 days for the non-fumigated control fruit. Fumigation with SO_2 or ClO_2 alone or in combination induced MAPKs genes (*MPK3* and *MPK6*) expression in longan within the first 3 hours to 2 days after fumigation. In non-fumigated fruit, MAPK activation was minimal and remained constant throughout storage The increase in MAPKs gene expression, *MPK3* and *MPK6* also coincided with an increase in energy level or ATP production in longan fumigated with SO_2 or ClO_2 alone or in combination, while in the control fruit, ATP levels decreased over the storage period. The transcript levels and activity of antioxidant enzymes (catalase, ascorbate peroxidase and glutathione peroxidase) were significantly enhanced in fruits treated with SO_2 or ClO_2 alone or in combination, reaching a maximum 6 to 24 hours after treatment. Moreover, the expression of *MPK3* and *MPK6* was activated by exogenous ATP (eATP) in a time-dependent manner, similar to the effects observed in fruits fumigated with SO_2 or ClO_2 alone or combination. These results suggest that fumigation with SO_2 or ClO_2 or combination triggers the ATP production and MAPK cascade activation and enhancing the cellular antioxidant system in longan fruit. This response could reduce ROS production, thereby reducing longan senescence and maintain fruit quality during storage.

ENHANCING THE FUNCTIONAL PROPERTIES OF HEMP PROTEIN THROUGH ULTRASOUND-ASSISTED MAILLARD CONJUGATION WITH CHITOSAN DERIVATIVES

Nareekan Chaiwong,[1,*] Yuthana Phimolsiripol,[1,2]
[1]Faculty of Agro-Industry, Chiang Mai University, Chiang Mai 50100, Thailand
[2]Center of Excellence in Agro Bio-Circular-Green Industry, Chiang Mai University, Chiang Mai 50100, Thailand
*e-mail: nareekan_ch@cmu.ac.th

Abstract:
This study investigates the enhancement of hemp protein (HP) functionalities through an ultrasound-assisted Maillard reaction (UMR) as reflected by its suitability in the carrier system of plant protein and bioactive compounds for functional foods. The effects of different chitosan derivatives, including carboxymethyl chitosan (CMC) and chito-oligosaccharide (COS) were prepared using UMR at 90°C for 30 min. The resulting HP-CMC and HP-COS conjugates were analyzed for color development, degree of grafting, and protein functionalities. Results showed that HP-COS exhibited better solubility (76%) and emulsifying properties (emulsifying activity and stability were 41 m^2/g and 22 min, respectively) compared with the mixture (HP-COS) and native hemp protein (no reaction). Moreover, the UMR could effectively increase the degree of grafting of the conjugates. A degree of grafting of 28% for HP-COS and 32% for HP-CMC was achieved. It also improved the solubility as well as its emulsifying and foaming properties. This study demonstrates the successful preparation of HP-CMC and HP-COS conjugates using UMR, highlighting their potential to enhance the functional properties of hemp protein. These findings provide valuable insights for leveraging these conjugates in the development of plant-based foods within the food industry.

EVALUATION OF BIOACTIVE PROPERTIES OF RICE LEAF INFUSIONS FROM INDIGENOUS THAI BLACK RICE VARIETIES FOR POTENTIAL DIABETES MANAGEMENT

Kancha Watla-iad,[1,3] Plaipol Dedvisitsakul[1,2]*
[1]School of Science, Mae Fah Luang University, Chiang Rai, Thailand
[2]Microbial Products and Innovation Research Unit, School of Science, Mae Fah Luang University, Chiang Rai, Thailand
[3]Center of Chemical Innovation for Sustainability, School of Science, Mae Fah Luang University, Chiang Rai, Thailand
*e-mail: plaipol@mfu.ac.th

Abstract:
This study investigates the potential of rice leaf infusions from 14 indigenous Thai black rice varieties, classified into three groups based on leaf color, for diabetes management. The focus is on their ability to inhibit digestive enzymes α-amylase and α-glucosidase, along with antioxidant activity, phenolic content, and flavonoid levels. The leaves were processed through sun-drying and roasting.

Key findings revealed that sun-dried leaves showed antioxidant activity ranging from 0.03 to 0.081 mg/g ascorbic acid equivalent, while roasted leaves ranged from 0.0296 to 0.0524 mg/g, with green-black leaves exhibiting the highest activity. Black leaves had the strongest α-amylase inhibition (8.23% to 16.51%), while green leaves were most effective against α-glucosidase (10.73% to 14.98%). Roasted green-black leaves had the highest phenolic content (0.000292 to 0.000310 mg/g). Black leaves also demonstrated the highest flavonoid levels (0.28-2.25 mg/g), followed by green-black leaves (0.39-0.98 mg/g) and green leaves (0.21-0.42 mg/g).

Among the varieties, black rice leaves exhibited the strongest antioxidant activity and α-amylase inhibition, while green-black leaves showed superior phenolic content and consistent α-glucosidase inhibition.

Despite the relatively low enzyme inhibition percentages, indicating limited direct potential for blood glucose control, the study identified certain rice varieties and processing methods with promising antioxidant activity. Further research is needed to explore combining these extracts with other interventions to enhance their therapeutic potential and optimize their use as functional ingredients in diabetes management.

FORMULATING AND ENHANCING THE PALATABILITY OF BANANA FLOUR-BASED CHEWY HEALTHY SNACK

Pimsiri Danphitsanuparn,[1,*] Napath Rotchanacheewakom,[1] Worapinya Kittisiripraphan,[1] Anocha Suksomboon[2]
[1] Department of Biology and Environmental Science, Kamnoetvidya Science Academy, Rayong, Thailand 21210
[2] Department of Food Science, Faculty of Science, Burapha University, Chonburi, Thailand 20131
*e-mail: pimsiri.d@kvis.ac.th

Abstract:
A healthy snack designed to align with contemporary health and fitness trends was explored in this study, aiming to develop a novel banana flour-based snack tentatively named "BaNaCube Mochi". The goal was to create a product with reduced carbohydrates, no sugar added, and enhanced with plant-based protein. The ratios of carrageenan (C), konjac (K), banana flour (BF), and xylitol were varied. The experiments were divided into three phases: 1) determining the optimal carrageenan (C) to konjac (K) ratio for gelation, 2) optimizing the ratio of the carrageenan-konjac mixture (CK) to banana flour (BF), and 3) identifying the ideal amount of xylitol for sweetness. The results showed that a 1:1 ratio of C:K provided the best firmness, with a value of 3,747.03 ± 273.64 g force, closely aligning with the preferences of the target group. Increasing the amount of BF (0, 2, 4, 6 g) in the 1:1 ratio of C:K mixture resulted in decreased firmness. Various levels of xylitol (0, 4.5, 9, 13.5 g) were then added, with 9 g of xylitol emerging as the optimal choice, balancing sweetness and firmness. The product exhibited an increase in syneresis, reaching 9.75 ± 0.84% (n=4) within 3 days and rising to 14.27 ± 0.89% by day 30. The pH level shifted from basic (pH=9.5) to acidic (pH=5.8-6.2) within 3 days. Additionally, the physical, chemical, and structural properties of the product were analyzed using SEM, XRD, and FTIR to gain comprehensive insights into its characteristics.

IMPACT OF THE ADDITION OF *Wolffia globosa* ON PHYSIOCHEMICAL PROPERTIES OF EXTRUDE PRODUCT BASED ON CORN GRITS

Werawich Pattarayingsakul,[1]* Siriporn Tanjor,[1] Sunsanee Udomrati,[2] Nipat Limsangouan,[3] Worapol Pengpinit,[4] Sutatip Duangjai,[4]
[1]Department of Health and Nutrition, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
[2]Department of Food Chemistry and Physics, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
[3]Department of Food Processing and Preservation, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
[4]Department of Manufacturing and Distribution, Institute of Food Research and Product Development, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
*e-mail: werawich.p@ku.th

Abstract:
Wolffia globosa, a nutrient-rich aquatic plant, was successfully incorporated into corn extrudates as a functional ingredient. This study investigated the effects of Wolffia powder addition on the structural, physicochemical, and nutritional properties of the extruded products. Two formulations containing 2.5% and 5.0% Wolffia powder were compared to a control without Wolffia powder. The addition of Wolffia powder significantly increased the protein content of the extrudates from 12.5% in the control to 16.89% and 17.41% in the 2.5% and 5.0% formulations, respectively. Despite the protein increase, the *in vitro* protein digestibility remained consistently high at approximately 90% for all samples. In terms of structural properties, the addition of Wolffia powder did not adversely affect the expansion ratio or bulk density. In fact, the 2.5% Wolffia powder formulation exhibited a higher expansion rate and lower bulk density compared to the control. The addition of Wolffia powder to corn extrudates also increased their chewiness and hardness. Texture analysis revealed that the addition of Wolffia powder increased chewiness from 276.515 to 461.374 N×mm, while hardness increased from 4,812.368 to 7,851.534 N. Moisture content and water activity were slightly affected by Wolffia powder addition, but the effects were minimal and did not significantly impact the overall quality of the extrudates. These findings suggest the feasibility of using Wolffia powder as a functional ingredient in extruded products, enhancing their nutritional.

INVESTIGATION OF ANTIFUNGAL PROPERTIES OF ESSENTIAL OIL FROM FRUIT PEEL OF CALAMONDIN (*Citrofortunella microcarpa*) AGAINST *Candida albicans*

Fozia Ibrahim,[1] Narin Charoenphun,[2] Jittimon Wongsa,[3] Achirawit Ngamsomchat,[4] Suporn Charumanee,[5] and Thararat Chitov[1,*]
[1]Microbiology Division, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2]Faculty of Science and Arts, Burapha University Chanthaburi Campus, Chanthaburi, 22170, Thailand
[3]Department of Agricultural Engineering for Industry, Faculty of Industrial Technology and Management, King Mongkut's University of Technology North Bangkok, Prachinburi Campus, Prachinburi, 25230, Thailand
[4]Office of Research Administration, Chiang Mai University, Chiang Mai, 50200, Thailand
[5]Department of Pharmaceutical Sciences, Faculty of Pharmacy, Chiang Mai University, Chiang Mai, 50200, Thailand
*e-mail: thararat.chitov@cmu.ac.th

Abstract:
Candida albicans is the primary cause of oral *Candida* infection in immunocompromised and elderly individuals. Treatments typically involve the use of antifungal medications and chemicals. These, however, may result in undesirable effects and resistance to antifungal medications. This study aims to investigate the antifungal properties of essential oils (EOs) obtained after juice extraction from the fruit peel of calamondin (*Citrofortunella microcarpa*), also known as calamansi orange, against *C. albicans*. Essential oils were extracted from the peel of organically grown calamondin fruits using five extraction methods. These included pressing extraction, cold extraction by centrifugation (mechanical, non-thermal extraction methods), steam distillation, microwave extraction, and supercritical CO_2 extraction (thermal extraction methods). The EOs were tested for their antifungal activities against *C. albicans* DMST5815 using disc diffusion assay with 0.12% chlorhexidine taken as a positive control. Minimum Inhibition Concentration (MIC) and Minimum Fungicidal Concentration (MFC) were also determined. *Candida* reduction after being in contact with a mouthwash with calamondin EO was observed in comparison with a control mouthwash (alcohol- and preservative-free formula, containing 0.1% Tween80, 0.05% hydroxypropyl methyl cellulose, 0.5% poloxamer 188, and 15% of 700mg/mL sorbitol). The disc diffusion assays showed that the essential oils extracted through pressing and cold centrifugation inhibited *C. albicans* with inhibition zones of 11.7 ± 0.4 mm and 8.4 ± 1.1 mm, respectively. The extracts prepared using steam distillation and microwave extraction showed less activity (6.5 ± 0 mm). The supercritical CO_2 extract did not have inhibitory activity. The MICs of the EOs extracted through pressing, cold centrifugation, and steam distillation were 2.5%, 5.0%, and 5.0%, respectively. MFC was observed only for the EO extracted using the pressing method, which was 5.0%. Compared with the mouthwash, which exhibited 0.26 log CFU/mL reduction, *C. albicans* DMST5815 was reduced by 0.45 log CFU/mL after 3 min exposure to mouthwash incorporated with 5.0% calamondin EO. This level of reduction, although not high (less than one log CFU/g), points out that the peel of calamondin fruits, an industrial by-product of calamondin juice extraction, is a potential source of EO with anti-*Candida* properties. However, the antifungal activities were extraction method-dependent, with non-thermal methods being more effective than thermal-based ones. The efficacy against clinical *Candida* isolates, the toxicity, and the sensory acceptance must be further evaluated before its oral healthcare applications.

PRODUCTION OF BIODIESEL USING OIL AND LIPASE FROM NILE TILAPIA (*Oreochromis niloticus*) VISCERA AS AN ALTERNATIVE SUBSTRATE AND CATALYST

Sakonwat Kuepethkaew[1], Sappasith Klomklao[2,] *, Jarurat Panyo[2], Natthaporn Phonsatta[3], Atikorn Panya[3], Soottawat Benjakul[4], Hideki Kishimura[5]
[1] Division of Food Science and Technology, Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi, Pathum Thani, 12120, Thailand
[2] Department of Food Science and Technology, Faculty of Agro and Bio Industry, Thaksin University, Phatthalung Campus, Pa-Phayom, Phatthalung, 93210, Thailand
[3] Food Biotechnology Research Team, Functional Ingredients and Food Innovation Research Group, National Center for Genetic Engineering and Biotechnology, Pathum Thani, 12120, Thailand
[4] International Center of Excellence in Seafood Science and Innovation (ICE-SSI), Faculty of Agro-Industry, Prince of Songkla University, Hat Yai, Songkhla, 90110, Thailand
[5] Laboratory of Marine Chemical Resource Development, Faculty of Fisheries Sciences, Hokkaido University, Hakodate, Hokkaido 041-8611, Japan
*e-mail: sappasith@tsu.ac.th

Abstract:

Nile tilapia (*Oreochromis niloticus*) is an important freshwater species for aquaculture in Thailand and is a white meat fish that supplies a high-quality source of protein. Nowadays, Nile tilapia is used as raw material for fermentation and drying. The growth of the Nile tilapia manufacturing industry has resulted in the production of large quantities of fish wastes, especially viscera. However, the viscera of Nile tilapia could be utilized to extract oil and lipase and used as a low-cost feedstock and catalyst, respectively, for producing biodiesel. The investigation aimed to study the transesterification reaction using oil from Nile tilapia viscera (NTVO), and to use it for manufacturing biodiesel using Nile tilapia viscera lipase (NTVL)-based catalyst. Optimizing the synthesis of biodiesel from NTVO utilizing NTVL catalyst was also studied. The catalyst dose of 20 kUnits, reaction temperature of 35°C, water content of 1%, reaction period of 18 h, and methanol to oil molar ratio of 4:1 were found to provide the greatest biodiesel yield (96.95%) ($P<0.05$). Therefore, using NTVL to obtain an environmentally friendly biodiesel from NTVO is a promising and effective alternative for biodiesel production catalysis.

Quality of fresh-cut Monthong durian wrapped in stretchable polyvinyl chloride film coupled with a perforated clamshell box as retail packaging

Piyapong Sonkaew, Amporn Sane, Panuwat Suppakul*
Department of Packaging and Materials Technology, Faculty of Agro-Industry, Kasetsart University 50 Ngamwongwan Road, Ladyao, Chatuchak, Bangkok, Thailand
*e-mail: fagipas@ku.ac.th

Abstract:

Recently, fresh-cut durian has obtained more interest due to concerns about waste from durian rinds at the destination. Packaging for fresh-cut durian, such as a rigid tray wrapped with PVC top film, is easily touched, while using a PP box is not suitable for preserving the pulp for an extended period. This is because the high barrier leads to anaerobic respiration of the durian pulp. Perforated rigid boxes are becoming a trend for storing durian pulp, but they pose a problem with sulfur-containing compounds being released into the environment. For these reasons, a study was conducted on durian wrapped in stretchable polyvinyl chloride (PVC) film coupled with a perforated clamshell box as retail packaging. The aim was to prevent contact with the pulp and reduce the release of sulfur-containing compounds into the environment while using a perforated rigid box to protect the pulp. Stretched PVC with biaxial orientation, especially in the cross-machine direction, can enhance gas transmission. PVC film with barrier properties of oxygen transmission rate (OTR), carbon dioxide transmission rate (CO_2TR) and water vapor transmission rate (WVTR) of more than 18,000 cc·m^{-2}day^{-1}, 60,000 cc·m^{-2}day^{-1}, and 240 g·m^{-2}day^{-1}, respectively, was used to wrap durian pulp as a skin pack before packing it in perforated PP or PET boxes to prevent contamination. The samples were stored at 5°C and 15°C for 12 and 7 days, respectively. Changes in the pulp's color (L*a*b* chroma, and hue) were not significant. Weight loss was lower compared to conventional packaging at both 5°C and 15°C. The texture of the pulp decreased from 16 N to 2 N within 12 days. Volatile compounds in the pulp showed a decrease in ester compounds, while sulfur-containing compounds increased. This packaging system is suitable for fresh-cut durian retail packs. In the future research, a smart label attached to individual pulp will be applyed for monitoring pulp quality.

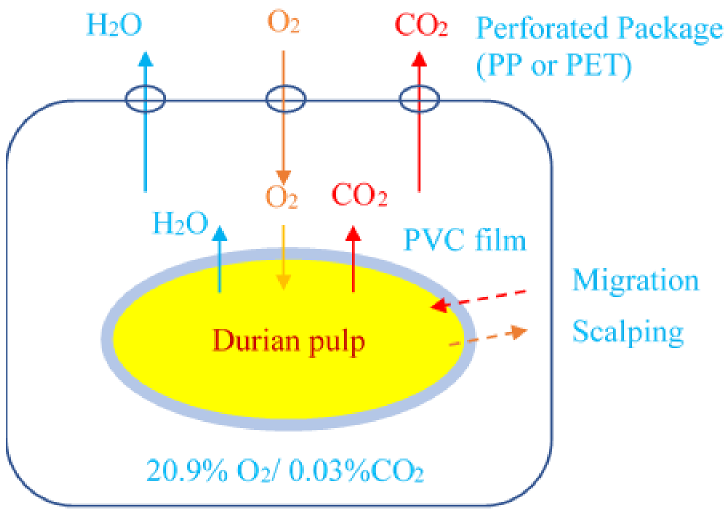


Figure 1. Stretch PVC-wrapped durian pulp and pack it in a perforated box

ROLE OF PIWI-INTERACTING RNAs (piRNAs) IN MODULATING IMMUNE RESPONSES OF PACIFIC WHITE SHRIMP (*Penaeus vannamei*) TO VIRAL AND BACTERIAL INFECTIONS

Waruntorn Luangtrakul[1], Chantaka Wongdontri[1], Phattarunda Jaree[2], Pakpoom Boonchuen[3],

Kulwadee Somboonviwat[4], Peter Sarnow[5], Kunlaya Somboonwiwat[1,*]

[1]Center of Excellence for Molecular Biology and Genomics of Shrimp, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[2]Center of Applied Shrimp Research and Innovation, Institute of Molecular Biosciences, Mahidol University, Nakhon Pathom, Thailand.
[3]School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, Nakhon Ratchasima, 30000, Thailand
[4]Department of Computer Engineering, Faculty of Engineering at Sriracha, Kasetsart University Sriracha Campus, Chonburi, Thailand
[5]Department of Microbiology and Immunology, Stanford University SOM, Stanford, CA 94305, USA

*e-mail: kunlaya.s@chula.ac.th

Abstract:

Piwi-interacting RNAs (piRNAs), the largest class of small non-coding RNAs, form complexes with PIWI proteins to suppress transposons and protein-coding genes through transcriptional and post-transcriptional mechanisms. While piRNAs are recognized for their immune functions in various organisms, this study aims to explore their role in shrimp immune responses to both bacterial and viral infections. By reanalyzing small RNA libraries from hemocytes of Penaeus vannamei infected with white spot syndrome virus (WSSV) and *V. parahaemolyticus* AHPND (VP_{AHPND}), we identified piRNA homologs with 1U bias and 10A bias characteristics that are differentially expressed under both conditions. To investigate the antiviral functions of selected piRNAs, we predicted interactions between these piRNAs and genes from both shrimp and WSSV using CU-mir program. We confirmed the genuine interaction between a downregulated piRNA, piR-pva-926938, and the target *WSSV186* gene in vitro and in vivo. Introduction of piR-pva-926938 into shrimp during WSSV infection resulted in the downregulation of certain shrimp immune-related genes, *calcineurin B* and *dynamin-binding protein*, potentially contributing to an increase in WSSV copies. Additionally, the target gene of VP_{AHPND}-responsive piRNAs were identified. Of those piR-pva-29948104 was found to target and suppress *PvRNF26* expression, which leads to the upregulation of shrimp immune genes *PvVago5* and *PvPEN4*. These findings represent the first report of piRNAs involved in shrimp immune responses to both bacterial and viral infections, offering new insights into piRNA-mediated regulation. The identified piRNAs have the potential to be used as biomarkers for developing disease-resistant shrimp lines, enhancing aquaculture resilience against pathogens.

SUSTAINABLE INSECT FEED: UTILIZING SPENT MUSHROOM SUBSTRATE FOR BLACK SOLDIER FLY LARVAE (*Hermetia illucens* (Linnaeus, 1758))

Aroonsiri Khuanlay,[1] Yupa Hanboonsong,[2] Papitchaya Teawkul[3,*]
[1,2,3] Department of Entomology Faculty of Agriculture, Khon Kaen University, Thailand.
*e-mail: Papit@kku.ac.th

Abstract

The production of spent mushroom substrate (SMS) is increasing yearly due to the expansion of the mushroom industry, particularly in Thailand. This study assessed the potential of using agro-based waste mushroom substrate (SMS) as feed for black soldier fly larvae (BSFL). We examined the nutritional availability and heavy metal content (Fe, Zn, Cu, As, Cr, Cd, and Pb) in four different mushroom substrates: Oyster mushroom (*Pleurotus ostreatus*), Phoenix oyster mushroom (*Pleurotus pulmonarius*), Lentinus sect. Rigidi (*Lentinus squarrosulus*), and Straw mushroom (*Volvariella volvacea*). Furthermore, the study investigated the growth rate and survival rate of BSFL. The findings revealed that SMS had protein in the range of 1.9 to 5.83% with SMS of Straw mushroom (*Volvariella volvacea*) showing the highest protein and fiber in SMS ranging from 31 to 45.7% with SMS of Oyster mushroom (*Pleurotus ostreatus*) showing the highest fiber. SMS of Phoenix oyster mushroom (*Pleurotus pulmonarius*) accumulated the highest amount of heavy metal (4,859.52 mg/kg), followed by Lentinus sect. Rigidi (*Lentinus squarrosulus*) (2,753.46 mg/kg) and Oyster mushroom (*Pleurotus ostreatus*) (2,410.04 mg/kg). While some heavy metals were detected, their concentrations do not exceed regulatory limits based on the standards for metal concentrations in animal feed set by the EU, USA, Canada, and China. The survival rates in larvae and pre-pupae were similar across the spent mushroom substrates. In our initial analysis, the metal concentration in the larvae was found to be extremely low. Overall, these findings indicated that SMS has significant promise as feed material for insect-based protein production and can on attributed to effective waste management practices.

TOTAL PHENOLIC CONTENT OF NAM PRIK TA-DAENG MADE WITH *Hibiscus sabdariffa* L. AND *Piper retrofractum* Vahl.

Thawalrat Ratanadachanakin,[1,*] Tippawan Raya,[1] Narin Toakaenchan,[2] Willard E. Collier[3,*]
[1] *Division of Chemistry, Faculty of Science, Maejo University, Sansai, Chiang Mai, 50290, Thailand*
[2] *Division of Medicinal Plant Science, Faculty of Agricultural Production, Maejo University, Sansai, Chiang Mai, 50290, Thailand*
[3]*Department of Chemistry, Tuskegee University, Tuskegee, AL 36088, United States of America*
*e-mail: thawalrat4@gmail.com, wcollier@tuskegee.edu

Abstract:
Nam Prik Ta-Daeng (red hot chili paste/dip) is a traditional Thai food that was created to impart deliciousness to vegetables with rice and side dishes. It has become a staple food for families in every region of Thailand and each region has developed their own unique flavor. Nam Prik Ta-Daeng is a combination of various seasonings, but dry chilis are the main ingredient. Its regionally unique flavor results from local seasonings and local vegetables that contribute medicinal and nutritional value to Nam Prik Ta-Daeng. Chili paste has many health benefits from the vegetables, herbs, and spices used to make the chili paste. Antioxidants are a major contributor to the health benefits of consuming chili paste as antioxidants are important in reducing the activity of free radicals in the body. The objective of this study was to formulate a Nam Prik Ta-Daeng higher in antioxidants and as delicious to consumers as those commercially available. *Hibiscus sabdariffa* L. and *Piper retrofractum* Vahl. were added to a traditional Nam Prik Ta-Daeng formulation to increase antioxidant levels. The AOAC Official Method 2017.13 was used to determine the total phenolic content of the traditional Nam Prik Ta-Daeng formulation and those formulations with added *Hibiscus sabdariffa* L. and *Piper retrofractum* Vahl. The data indicate the formulations with added *Hibiscus sabdariffa* L. and *Piper retrofractum* Vahl. are significantly higher in total phenolic content than the traditional Nam Prik Ta-Daeng formulation. A sensory evaluation panel of all formulations revealed no significant consumer preference among formulations. These results are important in the quest to improve health through better nutrition.

Keywords: Nam Prik Ta-Daeng, *Hibiscus sabdariffa* L., *Piper retrofractum* Vahl., Total phenolic content, Antioxidants

UTILIZTION OF POLYHYDROXYALKANOATE AS GROWTH STIMULATOR AND NITROGEN CONTROLLER IN NILE TILAPIA AQUACULTURE

Atitiya Kruaejun[1] Jamjun Pechsiri[2] Kanokphorn Sangkharak[3,*]
[1]Master of Science in Biotechnology Program, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung, Thailand
[2]Department of Biological and Environmental Science, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung, Thailand
[3]Innovative Materials Chemistry for Environment Center, Department of Chemistry, Faculty of Science and Digital Innovation, Thaksin University, Phatthalung, Thailand
*e-mail: skanokphorn@yahoo.com

Abstract:
Polyhydroxyalkanoates (PHAs) are microbial polyesters that accumulate intracellularly under stress conditions as a reserve of carbon and energy. Although PHAs have been studied as growth stimulators in various aquaculture species, their effects on Nile tilapia (*Oreochromis niloticus*) have not been previously reported. In this study, PHAs were isolated from *Enterobacter* sp. and incorporated into the diets of Nile Tilapia juveniles, which were obtained from a local farm in Phatthalung, Thailand. The fish were maintained in concrete ponds and fed diets supplemented with 0-1% PHA over a 4-week period. Daily observations were conducted to monitor fish behavior, morphological changes, and overall health. At the end of the feeding trail, fish fed a diet containing 0.5% w/w PHA exhibited the lowest feed conversion ratio (1.0 ± 0.2) and the highest survival rate (98.3 ± 2.9%). Additionally, specific growth rates increased over the feeding period. In addition, the ability of PHA to control nitrogen content in Nile tilapia aquaculture was also determined. Ammonia is formed from the metabolism of protein and is the major waste product of fish. Ammonia is also formed as uneaten feed or other organic matter in an aquaculture decomposes. High concentrations of ammonia in the water make it difficult for fish to eliminate ammonia from their bodies. The buildup of ammonia can cause stress, gill and internal organ damage, and eventually death. Notably, no detectable nitrogen content was observed in systems where PHA-supplemented diets were used, whereas significant nitrogen accumulation was found in systems using commercial diets. The results suggest that PHA serves as an exogenous carbon source, promoting the activity of denitrifying bacteria and thus reducing nitrogen levels in the system. This study is the first to demonstrate that PHA supplementation in Nile tilapia feed can enhance growth performance and contribute to nitrogen management, offering a promising strategy for sustainable aquaculture.

