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Reversing the Decline of the Manufacturing
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*Harnessing Science and Technology:
Reversing the Decline of the Manufacturing
Sector in the Philippines*

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2. Underlined name : Presenting Author
3. Name with asterisk : Corresponding Author

AGRICULTURAL SCIENCES

AS-01

ACCEPTABILITY OF CASSAVA (*Manihot esculenta*) SIOPAO

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Cassava is abundant in the Philippines and is only considered as supplemental food. Being abundant in Camotes Island, cassava was used as a dough ingredient of siopao. To find out its acceptability, experiments were set-up using 5 treatments: T0 (control) using all-purpose flour as dough filled with ground pork and other ingredients; T1 using 25% cassava flour mixed with 75% all-purpose flour; T2 using 50% cassava flour mixed with 50% all-purpose flour; T3 using 75% cassava flour mixed with 25% all-purpose flour; and T4 using 100% cassava flour. All the treatments were subjected to organolyptic tests in terms of texture, odor, flavor, palatability, and general acceptability. T4 was rated as having the best taste. As to texture and odor, T0 was rated highest, followed by T2. For palatability, T2 was rated highest followed by T4. For flavor, T4 was rated highest, followed by T2. For general acceptability, T4 was rated highest, followed by T0. ANOVA showed that there were no significant differences on the acceptability of cassava as a dough ingredient of siopao filled with ground pork and other ingredients in terms of flavor, odor, texture, palatability and general acceptability.

Keywords: *Manihot esculenta*, siopao, acceptability, cassava, Camotes Island

AS - 02

**IMBAW (*Adontia edentula*) AS A RESOURCE,
FOOD AND LIVELIHOOD OF CAMOTES ISLANDS,
CENTRAL PHILIPPINES**

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Imbaw, known as mangrove clam (*Adontia edentula*) and an abundant resource in the mangrove areas of Camotes Islands, Cebu, was studied with respect to its perceived abundance, food processing, and livelihood of the inhabitants. An interview questionnaire was prepared for the gleaners, vendors, and selected residents of Camotes Islands. Results show that imbaw are usually found in muddy areas with less pneumatophores and usually caught 2 feet below the surface. They are gathered throughout the year during low tide. Phases of the moon have nothing to do with its abundance. Collection relies on visual techniques and direct contact with the bottom. Perceived distance between clams is 3 meters. Imbaw is prepared as tinola, broiled, and salad (kinilaw). Broiled imbaw mixed with a bit of margarine is served during special occasions. Gleaning usually is concentrated in mangrove areas of Teguis, Poro Cebu being the largest mangrove area in Camotes Islands. Marketing is done through middle men with an average of 5 pieces large clams and 15 pieces smaller clams, which require an hour of gleaning. Prices for bigger clams range from Php2.00 to Php3.00 per piece and smaller clams is Php0.50 to Php1.00 each. Results further show that 1/3 of their catch was left for the gleaners' kitchen and 2/3 for the market. Proceeds of clam gleaning are usually for food purposes only. Perceived problems are the many gleaners; areas are severely disturbed and lower catch when smaller clams are gathered due to its scarcity. Reforestation and size limits were the suggested measures to solve scarcity.

Keywords: Imbaw, *Adontia edentula*, resource, food, livelihood

AS - 03

DEVELOPMENT OF A TECHNOLOGY TO INCREASE THE PRODUCTIVITY OF TUGUI (*Dioscorea esculenta*)

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Yams (*Dioscorea*) play a vital role as source of human food in the country especially in times of food scarcity. *D. esculenta*, locally known as tugui, is one of two species which are of economic importance in the Ilocos Region. Tugui thrives well in marginal areas and is considered as cash crops by upland farmers. The lack of a recommended high-yielding and acceptable variety and a production technology however, limits the productivity of farmers to only about 2.6-3.3 t ha⁻¹. In an effort to increase productivity, a series of research projects were conducted to identify promising accessions that could be recommended to farmers and improve the existing cultural management practice. After three years of evaluation both on-station and on-farm, six accessions (Accessions # 9, 3, 2, 1, 4, and 15) were identified, with mean yields ranging from 13.33 t ha⁻¹ to 14.54 t ha⁻¹. These accessions are also highly acceptable to consumers. In terms of crop management, the application of two tons organic fertilizer per hectare was found to sustain high yield and maintain the residual fertility of the soil after continuous cropping, thus shifting cultivation is avoided. In addition, the use of bigger setts (40-90 g) was found to significantly increase yield by 138% as compared to the farmers' practice of using small setts. Planting the identified promising accessions, coupled with improved cultural management practices increase the productivity of tugui. With this, the marginal/idle areas can be made productive and be used to support the government's program on food security.

Keywords: yam, marginal, accession, *Dioscorea*, tugui

AS - 04

OPTIMUM CONDITIONS FOR MYCELIAL GROWTH AND FRUITING BODY PRODUCTION OF *Pleurotus pulmonarius* (Fries) Quélet SPANISH STRAIN

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Pleurotus pulmonarius (Fr.), commonly known as Indian Oyster or Phoenix mushroom is an exotic species of mushroom in the Philippines. It usually grows on lignocellulosic substrates such as hardwood, wood products and agricultural wastes such as rice straw, corn cobs, sugar cane bagasse, coffee residues and banana stalks. This species of mushroom is not yet commercially cultivated in the country due to lack of production technology. With the objective of developing practical and innovative production technology, we evaluated the influence of locally available indigenous culture media and physical conditions (pH, aeration, illumination, and temperature) on the mycelial growth and rice straw based substrate formulations for fruiting body production. *P. pulmonarius* cultured in potato sucrose gelatin with pH of 5.5 and incubated in sealed and dark condition at room temperature recorded fastest mycelial growth with a mean of 90 mm after 7 days of incubation. Among the grain spawning materials evaluated, corn grit produced luxuriantly thick mycelia and shortest incubation period with a mean of 6 days. Substrate formulation composed of 9 parts rice straw: 1 part sawdust recorded the shortest incubation period (12.67 days), highest mean weight of the fruiting bodies (86.71 g) and highest biological efficiency (24.77%).

Keywords: *P. pulmonarius*, physical conditions, indigenous culture media, rice straw based substrate

AS - 05

BIOACTIVES AND PROTEINS IN INDIGENOUS EDIBLE MINDANAO FERNS AS AN ALTERNATIVE FOOD SOURCE

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Many Filipinos suffer from cancer, atherosclerosis, and other degenerative diseases which may be due to the high concentration of free radicals from pollutants and to the type of food we eat. Ferns in the Philippines had been used by native people as food, tea and medicine for a long time. We conducted a study to determine the protein content and antioxidant potential of our ferns to demonstrate their health and wellness benefits for possible reintroducing into the Filipino diet. Ten species of indigenous edible ferns from Mindanao were determined using the Bradford assay to have protein content ranging from 0.08 to 4.39 mg/g wet weight and antioxidant activity by the DPPH assay as high as 83% that of ascorbic acid or at 143 to 588 ORAC units/g wet weight. Of these ten fern species, *Marsilea crenata* (upat-upat) gave the highest protein content and antioxidant activity per wet weight with *Cyathea contaminans*, a tree fern, having the lowest protein content/wet weight. Phytochemical profiles were prepared by Thin Layer Chromatography (TLC). The relative component proteins by SDS-PAGE indicated proteins with molecular weights ranging from 19 – 92kDa, each with only one subunit. The profiles among the ten ferns were similar and differences in the band intensities and the integrity of the proteins were maintained. We established a pteridogarden of these ten ferns in the University Fernery with mass production in the Mt. Musuan Botanical and Zoological Gardens. As an output of the study, we prepared fern gourmet where staff and caterers participated in a contest evaluated by a sensory panel. As part of our extension work to educate the public of the health and wellness benefits of ferns in the diet, we held seminars and trainings, and prepared brochures on the propagation of these ferns and recipes for the fern gourmets.

Keywords: pteridogarden, ferns, anti-oxidants, proteins, phytochemicals

AS - 06

SURVEY AND CHARACTERIZATION OF INDIGENOUS FOOD PLANTS IN ILOCOS NORTE, PHILIPPINES

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Indigenous and traditional edible plant species, usually referred to as indigenous food plants (IFPs), are disappearing at an alarming rate, posing serious threats to food security and agricultural production especially in areas that depend on them for food and livelihood. This study was undertaken to document the IFPs of seven upland and remote municipalities of Ilocos Norte province. It generated information on the IFP's identity and taxonomic nomenclature, socio-economic importance, ethnobotany, and geographic location. A total of 46 IFPs representing 28 plant families were identified. Most of them were wild species; the others were landraces or native varieties of cultivated crops. The identified IFPs are important plant genetic resources contributing to food sufficiency, nutrition, and household income supplements in the study sites. Ethnobotanical data indicate that the plants have become an integral part of the people's daily diet. Seven of the IFPs showed specific elevation, temperature and soil moisture requirements which contributed to the uniqueness of a species in one or two sites. Many of them, however, showed adaptability to a wide range of geomorphic and soil conditions. Recognizing the benefits of these IFPs, the upland communities conserve them through *in situ* conservation and conservation through use. Additionally, the Mariano Marcos State University (MMSU) collected available germplasm and maintains them as living plants and seeds. To prevent further genetic erosion and to protect the IFPs from extinction, collaborative efforts and interventions among various stakeholders should be instituted and strengthened.

Keywords: indigenous food plants, biodiversity conservation, plant genetic resources, wild plant species, traditional varieties

AS - 07

**NEXT GENERATION MAINTAINER LINES:
MULTIPLE BACTERIAL BLIGHT RESISTANCE GENES
AND GOOD GRAIN QUALITY**

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Marker-assisted breeding of bacterial blight resistant hybrid rice maintainer lines was started at PhilRice in 2003. Although carried out successfully, there were difficulties in using them for cytoplasmic male sterile (CMS) conversion due to residual fertility restoration capacity. Thus, the first generations of improved maintainer lines were not effectively used in developing resistant F₁ hybrids. In this study, we sought to develop a new generation of maintainer lines with two or multiple resistance genes and no residual fertility in converted CMS lines. Maintainer lines assembled at PhilRice were screened by inoculating them with *Xanthomas oryzae* pv. *Oryzae* (*Xoo*) isolates and confirmed what possible genes were present using gene markers. We utilized IRBB62, a pyramided line having *Xa4*, *Xa7* and *Xa21* genes, and identified maintainer lines showing broader resistance for bacterial blight resistance gene but poor in morpho-agronomic traits as donor parents. A combination of forward breeding and marker assisted selection (MAS) were used in development and improvement of maintainer lines. After six generations, ten advanced lines were already uniform. Initial pollen sterility evaluation of F₁ progenies, using three cytoplasmic sources, showed different reaction to iodine staining. This implied the occurrence of sterility inducing factor present in the cytoplasm or in the nucleus of both parents. Grain qualities of these advanced lines exhibited acceptable value for percent chalkiness and amylose content. Therefore, with appropriate CMS source and proper selection, the development of new CMS lines in the background of improved maintainer line having resistance gene is possible.

Keywords: hybrid rice, maintainer line, *Xoo* isolates, bacterial blight, MAS

AS - 08

SUBMERGENCE TOLERANT RICE: MITIGATING THE EFFECT OF CLIMATE CHANGE IN FLASH FLOOD-PRONE AREAS IN THE PHILIPPINES

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Cultivated rice, *Oryza sativa* L., needs water in order to grow and produce the most important staple food for more than half of world's population. When completely underwater for several days particularly at vegetative stage, rice seedlings wilt and die causing significant reduction in yield. This paper describes the genetic improvement of rice *via* transfer of *sub1* locus for submergence tolerance from IR64-Sub1 into high yielding varieties using marker-assisted breeding methods. Six commercial varieties - NSIC Rc160, NSIC Rc128, NSIC Rc154, NSIC Rc158, and PSB Rc82 - were used in conventional hybridization and development of progenies. Using *sub1* markers ART5 and RM8300 in chromosome 9, foreground selection of plants with *sub1* identified improved lines currently at BC2F2 and BC3F1. Recombinant selection using 5 microsatellite markers in the *sub1* region combined with background selection using 27 markers identified 7 improved PSB Rc82, now at BC2F2. Promising submergence tolerant rice cultivar in the background of NSIC Rc160 showed 58% survival compared to IR64-Sub1 and IR42 (control) at 39% and 0%, respectively, under on-farm evaluation in San Antonio, Nueva Ecija. The development of submergence tolerant rice varieties will give farmers an option to alleviate the effect of submergence as a result of climate change particularly in flash flood-prone areas in the country.

Keywords: rice, *sub1*, submergence tolerance, marker assisted selection, genetic improvement

AS - 09

**CONFINED FIELD TEST OF PRO-VITAMINA
ENRICHED ‘GOLDEN RICE’ EVENT GR2-R
INTROGRESSED LINES OF IR64 AND PSB Rc82**

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The Golden Rice 2 event “R” (GR2-R) was introduced from the donor Kaybonnet harboring the GR2-R locus into two popular Philippine varieties, IR64 and PSB Rc82. IRRI scientists performed the preliminary work in the Philippines using marker-assisted backcrossing and line selection. Selected progenies and introgression lines were tested under contained and confined conditions at IRRI. In this study conducted by PhilRice, a total of 80 introgression lines derived from these crosses were subjected to confined field testing (CFT) with the approval and under the regulatory supervision of the Bureau of Plant Industry, Department of Agriculture. The CFT involved 38 introgression lines of IR64 at BC3F3, 32 lines of PSB Rc82 at BC3F1, and 10 lines of PSB Rc82 at BC2F3. Evaluation focused on the following parameters: morpho-agronomic and post-harvest characteristics, reaction to pests and diseases, genetic similarity to the recurrent parent based on 373 genome-wide SNP markers, and total carotenoid content after two months of storage at ambient temperature. Among the IR64-GR2R lines, 32 were selected as closely resembling the wild type IR64 based on phenotypic acceptability and morpho-agronomic characteristics. The selected IR64-GR2R lines had the following characteristics: 75 to 126 cm plant height, 80 to 86 heading days, 101 to 106 maturity days, and 5.17 to 11.20 µg/g total carotenoid content, as compared to 7.65 µg/g in Kaybonnet and 0.42 µg/g in IR64. Among the PSB Rc82-GR2R lines, 13 were identified as similar to wild type PSB Rc82, having 92 to 132 cm plant height, 81 to 86 heading days, 104 to 111 maturity days, and 80.5 to 90.5% recurrent parent genome recovery. Based on these results, selected lines will be subjected to generation advance, phenotypic selection and multi-location field evaluation.

Keywords: Golden Rice 2, confined field test, vitamin A deficiency, beta carotene, SNP genotyping

AS - 10

**EVALUATION OF GROWTH AND YIELD PERFORMANCE
OF TRADITIONAL UPLAND RICES IN LOW ELEVATION
UPLAND AGROECOSYSTEM**

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In answer to the Philippines' rice self-sufficiency goal, the expansion of production areas for upland rice and propagation of traditional rice varieties for food security are recommended. Traditional upland rice (TUR) is usually cultivated through *kaingin* system in high elevation mountainous areas that pose ecological hazards to the upland agro-ecosystem and forest resources. Considering the wide agro-ecological adaptability and resiliency of this crop, the utilization of less risk-prone areas (*i.e.* lower-elevation and marginal upland) is possible resulting not only in converting less productive soil to become productive but also enhancing the sustainability of the environment. A total of 42 traditional upland rice varieties were planted in low elevation upland areas of Batac, Ilocos Norte during the 2010 and 2011 wet seasons in order to evaluate the agronomic performance and to identify high yielding TUR varieties adaptable to lower elevation upland agro-ecosystem. Six promising entries were found adaptable for low elevation (78-97 meter above sea level) uplands as manifested by their good growth and yield performance. TUR 36, TUR 4 (*Isek*), TUR 28 (*Pamplona*), TUR 42 (*Maluit*), TUR 46 (*Wagwag*) and TUR 47 (*Limon*) consistently produced yields of 3.3 to 4.6 t ha⁻¹. They are tall and low tillering, have medium panicles, are fertile to highly fertile, medium maturing, and weighed approximately 26 to 30 g/1000 grains. These entries also possess highly acceptable sensory qualities, *i.e.* aroma, gloss, smoothness and taste.

Keywords: traditional upland rice, rice self-sufficiency, agronomic evaluation, promising traditional upland varieties, sensory qualities

AS - 11

MORPHO-AGRONOMIC DIVERSITY OF UPLAND RICE LANDRACES AND TRADITIONAL VARIETIES FROM BUKIDNON

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Cortes (2011) collected 140 upland rice landraces and traditional varieties (URLTVs) from 24 barangays in Bukidnon that were culturally valuable to indigenous communities. These were highly diverse for most seed traits. Sixty-six URLTVs with adequate viable seeds were grown on August 2012 at the CMU-Agricultural Experiment Station for morpho-agronomic characterization to determine their potential use in upland rice breeding. The study was a balanced lattice design with two replications. Only 55 URLTVs with adequate plant stand were considered for data collection. Most URLTVs were short-statured, perhaps as a natural adaptation to wind-threatened agro-ecosystem conditions, although based on Shannon-Weaver Diversity Index, plant height at 35 and 90 days after planting (DAP) were highly diverse ($H' = 0.94$ and 0.83 , respectively). At 90 DAP, height ranged from 51.60 to 95.80 cm. Other highly diverse traits were: flag leaf length ($H' = 0.90$), number of culm ($H' = 0.90$), culm length ($H' = 0.88$), days to first heading ($H' = 0.82$), and main heading date ($H' = 0.92$). Qualitative traits often useful as genetic markers have variable diversity: presence/absence of awn ($H' = 0.22$), auricle color ($H' = 0.36$), and leaf blade attitude or angle ($H' = 0.32$) had low diversity; panicle exertion ($H' = 0.49$) had moderate diversity, whereas panicle: attitude (or angle) of branches ($H' = 0.53$) and lemma/palea color ($H' = 0.83$) with 9 colors identified had high diversity. Such phenotypic variations need to be confirmed at the molecular level to fully determine their value in upland rice varietal improvement.

Keywords: rice breeding, *Oryza sativa*, rice, traditional varieties, landraces, Bukidnon

AS - 12

**COMPARATIVE CHARACTERIZATION OF
IN SITU *Oryza rufipogon* Griff. POPULATIONS IN LAKES
APO AND NAPALIT, BUKIDNON**

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Wild rices are valuable gene sources for rice breeding. Four of the 25 wild *Oryza* species can be found in the Philippines; one of these is *O. rufipogon* which grows around Lake Apo (~373 meters above sea level, masl), Bukidnon, reported in 1961. It is believed to be one of the progenitors of *O. sativa* and has valuable traits for cold, drought and salinity tolerance, as well as resistance to tungro virus. On February 2012, sightings of *O. rufipogon* in Lake Napalit (~2,824 masl), Bukidnon were confirmed by faculty and student researchers of Central Mindanao University. This study compared the morpho-ecological status of *O. rufipogon* populations around the two lakes. Ten 1 m x 1 m quadrants with *O. rufipogon* clusters were established per lake. Initial findings from November 2012 to January 2013 showed that Lake Apo populations (LAP) have longer leaves (35.10 cm), culms (123.58 cm), and awns (65.19 cm) than those in Lake Napalit (LNP): 20.70 cm leaf, 70.55 cm culm, and 49.37 awn lengths. However, leaf width (0.85 cm LAP, 0.84 cm LNP), panicle length (35.90 cm LAP, 37.49 cm LNP), percent panicle shattering (71.99% LAP, 68.33% LNP), and number of basal primary branches per panicle (7 LAP, 6 LNP) were comparable. Rainfall was higher in Lake Napalit (73.50 mm) than in Lake Apo (26.33 mm). Temperature was relatively cooler in Lake Napalit (23.5°C) than in Lake Apo (25.3°C). Variable characteristics between the two populations will be potentially useful in rice breeding.

Keywords: wild rice, Bukidnon, rice breeding, *Oryza rufipogon*, plant genetic resources, Lake Apo, Lake Napalit

AS - 13

YIELD POTENTIAL AND NITROGEN USE EFFICIENCY OF IRRIGATED LOWLAND RICE VARIETIES THROUGH LEAF COLOR CHART (LCC)-BASED NITROGEN MANAGEMENT WITH VARYING N-P-K RATIOS

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Nitrogen (N) is usually limiting in irrigated rice production due mainly to leaching and volatilization. Therefore, increasing N use efficiency is needed to improve grain yield and reduce N losses and groundwater contamination. The leaf color chart (LCC) is an inexpensive (P50/unit) and practical tool used to assess the “real time” plant need for N. The LCC can be used to attain the grain yield potential (maximum yield under optimum crop management) and agronomic N use efficiency (ANUE or kg grain/kg N applied) and to lower cost of N fertilizer. However, phosphorus (P) and potassium (K) are also important in the attainment of yield potential. Inbreds PSB Rc82 and NSIC Rc160, and hybrid Mestiso 20 were tested in 2012 dry season. Fertilizer treatments were: a) control with no fertilizer; b) nutrient omission plots: (b1) N omission plot (-N,+P,+K), (b2) P omission plot (+N,-P,+K), (b3) K omission plot (+N,+P,-K); c) LCC-based N management with 4:2:1 NPK ratio, where 35 kg N/ha was applied when LCC reading was below 4; d) LCC-based N with 4:1:2 NPK ratio, where 35 kg N/ha was applied when LCC reading was below 4; and e) growth stage-based N management, where N was applied in three splits: 35 kg N/ha each at mid-tillering, panicle initiation and flowering stages. All P and K fertilizers were applied basal at 14 days after transplanting. Mestiso 20 had significantly higher yields (6.6-10.4 t/ha) than yields of PSB Rc82 and NSIC Rc160 (5.2-9.5 and 5.0-8.9 t/ha), higher harvest index than PSB Rc82 and NSIC Rc160, and higher ANUE of 31.9-53.9 kg grain/kg N applied than inbred varieties. With LCC, varying the N, P and K ratio did not affect yield and ANUE since P and K were optimum under Maligaya clay soil condition based on nutrient omission plot technique.

Keywords: agronomic nitrogen use efficiency, hybrid rice variety, inbred rice variety, leaf color chart, yield potential

AS - 14

**DISEASE RESISTANCE AND YIELD ASSESSMENTS OF
PEANUT (*Arachishypogaea* L.) INOCULATED WITH
Sclerotium rolfsii Sacc. AT DIFFERENT GROWTH STAGES**

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Sclerotium rolfsii Sacc. is an economically important pathogen causing damping-off, seed borne rot, pod rot, and stem and root rot diseases in peanut. A study using split plot arrangement in Randomized Complete Block Design replicated three (3) times was conducted to determine the yield potential of three promising peanut varieties (PSB Pn 1, PSB Pn 6, and CV Pn 90320) as influenced by growth stage inoculation and varietal resistance to *Sclerotium rolfsii*. Inoculation of *S. rolfsii* served as the factor under the Main Plot, Variety represented the Subplot factor, and Growth Stage for the Sub-subplot. The inoculation of *S. rolfsii* had a highly significant effect on the severity of stem rot infection while variety factor had a significant effect on the percent pre- and post-emergence damping-off infection in variety CV Pn 90320 at 20.766% and 18.192%, respectively. There was also a highly significant effect of growth stage on the percent pre- and post-emergence damping-off infections. On the three-factor interaction, the Seedling Stage was the most susceptible stage of peanut to pre-emergence damping-off while Full Pod Stage was the most susceptible to post-emergence damping-off, stem rot, and pod infections. The highest yield of 1,447.7 kg/ha was recorded from variety PSB Pn 1 inoculated with *S. rolfsii* at full pod stage. The three-factor interaction effect was found to have no significant difference on yield. However, the same interaction caused a significant effect on the percent pod infection of the three peanut varieties.

Keywords: *Sclerotium rolfsii*, inoculation, peanut, varietal resistance, yield

AS - 15

SCREENING EGGPLANT GERMPLASM FOR DROUGHT TOLERANCE UNDER GREENHOUSE CONDITION

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Drought stress can adversely affect the plant morphology, physiological processes and potential fruit yield of hardy vegetable crops like eggplant (*Solanum melongena* L.). The threat of climate change has made it imperative to develop new eggplant varieties for drought-prone environments. One hundred eggplant genotypes consisting of commercial varieties and different species from the national eggplant germplasm collection were screened for drought tolerance under greenhouse conditions. Greenhouse experiments were conducted in batches with two commercial varieties (Dumaguete Long Purple and Mistisa) as controls. Three-week old seedlings were transplanted to 16 liter-plastic pails containing 10 kilograms soil. Drought was imposed on 6 week-old seedlings by discontinuing irrigation for drought treatment and regular watering for the well-watered treatment. The top 20% and the lowest performing entries for each batch were included in a verification trial in order to identify possible parental materials. The performance of 27 selected genotypes together with the check varieties was reassessed under drought condition in the greenhouse. These genotypes differed significantly in terms of measured morphological and physiological traits. Wide variation in stomatal conductance, an indication of stomatal opening under stress, was observed with values ranging from 64.02 – 294.49 mmol/m²s. The relative leaf water content (RWC) of the entries also differed significantly with RWC values of 43 to about 100% under drought. On the other hand, the root shoot (RS) ratio values showed entries with high dry matter allocation to the roots. Moreover, root dry weight values ranged from 0.12 to 1.72 g plant⁻¹. The significant variation among eggplant genotypes under drought condition indicated opportunities for the development of drought tolerant eggplant varieties.