SP2-BIOMATERIALS AND MEDICAL DEVICES

ADVANCEMENT OF BIODEGRADABLE MONOFILAMENT SUTURE WITH ANTIMICROBIAL COATING BASED ON MEDICAL-GRADE POLY(LACTIDE-*CO*-CAPROLACTONE) COPOLYMER

Montira Sriyai[1,2,3], Jagkrit Tasati[4], Robert Molloy[3], Jomkwan Meerak[3,5], Puttinan Meepowpan[3,4], Winita Punyodom[3,4*]
[1]Office of Research Administration, Office of the University, Chiang Mai University, Chiang Mai, Thailand
[2]Bioplastics Production Laboratory for Medical Applications, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[3]Center of Excellence in Materials Science and Technology, Chiang Mai University, Chiang Mai, Thailand
[4]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[5]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
*e-mail: winitacmu@gmail.com

Abstract:
In this study, a medical-grade poly(L-lactide-*co*-ε-caprolactone) (PLCL) copolymer with a monomer ratio of 70:30 mol % L-lactide to ε-caprolactone was synthesized for use as an absorbable surgical suture via ring-opening polymerization (ROP) using a novel soluble liquid tin(II) *n*-butoxide ($Sn(OnBu)_2$) initiator. Fiber fabrication involved copolymer melt extrusion followed by controlled hot-drawing and fixed-annealing, resulting in oriented semicrystalline fibers with enhanced mechanical properties. To promote healing, the fibers were dip-coated with levofloxacin (LVFX) by incorporating the drug into a solution mixture of acetone, poly(ε-caprolactone) (PCL), and calcium stearate (CaSt) in a ratio of acetone:PCL:CaSt = 100:1% w/v: 0.1% w/v. The coated fibers exhibited a tensile strength of approximately 400 MPa, comparable to that of commercial polydioxanone (PDS II) sutures of similar size. The drug-coated fibers demonstrated continuous drug release for up to 30 days and showed antimicrobial efficacy against *Staphylococcus aureus* (MRSA), *Escherichia coli* O157:H7, and *Pseudomonas aeruginosa*, with inhibition zones ranging from 20−24 mm over 90 days. Cytotoxicity testing revealed that the drug-coated fibers had a cell viability rate of over 70%, indicating they were non-toxic.

Antibacterial effects and biofilm formation inhibition of Streptococcus mutans by Clerodendrum indicum Root

Naiyana Phonpituk[1], Kantika sensed[1], Ratchadawan Aukkanimart[1], and Pranee Sriraj[1]*
[1]Department of Thai Traditional Medicine, Faculty of Natural Resources, Rajamangala University of Technology Isan Sakon Nakhon Campus, Sakon Nakhon, 47160 Thailand
*e-mail: srirajp11@gmail.com, naiyana.po@rmuti.ac.th

Abstract:
The global prevalence of tooth decay remains a significant health issue, with Streptococcus mutans identified as a primary causative agent of dental caries. This study aims to assess the antibacterial and anti-biofilm properties of Clerodendrum indicum root extract against Streptococcus mutans. The antibacterial activity was evaluated using the disc diffusion method, revealing an inhibition zone of 5.08 ±0.24 millimeters at a concentration of 1,000 milligrams per milliliter. Further investigation determined that the extract exhibited a Minimum Inhibitory Concentration (MIC) of 0.312 milligrams per milliliter and a Minimum Bactericidal Concentration (MBC) of 0.625 milligrams per milliliter. The extract also demonstrated the ability to inhibit biofilm formation at IC_{50} 0.31 ±0.22, which is consistent with the results observed under a phase contrast microscope, with increased concentrations resulting in a corresponding decrease in biofilm production. These findings suggest that Clerodendrum indicum root extract possesses significant antibacterial activity against Streptococcus mutans and holds promise as a potential anti-cavity agent for future product development.

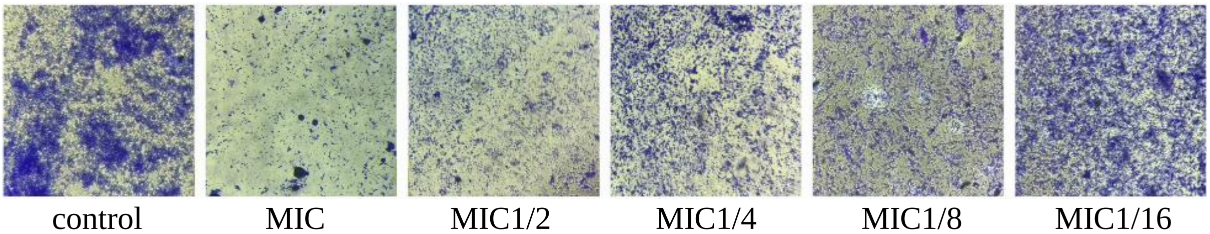


Figure 1.
Effect of Clerodendrum indicum root extract on biofilm formation of Streptococcus mutans under phase contrast microscopy

ENHANCED MECHANICAL, ELECTRICAL, AND *IN-VITRO* APATITE-FORMING ABILITY OF THE NANO-HYDROXYAPATITE BIOCERAMICS VIA $Bi_{0.50}(Na_{0.80}K_{0.20})_{0.5}TiO_3$ ADDING

Pharatree Jaita,[1,2,3] Pimpilai Wannasut,[1,2,3] Orawan Khamman,[1,3] Anucha Watcharapasorn,[1,3] Parkpoom Jarupoom[4,5,*]

[1]Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Office of Research Administration, Chiang Mai University, Chiang Mai 50200, Thailand
[3]Center of Excellence in Materials Science and Technology, Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[4]Department of Industrial Engineering, Faculty of Engineering, Rajamangala University of Technology Lanna (RMUTL), Chiang Mai 50300 Thailand
[5]Materials and Medical Innovation Research Unit, Faculty of Engineering, Rajamangala University of Technology Lanna (RMUTL), Chiang Mai 50300, Thailand
*e-mail: noteparkpoom@gmail.com (P. Jarupoom)

Abstract:
In this research work, the bioceramics system of nano-hydroxyapatite-bismuth sodium potassium titanate or $Ca_{10}(PO_4)_6(OH)_2/xBi_{0.50}(Na_{0.80}K_{0.20})_{0.5}TiO_3$ (HAp/*x*BNKT), where x = 0, 20, 40, and 60 wt.% were studied. The effect of BNKT concentration on phase, physical, microstructure, mechanical (Vickers hardness (*HV*), Knoop (*HK*) hardness, and fracture toughness (K_{IC})), dielectric, ferroelectric, and piezoelectric properties as well as the *in-vitro* apatite-forming ability of the HAp ceramic was investigated. XRD revealed that all compositions have mixed phases of HAp and BNKT. The prepared bioceramics exhibited more dense structure and increased linear shrinkage with increasing BNKT content. Adding more BNKT inhibited grain growth and improved the mechanical properties (HV = 5.49 GPa, HK = 5.28 GPa, K_{IC} = 6.90 MPa.m$^{1/2}$). With increasing BNKT content, the improvement of electrical properties were also observed. The maximum values of dielectric (ε_r = 230.28, $\tan\delta$ = 0.0728, ε_{max} = 443.33), ferroelectric (P_{max} = 25.46 μC/cm^2, P_r = 18.99 μC/cm^2, E_c = 10.08 kV/cm), and piezoelectric (d_{33} = 66 pC/N) performances were observed for the HAp/60BNKT sample. *In-vitro* apatite-forming ability test suggested that all HAp/*x*BNKT bioceramics have a good apatite-forming ability after poling process. Based on the obtained results indicated that these HAp/*x*BNKT bioceramics system has the potential to exhibit good mechanical and electrical performances with excellence bioactivity when compared to other previous studies, and are promising biomedical application candidates such as electro-active scaffold for tissue regeneration.

EVALUATING THE *In vitro* CYTOTOXICITY AND RESPONSE OF TITANIUM-TANTALUM NITRIDING (TiTaN) THIN FILM USING MACROPHAGES CELLS

Phakpoom Jeeauy,[1] Patipat Kamdenlek,[1] Komgrit Eawsakul,[2] Artit Chingsungnoen,[3] Chavin Jongwannasiri,[4] Chawan Manaspon[1,5,*]
[1]Biomedical Engineering Institute, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Department of Applied Thai Traditional Medicine, School of Medicine, Walailak University, Nakhon Si Thammarat 80160, Thailand
[3]Technological Plasma Research Unit, Department of Physics, Faculty of Science, Mahasarakham University, Maha Sarakham 44150, Thailand
[4]Princess Srisavangavadhana College of Medicine, Chulabhorn Royal Academy, Bangkok 10210, Thailand
[5]Biomedical Engineering and Innovation Research Center, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: chawan.m@cmu.ac.th

Abstract: Titanium alloys are considered the leading implant materials in dental applications. Surface modification has become one of the methods to enhance material properties and stimulate the desired biological response. Previously, modification of titanium with tantalum followed by plasma nitriding to create TiTaN has been confirmed to increase alveolar bone adhesion, enhance cell proliferation, stimulate mineral accumulation, and upregulate bone gene marker expression. This study aimed to investigate the basic effects of TiTaN on the *in vitro* cytotoxicity using a mouse macrophage cell line (RAW264.7). RAW264.7 cells were seeded directly onto the TiTaN surface and evaluate their lactate dehydrogenase (LDH) release and nitric oxide level (NO assay). LDH levels were not significantly different from the control group. Moreover, no dead cells were observed after 24 hours of cell seeding as determined by fluorescence microscopy. The NO levels did not significantly differ between the TiTaN, the control group, and the LPS-stimulated group. These results suggest that this material did not induce a significant inflammatory response and need for further investigations into other parameters, such as cytokine expression.

IN SILICO INVESTIGATION OF ANTICANCER DRUGS AS POTENTIAL INHIBITORS FOR INTERLEUKIN 1 WHICH COULD BE USED TO TREAT LUNG CANCER CAUSED BY PM2.5 INFLAMMATION

Andrea Warnnissorn[1], Mary Ann Warnnissorn[2], Netnaphis Warnnissorn[3], Kiattawee Choowongkomon[4]*
[1]International program Cambridge, Satree Phuket School, 1 Damrong Rd, Talad Yai, Amphoe Muang, Phuket 83000, Thailand
[2]Phuket Wittayalai School, 73/3 Thep Krasattri Rd, Tambon Talat Yai, Mueang Phuket District, Phuket 83000, Thailand
[3]Faculty of Medicine, Praboromrajchanok Institute, Tiwanon Rd, Amphoe Muang, Nonthaburi 11000, Thailand
[4]Department of Biochemistry, Faculty of Science, Kasetsart University, Bangkok, Thailand
Email: kiattawee.c@ku.th

Abstract

Many past scientific studies have shown a strong correlation that air pollution can lead to various types of diseases affecting the respiratory system. One of the main components within air pollution is fine particulate matter 2.5 (PM2.5), which are particles that are less than 2.5 µm in aerodynamic diameter. Due to its minute size, PM2.5 can easily evade the nasal mucosa and permeate into the lungs. When in the lungs, PM2.5 causes inflammation of the epithelial cells lining the lungs, the combination of cancer-causing mutations and inflammation from PM2.5 causes the cells to overexpress their genes and replicate uncontrollably, forming tumours. When irritants like PM2.5 enter the lungs, macrophages within the lungs release interleukin-1β (IL-1β), a pro-inflammatory cytokine that promotes the inflammatory response. Cells damaged or killed by the irritants release another inflammatory cytokine, Interleukin-1α (IL-1α), which further promotes the secretion of IL-1β by macrophages, worsening the inflammation and increasing the chances of cancerous cells forming.

In this experiment, we used sets of FDA-approved anticancer drugs (Diversity Set VI) from the National Cancer Institute. The protein-ligand docking software GOLD and molecule visualizer Discovery Studio was used to determine the binding affinity of the ligands with IL-1α and IL-1β, with ChemPLP and Goldscore used as scoring functions. A total of 12 molecules were chosen as the top-ranking ligands from the docking program. The ligands selected share bonds with critical binding residues within IL-1. Considering that the ligands were able to bond with the residues, it could mean that the ligands or the compounds akin to them might have some potential in inhibiting the actions of IL-1.

POLY(*L*-LACTIDE-CO-GLYCOLIDE)/ POLY(ETHYLENE OXIDE)
PERIODONTAL MEMBRANE: SURFACE MORPHOLOGY, HYDROPHILICITY AND MECHANICAL PROPERTIES

Thannaphat Jenvoraphot[1], Chayarop Supanchart[2], Robert Molloy[3,4], Winita Punyodom[1,3,5] and Donraporn Daranarong[6]*
[1]Office of Research Administration, Chiang Mai University, Chiang Mai, Thailand
[2]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Chiang Mai University, Chiang Mai, Thailand
[3]Bioplastics Production Laboratory for Medical Applications, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[4]Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[5]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[6]Multidisciplinary Research Institute, Chiang Mai University, Chiang Mai, Thailand
*e-mail: d.daranarong@gmail.com

Abstract:
In this study, poly(*L*-lactide-co-glycolide) (PLG) and poly(ethylene oxide) (PEO) blends with PLG:PEO weight ratios of 1:1, 1:2 and 2:1 and loaded with fixed LL37 protein (20 *u*M) were fabricated as porous nanofibrous membranes by electrospinning. Their intended use was as barrier membranes in dental applications. The optimal electrospinning conditions for preparing the porous membranes were also studied. Fabrication by the technique of electrospinning has been shown to be capable of producing highly elastic polymer blend membranes comprising 3-dimensional networks. The results in this work have shown that the weight ratio of PLG to PEO and the LL37 protein loading had significant effects on the membrane surface, fiber diameters, tensile properties, water contact angle and surface energy. With 1:1 and 1:2 of LL37 protein loading ratios, the membrane became more hydrophilic and at 2:1 ratio the hydrophilicity decreased due to the effect of higher PLG than PEO ratio. In contrast, the surface energy values, it is inversely proportional to the water contact angle value. Membrane with PLG:PEO ratio 1:2 LL37 has the best tensile strength. The ultimate aim of this research is that it will lead to the fabrication of periodontal membranes which are of comparably high quality but are much less expensive when compared with the currently available commercial products for periodontal repair in Thailand.

SYNTHESIS AND CHARACTERIZATION OF PCL/TNPP FOR MEDICAL APPLICATIONS: A STUDY OF STRUCTURE, MOLECULAR WEIGHT AND THERMAL PROPERTIES

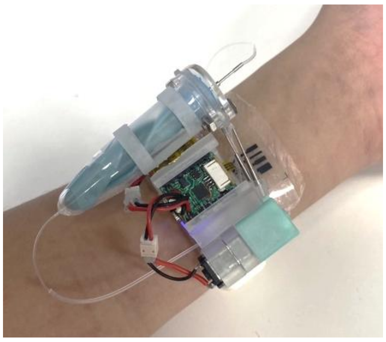
Tanyaluck Mekpothi,[1,2,3] Manasanan Namhongsa,[2,3,] Donraporn Daranarong,[2,3,4] Kittisak Yarungsee,[3] Winita Punyodom[2,3*]
[1]Office of Research Administration, Chiang Mai University, Chiang Mai 50200 Thailand
[2]Bioplastics Production Laboratory for Medical Applications, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[4]Science and Technology Research Institute, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: winitacmu@gmail.com

Abstract:
Because of its biocompatibility and biodegradability, poly(ε-caprolactone) (PCL) is widely used in many biomedical applications such as for use as artificial cartilage. However, PCL has a low thermal resistance as well as a low T_g (-61 °C), and low melting point (65 °C) which restrict its industrial applications. To overcome these limitations, PCL is often blended with compounds such as chain extenders, plasticizers and other types of additives to improve its overall properties. In this study, PCL was synthesized via bulk ring-opening polymerization (ROP) using tris(nonylphenyl) phosphite (TNPP) as a chain extender at concentrations of 0.25, 0.50, and 0.75 wt%. The polymerization was conducted using 0.015 mol% liquid tin(II) *n*-butoxide ($Sn(OnBu)_2$) as the initiator at 120 °C for 72 hours. The polymerization behavior of *ε*-caprolactone was studied using varying amounts of TNPP. Structural confirmation of PCL was carried out using a combination of nuclear magnetic resonance spectroscopy (^{1}H-NMR) and Fourier-transform infrared spectroscopy (FT-IR). The results indicated that the melting temperatures of the PCL obtained ranged from 48-58 °C with a thermal decomposition temperature of 431-439 °C and a weight loss of about 94-96%. The synthesized PCL exhibited high molecular weights with weight-average molecular weights ($\bar{M}_w$) ranging from 140,000-200,000 g/mol and a narrow dispersity (*Đ*) of 1.6. From the results, the PCL obtained from this experiment was white solid granules with >80% yield. The concentration of TNPP affected the PCL molecular weights and melt stability adversely. It has been reported that a low concentration of TNPP enhances the thermal stability of PCL, which will be further studied.

WEARABLE CHEMICAL SENSOR FOR SWEAT MONITORING DURING EXERCISE

Hiroyuki Kudo,* Shotaro Kawana, Yuki Akaba, Shoto Nakatsuka, Takuma Kajino, Ryoka Kaino
School of Science and Technology, Meiji University, Japan
*e-mail: hkudo@meiji.ac.jp

Abstract:
Here, we report a wearable chemical sensor aimed at sweat monitoring. Our system uses a continuous carrier flow for collecting sweat fluids instead of using chambers or cells for storing excreted sweat at the skin surface. The carrier flow is perfused over the skin to actively transport secretions from the skin surface to the downstream biosensor. This minimizes the influence of sweat rate, and the initial state of the skin surface is maintained throughout the measurement. We integrated a pump, a reservoir, a biosensor and a control circuit and a lithium-polymer battery into a wrist-watch device, which can be operated by a lab-build smartphone APP, and applied it for the real-time sweat monitoring. We applied the wearable chemical sensor for continuous monitoring of lactic acid in sweat during a bike exercise. The exercise task had an initial warm-up and rest (0 - 1000 seconds) and exercises gradually increased the load from 80 W to 200 W. The increase and decrease of the sweat lactic acid were confirmed as shown in the figure 1. Since the transportation distance from sampling to sensor, the delay time was shortened to about 10 seconds. At the same time, signal degradation due to diffusion during transportation to the biosensor has been reduced, allowing the signal to adequately follow the change in exercise intensity in a short period of time. The lactate secretion could be monitored even under conditions of large fluctuations in perspiration rate. We will also present our latest results on real-time multi-analyte monitoring at the conference.



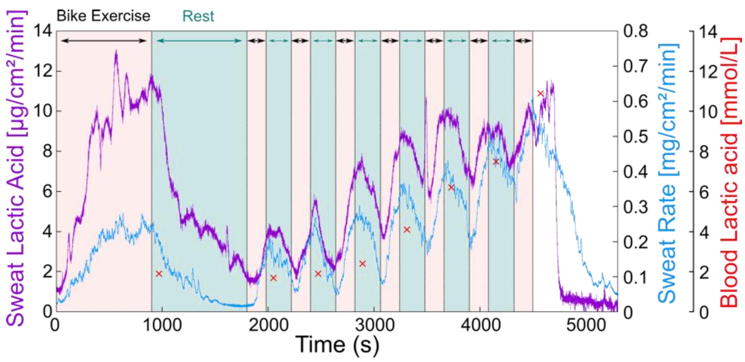


Figure 1.
Wearable sweat chemical sensor (left) and a typical change of sweal lactic acid during a bike-exercise (right)

SP3-MICROBIAL DIVERSITY AND SUSTAINABLE UTILIZATION

MACHINE LEARNING-BASED PREDICTION OF THONG DEE POMELO SWEETNESS USING EXTERNAL PHYSICAL CHARACTERISTICS

Thanchanok Pinyamoon[1], Piyapoom Janpanmuang[1], Chainun Poraha[1], Limpapat Bussaban[1,2], Prondanai Kaskasem[1,2,*],

[1]Department of Mathematics, Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand
[2]Research Center for Academic Excellence in Mathematics, Department of Mathematics Faculty of Science, Naresuan University, Phitsanulok, 65000, Thailand
*e-mail: prondanaik@nu.ac.th

Abstract:
This study investigates the application of various machine learning techniques to predict the sweetness of Thong Dee pomelo based on external physical characteristics. The attributes used for this study include weight, circumference, height, height from floor to circumference, and the diameter of the stalk. The dataset comprises 108 original pomelos and two synthetic datasets with 200 and 400 pomelos generated using REaLTabFormer. We employed several machine learning models, including Logistic Regression, Decision Tree, Support Vector Machine, k-nearest neighbors, Naïve Bayes, Random Forest, and XGBoost. Our findings revealed that Logistic Regression achieved the highest accuracy of 72% on the original dataset. In contrast, both Decision Tree and Random Forest demonstrated superior performance on the synthetic datasets, achieving an accuracy of 97.5%. This research underscores the potential of machine learning algorithms, particularly Decision Tree and Random Forest, in effectively predicting Thong Dee pomelo sweetness based on external physical characteristics, especially when leveraging synthetic data to enhance model training.

ADDITIONS OF SAPROBIC FUNGI ASSOCIATED WITH MACADAMIA TREES IN CHINA AND THAILAND

Xian Zhang1,2,3, Jaturong Kumla1,2, Samantha C. Karunarathna2,3, Saisamorn Lumyong1,2, Saowaluck Tibpromma2,3*, Nakarin Suwannarach1,2*

[1] Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Center of Excellence in Microbial Diversity and Sustainable Utilization, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3] Center for Yunnan Plateau Biological Resources Protection and Utilization, College of Biological Resource and Food Engineering, Qujing Normal University, Yunnan 655011, China
*e-mail: saowaluckfai@gmail.com (S.T.); nakarin.su@cmu.ac.th (N.S.)

Abstract:
Macadamia integrifolia, *M. tetraphylla*, and their hybrids, high-valued tree nuts cultivated in tropical and subtropical regions, have recently gained popularity, leading to a gradual increase in production worldwide. With a unique global perspective, this study focuses on saprophytic fungi isolated from fungal fruiting bodies on dead branches of macadamia collected from Yunnan Province, China, and Chiang Mai Province, Thailand. The samples were collected in 2023 and 2024. The morphological characteristics of the fruiting bodies of saprobic fungi were observed, and pure cultures were isolated using the single spore isolation method. The phylogenetic positions of the obtained fungi were determined by molecular analysis using multiple gene sequences of ITS, LSU, SSU, *TUB*, and *TEF*1-*α*. The results revealed two novel species in *Dothiorella* and *Phaeoacremonium*, as well as two new records of *Melomastia puerensis* and *M. guangdongensis*, adding exciting new knowledge to the field and potentially opening up promising new avenues for research and application in mycology and agriculture.

Anti-skin Aging Properties of Culturable Endophytic Fungi Isolated from Onion

Napalai Chaiwan[1,*], Itthayakorn Promputtha[2]
[1]Office of Research Administration, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: baimai_napalai@hotmail.com

Abstract: This study explores the anti-skin aging potential of culturable endophytic fungi derived from onion, a novel approach in the growing field of natural anti-aging remedies. Endophytic fungi, which reside asymptomatically within plant tissues, are known for producing a diverse range of bioactive secondary metabolites that can be employed for human health applications. With the increasing demand for natural skincare solutions, these fungi present a promising source of bioactive compounds. In this study, endophytic fungi were isolated from healthy onion tissues, and their bioactive compounds were extracted and evaluated for anti-aging properties, including anti-oxidation, anti-collagenase, anti-elastase, and anti-tyrosinase activities. The inhibitory concentration to achieve 50% (IC50) activity against DPPH radicals, collagenase, elastase, and tyrosinase were found to be 55.55, 113.63, 8.33, and 37.31 mg/mL, respectively. Among these activities, anti-elastase demonstrated the highest efficacy with the lowest IC50 value of 8.33 mg/mL, indicating superior effectiveness in inhibiting elastase, an enzyme critical for maintaining skin elasticity. In comparison, the IC50 values for epigallocatechin gallate (EGCG) against collagenase and elastase are typically reported as 67.8 mg/mL and 10.2 mg/mL, respectively, while kojic acid exhibits an IC50 value of approximately 29.1 mg/mL for tyrosinase inhibition. The comparable or even superior efficacy of the fungal extracts to these known anti-aging agents highlights their potential as natural alternatives for skincare. This study underscores the value of endophytic fungi in combating skin aging and opens avenues for further research into their broader dermatological applications, particularly in developing sustainable and effective natural skincare products.

Cultivable Actinobacteria from Northern Thailand Limestone Habitats: Unveiling Their Potential for Plant Growth Promotion

Pharada Rangseekaew*, Wasu Pathom-aree
Department of Biology, Faculty of Science, Chiang Mai University, Thailand
*e-mail: pharada.rang@cmu.ac.th

Abstract:
Limestone habitats are unique ecosystems predominantly composed of calcium carbonate ($CaCO_3$), encompassing environments such as caves, karst landscapes, and limestone quarries. These habitats present extreme and unique conditions that challenge microbial survival and adaptation. Despite these challenges, they offer valuable opportunities to explore microbial diversity, particularly actinobacteria. In Thailand, studies on actinobacteria in limestone habitats are very rare. Therefore, this study aims to explore the diversity of cultivable actinobacteria from five limestone habitats in northern Thailand: Chiang Dao cave, Muang-On cave, Tham Pla cave, Forest industry organization, and the quarries of the Siam cement public company limited. Soil, dripping water, and cotton swab samples were collected from five limestone habitats to isolate actinobacteria. Microwave treatment and five selective media were employed as isolation strategies. Rare actinobacteria were the dominant group in all habitats except Tham Pla cave. Among all habitats, Chiang Dao and Muang-On caves had the highest number of actinobacterial genera (seven genera), followed by the forest industry organization (four genera), Tham Pla cave (two genera), and the quarries area of the Siam cement public company limited (two genera). Members of the genera *Epidermidibacterium* and *Promicromonospora* (Chiang Dao Cave); *Mycolicibacterium* and *Sinomonas* (Muang-On Cave); *Rugosimonospora* (Forest Industry Organization); and *Mycolicibacterium* (quarries area) were isolated from limestone habitats for the first time. Our results support the concept that utilizing different enrichment and pretreatment methods for environmental samples enhances the recovery of a wider range of rare actinobacterial genera. Moreover, cultivable actinobacteria were evaluated for their plant-growth promoting properties. Most actinobacteria exhibited at least one of the following properties, the production of indole-3-acetic acid, siderophores, or phosphate solubilization. In conclusion, limestone habitats in northern Thailand harbor diverse actinobacteria with potential applications in agriculture.

ENDOPHYTIC FUNGI ASSOCIATED WITH *Cannabis sativa* AND THEIR ANTAGONISTIC POTENTIAL

Toe Swe Zin Ei[1], Jutamart Monkai[1], Kritsana Jatuwong[1], Worawoot Aiduang[1], Rungtiwa Phookamsak[2,3], Arnat Tancho[4] and Saisamorn Lumyong[1,5*]

[1]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Department of Economic Plants and Biotechnology, Yunnan Key Laboratory for Wild Plant Resources, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, China
[3] Honghe Center for Mountain Futures, Kunming Institute of Botany, Chinese Academy of Sciences, Honghe, 654400, China
[4]Department of Agriculture, Maejo University, Chiang Mai, Chiang Mai 50290, Thailand
[5] Center of Excellence in Microbial Diversity and Sustainable Utilization, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: scboi009@gmail.com

Abstract:
Cannabis sativa sub sp. *sativa* (hemp) and *C. sativa* sub sp. *indica* (marijuana) is well known as medicinal plant; however, the endophytic fungi associated with these two plants have been relatively few studied in their potential secondary metabolites utilizing as biocontrol agent. This study is focusing on endophytic fungi associated with leaves of hemp and marijuana and utilizing the potential strains as biocontrol agents against plant disease for green agricultural sustainability. The fungal endophytes were isolated from healthy leaves, of cannabis in Chiang Mai Province, Thailand. A total of 66 endophytic fungi were isolated, of which 34 isolates were from hemp and 32 isolates were from marijuana. Preliminary identification using internal transcribed spacer (ITS) sequence data was demonstrated 15 genera on hemp such as *Clonostachys*, *Colletotrichum*, *Epicoccum*, *Fusarium*, *Nemania*, *Neodeightonia*, *Neofusicoccum*, *Nigrospora*, *Macrophomina*, *Muyocopron*, *Pestalotiopsis*, *Phoma*, *Stagonosporopsis*, and *Trichoderma*. Ten genera occurred on marijuana such as *Aspergillus*, *Clonostachys*, *Colletotrichum*, *Daldinia*, *Diaporthe*, *Fusarium*, *Lasiodiplodia*, *Nigrospora*, and *Paecilomyces*. Among them, *Fusarium* is most abundant on both hemp and marijuana. Based on the preliminary screening of fungal secondary metabolites, ten endophytic fungi were showed highest inhibition in dual culture assay. Further testing of their antagonism against potato diseases, two bacterial pathogens (*Pectobacterium* sp. and *Ralstonia solanacearum*) and two fungal pathogens (*Sclerotium* sp. and *Fusarium* sp.) were selected based on the Koch's postulate pathogenicity test. Interestingly, strain no. TS01 (*Pestalotiopsis* sp.) has high inhibition against two bacterial pathogens. On the other hand, strain no. TS02 (*Aspergillus* sp.), and TS06 (*Colletotrichum* sp.) showed great antagonistic effects in fungal pathogen of *Fusarium* sp. in dual culture assay. The present study is an initiative step in finding new and interesting endophytes in cannabis and their potential bioactive compounds utilizing in sustainable agriculture.

ENTOMOPATHOGENIC FUNGI STUDY IN NORTHERN THAILAND

Alviti Kankanamalage Hasith Priyashantha[1], Samantha C. Karunarathna[2], Jaturong Kumla[3], Saowaluck Tibpromma[2], Saisamorn Lumyong[1,3*]

[1]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Center for Yunnan Plateau Biological Resources Protection and Utilization, College of Biological Resource and Food Engineering, Qujing Normal University, Qujing 655011, China
[3]Center of Excellence in Microbial Diversity and Sustainable Utilization, Chiang Mai University, Chiang Mai 50200, Thailand
*Correspondence: scboi009@gmail.com

Abstract:
Entomopathogenic fungi (EPF) studies are gradually increasing worldwide. Surveys on EPF have been carried out mainly in forests, however, their presence in urban areas has been underestimated. In this study, we investigated EPF in northern Thailand from 2023 to 2024. Our sampling procedure was meticulous, thoroughly examining the soil surface, leaf litter, plant leaves, trunks, and branches up to two meters in height. The infected insects were placed into a collection box, taken to the mycology laboratory at Chiang Mai University, examined, and directly isolated using the single spore isolation technique. A total of 52 infected insect samples were collected. For fungal isolation, a total of 21 pure fungal cultures were obtained. The fungi were identified comprehensively, combining morphology and sequence data from the internal transcribed spacers (ITS) of nuclear ribosomal DNA. The results revealed that most of the isolated fungi belong to *Beauveria*, *Clonostachys*, *Cordyceps*, *Lecanicillium*, and *Metarhizium*. Furthermore, the results indicated that *Beauveria* is the most prevalent, with 73% of the total collected samples. This study particularly evidences the presence of considerable EPF diversity even in northern Thailand's urban areas.

FUNGAL DIVERSITY IN WAHAVA HOT SPRING IN SRI LANKA

Fara Nifla,[1] Chathuranga Bamunuarachchige,[1,*] Ajith Rathnayake,[1] Heethaka Krishantha Sameera De Zoysa,[1] Jayarama Bhat,[4,5] Turki Dawoud[4] Nalin Wijayawardene[1,2,3]
[1]Department of Bioprocess Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
[2] Center for Yunnan Plateau Biological Resources Protection and Utilization, Qujing Normal University, Quijing, Yunnan Province 655011, P.R. China
[3]Tropical Microbiology Research Foundation, Pannipitiya 10230, Sri Lanka
[4]Department of Botany and Microbiology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia
[5]Biology Division, Vishnugupta Vishwavidyapeetam, Ashoke, Gokarna, 581326, India
Email:*tcbamunu@tec.rjt.ac.lk

Abstract
Fungi in the geothermal ecosystem can play a vital role in industrial biotechnology because of their ability to produce thermostable enzymes. Even though the prior investigations by culture-dependent and culture-independent studies have revealed the prokaryotic diversity in the Wahava hot spring, the fungal diversity remains unexplored. The present study aimed to explore the identification and characterization of culturable fungi in the Wahava hot spring in Padiyathalawa in the Ampara district, Sri Lanka. It's the only hot spring located above the mean sea level of approximately 100m in Sri Lanka and has temperatures ranging between 40.1°C and 46.7°C, with a pH range of 7.2 to 7.4. The fungi were isolated from collected sediment and water samples from the hot spring. The amplicons of the internal transcribed spacer (ITS) region were identified for culture-dependent identification followed by culture-characteristic observations. The isolated plates were incubated from 20°C to 55°C with 5°C intervals to differentiate thermophilic and thermotolerant fungi. As a result, 90 isolates were obtained from the collected samples. Among these strains, only *Pseudothielavia* sp. appeared to have an upper limit of thermal growth at 45°C. Our finding provided the first report of fungi in the Wahava hot spring in Sri Lanka as an initial step to the exploration of fungal diversity in the remaining hot springs of Sri Lanka and their potential industrial applications.

GENOMIC INSIGHTS INTO PLANT GROWTH PROMOTION AND SALT STRESS TOLERANCE IN *Tsukamurella* MT6.1^{T}

May Tharaphu Thein Win,[1] Inthira Wongchompoo,[1] Pharada Rangseekaew,[2] and Wasu Pathom-aree[2,*]
[1]Master Program in Applied Microbiology (International Program), Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Center of Excellence in Microbial Diversity and Sustainable Utilization, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
email: wasu.p@cmu.ac.th, may_tharaphutheinwin@cmu.ac.th,

Abstract:
Excessive soil salinity poses a significant challenge to agricultural productivity and global food security, particularly in arid and semi-arid regions. The detrimental effects of high salinity disrupt water availability, nutrient uptake, metabolic processes, and osmotic balance in plants, resulting in reduced crop yields. This study investigates the salt tolerance mechanisms and plant growth-promoting potential of *Tsukamurella* MT6.1^{T}, a deep-sea actinobacterium capable of thriving in up to 8% (w/v) NaCl. Comprehensive genomic analysis, conducted using multiple bioinformatics tools, revealed key genes associated with plant growth-promoting traits, such as tryptophan biosynthesis, a precursor for indole-3 acetic acid (IAA), and genes involved in nutrient acquisition, including iron, phosphorus, nitrogen, and potassium. Moreover, the presence of multiple biosynthetic gene clusters (BGCs) in the genome, such as betalactone, ectoine, terpene, and NRPS, indicates the strain's potential for secondary metabolite production and survival in high salinity environments. Notably, the complete ectoine biosynthesis pathway (*ect*A, *ect*B, *ect*C, *ect*D) suggests a robust mechanism for mitigating high salinity and osmotic stress. Additionally, the strain's analogous CAZymes compositions, including glycoside hydrolases, glycosyltransferases, and carbohydrate esterases, highlight its capability to metabolize various carbohydrates, aiding in stress adaptation. In conclusion, this study underscores the multifaceted plant growth-promoting traits of *Tsukamurella* MT6.1^{T} and its potential to enhance plant growth and stress tolerance. These findings hold promising applications in agriculture and biotechnology, particularly in improving crop resilience in saline environments.

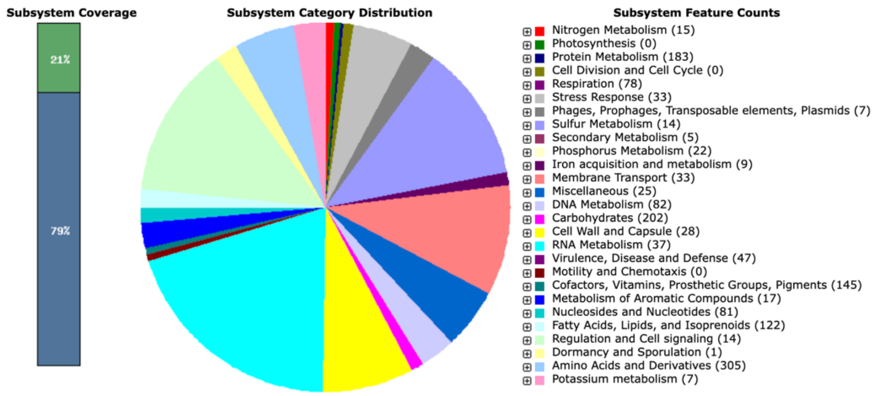


Figure 1. Subsystems of predicted genes in *Tsukamurella* MT6.1^{T} genome using RAST server.

INTEGRATED ANTAGONISTIC STRATEGIES OF TERMITES AND THEIR SYMBIOTIC GARDEN MICROBES AGAINST GARDEN-CONTAMINATED FUNGI

Er-Fu Yang[1,2], Karunarathna C. Samantha[2], Milan C. Samarakoon[3], Chun-I Chiu[3], Itthayakorn Promputtha[1*], Saowaluck Tibpromma[2*]

[1]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[2]Center for Yunnan Plateau Biological Resources Protection and Utilization, College of Biological Resource and Food Engineering, Qujing Normal University, Qujing, China
[3]Department of Entomology and Plant Pathology, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand

*E-mail: itthayakorn.p@cmu.ac.th (I.P.); saowaluckfai@gmail.com (S.T.)

Abstract:

The termite fungus garden, a vulnerable yet indispensable structure meticulously crafted by termites of the subfamily Macrotermitinae, serves as a monoculture bed for the highly specialized basidiomycete fungus, *Termitomyces*. The termites and their defensive symbionts maintain this nutrient-rich substrate, ensuring optimal *Termitomyces* cultivar growth. Due to their garden's high nutritional structure, close contact with soil, and termites continuously using foraged plant materials to pile up, the *Termitomyces* garden becomes an attractive target for many plant and soil-borne microorganisms. To safeguard their fungal gardens, termites employ various defensive strategies, including the secretion of antimicrobial compounds, meticulous grooming, avoidance, burying behaviors, and removing contaminated substrates. This meticulous grooming, in particular, is a testament to the dedication and care involved in maintaining the health and productivity of their fungal crops. However, systematic research on termites and their symbiont defensive strategies is lacking. Our investigation of the fungus-growing termite *Macrotermes annandalei* observed termite workers take a series of actions to remove fungal contaminants (*Aspergillus*, *Trichoderma*, and *Pseudoxylaria*) from their gardens. In contrast, gardens without termites were occupied by fungal contaminants of those three genera, just as weeds in agricultural crops. This study investigated different termite behaviors toward different weedy fungi and the absence or presence of the fungus *Termitomyces* in Potato dextrose agar medium. The isolated weedy fungi from gardens without termite maintenance, conducting dual culture tests with four bacteria strains from parts of termite colonies (worker intestines, mound soil, and fungus garden) and 20 fungal strains from termite colonies. All microbial strains present more or less of an inhibitory response to those weedy fungi *in vitro*. Our findings suggest that termites can detect the presence of weedy or disliked fungi and respond promptly. These bacterial mutualists and non-*Termitomyces* fungi may have been selected to co-evolve by termites, serving as defensive symbionts to assist termite social immunity. The importance of this research in understanding termite defensive strategies and the potential of the microbial strains for future studies is significant and should not be underestimated, as it paves the way for further studies in this field.

Keywords: Fungus growing termite, *Macrotermes annandalei*, microbial interactions, termite behaviors, weedy fungi

Lasiodiplodia crassispora AND _L. pseudotheobromae_ ISOLATED IN SRI LANKA SHOW MYCOREMEDIATION ABILITIES FOR DECOLORIZING CRYSTAL VIOLET

Madhara Wimalasena,[1,2] Nalin Wijayawardene,[2,3,4] Thushara Bamunuarachchige,[2,*] Nimesha Gunasekara,[2] Dong-Qin Dai,[3] Udeni Jayalal,[5] Jayarama Bhat,[6,7] Turki Dawoud,[6] Gui-Qing Zhang,[3] Susan Dharmarathne,[2] Ajith Rathnayake[2]
[1]Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka
[2]Department of Bioprocess Technology, Faculty of Technology, Rajarata University of Sri Lanka, Mihintale 50300, Sri Lanka
[3]Center for Yunnan Plateau Biological Resources Protection and Utilization, Qujing Normal University, Quijing, Yunnan Province 655011, P.R. China
[4]Tropical Microbiology Research Foundation, Pannipitiya 10230, Sri Lanka
[5]Department of Natural Resources, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya 70140, Sri Lanka
[6]Department of Botany and Microbiology, College of Science, King Saud University, P.O. Box 2455, Riyadh 11451, Saudi Arabia
[7]Biology Division, Vishnugupta Vishwavidyapeetam, Ashoke, Gokarna, 581326, India
Email:*tcbamunu@tec.rjt.ac.lk

Synthetic dyes resist natural degradation because of their complex structures, posing risks upon their direct release into aquatic systems and adversely impacting the environment and human health. Physicochemical treatments are used for colour removal from wastewater, whereas mycoremediation offers a cost-effective and environmentally friendly alternative for decolorizing synthetic dyes. In this study, crystal violet (CV) (triphenylmethane dye) was used as a test dye to assess the decolorization ability of *Lasiodiplodia crassispora* (RUFCC2463) and *L. pseudotheobromae* (RUFCC2464) isolated from Mahakanadara Tank and Mihintale Tank respectively in Sri Lanka. These fungi were identified using a biphasic approach that included morphological characterization and molecular multi-gene analyses (ITS and *tef1*). Screening on potato dextrose broth (PDB) containing CV showed that *L. pseudotheobromae* achieved the highest percentage decolorization (95.23% ± 0.82), followed by *L. crassispora* (93.18% ± 0.51). This study extends beyond *in vitro* applications to real-world scenarios by providing novel methodologies in mycoremediation. This innovative system comprises a temporary wastewater storage chamber, four capsule incubators, and a water sterilization chamber. The mycoremediation process was conducted under sterile conditions, and the entire decolorization process took one month. Wastewater containing CV is directed into the capsule incubator from the temporary wastewater storage tank through a filtering system. The capsule chambers contain PDB with antibiotics (tetracycline 50 mg L^{-1}). Every seven days, wastewater was transferred sequentially through each capsule chamber, with each chamber retaining the wastewater for a one-week period with shaking to facilitate fungal enzymatic reactions. By the end of the fourth capsule chamber, the decolorization process was completed due to fungal activities. In the water sterilization chamber, treated wastewater was held for two days and sterilized with heat or chlorinated water, eliminating any harmful effects from the fungi used in remediation. A promising avenue for the future is the use of capsule mycoremediators for effective synthetic dye decolorization.

UNVEILING DUAL LIFESTYLES OF *Colletotrichum fructicola* AND *Colletotrichum siamense* ON *Camellia sinensis* FROM NORTHERN THAILAND

Vidyamali Koodalugodaarachchi[123], Thilini Chethana Kandawatte[3], Kevin Hyde[3], Saisamorn Lumyong[12]*

[1]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Center of Excellence in Microbial Diversity and Sustainable Utilization, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3]Center of Excellence in Fungal Research and School of Science, Mae Fah Luang University, Chiang Rai 57100, Thailand
*e-mail: scboi009@gmail.com

Abstract:
Endophytic fungi, the fungal consortium that asymptomatically inhabits the plants, are capable of improving plant health for the well-being of the host. In contrast, phytopathogenic fungi intrude on the structural integrity and metabolic processes of the host plant to assimilate nutrients for their survival, causing a disease that ultimately leads to the demise of the plant. Many discussions surfaced in the last few decades about the endophytic lifestyle as a transient phase of opportunistically pathogenic fungi until favorable conditions trigger virulence and invade the host. The current study focuses on reporting of *Colletotrichum fructicola* and *C. siamense* in both endophytic and pathogenic life modes on *Camellia sinensis* var. *assamica*, which were previously reported as highly virulent pathogens on several occasions. Both species were isolated as endophytic and pathogenic strains from asymptomatic and symptomatic fresh leaves of *Ca. sinensis*, respectively. Species delineation was carried out based on morphological and phylogenic data. Furthermore, culture morphologies of endophytic and pathogenic strains of both taxa were compared using the slide culture method. The results of phylogenetic tree constructed with the combined internal transcribed spacer (ITS), beta-tubulin (*β-tubulin*), glyceraldehyde-3-phosphate dehydrogenase (*GPDH*), chitin synthase (*CHS*) and actin (*ACT*) regions revealed that the endophytic and pathogenic counterparts were phylogenetically similar to their respective *C. fructicola* and *C. siamense* isolates, despite the minor differences in base pairs. Interestingly, culture morphology comparison exhibited the ability of endophytes to produce appressoria as their pathogenic strains, which is normally formed by pathogenic *Colletotrichum* species during host infection. Additionally, this study reports the first incidence of *C. fructicola* and *C. siamense* on *Ca. sinensis* from Thailand. The findings of the current study will be able to provide solid evidence for the phenomenon of life mode transition from endophytes to pathogens. Hence, in turn, it facilitates future insights into the evolution of two reported species from the symbiotic to the pathogenic stage.

Figure 1. Image of appressoria produced by *C. fructicola* strains; a-c. appressoria from endophytic culture d-e. appressoria from pathogenic culture

SP4-CHALLENGES AND OPPORTUNITIES IN CLIMATE AND ENVIRONMENTAL CHANGES

ADSORPTION OF DICLOFENAC IN MUNICIPAL WASTEWATER ON ACTIVATED SLUDGE BIOMASS

Pumis Thuptimdang,[1,2,]* Keletso Chakalisa,[2] Kullapa Chanawanno[1]

[1]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[2]Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: pumis.th@cmu.ac.th

Abstract:
Pharmaceutical residues have been widely detected in wastewater including diclofenac (DCF), which brings an environmental concern for municipal wastewater treatment plants (MWWTPs) as they were not designed for removing these emerging pollutants. Most of the MWWTPs use activated sludge (AS) that can treat wastewater by using two major mechanisms, i.e., biodegradation and adsorption. This study aimed at determining the DCF removal in wastewater using AS from Suan Dok WWTP, Chiang Mai University (CMU-WWTP). Adsorption experiments were conducted in the laboratory with dried AS biomass and wastewater obtained from the facility spiked with 1.0 and 10 mg/L of DCF salts. Results showed that the adsorption process was both pH and sludge dosage dependent. Dried AS had the highest adsorption capacity in the DCF solution at the neutral pH 7 (14.4×10^{-2} mg/g), followed by pH 10 at 12.3×10^{-2} mg/g, then pH 4 (4.0×10^{-2} mg/g). The adsorption capacity reduced as the sludge dose increased whilst the removal percentage increased as the sludge dosage increased from 35.08 to 53.5, and 71.3% for 1, 2, and 4 g of sludge, respectively. The adsorption was better fitted to a pseudo-second-order kinetic model with R^2 values > 0.98, which should be dominated by the chemisorption process. Findings from this study showed that the AS process could be possible to remove DCF in wastewater.

Assessing the Role of Brown Carbon in PM2.5 Light Absorption from Biomass Burning Emissions in Chiang Mai, Thailand

Pattira Mokthong,[1,2] Somporn Chantara[1,2], Pavidarin Karisitnitikul[2,3], Nattahanit Kantarawilawan[1], Wan Wiriya[1,2,*]
[1] Environmental Science Program, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Environmental Research Chemistry Laboratory, Chemistry Department, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[3] Office of Research Administration, Chiang Mai University, Chiang Mai 50200
*Email: wan.w@cmu.ac.th

Abstract:
Brown Carbon (BrC) originates from incomplete biomass burning, while particulate matter less than 2.5 micrometers (PM2.5) significantly contributes to air pollution. Both BrC and PM2.5 absorb sunlight, leading to warming in the atmosphere, with pronounced effects in areas where biomass burning is prevalent. This study examines the seasonal variation of BrC during the biomass burning period in Chiang Mai, Thailand, to understand its role in air pollution alongside PM2.5. BrC samples were extracted using water and methanol, and their light absorption was measured with a UV-Vis spectrophotometer. The PM2.5 concentrations ranged from 17.57 to 135.84 $\mu g/m^3$, as measured by high-volume air sampling in Chiang Mai City. The results indicated that the absorption coefficient for water-extractable BrC at 365 nanometers was 69.3 Mm^{-1} to 165.2 Mm^{-1}, while for methanol-extractable BrC, it ranged from to 67.1 Mm^{-1} to 180.7 Mm^{-1}. The mass absorption efficiency (MAE) for water-extractable BrC was between 2.0 and 9.8 m^2/g, and for methanol-extractable BrC, it was between 2.2 and 9.5 m^2/g. These findings highlight the importance of continuous monitoring and stricter air quality controls to mitigate the environmental and public health risks associated with BrC emissions, especially during biomass burning periods.

BACTERIAL POLYMERS: A POTENTIAL SOLUTION FOR ENVIRONMENTAL CHALLENGES

Panaya Kotchaplai,[1,2,3*] Tanaporn Wichai,[1] Emmanuel O. Opadokun[4]
[1]Institute of Biotechnology and Genetic Engineering, Chulalongkorn University, Bangkok, Thailand
[2]Water Science and Technology for Sustainable Environment Research Unit, Chulalongkorn University, Bangkok, Thailand
[3]Center of Excellence in Bioconversion and Bioseparation for Platform Chemical Production, Institute of Biotechnology and Genetic Engineering, Chulalongkorn University, Bangkok, Thailand
[4]Program in Biotechnology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand
*e-mail: panaya.k@chula.ac.th

Abstract:
Human activities, together with natural processes, have resulted in escalating environmental problems, including climate change, pollution, and resource depletion. To address these urgent challenges, researchers are exploring various innovative solutions. Among these, biopolymers, polymeric materials produced by living organisms, appear to be one of the promising solutions. Microbial biopolymers, for example, polyhydroxyalkanoates, have been used as an alternative to petroleum-based plastics, contributing to reduced fossil energy use and greenhouse gas emission. Additionally, several microbial biopolymers are proving effective for the remediation and reclamation of degraded soil. Poly-glutamic acid (PGA), a polymer of amino acid, has been used as a flocculant and adsorbent for wastewater and contaminated soil treatment. It can be developed into hydrogel and used as soil amendment for improving water retention and mitigating drought stress. However, the high production costs and complex downstream processes yet remain challenges. Our research group has isolated an exogenous glutamate-independent PGA-producing strain, thereby reducing production costs. Pot experiments have shown that, without purification, direct application of fermentation medium containing PGA significantly enhances soil moisture retention, and increases corn root and shoot length. These findings highlight the potential of bacterial biopolymers, particularly PGA, as a solution to environmental issues.

Comparative Health Risk Analysis of Volatile Organic Compounds in Different Indoor Environments

Sasipat Deemak,[1,2] Somporn Chantara[1,2], Wan Wiriya[1,2,*]

[1] Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Environmental Research Chemistry Laboratory, Chemistry Department, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand

*E-mail: wan.w@cmu.ac.th

Abstract:

Volatile Organic Compounds (VOCs) are harmful indoor air pollutants that pose significant health risks. This study monitored VOC levels in various rooms at Chiang Mai University, focusing on BTEX (Benzene, Toluene, Ethylbenzene, Xylene) and total volatile organic compounds (TVOCs), including 1,2- Dichloroethane, 1,3-Butadiene, Acrolein, Dichloromethane, Tetrachloroethylene, Chloroform, 1,1- Dichloroethane, Vinyl chloride, Acrylonitrile, 1,2-Dichloropropane, Acetic acid, trans-1,2-Dichloroethene, Acetoin, 5-Hydroxymethyl-2-Furfural, Bromoethane, Acetaldehyde, and Benzyl alcohol. The results showed that the concentration of TVOCs followed a descending order: office (130.46 mg/m^3) > laboratory (107.75 mg/m^3) > classroom (107.33 mg/m^3) > library (82.98 mg/m^3). For BTEX concentrations, the order was library (17.26 mg/m^3) > classroom (12.47 mg/m^3) > laboratory (10.20 mg/m^3) > office (7.77 mg/m^3). Acrylonitrile exhibited the highest average concentration across all room types. In the health risk assessment of VOC exposure, the Hazard Quotient (HQ) was used to calculate risk. The highest TVOC levels were found in offices, while the highest BTEX levels were detected in libraries. Acrylonitrile was the most concentrated compound across all rooms. The assessment revealed that acrolein posed the greatest health risk, with teenagers (ages 16–21) being more vulnerable to VOC exposure than adults (ages 21–70). These findings underscore the urgent need for improved indoor air quality management at Chiang Mai University to protect the health of its occupants.

COMPARATIVE STUDY OF AMBIENT NITROGEN DIOXIDE PASSIVE SAMPLING METHODS IN CHIANG MAI USING SPECTROPHOTOMETER AND MICROPLATE READER

Zuheng Sun,[1], Win Mar Khine[1], Khin Saw Htay[1], Aye Nyein Khant[1], Eaint The Hsu[1], Sit Thway Aung[1], Sharjeel Shakeel[1,2], Muhammad Shoaib Qamar[1], Muhammad Zakir Afridi[1], Siwat Kamepuang[2], Somporn Chantara[1,2], Wan Wiriya[1,2,*]

[1] Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Environmental Research Chemistry Laboratory, Chemistry Department, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand

wan.w@cmu.ac.th

Abstract:

This study evaluates the effectiveness of using a microplate reader to measure nitrogen dioxide (NO_2) concentrations in urban Chiang Mai, Thailand, by comparing it with the traditional spectrophotometric method. Passive samplers were deployed at six sites around Chiang Mai University, each with varying levels of traffic and activity. The spectrophotometric analysis served as a reliable reference, while the microplate reader offered a faster method to estimate NO_2 levels. The results indicated that NO_2 concentrations were higher on workdays compared to weekends, with the highest levels observed near the busy MAYA Mall (79.12 ppbv), and the lowest levels recorded at the green, low-traffic AngKeaw Reservoir (4.11 ppbv). A strong correlation ($r = 0.867$) was observed between the two methods, indicating that the microplate reader offers a practical, rapid, and cost-effective alternative for NO_2 monitoring. However, some discrepancies at elevated NO_2 concentrations suggest that further calibration of the microplate reader may be required for optimal performance. Overall, this study highlights the potential of the microplate reader to enhance the accessibility and scalability of air quality monitoring in urban environments.

EVALUATION OF CLIMATE CHANGE IMPACT ON SEASONAL BIOGEOCHEMICAL VARIATIONS IN THE MUN RIVER WATERSHED USING WATER QUALITY DATA AND GEOCHEMICAL MASS BALANCE METHOD

Supanut Suntikoon,[1,]* Schradh Saenton[1,2]
[1]Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200 THAILAND
[2]Department of Geological Sciences, Faculty of Science, Chiang Mai University, Chiang Mai, 50200 THAILAND
*e-mail: supanut_suntikoon@cmu.ac.th

Abstract:
The Mun river watershed, one of the major water resources in Northeastern Thailand, has faced significant challenges in water quality and quantity due to climate change. This study aimed to evaluate the seasonal biogeochemical variations within the Mun River watershed, with a particular focus on the impacts of climate change on water quality and geochemical processes. Mun river water samples were collected from 19 surface water sites during both the dry season (March-April 2024) and the wet season (July-August 2024). These samples were analyzed for dissolved major ions, and using the Geochemical Mass Balance (GMB) method to quantify seasonal differences in weathering rates and biomass degradation. The analysis revealed significant shifts in hydrochemical facies, from Ca-HCO_3 dominance in the wet season to Na-Cl in the dry season, reflecting an increased salinity and altered geochemical conditions influenced by climate variability. Mineral weathering rates were significantly higher during the wet season, particularly for halite and feldspar, with the northern watersheds showing increased human activity. Biomass degradation also exhibited substantial seasonal variation, with increased rates in the wet season due to intensified microbial activity, a process likely to be further exacerbated by climate change. Climate change is amplifying the seasonal biogeochemical variations in the Mun River watershed, leading to pronounced shifts in hydrochemical facies and enhanced geochemical and biological activities during the wet season. These findings underscore the critical need for adaptive watershed management strategies that address the increasing influence of climate change on seasonal water quality dynamics.