Keywords: eggplant, drought, germplasm, breeding, root morphology

AS - 16

DETECTION OF CAPRINE ARTHRITIS ENCEPHALITIS (CAE) VIRUS IN BLOOD SAMPLES BY LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) ASSAY

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Caprine arthritis encephalitis (CAE) virus, of the subfamily Lentivirus of the Retroviridae causes persistent disease which is characterized by polyarthritis and mastitis in adult goats and progressive paresis (leukoencephalomyelitis) in kids. This is transmitted mainly through ingestion of virus-infected colostrum and by direct contact. A loop-mediated isothermal amplification (LAMP) assay was developed for the detection of caprine arthritis encephalitis (CAE) virus using blood samples. Species-specific primers amplifying the *gag* gene of the proviral region were used to detect CAE virus. The LAMP reaction result was obtained 60 minutes after incubation at a constant temperature of 63°C in a heating block. Resulting amplicons of the assay were visualized by addition of SYBR green dye after the reaction and by agarose gel electrophoresis. The sensitivity of LAMP assay was evaluated by comparing its result with nested-PCR. Based on the experiments, the result of the assay indicates a rapid and sensitive test for the detection of CAE virus.

Keywords: loop-mediated isothermal amplification (LAMP), caprine arthritis encephalitis (CAE) virus, proviral region, nested-PCR

AS - 17

DEVELOPMENT OF LOOP-MEDIATED ISOTHERMAL AMPLIFICATION (LAMP) PROTOCOL FOR RAPID DETECTION OF WHITE SPOT SYNDROME VIRUS (WSSV) IN SELECTED SITES OF THE PHILIPPINES

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Shrimp disease outbreaks in the Philippines have remained uncontrollable because disease diagnostics is inaccessible to most shrimp farmers. A new technology known as loop-mediated isothermal amplification (LAMP) is a practical alternative for rapid detection of viral and bacterial pathogens. This assay is performed under isothermal condition using four sets of primers that target six distinct regions in the DNA template. In this study, loop mediated isothermal amplification protocol for detection of WSSV was developed which we hope to bring to the farmer's level. Asymptomatic *Litopenaeus vannamei* samples were collected from selected sites (Iloilo, Batangas, Bulacan, Laoag, and Leyte) were tested for WSSV infection using LAMP. Results showed that samples from Iloilo, Batangas, Bulacan, and Leyte were positive for WSSV infection, while shrimps collected from Laoag were found to be WSSV-free. LAMP assay was performed along with the conventional PCR method for further confirmation and detection. Temperature range of 55p C - 68p C for WSSV detection and incubation period of 45 minutes to 1 hour were shown to be viable conditions for the LAMP assay. The detection of WSSV using LAMP was found to be 10 times more sensitive than PCR. These results suggest that LAMP protocol can serve as a good alternative for the conventional PCR due to its higher sensitivity, speed, and practicality because it does not need an expensive thermal cycler. This can make pathogen detection accessible to small scale shrimp industries in the country.

Keywords: LAMP, WSSV, PCR, *Litopenaeus vannamei*, shrimp

AS - 18

**GENOTYPING AND MOLECULAR CHARACTERIZATION
OF NRAMP1/-2 GENES AS LOCATION OF MARKERS
FOR RESISTANCE AND/OR SUSCEPTIBILITY TO
Mycobacterium bovis IN SWAMP AND
RIVERINE WATER BUFFALOES**

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Natural resistance-associated macrophage proteins (*NRAMP*) is associated with disease resistance across animal species. It plays a critical role in innate immunity and adaptive immunity. This study investigated the contribution of *NRAMP1* and *NRAMP2* to the resistance or susceptibility of water buffalo to *Mycobacterium bovis* infection. Water buffaloes were TB tested by single intradermal tuberculin test (SITT) using Bovine antigen. Animals which reacted to SITT were subjected to comparative intradermal tuberculin test (CITT). *NRAMP* genes were then further examined by PCR and single strand conformational polymorphism (SSCP) assay. The isolated genes were also cloned and sequence to confirm the nucleotide polymorphisms. Nucleotides were assessed by sequence alignment. The SSCP result showed that among the reactor and non-reactor animals to intradermal tuberculin test, four conformational patterns were observed in *NRAMP1* while two conformational patterns in *NRAMP2*. SSCP showed that the frequency of occurrence of four-band pattern were mostly from the reactor animals (66.41%). Sequence alignment clearly established the nucleotide polymorphisms between the conformational patterns. This study suggests that these polymorphisms are potential markers for resistance or susceptibility to *Mycobacterium* infection. The findings regarding the allelic patterns comparing the reactor and non-reactor water buffaloes will be very useful in future breeding plan for the selection of TB resistant animals.

Keywords: *NRAMP1*, *NRAMP2*, water buffalo, *Mycobacterium*, disease resistance, disease susceptibility

AS - 19

VALIDATION OF CATTLE DNA MARKERS FOR GENETIC DEFECT SCREENING IN WATER BUFFALOES

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Genetic defect screening is one of the important techniques contributing to the advancement of livestock industry. It involves a systematic method of determining genetic or inherited aberrations affecting different species of animals. Here, the use of DNA markers established for screening genetic defects in cattle, *i.e.* Bovine leukocyte adhesion deficiency (BLAD), Deficiency of uridine monophosphate synthase (DUMPS), citrullinemia and freemartinism, were applied to water buffaloes accordingly. Evidences on the genomic relatedness of cattle to water buffaloes would guide the use of the more established genetic information of cattle on buffaloes. PCR and restriction fragment length polymorphisms (RFLP) were utilized to identify the inherited heterozygous and recessive allele conditions. DNA sequencing was also performed to verify the PCR products identifying the specific base change. Apparently, the mutation lethal in cattle was found in normal buffaloes for BLAD; thus, the established target gene markers for cattle may not be suitable for water buffaloes. Nevertheless, this study emphasizes the effectiveness of cattle gene markers for DUMPS, citrullinemia, and freemartinism for genetic defect screening applications on water buffaloes. Therefore, this study leads to having a standard molecular method for breeders in screening the animals at risk for the defects and identify carriers to eliminate recessive defect genes in the Philippine livestock.

Keywords: genetic defect screening, Philippine Carabao Center, BLAD, DUMPS, citrullinemia, freemartin

AS - 20

**SINGLE NUCLEOTIDE POLYMORPHISMS IN THREE
GENES OF THE WATER BUFFALO (*Bubalus bubalis*)
ASSOCIATED WITH MILK YIELD AND MILK
COMPONENT TRAITS: THEIR IMPLICATION TO THE
PHILIPPINE CARABAO CENTER'S DAIRY BUFFALO
BREEDING PROGRAM**

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Selection of dairy buffalo cows by the Philippine Carabao Center (PCC) involves collecting milk performance data for 2-3 lactations prior to ranking them based on the milk production, a process which requires 6-7 years to identify a good milker. In the case of bulls, milk performance data of daughters are first evaluated, requiring around 8 years to identify animals with high genetic merit. Using available performance records coupled with deoxyribonucleic acid (DNA) markers (i.e., single nucleotide polymorphisms, SNPs) associated with milk traits, identification of good dairy animals can be dramatically shortened to 2- 3 years while increasing the accuracy of selection. Thus this study sought to identify water buffalo SNPs associated with milk yield and milk component traits. DNA samples of buffalo cows with milk performance data were used in the study. Since the buffalo genome has not yet been sequenced, primers used to amplify the coding regions were based on the gene sequence of cattle. Association studies revealed that the combined effect of three SNP markers found in beta-lactoglobulin, protease inhibitor and prolactin receptor genes have favorable association with milk yield, fat yield, protein yield, milk protein, and milk fat percentages. Only young semen donor bulls with high genetic merit that carry the favorable genotypes of the three markers will be used for breeding immediately rather than wait for progeny testing (PT), thereby reducing the number of bulls entering the PT program, resulting in lower investment costs in the long term.

Keywords: water buffalo, milk production, DNA, SNP, breeding program

AS - 21

VACCINE TRIAL OF RECOMBINANT *Schistosoma japonicum* PARAMYOSIN IN WATER BUFFALOES

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The overall aims of this project are to assess the safety and immunogenicity of the *Schistosoma japonicum* vaccine Paramyosin among water buffalos residing in endemic areas. The study was conducted in four villages in Leyte, an area highly endemic for *S. japonica*. One hundred fifteen animals provided baseline stool samples for coprologic examination, with preliminary results using FLOTAC showing a 10% prevalence of schistosomiasis. Forty-nine animals were treated with 25 mg/kg Praziquantel, and 40, 36 and 32 animals were given the first, second, and third dose of the paramyosin vaccine, respectively. The safety trial involved the first 20 animals and included skin testing, vaccination, anaphylaxis monitoring, and hematology and serum chemistry analysis. None of the animals exhibited anaphylaxis, and all hematology and serum chemistry markers were within normal range or were similar to pre-vaccination levels. Immunogenicity assessment showed that the paramyosin vaccine induced robust antibody responses to all animals, as assessed by ELISA. Overall, this project demonstrated that the *S. japonicum* paramyosin vaccine is safe, well-tolerated, and immunogenic among water buffalos residing in endemic areas. Moreover, the outcome of this work shows promise for the development of a schistosoma vaccine for humans.

Keywords: *Schistosoma japonicum*, paramyosin, vaccine, immunogenicity, water buffaloes

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DETECTION AND ISOLATION OF *Fusarium* spp. CAUSING DEGNALA DISEASE IN WATER BUFFALOES

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Degnala disease is an endemic, more or less fatal disease of water buffalo. This disease characterized by necrosis, followed by gangrene of body appendages. The animal becomes weak and emaciated, but also becomes crippled, causing enormous economic losses due to decreased productivity and functional capacity in the form of reduced milk production and draught capacity. This disease is believed to be caused by mycotoxicosis resulting from ingestion of contaminated feeds with *Fusarium* spp. which are opportunistic nosocomial pathogen often fatal invasion mycoses. A total of three animals were found suffering from necrotic lesions on feet and between digits. Moreover, gangrenous ulceration of the earlobes and tail rot were observed. This study aimed to identify the causative agent by performing differential diagnosis, such as ELISA and conventional serological tests for viral and bacterial diseases, as well as plate culture for fungal isolation. The result showed negative from various tests. However, a *Fusarium* species was isolated from the rice straw fed to water buffaloes and clearly identified by staining and direct microscopic exam. The *Fusarium* species was recognized based on colony and presence of multiseptated sickle-shaped conidia. This finding confirmed the presence of Degnala disease caused by the mycotoxicosis produced by *Fusarium* spp. It is recommended to avoid feeding mouldy rice straw in buffalo. However, further field and laboratory investigation are needed to understand the mycotoxin involved in producing Degnala disease.

Keywords: Degnala disease, *Fusarium* spp., Water buffalo, mycotoxicosis

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PARENTAGE VERIFICATION USING MICROSATELLITE MARKERS IN WATER BUFFALOES (*Bubalus bubalis*)

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Generation of breeding values requires accurate recording of sire, dam and offspring in the pedigree or herd registry. Misidentification of an animal may give undue credit to a wrong bull thereby affecting the breeding value prediction. Verification of pedigree lines is very important, particularly for those who avail of the many breeding technologies in livestock that have been developed and are being widely used today (such as artificial insemination and embryo transfer). The advent of DNA marker technology, in particular analysis using microsatellite (MS) markers, offers several advantages over conventional parentage testing systems. This study sought to identify polymorphic microsatellite markers that can be used for routine parentage verification of Philippine buffaloes. Out of 75 cattle MS markers genotyped by fragment analysis, twenty markers were found to be polymorphic in Philippine Carabao Center's dairy buffalo population. These twenty markers - FBN12, BM1706, CSSM047, INRA006, RM372, RM209, MB101, RM04, BMS1001, MAF65, ILSTS012, BMS555, MAF45, TGLA227, CSSM019, BM8129, BOVILS30, BMS2152, CSSM037 and TGLA73 - had a PIC value greater than 0.5 and heterozygosity values greater than 0.6. Paternity analysis using at least twelve markers with the aid of the Cervus 3.0 software resulted in the identification of the most probable sire (out of several candidate males). Moreover, parent pair analysis with known sexes resulted in the identification of the most likely dam (out of four possible females) and sire (out of four possible males) of an embryo transfer (ET) calf.

Keywords: water buffalo, parentage verification, DNA, MS marker, paternity analysis

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CHARACTERISITICS OF ST. CROIX PROGENIES

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Sheep is the least developed among the livestock industry. Smallholder farmers raise it to supplement their family income. The low productivity of sheep can be attributed to poor genetic quality, poor nutrition, and poor management practices. Genetic quality can be improved through breeding using improved breed. St. Croix has been reported as adapted to tropical condition, fertile, and resistant to parasites. It has no horn, long tail and is pure white in color. This study was conducted to evaluate the reproductive performance of the parental stocks using their offspring. Two groups of ewes and two purebred St. Croix rams were used. Flock mating system was practiced. All animals were fed by combined grazing and cut and carry feeding system. F1 lamb had an average birth weight of 2.34 kg, average weight at 8 months of 17.02 kg, sex ratio of 1.48, twinning percentage of 25.5% and percent mortality of 8.75%. The color of the lamb produced varied from pure white, pure brown, 50% white and 50% brown, 90% black and 10% white. Male lamb produced had horns and all the lamb produced had long tails. Physical characteristics of of the male parent dominantly showed in the progenies like color and the size of tail.

Keywords: Lamb, sheep, St. Croix, progeny, F1

AS - 25

**EGG PRODUCTION RATES OF THREE CALANOID
COPEPOD (CRUSTACEA, COPEPODA) SPECIES FROM
A SARDINE FISHERY SITE OFF DIPOLOG CITY,
ZAMBOANGA DEL NORTE, PHILIPPINES**

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Sardines are important fisheries species in the Philippines. These species are primarily zooplanktivorous in almost all their life stages, but studies on their zooplankton prey are very rare. Many studies point to the fact that prey population dynamics are strongly linked with positive recruitment and reproduction in many of subtropical and temperate sardine species. This study determined egg production rates of three copepod species from a sardine fishery site off Dipolog City. Females of *Cosmocalanus darwini*, *Subeucalanus* sp., and *Paracalanus* sp. were fed singly or a mixture of the microflagellate *Isochrysis* sp. and the chain-forming diatom *Chaetoceros* sp. for 12 hours, and their egg production rates were determined. Compared with copepods in the control (unfed) group that showed mean egg production rates of 0-4 eggs female⁻¹ day⁻¹, all three copepod species fed singly with *Isochrysis* sp. showed highest mean rates of 7-12 eggs female⁻¹ day⁻¹. Highest egg production rates may be related with high polyunsaturated fatty acid content in *Isochrysis* sp., which is essential for the growth and egg production of these copepod species.

Keywords: copepods, egg production, *Cosmocalanus darwini*, *Paracalanus* sp., *Subeucalanus* sp., *Isochrysis* sp., *Chaetoceros* sp.

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**SPECIES OF MYSIDS (CRUSTACEA, MYSIDACEA) IN
SEAGRASS BEDS OF MISAMIS OCCIDENTAL,
NORTHERN MINDANAO, PHILIPPINES**

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Tropical seagrass beds are important coastal ecosystems as habitat, nursery and spawning grounds for many ecologically and commercially important shellfish and finfish species, but studies and information on the prey of these fishes, the seagrass zooplankton, are scarce. An indicator of a healthy seagrass bed ecosystem - mysidacean shrimps - are very common resident seagrass zooplankton that trophically link small zooplankton and finfish species. This study was conducted to identify and classify the different mysid species collected from seagrass beds of seven municipalities of Misamis Occidental. Eight species were identified, and all species were found to be new records from the study area. All under Family Mysidae, Subfamilies Siriellinae, Gastrosaccinae, and Mysinae were represented respectively by *Siriella gracilis* and *S. sinensis*; *Anchialina grossa*, *Haplostylus bengalensis*, *Haplostylus* sp., *Iiella ohshimai* and *Pseudanchialina inermis*; and *Mesopodopsis* sp. *Siriella sinensis* was present in all sampling sites. *Haplostylus* sp. and *Mesopodopsis* sp. are possible new species.

Keywords: seagrass ecosystem, zooplankton, Mysidacea, taxonomy, Misamis Occidental

AS - 27

POPULATION OF JANITOR FISH (*Hypostomus plecostomus*) IN PULANGUI LAKE, BUKIDNON, CENTRAL MINDANAO

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A study on the population of janitor fish (*Hypostomus plecostomus*) in Pulangui Lake, Bukidnon was conducted with the aim to determine the population level of janitor fish and its effect on the fishing gears of the fishermen. Specifically, this study sought to: 1) determine the percentage composition of janitor fish in the gillnet catch; 2) determine the Catch Per Unit Effort (CPUE) for the janitor fish in the lake; and 3) describe the gillnets of fishermen reported damaged by the janitor fish. Two study sites were chosen situated at Dologon and Tubigon, both in Maramag, Bukidnon, with 3 sampling periods in both study sites. There were 46 fishermen respondents: 26 in Station 1 (Dologon) and 20 in Station 2 (Tubigon). The study showed that the janitor fish was a minor component of the total catch (8.23%) and a CPUE of 0.298 (kg/person/gillnet/trip). A total number of 190 janitor fish was collected during the entire study. Most of the janitor fish collected were 21 - 30cm in length. Characteristic damage made by the janitor fish on the gillnets were in the form of jagged cuts on the nylon strand caused by the spiny hard skin and sharp fins of the janitor fish. Based on the findings of this study, the janitor fish being a minor component of the fish catch is a minimal threat at present. However, like other invasive species, this can be a potential ecological and fisheries problem in Pulangui Lake in the future. It is therefore recommended that population control measures of this fish should be given immediate attention by the concerned authorities. Further study is recommended to include other fish landing areas and longer data monitoring to determine further changes in the population of janitor fish in the lake.

Keywords: population, janitor fish, Pulangui Lake, CPUE

AS - 28

**POPULATION STOCK STRUCTURE OF YELLOWFIN
(*Thunnus albacares*) TUNA IN WESTERN
AND CENTRAL PACIFIC INFERRED FROM
MICROSATELLITES ANALYSIS**

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Yellowfin tuna is one of the highly migratory larger tuna species. It is shared by the Philippines with neighbor fishing countries which are likewise highly dependent on the tuna industry for their economy. The sustainable management of tunas, particularly of yellowfin, in the Philippines and in the Western and Central Pacific (WCP) is therefore imperative and this requires an established stock identity. In this study, the population structure of yellowfin tuna in the region was analyzed through 243 individuals from Zambales, Puerto Princesa, Samar, General Santos, and Bismarck Sea using nine microsatellite loci. A significant level of genetic differentiation among the populations was observed ($F_{st} = 0.1644$, $P < 0.05$). The STRUCTURE analysis revealed that Bismarck Sea samples were different from the Philippine samples. Two divergent stocks in the WCP may exist.

Keywords: *Thunnus albacares*, highly migratory, microsatellite, genetics, population structure

AS - 29

SEVEN SPECIES IN ONE: USING MITOCHONDRIAL DNA TO RESOLVE THE GENETIC IDENTITY OF *DULONG*

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Sustainable management of marine resources requires accurate identification of fish species in all their life stages. Such information is essential for managing biodiversity hotspots, such as the Verde Island Passages in the southern tip of Luzon Island. Among the marine species in the area is a group of small fishes collectively known as *Dulong*. Morphological data from previous investigations concluded that this congener is composed of either the family Clupeidae or Engraulidae in their larval stage. To verify these findings, we utilized partial fragments of the 16S rRNA gene. Seven species from the families Clupeidae, Gobidae and Scombridae were identified among the collections. However, no members of Engraulidae were identified among the samples, possibly due to the seasonality of its abundance. Species distribution and genetic data suggest high connectivity among most sampling sites. Interestingly, individuals collected from the outermost fringes of the Verde Island Passages exhibited different species composition. Such pattern might indicate different ecosystems within this region which merits further investigation.

Keywords: *Dulong*, Clupeidae, 16S rRNA, species composition, connectivity

AS - 30

WATER MANAGEMENT IN BRACKISHWATER FISHPOND: THE METHODS AND PRACTICES OF MILKFISH GROWERS IN PADRE BURGOS, QUEZON

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In brackishwater fishpond culture, water management is the most important aspect of fishpond operation. A sufficient supply of good quality water is essential because it affects production, growth, and survival of fish. This study was conducted to assess the methods and practices involved in water management of brackishwater fishpond. The data can also be used as baseline information for the planning and development of mariculture. This study utilized the descriptive type of research and the survey questionnaire as the main tool for gathering the data. Key informant interviews (KII) and focusedgroup discussions (FGD) were conducted in Padre Burgos, Quezon Province. Results of the study showed that the culture system practiced is the extensive system with 65.71%, followed by semi-intensive 28.57%, and 5.71% for intensive system. The species cultured include: milkfish (*Chanoschanos*), shrimp (*Penaeusmonodon*), mudcrab (*Scylla serrata*), and grouper (*Epinepheluscoioides*). Sizes of fishponds vary from 0.4 to 55.0 hectares per individual fishfarmer. The source of water is through tidal fluctuation, brought into the ponds through river or creek. During low tide, 20 to 50% of pond water is released from pond, and when the tide begins to rise, the gate's slabs are removed and new water is allowed to enter until it reaches the desired water depth (50 - 100 cm) or when the water is fully replaced. Sixty percent of fishfarmers change water daily following the tides; 25.7% changed water twice a week and 14.3% changed the water once a week. Frequent change/freshening of pond water help improved water quality, thus improving fish growth. Maintaining optimum environmental conditions for fish growth is crucial to the success of one's venture in brackishwater fish production and proper water management is of utmost importance.

Keywords: water management; brackishwater fishpond; milkfish growers; methods and practices; Padre Burgos, Quezon

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PRODUCTION OF *Porphyra* “GAMET” AND ITS IMPACT TO LIVELIHOOD IN COASTAL AREAS

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Porphyra is the most expensive seaweed produced in Ilocos Norte. It is the most sought-after seaweed locally and internationally, which explains its demand. The *Porphyra* production in Ilocos Norte is confined to gathering that local seaweed from the wild. However, *Porphyra* production has failed to progress from its primitive state due to its age-old method of sun-drying to prolong the shelf life of *Porphyra*. This study highlighted the status of *Porphyra* production and its impact on the livelihood of those who are engaged in the industry. Data were gathered from a semi-structured interview of 57 respondents who have been engaged in *Porphyra* production in Ilocos Norte. The demographic and socio-economic profiles of the respondents and their harvesting and sale practices were determined as frequencies and percentages: Pearson's r correlation coefficient and chi square determined the relationship between respondent's practices as to the frequency of gathering. The harvesting practices of *Porphyra* gatherers were: 50-69 gatherings per season; frequency of gathering was five times a week with an average volume of three ganta (1,400 g fresh weight) of *Porphyra* harvested per gathering. Improvement of drying technique of *Porphyra* would increase production and consequently, give higher income to gatherers. It is recommended that the local governments of Burgos and Pagudpud, Ilocos Norte should form a cooperative and acquire mechanical dryers for drying *Porphyra*.

Keywords: harvesting practices, mechanical dryer, livelihood, *Porphyra* production, socio-economics, sun-drying

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GROWTH PERFORMANCE OF RED ALGAE *Gracilaria* sp. USING LONG LINE AND NET CAGE METHOD

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A study was conducted in Simbuco, Kolambugan, Lanao del Norte to: 1) determine the growth of *Gracilaria* sp. in terms of weight (g) and total length (cm) using long line method; 2) determine the growth in terms of weight (g) and total length (cm) using net cage method; and 3) determine the survival rate (%) using long line method and cage method after 45 days and monitor the physico-chemical parameters of the water, such as temperature (°C), pH, and salinity (ppt). Two treatment methods were used: long line method as treatment (T_1) and net cage method as treatment 2 (T_2). These were arranged in a complete randomized design (CRD) with 3 replications each. There were 3 long line and 3 net cages planted with 20 fragments of *Gracilaria* sp. with an initial length of 15 cm per fragment. Results of the study showed that after 25 days, T_1 had a mean weight (g) of 213.62 while T_2 was only 77.69. After 45 days, the total weight (g) and length (cm) of *Gracilaria* sp. increased with a mean of 347.35 (T_1) compared to T_2 of 83.34 only. Analysis of variance showed that T_1 had significantly higher growth than the net cage method ($P < 0.01$). In total length (cm), T_1 had a mean length (cm) of 22.22 while T_2 was only 15.89 ($P < 0.05$). However, no significant difference was observed in terms of total length after 45 days of culture ($P < 0.05$). A significantly higher survival of *Gracilaria* sp. was observed from T_1 of 18.34 (91.70%) than T_2 of 10 (50%) ($P < 0.01$) after 45 days of culture. Mean readings of selected physico-chemical parameters of water were: temperature: 23.5 to 24.6°C; salinity: 25.0 to 26.5 ppt; and pH: 7.5 to 7.8. Thus, the use of long line method gave higher production than the net cage method. It is recommended that further studies be conducted to compare the floating net cage and submerged net cage methods in terms of growth and survival in the same culture period.

Keywords: growth performance, red algae, *Gracilaria* sp., long line method, net cage method

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ENHANCING THE PRODUCTIVITY OF WHITE CORN THROUGH THE UTILIZATION OF CORN COBS AS POTASSIUM FERTILIZER

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Corn is the second most important cereal crop in the Philippines and the corn industry contributes significantly to the country's economic development. White corn is now being promoted as an alternative staple to rice to supplement the country's food gap. An aspect that can enhance white corn productivity is the effective use of nutrients from agricultural waste, such as corn cobs and naturally occurring indigenous fertilizers. Corn cobs are part of the maize ears that are not utilized for food; these are usually used for cooking fuel or just burned in the field. The mineral nutrients of corn cobs have not been analyzed. In particular, knowledge of the potassium content and the incorporation of corn cobs in the soil as organic fertilizer source (substitute for inorganic source), may mean substantial savings for the corn farmer. This project sought to: 1. compare the cobs from different corn cultivars and their contribution to soil fertility and corn yield in terms of available potassium and other nutrients; 2. to evaluate the effectiveness of corn cobs and ashes when used as K-source for the soil and as foliar spray; and 3. to determine the time required for the potassium to be available for plant uptake in the field. Greenhouse and field experiments were conducted in UPLB, Isabela, and Bukidnon. Preliminary results show that corn cobs are promising materials as potassium source for fertilization of white corn. Ten to fifteen tons cobs per hectare for open pollinated variety, and 20 tons per hectare for hybrids are recommended to provide sufficient K fertilization and rapid growth. Corn fields yielding 6-8 tons grains per hectare can produce 1.5-2 tons cobs/ha at 80% shelling percentage. Ashed corn cobs gave the highest growth and biomass production compared to whole, shredded or finely ground cobs.

Keywords: white corn, corn cobs, potassium fertilization, potassium nutrition, ashed corn cobs

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EVALUATION OF BIO-WASTE MIXTURES AND RATIOS TO IMPROVE ORGANIC FERTILIZER PRODUCTION

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The most eco-friendly option to manage generated biodegradable wastes is to convert these into a valuable resource, one of which is organic fertilizer (OF). However, because of the diversity of these wastes, appropriate mixture combination coupled with the right ratio are necessary considerations in the conversion process because this can facilitate faster decomposition, improve nutrient composition, and offer better recovery rate. Considering these as the criteria, eight mixture combinations and ratios of bio-wastes were evaluated, as follows: OF₁ - 55% plant debris (PD): 35% animal manure (AM): 10% carbonized rice hull (CRH); OF₂ - 35% PD: 55% AM: 10% CRH; OF₃ - 90% fresh plant debris (FPD): 0% AM: 10% CRH; OF₄ - 40% saw dust (SD): 50% AM: 10% CRH; OF₅ - 30% PD: 30% AM: 30% SD: 10% CRH; OF₆ - 40% AM: 50% PD: 10% CRH; OF₇ - 50% AM: 40% PD: 10% CRH; and OF₈ - Vermicomposting. Results showed that OF₁, OF₃, and OF₈ are preferred as the best conversion/production options because these have the highest NPK content (2.15%, 2.00% and 1.95% N, respectively; 3.55%, 3.50% and 1.06% P, respectively; and 1.45%, 2.75% and 2.12% K, respectively); fastest decomposition period (2 to 2.5 months); and highest recovery rate (50 to 70%), except OF₃ which gave only 50%, which is attributed to the composition of the mixture (90% FPD). These also gave better return of investment (ROI) ranging from 37% to 43%. These findings suggest that factors such as different bio-waste materials, mixture combinations, and ratios affect OF production with respect to quality, duration of production, and recovery rate.

Keywords: organic, fertilizer, biodegradable, NPK, decomposition

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**ON-FARM PRODUCTION OF VERMICOMPOST AND
EARTHWORM BIOMASS (*Eudrilus eugeniae*) FOR NILE
TILAPIA (*Oreochromis niloticus*) CULTURE IN
FRESHWATER PONDS**

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In organic aquaculture, the non-use of chemical fertilizer and fish meal is advocated. Vermicomposting was done using paragrass (*Brachiaria mutica*) and the “African night crawler” (*Eudrilus eugeniae*). The processed grass was stocked in outdoor beds at 100 and 200 kg/m² and 1 kg/m² of the earthworm. In the first trial, the vermicompost which was obtained after 30 days was applied at 2.5 and 5 t/ha in 200-m² freshwater ponds during the 120-day culture of sex-reversed Nile tilapia (*Oreochromis niloticus*) fingerlings stocked at 2/m². In the second trial, only application of the vermicompost at 2.5 tons/ha was done in the ponds stocked with the fish at 1/m² for 120 days in Treatment I; in Treatment II, the ponds were fertilized with vermicompost at 2.5 t/ha in the first 60 days of culture and feeding of a moist feed consisting of 850 g of fine rice bran and 1 kg of processed earthworm biomass was given to the fish every other day for the last 60 days of culture. The results showed that a production of 41.85 kg of vermicompost and 2.17 kg of earthworm biomass were obtained with 200 kg/m² of the processed grass after 30 days of vermicomposting compared to 19.8 kg of vermicompost and 1.05 kg of earthworm biomass with 100 kg/m² of the processed grass. In the first trial, the yield of harvestable-sized fish (>50g) was significantly greater (P<0.05) in the ponds fertilized with vermicompost at 2.5 t/ha compared to those of the control ponds and ponds fertilized at 5 t/ha. In the second trial, the yield of harvestable-sized fish in the ponds initially fertilized with vermicompost at 2.5 t/ha in the first 60 days and where fish were fed with the moist feed in the last 60 days of culture was 44% more than that of the fish in ponds fertilized only for the whole culture period. The results also indicated that use of vermicompost as organic fertilizer at 2.5 t/ha for 120 days and feeding of the fish with the moist feed in the last 60 days of culture were more cost-effective compared to those of the controls.

Keywords: vermicompost, earthworm, Nile tilapia, freshwater ponds

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SYNERGY EFFECTS OF BIOFERTILIZERS MYKOVAM™ AND BIO-N™ ON GROWTH AND SURVIVAL OF INDIGENOUS TREE SPECIES IN A GRASSLAND IN CAVINTI, LAGUNA

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Indigenous tree species are priority planting materials for the National Greening Program of the Department of Environment and Natural Resources. Areas for reforestation are marginal grasslands where plant growth is stunted and seedling survival is low. BIOTECH's biofertilizers such as Bio-N™ (containing N-fixing bacteria) and Mykovam™ (contains phosphorus and other nutrients absorbing mycorrhizal fungi) can increase seedling growth and survival in such areas. No studies have been done to determine the synergy effects of these biofertilizers on trees. Narra (*Pterocarpus indicus*), salago (*Wikstroemia lanceolata*), kisubeng (*Sapindus saponaria*), and tuai (*Bischofia javanica*) seedlings were either uninoculated or inoculated with Mykovam and outplanted in a grassland in Cavinti, Laguna after four months at BIOTECH, UPLB. Bio-N was added during outplanting. During outplanting, the Mykovam inoculated tuai, salago, kisubeng, narra, and salago exhibited better growth than the control. Mykovam inoculated indigenous tree species were 3 to 26% taller than the control. Four months after outplanting, seedling survival was 100% except the uninoculated salago (5% mortality). Synergy effects of the two biofertilizers were observed on salago and narra. Mykovam+Bio-N increased stem diameter of narra by 53% as compared with Mykovam (32.5%) and BioN (15%). Bio-N+Mykovam promoted the highest number (n=32) of branches in salago followed by those inoculated with Mykovam alone (n=24). BioN promoted the greatest increase in height (17%) of tuai. In kisubeng, Bio-N and Mykovam applied singly gave the greatest increase in stem diameter (20 and 18%, respectively) and the lowest (7%) was in Mykovam+Bio-N treatment. In conclusion, narra and salago inoculated with combined Bio-N™ and Mykovam™ gave the best growth and can be recommended for a successful reforestation in grasslands in Cavinti, Laguna.

Keywords: mycorrhizal fungi, narra, salago, kisubeng, tuai

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UTILIZATION OF WATER HYACINTH DEBRIS AS BULKING MATERIAL FOR COMPOSTING OF MARKET WASTE

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A pilot-scale study was conducted to determine the technical viability of composting technology as an alternative disposal option for large-scale water hyacinth debris. Feedstock materials consisted of chopped, dried water hyacinth (33%), swine manure (10%), and shredded market waste (57%). Dried water hyacinth served as bulking material, swine manure as nitrogen source, and market wastes as wet organic materials. Microbial inoculant was added as a component of the bioreactor composting technology. The composting process was initiated with loading of feedstock materials into the ITDI-developed bioreactor. Partially degraded materials harvested from the reactor were kept in the curing area for further degradation. Based on two pilot-scale runs, the compost produced had the following characteristics: dark brown, humus-like, odorless, pH of 7.9, 37% organic carbon, 14:1 C:N ratio, 12% total NPK, 80% total solids, non phytotoxic, and with acceptable levels of trace elements. These characteristics are indicative of a mature compost product and proved that dried water hyacinth can be an alternative bulking material for composting. Based on the feasibility studies conducted, composting with water hyacinth as dry matter was considered economically viable with an internal rate of return (IRR) of 61.5%. However, the economic viability of composting water hyacinth alone was found even better with an IRR of 85.1% and a lower investment requirement.

Keywords: water hyacinth, composting, in-vessel composting, bioreactor composting, *Eichhornia crassipes*

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ASSESSMENT OF COSTS AND BENEFITS OF A CARBON SEQUESTRATION PROJECT IN MANGROVE PLANTATION

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Payments for environmental services, such as carbon sequestration, propose a win-win solution in climate change mitigation and poverty alleviation. Recognizing the potential economic benefits that can be derived in establishing a carbon sequestration project, a cost and benefit study was done in a mangrove plantation site in northern Bohol, Philippines. Twelve sample plots were established to assess carbon stocks. Three carbon prices were used to determine the net incremental benefits at different ages (15, 20 and 40 years old) of plantations, namely, 10, 15 and 20 USD/ton. Correspondingly, the net present values (NPV) of plantations at different ages and prices were computed. Additionally, the internal rates of return (IRR) were computed for each price of carbon. By estimate, the community will receive negative NPVs if the purpose of the plantation establishment was solely devoted to carbon market at USD 10 per ton and at $i = .08$. The NPV starts to become positive at USD 15.0/ton at year 20 to 50. At price USD 20, all NPVs are positive. These values indicate that the feasibility of establishing mangrove plantation for carbon market alone is very sensitive to carbon price, *i.e.* at prices below USD 15.0 per ton, the plantation project would not be feasible. Similarly, if the interest rate will increase to 16 percent, the project would become only feasible at price USD 20.0/ton. Consequently, the IRR obtained were 5%, 14% and 50% for prices USD 10, USD 15 and USD 20, respectively. At prevailing market rates of interest at 8.0 percent, the project would not be feasible at USD 10.0 carbon price.

Keywords: carbon stock, conservation, economic value, mangrove plantation, PES

AS - 39

SEAGRASS CONTRIBUTION TO BLUE CARBON STOCKS IN THE PHILIPPINES

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Like other marine ecosystems, seagrasses play a vital role in enhancing blue carbon stocks. Blue carbon pertains to carbon that is stored and sequestered in mangroves, salt marshes, and seagrass meadows. Seagrasses are ribbon-like subtidal plants that are usually found along intertidal zones, particularly in areas where there is pooling of water during low tide. Globally, they cover 0.1% (18 million ha) and contribute 12% (20 Pg) to the total organic carbon buried in the ocean. To estimate the carbon stocks of a typical seagrass site in the Philippines, standard quadrat sampling was done in Banacon Island, Bohol to collect plant and sediment samples for biomass and carbon density analysis. Banacon Island is the largest man-made mangrove in Asia and is one of the key biodiversity conservation sites in Sulu Sulawesi Seascape. By estimate, seagrass plants contain a carbon stock of about 1.84 tC ha⁻¹. Three seagrass species were identified namely, *Halophila ovalis*, *Cymodocea rotundata* and *Enhalus acoroides*. Among these, *E. acoroides* was the most common. On the other hand, carbon stock in sediment was larger at 57.32 tC ha⁻¹. Contributing much to this value is the thick sediment layer observed that ranged from 56 cm to 100cm. Overall, seagrass meadows of Banacon Island contribute to about 59 tC ha⁻¹, a value that justifies their conservation, in addition to countless ecological services that they also provide to marine organisms and humans. By rough estimate, the Philippine seagrass meadows (27,282 sq km) contain 161 Mt of carbon stock.

Keywords: blue carbon, carbon stock, climate change, forest conservation, seagrass meadow

AS - 40

TOTAL ECONOMIC VALUATION OF KEY MANGROVE SERVICES IN THE PHILIPPINES: THE CASE OF BOHOL AND PALAWAN

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Total economic value (TEV) was used to estimate the values of different mangrove goods and services in Palawan and Bohol. Contingent valuation method (CVM) and travel cost method (TCM) were done to determine biodiversity and recreational values. Results showed that the highest direct use value per year was estimated at P25.521 million for Kamuning site, Palawan compared to P21.784 million for Banacon site, Bohol. For both sites, the highest benefit came from shrimp farming with P 8.1 million and P 4.3 million, respectively. Mollusk catch gave higher benefits to Kamuning (P 17.65 million per year) than in Banacon (P 2.362 million). Benefits from crabs and fish catch were higher in Banacon (P 6.6 million and P 3.2 million, respectively) than in Kamuning (P 0.604 million and P 0.166 million, respectively). Nipa thatch was the second highest benefit for Kamuning amounting to P 2.4 million. Contingent valuation analysis revealed a willingness to pay (WTP) of P 44/month per individual in both sites. The different factors affecting WTP include education, income and information. Recreation value of mangroves was estimated at P 83,079 in Banacon and P 2,769 in Kamuning. Overall, mangrove forests have multiple benefits to communities. It is important to consider that mangrove management be devolved to local communities for better resource accountability.

Keywords: economic valuation, ecotourism, mangrove, sustainable management, willingness to pay

AS - 41

MANGROVE COMMUNITY STRUCTURE AS INFLUENCED BY MINING ACTIVITIES IN CLAVER, SURIGAO DEL NORTE

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Surigao del Norte was identified as one of the municipalities with highest mangrove cover in the Philippines. However, the province also has active mining activities as it is blessed with rich mineral resources. The aim of the study was to determine the mangrove structure after decades of mining in the area. Specifically, the objectives were to conduct inventory of mangroves and associated species, biodiversity assessment, vegetation analysis, and regeneration of seedlings and saplings. There were 6 quadrats established with an area of 400 m². Within the quadrat, 3 regeneration plots were laid. Biodiversity indices, vegetation analysis and regeneration success were determined. Multivariate analysis was used to generate an ordination of the mangrove community. Bray-Curtis similarity index was constructed and the resulting matrix submitted to single linkage clustering and non-metric multi-dimensional scaling (nMDS). PRIMER 6 and BioDiversity Pro softwares were used in the analyses. The results showed 16 mangroves and 11 associated species observed. Dominance was highest in quadrat 3, Shannon's diversity in quadrat 1 and supported by the rarefaction analysis, evenness in quadrat 4, and species richness in quadrats 1, 2 and 6 with 9 species observed. The species distribution of pooled samples was random (P=0.04). Vegetation analysis revealed 3 species with highest importance values and these were: *Lumnitzera littorea* (68.76%), *Bruguiera sexangula* (44.42%), and *Scyphiphora hydrophyllacea* (40.29%). *Bruguiera gymnorrhiza* gave excellent seedling regeneration. All saplings gave poor regeneration condition. Similarity index revealed quadrats 4 and 5 separated from other groups at 87.7%, followed by quadrats 1 and 2 at 67.6%. The matrix was projected into nMDS overlaid with biodiversity indices showing 0.01 stress value.

Keywords: biodiversity, assessment, multivariate analysis, regeneration, importance values

AS - 42

BANAHAW DE DOLORES AFTER FIVE YEARS OF RESTRICTED PUBLIC ACCESS: ITS WATER QUALITY AND SOCIO-ECONOMIC STATUS OF THE COMMUNITY

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In 2004, certain areas of Mount Banahaw were declared closed to public access by the Protected Area Management Bureau of the Department of Environment and Natural Resources (PAMB-DENR). This declaration was made to restore the ecosystem integrity from the deterioration caused by unregulated human activities. As a major watershed in Quezon and Laguna, this resource needs restoration activities to ensure that the water sources in the area can regain their intended use before it is re-opened to the public. Water quality assessment was conducted in the three major water sources (Kristalino, SalamingBubog and Suplina Falls) in the closed area from September 2010 to August 2011 using physical and bacteriological parameters. The impact of closure on the socio-economic of Barangay Kinabuhayan, the community nearest to the closed area, was also determined. Results revealed that water from Banahaw de Dolores was generally cold (18.2°C-21°C) with near neutral pH (6.37-7.76) and low levels of chemical contaminants (43.1-45.4 ppm total dissolved solids, TDS). Coliform analysis showed that SalamingBubog Falls has overall status of Class AA, while Kristalino Falls and Suplina Falls have Class A status based on the water quality criteria set by DENR. This indicates that the water sources have regained their beneficial use as public supply of water after five years of moratorium. Survey showed that 93% of the households in the community are dependent on the mountain for their livelihood. Because farming activities were not affected by the closure, only 12% of the residents (porter/guide and store owners) reported a decrease in income due to the moratorium. Despite the perception among residents that closure did not affect their living condition, data indicated that 60% of them remained below the poverty line based on the 2011 poverty threshold. It is recommended that the local government of Dolores should initiate livelihood programs to empower the community through income diversification.

Keywords: Barangay Kinabuhayan, Mt. Banahaw de Dolores closure, water quality, socio-economic, protected area

AS - 43

WATERSHED CHARACTERISTICS AND WATER RESOURCE QUALITY

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Understanding the watershed, determining what needs to be restored and protected requires an understanding of its natural features, how it is used and its environmental quality. The study was conducted in the Parang River Basin, Pasuquin, Ilocos Norte to determine the watershed characteristics and its water resource quality, specifically the following: area length of the main stream, slope of the main stream, perimeter of the watershed, length of the streams, stream density, stream orders, length of perennial streams, drainage area and density, stream frequency, basin relief, and the ruggedness number. Interviews were also conducted among the residents of the area. Each age group was represented and was randomly selected from the population. Research results revealed that the Parang River Basin has been used for irrigation, drainage, and recreation for several centuries, despite having a high level of salinity (2000.0 milligram per liter electrical conductivity (EC) or ppm), compared to the threshold level of less than 1000.0 ppm EC. It must be noted that the basin is 7.0 km from the coastline; however, the tip is at Papatawen Falls of the same barangay. Papatawen Falls is very saline, 4000.0 ppm EC and the drainage area is the Parang River. The river basin has a 150 ha service area. Existing deep and shallow tube wells used by farmers had an alarming salinity level at an average of 1500.0 ppm EC. Watershed characteristics measured are within the normal values. Comprehensive research studies on surface water management strategies are recommended to determine possible mitigation strategies.

Keywords: river basin, watershed, water quality, Ilocos Norte, water resource

AS - 44

WATERSHED VULNERABILITY ASSESSMENTS OF MAKILING-BANAHAW GEOTHERMAL AREA, PHILIPPINES

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CHEVRON Geothermal Philippines Holding Inc. (CGPHI) is operating within watershed areas that are supporting multiple uses other than geothermal power generation. This is the first study that undertake an assessment of environmental conservation areas and practices that would enable CGPHI management to plan and implement specific interventions and provide key information on environmental conservation areas and practices within the ecological influence areas using remote sensing/GIS and rapid watershed appraisals. The study revealed that Mak-Ban area straddles seven sub-watershed areas that drain from Mt. Makiling and Mt. Bulalo towards the southern shores of Laguna Lake. Greater proportion of the ecological influence areas are covered with vegetation canopies ranging from low to high density. The vegetation cover and land use in the area includes intact natural forests (mossy forest, lowland dipterocarp forest), secondary forests, coconut plantations, fruit orchards, banana plantations, as well as grassland areas. The study also revealed that it is considered critical areas because of elevation and slope are the upper slopes of Mt. Makiling, Mt. Bulalo and Mt. Olila. Relatives to CGPHI facilities, all slopes of Mt. Bulalo poses threat, with the greatest towards the western slopes because of more facilities that would be affected. Vegetation cover can help mitigate the risks inherent in steep areas and good things about the steep areas around CGPHI is that they are currently under vegetation cover, except for Mt. Bulalo, whose summit areas are degraded as well as its southern slopes.

Keywords: CGPHI, ecological influence areas, environmental conservation practices, forest-based cropping systems, watershed vulnerability

AS - 45

GROWTH PERFORMANCE OF BATINO (*Alstonia macrophylla* L.) INOCULATED WITH DIFFERENT MYCORRHIZAL FUNGI UNDER NURSERY AND FIELD CONDITIONS

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The Caliraya-Lumot-Cavinti watershed area needs immediate reforestation in order to sustain the water required for the hydroelectric power. The soil has a pH of 3.5-5.5, and is deficient in nutrients, in particular nitrogen and phosphorus. Thus, the growth of plants is stunted. Arbuscular mycorrhizal (AM) fungi play an important role in promoting growth and seedling survival in this type of soil condition. Batino (*Alstonia macrophylla* L.) is a fast growing indigenous tree species with good wood for a variety of wood products. However, it is not known which AM fungi are most suited for batino. One month-old batino seedlings were inoculated with ten AM (unidentified species under the genera *Glomus*, *Acaulospora* and *Entrophospora*) fungi including Mykovam™. The growth of this reforestation species was monitored for four months at BIOTECH's nursery, UPLB and then outplanted in a grassland in the Caliraya-Lumot-Cavinti watershed area following RCBD. Under nursery conditions, the growth of seedlings mycorrhizal with eight out of ten AM fungi studied was better than the control. Under field conditions, the top four AM fungi that promoted higher height increment were: Surigao (2.16x), G19 (2.12x), Mykovam™ (2.05x) and G49 (2.01x), compared to the control (12cm). The KFRI fungus gave lower (-7%) height and stem diameter increment than the control. Surigao increased stem diameter increment by 4.07x, G19 by 4.25x, Mykovam by 4.52x, and G49 by 3.92x, over the control (3.54cm). Mykovam gave the highest leaf and root P concentrations and the lowest was the control. In conclusion, AM fungi coded as Surigao, G19, G49 and Mykovam™ can be used to inoculate batino seedlings for reforestation in grasslands in the Caliraya-Lumot-Cavinti watershed area.

Keywords: *Glomus*, *Acaulospora*, *Entrophospora*, biofertilizer, Mykovam™

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GROWTH RESPONSES OF KAWAYAN TINIK (*Bambusa blumeana*) SEEDLINGS USING DIFFERENT LEVELS OF BAMBOO BIOCHAR AND ORGANIC FERTILIZER

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The ever increasing demand for bamboo, particularly for kawayan tinik or *Bambusa blumeana*, along with the very limited number and poor quality of bamboo poles available to supply the bamboo industry has made it imperative to enhance bamboo productivity through the use of high quality bamboo planting materials to produce good quality poles for the bamboo industry. The production of quality planting materials is affected by various factors which influence the growth and development of the seedlings. The use of organic fertilizers and soil enhancers are necessary to improve growth and survival of bamboo seedlings. This study aims to: (1) determine the effect of bamboo biochar in the growth of kawayan tinik seedlings; (2) determine the effect of bamboo biochar to the soil as conditioner; and (3) determine and recommend the best level of mixture of bamboo biochar and organic fertilizer. The experiment was laid out in randomized complete block design (RCBD) with four replicate and four treatments. Bamboo biochar has been found to have an influence in the growth and survival of the bamboo seedlings. Seedling grown in pots with a combination of $\frac{3}{4}$ bamboo biochar and $\frac{1}{4}$ organic fertilizer had the highest growth measurements and survival counts compared to the other treatments. The same treatment had also a significant impact in terms of the soil's chemical properties, specifically on the increase of macronutrients (NPK) and organic matter content. The best potting mixture combination for the rapid increase in growth and survival of bamboo seedlings was the combined effect of $\frac{3}{4}$ bamboo biochar and $\frac{1}{4}$ organic fertilizer for the production of high quality bamboo planting materials.

Keywords: bamboo, biochar, soil conditioner, chemical properties, organic fertilizer

AS - 47

INFLUENCE OF WATERING REGIMES TO THE ROOTING PERFORMANCE OF BANABA (*Lagerstroemia speciosa* Linn.)