From Sanctuary to Strife: The Unintended Climate Consequences of Chronic Crisis-Driven Forest Inhabitants

Htet Sint Pine*

Abstract:

This paper investigates the dynamic relationship between chronic crisis and climate change in a Mon community facing long-term displacement in southeast Myanmar. The community has experienced what Vigh (2008) refers to as a 'chronic crisis' for more than seven decades, exacerbated by recent civil conflict and limited access to basic needs. Situated near the Thai border, the village faces complex governance arrangements, including mixed control by the Myanmar military State Administration Council (SAC), the New Mon State Party (NMSP), and the Karen National Union (KNU), who all vie for control of both people and natural resources in the area (Lund, 2017). As a result of these dynamics, much of the surrounding forest land has been converted into rubber plantations owned largely by armed elites. On top of this, the community is now dealing with the effects of climate change, which has affected their ability to survive off the local environment.

This study draws on mixed methods analysis, triangulating precipitation and temperature data with ethnographic fieldwork. The author examines how the observed and projected impacts of climate change, including rising temperatures and changes in precipitation, are exacerbated by the chronic crisis and ongoing mismanagement of forest land by different authorities. The author further analyses how the decline in forest resources due to the rubber plantations impacts subsistence agricultural production while exploring the socio-economic implications for the local population. The findings underscore the urgent need for context-specific interventions tailored to the complex challenges faced by displaced communities relying on the environment for survival. The ethnographic lens provides a rich comprehensive narrative that enhances our understanding of the community's resilience in the face of difficulty.

Influence of Atmospheric Ventilation on PM2.5 Concentrations During the Biomass Burning Season in Chiang Mai

Sadanon Jaisaksern,[1,2] Somporn Chantara[1,2], Sukrit Kerdsang[3], Wan Wiriya[1,2,*]

[1] Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Environmental Research Chemistry Laboratory, Chemistry Department, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[3] The Northern Meteorological Center, Chiang Mai, 50200, Thailand

*Email: wan.w@cmu.ac.th

Abstract:
This study explores the correlation between ventilation rates and PM2.5 concentrations in Chiang Mai during 2024. This year was marked by severe air pollution, particularly during the dry season when biomass burning was prevalent. PM2.5 causes significant health risks. It can penetrate deep into the lungs and enter the bloodstream, leading to respiratory and cardiovascular issues. Ventilation rate, a critical factor in air quality, is influenced by conditions reported by the Northern Meteorological Center. These conditions include wind speed, wind direction, and atmospheric pressure, all of which impact the dispersion and concentration of PM2.5 in the atmosphere. The study found that the ventilation rate and mixing height in the morning were lower than in the afternoon, primarily due to temperature and wind speed. Both the ventilation rate (1,129 ± 2,071 m^2/s) and the mixing height (298 ± 408 meters) were low in the morning of March 2024, which corresponded to a high average PM2.5 concentration of around 150 $\mu g/m^3$ during this period. The study used detailed ventilation rate data from 2023, provided by the Northern Meteorological Center. It was found that higher ventilation rates facilitated the dispersion and dilution of PM2.5, resulting in lower concentrations. On the other hand, low ventilation rates, often leading to stagnant conditions, caused an increase in PM2.5 levels, exacerbating the city's air pollution problems.

MICROPLASTIC POLLUTION - A TREAT TO HUMAN HEALTH: WHAT CAN CAMBODIA DO?

Seakleang Soknea, Seihakpanha Makara, TJ Moore, Sreynich Chhun*
Department of Science Research, Faculty of Health Science and Biotechnology, University of Puthisastra, Phnom Penh, 12211, Cambodia
*e-mail: csreynich@puthisastra.edu.kh

Abstract:
Microplastics (MPs) are types of semi-synthesis plastic that are smaller than 5mm—and present in almost terrestrial, marine, and atmospheric environments. These MPs are generally toxic to human health potential, such as oxidative stress, cardiovascular disease, and cancer. This study aims to emphasize the importance of developing policies and regulations to reduce MPs in the environment and the related health implications. The currently available data and policies from Cambodia and other ASEAN nations were reviewed to determine the current status of the regulation of plastics. As a result, while some ASEAN governments have developed national strategies or plans on the use and management of plastics, Cambodia has little regulation so far, with only a Sub-Decree on Management of Plastic Bags (2017) and another on Plastic Waste Management. Among ASEAN member states; Indonesia and Thailand have the most experience in developing and implementing policies on plastic and waste management, including phasing out or banning single-use plastic, tax reductions for retailers using biodegradable plastics, and import bans on plastic waste. Cambodia could benefit from these as a starting point to plan, develop, and adopt the policies as much as possible to reduce or eliminate microplastics. In brief, Cambodia needs to implement strong policies similar to those in other Asian countries to manage waste sustainably and safeguard public and environmental health.

SEASONAL VARIATIONS OF BLACK CARBON AND PM2.5 DURING THE BIOMASS BURNING SEASON IN CHIANG MAI, THAILAND

Sharjeel Shakeel,[1,2] Somporn Chantara[1,2], Pavidarin Karisitnitikul[2,3], Nattahanit Kantarawilawan[1], Xavier Mari[4], Wan Wiriya[1,2,*]

[1] Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[2] Environmental Research Chemistry Laboratory, Chemistry Department, Faculty of Science, Chiang Mai University, Chiang Mai, 50200, Thailand
[3] Office of Research Administration, Chiang Mai University, Chiang Mai 50200
[4] Aix Marseille Univ, Université de Toulon, CNRS, IRD, MIO UM 110, 13288 Marseille, France

*e-mail: wan.w@cmu.ac.th

Abstract:
PM2.5 (Particulate Matter less than 2.5 micrometers) and Black Carbon (BC) are critical components of air pollution, with significant impact on human health, climate, and the environment. This study examines the seasonal variations of PM2.5 and BC during the biomass burning season in Chiang Mai, Thailand, where air quality frequently deteriorates. Over a two-year period (2023-2024), data were collected at the Science Complex Building 1, Faculty of Science, Chiang Mai University, with PM2.5 data sourced from the Pollution Control Department (PCD) station and sensors, and BC data obtained using the portable microAeth® MA200. Significant increases in PM2.5 and BC levels were observed in March (159 and 11.19 $\mu g/m^3$, respectively) and April (204 and 7.22 $\mu g/m^3$, respectively), strongly correlating with the peak burning season. PM2.5 data from low-cost sensors showed a high positive correlation with PCD data. The direction of the air mass, primarily from the southwest of Chiang Mai and the transboundary area (Myanmar), during the biomass burning season, contributed to the observed elevated pollution levels. These findings underscore the importance of continuous monitoring and informed policy action to address the persistent air pollution challenges in Chiang Mai

SP5-DATA SCIENCE AND DATA PRIVACY

CAUSALITY DISCOVERY USING MARKOV BLANKET AND DOMAIN KNOWLEDGE INTEGRATION FOR IDENTIFYING DRUG-DRUG INTERACTIONS

Sitthichoke Subpaiboonkit[1,*]
[1]Department of Computer Science, Faculty of Science, Chiang Mai University
*e-mail: Sitthichoke.s@cmu.ac.th

Abstract:
This work addresses the challenge of automatically detecting drug-drug interactions, with a specific focus on adverse reactions resulting from the simultaneous administration of multiple drugs, based on reports from the spontaneous reporting system of suspected cases. This task is critical due to the significant health implications of accurately identifying such interactions. Furthermore, automating the detection process could facilitate large-scale analysis and continuous monitoring. However, existing automated approaches primarily rely on associative and correlational relationships between related drug data, which are insufficient for uncovering causal relationships. This work proposes a novel approach that integrates Markov Blanket and domain knowledge to automatically identify causal relationships and determine the causal direction in the drug-drug interaction discovery problem. The approach was tested on a real-world dataset of drug usage with adverse effects.

SP7-CEMENT AND CONCRETE: SCIENCE, TECHNOLOGY AND APPLICATIONS TOWARDS GREEN AND SUSTAINABLE FUTURE

DEVELOPMENT OF DRY PREMIXED CONCRETE FOR MARINE ENVIRONMENT PRODUCTS TO ENHANCE RESISTANCE TO CHLORIDE PENETRATION

Jaroon Junsomboon,[1,*] Jutarut Sappatavee [2]

[1]Construction Material Group, Division of Engineering Materials, Department of Science Service, Ministry of Higher Education, Science, Research and Innovation, Bangkok 10400 Thailand

[2]Cemkrete Company Limited, 213 Soi Charoen Krung 109 Lane 7, Charoen Krung Road, Bang Kho Laem, Bangkok 10120 Thailand

*e-mail: jaroon@dss.go.th

Abstract: This study focuses on the development of dry premixed concrete specifically designed for marine environments products. By incorporating fly ash and silica fume in an optimal ratio, the resistance to chloride penetration is significantly enhanced. The analysis was done using the standard test method for the electrical indication of concrete's ability to resist chloride ion penetration. The resulting formula demonstrated chloride permeability values ranging from 73 to 930 coulombs at a water-to-concrete ratio of 9.0-12.5% W/C, indicating very low chloride ion penetrability. The developed product can be easily mixed with water for immediate use and its properties comply with the Thai industrial standard (TIS 3203 - 2564).

DEVELOPMENT OF LIGHTWEIGHT AND THERMAL INSULATION MATERIAL BASED ON AGRO-INDUSTRIAL WASTE

Sutthima Sriprasertsuk,* Saijit Daosukho
Department of Science Service, Bangkok, Thailand
*e-mail: sutthima@dss.go.th

Abstract:
Growing economic development has highlighted the problem of high energy use in buildings. Improving building thermal insulation is a key approach to tackling this issue. In parallel, the use of waste products from agriculture and industry for insulation purposes has gained significant attention. Generality of mussel farming is dedicated to canning. This industry produces over a million tons of shell waste annually, which is primarily disposed of in landfills or dumped into the ocean, causing significant environmental damage. This research aims to demonstrate the potential of mussel shells as a viable lightweight insulating material. Calcium carbonate derived from powdered mussel shell waste served as a calcium source in concrete mixture containing natural pozzolanic materials, namely bagasse ash and pottery stone. The autoclaved sample made from the agro-industrial waste has been physically and chemically analyzed. Mechanical properties, including compressive strength, density and thermal conductivity were investigated. A material body incorporating mussel shell waste exhibited high compressive strength while showing low density and good thermal insulation. The lightweight and thermal insulation material offers economic advantages by using mussel shells as a lime substitute and bagasse ash as a cement replacement. This approach promotes the sustainable reuse of these agro-industrial waste materials.

Effects of water, plastic sealed and air curing on compressive strength and microstructure of Portland cement - calcined clay mortars

Supakporn Aodkeng1,[1, 2,] * Arnon Chaipanich2,[2]
[1] Office of Research Administration, Chiang Mai University, Chiang Mai 50200, Thailand
[2] Advanced Cement-based Materials Research Laboratory, Department of Physics and Materials Science, Faculty of Science, Chiang Mai University Chiang Mai 50200, Thailand
*e-mail: Supakporn.a@gmail.com

Abstract:
Curing methods are one of the important factors affecting the strength of cement in mortar and concrete mixes. The interest on calcined clay as supplementary cementitious material has increased with numerous attentions worldwide as a strategy for reducing CO_2 from Portland cement production. Effects of calcined clay as Portland cement replacement on compressive strength and microstructure were investigated under different curing methods. In this work, medium-grade calcined clay from Lopburi in Thailand was used at 10% and 20% by weight. Mortars were cured in water, plastic sealed and air at a temperature of 23±2 °C. Phase characterizations were determined with the use of X-ray diffraction (XRD), thermogravimetric analysis (TGA) and scanning electron microscope (SEM). It was found that the compressive strength of 20% wt. of calcined clay is highest in all curing methods, which shows its effectiveness in being used as a replacement material for Portland cement. TGA results showed the increasing pozzolanic reaction with increase calcined clay content that related to the higher compressive strength when replaced Portland cement with calcined clay. XRD patterns found $CaCO_3$ peak increasing when curing in air from carbonation reaction.

MECHANICAL AND FIRE-RESISTANT PROPERTIES OF FIRED CLAY AND KAOLINITIC CLAY SUBSTITUTION IN COAL FLY ASH BASE GEOPOLYMERS

Maneerat Thala,[1] Auekarn Chuwongwittaya,[1] Kedsarin Pimraksa[1,2*]
[1] Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Thailand
[2] Center of Excellence in Materials Science and Technology, Faculty of Science, Chiang Mai University, Thailand
*e-mail: kedsarin.p@cmu.ac.th

Abstract:
This research aimed to prepare a geopolymer using coal fly ash (FA) from Mae Moh Power Plant (Thailand) as a main raw material. NaOH and Na_2SiO_3 were used to prepare alkaline activator with various NaOH concentrations (3M, 5M and 7M). The cube geopolymer pastes were tested compressive strength and investigated phases development using X-ray diffractometer (XRD), Scanning Electron Microscope (SEM) & Energy Dispersive X-Ray Spectroscopy (EDS). The result showed that 5M NaOH provided the highest compressive strength of FA-geopolymer at 33.4 and 54.9 MPa of 5 day and 14 day curing times, respectively. The 5 M NaOH condition was selected for a study of FA substitution by fired clay or kaolinitic clay from 0 to 40 wt%. The influences of the substitution on mechanical and fire-resistant properties of geopolymers were studied. Geopolymers with the mixture of FA and fired clay or kaolinitic clay contained high quartz content with an increase in the replacement amount. The microstructure of geopolymer illustrated small particles of unreactive fired clay or kaolinitic clay in FA-geopolymer leading to a strength degradation. In the contrary, the substitution of fired clay or kaolinitic clay showed a better fire-resistant geopolymer with no crack appearance at 1,100 °C. The compressive strengths of 1,100 °C fired products with 10, 20, 30 and 40 wt% fired clay replacement were 55.4, 70.8, 132.4 and 128.9 MPa, respectively. For FA replacement with kaolinitic clay, the strengths of fired products were 57.4, 94.1, 116.8 and 81.6 MPa, respectively. After firing at 1,200 °C, the geopolymer products started to melt and deform. Sample with fired clay replacement showed more deformation than that with kaolinitic clay and FA replacements.

MICROSTRUCTURE AND COMPRESSIVE STRENGTH OF FLY ASH-CALCINED CLAY-PORTLAND CEMENT MORTARS MIXED WITH SODIUM HYDROXIDE SOLUTION

Ananya Nararueang[1], Supakporn Aodkeng[1], Kornnika Wianglor[1], Arnon Chaipanich[1,*]
[1]*Advanced Cement-based Materials Research Laboratory, Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand*
[*]*email: arnon.chaipanich@cmu.ac.th*

Abstract:
Alkali activated material is a low-carbon material that is of current global interest. This research work reports the microstructure characteristic and the compressive strength of alkali-activated fly ash-calcined clay mortar under 60 ℃ at 7 and 28 days curing time. Fly ash (FA) and calcined clay (CC) were used to replace Portland cement (PC) at 70, 80, 90, and 100% by mass of binder, keeping calcined clay constant at 20% by mass. Sodium hydroxide (NaOH) was used as an activating agent. NaOH of 10 molar concentration and a liquid to binder ratio of 0.5 was used. The results showed that when activated with NaOH, the compressive strength was highest for mixes with 10%PC (70%FA20%CC) and 0%PC (80%FA20%CC) mixes. This is due to the synergic use of these materials.

SYNTHESIS OF GEOPOLYMER COMPOSITE MATERIALS USING CLAY-LIGNITE BOTTOM ASH MIX

Chanikarn Kumprom,[1] Kedsarin Pimraksa [1,2*]
[1] Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, 50200, Thailand
[2] Center of Excellence in Materials Science and Technology, Faculty of Science, Chiang Mai University, 50200, Thailand
*e-mail: kedsarin.p@cmu.ac.th

Abstract:
This research investigated the synthesis of geopolymer composite materials using china clay and lignite bottom ash as main raw materials with an initial SiO_2/Al_2O_3 molar ratio of 4.0. Additions of calcium additives viz. calcium carbonate (CaO/SiO_2 = 1, 2, and 3) and calcium hydroxide (CaO/SiO_2 = 1) with different NaOH concentrations (5 and 9 M) were investigated. Curing times (7 and 14 days) were also varied to study its effect on mechanical properties of the synthesized geopolymer. The compressive strength of geopolymer composite materials at 14 days with calcium carbonate containing CaO/SiO_2 molar ratios of 1, 2 and 3 at 5 M was 34.7, 26.8 and 24.0 MPa, respectively and at 9 M was 36.5, 28.4 and 18.0 MPa, respectively. While, the composite material with 9 M NaOH and calcium hydroxide containing the CaO/SiO_2 ratio of 1.0 possesses 20.8 MPa at 14 days. At the same CaO/SiO_2 ratio, $CaCO_3$ provided a stronger geopolymer composite materials. In addition to the study of the mechanical properties, phase development using X-Ray Diffractometer (XRD), microstructure using scanning electron microscopy and energy dispersive spectroscopy (SEM-EDS) and thermal properties using differential thermal analysis & thermal gravimetric analysis (DTA&TGA) were carried out.

SP8-THE SCIENCE OF RESTORING TROPICAL FOREST ECOSYSTEMS: 30 YEARS OF PROGRESS AND BEYOND

BIODIVERSITY RECOVERY: ADVANCES IN BIOACOUSTIC MONITORING OF BIRDS

George Gale[1]
[1]Conservation Ecology Program, School of Bioresources & Technology
King Mongkut's University of Technology Thonburi
Bangkok 10150, Thailand
e-mail: george.a.gale@gmail.com

Abstract:
Wildlife monitoring during forest restoration addresses key questions particularly: Which species have re-colonized the area under restoration and how many individuals of such species are present? In this brief review, I assess the relative advantages and limitations of the current methods of passive acoustic monitoring (PAM) techniques for birds, likely the most numerous seed dispersers in many landscapes. PAM can be advantageous by 1) minimizing potential human disturbances from observers that could influence the monitoring data of particularly sensitive or cryptic species, 2) PAM can potentially generate large amounts of data over space and time that can be analyzed at different spatial and temporal scales to refine biodiversity monitoring methods and 3) PAM data provide a long-term dataset that can perpetually reanalyzed as new questions arise. However, there are significant obstacles that can limit PAM for estimating population characteristics. PAM focus on vocalizing animals only; therefore, it is assumed that biotic sound diversity reflects overall community diversity. Critical ecological parameters such as species abundances can also be extremely challenging to estimate from sound recordings. Another challenge is detection of species that infrequently vocalize or otherwise cryptic species. Lastly, PAM generates a huge amount of data that needs specialized methods to process. Automatic classifiers such as BirdNET have the capability to process long recordings quickly, but are not as accurate as human observers for specific species identifications. Overall, passive acoustic monitoring, especially in combination with other automated systems such as UAVs, hold significant promise for monitoring biodiversity recovery.

CONSERVING SEED OF MOUNT CIREMAI'S NATIVE TREE SPECIES IN THE INDONESIAN SEED BANK, INDONESIA: CURRENT STATUS OF THE COLLECTIONS

Indriani Ekasari[1]*, Ade Yusup Yuswandi[2], Dian Latifah[3], Yayan Wahyu Candra Kusuma[1], Hendra Helmanto[1], Aulia Hasan Widjaya[2], Rizmoon Nurul Zulkarnaen[1], Iin Pertiwi A. Husaini[3], Kate Hardwick[4]

[1]Research Center of Ecology and Ethnobiology- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[2] Directorate of Scientific Collection Management- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[3]Research Center of Applied Botany -National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[4]Millennium Seed Bank Partnership- Royal Botanic Gardens Kew, Ardingly, Haywards Heath, Sussex, RH17 6TN, United Kingdom

*e-mail: indriani.ekasari@brin.go.id

Abstract:

Mount Ciremai's biodiversity is representative of the much-diminished montane forests of Java, Indonesia. Fires, poaching, and illegal farming currently pose serious threats to this biodiversity, necessitating stringent conservation efforts. Seed conservation is an effective method for preserving biodiversity, providing a long-term security backup for plant species and their genetic diversity. However, seed storage behaviour varies between species. For 'orthodox' species, reducing the temperature to -20°C and humidity to 15% equilibrium Relative Humidity can ensure that a significant proportion of seeds remain viable during storage for timely regeneration after decades or even hundreds of years. In contrast, 'recalcitrant' species cannot survive such storage conditions. They will require alternative ex-situ conservation methods, such as cryopreservation and planting in botanic gardens. More research is required to determine the seed storage behaviour of the tree species on Mount Ciremai. This project aimed to collect seeds from known orthodox native ecosystem species of Mount Ciremai and its surroundings and store them in the Indonesian seed bank. A total of 888,673 seeds, representing 96 species, were successfully collected and deposited in the seed bank, from 2022 to 2023. The seeds were collected from Kuningan, Majalengka, Mount Sawal, Mount Subang, and Mount Tampomas : 28, 29, 10, 17, and 17 species, respectively. The number of seeds, collected per species, ranged from 49 to 110000, with *Ficus benjamina* having the largest number. Species identification has been a challenge, with only 64 species from 33 families identified so far. Twenty-seven genera from 5 families still await identification at the species level. To address this issue, a follow-on project, the Global Tree Seed Bank: Unlocked, will produce an identification guide to the tree flora of Mount Ciremai, including data on the species' ecology and fruiting phenology. This project was part of Garfield Weston Phase 3 and will be continued under Phase 4.

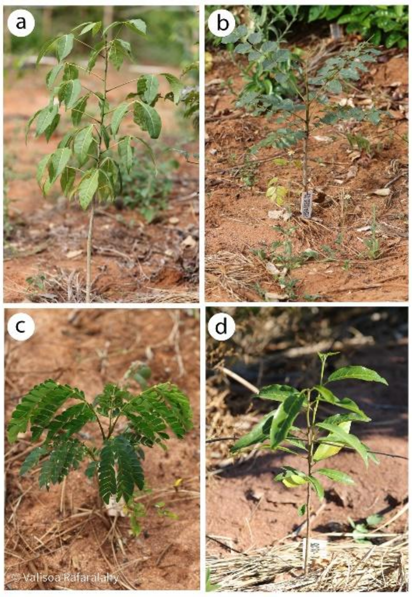
Keywords: Bogor Seed Bank, Mount Ciremai, seed collections.

DEVELOPING THE FRAMEWORK SPECIES APPROACH FOR DRY FOREST IN MADAGASCAR

Vonona Randrianasolo, Valisoa Rafaralahy
[1]Millennium Seed Bank, Royal Botanic Gardens, Kew
*e-mail: v.randrianasolo@kew.org; r.louisicael2@kew.org

Abstract :

Developing a Framework Species approach, to restore dry forest in Madagascar, introduces an innovative strategy, aimed at restoring and conserving some of the most unique forest ecosystems found in Madagascar. Central to this approach is the careful selection and planting of "framework species", capable of promoting natural regeneration and enhancing biodiversity. Madagascar's dry forests face significant challenges, including unique soil conditions, primarily sandy soils, drought, low regeneration capacity, slow plant growth and frequent fires. These factors highlight the importance of the framework species approach for successful restoration efforts. This methodology focuses on identifying native, early successional species alongside late successional species, highlighting the careful integration of both and the planting of a substantial number of each in a single step. Furthermore, our research will deepen the understanding of root-system ecology in our study site. Our presentation will emphasize the need to integrate ecological expertise with community engagement, to ensure sustainability of restoration initiatives. By enhancing biodiversity and resilience within Madagascar's dry forests, this approach will not only contribute to global conservation efforts, but also strengthen ecological vitality, ultimately securing a sustainable future for Madagascar's extraordinary biodiversity and the people who live amongst it.



Framework species

Local Community Nurseries

DIRECT SEEDING – AN EFFECTIVE ALTERNATIVE TO TREE PLANTING?

Dia Panitnard Shannon*, Khuanphirom Naruangsri, Panya Waiboonya, Hathai Sangsupan, Pimonrat Tiansawat, and Stephen Elliott

Forest Restoration Research Unit, Biology Department, Science Faculty, Chiang Mai University, Thailand 50200

*p.dia.shannon@gmail.com

Abstract:

Direct seeding has emerged as a promising alternative to traditional tree planting methods. This approach offers several potential benefits, including cost-effectiveness, scalability, and enhanced ecological compatibility. However, the success of direct seeding is often hindered by issues such as seed predation, low germination rates and poor seedling establishment, all of which are exacerbated by the typically harsh environmental conditions of restoration sites. This review synthesizes key findings from research in Thailand to offer a comprehensive guide for maximizing direct-seeding success. We tested 74 species across various forest ecosystems in both northern and southern regions, to develop broader guidelines for practitioners. It provides practical insights into seed selection, site preparation, timing, sowing techniques and post-sowing management, focusing on strategies to overcome common challenges. Addressing these issues can significantly enhance the effectiveness of direct seeding and promote the restoration of diverse, resilient forest ecosystems. Direct seeding can be up to 50% more cost-effective than conventional tree planting methods, significantly reducing overall costs, whilst achieving comparable or improved restoration outcomes. Additionally, the use of drone technology for aerial seed delivery can facilitate the large-scale application of direct seeding, thus potentially improving the efficiency in forest restoration efforts. Whilst direct seeding shows great promise, its long-term feasibility and effectiveness in the face of future climate unpredictability will require ongoing research and adaptation, to ensure continued success in diverse and changing environmental conditions.

ELMINA URBAN BIODIVERSITY CORRIDOR: A MALAYSIAN CASE STUDY URBAN ECOLOGICAL RESTORATION

Afzaa Abdul Aziz, Dzaeman Dzulkifli, Syed Danial Syed Abu Bakar, Intan Syafiqah Mohd Hamezan, Nur Syahaiza Ahmad Zamri, Akmal Hisham, Adleen Abdullah.
[1]Tropical Rainforest Conservation & Research Centre, Malaysia

*e-mail: ask@trcrc.org

Abstract:

Forest fragmentation due to rapid urban expansion been on the rise in the greater Klang Valley region, Malaysia. In this paper, we present baseline results of flora and fauna studies carried out by the Tropical Rainforest Conservation and Research Centre (TRCRC) at the Elmina township that neighbors a forest reserve. Furthermore, we present preliminary plans to connect and restore ecological connectivity, showcasing the need to integrate these fragments by urban planning and the adoption of biodiversity focused development. As a result of these preliminary findings, TRCRC, along with Sime Darby Property (SDP), developed strategies and are embarking on extending the fragmented habitat into an integrated 300-acre Elmina Central Park. The restoration strategies will inform and integrate habitat connectivity and ecological restoration plans for future development. By using native species, and by focusing on rare and endangered species, we aim to achieve multiple, national, biodiversity targets as well as Sime Darby Property's sustainability pledges. This collaborative effort, between a non-governmental environmental organization and a real estate player, to restore the ecological functions to townships, also demonstrates the growing importance of strong partnerships in bringing back (rewilding) urban biodiversity into spaces where communities thrive.

Afzaa Aziz is a Project Manager, based in Elmina Rainforest Knowledge Centre. She is responsible for activating public-outreach programs and managing the *ex-situ* Elmina Living Collection Nursery of endangered, native, rainforest, tree species in Selangor. She is involved in stakeholder and community engagement and in biodiversity and conservation management. She holds a Master's Degree in Sustainable Cities from King's College London and a Bachelor's Degree in Development Studies & Economics from SOAS, University of London. She became actively dedicated to tropical rainforest conservation and community-led conservation after a stint at Osa Conservation, Costa Rica.

EXAMINING HOW FUNCTIONAL TRAITS OF NINE NATIVE DECIDUOUS TREE SPECIES IMPACT SEEDLING SURVIVAL IN RESTORATION PLOTS

Rattanamon Aisow* and Dia Panitnard Shannon

Forest Restoration Research Unit, Biology Department, Science Faculty, Chiang Mai University, Thailand 50200

*somrattanamon@gmail.com

Abstract:

Forest ecosystem restoration in Thailand faces challenges due to the El Niño weather pattern, which has led to reduced rainfall and drought, which negatively impacts seedling survival after planting out on exposed deforested sites. Studying plant functional traits, under extreme conditions, is crucial for selecting suitable tree species for future restoration efforts. The objective of this study is to explore the relationships between functional traits and seedling survival of nine deciduous tree species in one-year-old restoration plots in Nan Province. These species include *Afzelia xylocarpa*, *Bombax ceiba*, *Careya arborea*, *Chukrasia tabularis*, *Gmelina arborea*, *Irvingia malayana*, *Oroxylum indicum*, *Phyllanthus emblica*, and *Spondias pinnata*. Five seedlings of each species were selected from the nursery for measuring 13 key functional traits: leaf mass fraction (LMF), leaf area (LA), leaf area ratio (LAR), leaf dry-matter content (LDMC), specific leaf area (SLA), stem dry-matter content (SDMC), stem density (SD), root length per unit leaf area (RLLA), root length per unit plant mass (RLPM), root dry-matter content (RDMC), specific root length (SRL), root length (RL), and root: shoot ratio (RS). Plant functional traits were not significantly correlated with survival rates. However, the species were classified into four groups based on their traits and survival for further analysis. Species with higher field survival rates tended to exhibit higher root-to-shoot ratios, longer roots, and greater specific root length. These traits improved the ability of planted seedlings to compete for water and other essential resources. These findings suggest that while functional traits offer valuable insights, successful forest restoration efforts will also need to integrate considerations of seedling quality, seed sourcing, planting techniques and post-planting maintenance to address future challenges effectively.

FOREST STRUCTURE AND CARBON STOCK ASSESSMENT IN REMNANT FOREST AND 8-YEARS-OLD RESTORED FOREST AT BAN BOON CHAEM, PHRAE PROVINCE

Thanakorn Lattirasuvan,[1,*] Supalak Siri[2]

[1]Forest Management Program, The Established Project of College of Forestry, Maejo University, Phrae Campus, Phrae 54140, Thailand
[2]Forestry Program, The Established Project of College of Forestry, Maejo University, Phrae Campus, Phrae 54140, Thailand
*e-mail: formanmju@gmail.com

Abstract:

Carbon stocks in remnant old-growth forests and an 8-year-old restored forest in Ban Boon Jam, Nam Lao Subdistrict, Rong Kwang District, Phrae Province were compared. Three 40 x 40 meter plots were established in the remnant forest, and five in the restored forest, with an additional 10 x 40 meter plot in each area for forest structure analysis. The biomass of restored was 34.63 tons per rai (216.45 tons per hectare) and stores carbon at 16.27 tons per rai (101.72 tons per hectare), whilst biomass of remnant forest was 65.09 tons per rai (406.78 tons per hectare), with carbon storage being 30.59 tons per rai (191.17 tons per hectare). Carbon sequestration was determined by the number and size of trees. The remnant forest comprised 23 species, 22 genera, and 13 families, with a species diversity index of 2.84 for trees. Saplings comprised 11 species, 11 genera, and 10 families, with a species diversity index of 2.08 and seedlings comprised 11 species, 10 genera, and 7 families, with a species diversity index of 2.25. In the restored forest, 14 species, 14 genera, and 8 families of trees were found, with a species diversity index of 2.76, while seedlings consisted of 3 species, 3 genera, and 3 families, with a species diversity index of 0.94. Although carbon stock in the restored forest is increasing, it was estimated that it will take about 16 years to reach levels similar to those of the remnant forest.

Keywords: Carbon stock, Biomass, Forest restoration, Remnant forest

LEVERAGING DIGITAL PLATFORMS FOR FOREST RESTORATION AND SUPPLY CHAIN SUSTAINABILITY

Nur Bahar,[1] Satrio Wicaksono,[2] Annisa Satwika Lestari[3,]

[1]Forest House Sdn Bhd, Malaysia
[2]IUCN Asia, Thailand
[3]Restor, Indonesia
*e-mail: nur.abdulbahar@gmail.com

Abstract:

This review analyzes key online and geospatial platforms that facilitate the integration of forest restoration initiatives with funding mechanisms and supply chain connections. We employ a qualitative analysis based on platform features, case studies, and interviews to identify critical success factors and recommend strategies to enhance their effectiveness in driving large-scale forest restoration and mitigating deforestation risks.

Online platforms like Restor, Acorn, CARBEXX and explorer.land, among others, play a pivotal role in mobilizing financial resources, facilitating carbon biomass estimation, and promoting sustainable sourcing practices within supply chains. The key success factors include user-friendly interfaces, robust data integration capabilities, and strong partnerships with multi-stakeholders. Recommended strategies to enhance platform effectiveness include: (1) expanding platform functionalities to support a wider range of restoration activities; (2) developing incentives for platform adoption and use; and (3) fostering collaboration among platforms to create a more interconnected ecosystem for forest restoration.

Figure 1. List of forest restoration and conservation sites in Southeast Asian region as showcased in the Restor platform (https://restor.eco/sites)

MONTANE FORESTS IN MOUNT CIREMAI ARE BETTER ECOSYSTEM REFERENCE FOR RESTORATION

Yayan Wahyu Candra Kusuma[1]*, Rizmoon Nurul Zulkarnain[1], Indriani Ekasari[1], Dian Latifah[2], Hendra Helmanto[1], Ade Yusup Yuswandi[3], Aulia Hasan Widjaya[2], Kate Hardwick[4]

[1]Research Center for Ecology and Ethnobiology- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[2]Research Center for Applied Botany -National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[3]Directorate of Scientific Collection Management- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[5]Millenium Seed Bank Partnership-Royal Botanic Gardens Kew, Ardingly, Haywards Heath, Sussex, RH17 6TN, United Kingdom
*e-mail: yaya022@brin.go.id

Abstract:

Montane forest ecosystem supports high species richness and species diversity provide various ecosystem services that benefit the surrounding areas. Habitat degradation could negatively affect the ecological function of the montane forest and impair such services. Mount Ciremai National Park, West Java, Indonesia has experienced multiple forest fires in the recent past damaging several areas in the northern part of the mountain, which would benefit from habitat restoration to restore biodiversity and ecosystem services. Nearby intact old growth vegetation is an important resource for ecosystem restoration, serving as a reference ecosystem and seed source. In order to determine the best reference ecosystem for restoration within Mt. Ciremai National Park, we assessed tree species composition in several areas on Mt. Ciremai and on nearby mountains, Mt. Sawal and Mt. Tampomas, as part of Phase 3 of the Global Tree Seed Bank project, funded by the Garfield Weston Foundation. Based on our rapid assessment using 20 x 20 m plots (dbh of 10 cm up and 20 cm up) in the three mountains, 30 purposively selected plots were placed. We found a total of 59 families, 109 genera and 172 tree species, with 53 families, 90 genera and 139 tree species for dbh 10 cm up and 26 families, 39 genera and 45 tree species for dbh 20 cm up. We found that forest on the Kuningan side of Mt. Ciremai holds the highest number of families, genera, and tree species with dbh 10 cm up, accounting for 64%, 61%, and 50% respectively of the totals found in the two mountains combined. The Majalengka side of Mt. Ciremai had the second highest species richness, followed by Mt. Sawal. For the dbh 20 cm up, the number of families, genera and species in Mt. Ciremai are also higher than Mt. Tampomas. Mt. Ciremai also had the highest proportion of climax species, indicating that it was the least degraded ecosystem. Our results indicate that several areas of remnant vegetation on Mt. Ciremai are less degraded and more representative of the natural montane forest ecosystem than nearby mountain areas. Therefore, it is recommended that the remaining areas of forest on Mt. Ciremai serve as the reference ecosystem for restoring the montane forest in Mt. Ciremai National Park, and are prioritized for seed collecting. Analysis of the reference forest ecosystem will be continued under Phase 4 of the project – the Global Tree Seed Bank: Unlocked.

Figure 1.
Vegetation analysis in Mt Sawal (left) and Mt Ciremai, Kuningan (right).

Figure 2. Summary of family, genera, and tree species with dbh 10 cm up found in the two mountains.

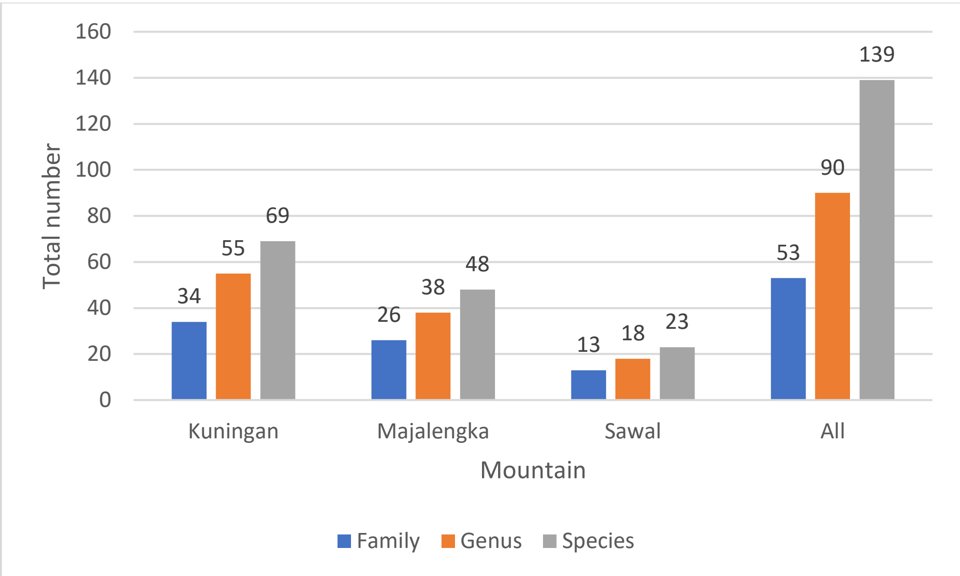
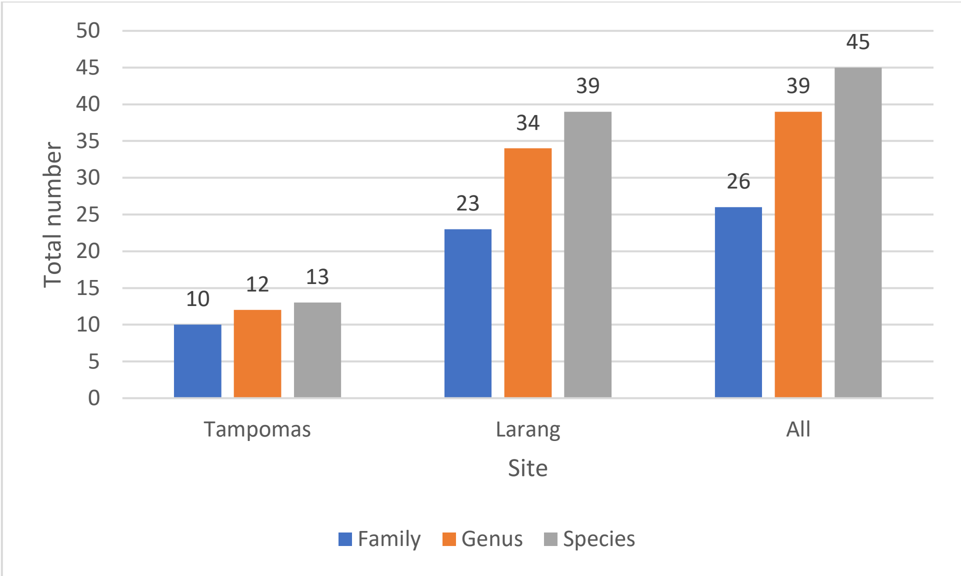


Figure 3. Summary of family, genera, and tree species with dbh 20 cm up found in the two mountains.



MULTI-SPECTRAL UAVS FOR SEASONAL NDVI ASSESSMENT IN FOREST RESTORATION PLOTS

Worayut Takaew[1], Stephen Elliott[2], Watit Khokthong[3]

[1] Doctor of Philosophy Program of Science Program in Environmental Science, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand

[2] Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand

[3] Forrest Restoration Research Unit, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand

Abstract:

The application of UAVs (Unmanned Aerial Vehicles) for forest surveys can significantly reduce time, budget, and labor requirements. The decreasing cost of UAV technology has made it more accessible to researchers for various projects. Multi-spectral drones are particularly useful for collecting forest data and calculating NDVI (Normalized Difference Vegetation Index), which provides a preliminary assessment of forest health. Such drones enable ground teams to work more precisely and efficiently by identifying key differences in forest conditions. This study used drone-acquired multi-spectral imagery to compare the NDVI of non-planted control plots with those of restoration plots ranging in age from 12 to 24 years old in a restoration chrono-sequence established by Chiang Mai University" Forest Restoration Research Unit (FORRU-CMU) in the upper Mae Sa Valley, northern Thailand. The assessment compared NDVI's between the dry and wet seasons of 2024 (in April and July respectively). The non-planted control plot had the lowest average NDVI values in both seasons—0.780 in April and 0.876 in July. All restoration plots exhibited higher NDVIs. Even the lowest NDVI of the restoration plots, for example, the 2010 plot (14 years old, 0.9 ha.) had an NDVI of 0.784 in the dry season, and the 2012 plot (12 years old, 1.3 ha.) had an NDVI of 0.882 ±0.033 in the rainy season, both still marginally outperforming the control plot during two seasons. The top three plots with the highest NDVI values in the dry season were Plot 2001 1-8 (23 years old, 1.7 ha.), Plot 1997.2 (24 years old, 0.4 ha), and Plot 2012 (12 years old,1.3 ha.), with values of 0.871, 0.866, and 0.849, respectively. During the rainy season, the highest NDVI values were recorded in Plot 2011(13 years old,0.7 ha.), Plot 2007 WWF (17 years old, 2.1 ha.), and Plot 2010 (14 years old, 0.9 ha.), with values of 0.894, 0.892 and 0.892, respectively. When using multispectral drones to generate NDVI values, it is essential to account for seasonal variations, plot size and fluctuating solar light conditions, as these environmental factors cannot be controlled in the natural environment. Consistent data collection times and proper calibration can help mitigate the effects of these variables.

Rejuvenating Tree Structure in Relation to LiDAR-Detected Structural Complexity in Aging Agricultural Landscapes

Waiprach Suwannarat[1], Chichaya Osothsomboon[2],Wachiraya Thongprapai [2], Worayut Takeaw[3], Dia Shannon[3,4], Watit Khokthong[3,4,*]
[1]Master of Science Program in Environmental Science, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[2]Chiang Mai University Demonstration School, Chiang Mai, Thailand
[3]Environmental Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[4]Forrest Restoration Research Unit, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
*e-mail: watit.khokthong@cmu.ac.th

Abstract:
Intensive monoculture plantations, such as oil palm (*Elaeis guineensis*), support low biodiversity even after abandonment. Abandoned plantations typically become covered with shrubs and tree saplings, including both native and invasive species, that can tolerate partial shade or small openings. Whilst working oil palm plantations are generally homogeneous, abandoned ones tend to develop higher structural complexity, due to the proliferation of native and non-native species. When planning forest ecosystem restoration on such sites, the extent to which natural regeneration contributes to the recovery of structural complexity and habitat diversity for biodiversity recovery should be considered. Therefore, we are evaluating the impact of natural forest regeneration on the recovery of forest structural complexity, when planning forest ecosystem restoration within an abandoned oil palm plantation in Chiang Mai University "Hariphunchai" Centre, Lamphun, Thailand. The palm trees were planted in 2005, and the plantation was abandoned in 2011. We are collecting terrestrial LiDAR scanning data from 184 scanning points (115 points/hectare) within the abandoned plantation, and 59 points (61 points/hectare) from an oil palm plantation, still being worked. At each scanning point, the LiDAR point clouds are categorized into two layers: 1) the oil palm canopy and 2) below the oil palm canopy, including natural tree regeneration. We are using "vegetation area index" (VAI), as an indicator of structural complexity, describing stand total surface area of vegetation per unit of ground area. We hypothesize that VAI will be greater in abandoned plantations, compared with working plantations. While assisted natural regeneration is often a preferred method, to restore natural forest ecosystems, tree planting may be employed to complement it, particularly to accelerate biodiversity recovery. Our results will show the extent to which tree and shrub regeneration below the oil palm canopy promote rapid recovery of structural complexity and thus reduce the need to plant trees, to bring about full forest ecosystem restoration.

RESEARCH FOR RESTORING THAILAND'S TROPICAL FOREST ECOSYSTEMS – 30 YEARS OF PROGRESS

Stephen Elliott,* Sutthathorn Chairuangsri, Dia Shannon, Pimonrat Tiansawat, Watit Khokthong, Prasit Wangpakapattanawong
Forest Restoration Research Unit, Biology Department, Science Faculty, Chiang Mai University, Thailand
* e-mail: stephen_elliott1@yahoo.com

Abstract:

Thirty years ago, many conservationists regarded the restoration of tropical forest ecosystems as technically unfeasible and a distraction from the imperative of protecting remaining primary forests. Since 1994, Chiang Mai University's Forest Restoration Research Unit (FORRU-CMU) has challenged this view, by studying natural forest-regeneration mechanisms, identifying optimal seed-collection times, developing cost-effective planting-stock production methods, evaluating the field performance of hundreds of indigenous tree species and monitoring subsequent carbon accumulation and biodiversity recovery. The results were used to refine the Framework Species Method (FWM) of forest restoration, by identifying tree species, typical of the reference forest, which, when planted on exposed deforested sites, have high survival and growth rates, suppress weed growth and attract seed-dispersing animals. Up to 30 such tree species are planted, 1.8 m apart, to complement natural forest regeneration, followed by weeding and fertilizer application for at least 2 years. This method can restore forest biomass, structural complexity, biodiversity and ecological functionality to levels typical of the reference forest in 20-30 years, provided mature natural forest and viable populations of seed-dispersing animals remain in the surrounding landscape. The unit is now investigating the feasibility of using drones and other modern technologies to improve the practicability of deploying the FSM on a wide scale. FORRU-CMU also disseminates science-based practical advice to a wide range of restoration stakeholders via its outreach program. The FSM is now practiced in at least 12 countries and is contributing to global forest-restoration initiatives to tackle climate change and biodiversity loss. Highlights from the unit's 30 years of scientific research will be presented.

Left: Former evergreen forest-land in the upper Mae Sa Valley in 2000. The bamboo sticks mark the planting spots for framework tree species, amidst scattered naturally regenerating trees. Right: 20 years later, the biomass, structural complexity, biodiversity and ecological functionality of the restored forest approaches those of the reference forest.

RESPONSE OF SOIL MYCOBIOME IN YOUNG FOREST RESTORATION PLOTS, NORTHERN THAILAND

Chakriya Sansupa[1,2,*], Jutatip Jainuan[3,4], Dia Shannon[4,5], Terd Disayathanoowat[2,6]

[1]Siriraj Center of Research Excellence in Metabolomics and Systems Biology (SiCORE-MSB), Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand
[2]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[3]The Next Forest Company Limited, Chiang Mai 50200, Thailand
[4]Forest Restoration Research Unit, Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[5]Environmental Science Research Centre, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
[6]Research Center of Deep Technology in Beekeeping and Bee Products for Sustainable Development Goals (SMART BEE SDGs), Chiang Mai University, Chiang Mai 50200, Thailand

*e-mail: Chakriya.sansupa@gmail.com

Abstract:

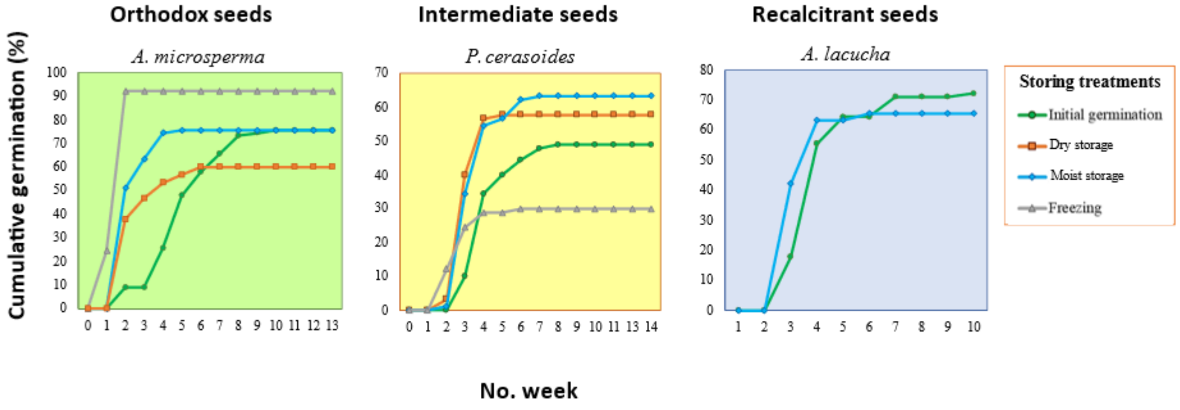
Biodiversity recovery, during forest restoration projects in Northern Thailand, is usually assessed as recovery of flora and fauna. Recovery of soil microorganisms, which can greatly influence restoration outcomes, is less well studied. In Nan Province, northern Thailand, the framework species method, both full planting and applied nucleation, was used, to restore indigenous forest ecosystems on abandoned agricultural fields. The “applied nucleation” approach was adopted, by planting a mix of framework tree species in square patches of two different sizes: 10 x 10m and 15 x 15m. Soil samples were collected from the restoration sites (3 years after planting), nearby reference forests, maize fields and non-planted control plots. Differences in soil fungal diversity, community composition, and taxonomic abundance among the different study sites were assessed, using amplicon sequencing methods. Differences in the fungal community between control plots and those subjected to different restoration techniques were insignificant ($p<0.05$). However, the community composition in the restoration plots differed from that of the maize field, showing a shift toward that of the reference forest, but still remaining distinct ($p<0.05$). Basidiomycota, a common prevalent taxon in forest soil, was the most abundant taxa in the referent forest, whereas Ascomycota dominated the other plots. Some taxa, such as *Cyphellophora* and *Fusarium*, which were abundant in the maize field, were also prevalent in the restoration plots. Notably, more Basidiomycota, particularly ectomycorrhizal fungi (*Russula, Sebacina,* and *Clavulina*), were found in the restoration plots than in the maize field. These taxa may have been introduced into the restoration plots on the roots of the planted trees. Further studies in older restoration plots are needed to clarify the response of different restoration techniques.

SEED STORAGE BEHAVIOR OF FOURTEEN INDIGENOUS FOREST TREE SPECIES OF NORTHERN THAILAND

Khuanphirom Naruangsri,* Wasu Pathom-aree, Stephen Elliott, Pimonrat Tiansawat
Department of Biology, Faculty of Science, Chiang Mai University, 239 Huaykeaw Road, Mueang District, Chiang Mai, Thailand, 50200
* aom.khuan@gmail.com

Abstract:

Seed storage of native tree species is an essential procedure for forest restoration by direct seeding or aerial seed delivery, and for seedling production for conventional tree planting. Knowledge of seed-storage behavior (orthodox, intermediate or recalcitrant) is key to deciding suitable storage conditions. Consequently, the research reported here determined seed-storage behavior of fourteen indigenous forest tree species, used to restore upland forest ecosystems in northern Thailand. Germinability was compared among seeds subjected to various desiccation treatments and baseline data (fresh seed, no desiccation treatments). The results were used to categorize the seeds as orthodox, intermediate or recalcitrant. Seeds of nine of the species were classified as orthodox (able to withstand freezing at -20°C with 5%MC) including *Cassia bakeriana, Acrocarpus fraxinifolius, Adenanthera microsperma, Phyllanthus emblica, Prunus cerasoides, Sapindus rarak, Gmelina arborea, Choerospondias axillaris* and *Diospyros glandulosa.* Seeds of three species were classified as intermediate (able to survive desiccation, but sensitive to low temperature): *Magnolia baillonii*, *Alangium kurzii* and *Balakata baccata*. Both orthodox and intermediate seeds can maintain viability when stored under appropriate conditions, before being used for seed-based forest restoration procedures. However, seeds of two species; *Syzygium fruticosum* and *Artocarpus lacucha* were classified as recalcitrant (they are killed by drying and freezing). Such species cannot be stored in a freezer. Therefore, the seeds of such species must be sown immediately after seed collection. Inclusion of such tree species in forest restoration projects can be done either by direct sowing them immediately after seed collection (provided they fruit at the start of the rainy season) or by growing saplings in nurseries and planting them out at the start of the subsequent rainy season.



The figure shows an example of cumulative percent germination of species in response to various seed moisture contents and storage conditions.

GERMINATION AND SEEDLING SURVVIAL OF CANDIDATE FRAMEWORK TREE SPECIES FOR RESTORATION RESEARCH AT KUNINGAN BOTANICAL GARDENS

Aulia Hasan Widjaya[1]*, Rizmoon Nurul Zulkarnaen[2], Indriani Ekasari[2], Dedi Kurniawan[3], Sumarno[3], Doni Nurpriatna[3], Ramdani[3], Rizal Rusdiantoro[3], Epi Hadipratiwi[3], Hendra Helmanto[2], Dian Latifah[1], Yayan Wahyu Candra Kusuma[2], Putri Kesuma Wardhani[1], Ade Yusup Yuswandi[4], Kate Hardwick[5], Sri Ulie Rahmawati[6]

[1]Research Center for Applied Botany -National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[2]Research Center for Ecology and Ethnobiology- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[3]Kuningan Botanical Garden- Environmental Service of Kuningan Regency, Padabeunghar, Pasawahan, Kuningan Regency, West Java, Indonesia
[4]Directorate of Scientific Collection Management- National Research and Innovation Agency Republic of Indonesia. Jl. Raya Jakarta-Bogor Km.46, Cibinong, Bogor 16911, West Java, Indonesia.
[5]Millennium Seed Bank Partnership-Royal Botanic Gardens Kew, Ardingly, Haywards Heath, Sussex, RH17 6TN, United Kingdom
[6]Freelance Researcher
*e-mail: auli001@brin.go.id

Abstract:

Research on preparing planting stock to test the effectiveness framework species method for restoring lower montane forest was performed at Lambosir KUningan West Java, as part of the Garfield Weston Project, Phase 3 and will be continued under Phase 4. Under Phase 3, seeds of 100 tree species were collected and banked at the National Seed Bank, under the National Research and Innovation Agency (BRIN). They will also be utilized as seed sources for restoration research. Seeds and wildings were collected in Mount Ciremai National Park (MCNP) and surrounding areas to candidate framework tree species i.e. those likely to promote forest-ecosystem restoration on the degraded lands with a long-history of wild fires. Both seeds and wildings of selected species were collected in the field from 2021 to 2022 in MCNP and its surroundings. Seeds were processed and germinated and seedlings/wildings were grown on for restoration research at Kuningan Botanical Garden (KBG), near Mount Ciremai National Park (MCNP). A total of 25 species and 2160 individual seedlings were recorded and maintained for planting in the restoration-research plots in Lambosir Kuningan. Initial experiments in the KBG nursery revealed highest seed germination was attained by *Dracontomelon dao* (70%), *Kibara coriacea* (88%) and *Ficus* sp DL 317 (100%). The highest number of seedlings produced per species were; *Dipterocarpus retusus* (450 individuals), *Syzygium lineatum* (369 individuals) and *Pinanga javana* (243 individuals) are the three species having the highest number of seedlings. These three species are native to Java. Furthermore, *Dipterocarpus retusus* is categorized as an endangered species on the IUCN RedList.

Keywords: Germination, restoration, seedlings, mount ciremai,

Figure 1.
Seedlings maintained under shade in Kuningan Botanical Garden nursery in 2024 (left) and seedlings acclimated in open area, 2023 (right).

THE EFFECTS OF SEED STORAGE CONDITIONS ON THE GERMINATION PERFORMANCE OF NATIVE TREE SPECIES IN NORTHERN THAILAND

Kunnaree Pakkad* and Dia Panitnard Shannon

Environmental Science Research Center (ESRC), Forest Restoration Research Unit, Biology Department, Science Faculty, Chiang Mai University, Thailand 50200

*kunnaree_pakkad@cmu.ac.th

Abstract:

Effective seed storage is crucial for maintaining seed viability and ensuring successful germination, which are key factors in the success of forest restoration projects, especially for native tree species in northern Thailand. This study assessed optimal seed storage conditions, and the impact of seed moisture content and relative humidity on germination of seven framework tree species in Northern Thailand, including *Adenanthera pavonina* L., *Ceiba pentandra* (L.) Gaertn, *Antidesma bunius* (L.) Spreng, *Walsura trichostemon* Miq., *Diospyros coaetanea* Flet., *Mesua ferrea*, and *Vitex limonifolia* Wall. ex C.B. Clarke. Seeds were sown after applying species-specific pretreatment to assess their viability, then divided into two groups for storage at room temperature and at 4°C in a refrigerator. Moisture content was measured before and after storage, using the standard oven method, and results were compared with relative humidity measurements obtained from a hygrometer. In general, there were no significant differences in mean germination percentages between seeds stored at room temperature and those stored at 4°C were not statistically significant. However, three species—*Walsura trichostemon*, *Diospyros coaetanea*, and *Mesua ferrea*—exhibited significant differences in germination percentages between these storage conditions, with the control condition consistently showing higher germination rates compared to refrigerated and room temperature conditions. The correlation coefficient between moisture content measured by the oven method and hygrometer readings was 0.814, confirming the reliability of both instruments. This study highlights the importance of optimizing seed storage conditions to improve germination success, thereby advancing forest restoration efforts and supporting biodiversity conservation.