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Banaba tree is used to beautify parks due to its attractive flowers and medicinal value. A study was conducted to evaluate its rooting performance under various watering regimes. It was carried-out in a randomized complete block design with four replications. Treatments include daily watering (T1), watering every 3 days (T2), watering every seven days (T3), and watering once the plants show signs of wilting (T4). Two-month old seedlings with average height of 8 cm were potted in 5" x 7" polyethylene bags using loamy soil. Initial data were taken from the seedlings prior to the establishment of the study. Findings revealed that water stressed treatment (T4) had the highest length gain of the primary root at 3.225 cm. On the other hand, T1 had the lowest at 0.663 cm. Regarding percent survival, no significant difference was shown among treatments but T1 was highest at 90 % while water stressed treatments (T3 and T4) were lowest at 80 %. In terms of the number of lateral roots, treatments under water stress (T3 and T4) had slightly higher production with 4.24 and 4.07, respectively, while, the daily watering (T1) had only 4.06. On shoot-root ratio, significant differences were observed among treatments with the water stressed (T4) having the greatest at 1.308. Root-shoot ratio of T1 was 0.968 while T3 and T4 had 0.915 and 0.865, respectively. Findings imply that water-stressed plants concentrated more of its growth development on the root system rather than on the above ground parts. Root-shoot ratio is usually correlated with seedling quality. For forest trees, potential seedlings for planting must have a root-shoot ratio between 0.5 to 1.

Keywords: *Lagerstroemia speciosa*, water stress, watering regimes, rooting performance, root-shoot ratio

AS - 48

WOOD ANATOMY OF NATURALLY GROWN PHILIPPINE TEAK (*Tectona philippinensis* Benth. & Hook. f.)

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Filipino scientist and educators intend to utilize fully the country's endemic forest tree species like Philippine teak (*Tectona philippinensis* Benth. & Hook. f.) of the family Verbenaceae. The species is predominantly found in dry and exposed ridges of Lobo, Batangas. The wood of Philippine teak is classified as comparatively heavy and durable and can be a substitute for molave (*Vitex parviflora* Juss.). The residents of Batangas utilize them for posts and general construction often substituting it for molave. Its potential as first class timber has not yet been investigated. Studies of the basic wood anatomical and morphological characteristics will lead ultimately to the optimum utilization of the species. Macroscopic observations and other physical attributes showed that the wood of Philippine teak is light yellow, grain is slightly wavy and texture is fine, glossy, hard, and heavy. Fiber mensuration indicates that Philippine teak is medium-sized and thin-walled. Rays are observed to be of two kinds: uniseriate and multiseriate and are classified as extremely low. Philippine teak wood can be differentiated from teak (*Tectona grandis* L. f.) with the former having smaller pores and thinner rays. The most common anatomical features of the two *Tectonas* are the presence of whitish deposits and tyloses. Being heavy and hard wood species with relative density at 0.710 is an indicator that Philippine teak has strong potential for structural timber. This study addresses a gap in technical information that will lead to harness the potential of the Philippine teak, lead to establishment of plantations to maximize the full utilization of Philippine teak, not only in raw form, but also in engineered and other finished products.

Keywords: *Tectona*, Philippine teak, Lobo, Batangas, wood anatomy

AS - 49

PHENOLOGY AS TOOL IN PREDICTING PEST INCIDENCE OF ILOCOS WHITE GARLIC IN ILOCOS NORTE

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The study on the phenology and pest incidence at different phenophases of Ilocos white garlic was conducted to determine the appropriate time of applying pest management strategies based on the phenological events of this crop. Purple blotch (*Alternaria porii*) and Cercospora leaf spot (*Cercospora duddiae*) began to have a slight damage as early as the development of the 10th leaf (later part of bolting stage) and 11th leaf (early part of pre-harvest stage), respectively when there was an occurrence of rainfall or when relative humidity was $\geq 88\%$. These diseases spread rapidly reaching a very high level of damage when the relative humidity was consistently higher than 90% but did not progress rapidly when the relative humidity was below 85%. Likewise, these diseases occurred with slight damage during the development of the 15th leaf (later part of pre-harvest stage) when the relative humidity was consistently below 85%. There was no occurrence of these diseases during the vegetative and early bolting stages of the plants even if there was high relative humidity ($>90\%$) and occurrence of rainfall. Mite damage (called tangle top) appeared as early as the development of the 4th leaf (vegetative stage) when there was a change (low to high) in air temperature of about 1°C or more.

Keywords: phenology, pest management, garlic, diseases, phenophases

AS - 50

ENVIRONMENTAL FATE OF LAMBDA CYHALOTHRIN IN LOWLAND RICE AREA

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The use of insecticides in lowland rice farming is considered as a major contributor to contamination of the environment. It is therefore of utmost importance to determine the environmental fate of insecticides for the formulation of effective water management practices in order to minimize its adverse effect on the environment and to the community. Paddy plots with dimensions of 12m x 12m were setup for this experiment and were sprayed with lambda-cyhalothrin insecticide. Water samples were collected on day 1, 2, 3, 5, 9, and 14 after the insecticide application. Samples were brought to the National Pesticide Analytical Laboratory for analysis. The results reveal that there is a non-linear trend in the decrease of lambda-cyhalothrin insecticide concentration in the paddy water. One day after the application, the insecticide concentration in the paddy water was reduced by 35.52% from the initial concentration. Two and three days after the insecticide application, the concentration was reduced by 97.75% and 98.42%, respectively. On the fifth day, there was no more insecticide residue found in the paddy water. Hence, in order to prevent or minimize insecticide contamination of bodies of water near the paddy field areas, lowland rice farmers should ensure that the paddy water is properly contained and should not be drained from the field up to five days after the application of insecticide.

Keywords: environmental fate, irrigated rice area, insecticide concentration, lambda-cyhalothrin, water management practices

BIOLOGICAL SCIENCES

BS - 01

**PRELIMINARY REPORT OF ANURANS IN TWO
MOUNTAIN ECOSYSTEMS IN BUKIDNON,
MINDANAO, PHILIPPINES**

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A field survey of anurans was conducted in two mountain ecosystems in the province of Bukidnon, Mt. Kiamo, Malaybalay and Mt. Pantaron range, from January to December 2012. Field sampling was performed using a combination of belt transect, opportunistic and random sampling techniques. Field investigations were done across vegetation and elevation gradients from 750-1,500 meters above sea level (masl), which include an agro-ecosystem, montane, and mossy forests. Baseline data on species richness, local distribution, conservation status, and microhabitat preferences of anurans were determined and documented. The study revealed 21 anuran species belonging to five families and 15 genera, 52% of which were endemic in the Philippines. Moreover, four noteworthy Mindanao island endemic species identified, namely: *Ansonia muelleri*, *Leptobrachium lomarudom*, *Megophrys stejneri*, and *Rana grandocula*. Eight species of anurans were common to both mountains. As to the conservation status, the two vulnerable species recorded were *A. muelleri* and *M. stejneri*, whereas *Limnonectes magnus* was categorized as near threatened. A majority of the anurans was observed in the ground microhabitat especially in the leaf litters, fallen and decaying logs, while some species were collected near the bodies of water, such as rivers and streams which are associated with the indigenous Manobo inhabitants. The results of the survey show that the richness of anurans in the two-mountain ecosystem is high and more species are likely to be found. It is recommended that this two-mountain ecosystem be declared as protected area in order to conserve the endemic and threatened species and ecosystem as a whole.

Keywords: species richness, Anurans, microhabitat, endemic, Mindanao

BS - 02

**SPECIES COMPOSITION AND ABUNDANCE
OF SNAILS (GASTROPODA) IN MT. MALAMBO,
DAVAO DISTRICT PHILIPPINES**

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Mt. Malambo is a petit mountain along the highway of Datu Salumay, Marilog, Davao District. It has peak elevation of 1,379 meter above sea level (masl) and is covered with original or native plants in the fragmented montane forest at the base and mossy near the top. Transect survey for snails was conducted on the western slope to provide information on snail species composition. A total of 6 snail species under one family of snail were listed at the total of 82 individuals. The most abundant species was *Cyclophorus presto* (n=30) and the least abundant species was *Leptopoma perlycidum* (n=5). Mt. Malambo is home for 6 species of snails. The effort to conserve the snail species will also conserve the forest and the fireflies therein as they are food for the fireflies and for ecological balance.

Keywords: Species composition, Abundance, Snail, Mt. Malambo, Philippines

BS - 03

INVENTORY OF ASTEROIDEA SPECIES IN JASAAN, MISAMIS ORIENTAL, NORTHERN MINDANAO

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This study was conducted to assess the sea star population in three selected barangays of Jasaan, Misamis Oriental. The specific objectives of this study were: 1) to collect and identify the Asteroidea species present; 2) to determine the species abundance and diversity; and 3) to determine some physico-chemical parameters in the study stations. Three study stations located in Solana, Bobontugan and San Antonio were established, each with a 100m² plot divided into 100 quadrats about 35-45 m from the shore. Asteroidean species present were counted, collected, and preserved for identification and classification. Sampling was done twice. Photographs of the sea stars and study sites were taken. Physico-chemical conditions during the time of sampling were recorded. Species importance value was computed based on the relative density and relative frequency of the species. There were four species of Asteroidea collected with a total of 74 individuals: *Acanthaster planci*, *Linckia laevigata*, *Culcita novae-guinea*, and *Nardoa tuberculata*. In Solana, the most dominant and the most frequently observed was *N. tuberculata* (IV=1.270, f=0.075); in Bobontugan and San Antonio, the dominant species was *L. laevigata* (IV=0.951, f=0.075 and IV=1.378, f=0.065, respectively). Among the three stations, the most diverse was Bobontugan (H=0.458). The physico-chemical conditions of the three areas did not vary much. pH was 8 and the water was clear, with a slight range of water temperature (27-30°C). The substrate of the three areas was almost the same: coralline, rocky and sandy. Similar associated organisms were found in three areas, except in San Antonio which had tall and abundant *Sargassum*. Based on the Shannon-Wiener diversity classification, species diversity in the three study areas was relatively low with a mean value of 0.402.

Keywords: inventory, Asteroidea species, abundance, diversity, Jasaan, Misamis Oriental

BS - 04

**MACROINVERTEBRATES AS WATER QUALITY
BIOINDICATORS OF SEBASI RIVER
IN OZAMIZ CITY, PHILIPPINES**

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Sebasi River is the water source for domestic, commercial and agricultural needs of several barangays in Ozamiz City. Due to climate change and continuous human related activities, water quality and aquatic organisms are threatened. This descriptive research was conducted to determine the status of upstream, midstream and downstream of the river using macroinvertebrates which are useful biological indicators of change in the aquatic ecosystems. Physico-chemical parameters (air and water temperatures and pH) were measured using standard field methods. Dip and kick-net methods were used to sample macroinvertebrates. Organisms were categorized depending upon their tolerance to organic pollution (sensitive, somewhat sensitive, and tolerant). These were then subjected to biotic index. Results showed that air and water temperatures and pH values were still within the tolerable range. Based on macroinvertebrates, the upstream had total index value of 29 that signified excellent water quality, midstream with total index value of 15 (fair), and downstream with total index value of 8 (poor). This implied that the cleanest water can be found at the upstream while the most impure water is found in the downstream. An environmental protection and proper management of natural resources program in Sebasi River should be implemented.

Keywords: bioindicators, macroinvertebrates, water quality, river

BS - 05

**PHYTOPLANKTON, MACROINVERTEBRATES
AND RIPARIAN, CHANNEL, AND ENVIRONMENTAL
(RCE) INVENTORY OF THE FRESHWATER SYSTEMS
WITHIN PLATINUM GROUP METALS CORPORATION
(PGMC), CLAVER, SURIGAO DEL NORTE**

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The Platinum Group Metals Corporation (PGMC) is one of the many nickel mines in Claver, Surigao del Norte. Two freshwater biological studies had been conducted within its vicinity in the last 10 years: a baseline study in 2002 and a biological assessment in 2010. The present study was performed as a follow-up assessment of the status of the freshwater systems in the mining site by making an inventory of the plankton and macroinvertebrates while performing a riparian, channel and environmental evaluation. This study showed the absence of phytoplankton, the appearance of pollution-tolerant hemipterans and chironomids and confirmed the paucity in macroinvertebrate species reported in 2002. All five freshwater stations within the mine site obtained poor ratings using the riparian, channel, and environmental evaluation compared to the 2010 study where at least 1 station was given a fair rating. Immediate remedial action is recommended to enable natural systems to reverse the degradation of the freshwaters.

Keywords: freshwater biology, mining, pollution, phytoplankton, macroinvertebrates

BS - 06

**ORCHID FLORA OF MT. APO AND MT. KITANGLAD
LONG-TERM ECOLOGICAL SITES
IN MINDANAO ISLAND, PHILIPPINES**

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Orchids are among the most attractive and highly priced plants harvested in the mountains of Mindanao. Unfortunately, several species are already endangered and threatened due to habitat destruction, over-collection and illegal trade. Taxonomic studies are therefore badly needed to identify and assess the status of this economically important flora. Floristic studies were conducted in one-hectare permanent plot established in Mt. Kitanglad, Lantapan and Mt. Apo, Kidapawan. Fieldwork inventory of orchid flora were conducted for *ex-situ* propagation and conservation. Field collections and documentation were made for taxonomic verification of the plant materials. Results gave a total of 15 species of orchids belonging to 11 genera. Species richness was higher in Mt. Kitanglad with 13 species, while Mt. Apo was represented with 10 species. Eight species were found to be common in the two mountain ecosystems. *Mycaranthes* and *Cryptostylis* species were found only in Mt. Apo while *Cystorchis*, *Stichorkis*, *Hippeophyllum*, and *Pinalia* species were unique to Mt. Kitanglad. *Dendrochilum*, *Agrostophyllum*, and *Crepidium* were the most dominant in both sites. On-going *ex-situ* conservation of dwindling orchid populations was initiated for more effective conservation.

Keywords: species richness, orchids, *ex-situ* conservation, long-term ecological sites, Mindanao

BS - 07

FOUR NEW COMBINATIONS FROM THE PHILIPPINE ENDEMIC *Canthium* Lam. (RUBIACEAE): EVIDENCES FROM NUCLEAR AND PLASTID DNA SEQUENCE DATA

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Canthium Lam. (Vanguerieae, Rubiaceae) forms a polyphyletic assemblage based on current phylogenetic studies. The genus is presently delimited to include species with spines. In contrast, several Philippine endemic species of *Canthium*, such as *C. gynochtodes*, *C. oblongifolium*, *C. obovatifolium*, and *C. oligophlebium* do not possess spines. This raises a question on the true generic identities of these *Canthium* species. In this first molecular study of Philippine *Canthium*, the plastid (*trnL-F* region) and nuclear (ITS region) DNA were sequenced and assembled together with the previously published sequences of Vanguerieae to determine its phylogenetic position and true generic affiliations. The majority-rule consensus tree of the Bayesian inference showed a well-supported clade of the whole Vanguerieae. Interestingly, *Canthium oligophlebium*, *C. obovatifolium*, and *C. oblongifolium* were nested within the *Pyrostria* clade (PP=1.00), while *C. gynochtodes* was in *Psydrax* (PP=0.76). These molecular results strongly corroborate with the morphology of *Pyrostria* and *Psydrax*, leading to the establishment of two additional genera in the Philippine's biodiversity. Four novel combinations from the Philippine *Canthium* are here proposed.

Keywords: *Canthium*, ITS (nrDNA), Philippine endemic, *Pyrostria*, *Psydrax*, *trnL-F* (cpDNA)

BS - 08

**MOLECULAR AUTHENTICATION OF SPERMACOCEAE
S.L. (RUBIACEAE) SPECIES FROM WESTERN PANAY
PENINSULA USING MULTI-LOCUS DNA
BARCODES REVEAL A NEW PHILIPPINE ENDEMIC
SPECIES OF *Hedyotis* L.**

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The introduction of DNA barcoding as a technology to discriminate land plants has been restrained by the lack of consensus as to what genetic markers will be used to serve as universal standards in facilitating species identification. Throughout its taxonomic history, the circumscription of the primarily herbaceous tribe Spermacoceae *sensu lato* of the family Rubiaceae has been the subject of disputes among plant systematists due to its anatomical and morphological heterogeneity, leading to problematic authentication of its taxa. In this paper, we used two non-coding (*rps16* intron, *trnL-F* intergenic spacer) loci of the chloroplast DNA to test the possibility of their use as barcodes to validate Spermacocean species of the Western Panay Peninsula. Ten accessions were sequenced from five collected samples and were included in a data matrix comprised of 78 and 81 Spermacoceae GenBank accessions for *rps16* and *trnL-F*, respectively. Single locus resolution ranged from 0-11.48% (*rps16*) to 0-17.68% (*trnL-F*), while the combined loci revealed reasonable success rate of 35.13%. In addition, comparison of the sampled dioecious *Hedyotis panayensis* to extant type specimens supported our proposal for a novel Philippine endemic.

Keywords: biodiversity, DNA barcoding, cpDNA, flora, Spermacoceae

BS - 09

**MOLECULAR PHYLOGENY OF PHILIPPINE *Blechnum* L.
(BLECHNACEAE) BASED FROM *trnL-trnF* (cpDNA)
SEQUENCE DATA**

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The genus *Blechnum* L. (Blechnaceae) comprises 20 taxa (17 species and 3 subspecies) of the Malesian region, 8 of which can be found in the Philippines. Recent molecular studies involving the genus have failed to include Philippine representatives. In this first molecular phylogenetic study on Philippine (PH) *Blechnum*, the *trnL-trnF* (cpDNA) regions were sequenced and analyzed together with the previously published related sequences from the GenBank. Specifically, the present study intended to reassess the monophyly of the genus *Blechnum* and the phylogenetic relationships of the PH *Blechnum* with New Zealand (NZ) and other overseas Blechnaceae species. Two-hundred ninety out of 983 aligned nucleotide positions (29.50%) were found to be parsimony-informative characters. The strict consensus tree revealed a paraphyletic *Blechnum* as other genera (*Doodia*, *Sadleria*, and *Stenochlaena*) are nested within the genus. Interestingly, the PH *B. egregium* is more closely related to the South American *B. brasiliense*. These two *Blechnum* species formed a subgroup together with all the sampled *Doodia* species. Similarly, the two sampled *B. orientale* formed a subgroup with *Sadleria* and *Stenochlaena*. The rest of the PH *Blechnum* species have high affinities with the NZ and Australian species.

Keywords: Blechnaceae, Philippine *Blechnum*, molecular phylogeny, *trnL-trnF*

BS - 10

**COMPARATIVE DIVERSITY OF GROUND-DWELLING
ANTS (HYMENOPTERA: FORMICIDAE) IN TWO
PERMANENT PLOTS IN MAKILING FOREST RESERVE,
LOS BAÑOS, LAGUNA, PHILIPPINES**

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The study of comparative diversity of ground-dwelling ants done in Mt. Makiling Forest Reserve aimed to assess and compare the diversity of PFLA 1 and 3. Data collection was conducted through pitfall trapping and active searching of ants. There was a total of 14 species of ants collected in PFLA 1 and 3. Four species were identified as follows: *Anoplolepis gracilipes* (Formicinae: Plagiolepidini); *Diacamma* sp. (Ponerinae); *Odontomachus infandus*, and *Odontomachus* sp. (Ponerinae). Other species remained unidentified. Results showed that *Odontomachus infandus* was the most dominant species in PFLA 1 while Unidentified Species 2 was the most dominant species collected in PFLA 3. After computing the different diversity measurements, PFLA 1 was found to be more diverse than PFLA 3. The *t*-test showed that PFLA 1 and 3 had significantly different species diversity. It is recommended that more studies about ant diversity be conducted which will further contribute to biodiversity studies.

Keywords: *Anoplolepis gracilipes*, *Diacamma* sp., ground-dwelling ants, *Odontomachus infandus*, *Odontomachus* sp.

BS - 11

**DIVERSITY OF ODONATA: THE LOCAL WAY OF
ASSESSING WATER QUALITY IN LAKE PINAMALLOY,
DON CARLOS AND DOLOGON SPRING,
MINDANAO, PHILIPPINES**

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Water quality assessment of Lake Pinamaloy and Dologon spring, Bukidnon was conducted using diversity indices of Odonata species to provide information as to whether species composition, diversity and status of Odonata in the vicinity of Lake Pinamaloy and Dologon Spring can be used by locals in assessing water quality. A total of 3 families, 11 genera, and 18 species of Odonata are found in Lake Pinamaloy, and 3 families, 13 genera, and 20 species are found in Dologon Spring. The species diversity in Odonata in Lake Pinamaloy and Dologon Spring are low: $H'0.66$ and $H'0.875$, respectively. Field biotic index (FBI) showed medium water quality for both (50.7 and 60, respectively). Species richness of Odonata was higher in Dologon spring with forest fragments and less human activities near the source. Two endemic species were listed and Odonata are unevenly distributed in the two sites. Distribution varied in two sites with different vegetation types, degree of light penetration, presence of microhabitats and quality water. The results suggest that Odonata can be useful in assessing and monitoring water quality in the absence of ecological kits. The local communities can be empowered to creating water conservation culture, especially when they recognize that Odonata are sensitive indicators for testing water quality.

Keywords: Odonata; diversity; water quality; Mindanao, Philippines

BS - 12

DIVERSITY OF CICADAS IN THREE SELECTED MOUNTAINS OF MINDANAO, PHILIPPINES

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Diversity of cicadas in three selected mountains of Mindanao namely: Mt. Musuan, Mt. Kitanglad and Mt. Hamiguitan. Cicadas are considered for study being biomass converters and indicator of a forest quality. They are dependent on trees for shelter. Hence its diversity indicates habitat quality. This paper aimed to provide information on cicada species composition and species level-diversity in three selected mountains of Mindanao. Data generated may be used for species monitoring, distribution, biogeography and conservation of cicadas. Belt transect, time constraint, transect walk sampling, light trap, malaise trap and pan traps were employed from April 2011 to May 2012. We captured a total of 21 species of cicadas: 8 from Mt. Musuan, 9 from Mt. Kitanglad and 17 from Mt. Hamiguitan. Species diversity level using Shannon-Weiner index showed low level in all sites. In Mt. Musuan $H'0.697$, Mt. Kitanglad $H'0.965$ and Mt. Hamiguitan $H'1.063$. Highest species richness was observed in Mt. Hamiguitan, lowest in Mt. Musuan. Bray-Curtis analysis on species composition showed that all sites are unique habitat for cicadas. This result suggests that cicada species has specificity for habitat. The locals utilize cicadas for food, bait for fishing and for forecasting weather conditions. They also recognized that cicadas are worthy for conservation as they indicate forest quality.

Keywords: diversity, cicadas, mountain, Mindanao, species composition

BS - 13

**LEAF METHANOLIC EXTRACT OF *Ardisia* sp. INHIBITS
ANGIOGENESIS IN THE DUCK *Anas platyrhynchos*
CHORIOALLONTOIC MEMBRANE**

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The present study was conducted to evaluate whether the methanolic extract of *Ardisia* sp. can effectively inhibit angiogenesis in the duck chorioallantoic membrane. Different concentrations of *Ardisia* sp. (2, 4, and 6 mg/ml) were topically applied in the duck chorioallantoic membrane. Histochemical analysis of CAM and histological analysis of the heart were conducted. There was a significant difference between the treatments and the control group, but there were no significant differences of the mean vascular densities between doses. Histochemical analysis of the chorioallantoic membranes using alcian-blue stain showed that the intensity of the stain is less in the treated samples. There were no abnormalities observed in the gross morphology of the duck embryos and in the histology of the hearts. This work showed that the methanolic extract of *Ardisia* sp. has potential anti-angiogenic property.

Keywords: *Ardisia* sp, anti-angiogenic, *Ardisia* leaf methanolic extract, chorioallantoic membrane assay, angiogenesis

BS - 14

BIOLOGY AND ECOLOGY OF THE LAKE TAAL SEA SNAKE, *Hydrophis semperi*

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We studied the basic biology and ecology of the endemic Lake Taal Sea Snake (*Hydrophis semperi*) in Lake Taal, Philippines. Despite its conservation status (vulnerable), it is scientifically understudied. This study provides baseline scientific information on the unique sea snake species occurring in freshwater habitat. Gill net trapping was primarily employed during the sampling period (June-November 2012). Morphometric data were gathered from snake samples with live snakes tagged and released, and dead samples extracted of its gut content. Environmental parameters (*e.g.*, water temperature, light intensity, conductivity) were also collected for multivariate analysis. Out of 112 snakes, mostly collected from the south basin, only 24 individuals belonged to *Hydrophis semperi*. No sea snake was caught in the north basin of the lake. The remaining samples (n=88) were identified as the Little File Snake (*Acrochordus granulatus*) with one recapture from tagged samples (n=33). Snake captures reflect the relatively lower abundance of *H. semperi* and the high capturability of *A. granulatus*. Identification of snake gut contents reveal that *H. semperi* feeds on three families of fish (Gobiidae, Hemiramphidae, and Anguillidae). The sympatric *A. granulatus* were found to contain prey items belonging to only one family (Gobiidae). Prey items found in the gut of the endemic sea snake species suggest that it is a gape-limited generalist predator. *In-situ* observations reveal that *H. semperi* exhibits a “surface-arch” movement distinct from *A. granulatus* when surfacing from underwater. Further observations suggest that both species are strongly associated with rocks and crevices. Higher conductivity values present at the mouth of the river near the lake reflect the marine origins of the lake and its volcanic nature which may have created the conditions which are suitable for the survival of *H. semperi*. This study provided insights for further investigation.

Keywords: hydrophiinae, hydrophis, Lake Taal, freshwater, sea snakes

BS - 15

**EVALUATION OF THE GLYCEMIC EFFECT OF
Parameria laevigata (A. Juss) Moldenke IN NORMAL
AND ALLOXAN-INDUCED DIABETIC JUVENILE
MICE (*Mus musculus* L.)**

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The rise in the incidence of diabetes has been alarmingly rapid in both developed and developing countries. In developing countries medicinal plants have always played a significant role in the maintenance of health and management of diseases. In the Philippines, there are many plants with reported antidiabetic property but are not scientifically tested yet. Using male mice as model organism, the ethanolic extract from the leaves of *Parameria laevigata* was tested for hypoglycemic activity in both normoglycemic and alloxan-induced diabetic mice. The extract reduced blood glucose levels (BGL) in a dose-dependent manner. When given to normal and alloxan-diabetic mice, the extract at 100 mg/kg bw reduced the level of hyperglycaemia by 20% and 45%, respectively, 1 hr after treatment compared to controls. Moreover, a significant reduction in BGL was noted in diabetic mice 2 and 3 hrs post treatment ($P < 0.05$) at a dose of 50 mg/kg bw. These results clearly indicate that the ethanolic extract from the leaves of *P. laevigata* has high antidiabetic potential in a dose-dependent manner. Further characterization of the active components of these plants is warranted to understand the mechanism of its hypoglycemic action.

Keywords: alloxan, antidiabetic, hypoglycemic, normoglycemic, *Parameria laevigata*

BS - 16

SURVIVAL RATE OF FEMALE WHITE MICE *Mus musculus domesticus* TREATED AT VARIOUS MONOSODIUM GLUTAMATE CONCENTRATIONS

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A completely randomized design (CRD) experimental set-up was conducted to determine the survival rate of *Mus musculus domesticus* at various concentrations of monosodium glutamate (MSG). Adult female white mice from 20 inbred strains were used as test organisms. Four different treatment groups of free-access oral drinking solutions at various MSG concentrations were prepared, namely: $T_1=74\%$, $T_2=55\%$, $T_3=37\%$, $T_4=18\%$; T_5 was the control group that contained only distilled water. In each group, there were four replicates that were caged individually. Each mouse received normal food diet and 20 mL of drinking solution daily at 7:30 AM for 30 days. The volume of the solution consumed by each mouse 24 hours later was then measured. Survival rate of the mice were determined. Statistical analysis was carried out using Analysis of Variance (ANOVA) to determine if there were significant differences in the mean intake for the 30-day period of observation, between and among the experimental groups and the control group. To determine which groups differ, Tukey HSD was utilized for multiple comparisons. Results showed that the F value of 31.300 was highly significant at $\alpha=0.01$; that is, at 99% confidence that there were significant differences between the groups. From the results there were no significant differences between the mean MSG intake among the four treatment groups; however, the mean MSG intake of the four treatment groups differed significantly from the control group. This implied that the higher the concentration of MSG solution consumed, the lower the survival rate, as given by a correlation value of -0.5777 , or equivalently, a determining factor of $(-0.5777)^2 \times 100\% = 33.29\%$. This means that the concentration of MSG solution significantly affects survival rate of the white mice.

Keywords: monosodium glutamate, oral drinking solutions, oral intake, white mice, treatment, mortality, survival rate

BS - 17

**DNA FINGERPRINTING AND GENETIC DIVERSITY
ANALYSIS OF PHILIPPINE SABA (*Musa balbisiana* Colla)
CULTIVARS USING MICROSATELLITE MARKERS**

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Saba (*Musa balbisiana* Colla) is an endemic crop and one of the most important cultivars of banana grown in the Philippines. In recognition of the importance of Philippine Saba as a source of food, it is essential to identify Saba cultivars with good fruit quality and high potential for processed food and industrial application. Microsatellites markers were used to generate DNA fingerprints and to characterize the genetic diversity among 14 Philippine Saba cultivars. A total of 45 primer pairs obtained from INIBAP (International Network for the Improvement of Banana and Plantain) were tested for PCR amplification and polymorphism across the 14 Saba cultivars. Of these primers, 19 were polymorphic markers and two were monomorphic markers. A total of 67 alleles were generated, with a mean of 3.5 alleles per locus, ranging from 2 to 8 alleles. The resolving power of molecular markers measured as the Polymorphism Information Content (PIC) ranged from 0.05 to 0.94. The dendrogram using UPGMA-SAHN cluster analysis based on microsatellite amplification and polymorphism showed that the Saba cultivars clustered into ten groups at the 88 % similarity level. Cluster analysis separated the cultivars of *Musa balbisiana* Colla from genotypes of *Musa acuminata* Colla. The 19 polymorphic SSR primers were shown to be able to identify and differentiate the 14 Saba cultivars. The results of this study provide useful information for proper identification of Saba cultivars suitable for specific needs of the industry.

Keywords: Saba, *Musa balbisiana*, microsatellites, polymorphism, genetic diversity, DNA fingerprinting

BS - 18

**GENETIC DIVERSITY ANALYSIS OF PILI
(*Canarium ovatum* Engl.) USING CROSS-SPECIES
AMPLIFICATION OF SIMPLE SEQUENCE REPEATS**

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Pili (*Canarium ovatum* Engl.) has its center of diversity in the Bicol region. Due to a high degree of open pollination, pili trees grown from seeds exhibit variability in many important horticultural characters. This study used Simple Sequence Repeat (SSR) markers from papaya (*Carica papaya*) and Chinese white olive (*Canarium album*) to assess the genetic diversity of 95 pili accessions obtained from the collections of the Crop Science Cluster (CSC): UPLB, DA Pili Research and Technology Center, Tabaco, Albay, and three private pili farms in Barangay San Rafael, Bulusan, Sorsogon. Five SSR primers (SSR12, SSR31, *CasC120*, *CasA131* and *CasC183*) produced high quality, polymorphic PCR products from genomic DNA. Thirty seven alleles were obtained using the five SSR primer pairs with an average of 7.4 alleles per marker. The average Polymorphism Information Content (PIC) of the five primers was 0.7660 which indicated their capability to detect and quantify genetic diversity in *C. ovatum*. Cluster and ordination analyses using NTSYSpc software gave three major clusters at 0.60 similarity coefficient. Group I consisted of mostly IPB-CSC accessions, some accessions from Pili Drive (PD)-CSC and two varieties, Katutubo and Laysa. Group II was mostly PD-CSC genotypes with some Bicol accessions. The other five registered varieties - Lanuza, Magayon, Mayon I, Orolfo and Magnaye - clustered together forming Group III. Cross-species amplification of SSR markers successfully revealed the high genetic variation among the pili genotypes studied.

Keywords: pili, genetic diversity, simple sequence repeats, DNA markers, *Canarium*

BS - 19

**COMBINING ABILITY ANALYSIS OF WHITE CORN
GENOTYPES FOR NITROGEN USE EFFICIENCY IN
IRRIGATED AND MOISTURE-LIMITING CONDITIONS
USING THE SAND CULTURE TECHNIQUE**

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We report the results of combining ability analysis of a full diallel mating design of eight white corn inbreds. This study was conducted to identify superior genotypes in terms of nitrogen use efficiency under irrigated and moisture-limiting conditions. We evaluated 36 progenies comprising 8 selfs (parentals) and 28 F₁ hybrids for NUE, plant dry matter, plant height, and root volume during the vegetative stage using sand culture technique. We employed three levels of nitrogen (*i.e.*, 0, 60 and 120 kg/ha) and two water treatments (*i.e.*, irrigated and drought-imposed) in a split-split plot in completely randomized design with three replications under greenhouse conditions. We analysed the data on plant dry matter for combining ability using Griffing's method 2 (model 1). Analysis of variance showed that the performance of the genotypes tested for NUE, plant dry matter, plant height, and root volume vary across nitrogen and water treatments. Combining ability analysis revealed that CML377 has the highest General Combining Ability estimate (GCA = 0.0553) among the rest of the parentals, which implies that it would contribute to good plant dry matter production in a wider array of crosses. We noted that CML377 was a common parent for the two F₁ hybrids that perform consistently well in various nitrogen and water treatments. These F₁ hybrids were also among those that attained the highest SCA estimates for all genotypes that were evaluated. The components due to SCA (0.0335) were found to be higher than that of GCA (0.0014), which means that the portion of the genetic effects due to dominance is higher than the additive portion. We recommend CML377 as parental for generating subsequent single-cross combinations in white corn breeding for drought tolerance.

Keywords: white corn, combining ability analysis, nitrogen use efficiency, drought, sand culture technique

BS - 20

MOLECULAR CLONING, IDENTIFICATION AND CHARACTERIZATION OF RICE *DSS* GENE ENCODING A CYTOCHROME-P450 IMPLICATED IN GIBBERELLIN BIOSYNTHESIS

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Gibberellic acid (GA) is a phytohormone that controls many aspects of plant development. In this study, we successfully cloned and characterized rice *DSS* gene encoding a cytochrome-P450 (CYP450) involved in various plant metabolisms. The gene was isolated via map-based cloning from dwarf mutant with small seeds and dark green leaves (*dss*) from *Oryza sativa ssp. japonica* cultivar *Hitomebore* population that had been treated with ethyl-methanesulfonate. The gene locus was mapped in chromosome 3 using simple sequence repeats (SSR) and In-del markers to about 117 kb using the F₂ segregating plants from the cross between mutant and the *Indica* cultivar *Kasalath*. Comparing the delineated sequence of the mutant to a reference sequence, *Hitomebore* found a base change (A→T) which resulted in an amino acid change from glutamic acid to valine. GFP fusion confirmed that it was localized in the endoplasmic reticulum, as observed in other CYP450 gene families involved in mediated stage of GA biosynthesis. Phytohormone assay revealed that the *dss* mutant had a positive response to GA, informatively important for exploring the gibberellins' molecular mechanism using the *dss* mutant. The transformants from RNAi had reduced transcript level and exhibited dwarf phenotype. Accordingly, overexpression of the *DSS* gene strongly confirmed that the gene indeed controls plant architecture in rice.

Keywords: gibberellic acid, phytohormone, cytochrome-P450, map-based cloning, RNAi

BS - 21

**FUNCTIONAL ELUCIDATION OF CONTIG 34 OF
Marsupenaeus japonicus TO WHITE SPOT SYNDROME
VIRUS (WSSV) BY dsRNA INTERFERENCE**

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The genome of the kuruma shrimp, *Marsupenaeus japonicus*, is thus far incomplete, yet it may hold many answers to the immunity response of the shrimp to different pathogens, including White spot syndrome virus (WSSV), one of the most destructive viral diseases among crustaceans, causing one hundred percent (100%) mortality within 3 to 7 days of infection. Contig 34 of *M. japonicus* was found to be homologous to the WSSV genome and might play a role in the infectivity of the virus. To verify this, RNA was extracted from shrimp samples for gene expression, followed by dsRNA synthesis, and interference by injection. Experimental samples were challenged with WSSV, while PBS and GFP were used as controls. Mortality data revealed that contig 34 inferred some protective effect with a survival rate of 32% at Day 5 p.i.

Keywords: host-virus, WSSV, RNAi, kuruma shrimp, contig

BS - 22

**SCREENING OF A GALACTOSE- SPECIFIC LECTIN
GENE IN *Bauhinia purpurea* L. THROUGH PCR ANALYSIS**

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Lectins constitute a class of proteins that bind reversibly to mono- and oligosaccharides. Studies conducted on lectins support the claims of its antiviral, anti-bacterial, anti-fungal and anti-insect activities. Although lectins cannot alter the structure and permeability of the cell membrane and cannot change the normal intercellular activity of bacteria through its attachment to extracellular glycans on bacterial cell walls, lectins can inhibit bacterial activity by blocking their motility. Because lectins are able to recognize and bind to glycoconjugates of animal cell membranes, lectins are used in glycoconjugate isolation, as well as in studying cell structures and blood typing. Their ability to precipitate or agglutinate cells also make them of great use in immunology, cancer research and toxicity studies. In the present study, genomic DNA from the leaves of *Bauhinia purpurea* L., commonly known in the Philippines as butterfly tree, was extracted. Genomic DNA was amplified using lectin gene primers through the Polymerase Chain Reaction. PCR amplification yielded a single band with a molecular weight of 1,636 bp. This result is parallel to the finding of the lectin gene identified in Brazilian *Bauhinia variegata*. It suggests that the *B. purpurea* widely grown in the Philippines may be a source of the lectin protein which is of great interest due to its carbohydrate-binding activity. Sequencing of the PCR products for the lectin gene is underway.

Keywords: lectin, glycoconjugate, *Bauhinia purpurea*, immunology, gene

BS - 23

**TISSUE CULTURE TECHNIQUE FOR CLONAL
PROPAGATION OF NIPA PALM (*Nypa fruticans*
Wurmb., ARECACEAE)**

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In the Philippines, nipa palm is becoming an important source of industrial and many other derivative products. Recently, research on nipa has focused on its potential use as a biofuel crop because it has several advantages compared with other biofuel-alcohol crops. However, making industrial alcohol from nipa is hampered by the availability of superior planting materials in a large quantity. *In vitro* clonal propagation is a promising alternative for producing large quantities of uniform planting materials of high quality. This is the first attempt to develop *in vitro* clonal propagation technique for nipa using embryos from mature fruits of nipa. Sterilization of explants using 5.25% NaClO with 5 drops of Tween20 for 20 minutes gave the best result among the four sterilants tested with 90% decontamination. MY3 (Euwens, 1978), N6 (Chu et al., 1975), and MS (Murashige and Skoog, 1962) basal media with different concentrations of 2,4-D, Ki, and IAA in different combinations were evaluated for shoot induction and root formation. To prevent the tissues from browning, all media were supplemented with 0.25% activated charcoal. MY3 medium supplemented with 7.0 mg/L 2,4-D generated the most number of germinated plantlets. The embryos germinated after three weeks in culture and eventually developed into green plantlets. Plants with 3-4 leaves were transferred into different rooting media. Root formation was observed on MS medium with 5.3 mg/L 2,4-D. Clonal propagation was performed by cutting the plantlets longitudinally along the shoot apical meristem into four sections and cultured in the regeneration medium. The results of this experiment indicated that it is possible to produce 200 seedlings from one seed of nipa in one year at 80% survival rate through *in vitro* clonal propagation, while conventionally it takes at least 5-6 years to generate 15-36 seedlings at 60-93% germination rate.

Keywords: *Nypa fruticans*, nipa palm, *in vitro* clonal propagation, alcohol, biofuels

BS - 24

**UNIQUE DNA FINGERPRINTS IDENTIFY
THE SEVEN NSIC-REGISTERED PILI
(*Canarium ovatum* Engl.) VARIETIES**

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Pili (*Canarium ovatum* Engl.) is a fruit tree species endemic in the Philippines with its center of diversity in the Bicol region. There are seven pili varieties registered with National Seed Industry Council (NSIC)-registered varieties: Katutubo, Laysa, Lanuza, Magnaye, Magayon, Mayon I, and Orolfo. To date, there are no reports on pili variety identification using DNA markers. This study sought to develop a DNA fingerprinting system for the seven NSIC-registered varieties using cross species amplification of simple sequence repeat (SSR) markers from papaya and *C. album*. SSR markers from papaya (SSR7, SSR12, SSR31, SSR34, and SSR38) and *C. album* (*CasA131*, *CasA183*, *CasC120*, *CasC242*, and *CasC254*) amplified a total of 36 polymorphic alleles. The average Polymorphism Information Content (PIC) of the ten SSR markers was 0.61 suggesting their potential for variety differentiation. Cluster analysis using NTSysSpc software of the SSR markers grouped the seven varieties into four at 0.80 coefficient of similarity: Group I– Katutubo and Orolfo; Group II–Magnaye and Magayon; Group III–Lanuza and Mayon I and Group IV–Laysa. Furthermore, the ten SSR markers revealed unique DNA fingerprints for each of the seven pili varieties. We have generated specific DNA fingerprints for the seven NSIC pili varieties that can differentiate them from each other.

Keywords: pili, *Canarium ovatum* Engl., variety identification, simple sequence repeats, fruit morphology

BS - 25

**DOUBLE-STRANDED (ds) RNA ISOLATION AND
MOLECULAR CHARACTERIZATION FROM THREE
WILD-TYPE AND NINE REDUCED GENOME
COMPLEMENT STRAINS OF *Rhizoctonia solani* ISOLATES**

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The presence of dsRNAs in pathogenic fungi can either increase or decrease their pathogenicity depending on the type and concentration of dsRNA present in them. This study utilized 12 isolates of *Rhizoctonia solani* for isolation and molecular characterization of dsRNA: three wild type strains that are heterokaryons (RS 29, RS 114 and TE2-4) and nine reduced-genome complement strains or mutants (RS 29.5, RS 29.6, RS 29.7, EGR4, EGR7, 123E, T2, TOM7, and strain 115) that are homokaryons. The presence of dsRNAs from four age groups of *R. solani* (25-day old, 50-day old, 75-day old and >75-day old) was determined. The dsRNAs were characterized according to their sensitivity to DNase and RNase and size fractionation based on electrophoretic mobility. All age-group samples showed dsRNA in the homokaryon isolates EGR4 and T2. Also, 50-day old age-group samples showed dsRNA in RS 29. Moreover, >75-day old samples showed dsRNA in RS114 and TE2-4. Observed sizes of dsRNA ranged from 2.1 kbp (T2) to 3.3 kbp (EGR4); concentration of the isolates varied from 0.065 ug/uL to 3.16 ug/uL. Interestingly, dsRNA of TE2-4 was found to be a candidate for specific quantitation using a dual-labeled oligonucleotide probe.

Keywords: *Rhizoctonia solani*, dsRNA, heterokaryon, homokaryon, fungi

BS - 26

**FRUIT COLOR AS AN INDICATOR OF SEED
GERMINATION, SEEDLING PERFORMANCE AND
OIL CONTENT OF *Jatropha curcas* L**

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The escalating prices of imported crude oil by the Philippines prompted the government to develop measures to help the country reduce its use of fossil fuels through greater utilization of indigenous energy resources. One of the species identified as a potential source of biofuel for biodiesel production was *Jatropha curcas* L. This study sought to: (1) document the changes of fruit color from the time the flower emerged until the fruit becomes black; (2) determine the fruit color of jatropha that yields the highest oil content for the production of biodiesel; and (3) assess the performance of jatropha seeds selected based on fruit maturity relative to germination capacity and seedling growth. The experiment was laid out in Randomized Complete Block Design with four treatments and three replications. Changes in fruit color starting from the development of fruit until the color turned black were documented for a period of 34 days using the Royal Horticultural Color Chart (RHCC). Seeds produced during the dry season had higher oil content than seeds produced during the wet season. Seeds taken from yellow fruits had the highest oil yield in both seasons. Seeds taken from black colored fruits during the dry season and dark yellow for the rainy season are recommended for better germination and growth. Fruit maturity was been found to have an influence on the germination capacity, growth performance of jatropha seeds and seedlings, and percentage crude fat content. The best maturity color of jatropha for oil yield production was yellow for both seasons. Black fruits were the most promising in terms of germination and growth performance.

Keywords: *Jatropha curcas*, fruit color, crude fat content, oil yield, seed germination

BS - 27

**ACCUMULATION OF TANNIN IDIOBLASTS AROUND
THE VASCULAR TISSUES OF *Medinilla magnifica*
(MELASTOMATACEAE): IMPLICATIONS FOR
A PLANT'S SYSTEMIC DEFENSE**

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Histological localization of tannin idioblasts in vegetative and reproductive organs of *Medinilla magnifica* was investigated. Histochemical tests confirm that tannin idioblasts are densely accumulated around vascular tissues of almost all structures of the plant. In the vegetative organs, tannin idioblasts conspicuously ensheath major and minor vascular bundles of the leaves and they heavily outline the interior of the vascular cylinder of the stems. The same pattern of accumulation was observed in the reproductive organs where tannins densely surround the vascular tissues of the flower, reaching even up to the funiculus of the ovules and the filament of the anthers. The presence of tannins in plants has long been interpreted as an important systemic defense against pathogens. Hydrolysable tannins have been proven to exhibit significant antimicrobial activity against a number of pathogens, including *Botrytis cinerea*, a necrotrophic fungus that affects many plant species. Various studies have determined that *M. magnifica* contains a considerable amount of hydrolysable and condensed tannins. The distinct pattern of histological localization of tannins in *M. magnifica* suggests advanced systemic defense of the plant against infection which could be a good prospect for future investigations.

Keywords: *Medinilla magnifica*, tannin idioblasts, vascular tissue, hydrolysable tannins, plant's systemic defense

BS - 28

**CHARACTERIZATION OF TWO SPECIES OF *Hylocereus*
Britton and Rose (DRAGON FRUIT) THROUGH
MORPHOANATOMY AND HISTOCHEMISTRY**

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Hylocereus or dragonfruit is an exotic fruit, which is gaining popularity in the Philippines due its high antioxidant content. Its taxonomic classification however is vague. The morphological, anatomical and histochemical properties of *Hylocereus undatus* (white-fleshed) and *H. polyrhizus* Britt. & Rose (red-fleshed) were elucidated. Both species of *Hylocereus* are climbing or hemi-epiphytic cacti with triangular, branching, succulent, green and spinous stems. Their root system is adventitious. The flowers are white in color, night blooming, large, bell-shaped, epigynous, and perfect. Fruits are berry type, with scales and numerous seeds. The two species can be distinguished by several characteristics. *H. undatus* has brown undulate stem margin, less spinous leaves, cream to white flower petaloid color, yellowish green sepaloid color, fruit pulp color is white and not sweet. For *H. polyrhizus*, the stem margin is green and straight, leaves are more spinous, petaloid color is white or yellow, sepaloid color is pinkish-red, purple to violet, fruit pulp color is magenta and sweet. *H. polyrhizus* has more scales (mean = 31) than *H. undatus* (mean = 21). *H. undatus* topmost scale is longer (mean = 5.05 cm) than *H. polyrhizus* (mean = 4.19 cm). In terms of anatomy, the two species are very similar. Transection of the roots and stems show eustelic type of stele, collateral vascular bundle and uniseriate root epidermis. Young aerial roots have pith and more xylem ridges than young terrestrial root in both species. Stem epidermis is multiseriate. Root and stem cortex are parenchymatous and multiseriate with secretory canals. The red dragon fruit (*H. polyrhizus*) generally contains more phytochemicals than the white dragon fruit (*H. undatus*). This includes alkaloids, tannins, saponins, amygdalin, organic acids and fats and oils. It is concluded that the two plants are of the same genus but of different species.

Keywords: *Hylocereus*, dragon fruit, morphology, anatomy, histochemical test

BS - 29

**COMPARATIVE STUDY ON THE FLOWERING PATTERN,
FLOWER AND POLLEN MORPHOLOGY OF *Cassia fistula*
Linn. AND *Cassia alata* Linn. (FABACEAE)**

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Pollen grains of the species of the family Fabaceae are easily transported by wind and may cause many allergies like asthma, allergic rhinitis, and hay fever. This study was conducted to compare the flowering pattern, flower, and pollen morphology of *Cassia fistula* Linn. and *C. alata* Linn. Similarities in qualitative characters in both species in flower and pollen morphological characters were observed. Similarities in floral morphology include the type of flower, floral symmetry, internodal elongation in flower, calyx, corolla, attachment of filament to anther lobe, and length of stamens. They differ in the type of inflorescence which is spike in *C. alata* and pendulous raceme in *C. fistula*, form of corolla in *C. fistula* is rosaceous while caryophyllous in *C. alata*. The attachments of filament to anther lobe are all basifixed. For pollen morphology, the species differ in the shape which is circular in *C. fistula* and triangular in *C. alata*. The flowering pattern of *C. fistula* and *C. alata* showed similarities in the months when flowers are numerous, but they differ in the duration and frequency of flowering. *C. fistula* flowered numerous during March–May and September–November, 2-3 times in a year with the average duration of 35 days, while in *C. alata*, it flowered numerous during March–May and September–December, 3-4 times in a year with an average duration of 38 days.