THE GLOBAL TREE SEED BANK: UNLOCKED

Clare Callow[1]
[1]Millennium Seed Bank, Royal Botanic Gardens, Kew
*e-mail: c.callow@kew.org

Abstract:
The Global Tree Seed Bank is the largest programme of Kew’s Millennium Seed Bank. Funded by the Garfield Weston Foundation in three phases starting in 2015 and working across 41 countries and territories, the objectives of the global programme were:

- Increased *ex-situ* conservation of the world’s trees in areas of high biodiversity and high threat through collecting, banking and research
- Expanded training and technical support across all partners through provision of Seed Conservation Techniques training, seed conservation standards reviews and technical knowledge exchanges
- Improved conservation planning capability through increasing red list assessments in partner countries
- Improved restoration outcomes through nursery trials, propagation and reforestation trials and improving seed supply chains and data management

The poster will present the achievements of the global programme to date and our objectives and plans for the next phase of the programme running until the end of 2026, with FORRU-CMU being one of the main programme partners.





VEGETATION RAPID SITE ASSESMENT (RSA): PREPARATION OF RESTORATION IN MOUNT CIREMAI NATIONAL PARK

Hendra Helmanto[1]*, Aulia Hasan Widjaya[2], Indriani Ekasari[1], Yayan Wahyu Candra Kusuma[1], Rahmat Hidayat[3], Azis Abdul Kholik[3], Dian Latifah[2], Kate Hardwick[4]

[1]Research Center for Ecology and Etnobiology, National Research and Innovation Agency, Dr. (H.C) Ir. H. Soekarno Science and Technology Area, Cibinong, West Java, Indonesia.
[2]Research Center for Applied Botany, National Research and Innovation Agency. Dr. (H.C) Ir. H. Soekarno Science and Technology Area, Cibinong, West Java, Indonesia
[3]Mount Ciremai National Park, Ministry of Environment and Forestry, Jl. Raya Kuningan-Cirebon Km 9 No.1 Manislor, Kuningan, West Java, Indonesia.
[4]Millennium Seed Bank Royal Botanic Gardens, Kew, Ardingly, Haywards Heath, Sussex, RH17 6TN. United Kingdom.
*e-mail: hend017@brin.go.id

Abstract: Mount Ciremai National Park (MCNP) is forest conservation area, which provides environmental services, particularly watershed services, and opportunities for ecotourism development in West Java. Forest ecosystem restoration by the framework species method is an effective management strategy, to maintain and enhance such roles, and the overall function of the park. The method requires meticulous planning, based on initial assessments of pre-existing 3 treatments vegetation at restoration sites. Trees are planted to complement assisted natural regeneration. Therefore, knowledge of the pre-existing density of natural regeneration is essential. Here, we present the results of a rapid site assessment (RSA), to determine the extent of natural forest regeneration at a site before restoration is implemented. This assessment was performed in disturbed lower-montane forest, Lambosir, Kuningan Jawa Barat, under the Garfield Weston Project, Phase 3; restoration implementation and monitoring will be continued under Phase 4. In November 2023, in the Lambosir block of MCNP, at elevations of 800-830m asl, rectangular plots 83 m x 118 m were divided into 12 sub-plots (species), 3 treatments i.e. no extra watering, watering and no intervention (4 replications). In each sub-plot (25 m x 27 m), a rapid site assessment protocol was followed within circular plots of radius 5 m, placed in the centre of each square sub-plot. All saplings, taller than 50 cm and live tree stumps were recorded in each circle. A total of 157 natural regenerants of 26 species (comprising 20 pioneer species and 6 climax species) *Ficus hispida*, *Phyllanthus tomentosa*, *Phyllanthus emblica*, *Gmelina orborea* and other species recorded within all 12 circles combined, averaging 13.08 regenerants per circle, which corresponds to a density of 1,665 regenerants/ha. Since the recommended starting stocking density for the framework species method is 3,100/ha (average spacing 1.8 m), the conclusion from the site assessment is to prepare 1,435 saplings per hectare for planting, of 20-30 species that were not already recorded in the RSA (to increase tree diversity), in order to initiate the framework species method at this site.

Keywords: Lambosir block, Mount Ciremai National Park, rapid site assessment, restoration.

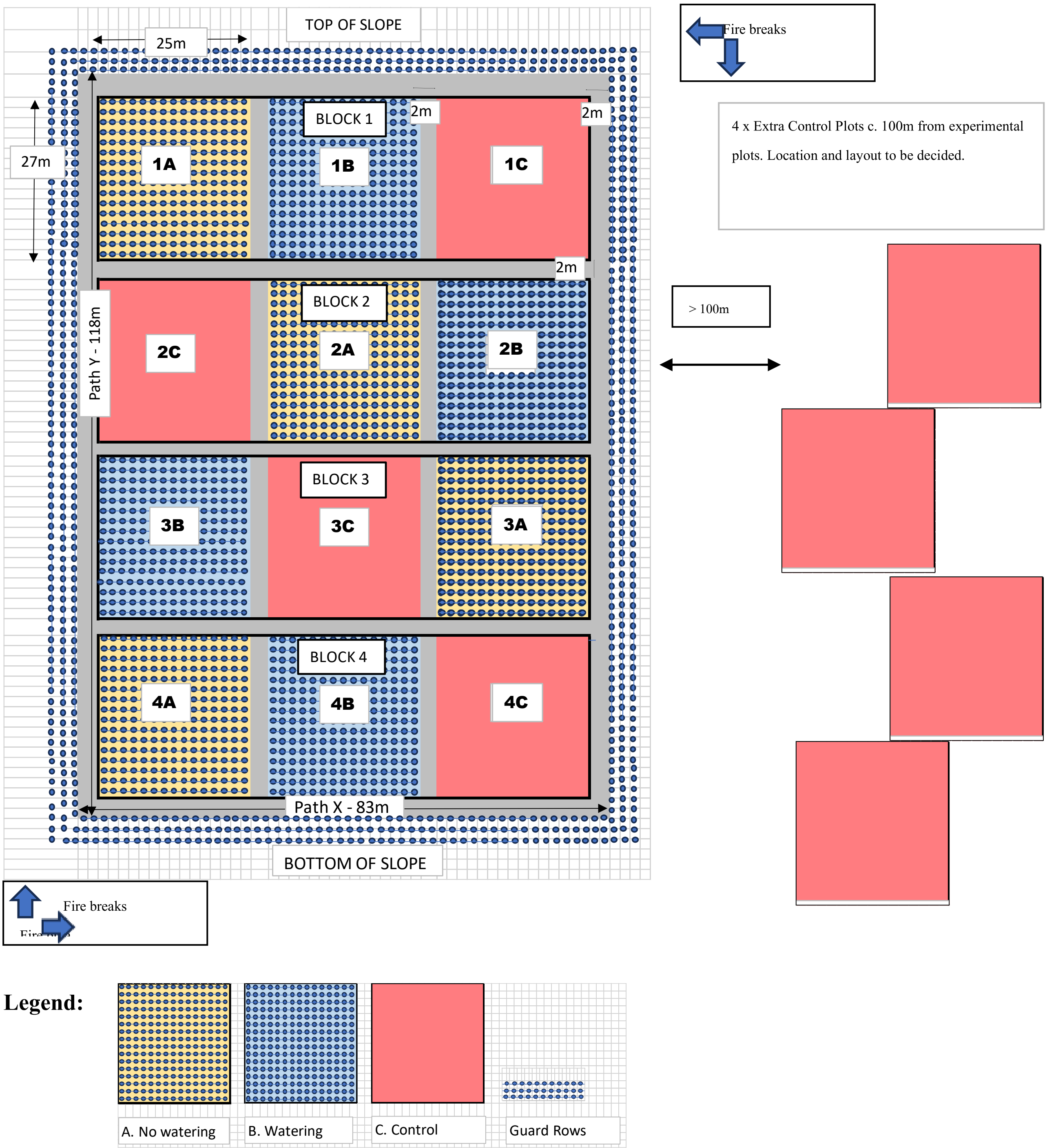


Figure 1: Planting design for trial plots. Randomised complete block design with 4 blocks and 12 plots in total. Blocks are arranged from Block 1 at top of slope near the road to Block 4 at the bottom of the slope. Each block includes three 25 x 27 m plots, each with 1 treatment plot: A) Planting + No Extra Watering (only when planted) + Weeding; B) Planting + Watering (frequency of watering to be decided) + Weeding; C) Control = No intervention (No planting, no watering, no weeding). Guard Rows three seedlings wide, using spare seedlings, are planted around the edge of the Trial Plots. Fire Breaks should be cut around the outside of the Guard Rows. Four ‘Extra Control’ plots to be established at least 100 m from the main trial plots, to provide long-term controls, as the maturing trees in the planted plots are expected to influence the Control Plots in the Trial after a few years.

Figure 2. Restoration preparation in Mount Ciremai National Park

SP9-GENERATIVE AI: AN EMERGING AI TECHNOLOGY

INTEGRATING QR CODES WITH AI-GENERATED ART FOR ENHANCED PATIENT IDENTIFICATION AND NAVIGATION IN HEALTHCARE SETTINGS

Kornprom Pikulkaew[1,*]
[1]Department of Computer Science, Faculty of Science, Chiang Mai University, Thailand
*e-mail: kornprom.pikul@cmu.ac.th

Abstract:

In healthcare, the development of generative AI and its application across various sectors have paved the way for innovative solutions. This study aims to integrate QR codes with AI-generated art to enhance the identification of patients, particularly those suffering from Alzheimer's disease, memory loss, or elderly individuals. The QR codes, embedded within generative AI works created using Stable Diffusion, provide vital patient information that can be easily accessed through a smartphone or other devices. Making important data readily available in emergencies is a revolutionary approach that is both visually appealing and non-stigmatizing for those who require such identification methods. Additionally, this research proposes using these integrated QR codes as wearable tags for patients in ICUs or hospitals, ensuring that their details, including medical history and emergency contacts, are quickly accessible. In the future, this technology could evolve into an augmented reality (AR)-enabled device, allowing users, such as caregivers and patients, to navigate their way home virtually through Google Maps while still within a medical facility. This research, therefore, seeks to blend the aesthetic appeal of AI-generated art with the functional utility of QR codes, contributing to more humane and efficient patient care practices.

SP10-UNIVERSITY - INDUSTRY RESEARCH COLLABORATION

DEVELOPMENT AND FUTURE OF THE GLASS INDUSTRY IN THAILAND

Pitcharat Ineure
Glass Bridge Co., Ltd., Thailand
*e-mail: pitcharat.glassbridge@gmail.com

Abstract:

The future development of the glass industry in Thailand will inevitably need to align with global trends, particularly focusing on reducing environmental impact. The primary issues can be categorized as follows: High Energy Consumption, Air Pollution, Waste Management, Raw Material Use and Management, Improvement and Development of New Products.

The future of the glass industry will focus on addressing the mentioned issues. For example: Development of Energy-Efficient Technologies, technologies that reduce energy consumption and emissions of heat and greenhouse gases (CO2, NOx, SOx, CO, or Methane) are being developed. Use of Renewable and Mixed Energy, there is an increasing adoption of hybrid furnaces and electric furnaces. For instance, new electric furnaces are now capable of producing more than 200 tons per day. Process Improvements, traditionally, natural gas was used to maintain glass temperature during forming processes. Now, there is a shift towards using cleaner energy sources, such as hydrogen gas, as a replacement. Waste Management, increasing the use of recycled materials in glass production reduces reliance on new raw materials. However, challenges remain in managing fine glass residues and certain types of glass that are not yet fully recycled. Raw Material Use and Management, specialized raw materials improve melting efficiency and heat transfer, leading to reduced energy consumption and higher production capacity. Improvement and Development of New Products, advances in forming processes allow for the production of thinner, yet stronger, glass products, improving energy efficiency and cost-effectiveness. Integrating technology into production systems consolidates processes (melting, forming, quality inspection) into a single system to boost efficiency and reduce production time.

The development of Thailand's glass industry requires strategic planning and collaboration among research institutions, private enterprises, and the industry itself. Key aspects include: Product and Innovation Development, researching new materials to improve melting efficiency and developing innovative products with unique features, such as high-strength glass, UV and IR protection, and specialized glass for solar energy, construction, and automotive applications. New Techniques Development, advancing melting and production techniques to enhance competitiveness, sustainability, and flexibility in manufacturing. Skill Development and Training, establishing R&D centers and centralized research facilities to foster collaboration, transfer knowledge, and boost Thailand's global competitiveness. Integrating these strategies will help Thailand's glass industry meet global market demands, achieve sustainable growth, and reduce environmental impact.

EFFECT OF OXIDE FILMS ON NITROCARBURIZING OF ROLLED LOW CARBON STEEL

Teerapat Mungwattana[1], Nipon Taweejun[1], John Thomas Harry Pearce[2], Torranin Chairuangsri[2], Sankum Nusen[2]*

[1]Thai Tohken Thermo Co. Ltd, Chonburi 20160 Thailand
[2]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200 Thailand
*e-mail: nusen.san@gmail.com and sankum.n@cmu.ac.th

Abstract:

Nitrocarburizing is a thermochemical surface hardening treatment that involves diffusion of both nitrogen and carbon into the surface of a steel workpiece. This process is typically performed at temperatures between 500-600°C, where the steel has a ferritic matrix. During nitrocarburizing, the steel is exposed to a nitrogen-rich atmosphere, consisting of ammonia, nitrogen, and carbon-bearing gases such as propane. This results in the formation of a hard, wear-resistant layer on the surface of the steel, known as the compound layer. This layer is typically composed of iron nitrides (such as Fe_4N (gamma prime, γ′) and $Fe_{2-3}N$ (epsilon, ε) and iron carbides (e.g. Fe_3C), which are responsible for enhanced surface properties. Nitrocarburizing is commonly employed to improve the wear resistance, fatigue life, and corrosion resistance of steel components. The process finds application in various industries, including automotive, aerospace, and tooling. The presence of oxide films on the steel surface prior to nitrocarburizing can significantly influence the effectiveness of the process, and the resulting surface properties. This study investigated nitrocarburized cold-rolled steel (SPCC) and hot-rolled steel (SPHC) using a temperature of 570°C at various times between 1.5-2.5 h. The microstructure of the compound layer was analyzed by light microscopy and scanning electron microscopy and energy-dispersive X-ray spectroscopy (EDS). Before nitrocarburizing the thickness of the oxide film present on SPHC was about 5.5 µm, whereas the SPCC had no oxide films. The results showed that the thickness of the compound layer on SPCC was about 15±1 µm and about 17±2 µm on SPHC at a nitrocarburizing time of 2.5 h. There is no significant difference between the compound layer thickness, however the phase ratio of ε/γ′ of the compound layer on SPCC (3.43) was lower than that on SPHC (5.86) due to the presence of oxide film on SPHC. The depth of the porous region in the compound layer on nitrocarburized SPCC was higher than that on SPHC as shown in Figure 1.

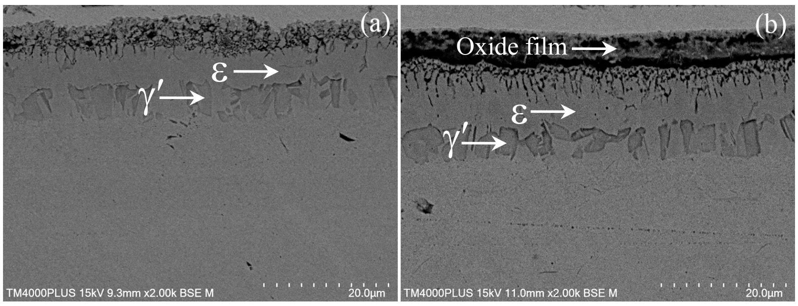


Figure 1. Backscattered electron images in SEM of the compound layer on nitrocarburized steel: (a) SPCC and (b) SPHC at temperature 570°C for 2.5 h.

IMPROVEMENT IN WEAR RESISTANCE OF HIGH CHROMIUM CAST IRONS BY MO AND W ADDITION AND HEAT TREATMENT

Kittikhun Ruangchai[1], Ruangdaj Tongsri[2], John T.H Pearce[3], Torranin Chairuangsri[3], Amporn Wiengmoon[1,*]
[1]Department of Physics, Faculty of Science, Naresuan University, Phitsanulok 65000, Thailand
[2]MTEC, National Science and Technology Development Agency (NSTDA), Pathum Thani, 12120, Thailand
[3]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
*e-mail: ampornw@nu.ac.th

Abstract:
In the present work, the microstructure, hardness, and dry-sliding wear behavior of 28wt.%Cr irons with 1wt.%(Mo/W) addition under heat treatment conditions were investigated. As-cast samples were destabilized at 1000°C for 4 hours, followed by air cooling to room temperature. The effect of prior-annealing at 800°C for 4 hours plus destabilization was also studied. Microstructure was analyzed using X-ray diffraction, optical microscopy, and scanning electron microscopy. Vickers hardness and dry-sliding wear resistance were tested. The as-cast microstructure in the 28wt.%Cr-2.3wt.%C iron showed the hypoeutectic structure, which consisted of primary austenite dendrite and eutectic M_7C_3 carbide. Mo addition promoted the formation of multiple eutectic $M_7C_3/M_{23}C_6/M_6C$ carbides, while W addition was a hypereutectic structure with primary M_7C_3 carbide. After destabilization, the transformation of austenite to martensite with secondary carbides precipitation was found in all the irons, including, the eutectic M_7C_3 carbides changed to a duplex structure. After annealing plus destabilization, the secondary carbides had a smaller size and higher area fraction. Hardness and dry-sliding wear behavior, adding Mo or W enhanced the hardness and wear resistance in the as-cast condition. After destabilization alone, it led to increased hardness and wear resistance in the R and Mo1 irons, while annealing plus destabilization reduced wear resistance. Dry-sliding wear mechanism involves plastic deformation and shallow wear grooves in the matrix including cracking of carbides. Cross-section observation clearly explains the wear mechanism in the irons.

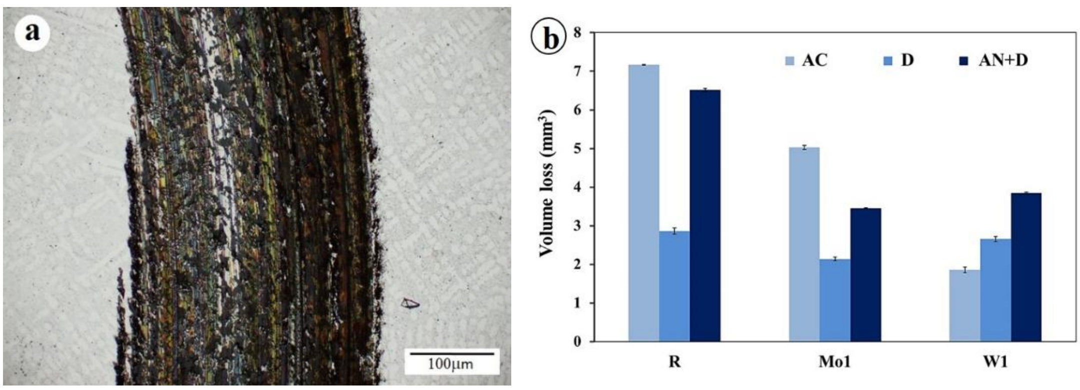


Figure 1. (a) OM micrograph shows the wear track, (b) the volume loss during pin on disc wear testing.

NOVEL COFFEE FERMENTATION PROCESS UTILIZING CO-CULTURE OF LACTIC ACID BACTERIA AND YEAST FOR ECO-FRIENDLY IN COFFEE INDUSTRY

Teerawat Ngamnok,[1,2] Sakhin Pengsuriya,[2] Jomkhwan Meerak[2,3,*]
[1]Doctor of Philosophy Program in Applied Microbiology (International Program), Faculty of Science, Chiang Mai University, under the CMU Presidential Scholarship, Chiang Mai, Thailand
[2]Department of Biology, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand
[3]Center of Excellence in Materials Science and Technology, Chiang Mai University, Chiang Mai, Thailand
*e-mail: jomjoyjon@hotmail.com

Abstract:
Health benefit coffee has been concerned by consumers due to the new generation of global wellness coffee. Special flavors and health-promoting coffees can be developed by microbial fermentation. In this study, co-culture of bacteria and yeast were used for Thai arabica coffee fermentation. *Lactiplantibacillus* spp. and selected 4 yeasts, were combined and co-cultured to digest the coffee bean by enzymatic method. Five fermentation conditions were established and examined for biological activity of fermented coffee extracts. Microbial growth and enzyme activity were monitored throughout the process. Fermented coffee beans were roasted and subjected to sensory evaluation by Quality Graders and fermented coffee expressed higher cupping scores. The combination of *Lactiplantibacillus and Saccharomyces* exhibited flavor of orange, sugarcane, and sweetness, while *Lactiplantibacillus and Yarrowia* expressed toast, sweetness, kombucha, and butter. Additionally, the biological properties of total phenolic content, antioxidant activity, and antibacterial properties, were determined. Antioxidant and total phenolic compounds of fermented coffee bean extracts were significantly higher than those of ordinary coffee and non-fermented bean. In addition, fermented coffee revealed significantly higher of anti-foodborne bacteria against *B. cereus* and *L. monocytogenes*. These findings have significant implications for the coffee industry and novel fermentation methods for the 4th generation of coffee business.

PRACTICAL GUIDE TO THE IDENTIFICATION OF M_7C_3, $M_{23}C_6$ AND M_6C CARBIDES IN AS-CAST HIGH CHROMIUM IRONS CONTAINING Mo OR W BY ELECTRON MICROSCOPY

Torranin Chairuangsri[1]*, Sutthawan Imurai[1], Sankum Nusen[1], John Thomas Harry Pearce[1] and Kenji Tsuda[2]
[1]Department of Industrial Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200 Thailand
[2]Institute for Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University, Sendai 980-8577 Japan
E-mail: torranin.c@cmu.ac.th, tchairuangsri@gmail.com

Abstract:

High chromium cast irons (HCCIs) have been widely used as wear resistant materials in the mining, minerals, and cement industries since 1930s. The wear resistance of HCCIs depends on the type, morphology, and volume fraction of carbides and their surrounding matrix. Practical identification of carbides in HCCIs is therefore important in assessing wear performance. In general, eutectic carbide in as-cast HCCIs with 28wt%Cr and a Cr/C wt% ratio about 10 is M_7C_3-type carbide. With Mo or W addition, $M_{23}C_6$-type and M_6C-type carbides can also be present in as-cast microstructures. Light microscopy images in Figure 1 show an example of M_7C_3, $M_{23}C_6$ and M_6C types of carbide in as-cast HCCIs containing Mo, which cannot be identified by morphology alone. The present work will give a practical guideline for identification of the M_7C_3-type, $M_{23}C_6$-type and M_6C-type carbides in as-cast HCCIs with 28wt%Cr and up to 10wt% addition of Mo or W by scanning electron microscopy (SEM), transmission electron microscopy (TEM) and energy-dispersive X-ray spectroscopy (EDS). M_6C-type carbide can be distinguished from other carbides using backscattered electron images in SEM together with comparing the Fe/Cr, Si/Cr, Mo/Cr or W/Cr %ratios in SEM-EDS. M_7C_3-type carbides can be distinguished from other carbides using faulting-like contrast in bright-field TEM images together with comparing the Fe/Cr, Si/Cr, Mo/Cr or W/Cr %ratios in TEM-EDS. In general, there should be some difficulty in identification of fcc $M_{23}C_6$-type and diamond cubic M_6C-type carbides by electron diffraction in TEM due to their close lattice parameters and crystal structures. Hence, a practical guideline on using electron diffraction in TEM together with simple simulation by the CaRIne Crystallography@ software for identifying $M_{23}C_6$-type and cubic M_6C-type carbides will also be discussed.

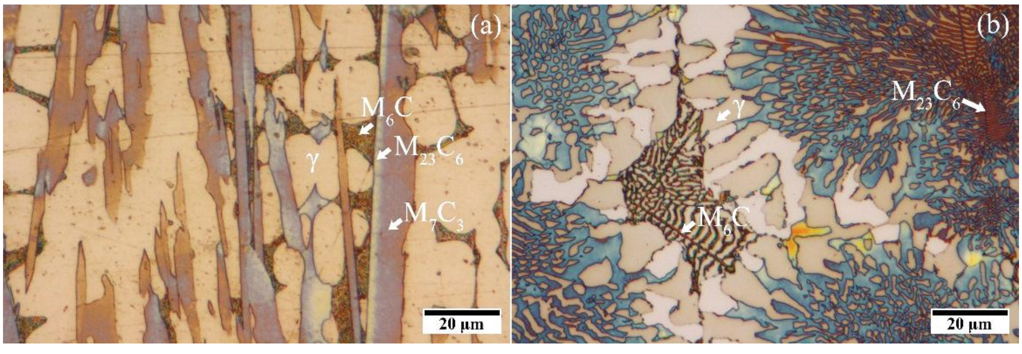


Figure 1. Light microscopy images show M_7C_3-type, $M_{23}C_6$-type and M_6C-type carbides in HCCIs containing: (a) 6 wt%Mo and (b) 10 wt%Mo.

SP11-X-RAY CRYSTALLOGRAPHY

A CHIRAL HYDROGEN-BONDED ORGANIC FRAMEWORK ASSEMBLED FROM *LANNOSTANE TRITERPENE* NATURAL PRODUCT

Jannarong Ngoensri,[1] Yupa Pootaeng-On,[2] Kanok-on Rayanil,[2] Kittipong Chainok[1,]*
[1]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Klong Luang, Pathum Thani 12121, Thailand
[2]Department of Chemistry, Faculty of Science, Silpakorn University, Nakhon Pathom 73000, Thailand
*e-mail: kc@tu.ac.th

Abstract:
We describe an interesting case of a chiral hydrogen-bonded organic framework (HOF) self-assembling *from lannostane triterpene*, a naturally occurring molecule. Hydrogen bonding and van der Waals forces establish the supramolecular framework (Figure 1), and Hirshfeld surface analysis visually assesses these interactions.