Keywords: *Cassia fistula*, *Cassia alata*, pollen grains, flowering pattern, flower

BS - 30

FIBER MORPHOLOGY AND RECOVERY, CHEMICAL COMPOSITION AND PULP PROPERTIES OF ABACA (*Musa textilis* Nee) cv. Inosa HARVESTED AT DIFFERENT STAGES OF STALK MATURITY

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The morphological, chemical, physical and pulp properties of abaca fibers cv. Inosa harvested at different stages of stalk maturity was investigated to determine the suitability of the fibers in the production of pulp and paper products and to explore the possibility of getting maximum extractable fibers from abaca leaf sheaths using different stripping methods. The fibers were extracted using the mechanical spindle stripping and the modified spindle stripping methods. Abaca cv. Inosa at 8-10 months old (young) already possess the inherent desirable characteristics of fibers for pulp and paper, such as extremely long fiber cells (over 3 mm), thin cell walls, low runkel ratio (less than 0.70), high flexibility coefficient, and high slenderness ratio. The morphological dimensions of fibers taken from young stalks were already comparable to fibers taken from mature stalks (18-24 months old). Fibers from 8-10 months old abaca already possessed the desirable chemical properties for pulping as shown by the characteristic low lignin and ash content, high alpha-cellulose, holocellulose, and hemi-cellulose contents, comparable with those from intermediate and mature stalks. The average pulp recovery, Kappa number, and viscosity of pulp were higher in all the three stages of stalk maturity compared to Laylay and Linawaan cultivars. The maximum fiber yield potential of the abaca cv. Inosa was not yet attained at early stage of maturity. Fiber yield of 8-10 months old abaca stalks was only 21% to 32% of those obtained from mature stalks, but usage wise, the fibers are already suitable for pulp and paper production. Fiber recovery was significantly increased by almost 100% using the modified spindle stripping method resulting in a 64% increase in net income compared to the standard stripping method.

Keywords: fiber morphology, chemical composition, pulp properties, Inosa, stalk maturity

BS - 31

**DEVELOPMENTAL ANATOMY OF OIL CELLS, OIL
GLANDS AND JUICE SACS IN THE FRUIT AND SEED
OF *Citrofortunella microcarpa* Bunge (CALAMANSI)
AND ITS IMPLICATIONS ON THE UTILIZATION OF
CITRUS PEEL AND SEED WASTE**

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There are several reports on the uses of *Citrofortunella microcarpa* (calamansi) juice which varies from medicinal, culinary, and industrial, but few studies have been reported on the uses of the exocarp (fruit peel), juice sacs, and seed. Investigating their uses can convert a waste material into a product. The essential oils present in the rind and seeds are one example. This study on the development of the oil cells, oil glands, and juice sacs of the calamansi fruit and seed at different stages of development was carried out to maximize the extraction of oil for use as fragrance and to minimize peel and seed wastes. Samples were subjected to ethanol-xylol for dehydration and clearing. Nile blue sulfate was used for histochemical tests and image analysis was done to obtain measurements. Results showed that the count of oil glands in a 1 mm² area decreases as the surface area of the fruit increases. As the fruit ages, the oil glands also mature and increase in size, from 1% in young fruits to 45% in mature fruits, which allows them to store more essential oils. Also, an increase in the seed size of the fruit as it ages may imply a higher oil storage capacity in larger seeds due to an increase in the total number of oil cells. The fragrance of the essential oils extracted from the exocarp and juice sacs had the distinct fragrance of limonene although varying in strength. It was also observed that the seed extract had the distinct bitter aroma of limonoids.

Keywords: oil glands, oil cells, juice sacs, essential oils, limonene, limonoids

BS - 32

**HERITABILITY OF FACIAL SHAPES AMONG
MARANAOS IN LANAOS DEL SUR**

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The Maranaos are one of the tri people in the Philippines who engage in intermarriage. This study sought to identify aspects of the shapes of the faces which have high probability of being inherited or transmitted to the offspring of Maranao couples. A total of 240 individuals (from 40 families) from different clans in Lanao del sur took part in the study. Digital images were used and following standard procedures and then analyzed using the method of geometric morphometrics. A total of 39 landmark points were digitized and the X and Y coordinates of these points were used as input for relative warp analyses. Tests for correlation between the relative warp scores of the faces of parents and their offspring were used as measure of heritability. Results showed significant correlation in the shapes of the faces of mother and their sons (P -value = 0.04); in the shapes of the jaws of mothers and her offsprings (Mother-daughter: $3.71E-05$; Mother-son: $4.04E-08$); and the jaw of the father and his daughter (P -value: 0.018). The results of the study are discussed in the light of possible modes of inheritance of the shapes of the face and that of the jaw. Maternal inheritance and the influence of maternal effect genes are explored as possible explanation for the observed correlation in the shapes of the faces of mothers and her progenies.

Keywords: geometric morphometrics, heritability, facial shape, Maranao

BS - 33

OPTIMIZATION OF FERMENTATION MEDIUM OF PHILIPPINE ACTINOMYCETE FOR INSECTICIDAL ASSAY

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Biopesticides have been gaining increased attention and interest among those concerned with developing environmentally friendly and safe integrated insect management. This study sought to evaluate different available and cheaper carbon and nitrogen sources as substitute for production of bioactive compound from Philippine actinomycete for biopesticides. The fermentation medium of actinomycete sp. was optimized to elevate the yield of fraction with insecticidal activity. The effect of independent variables of medium composition, corn starch substitution with molasses, and corn steep liquor with coconut paring meal and whey were investigated. The brine shrimp assay showed that the medium substituted with molasses had the highest number of dead shrimp (94%) after 3 days of fermentation and killed 95% of mosquito larvae after 4 days of fermentation. However, the actinomycete isolate was not effective against corn borer even with the control and substituted medium. Thin layer chromatography showed the separation of bioactive compound in different substituted media. The present study showed the effectivity of Philippine actinomycetes in controlling mosquito larvae using modified media but not effective against corn borer.

Keywords: actinomycetes, mosquito larvae, fermentation medium, agar plug assay

BS - 34

**A NOVEL PHILIPPINE FRESHWATER CYANOBACTERIUM
WITH THERMOSTABLE BROAD SPECTRUM
ANTIBIOTIC ACTIVITY**

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Antibiotic-resistant infections continue to be one of the most dreaded global health threats today. To identify potential new and endemic sources of novel drugs, 20 microalgal isolates from selected Philippine water ecosystems were investigated. The microalgal extracts were screened for antibiotic potential against *Staphylococcus aureus* and *Escherichia coli* using the Kirby-Bauer test. The 16S rDNA of the cyanobacterium from Pagsanjan, Laguna, which showed antibiotic activity was sequenced. The cytosolic fraction was able to inhibit the growth of *S. aureus* (average microbial index of 3.67). If boiled, the cytosolic fraction was also able to inhibit the growth of *E. coli* (average microbial index of 1.92). Preliminary minimum inhibitory concentration of the crude extracts showed strong antimicrobial activity as well as thermostability even after a 10^{-4} dilution and boiling for 5 minutes. Phylogenetic analysis based on the 16s rDNA showed the Pagsanjan isolate to be most closely related to an uncultured gamma proteobacterium (98% maximum identity). While this prokaryote was formerly deemed viable but not culturable, results suggest that the culture techniques used in this study allowed axenic cultivation of the prokaryote under laboratory conditions. This study presents a novel Philippine cyanobacterium isolate with thermostable broad spectrum antibiotic activity. We envision the crude extract, if further purified, to become a potential new drug against antibiotic resistant bacterial pathogens.

Keywords: cyanobacteria, antibiotics, antibiotic resistance, cytosolic fraction, Pagsanjan

BS - 35

CUTANEOUS BACTERIA OF FROGS COLLECTED FROM MT. PALAY-PALAY MATAAS NA GULOD NATIONAL PARK, CAVITE FOR ANTI-CHYTRIDIOMYCOSIS ACTIVITY

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Chytridiomycosis is a disease in amphibians caused by a chytrid fungus *Batrachochytrium dendrobatidis* and has been implicated as the causal agent of mass mortality and amphibian extinctions. Mitigating strategies are thus among the major concerns in the conservation of amphibian population and biodiversity worldwide. Reports have shown that microorganisms found on the skin of amphibians may combat chytridiomycosis. In this study, cutaneous bacteria from frogs were isolated and examined for anti-chytridiomycosis activity. Eight species of frogs were collected in Mt. Palay Palay Mataas na Gulod National Park in Cavite - a site positive for the presence of chytrid fungus - including *Hylarana similis*, *Limnonectes woodworthi*, *Occidozyga laevis*, *Platymantis mimulus*, *P. corrugatus*, *P. dorsalis*, *Rhacophorus pardalis*, and *Polypedates leucomystax*. Bacteria were isolated from the skin of frogs by swabbing both the ventral and dorsal surfaces of the body and inoculation in R2A agar and incubation at 23±3°C for 24 hours. Chytrid fungus was determined by swabbing the ventral surface of the frog and inoculated in 1% tryptone agar incubated at 23±3°C for 5-7 days. Isolated bacteria were tested for potential inhibitory properties against chytrid fungus. Results showed that some cutaneous bacteria of frogs have potential property to inhibit the growth of chytrid fungus *in vitro*. Skin bacteria of frogs may contribute to their defense and immunity against the lethal chytridiomycosis.

Keywords: cutaneous bacteria, chytrid fungus, *Batrachochytrium dendrobatidis*, chytridiomycosis, frogs

BS - 36

**DIVERSITY OF ENDOGENOUS BANANA STREAK
BADNAVIRUS (BSV) SPECIES IN NATIONAL AND
SOUTHEAST ASIAN MUSA GERMPLASM COLLECTION**

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Banana Streak Virus (BSV) is the most widely distributed and considered potentially the most threatening among the viruses of banana because viral sequences are already integrated in the *Musa* genome and becomes pathogenic (episomal BSV). In determining the frequency and distribution of endogenous BSV sequences across the national and Southeast Asian germplasm collections, the accessions were indexed through standard PCR and multiplex PCR using BSV F1/R2 and species-specific primers, respectively. Results showed the presence of three known BSV species in the collection, namely: Mysore, Goldfinger, and Imove. These species were strongly associated with B and AB genomes. Accessions/cultivars with unknown BSV sequences will be further characterized.

Keywords: banana streak virus, endogenous BSV, episomal BSV, multiplex PCR

BS - 37

INFLUENCE OF LP-3G3 PROBIOTIC FOODS ON THE DISTAL GUT BACTERIAL FLORA OF MICE (*Mus musculus* L.)

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Pediococcus acidilactici (LP-3G3), a lactic acid bacterium, can be formulated into functional foods for preventing and managing lifestyle-associated diseases such as obesity. To initially assess the efficacy and safety of LP-3G3 as a probiotic, the influence of LP-3G3 probiotic foods on the distal gut (colon) bacterial flora of mice was determined. Locally formulated chocolate bar and drink containing LP-3G3, Yakult probiotic drink containing *Lactobacillus casei* strain Shirota (LcS) and Orlistat[®] were orally administered to groups of standard diet (SD)-fed and high-fat diet (HFD)-fed BALB/C mice. The bacterial profile was obtained through PCR and denaturing gradient gel electrophoresis (DGGE) and analyzed using Dice's index of similarity. The bacterial community members were identified through rDNA sequencing. Baseline distal gut bacterial diversity in HFD-fed mice was greater than the SD-fed group. Upon feeding with LP-3G3 chocolate bar, the distal gut bacterial flora of HFD-fed mice became less diverse. LP-3G3 chocolate-fed mice had more diverse distal gut bacterial flora compared to the Orlistat-treated and the untreated mice. LP-3G3 probiotic drink had a greater effect than Yakult in shifting the distal gut bacterial flora of HFD-fed mice to the SD-type. However, LP-3G3 probiotic drink and Yakult had little effect on the distal gut bacterial flora of SD-fed mice. Orlistat had a similar effect as Yakult in all treatment groups. *Pediococcus acidilactici* had a greater influence than *Lactobacillus casei* strain Shirota on the distal gut bacterial flora, inhibiting the growth of Firmicutes bacteria which increased in number due to a HFD.

Keywords: *P. acidilactici*, probiotics, gut bacteria, rDNA, DGGE

BS - 38

**KINETICS STUDY AND SUBSTRATE OPTIMIZATION OF
Lactobacillus plantarum BSBY BATCH FERMENTATION**

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An optimization study of modified medium was done to predict the optimum substrate compositions necessary for the growth of *Lactobacillus plantarum* BS. Using Central Composite Design, the medium compositions were varied with values ranging from 1.3-5% w/v total sugars, 0.6-2% w/v nitrogen, and 2-5% w/v yeast extract, respectively. Cheese whey was used as the carbon-source, soybean meal extract as the nitrogen-source. The optimum viable cell count (7.56696×10^7 CFU/mL) was obtained in media consisting of 1.3% total sugars, 2.0% nitrogen, and 5.0 % yeast extract. The three medium components used all had significant effects on the growth of *L. plantarum* BS. The growth kinetics of *L. plantarum* BS in cheese whey was also studied. Total sugar concentrations of 2.3%, 4.15%, and 6.0% w/v were prepared with 2.0% nitrogen and 5.0% yeast extract. Total sugar consumption, pH, and viable cell count were monitored at regular interval for 10 hours. Substrate consumption was highest at 4.15% total sugars where the bacteria had the highest viable cell count equal to 7.75×10^{10} CFU/mL, and even higher than the growth in de Man-Rogosa-Sharpe (MRS) broth, a defined media for lactic acid bacteria. pH dropped as fermentation time progressed. The kinetic model that best described the growth of *L. plantarum* BS in cheese whey was the Moser Model. The calculated kinetic parameters were μ_{\max} equal to 0.365557 hr^{-1} and K_s equal to 1429.698 mg/mL having R^2 equal to 0.97913.

Keywords: *Lactobacillus plantarum*, central composite design, growth kinetics

BS - 39

**MICROBIAL DECOMPOSITION OF LEAF LITTER ON THE
MANGROVES OF PUNTA SULONG, BALIANGAO,
MISAMIS OCCIDENTAL, WESTERN MINDANAO**

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This study was conducted in the mangroves of Punta Sulong, Misamis Occidental to: 1) determine and describe the physical properties of the leaf litter; 2) determine the microbial decomposition rate of mangrove leaf litter; 3) compare the rate of microbial decomposition of the two study stations; and 4) describe the site in terms of its substrate, pH, peat depth, rainfall and temperature. Two study stations were established in the mangroves of Punta Sulong, wherein each station was subdivided into two zones, front and back. Yellowing leaves of dominant and co-dominant species of mangroves were collected. A 1mm mesh nylon window screening net was used for the three-litterbag harvest within a period of 42 days. Leaf biomass was estimated wherein $ODW = [0.508 + 0.211] \times [\text{fresh wt.}]$. Results showed that as the number of days of decomposition increased, a change in the color of the leaves occurred, which is evidence that leaching had occurred. After several weeks these were already fragmented to small pieces and others were highly disintegrated. Leaf thickness of *Rhizophora* leaves had a mean of 0.58mm and hardness with a mean of 17.88g. Leaf hardness showed significant correlation to microbial decay ($P=0.0241$). Leaf biomass loss was higher at the back zone which had 7.52g (20.73%) as compared to the front zone which had only 6.50g total loss (19.31%). Station 1 (along Kawayan River) showed a higher biomass loss with a mean of 8.00g (23.98%) as compared to Station 2 (along Dioyo River) which had a mean total loss of 6.12g (16.72). Rate of biomass loss in Station 1 was also higher (0.19g ODW/day) than Station 2 with only 0.14g ODW/day. The rate of biomass loss in both stations of the mangroves of Punta Sulong, Misamis Occidental was 0.17g ODW/day.

Keywords: microbial decomposition, leaf litter, mangroves, Punta Sulong, Baliangao, Misamis Occidental

BS - 40

**MICROBIAL EXTRACTION OF PECTIN FROM
CALAMANSI PEEL**

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Pectin is a widely used polysaccharide due to its gelling and emulsion stabilizing properties. Calamansi peel, a waste product was explored as source of pectin in the study. Current practice in the extraction of pectin involves the use of heat and acid which is not safe for the environment. Thus, extraction of pectin by microbial means was explored. *Saccharomyces cerevisiae* BIOTECH 2030 exhibited highest protopectin solubilising activity (1.2g crude dried pectin/50ml filtrate). Fermentation conditions for microbial extraction of pectin from calamansi peel using *S. cerevisiae* 2030 include substrate concentration of 7 g peel per 80 mL water, inoculum age and level of 24 hrs and 5%, respectively. The microbially extracted pectin from calamansi peel had galacturonic acid content comparable with commercial pectin.

Keywords: calamansi peel, pectin, yeast, protopectin , fermentation

BS - 41

PHILIPPINE *Bacillus* AS AGENT OF CONTROL AGAINST *Ralstonia solanacearum*

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Ralstonia solanacearum (Smith) (formerly called *Pseudomonas solanacearum*) is a devastating soil-borne pathogen that is widely distributed and considered a major limiting factor in the production of many crop plants around the world. *R. solanacearum* is the causal agent of bacterial wilt, a very destructive disease in tomato, banana, potato, eggplant, and some ornamentals. Although much progress has been made in the understanding of the biology of the pathogen, the disease continues to pose serious problems to farmers, particularly in the tropical and sub-tropical countries, like the Philippines. Application of chemical pesticide is still the method of control of *R. solanacearum*. But because of the health and environmental concerns, the use of microbes to control has been very significant in recent years. This research involved isolation and screening of *Bacillus* as control agent against bacterial wilt-causing pathogen, *Ralstonia solanacearum*. A total of 400 *Bacillus* isolates from soil were screened for their antibacterial activity against *R. solanacearum* (E. F. Smith) using agar plug method. Among the 135 *Bacillus* isolates that inhibited *R. solanacearum*, isolates BB142 and BC 152 showed the highest *in vitro* inhibition at 28.7mm and 32.8mm, respectively. Greenhouse experiment showed that the mixed antagonists, BB 142 and BC 152 proved to be the most effective against *R. solanacearum*. Infected tomato plants, root-dipped in mixture of both BB 142 and BC 152 isolates showed no incidence of wilting even after 16 days of inoculation. Biochemical and morphological characterization identified the *Bacillus* isolates BB142 and BC 152, as *Bacillus subtilis*.

Keywords: *Ralstonia solanacearum*, biocontrol, bacterial wilt, *Bacillus*, agent of control

BS - 42

**REPETITIVE SEQUENCE-BASED PCR AND
IDENTIFICATION OF DNA MARKERS IN SELECTED
LACTIC ACID BACTERIA STRAINS**

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Repetitive sequence-based PCR were done to determine the DNA profiles of bacterial isolates with beneficial properties and to identify species and strain-specific markers. A total of 22 bands were scored in nine *Lactobacillus plantarum* isolates and *Lb. plantarum* ATCC 8014. Repetitive Extragenic Palindromic (REP) primers generated nine types of profiles in ten *Lb. plantarum* strains demonstrating the usefulness of REP sequences in strain differentiation. Two bands, with sizes ranging from 0.38 to 0.55 kb, were present in all strains tested and thus could serve as markers for the species. Isolate F39 obtained from fermented guava leaves was most closely similar to two isolates from a fermented meat product. However, no strain specific marker for F39 was observed in its REP profile. Though highly similar profiles were observed between *Lb. fermentum* FM7 and *Lb. fermentum* F36, a 1.4 kb band differentiated F36 from FM7. Compared to REP sequences, the distribution of Enterobacterial Repetitive Intergenic Consensus (ERIC) sequences in *Lb. plantarum* strains was conserved, with a total of six common bands in all *Lb. plantarum* strains tested. Among the three repetitive sequence-based PCR, BOX A1R demonstrated the most conserved DNA profile in *Lb. plantarum*. No unique nor differential DNA marker could be detected for F39 in its BOX profile. Its usefulness in *Lb. plantarum* species identification relies on the presence of five bands. On the other hand, for *Lb. fermentum* F36, a very intense 3.3 kb band, which was not present in FM7, is a potential DNA marker for the strain.

Keywords: rep-PCR, DNA marker, lactic acid bacteria, *Lactobacillus plantarum*, *Lactobacillus fermentum*

BS - 43

**TERATOGENIC POTENTIAL OF CYANOBACTERIUM
(*Nostoc commune*) ON WHITE MICE (*Mus musculus*)**

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This study focused on the teratogenic potential of cyanobacterium *Nostoc commune* on white mice (*Mus musculus*). The dominant lethal test was employed through feeding using 20%, 40%, and 80% of *N. commune*. Sixteen mature females and eight mature males were randomly assigned into three experimental groups and a control. The female mice were sacrificed on the 19th day of pregnancy. Dunnett's Test and one-way ANOVA were used for the statistical analysis. It was found out that *Nostoc commune* has teratogenic potential. Eighty percent yielded the highest %dead implants, %females with resorption, and lowest gestation index, fertility index, and implantation index. There was a decrease in gestation index, implantation index, fertility index, and an increase in %dead implants and %females with resorption. Statistically, there was no significant difference on gestation index and implantation index between the experimental and control groups, but there was a significant difference in the fertility index, %dead implants, and %females with resorption.

Keywords: teratogen, teratogenicity, *Nostoc*, cyanobacterium, white mouse

BS - 44

**THE EFFECT OF STORAGE TEMPERATURE (4 °C) ON THE
ACTIVITY OF ISOLATED BACTERIOPHAGE AGAINST
Salmonella spp. ISOLATED FROM RAW CHICKEN**

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Salmonella is a gram-negative, rod-shaped, motile, non-spore forming bacterium which causes diarrhea to septicemia that is usually contracted through consumption of contaminated foods. Outbreaks of salmonellosis are a perennial problem especially in the poultry industry where alternatives to chemicals to battle this bacteria have been investigated. Bacteriophages, which are capable of lysing *Salmonella* by penetrating through their cell membrane and disrupting their metabolic processes have been explored as an alternative, considering they are safer to use. *Salmonella* Havana was isolated from raw chickens, following the ISO method 6579:2002. A bacteriophage, designated as Bacteriophage A3CE, capable of lysing *Salmonella* Havana was isolated from soil. When the ratio of bacteriophage to *Salmonella* Havana was 10 or more (MOI >10), the number of *Salmonella* Havana was reduced by > 90%, 6 hours after the bacteriophage reached its maximum burst size at room temperature. The same experiment was conducted at 4°C. Results showed that there is no significant difference between the activity of the isolated bacteriophage at room temperature and at 4 °C (P > 0.05). Thus, Phage A3CE was effective in reducing the amount of *Salmonella* Havana at both temperature conditions which makes it a promising alternative agent against the said bacterium.

Keywords: salmonellosis, *Salmonella*, raw chicken, bacteriophage, storage temperature

BS - 45

THE IMMUNOMODULATORY EFFECT OF *Exiguobacteria* sp. ISOLATED FROM SHRIMP GUT ON GROWTH AND SURVIVAL OF *Macrobrachium rosenbergii* CHALLENGED WITH SHRIMP PATHOGENS

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The use of alternative disease control measures such as the utilization of probiotics is widely studied nowadays for efficient management of shrimp aquaculture. This study examined the effect of the pre-isolated bacteria on the growth and immune responses of *Macrobrachium rosenbergii* against viral (White Spot Syndrome Virus) and bacterial (*Vibrio* spp.) pathogens. In addition, the median lethal dosage (LD₅₀) of WSSV and *Vibrio* spp. was determined. Furthermore, the analysis on *Exiguobacteria* sp. as potential probiotic was done through the determination and comparison the immune parameters such as the weight, survival, Total Hemocyte Count, and Phenoloxidase Activity of the experimental and controlled samples. The treatments included the following: *Exiguobacteria* sp. and *Bacillus* sp. separately incorporated to commercial shrimp feed, both of which were fed for 14 days and 21 days, and commercial feed with no addition of probiotics (control). Results showed that both BS (*Bacillus* sp.) and Exi (*Exiguobacteria* sp.) treatments affected ($P < 0.05$) the growth and exhibited increase in survival of *M. rosenbergii* as compared to that of the control group. This investigation suggested that *Bacillus* sp. and *Exiguobacteria* sp. are affective probiotics in rearing *M. rosenbergii* based on enhancement of growth and survival rate against *Vibrio* spp.

Keywords: probiotics, *Macrobrachium rosenbergii*, *Exiguobacteria* sp., *Bacillus* sp., white spot syndrome virus

BS - 46

JACKFRUIT BRONZING DISEASE IN THE PHILIPPINES IS CAUSED BY *Pantoeastewartii* (Smith) Mergaert *et al.*

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Jackfruit bronzing, an unreported disease affecting jackfruit, is characterized by yellowish-orange to reddish discoloration of the affected pulps and rags of the fruit. The disease etiology is the scope of this study. The pathogen was isolated from infected jackfruit, and pathogenicity was conducted. The pathogen was characterized and identified based on its cultural and morphological characteristics, staining reactions, physiological, biochemical characteristics, and other plant inoculations. Initial identification was confirmed through DNA analysis through polymerase chain reaction using *Pantoeastewartii*-specific primers. The bacterium produced a yellow pigment in culture; Gram negative; non-motile; slightly pleomorphic; facultatively anaerobic short-rods; measuring 1-2 um in length; catalase positive; able to hydrolyze gelatin and starch but not tween80; produced acid from glucose, galactose, fructose, sucrose and maltose but not from lactose; did not produce hypersensitivity to tobacco; caused pits but not soft rot on potato discs; and infected corn producing the same symptom as bacterial wilt or Stewart's disease. PCR analysis confirmed the cause as *Pantoeastewartii* or *Pantoeastewartii* subsp. *stewartii* (Smith) Mergaert *et al.*, (formerly *Erwiniastewartii*) (Smith) Dye, the same bacterium that causes bacterial wilt or Stewart's disease of corn.

Keywords: bronzing, disease, etiology, Jackfruit, *Pantoeastewartii*

BS - 47

ACTINOMYCETES AS BIOCONTROL AGENT AGAINST PANAMA DISEASE CAUSING *Fusarium oxysporum*

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Fusarium oxysporum sp. *cubense* tropical race 4 (Foc TR4) is a highly virulent form of Foc that attacks primarily the Cavendish variety of banana, a major export product of the Philippines. The study sought to evaluate the potential of actinomycetes to control Foc. Actinomycetes for biocontrol were isolated from soil samples in mangrove areas in Quezon and Bataan. Screening for biocontrol activity was initially done by agar plug and cup cylinder bioassays against Luzon isolates of Foc. Selected best isolates were then assayed against pure isolate of Foc TR4 that was obtained from Lapanday Foods Corporation through the University of Southeastern Philippines, Tagum City, Davao Oriental. Eighty-two out of a total of 199 actinomycetes isolated showed activity against the Luzon isolate of *F. oxysporum*. Six of these had a 18.0 mm zone of inhibition by agar plug assay. Five of these isolates gave high activity by cup cylinder assay with isolates AQ6, AQ30 and AQ121 as the best three isolates inhibiting *F. oxysporum* by 21.0 mm, 22.0 mm and 20.5 mm, respectively. The three best isolates selected also showed good biocontrol activity against Foc TR4. Bioassay of AQ6, AQ30 and AQ121 gave 24.6 mm, 20.2 mm and 19.0 mm zones of inhibition, respectively in the agar plug assay and 8.3 mm, 12.0 mm and 13.7 mm, respectively for the cup cylinder assay. Combinations of the three isolates yielded an inhibition of 13.5 mm by cylinder cup assay. The present study showed the effectivity of actinomycetes in controlling Foc TR4 *in vitro*. These findings led to the formulation of biocontrol using actinomycetes for greenhouse and field tests to manage the disease and prevent further spread of Foc TR4.

Keywords: actinomycetes, biocontrol agents, *Fusarium oxysporum*, Panama disease, agar plug assay

BS - 48

BIOMASS DEGRADATION ACTIVITY OF FUNGI ISOLATED FROM SUGARCANE BAGASSE UNDER SOLID STATE FERMENTATION

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Conversion of lignocellulosic biomass to ethanol as biofuel is a viable option to address problems of energy economics and environmental concerns. Residual non-food biomass from the agricultural sector like sweet sorghum serves as a promising alternative feedstock for ethanol production. In nature, fungi contribute significantly to the decay of biomass by producing lignocellulolytic enzymes. In this study, two strains of fungi isolated from sugarcane bagasse were evaluated for their biodegradation activity on sweet sorghum bagasse under solid state fermentation. Two fungal strains were isolated from decomposing sugarcane bagasse. One fungal strain (F1) exhibited the characteristics of an ascomycete, having a light green color with loose septate conidiophores. The other strain (F2) had spores distinct from basidiomycetes. Stalks of sweet sorghum were collected from the MMSU Sweet Sorghum project. Samples were dried, cut, and ground to 40 mesh. Samples were inoculated with individual spores of the two fungi. Incubation was carried out at 27°C on a rotary shaker (160 rev/min) for 30 days. Analyses of the biomass constituents of the extractive-free stalks - cellulose, hemicellulose, and lignin - was carried out before and after, following the TAPPI standard procedures. Treatment inoculated with F1 showed a decrease of cellulose, hemicellulose, and lignin at 19.30%, 3.67%, 1.03%, respectively, while F2 treated samples showed a decrease in cellulose (12.46%), hemicellulose (4.55%), and lignin (3.26%). Both fungi showed potential for biodegradation of sweet sorghum bagasse.

Keywords: lignocellulosic biomass, ethanol, sweet sorghum, fungi, biodegradation

BS - 49

BIOMASS DEGRADATION ACTIVITY OF INDIGENOUS FUNGI ISOLATED FROM BANANA STALK UNDER SOLID STATE FERMENTATION

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In solid state fermentation, lignocellulosic biomass is converted to carbohydrates which can be further fermented for the production of ethanol. The main purpose of this study was to determine the biodegradation activity of two indigenous fungi to banana using solid state fermentation. The fungi used in this study were isolated from decomposing sugarcane bagasse. One of the fungi (F1) used in this study has the characteristics of an Ascomycete. It is light green and its conidiophores are septate and are loosely branched. Its conidia are smooth, pale green and spherical in shape. The other fungus (F2) used in this study showed the characteristics of Basidiomycota spores. Banana pseudostem was ground to 40 mesh size. The samples were then inoculated with the spores of the two fungi using standard protocols in inoculating fungi for Solid State Fermentation. After 30 days of incubation, the lignocellulosic biomass of the samples were analyzed using TAPPI standard procedures. The samples treated with F1 showed a decrease in lignin, cellulose and hemicellulose at 1.05%, 18.70%, and 4.2%, respectively. The samples treated with F2 showed a decrease in lignin, cellulose and hemicellulose at 2.09%, 16.34%, and 2.2%, respectively. Consequently, both the fungi showed biodegradation activity on the banana pseudostem.

Keywords: solid state fermentation, banana, fungi, biodegradation, basidiomycota, ascomycota, ethanol

BS - 50

KINETICS STUDY AND SUBSTRATE OPTIMIZATION FOR THE GROWTH OF *Pediococcus acidilactici* 4E5 BY BATCH FERMENTATION

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Pediococcus acidilactici 4E5 isolated from “burong tilapia” is a bacteriocin-producing microorganism which inhibits growth of pathogenic microorganism which can be used in biopreservation processes. For large scale production, alternative low-cost nutrients as media components were investigated. Cheese whey, soybean meal extract and baker’s yeasts were used as carbon-source, nitrogen-source and yeast extract-substitute, respectively. The Central Composite Design was used to predict the optimum growth of *P. acidilactici* 4E5 in the modified low-cost media. The media formulation consisting of 1.3% carbon, 2% nitrogen and 5% yeast extract gave the highest average viable cell count of 8.875×10^7 CFU/mL. Having obtained the best media formulation for the growth of 4E5, kinetics study of 4E5 in low-cost growth medium was done. Media for kinetic study consisted of sugarcane molasses as carbon source at concentrations (1.3%, 3.15%, and 5%) with nitrogen (2%) and yeast extract (5%). Parameters such as pH, viable cell count, % titratable acidity, and total sugar were determined during the 12-hour fermentation. Results showed pH and total sugar concentrations decreased with fermentation time. An indication of the growth of 4E5 and subsequently, lowering of pH due to presence of lactic acid in the medium. The specific growth rate was determined. The growth of *P. acidilactici* 4E5 was best described by the Moser Model yielding a μ_{max} value of 0.173319 hr^{-1} and K_s value equal to 4744.6141 g/mL .

Keywords: *Pediococcus acidilactici*, central composite design, fermentation, kinetic study

BS - 51

**FUNCTIONALITY OF *Lentinus tigrinus* (Bull.) Fr.,
AN EDIBLE BASIDIOMYCETE FROM THE PHILIPPINES**

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Filipinos are now searching for organic foods with important nutrients and multifunctional activities, which are termed as nutraceuticals. The bioactive components of edible mushrooms have emerged as natural sources of compounds that are antioxidant, antibacterial, anti-hypercholesterolemic, anti-diabetic, antiviral, and antifungal. Our team has been continually searching for Philippine wild edible mushrooms with nutraceutical potential. One of the candidates is a white wood-rotting basidiomycete, the *Lentinus tigrinus* (Bull.) Fr. Recently, the optimum cultural conditions and production technology for this mushroom were established. In this study, we determined the antibacterial and hypoglycemic activities of *L. tigrinus*. *In vitro* antibacterial assay showed that the ethanolic extract of fruiting body and the immobilized secondary mycelia had high antibacterial activity against *Staphylococcus aureus*. The administration of lyophilized hot water extract of the fruiting body (both 100 mg/kg and 250 mg/kg dosages) to diabetic-induced mice significantly lowered the glucose level by 26.9% on the third week, which was comparable to the anti-diabetic agent glibenclamide. With these significant biological properties, *L. tigrinus* can be considered as natural source of safe nutraceutical.

Keywords: *Lentinus*, nutraceutical, functionality, mushroom, diabetes

BS - 52

**NUTRITIONAL AND PHYSICAL CULTURE CONDITIONS
FOR MYCELIAL GROWTH AND FRUITING BODY
PRODUCTION OF TWO STRAINS OF
Ganoderma lucidum (Leys.) Karst**

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Ganoderma lucidum (Leys.) Karst belongs to the group of Basidiomycetes. The fruiting body is glossy reddish- orange to brownish black color with definite stalk attach to the cap. It is usually found growing on dead trunks of trees in the forest. This study evaluated the optimum culture conditions for secondary mycelial growth and fruiting body performance of the two strains (*Munoz* and *Cuyapo*) of *G. lucidum*, with special reference to the influence of nutritional factors (different indigenous culture media), physical factors (pH, aeration, illumination and temperature), locally available granulated spawning materials (sorghum seeds, palay grains and feed conditioner), and rice straw based substrate formulation. Results revealed that regardless of the strain type, the most suitable culture conditions for mycelial growth of *G. lucidum* was coconut water gulaman at pH 7, incubated in unsealed plates, either dark or lighted at room temperature condition. Corn grit produced the very thick mycelia growth and shortest incubation period with a mean of 6.0 days. Furthermore, 7 parts rice straw + 3 parts saw dust combination produced the heaviest fruiting bodies (15.85 g) and highest biological efficiency (4.70%). The *Munoz* strain produced heavier fruiting bodies and higher biological efficiency than *Cuyapo* strain.

Keywords: *Ganoderma lucidum*, *Munoz* and *Cuyapo* strains, indigenous culture media, physical factors, secondary mycelia

BS - 53

**RADICAL SCAVENGING ACTIVITIES AND TLC-GUIDED
BIOAUTOGRAPHY OF THE SC-CO₂ EXTRACT OF
*Ganoderma applanatum***

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Supercritical carbon dioxide (SC-CO₂) extracts from the fruiting bodies of *Ganoderma applanatum* were characterized by reverse phase high performance liquid chromatography (HPLC) and fourier transform infrared spectroscopy (FTIR), and its antioxidant compounds were determined through DPPH Radical Scavenging Assay and TLC-guided bioautography. The extracts were found to be essential oils in 10 mPa and secondary metabolites in 20 & 30 mPa. The DPPH assay, which determines radical scavenging activity, showed that the SC-CO₂ extracts have antioxidant activity in the following order: 10 mPa < 30 mPa < 20 mPa < ascorbic acid. Results of TLC-bioautography using 2.54 mM DPPH showed that the compounds have antioxidant property through the changed in color of the extracts in the TLC plate. These results suggest that the extracts serve as a source of compounds with radical scavenging activity that can be used as antioxidants aside from its traditional uses.

Keywords: *Ganoderma applanatum*, SC-CO₂ extracts, Reverse-phase HPLC, FTIR, DPPH radical scavenging assay, TLC-guided bioautography

BS - 54

**SYNERGISTIC EFFECT OF CHEMICAL AND
ULTRAVIOLET IRRADIATION ON THE
BIODEGRADATION OF LOW DENSITY POLYETHYLENE
(LDPE) BY *Aspergillus oryzae***

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The ability of *Aspergillus oryzae* to degrade low-density polyethylene (LDPE) was tested with chemical and ultraviolet (UV) radiation pre-treatments. The degree of degradation was measured after 45 days incubation in Zchapek's broth medium with *Aspergillus oryzae*. LDPE plastic strips (1 in x 4 in) were soaked in 0.01% potassium permanganate solution for 48 hours and exposed to UV-A radiation for 120 hours. Elongation length, maximum force required to tear plastic and physical changes of the plastic material were noted. Results show a synergistic effect of chemical and UV pre-treatment, implicating the highest degradation result with 43.56% reduction of the maximum force needed to break the material and 84.26% reduction in the elongation length at break. With UV pre-treatment alone, there was only 35.81% reduction in maximum force and 70.02% reduction in elongation length. With chemical pre-treatment alone, a reduction of 31.88% in maximum force and 76.96% in elongation length were observed. Elongation length at break had been statistically proven significant at 5% level. Based on the analysis, both the chemical treatment ($p = 0.011$) and UV irradiation ($p = 0.019$) have a direct effect on the elongation length of the samples. It is therefore apparent that LDPE can be degraded through fungal exposure, provided that sufficient chemical and mechanical pre-treatments are administered.

Keywords: biodegradation, *Aspergillus oryzae*, low-density polyethylene (LDPE), UV irradiation, potassium permanganate

BS - 55

**FUNGAL ENDOPHYTES FROM MANGROVE
LEAVES AND STEMS: SOURCES OF METABOLITES
WITH ANTIMICROBIAL, ANTIOXIDANT,
AND CYTOTOXIC ACTIVITIES**

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The search for new drugs recently taps fungal endophytes associated with tropical plants. In this study, fungal endophytes from stems and leaves of Philippine mangroves (MFE) were grown *in vitro* for the mass production of bioactive secondary metabolites. Eighteen MFE crude culture extracts were then tested for their antimicrobial, antioxidant, and cytotoxic activities. Results showed that six MFE exhibited inhibitory activities (11-16 mm ZOI) against at least one of the nine test microorganisms. The crude culture extracts were more active against gram-positive than gram-negative bacteria as shown by the paper disk diffusion assay. Cytotoxic activity using the brine shrimp (*Artemmia salina*) lethality assay showed that six of the MFE killed at least 50% of the test organism at a concentration of 100 µg. One MFE exhibited 100% brine shrimp lethality. Of the seven MFE extracts tested for their antioxidant activity using DPPH assay, only four showed 40-52% radical scavenging activity. Our research study highlighted the potential of fungal endophytes from Philippine mangroves as sources of metabolites with pharmaceutical importance and for novel drug discovery.

Keywords: bioassay, biological activities, *in vitro* culture, mangrove fungi, secondary metabolites

BS - 56

***Lentinus squarrosulus* (MONT.) SINGER AND *Polyporus grammacephalus* BERK.: NEWLY DOMESTICATED, WILD EDIBLE MACROFUNGI FROM THE PHILIPPINES**

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Lentinus squarrosulus (Mont.) Singer and *Polyporus grammacephalus* Berk. are wild, edible macrofungi utilized as food by the indigenous Aeta tribes in Botolan, Zambales. Domestication of these wild edible mushrooms is thus necessary to render these fungi available all year round for food and other purposes. In this study, the two edible macrofungi were grown *in vitro* using different indigenous culture media, grain spawning materials, and combinations of rice straw and sawdust formulations for its secondary mycelial growth and mass production of fruiting bodies. Results showed that secondary mycelial growth was observed best on coconut water-*gulaman* medium. Sorghum seeds and/or corn grits also yielded very luxuriant mycelial growth at shortest incubation period of 6 days for *L. squarrosulus* and 7 days for *P. grammacephalus*. Highest biological efficiency (7.83%) was noted in 100:400 rice straw:sawdust formulation for *L. squarrosulus*. In contrast, highest biological efficiency (2.91%) was recorded for *P. grammacephalus* at 400:100 rice straw:sawdust formulation. The macrofungi reported in the study are new additions to the record of successfully domesticated wild, edible macrofungi in the Philippines.

Keywords: *in vitro* cultivation, mycelial growth, indigenous media, grain spawns, fruiting body production

**CHEMICAL, MATHEMATICAL
AND PHYSICAL SCIENCES**

CMPS - 01

SYNTHESIS AND CHARACTERIZATION OF MOLECULARLY IMPRINTED POLYMER USING TRANS OLEIC FATTY ACID AS TEMPLATE

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Labelling of trans fatty acid (TFA) content in foods is mandatory in many countries. The impact of TFA content in food labels prompts analytical laboratories to address outstanding issues on trans fatty acid analysis. In this work, a molecularly imprinted polymer (MIP) using trans oleic fatty acid methyl ester (FAME) as template was prepared by precipitation polymerization method using methacrylic acid as functional monomer, trimethylolpropane methacrylate as cross-linking agent, 2,2-azobis (isobutyronitrile) as the radical initiator, and dichloromethane as porogen. A non-imprinted polymer (NIP) was also prepared. Template removal was done by Soxhlet extraction using methanol-acetic acid (9:1 v/v) as the extraction solvent. The binding properties of trans oleic FAME imprinted polymers were evaluated in different solvent systems by equilibrium experiments. Scatchard plot analysis in heptanes revealed that there were two classes of binding sites populated in the imprinted polymers which indicated that the polymer possesses heterogeneous binding sites distribution. The stronger affinity binding type exhibits dissociation constant (K_d) 10 times smaller than that of the weaker type with binding capacity of 48.04 μg trans oleic FAME/mg MIP. The resulting Freundlich isotherm further demonstrated the heterogeneity of the binding sites of the MIP, with heterogeneity index "a" equal to 0.4758. Polymer characterization was done by scanning electron microscopy (SEM) and Elemental analysis (Combustion Method) to support the imprinting and rebinding process of trans oleic acid. This MIP is a potential adsorbent material for the solid-phase extraction (SPE) of trans oleic acid in food.

Keywords: Molecularly imprinted polymer, trans oleic acid, precipitation polymerization, Scatchard plot, Freundlich isotherm

CMPS - 02

ADSORPTION OF VOCs BY CARBONIZED OKRA STALKS

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Volatile organic compounds (VOCs) have become the focus of environmental health researches due to their role in indoor air pollution, called the sick building or sick house syndrome. The search for novel gas adsorbents has led to potential applications of lignocellulosics and waste biomass, such as kenaf, hay, peanut hulls, sawdust, and others. The okra stalk (*Abelmoschus esculentus* Moench syn. *Hibiscus esculentus* L.) was carbonized, activated, and tested for its potential in adsorbing VOCs specifically, formaldehyde, toluene, and xylene. Characterization of the okra stalk in its raw and carbonized form was done. Its ability to adsorb vapor, and mesoporosity and microporosity were also evaluated. VOC adsorption was determined by closed chamber method using a vacuum desiccator. The concentration of VOC in the chamber was measured using Formaldemeter hTV and corresponding Gastec indicator tubes. Adsorption of gases particularly polar and non-polar VOCs onto carbonized and activated okra stalks was shown to be promising, particularly with formaldehyde adsorption, which may be due to the hydrophilicity of formaldehyde and the ability of carbonized okra to retain vapor. Further, the okra stalks adsorbed better than the commercial activated carbon. A higher rate of adsorption was observed from the non-activated samples which could indicate that the number of polar sites on the carbon surface decreased with activation. On the other hand, non-polar VOC adsorption (toluene and xylene) showed that okra stalks activated at 800! and 900! adsorbed better than its non-activated counterpart.

Keywords: VOC, adsorption, okra stalks, charcoal, formaldehyde

CMPS - 03

**ANTI-ANGIOGENIC PROPERTY OF THE AQUEOUS
EXTRACT OF *Canarium ovatum* LEAVES
USING CAM ASSAY**

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The aqueous leaf extract (ALE) of *Canarium ovatum* was evaluated for possible anti-angiogenic effect in the duck (*Anas platyrhynchos*) embryos using chorio-allantoic membrane (CAM) assay. In the study, *C. ovatum* ALE at 1, 10 and 100 µg/mL was administered *in ovo* at day 3 of incubation using a modified windowing technique. Results revealed a significant inhibition in blood vessel formation in all the *C. ovatum* ALE treated samples in a dose dependent manner compared to the control group given with double distilled water only. The embryos treated with the highest dose (100 µg/mL) exhibited much reduction in primary blood vessel count and secondary blood vessel thickness resulting in relatively smaller embryos. The findings confirm the anti-angiogenic activity of *Canarium ovatum*. Further studies are warranted to determine its active components, the possible mechanism of action and therefore establish its potential as an antitumor agent.

Keywords: aqueous leaf extract, *Canarium ovatum*, anti-angiogenic, *Anas platyrhynchos*, chorio-allantoic membrane assay

CMPS - 04

**AN ELECTRONIC NOSE BASED ON CONDUCTING
POLYMERS FOR THE DIFFERENTIATION OF
PHILIPPINE COFFEE VARIETIES**

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An electronic nose (e-nose) based on conducting polymers was developed to discriminate different varieties of Philippine coffee: Arabica, Excelsa, Liberica, and Robusta. Conducting polymers such as polyaniline and polypyrrole doped with various counter-ions were utilized as the molecular recognition element in the e-nose system. Thin-film of conducting polymers were electro-deposited through potentiostatic polymerization onto the gap between the two gold wires (diameter = 620 μm ; distance = 200 μm) set on a Teflon substrate and these conducting polymers were conditioned at a potential of 250 mV. The sensors response was recorded as the voltage produced by a linearized wheatstone bridge circuit. The sensors responded rapidly when exposed to the headspace of the coffee beans sample. The response exhibited good reversibility and reproducibility. The response of the sensor array in the e-nose system exhibited distinct patterns for each coffee variety. This was visualised by bar graph and radar plot. Chemometric analysis through pattern recognition techniques such as principal component analysis (PCA) and cluster analysis (CA) highlighted clusters for each coffee variety. This system offers a simple, low-cost and reliable method for the discrimination of Philippine coffee variety. It can also be applied for the authentication for coffee variety.

Keywords: electronic nose, conducting polymers, coffee, principal component analysis and cluster analysis

CMPS - 05

APPLICATION OF DIGITAL IMAGING COLORIMETRY TO THE DETERMINATION OF METAL ION CONCENTRATION IN AQUEOUS SOLUTION

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Digital imaging colorimetry (DIC) is an alternative method for quantitative measurements in analytical chemistry, wherein accessible digital devices and images that employ the RGB color space are used. In this study, DIC was employed to quantify Co(II), Ni(II) and Cu(II) in aqueous solution. The study was carried out using a digital camera designed in a fixed position over an improvised light box set-up. The acquired image was digitized on the RGB color space using Adobe Photoshop. Then, calibration curves for each of the metal ions was constructed by plotting the concentration of metal ion against the selected digitized color values under optimized conditions (*i.e.*, camera distance and filter color). The highest linearity and sensitivity for each calibration curve was found to be associated with the digitized color value (R, G or B) complementary to the color of the metal ion solution. The dynamic linear range for each calibration curve was from 0.10 M to 0.60 M of the metal ion, and the linearity and sensitivity were 0.992 r^2 and -291.6 G-value/M for Co(II); 0.996 r^2 and -114.6 R-value/M for Ni(II); and 0.997 r^2 and -161.0 R-value/M for Cu(II). These calibration curves were comparable with those constructed using the conventional spectrophotometric method.

Keywords: Digital imaging colorimetry (DIC), colorimetric sensing, RGB color coordinate, Co(II), Ni(II), Cu(II), spectrophotometric method

CMPS - 06

AQUEOUS AND METAL-FREE ASYMMETRIC ALDOL REACTIONS ORGANOCATALYZED BY CHIRAL 2-PYRIDYLIMIDAZOLINES – A GREEN APPROACH TOWARDS STEREOSELECTIVE C-C BOND FORMATION

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Among the frontier challenges in the 21st century is the development of asymmetric reactions with excellent enantioselectivity and atom economy. After the birth of proline-catalyzed asymmetric carbon-carbon bond forming reactions, an explosion of various organocatalytic methodologies have been reported. Among the organocatalyst manifolds, the catalytic utility of 2-imidazolines has been less explored. In this study, various 2-pyridylimidazolines were screened for their catalytic activity towards direct asymmetric Aldol reaction. The chiral catalysts were synthesized through iodine-promoted oxidative condensation and cyclization of 2-pyridine carbaldehyde (or 2,6-pyridine dicarbaldehyde) with chiral 1,2-diamine derivatives in excellent yields. Various catalytic parameters were optimized to determine the best reaction condition, such as catalyst loading, temperature, reaction time, and solvent. The best conditions which gave excellent enantioinduction (up to 99:1 enantiomeric ratio) and yield were observed with brine as the solvent, a one hour reaction period at room temperature, and 10 mol% as the minimum catalyst load. Thus, our study demonstrates a green and sustainable approach en route the asymmetric construction of β -hydroxy carbonyl structures.