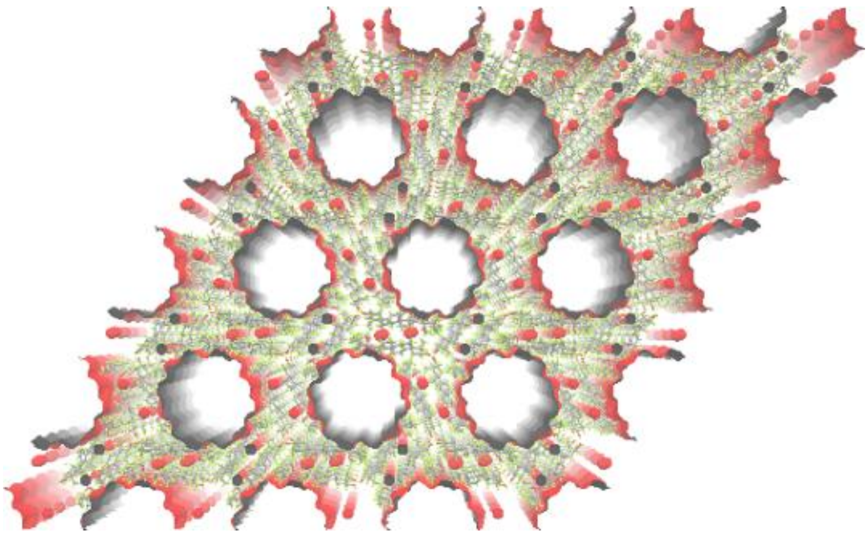


Figure 1. View of the 3D open framework of the title compound

A NEW ZINC(II) COORDINATION POLYMER CONSTRUCTED FROM 1,4-BIS((1-H-IMIDAZOLE-1YL)METHYL)BENZENE:SYNTHESIS,CHARACTERIZATION, CRYSTAL STRUCTURES AND ANIONIC EXCHANGE PROPERTIES

Chanikarn Kummuang[1], Suchada Phasawas[1], Kittipong Chainok[2], Nanthawat Wannarit[1,2]*
[1]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
[2]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand

*e-mail: nwan0110@tu.ac.th

Abstract:

A new Zn(II) coordination polymer, $\{[Zn(bix)_{1.5}(NO_3)]\cdot NO_3\cdot 1.8MeOH\}_n$ (**1**) (where bix = 1,4-bis(imidazole-1-methylbenzene)) was synthesized by using solvothermal method. The crystal structure of compound **1** has been determined by using single-crystal X-ray diffraction technique. Compound **1** crystallines in the triclinic crystal system with *P*-1 space group. The Zn(II) ion is surrounded by one oxygen atom from the nitrate group and three nitrogen atoms from different bix ligands, providing the distorted tetrahedral geometry. Each Zn(II) ion is connected by bix bridging ligand with *trans*-conformation, leading to a 1D ladder-like chain structure. Compound **1** shows interesting anionic exchange properties with azide ion, providing a new Zn(II) coordination polymer, $\{[Zn(bix)_{1.5}(N_3)]\cdot NO_3\}_n$ (**1′**). This compound crystallines in monoclinic system with $P2_1/n$ space group. The Zn(II) ion consists of two nitrogen donor atoms from different two azide ligands and three nitrogen donor atoms from different three bix ligand, leading to trigonal-bipyramidal geometry. The bix ligands link Zn(II) ions in *cis*-conformation, resulting a loop of $[Zn_2(bix)_2]$ unit which linked by bix ligand with *trans*-conformation, leading to 1D chain-like structure. In addition, the azide bridging anionic ligands connect those of 1D chains, resulting to 2D coordination network in crystallographic *ab* plane. The crystal structure of both compounds is stabilized mainly by the presence of non-classical hydrogen bonding (C−H···O) and weak π−π interactions.

ASSEMBLED OF 3D RARE EARTH-BROMOTEREPHTHALATE FRAMEWORKS WITH STP TOPOLOGY

Kittpong Chainok,* Suwadee Jiajaroen
Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:

Four isostructure three-dimensional (3D) rare earth-bromoterephthalate frameworks with stp topology, $[RE(Br_4tp)_{1.5}]\cdot 3H_2O$ (RE = Er, Tm, Yb, Lu) were synthesized by reacting tetrabromoterephthalic acid (H_2Br_4tp) with heavy RE elements under solvothermal conditions. The assembly of an open-framework is governed by the geometrically mismatched building blocks as well as the cooperative halogen and hydrogen bonds. In this architectural structure, micropore cavities enclose hydrogen-boned hexameric water clusters. The representative Lu-MOF was examined for its high CO_2 adsorption up to 10 bar at room temperature. Notably, DRIFTS and DFT calculations were used to quantify the mechanism of CO_2-MOF binding..

CATALYIC INVESTIGATION OF CARBON DIOXIDE CHEMICAL FIXIATION IN A COPPER(II)-SQUARATE MOF

Parattakotn Boonlert,[1] Peerawit Songponwarin,[1] Warakrittaya Klawkla,[1]
Kittipong Chainok[2]*.
[1]Science Classrooms in University-Affiliated School Project Thammasat University-Suankularbwittayalai Rangsit (SCiUS TU-SKR)
[2]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:
Under solvothermal conditions, copper(II) nitrate hexahydrate self-assembled with a rigid squaric acid to yield a copper(II)-square MOF. The Cu-MOF exhibits a three-dimensional open-framework structure, with the hydroxy groups orientated towards the cavity. This Cu-MOF was evaluated as a heterogeneous catalyst in a model CO2 fixation reaction, specifically the coupling of epoxide (epichlorohydrin) with carbon dioxide at atmospheric pressure and in the absence of additional solvent to form the corresponding cyclic carbonate.

CO-CRYSTALLIZATION OF INACTIVE GLYCOGEN DEBRANCHING ENZYME FROM *Corynebacterium glutamicum* (*Cg*GDE) AND MALTOTRIOSE

Watthanchai Saradhuldhat [1,2], Thatcheewa Apichatayanon [2], Karan Wangpaiboon [2] and Kuakarun Krusong [2,*]
[1] Program in Biotechnology, Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand
[2] Center of Excellence in Structural and Computational Biology, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
e-mail:
kuakarun.k@chula.ac.th

Abstract:

Debranching enzymes are divided into two groups. One includes pullulanases and isoamylases, and the other includes Glycogen Debranching Enzymes (GDEs). Pullulanase and isoamylase possess only α-1,6-glucosidase, whereas GDE is a multifuctional enzyme acting as α-1,6-glucosidase and α-1,4-transferase. This research aims to determine the binding properties of GDE from *Corynebacterium glutamicum* (*Cg*GDE) with ligands by X-ray crystallography. *CgGDE* gene in pET17b was mutated at catalytic residues and expressed in *E. coli* BL21 (DE3) to make an inactive enzyme. *Cg*GDE protein was purified via DEAE-FF column and Superdex^{TM} 200 pg column. *Cg*GDE was co-crystallized with maltotriose, and the diffraction data were collected at beamline BL13B1, The National Synchrotron Radiation Research Center (NSRRC, Taiwan). The *Cg*GDE mutant crystal belongs to space group P 1 21 1 with the unit cell parameters are a = 85.69 b = 174.827 c = 101.411, α = 90 β = 95.505 γ = 90. The crystal contains 4 molecules in the asymmetric unit with the highest resolution of 2.83. The crystal structure of inactive *Cg*GDE in complex with maltotriose was solved by Molecular Replacement.

CRYSTAL STRUCTURE AND CARBON DIOXIDE ADSORPTION IN 2D RARE-EARTH-OXALATE COORDINATION POLYMERS

Phasini Kasantikul,[1] Satida Prasantree,[1] Kittipong Chainok[2,*]
[1]Science Classrooms in University-Affiliated School Project Thammasat University -Suankularbwittayalai Rangsit (SCiUS TU-SKR), Pathum Thani 12121, Thailand
[2]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Klong Luang, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract: Solvothermal reactions of $RE(NO_3)_3$ and oxalic acid ($H_2C_2O_4$) afforded block shaped crystals of four new rare earth coordination polymers, $[RE(C_2O_4)(H_2O)](Me_2NH_2)$, RE = Ce, Pr, Nd, Sm. They are isostructural and crystallize in the orthorhombic system with the polar space group $Pn2a_1$. The structure is composed of two-dimensional layers consisting of RE^{III} ions connected by oxalate linkers. The disordered Me_2NH_2 cations serve as charge-balancing agents and template between the layers. Among all the compounds, the one containing Sm exhibits a gate-opening phenomenon for the adsorption of CO_2 at 273 K. This compound also exhibits a significant hysteresis loop during the process of desorption.

CRYSTAL STRUCTURE OF 3D RARE-EARTH MOFs CONTAINING OXALATE AND FORMATE MIXED LINKERS

Kanthida Kummoon,[1] Bunyarat Rungtaweevoranit,[2] Kittipong Chainok,[1,*]
[1]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
[2]National Nanotechnology Center (NANOTECH), National Science and Technology Development Agency (NSTDA), Pathum Thani 12120, Thailand

*e-mail: kc@tu.ac.th

Abstract:
A family of 3D ultramicroporous rare earth metal-organic frameworks (RE-MOFs) with oxalate (ox) and formate (form) mixed linkers, [DMA][RE(ox)(form)$_2$] (RE = Er, Tm, Yb, Lu; DMA = dimethylammonium), were effectively synthesized and structurally characterized by single crystal X-ray diffraction. These isomorphous RE-MOFs crystallize in the orthorhombic system with the *Cmca* space group and display an anionic 3D framework with ***spc*** topology. The charge-balanced DMA cations are present within anionic frameworks. These RE-MOFs have exceptional thermal and chemical stability. Significantly, they display fascinating gate-opening behavior while absorbing carbon dioxide under high pressures (up to 50 bar).

CRYSTAL STRUCTURE OF A NEW CADMIUM(II) COORDINATION POLYMER CONTAINING BENZIMIDAZOLE AND DICYANOARGENTATE(I)

Patticha Phakeephol,[1] Sirisak Nakpansa,[1] Wanwarin Jokloy,[1] Chompunuch Bunfrueang,[2] Pimmada Panupinthu,[3] Kittipong Chainok[4] and Nanthawat Wannarit[2,4*]

[1] Science Classrooms in University - Affiliated School Project, Thammasat University - Suankularb Wittayalai Rangsit School Center (SCiUS TU-SKR), Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand

[2] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand

[3] Bioenergy and Biochemical Refinery Technology Program, Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand

[4] Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand

*e-mail: nwan0110@tu.ac.th

Abstract:

A new Cd(II) coordination polymer, $\{[Cd(bzIm)_2(Ag(CN)_2)_2]\cdot 0.75H_2O\}_n$, (where bzIm = benzimidazole) has been successfully synthesized and characterized. The crystal structure of this compound has been determined by using single crystal X-ray diffraction technique. This compound crystallizes in monoclinic crystal system with *C2/c* space group. The Cd(II) ion is coordinated by six nitrogen donor atoms from two benzimidazole and four dicyanoargentate molecules, forming a distorted octahedral geometry. The Cd(II) centers are linked by bridging anionic dicyanoargentate(I) ligands along the crystallographic *a* and *c* axes, giving rise to present a two-dimensional net-like structure. The Cd-N bond lengths are in the range from 3.317(3) to 2.373(3) Å and bond angles are in the range of 81.50(12)° to 180.0°. The Cd···Cd distances are 10.651 and 11.017 Å. Moreover, the crystal structure has been stabilized by intermolecular interactions such as hydrogen bonding, π···π, C-H···π interactions between bzIm ligands. Interestingly, there is the Ag···Ag interaction with 3.112(1) Å, enhancing the crystal stability.

CRYSTAL STRUCTURE, AND CO_2 ADSORPTION IN A 3D Er^{III}/Li^{I} BIMETALLIC COORDINATION POLYMER

Laddawan Phruksachatkul, Nuttha Khakaew, Panita Pinyo, Kittipong Chainok,*
Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Klong Luang, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:
A new three-dimensional erbium(III)/lithium(I) bimetallic based coordination polymer of the formula $[Er(Li)(oxalate)_2]\cdot 2H_2O$ was successfully prepared under solvothermal conditions. The title compound crystallizes in the orthorhombic system with the space group *Cmcm*. Three-dimensional networks are formed by assembling oxalate bridging ligands with Er^{III} and Li^{I} ions. This network remained thermally stable at 300 °C. The activated network was also analyzed for its ability to adsorb CO_2 at temperatures of 273 and 298 K up to a pressure of 1 bar.

CRYSTAL TRANSFORMATION AND CARBON DIOXIDE ADSORPTION IN ULTRAMICROPOROUS RARE EARTH METAL-OXLATE FRAMEWORKS

Kenika Khotchasanthong,[1,4] Bunyarat Rungtaweevoranit,[2] Robert Oestreich,[3]
Christoph Janiak,,[3] Kittipong Chainok[4,*]
[1]Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
[2]National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), Pathum Thani 12120, Thailand
[3]Institut für Anorganische Chemie und Strukturchemie, Heinrich-Heine-Universität Düsseldorf, D-40204, Düsseldorf, Germany
[4]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:
Two families of rare earth metal-oxalate frameworks, $[Me_2NH_2][RE(C_2O_4)_2(H_2O)]\cdot 3H_2O$ (**1RE**, RE = Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Er) and $[Me_2NH_2][Ln(C_2O_4)_2]\cdot H_2O$ (**2RE**, RE = Tm, Yb, Lu). Compounds in **1RE** and **2RE** crystallize in the monoclinic space groups $P2_1/n$ and $I2/a$, respectively. Both families **1RE** and **2RE** exhibit a 3D framework with a diamond-like network. Upon thermal activation, the loss of coordinated water molecules in **1RE** can cause a structural transition into a family of **2RE**. The activated **1Gd** and **2Yb** display gate-opening behaviour of CO_2 sorption under high pressure conditions (up to 50 bar).

EFFECT OF HYDROXYL GROUP ON STRUCTURES AND CATALYTIC ACTIVITIES OF LANTHANIDE COORDINATION POLYMERS

Aaqib Khurshid,[1] Thammanoon Chuasaard,[1,2] Malee Sinchow,[1,2] Athipong Ngamjarurojana,[3,4] Apinpus Rujiwatra[1,4]*

[1]Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

[2]Office of Research Administration, Chiang Mai University, Chiang Mai 50200, Thailand

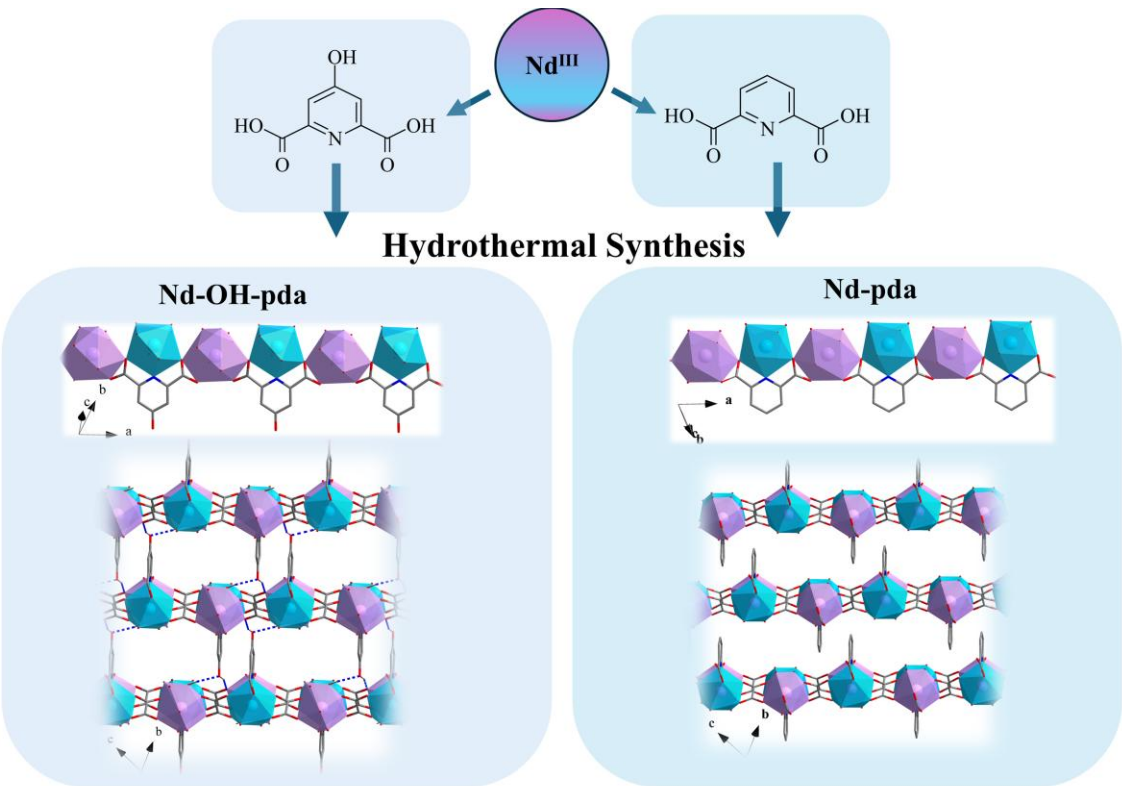
[3]Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

[4]Materials Science Research Center, Faculty of Science, Chiang Mai University, Chiang Mai 50200 Thailand

*e-mail: apinpus.rujiwatra@cmu.ac.th

Abstract:

The synthesis and characterization of new lanthanide coordination polymer, namely $[Nd^{III}_2(OH\text{-}pda)(ox)_2(H_2O)_4]\cdot 4H_2O$ (OH-H_2pda = 4-hydroxypyridine-2,6-dicarboxylic acid and H_2ox = oxalic acid), is reported. Its framework structure was revealed to be two-dimensional checkerboard-like layers constructed based on *TPRS*-$\{Nd^{III}NO_8\}$ and *SAPRS*-$\{Nd^{III}O_{10}\}$ structural motif. This structure is isostructural to $[Nd^{III}_2(pda)(ox)_2(H_2O)_4]\cdot 4H_2O$ containing pda^{2-}. The effect of the –OH group on framework structures as well as the catalytic activity towards the catalyzed CO_2 cycloaddition reaction with epoxide have then comparatively studied and is presented.



INVESTIGATING THE INFLUENCE OF pH ON THE STRUCTURAL DIVERSITY OF NEW ZINC(II) AND CADMIUM(II) COORDINATION POLYMERS CONSTRUCTED FROM 4,4′-BIPYRIDINE AND BENZOATE LIGANDS

Nanthawat Wannarit[1,*], Kulwadee Ponanunrirk[1], Kittipong Chainok[2]
[1] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Klong Luang, Pathum Thani 12120, Thailand
[2] Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Klong Luang, Pathum Thani 12120, Thailand
*e-mail: nwan0110@tu.ac.th

Abstract:
This research focuses on the design and exploration of new multidimensional d^{10} transition metal coordination polymers (CPs). By employing mixed linkers of 4,4'-bipyridine (4,4'-bipy) and benzoate (benz) under controlled pH conditions, we have successfully synthesized new Zn(II) and Cd(II) CPs namely $[Zn_3(4,4'\text{-bipy})_2(benz)_4(fum)_2]_n$ (**1**), $[Zn_2(4,4'\text{-bipy})_2(benz)_4]_n$ (**2**), $[Cd(4,4'\text{-bipy})(benz)NO_3]_n$ (**3**) and $[Cd_3(4,4'\text{-bipy})_4(benz)_6(H_2O)_2]_n$ (**4**) (fum = fumaraldehyde) have been successfully synthesized at different pH values of 6.5, 6.0, 5.0, and 7.0 for compounds **1-4**, respectively. All synthesized compounds were characterized by using ATR-FTIR, elemental analysis, TGA and PXRD techniques. The X-ray structures of all compounds have been determined by using single-crystal X-ray diffraction technique. The crystal structures of these compounds present diverse structural topologies. Compound **1** crystallizes in the triclinic crystal system with *P*-1 space group. Its structure is built from the connection of trimeric Zn(II) $[Zn_3(\mu\text{-benz})_2]$ SBU units with 4,4′-bipy and fum briding ligands, resulting to a three-dimensional structure with *pcu* topology. Compound **2** crystallizes in the monoclinic crystal system with *P*21/*n* space group. The molecular structure containing Zn(II) ions which are linked by 4,4′-bipy displays a one-dimensional zigzag-like chain along *c* axis. While compound **3** crystallizes in the monoclinic crystal system with *P*21/*n* space group. The structure of this compound is constructed from the connection of dinuclear unit, $[Cd_2(\mu\text{-benz})_2(NO_3)_2]$ linked by 4,4′-bipy ligands, giving a 1D ladder-like chain structure along the crystallographic *a* axis. And compound **4** crystallizes in the triclinic *P*-1 space group. In the structure of this compound, Cd(II) ion adopts a distorted octahedral $[CdN_2O_4]$ geometry which each Cu(II) ion is connected together by 4,4′-bipy, providing a one-dimensional linear chain-like structure along crystallographic *b* axis. These two adjacent linear chains are bridge by $[Cd(4,4'\text{-bipy})_2(benz)_2(H_2O)_2]$ units, leading to a 1D ladder-like net in the crystallographic *a* axis. The crystal structures of all compounds are stabilized by hydrogen bonding, π···π and weak CH···π intermolecular interactions.

MOLECULAR CRYSTALS: METALLOCYCLE VERSUS ORGANOCYCLES

Kirati Khotangka, Kritmethi Chaiyachokmongkon, Worachit Wongwichit, Kittipong Chainok*
Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand.
*e-mail: kc@tu.ac.th

Abstract:
we report the construction of two rationally designed Schiff base compounds with cyclic structure viz. metallocycle cobalt(II) complex based on 4,4'-(1,3-phenylenebis(propane-2,2-diyl))bis(N-(pyridin-2-ylmethylene)aniline (L) ligand, $[Co(L)Cl_2]\cdot H_2O$ (**1M**) and organocyclic tetraimines, $C_{32}H_{30}N_4\cdot C_6H_6$ (**1O**). Compound **1M** is a new member of dinuclear M_2L_2 metallomesocate formed by the self-assembly of two bis-bidentate chelating ligands L and a pair of metal ions. Whereas, **1O** represents an organocycle imines containing 42-membered ring derived from Schiff base condensation of amine and carbonyl subcomponents. Both compounds **1M** and **1O** possess good solvent stabilities and exhibit a reversible temperature induced desolvation/solvation behavior in a single-crystal to single-crystal manner.

STRUCTURAL FEATURES OF LANTHANIDE METAL COORDINATION POLYMER BASED ON CHLORANILIC ACID LIGAND

Hafawatee Khaosa-ard, Bhapimthong Promchanturk, Kenika Khotchasanthong, Kittipong Chainok*
Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:
Lanthanide chemistry has been extensively studied for the last two decades due to a wide range of photonic applications. Because lanthanide ions show a strong affinity toward the oxygen-atom donors, thus the kind of ligand contains oxygen-donor atoms have been widely used in the construction of variety lanthanide coordination polymers (LnCPs). In this work, chloranilic acid (H_2can) was used as an organic liker to construct a family of eight LnCPs, $[Ln(can)_{1.5}(H_2O)_3]\cdot 3.5H_2O$ (**Ln** = Sm (**1**), Eu (**2**), Gd (**3**), Tb (**4**), Dy (**5**), Er (**6**), Tm (**7**), Yb (**8**)). The compounds were synthesized by hydrothermal reactions and characterized by single crystal and powder X-ray diffraction, elemental analysis, IR spectroscopy, thermogravimetric analysis and UV-vis spectroscopy. Single crystal X-ray diffraction analyses reveal that compounds **1**−**8** are isostructural and present a two-dimensional brick-wall like layer structure with a (6,3) topological net, where the complete deprotonated chloranilate (can^{2-}) ligand adopts a μ_2-$\kappa^2 O,O'$:$\kappa^2 O'',O'''$ tetradentate bis-chelating coordination mode and connects to two nonacoordinate Ln^{3+} centres. The brick-wall layers are stacked in an −ABAB− sequence along the c axis, and are linked into a three-dimensional supramolecular architecture through extensive O−H···O and O−H···Cl hydrogen bonds involving the water molecules and the ca^{2-} ligands. In addition, these polymeric compounds exhibit high thermal stabilities as their framework structures can remain stabilization until 390 °C. Furthermore, the photophysical properties of these compounds have also been investigated.

STRUCTURE FEATURES OF ISOSTRUCTURAL HETEROMETALLIC ANIONIC METAL-ORGANIC FRAMEWORKS

Kunlanit Chinchan,[1] Bunyarat Rungtaweevoranit,[2] Sakchai Laksee,[3] Kittipong Chainok[1,*]
[1]Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
[2]National Nanotechnology Center (NANOTECH), National Science and Technology Development Agency (NSTDA), Pathum Thani 12120, Thailand
[3]Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization) (TINT), Nakhon Nayok, Thailand
*e-mail: kc@tu.ac.th

Abstract:
Three novel 3D heterometallic Cd/Ca MOFs containing benzene-1,3,5-tricarboxylate ligand, $(C_3H_5N_2)[CaCd_2(BTC)(HBTC)_2]\cdot 2H_2O$ (**1**), $((CH_3)_2NH)[CaCd_2(BTC)(HBTC)_2]\cdot 4H_2O$ (**2**), and $((CH_3)_2NH)((CH_3)_4N)[Ca_2Cd_4(BTC)_2(HBTC)_4]\cdot 8H_2O$ (**3**) were synthesized and structurally characterized using single-crystal X-ray diffraction. Compounds **1** and **2** crystallize in the centrosymmetric monoclinic space group *P*2/*c*, while **3** crystallizes in the space group *P*2. All systems have identical 3D anionic frameworks with various cantionic guest molecules, $C_3H_5N_2$, $(CH_3)_2NH$, and $(CH_3)_4N$, positioned within the channels. Their fluorescence sensing abilities and CO2 adsorption capacities under high pressure (up to 20 bar) were studied.

STUDY OF CRYSTAL STRUCTURE AND HIRSHFELD SURFACE ANALYSIS OF DINUCLEAR COPPER(II) COMPLEX CONTAINING 1,10-PHENANTHROLINE AND 2-HYDROXYBENZOATE LIGANDS

Chompunuch Bunfrueang,[1] Wanassanan Chaisuriya,[1] Kittipong Chainok[2] and Nanthawat Wannarit[1,2]*

[1] Department of Chemistry, Faculty of Science and Technology, Thammasat University, Khlong Laung, Pathum Thani, 12121, Thailand

[2] Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Khlong Luang, Pathum Thani 12121, Thailand

*e-mail: nwan0110@tu.ac.th

Abstract:

A new dinuclear copper(II) complex, $[Cu_2(phen)_2(2\text{-OHbenz})_2]\cdot(2\text{-OHbenzH})_2$ (where phen = 1,10-phenanthroline and 2-OHbenz = 2-hydroxybenzoate) has been successfully synthesized and characterized. The X-ray structure of this complex has been determined by using the single-crystal X-ray diffraction technique. The results of structural analysis show that this complex crystallizes in monoclinic crystal system with $P2_1/c$ space group. The Cu(II) ions in the dimer display a distorted square pyramidal geometry with a $[CuN_2O_3]$ chromophore which the basal plane build by two *N*-donor atoms from phen and two *O*-donor atoms from 2-OHbenz ligands while the apical position formed by an *O*-donor atom from hydroxy group of 2-OHbenz ligand. The crystal structure is stabilized by intermolecular interactions such as hydrogen bonds along crystallographic *a* axis, leading to 1D supramolecular chains and also C–O···π stacking and π···π stacking interactions along crystallographic *c* axis, providing 2D supramolecular network. Each 2D supramolecular network is assembled into a 3D supramolecular network by C–H···π interactions. Moreover, the hirshfeld surface analysis and the 2D-fingerprint plots have been studied to support the crystal structure analysis.

UNPRECEDENTED STRUCTURAL CHEMISTRY OF A 3D ERBIUM(III)-ORGANIC FRAMEWORK

Pacharapon Jearanaiwiwat, Kittipong Chainok*
Thammasat University Research Unit in Multifunctional Crystalline Materials and Applications (TU-MCMA), Faculty of Science and Technology, Thammasat University, Pathum Thani 12121, Thailand
*e-mail: kc@tu.ac.th

Abstract:

Erbium-squarate MOF was produced as light pink prismatic crystals by reacting hydrate erbium(III) salt with squaric acid. X-ray analysis revealed that the title compound crystallized in the high symmetry of cubic system with the space group *Pm*-3*m*. The structure is made up of hexanuclear erbium(III) oxohydroxo clusters linked together by squarate ligands to form a 3D framework. The hollow regions in the framework contain a large number of water molecules. The thermal stability of Erbium-squarate MOF is extremely high.

SP12-RADIOECOLOGY AND ENVIRONMENTAL RADIOACTIVITY

Activity concentration of natural radionuclides (^{40}K, ^{226}Ra and ^{232}Th) in beach sand and rock samples collected around the breakwaters located along coastal areas, Songkhla Province, Southern Thailand.

Komrit Wattanavatee,[1,*] Phatcharida Rakkaew,[2] Murnee Daoh,[3] Nawee Noonanat,[4]
[1,2]Division of Physical Science, Faculty of Science, Prince of Songkla University, Hat Yai, 90112,
[3]Department of Physics and General Science Program, Faculty of Science and Technology, Songkhla Rajabhat University, Mueang Songkhla, 90000, Thailand
[4]Division of Biological Science, Faculty of Science, Prince of Songkla University, Hat Yai, 90112, Thailand
*e-mail: komrit.w@psu.ac.th

Abstract:

Breakwater: - the permanent structure was constructed at a coastal area to against the wave and reduce coastal erosion. In Songkhla Province, two forms of the mound breakwater are ‘Riprap and Offshore’, which are made up from rocks, almost especially is granite. The research aims to determine the activity concentration of natural radionuclides (^{226}Ra, ^{232}Th and ^{40}K) and assess the radiation hazard derived from beach sand and rock samples around the breakwaters located along coastal areas, Songkhla Province.

Eight beach sand samples collected about 2-5 km away outside the breakwaters, while 5 beach sand samples and 6 rock samples were collected inside the breakwaters. After sample pretreatment, the gamma ray intensity was analyzed using the 70% relative efficiency HPGe gamma spectrometer, and IAEA-RGU1 was performed for determination the activity concentration of studied radionuclides. It was found that, the average activity concentration of ^{226}Ra, ^{232}Th and ^{40}K in beach sand samples collected inside the breakwaters are significantly higher (about twice) than outside the breakwaters. Although ^{226}Ra, ^{232}Th and ^{40}K in rock samples are high variability, their average activity concentration are more than 10 times compared to beach sand samples. Consequently, the calculated four radiation hazard indices Ra_{eq}, H_{ex}, D and AED derived from rock samples were more than 3 times above permissible values, in contrast, these indices were below for all beach sand samples.

CARBON ISOTOPIC SIGNATURES TRACING OF ORGANIC MATTER SOURCES IN THE THUNGKHA BAY

Wutthikrai Kulsawat*, Phatchada Nochit, Ritiron Samran, Waleeporn Pongkua
Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization) 9/9 Moo7, Ongkharak, Nakhon-Nayok 26120 Thailand
*e-mail: wutthikrai@tint.or.th

Abstract:
Organic matter (OM) in estuarine and coastal wetland sediments can be derived from natural and anthropogenic sources and can be a main substance of organic pollutants. Stable carbon isotope ($\delta^{13}C$) has been used to trace OM sources in coastal ecosystem according to their distinct $\delta^{13}C$ signatures. $\delta^{13}C$ in sediment core samples and mangrove plants collected from Thungkha inflow canal, Chumphon River Estuary, and Thungkha Bay in 2022-2024 were investigated to trace the OM sources in the Thungkha Bay, Results revealed the $\delta^{13}C$ in sediment cores of the Chumphon River varied from -29.64‰ to -18.37‰ and the Bay area were from -21.47‰ to -15.32‰ while the inflow canal revealed narrower values ranged from -23.05‰ to -19.81‰. The $\delta^{13}C$ of C3 mangrove plants ranged from -31.35‰ to -26.22‰ and C4 plants from -14.78‰ to -11.83‰. The enrichment of $\delta^{13}C$ signatures were found at the Thungkha canal and decrease toward the Chumphon Estuary which likely affected by C3 mangrove plants-derived OM such as plant detritus. The gradual increase of $\delta^{13}C$ in sediment from inflow river to the outer offshore suggested a primarily deposited land derived OM in the river with little distributed to the bay. The finding results indicated that the mainly OM sources in Thungkha Bay were a fraction of marine organic matter offshore such as seston, seagrass, and phytoplankton.

DETERMINATION OF LOW-LEVEL STRONTIUM-90 IN ECONOMIC MARINE SPECIES VIA CHERENKOV COUNTING

Natchakan Nakkaew,[1] Rungsak Suwanklang,[1] Pannaporn Pusomjit,[1] Yutthana Tumnoi,[1] Thawatchai Itthipoonthanakorn[1,*]

[1]Regulatory Technical Support Division, Office of Atoms for Peace, Bangkok, 10900, Thailand
*e-mail: thawatchai.i@oap.go.th

Abstract:

Strontium-90 (Sr-90) is a radioactive found in small amounts in the environment, including in marine species. Due to its potential impact on health and safety, monitoring Sr-90 levels in marine environments is crucial. To monitor and respond to radioactive contamination in the marine environment, the Office of Atoms for Peace (OAP) has analyzed Sr-90 levels in samples from economic marine species. However, the Sr-90 levels detected were extremely low, falling below the Minimum Detectable Activity (MDA) and thus could not be reported. This study aims to investigate the effect of sample size (dry weight: 20, 25, 30, 40, and 50 grams) on Sr-90 separation by solvent extraction with di-(2-ethylhexyl) phosphoric acid (HDEHP), followed by analysis using Cherenkov counting coupled with Liquid Scintillation Counter (LSC). The results indicated that the MDA decreases with the increase in amount of sample weight and then the MDA is stable at 40 grams. Therefore, 40 grams of dry sample weight was selected as an optimal condition. In this work, 121 economic marine species samples were demonstrated the applicability of the developed method. The detected values ranged from <MDA to 0.28 Bq/Kg, which is below the general standard for contaminants and toxins in food and feed (CODEX STAN 193-1995) for Sr-90 (<100 Bq/Kg).

DRY SEASON ELEVATED RADIOACTIVITY IN $PM_{2.5}$ RAISES CONCERNS IN THAILAND

Thawatchai Itthipoonthanakorn[1], Prannicha Hongpitakpong[1], Yutthana Tumnoi[1], Supitcha Chanyotha[2]*
[1]Safety Research and Development Section, Regulatory Technical Support Division, Office of Atoms for Peace, Bangkok 10900, Thailand
[2]Natural Radiation Survey and Analysis Research Unit, Department of Nuclear Engineering, Chulalongkorn University, Bangkok 10330, Thailand.
*e-mail: supitcha.c@chula.ac.th

Abstract:
Increased levels of fine inhalable particulate matter (PM2.5) during the dry season, surpassing the WHO recommended maximum level of 5 µg m-3 have raised health concerns in Thailand in recent years. Additionally, the Radionuclide Monitoring Station (RN65) in Nakhon Pathom, Thailand has identified average levels of natural atmospheric radioactive aerosols including 212Pb at 462 mBq m-3, which are higher than those in neighboring countries. This has prompted concerns about potential respiratory health risks, not only from PM2.5 but also from the radioactivity attached to the dust. Therefore, this study explores the connection between atmospheric particulate matter (PM2.5) and radionuclide concentrations (212Pb and 7Be) in Thailand's surface air. High-quality data from multiple monitoring stations, spanning January 2020 to December 2022, reveal seasonal PM2.5 patterns, primarily peaking during the dry season due to forest fires and agricultural burning. Significant correlations between PM2.5, 212Pb, and 7Be enable radiation exposure risk assessments. The study highlights the influence of meteorological factors, especially Northeast Monsoon winds, on aerosol distribution and emphasizes health risks associated with radionuclide exposure. These findings are valuable for assessing the risk of inhaled radiation doses as a health concern during dry season, particularly in regions with high levels of PM2.5 and airborne radioactivity.

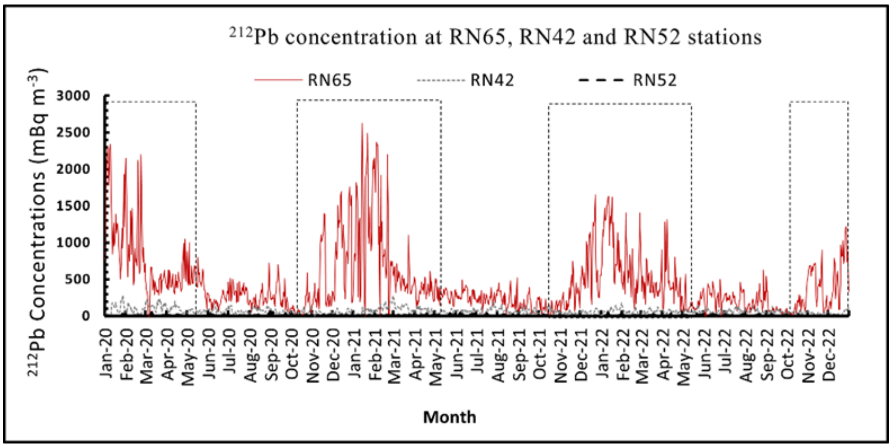


Figure 1.
Daily activity concentrations of ^{212}Pb between year 2020 and 2022 at station RN65 compared to RN station in Malaysia (RN42) and Philippines (RN52). The periods of the dry season and the wet season in Thailand are depicted inside and outside the highlighted dotted frame, respectively.

IMPACT ASSESSMENT OF SEA-LEVEL RISE ON MANGROVE SPECIES USING STABLE CARBON ISOTOPE TECHNIQUE

Phatchada Nochit,* Wutthikrai Kulsawat, Ritiron Samran, Waleeporn Pongkua
Nuclear Technology Research and Development Center, Thailand Institute of Nuclear Technology (Public Organization) 9/9 Moo7, Ongkharak, Nakhon-Nayok 26120 Thailand
*e-mail: phatchada@tint.or.th

Abstract:
Rising sea levels and extreme weather have caused greatly threat to the species diversity of mangroves. This study aimed to assess impact of sea-level rise (SLR) on current and historical status of three dominant mangrove species *(Avicennia marina, Rhizophora apiculata, and Nypa fruticans)* in the Trang estuary, Klong Luu (canal), Kantang district, Trang province using stable carbon isotope ($\delta^{13}C$) signatures. $\delta^{13}C$ analyses revealed the difference $\delta^{13}C$ in leaves among mangrove species. *Rhizophora apiculata* had a slightly $\delta^{13}C$ higher (-28.5 ± 0.2‰) than *Avicennia marina* (-29.1 ± 0.3‰) and *Nypa fruticans* (-30.2 ± 0.2‰). The $\delta^{13}C$ values in soils ranged from -29.5‰ to -27.6‰ for landward zone, -29.8‰ to -27.0‰ for mid zone, and −31.5‰ to −29.7‰ for seaward zone. The leaf carbon isotope signatures differed significantly among mangrove species can contributed to $\delta^{13}C$ values in soils. The study sites were occupied mostly with *N. fruticans* while *A. marina* and *R. apiculata* appeared to sporadic with less dense but taller trees. $\delta^{13}C$ values in soils reflected *A. marina* in landward zone also *A. marina* and *R. apiculata* in mid zone; however, both species were found to be low species richness. Therefore, the findings suggested that *Nypa* palm was a species that have a higher tolerance and adaptability under the sea level rise crisis. The $\delta^{13}C$ signatures in plants and soils indicated that the area has been influenced by the sea level and the area had formed mangrove secondary succession.

MEASUREMENT OF RADIOACTIVITY IN SEAFOOD IMPORTED FROM JAPAN FOLLOWING THE RELEASE OF ALPS-TREATED WATER

Natchakan Nakkaew,[1] Monthon Yongprawat,[2] Darunwan Chuenbubpar,[1] Saroh Niyomdecha,[1] Rungsak Suwanklang,[1] Varalee Kongcharoen,[1] Pannaporn Pusomjit,[1] Yutthana Tumnoi,[1] Thawatchai Itthipoonthanakorn[1,]*

[1]Regulatory Technical Support Division, Office of Atoms for Peace, Bangkok, 10900, Thailand
[2]Nuclear Technology Research and Development Center (NTRDC), Thailand Institute of Nuclear Technology (TINT), Nakhon Nayok, 26120, Thailand
*e-mail: thawatchai.i@oap.go.th

Abstract:

Consequence of the Fukushima Daiichi nuclear power plant accident in Japan in 2011, the Advanced Liquid Processing System (ALPS)-treated water with tritium levels not exceeding 1,500 Bq/kg has released into the sea. Since first release on 24 August 2023 more than 40,000 m^3 of treated water have been discharged. The Office of Atoms for Peace (OAP), in collaboration with the Department of Fisheries (DOF), the Food and Drug Administration (FDA), and the Thailand Institute of Nuclear Technology (Public Organization) (TINT), has analyzed radioactivity concentrations of tritium (H-3), strontium-90 (Sr-90), cesium-134 (Cs-134), and cesium-137 (Cs-137) of randomly collected of imported seafood and food products containing marine ingredients samples to monitor the radioactivity contamination. In this work, H-3, Sr-90, and Cs-134/137 levels were measured using Liquid Scintillation Counting (LSC), Cherenkov counting coupled with LSC, and gamma spectrometry, respectively. The results show that tritium concentration of 65 imported seafood samples ranged from below the Minimum Detectable Concentration (MDC) to 40.3 Bq/kg. Strontium-90 concentration of 47 imported seafood samples ranged from below the MDC to 0.3 Bq/kg. Additionally, cesium-134 and cesium-137 concentrations of 264 imported seafood and food products containing marine ingredients samples were below the MDC (0.16 to 2.32 Bq/kg and 0.21 to 2.33 Bq/kg, respectively). It concludes that concentration of interested radionuclides of all randomly collected of imported seafood and food products containing marine ingredients samples are complied with the general standards for contaminants and toxins in food and animal feed established by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) (CODEX STAN 193-1995).

Monte Carlo Simulation of Radon Detection in Temple Area in Thailand

Suttiwat Madlee,* Dumrongsak Rodphothong, Wipada Ngansom
Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand
*e-mail: suttiwat.m@rumial.ru.ac.th

Abstract:
Radon, a naturally occurring radioactive gas, poses significant health risks such as lung cancer in non-smokers, particularly through prolonged exposure in enclosed environments. This study investigates the impact of radon in air on healthcare using Geant4 simulations to model radon detection and exposure scenarios. The Geant4 toolkit was employed to simulate radon decay processes and its interactions with air, allowing for a detailed analysis of radon concentration in environments. The simulation incorporated the geometry of temple structures, environmental conditions to estimate radon levels in and around the temple. The results show effective dose estimation calculated by its concentration to compare with known risk coefficients for cancer. This study simulated indoor radon concentrations in a specific room, yielding an average of 1.289 Bq/m³. This value is notably lower than Thailand's national average of 23 Bq/m³, representing only 5.6% of the typical indoor concentration. For continuous annual exposure at the simulated concentration, the calculation indicates an estimated excess lifetime lung cancer risk of approximately 3.38×10^{-6}, or about 3.38 cases per million people exposed to this level continuously over a lifetime. This risk is substantially lower than that associated with the average radon levels in Thailand. The findings emphasize the importance of radon monitoring and mitigation in safeguarding public health, especially in regions where healthcare and tourism overlap, such as those from a temple in Thailand.

NUMERICAL INVESTIGATION OF RADON GAS DISPERSION FROM GRANITE SURFACES: EFFECTS OF METEOROLOGICAL DATA ON ATMOSPHERIC TRANSPORT

Dumrongsak Rodphothong[1]*
[1] Department of Physics, Faculty of Science, Ramkhamhaeng University, Bangkok, Thailand
*e-mail: dumrongsak.r@rumail.ru.ac.th

Abstract:

This study investigates the dispersion of radon gas from a granite floor to the atmosphere using computational fluid dynamics (CFD) simulations. The primary objective is to evaluate the influence of environmental factors, specifically wind speed, moisture content, and temperature gradients, on the transport and distribution of radon gas in an outdoor setting. A three-dimensional atmospheric boundary layer model was developed to simulate the radon emission from the granite surface, incorporating varying wind velocities, humidity levels, and temperature profiles. The simulation results indicate that wind speed significantly enhances radon dispersion, with higher velocities leading to a more extensive spread of radon away from the source. Conversely, elevated humidity levels and lower atmospheric temperatures were found to reduce radon dilution, leading to higher concentrations near the ground level. These findings provide critical insights into environmental controls on radon distribution, with implications for public health risk assessments in radon-prone areas. The study underscores the importance of incorporating meteorological data in predictive models of radon dispersion to improve accuracy in environmental risk evaluations.

RADIOACTIVITY DETERMINATION OF ^{137}Cs ^{226}Ra, AND ^{232}Th IN BEACH SHE-OAK BARK SAMPLES COLLECTED FROM THAILAND'S COASTAL REGIONS

Murnee Daoh, [1, 2] Komrit Wattanavatee, [1,] * Sawasdee Yordkayhun[1], Prakrit Noppradit[3]

[1]Division of Physical Science, Faculty of Science, Prince of Songkla University, Hatyai, 90110 Thailand
[2]Department of Physics and General Science Program, Faculty of Science and Technology, Song khla Rajabhat University, Mueang Songkhla, 90000 Thailand
[3]Coastal Oceanography and Climate Change Research Center, Faculty of Environmental Management, Prince of Songkla University, Hatyai, Songkhla, Thailand
*e-mail: komrit.w@psu.ac.th

Abstract:
Tree bark can serve as a biological indicator for the contamination of radioactive materials through atmospheric absorption. The key objective of this study is to evaluate the activity concentration of radioactive substances in beach she-oak bark as a biomonitor for radioactive contamination. The bark samples in 19 provinces along Thailand's coast were collected and analyzed using a high-purity germanium (HPGe) detector and gamma spectrometry system. The results show that the bark sample contained no detectable levels of ^{137}Cs radioactivity, implying no contamination of artificial radiation from historical nuclear power plant accident or man-made sources. The activity concentration of ^{226}Ra varied in the range of 1.30±0.30 to 8.5±0.8 Bq/kg, with an arithmetic mean of 3.8±0.5 Bq/kg, while the concentration is in the range of 2.6±0.6 to 15.1±1.9 Bq/kg, with an arithmetic mean of 7.8±1.4 Bq/kg, for ^{232}Th. We observed the significant difference in radionuclide activity values among the higher (>9^{o} N) and lower latitude (<9^{o} N) regions. The variation of activities in these regions could be influenced by the weather and rainfall amounts, which would lead to the accumulation of these nuclides. Notably, the highest ^{226}Ra and ^{232}Th concentration values were observed in the samples from Phuket and Phang Nga province, respectively. We believe that the higher activity concentrations of natural radionuclides in these provinces would be partly associated with granitic rocks exposed in the regions. Although the hazard index of activities in beach she-oak bark have not reported, this study served as the background radioactivity levels which is useful in terms of monitoring the region for human health.

Radium and Radon Concentration in Geothermal Springs, Surat Thani, Thailand

Saroh Niyomdecha[1], Wipada Ngansom[2], Dumrongsak Rodphothong[2], Monthon Yongprawat[3], Yutthana Tumnoi[1] and Thawatchai Itthipoonthanakorn[1*]

[1]Regulatory Technical Support Division, Office of Atoms for Peace, Bangkok, 10900, Thailand
[2]Department of Physics, Faculty of Science, Ramkhamhaeng University, Bangkok, 10240, Thailand
[3]Nuclear Technology Research and Development Center (NTRDC), Thailand Institute of Nuclear Technology (TINT), Nakhon Nayok, 26120, Thailand
* *Corresponding author*: thawatchai.i@oap.go.th

Abstract:
Three locations of geothermal springs in Surat Thani province were selected due to the high background of natural radium-226. In those areas, ambient gamma dose rates were measured using polymaster gamma surveys in conjunction with the Mobile-Integrated Nuclear Security Network (M-INSN) program developed by IAEA. Radioactivity of Ra-226 in sediment samples were measured using gamma spectrometry with HP-Ge detector of Terrestrial Radioecological Laboratory, Office of Atoms for Peace whilst radon concentration in spring samples were onsite counting using RAD-7 electronic radon detector. Results suggested area of Kao Tan saline hot spring has been highly contaminated with Ra-226 (1.132-14.83 µSv/h of ambient gamma dose rates, 16,983±920 Bq/kg of Ra-226 in sediment and 15±2-4103±119 Bq/L of radon in spring) whereas the area of Khawtok hot spring (0 . 2 1 0 -4 . 8 6 µSv/h, 14,972±811 Bq/kg and 55±4 Bq/L) and Ban Wad Kaew hot spring (0 . 1 24-2.369 µSv/h, 2,602±141 Bq/kg and 36±3 Bq/L) have been lower contamination. It concluded that in area of those geothermal springs have been contaminated with natural radium from the underground water but only radon in the spring at Kao Tan saline hot spring is higher than the limit of alternative maximum concentration level (AMCL) in raw water suggested by the US.EPA (150 Bq/L) and perhaps needs appropriate management.

THAILAND'S IMPLEMENTATION OF THE OBLIGATIONS UNDER THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY (CTBT)

Pimchanok Nakchuai,[1] Yutthana Tumnoi,[1] Thawatchai Itthipoonthanakorn[1,*]
[1]Office of Atoms for Peace
*e-mail: Thawatchai.i@oap.go.th

Abstract:

Thailand ratified the Comprehensive Nuclear-Test-Ban Treaty (CTBT) in 2018 and has been actively fulfilling its obligations under the treaty to date, including the installation and operation of facilities in the International Monitoring System (IMS), such as the radionuclide station (RN65) and the primary seismic station (PS41). IMS network comprises 321 stations in four technologies (seismic, hydroacoustic, infrasound, and radionuclide) and 16 radionuclide laboratories globally to provide verification capabilities for Treaty compliance. The Office of Atoms for Peace (OAP), designated as Thailand's station operator, has established and operated RN65, which features the particulate sampling system (THP65) located in Nakhon Pathom Province to detect radioactive particles in the atmosphere. Data from the station is collected and transmitted in near real-time to the International Data Centre (IDC) via a Global Communications Infrastructure (GCI) network. OAP and authorized users in States Signatories have open, equal, timely, and convenient access to all IMS data and IDC products. Furthermore, OAP has established and operated the national data center (NDC, known as N171) to promote the utilization of IMS data for civil and scientific application purposes in Thailand, in addition to verification purposes of the treaty.

The CTBT and IMS network, including the operation of the THP65, will be presented. Additionally, information will be provided on how to access benefit IMS data and IDC products for civil and scientific applications.

SP13-HARNESSING DIGITAL SCIENCE AND ENGINEERING FOR ENVIRONMENTAL SUSTAINABILITY

ENHANCED CO_2 CAPTURE PERFORMANCE USING METHYL DIETHANOLAMINE-FUNCTIONALIZED SILICA GELS: ASSESSING CO_2 CAPTURE CAPACITY

Petpitcha Boonmatoon,[1] Pacharapol Nokpho,[1] Pornpote Piumsomboon,[1]
Benjapon Chalermsinsuwan[1,*]
[1]Department of Chemical Technology, Faculty of Science, Chulalongkorn University, 254 Phayathai Road, Wangmai, Pathumwan, Bangkok 10330, Thailand
*e-mail: benjapon.c@chula.ac.th

Abstract: Carbon dioxide (CO_2) is one of the important greenhouse gases. This causes harm to the environment and humans. In 2023, the global concentration of CO_2 in the atmosphere increased to 420 ppm, a new record high. Therefore, technology for capturing CO_2 has been developed. At present, a wide variety of technologies have been proposed to capture CO_2. The adsorption technology is more affordable and requires less energy for regeneration. There are many potential solid adsorbents for CO_2 capture such as zeolites, alumina, metal-organic frameworks (MOFs), and mesoporous silicas. The unique properties of silica materials have potential applications as solid sorbents for CO_2 capture. They offer several advantages, including high adsorption capacity under dry conditions and ambient temperature, and low regeneration energy requirements. Amine functionalized siliceous adsorbents are one of the most promising methods for CO_2 capture purposes due to their high CO_2 efficiency and uptake rates. In this study, silica gels were grafted and impregnated by amine using methyl diethanolamine (MDEA). The effect of water content and amine loading on CO_2 capture performance was investigated. The MDEA grafted and impregnated on silica gel exhibited an excellent CO_2 efficiency of 0.36 and 0.38 mg-CO_2/g-sorbent respectively, which is higher than 15% of unmodified adsorbent. The results showed that the modified silica gel gave high CO_2 efficiency during the first three adsorption-regeneration cycles when water content and amine loading increased. Moreover, the nitrogen content increased with the amount of water content, leading to an increase in adsorption capacity.

MODELING INDUSTRIAL SCALE BUBBLING FLUIDIZED BED BOILER WITH BIOGAS COMBUSTION INVESTIGATION FOR REDUCE BIOMASS USAGE

Varudom Siri,[1] Phongpapop Kitisomkiat,[1] Benjapon Chalermsinsuwan,[1,*] Pornpote Piumsomboon[1,*]
[1]Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Thailand
*e-mail: benjapon.c@chula.ac.th, pornpote.p@chula.ac.th

Abstract:

Global warming has become a challenging problem in this century. Finding clean energy sources is important and urgently needed. Alternative energy is one of the several methods to change from polluting energy to cleaner energy. For the industrial sector, biomass has been used for a while as an alternative energy to avoid using fossil fuels, but biomass has many limitations such as transportation, planting time and harvesting, food crop competition, and waste disposal fees. Biogas is a renewable energy from anaerobic digestion and is consistently available as long as we have organic wastes. Biogas contains almost half methane, which can be used as fuel instead of being released into the atmosphere. When necessary, biogas can take the place of biomass in terms of reducing and mixing for co-combustion. In this study, the possibility of burning mixed fuel between biogas and biomass in a commercial-scale bubbling fluidized bed boiler using computational fluid dynamics (CFD) without modifying or inserting new equipment into the boiler was investigated. The result shows that biogas addition can improve thermal duty by increasing the furnace temperature in the boiler and helping combustion above the bed. Reducing the biomass feeding based on heating value and substituting it with biogas was found to have the potential to increase the internal heat. It increases the temperature at the top of the furnace even though the total fuel input was equal to the case of using only biomass.

STATISTICAL STUDY TO OPTIMIZE BIOGAS PRODUCTION FROM WASTEWATER TREATMENT USING ANAEROBIC DIGESTION

Krittin Korkerd,[1] Prathana Nimmanterdwong,[2] Ratchanon Piemjaiswang,[3] Tanakorn Pumchumpol,[4] Sorathan Tanprasert,[5] Benjapon Chalermsinsuwan[5,*]
[1]Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand
[2]Department of Mechanical Engineering, Faculty of Engineering, Mahidol University, Nakhon Pathom 73170, Thailand
[3]Environmental Research Institute, Chulalongkorn University, Bangkok 10330, Thailand
[4]Integrated Research Center Company Limited, Prachin Buri 25140, Thailand
[5]Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok 10330, Thailand
*e-mail: benjapon.c@chula.ac.th

Abstract:
The efficacy of anaerobic digestion (AD) for biogas production and wastewater treatment has been widely acknowledged. This study sought to elucidate the influence of influent Chemical Oxygen Demand (COD), Hydraulic Retention Time (HRT), and UASB reactor temperature on the methane content (%CH_4), a paramount indicator of biogas quality. Employing Aspen Plus simulation, a 2^k factorial experimental design was implemented to analyze wastewater treatment and biogas generation. The influent is industrial wastewater from ethanol production, characterized by a pH of 5 and concentrations of COD, Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), and Sulfate(SO_4^{2-}) at 38,000, 8,000, 700, and 300 ppm, respectively. The operating range of parameters in the 2^k factorial experimental design includes a COD range of 38,000 and 90,000 ppm, HRT of 24 and 96 hours, and UASB reactor temperatures of 30 and 38 °C. The findings unequivocally demonstrate that HRT exerts the most significant impact on %CH_4 content. Prolonged HRT facilitates enhanced organic compound degradation, thereby optimizing CH_4 production efficiency through ample substrate conversion. Elevated influent COD levels also contribute to increased CH_4 yield by augmenting the available organic matter.

STUDY OF SOLAR COLLECTOR POTENTIAL IN THAILAND USING COMPUTATIONAL FLUID DYNAMICS APPROACH

Phongpapop Kitisomkiat,[1] Varudom Siri,[1] Benjapon Chalermsinsuwan,[1,*] Kejvalee Pruksathorn[1,*]
[1]Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Thailand
*e-mail: benjapon.c@chula.ac.th, kejvalee.p@chula.ac.th

Abstract:

Due to the proximity of Thailand being near the equator, there is a significant potential for harnessing an excess amount of solar energy using a solar collector. The solar collector harvests solar energy by acting as a passive heat exchanger, receiving solar energy and transferring it to a fluid medium to be further utilized. This study presents the analysis of temperature outlet and pressure drop of a solar collector in Thailand, utilizing Earth's geological location, date, and time for solar energy calculations and employing Computational Fluid Dynamics (CFD) to predict the collector's efficiency. The CFD approach offers a reduction in the cost of experiments and environmental impact by minimizing waste from constructing experimental prototype equipment. A closed loop solar collector for water heater system with the width of 100 mm. and the length of 1000 mm. made with copper is selected for this study. The boundary conditions of the model are collected from the experimental data to ensure high accuracy during the validation process. The grid independence is done to ensure high accuracy simulation with CFD. The study also compares the collector performance with another geological location and with different water mass flow rates in the range of 0.554 to 2.582 g/s. The results confirm the potential of solar collector in Thailand by achieving efficiency of 69.61% at 11 a.m. with 2.332 g/s of mass flow rate.

AUTHORS INDEX

https://stt50.scisoc.or.th