Keywords: organocatalysis, 2-pyridylimidazolines, Aldol reaction, asymmetric catalysis

CMPS - 07

**BIOMOLECULAR AND CHROMATOGRAPHIC
CHEMICAL FINGERPRINTING OF SECONDARY
METABOLITES FROM *Moringa oleifera* Lam. OBTAINED
THROUGH SUPERCRITICAL-CO₂ EXTRACTION**

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Moringa oleifera is one of the most important food plants with potential nutraceutical value deserving complete characterization beyond phytochemical analysis. DNA-binding assay using a two-dimensional thin layer chromatography (2D-TLC) combined with Supercritical-CO₂ Extraction (SCE) can abbreviate the screening for target bioactive compounds by eliminating the use of voluminous toxic solvents and zeroing in on control of gene expression. The leaves, seeds, and roots of *M. oleifera* were extracted using Supercritical-CO₂ (SC-CO₂) with pressures of 10, 20, and 30 megaPascals (mPa). The extracts were screened for DNA binding property using two-dimensional thin layer chromatography (2D-TLC) in a solvent system of ethyl acetate and toluene (90:10 v/v). Extracts from seeds and roots at 10 mPa showed affinity to DNA with R_f ratios (R_f value without DNA/R_f value with DNA) of 0.647 and 0.789, while the seed extracts at 20 mPa gave an R_f ratio of 0.818. All extracts from the leaves showed the same organic compounds of oleic acid, erucic acid, ethylene/acrylic acid, and polyvinyl stearate as shown by Fourier-transform Infrared (FT-IR) spectroscopy. The seed and root extracts at various pressures displayed varied functional groups. The HPLC chromatograms of all extracts showed at least one peak at 15 minutes running time. Combined DNA-binding assay and SC-CO₂ extraction prove to be an efficient system for high throughput screening (HTS) for target bioactive compounds, with a high degree of purity as shown by HPLC chromatograms. The various organic compounds partially identified by FT-IR deserve further investigation with respect to their biological functions.

Keywords: 2D-TLC, SC-CO₂, FT-IR, HPLC, *Moringa oleifera*

CMPS - 08

***Citrus microcarpa* PEEL EXTRACT AS ACTIVE
INGREDIENT FOR LIQUID HAND WASH**

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Some liquid hand wash products contain *Citrus microcarpa* (calamansi) juice and virgin coconut oil as active reagents added to SLES, CDEA, Dehyton AB 30, propylene glycol, salt, preservatives, and water. Because calamansi juice as an active ingredient increases the cost of production, its peel extracts can be investigated as a substitute. This study determined the acceptability of calamansi peel extract as a substitute active reagent of calamansi juice for liquid hand wash to improve the viscosity of the product and reduce production cost. A three-day extracted peel extract of calamansi was formulated with varying concentrations of 20, 40, 60, 80 and 100% into a liquid hand wash and subjected to sensory evaluation. The liquid hand wash with 40% peel extract was the most preferred concentration with “like very much” as to appearance and foamability and “like moderately” as to scent and viscosity. The product was effective based on total plate count in cfu/20cm² using a swab test. The calamansi peel can be incorporated to calamansi juice as an active reagent for liquid hand wash and a 40% solution of the three-day extract of calamansi peel is recommended.

Keywords: *Citrus microcarpa*, peel, extract, hand wash, calamansi

CMPS - 09

DEVELOPMENT OF DRAWING INK FROM CEPHALOPODS

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The production of the squid ink, developed by the researchers of Cebu Technological University (CTU), Main Campus-Technology Research Center (TRC), promotes the utilization of ink from the sac of Cephalopods, in particular squid, diamondback squid, and cuttlefish, with the objective of decreasing the cost of commercial ink. The squid ink using different species of cephalopods is superimposed with water, acid, glycerin, thinner and varnish. The developed squid ink from *Thysanoteuthis rhombus* with 25% squid pigment and 50% acid concentration has a grayish black color, slightly desirable solvent-like odor, ink dryness with a sharp irregular line, thick and dry ink consistency which is comparable with the commercial ink as to its color, dryness, and consistency. An improved ink formulation from sac of cuttlefish has light black color, moderately desirable solvent-like odor, sharp regular line, thin and dry ink consistency. All attributes significantly differ among ink sac from different species of Cephalopods based on Analysis of Variance and Duncan Multiple Range Tests at 5% level of significance. The drawing ink from squid had a density (0.98 g/ml) which is close to commercial ink, and is safe for use since the lead content was less than 3.00 ppm. The researchers refining the ink density towards wider application of the newly formulated ink from a natural source.

Keywords: cephalopods, ink sac, drawing ink, squid ink, ink density

CMPS - 10

CONTROLLED DRUG DELIVERY CONSTRUCTED USING INKJET PRINTING

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Controlled drug delivery promotes the best efficient therapeutic effect of a medication in a patient. It involves delivering the drug in the proper dosage at the proper time at the site where it is needed. Several approaches have been developed to achieve this goal, including oil-in-water emulsion solvent evaporation, wet spinning, and compression-heat moulding. However, these methods require tedious procedure and result in a big amount of chemical wastage. In this study, the feasibility of using inkjet printing (IJP) in distributing dexamethasone (DEXP) throughout biodegradable poly(lactic-*co*-glycolic acid) (PLGA) platforms was investigated. The printed structures were rendered three-dimensional (3D) by simply rolling the 2D. These were then investigated for use as sustained delivery reservoirs. Release studies showed a minimal initial burst release, with a sustained release over an extended time period. Empirical modelling showed a good agreement with experimental *in vitro* release data. In conclusion, ink jet printing can be used to produce spatially resolved patterns that provide control over the release profile obtained. The preparation technique offers a simple procedure with a minimal amount of material waste.

Keywords: inkjet printing, drug release, biodegradable polymer, dexamethasone, controlled drug delivery

CMPS - 11

BLOOD LEAD ANALYSIS BY ANODIC STRIPPING VOLTAMMETRY COUPLED WITH METAL-EXCHANGE REAGENT SAMPLE PRE-TREATMENT

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Lead is ubiquitous and diagnosis of exposure to this toxic metal can be challenging as symptoms of lead poisoning may mimic other disorders. There is a need for a more sensitive technique with fast turnaround time. Lead in human blood samples was analyzed by anodic stripping voltammetry (ASV) following sample pretreatment with a metal-exchange reagent. The voltammetric analyzer used was E-Chem/Powerlab electrochemical system with thin mercury film, Ag/AgCl and platinum electrodes. The lead stripping peak appeared at the potential of -0.45 V in acetate buffer of pH 4.5. The optimum volume ratio of metal-exchange reagent to blood sample used was 2.9 mL: 100 μ L. Repeatable results were obtained in the analysis of blood spiked with lead (100-500 μ g/L). The intra-batch and inter-batch coefficient of variance (CV) values were 7.8% and 12%, respectively. Linear responses (i_p vs. Pb conc.) were obtained for low Pb conc. range (100-500 μ g/L) and high Pb concentration range (1.00 to 5.00 mg/L). The limit of detection (LOD) and the limit of quantitation (LOQ) were 9.00 μ g/L and 29.0 μ g/L, respectively. The % recovery ranged from 109.3 to 129.0%. Results of ASV analysis of five human blood samples gave values ranging from 1.23-35 μ g/dL (vs. reference value of 20.0 μ g/dL). The use of a metal-exchange reagent in the study was shown to be a promising alternative sample pre-treatment method for the measurement of lead levels in human blood.

Keywords: lead, anodic stripping voltammetry, metal-exchange reagent, sample pre-treatment, blood

CMPS - 12

ENHANCED ELECTROCATALYTIC ACTIVITY OF PULSE DEPOSITED Pt PARTICLES DISPERSED ON PEDOT-MODIFIED Au ELECTRODE TOWARDS ETHANOL OXIDATION

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Poly(3,4-ethylenedioxythiophene) (PEDOT)-modified Au electrodes were electrochemically prepared via potentiodynamic polymerization using 0.01 M EDOT and 0.10 M HClO₄ on a Au substrate at a potential range from 0.0 to 1.10 V (vs. Ag/AgCl). The PEDOT-modified Au electrode was electrochemically characterized in a monomer-free 0.10M HClO₄ electrolyte. The surface morphology was probed using Scanning Electron Microscopy (SEM). Platinum particles dispersed on PEDOT-modified Au electrodes were prepared in two steps: (1) aqueous electropolymerization of EDOT, and (2) pulse deposition of platinum. Pulse deposition of Pt nanoparticles was carried out using the following optimized parameters: -30 mA/cm² of pulse current with 0.2 s on-time and 0.4 s off-time at 700 pulses. Electrocatalytic activity of the prepared Pt/PEDOT/Au electrode was evaluated towards ethanol oxidation using 1.0 M ethanol in 0.10 M H₂SO₄ electrolyte solution from E = 0.0 V to E = 0.90 V (vs. Ag/AgCl) at a scan rate of 100 mV·s⁻¹. The CV profile of the prepared nanocomposite shows an anodic peak at E = +0.700V which is an indication of the presence of platinum. Examination of the surface morphology of the Pt nanoparticles (Pt NPs)/PEDOT/Au-modified electrode revealed well-dispersed platinum particles on the polymer matrix with a diameter of less than 100 nm. Enhancement of the electrocatalytic activity towards ethanol oxidation was observed in pulse-deposited platinum particles compared to potentiodynamically-deposited platinum particles on PEDOT-modified Au electrode.

Keywords: poly(3,4-ethylenedioxythiophene), electropolymerization, Pt nanoparticles, pulse deposition, electrocatalysis

CMPS - 13

ENHANCED PHOTOCATALYTIC DECOLORIZATION OF MALACHITE GREEN USING RUTHENIUM – DOPED TITANIUM DIOXIDE NANOCRYSTALS UNDER VISIBLE LIGHT ILLUMINATION

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Ruthenium-doped Titanium dioxide (TiO_2) photocatalysts were successfully prepared using sol-gel method and structural characterization involved X-ray Diffractometry (XRD), Scanning Electron Microscopy and Energy Dispersive X-ray Analysis (SEM +EDX), and Fourier Transform Infrared Spectroscopy (FT-IR). SEM image analysis revealed the synthesized Ru- TiO_2 particles are highly aggregated and surfaces are clearly rough. The phase composition using XRD analysis revealed that anatase and rutile peaks were found in undoped TiO_2 and only anatase peaks were present Ru-doped TiO_2 systems which were calcined at 500°C . Furthermore, an increase calcination temperature to 700°C promotes the transformation of anatase to rutile peaks. The Debye-Scherrer equation was used to estimate the crystallite size based from the diffractograms. The estimated values are 3.49 nm, 3.53 nm, 3.53 nm for 0.20, 0.50 and 0.80 mole % Ru-doped TiO_2 , respectively. The photocatalytic property of the Ru doped TiO_2 were tested against the decolorization of malachite green solution (MG). A plot $\ln C_0/C$ versus time gave R^2 values ranging from 0.9041 to 0.996 which suggests that the photodecolorization of MG using TiO_2 photocatalysts follows pseudo-first order kinetics. The photocatalytic activity of the catalysts was found to improve with the addition of ruthenium, from 20 % for undoped TiO_2 to 87 % for 0.8 mol % TiO_2 . The maximum percent removal of MG dye was achieved using 1.50 g/L of catalyst loading for 0.8 mol % ruthenium added. The TiO_2 photocatalyst prepared at calcination temperature of 500°C showed the highest percent removal compared to those calcined at 300°C and 700°C . When the calcination temperature was increased the photocatalytic activity of the synthesized catalyst was found to decrease over time.

Keywords: Malachite green, Photodecolorization, X-ray Diffractometry, Titanium Dioxide, Ruthenium

CMPS - 14

EXTRACTION AND CHARACTERIZATION PHENOLIC ANTIOXIDANTS FROM CALAMANSI PEEL, COFFEE HUSK AND CACAO POD HUSK

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Phenolic compounds from calamansi peel, coffee husk and cacao pod husk were extracted using a cheap solvent. The extracts were evaluated for their antioxidant capacity by 2,2-diphenyl-1-picryl-hydrazyl (DPPH) radical scavenging assay and ferric ion reducing antioxidant power (FRAP) test. Antimicrobial property and High Performance Liquid Chromatography (HPLC) analyses were also conducted. The DPPH radical scavenging activity of the phenolic extracts (PE) were in the order: cacao husk PE > coffee husk PE > calamansi peel PE. Both extracts from cacao and coffee husks were better free radical scavengers than the synthetic reference antioxidants, butylated hydroxyl-anisole (BHA) and butylated hydroxyl-toluene (BHT), but that from calamansi peel was not. The reducing power of the extracts, on the other hand, were in the order: coffee husk PE > cacao husk PE > calamansi peel PE. Based on DPPH assay and reducing power test, cacao and coffee husks appeared to be excellent sources of natural antioxidants but not calamansi peel. Phenolic extract from calamansi peel, however, exhibited better antimicrobial activity against some organisms than the two extracts. Results of HPLC analysis showed that per 200 mg powder, there was 0.8 ng caffeic acid in cacao pod husk; 0.3 ng caffeic acid and 0.9 ng chlorogenic in coffee husk; and 1.1 ng *p*-coumaric acid and 1.3 ng sinapic acid in calamansi peel.

Keywords: DPPH assay, FRAP test, phenolic compounds, antioxidants, calamansi

CMPS - 15

**HYDROLOGICAL CHARACTERIZATION OF THE
EASTERN SIDE OF BATAN, AKLAN AQUIFER**

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Groundwater is constantly being recycled and replenished by rainfall. However, because of the uneven distribution of rain and the heavy use of water in some areas, some basins/aquifers are experiencing environmental stress. To delineate the ground water recharge areas for the eastern side of Batan, Aklan, Philippines, and to assess the vulnerability of the aquifer to pollution and sea water intrusion, measurements on the filed parameters, pH, conductivity, as well as, the eight major ions calcium, magnesium, sodium, potassium, chloride, nitrate, sulfate, and bicarbonate were made. Radioactivity of the water samples was also measured. Some geochemical processes were recognized in the Batan, Aklan basin, the most important of which are water-bedrock interaction and sea water intrusion. The groundwater in the eastern Batan, Aklan basin is predominantly of the calcium magnesium bicarbonate type. Two clusters of water type were found. Cluster 1 (Aby, Mandong Manukan, and Poblacion Magkawit) and Cluster 2 (Banica Hill, Banica Plain, Poblacion Acacia and Angas-1). Recharge in Cluster 1 becomes sodium chloride dominated due to possible impending brackish water intrusion. Recharge in the Cluster 2 does not show salinisation/ seawater intrusion and may indicate active recharge to the subsurface water. The overall quality of subsurface water in the eastern side of Batan, Aklan can be considered good and compliant with the limits set by the Philippine National Standards for Drinking Water for the physicochemical parameters, except for the Angas-1 and Angas creek waters which have very acidic pH. Both the gross alpha and beta activities in all the sites were within the regulatory limits for radioactivity in drinking water of the Department of Health.

Keywords: pH, groundwater, recharge, major ions, Aklan

CMPS - 16

**MORPHOLOGICAL AND CHEMICAL PROPERTIES OF
BIOLOGICAL APATITE POWDERS FROM 0.5M
HYDROCHLORIC ACID (HCl) PRE-TREATED AND
THERMALLY-TREATED TILAPIA BONES**

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Hydroxyapatite (HAp) from biological apatite has been widely studied for its ability to replace broken bones and teeth. Numerous techniques can produce good quality HAp; however, these techniques are expensive. In this research, the production of biological HAp powders from 0.5M HCl pre-treated tilapia bones using thermal treatment is presented. Proper cleaning of bones was done before thermal treatment (700°C to 1000°C). Energy dispersive x-ray (EDX) spectroscopy and scanning electron microscopy (SEM) were used to elucidate the elemental and surface morphology, respectively. The characterization results confirmed the presence of HAp in all prepared samples. Better HAp crystals are observed compared with the untreated tilapia bones. As the annealing/calcination temperature of tilapia bones increased, the good quality of HAp crystal is formed as shown in SEM-EDX results. SEM micrographs depict the round-like and rod-like shapes of HAp powders along with the coalescence of particles as calcination temperature increases which are better than untreated prepared samples. Furthermore, EDX results also confirm the calcium-deficient formation of HAp powders. However, formation of 0.5M HCl pre-treated HAp crystals is observed at 800°C as revealed by [Ca]/[P] ratio. These results conform to the properties and composition of biological apatites implying that the produced HAp powders have better quality than untreated samples and are now ready for further studies on its applications.

Keywords: HAp, apatite, biological apatite, SEM-EDX, thermal treatment

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OPTIMIZATION STUDY ON THE DILUTE ACID PRETREATMENT AND ENZYME SACCHARIFICATION OF THE MACROALGAE *Sargassum* spp. FOR ETHANOL PRODUCTION

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A promising alternative non-food feedstock for bioethanol is macroalgae, not only due to their fast growth rate and large biomass yield but also because the Philippines is already one of its major global commercial producers. This study focused on the optimization of the acid pretreatment and enzyme saccharification of the macroalgae *Sargassum* spp. using the Response Surface Methodology (RSM). The dried and ground *Sargassum* was treated with H₂SO₄ to final concentrations of 0 to 6.36% (w/v) at solid loading of 10% (w/w) at varying temperatures (111 to 129 °C) and reaction time (0.16 to 1.84 hr). The acid-treated biomass was subjected to enzyme saccharification using cellulase and cellobiase at pH 4.8 at a temperature of 50 °C and 100 rpm in a water bath shaker for 48 hrs. The total reducing sugars and glucose of the samples were determined by the DNS (dinitrosalicylic acid) method and high performance liquid chromatography, respectively. Results showed that the effects of temperature, acid concentration and reaction time on glucose released were statistically significant ($p < 0.05$) with the increase in acid concentration from 0.1 % (w/v) to 1.0 % (w/v) to be the least significant. For maximum reducing sugar and glucose yields, the predictive model provided the optimum conditions of 3.36 to 4.15% (w/v) H₂SO₄, 115 °C and 1.44-1.50 hrs. This optimal pretreatment conditions, as well as the conditions employed in enzyme saccharification, are relatively milder compared to that of terrestrial biomass.

Keywords: acid pretreatment, bioethanol, enzyme saccharification, macroalgae, *Sargassum*

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PRODUCTION OF PLANT OILS AND METHYLESTERS USING THE SUPERCRITICAL FLUID EXTRACTION METHOD

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The oil from jatropha seeds and grated coconut meat can be effectively extracted by supercritical carbon dioxide. Extractions were conducted using a SCFE equipment, Model: 46-19360-60Hz equipped with Super pressure Compressor 6000 PSI Motor Driven. The extraction temperature and extraction pressure significantly affected the extraction rate of SFE. The fatty acid profile of jatropha oil was composed of oleic, linoleic, palmitic and stearic fatty acids, while the fatty acid profile of coconut oil was composed of caprylic, capric, lauric, myristic, and palmitic acid, with lauric acid as the most predominant. Methyl esters can be produced by *in situ* supercritical methanol transesterification directly from the jatropha seeds and grated coconut. Operating conditions were: reaction temperature/pressure (70 °C/7000-8000 psi). Ratio of methanol to weight of ground jatropha seeds was 1:2. As the temperature increased, the crude biodiesel and FAMES yields also increased. The method is a single-step process, where the usual oil extraction process is avoided. In addition, because this process does not require a catalyst as in the usual method, the purification of products after transesterification reaction is much simpler. Therefore, this new process can offer an alternative way to convert jatropha seeds and coconut meat directly to methyl esters by a simpler and shorter production process eliminating waste products. The use of supercritical fluid extraction (SCFE) has gained attention in the production of oils and methyl esters due to the use of carbon dioxide supercritical fluid solvent. It is cheaper in price, a nonflammable compound, and O₂-free, thus protecting samples against any oxidative degradation.

Keywords: Supercritical fluid extraction, jatropha oil, methyl ester, supercritical methanol, transesterification

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**PRODUCTION AND ENZYMATIC MODIFICATION OF
FIBER FROM CACAO POD HUSK AND ITS UTILIZATION
AS BAKERY INGREDIENT**

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The cacao processing industry generates 10 tons of husk (fresh weight) from each ton of dry cacao seeds which present serious disposal problem to the cocoa industry. Its utilization as source of dietary fiber was the objective of this investigation. On a dry matter basis, the dietary fiber components consist of about 13% hemicelluloses, 11% cellulose, and 24% lignin. Analysis of functional properties showed that fiber from cacao skin has more absorptive power in both water and oil, higher swelling power and starch solubility. Glucose dialysis retardation index (GDRI) analysis of fibers showed comparable values with the fiber-rich powders from asparagus by-products, rice bran, guar gum and psyllium powder. Enzymatic treatments involving cellulases, xylanases and pectinases showed changes in the functional properties, total phenolic content, and GDRI of enzymatically-modified fibers. Utilization in cookies and cupcake formulations showed acceptable sensory qualities up to 20% flour substitution with cacao husk flour. Increase from 10% to 20% resulted to increase in crude fiber content by about 36% in cookies and 67% in cupcakes. Increase in total polyphenols by 57% was also observed.

Keywords: cacao pod husk, dietary fiber, enzymatic treatment, GDRI, polyphenols

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**DETERMINATION OF FOLIC ACID IN FORTIFIED FOODS
AND FOLATE IN SOME PHILIPPINE VEGETABLES
BASED ON THE DEVELOPED AND VALIDATED
METHODS OF ANALYSES**

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Microbiological assay has been regarded as the reference method in the analysis of folates and folic acid (FA) in foods, but trends in analytical chemistry towards simple and less time-consuming analytical methods set forth other reliable type of analysis. High-performance liquid chromatographic analysis with UV detection at 280 nm was developed and validated to determine the FA content of fortified foods. The analytical method involves FA extraction with phosphate buffer or amylase treatment after buffer extraction (for samples with carbohydrate bound-FA) and analysis with HPLC. A limit of detection of 0.0524ppm, limit of quantitation of 0.1747ppm, and an average correlation coefficient (*r*) of 0.998 were obtained during in-house method validation. The repeatability and intermediate precision were also evaluated based on relative standard deviation and found to be 3.91% and 10.97%, respectively. Recovery of the test results was established at 81% to 97%, while the accuracy of the method was verified using SRM 1849. The validation parameters obtained indicated that the method is fit for use in the determination of folic acid in food. Fifteen fortified food samples available in the market were analyzed using the validated method and revealed that the folic acid contents of most of the samples tested were lower than those indicated in their nutritional labels. On the other hand, 5-CH₃-THFA, 5-CHO-THFA and THFA in seven green leafy vegetables were also assessed through extraction by triple-enzyme digestion with amylase, protease, and conjugase but only 5-CHO-THFA and THFA were successfully quantified by HPLC. Extracts of alugbati, malunggay, and swamp cabbage were subjected to LC-MS analysis for reevaluation but no mass fragments similar to standards were obtained.

Keywords: folates, folic acid, reversed-phase high performance liquid chromatography, in-house method validation, fortified foods

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**PUTATIVE ALLERGENS IN GMO VERSUS
CONVENTIONALLY-BRED RICE**

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This study used *in silico* approach to screen nascent allergens in GMO and conventionally-bred rice. The protein sequences that were analyzed were taken from published data from various studies on GMO and conventionally-bred rice. To determine allergenicity of the proteins, allergen databases and algorithms, such as Allermatch, Algpred and Appel were used. The analysis revealed the following putative allergenic proteins for the GMO rice, namely: cysteine proteinase precursor, putative germin A, glycosyl hydrolases, and subtilisin-like serine proteinase, an unknown protein, and late embryogenesis abundant for the conventionally-bred rice. The proteins that computationally showed allergenicity are related to stress and defense response, metabolism, and storage and degradation of proteins.

Keywords: allergens, GMO, bioinformatics, food safety assessment

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RADIOLOGICAL AND PHYSICO-CHEMICAL APPRAISAL OF AKLAN RIVER

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In this study, gammametric counting and gross alpha-beta measurement by Liquid Scintillation Spectrometry (LSC) were used to mark out regions with impending elevated concentrations of minerals/pollutants in the offshoot streams of the Aklan River. The study was done in line with the establishment of a baseline data of geo-environmental pollutants and mineral resources in the province of Aklan, and to set up action limits for soil, sediment, and water contamination using the local baseline. Seven tributaries were selected as sampling points. Streambed sediments were collected from the 7 sites and were analyzed for gamma emitting radionuclides using a high purity Germanium (HPGe) detector; surface water from all of the five sites were analyzed for bicarbonate ions by titrimetry; pH and conductivity by selective electrodes; and radioactivity by Wallac 1414 Liquid Scintillation Counting; and microbial load by Sim Plate method. None of the watercourses exceeded the regulatory limits set by the Philippine National Standards for Drinking Water for conductivity, pH, and bicarbonate parameters for surface waters. As far as radioactivity is concerned, all of the sites' water samples gave total alpha activity of less than the detection limit, LLD, (LLD= 0.03 Bq/L), which was way below the drinking water regulatory limit of 0.1 Bq/L for alpha emitters. All the samples exhibited beta activities of less than LLD (LLD= 0.3 Bq/L), which was also way below the drinking water regulatory limit of 1.0 Bq/L for beta emitters. In terms of radiogenic nuclides in sediments, all the sediments had Cs-137, Sr-90, and I-131 concentrations of less than 3 Bq/K. Microbial load was elevated at site 7 with approximately 738 populations per plate during a post monsoon sampling.

Keywords: Aklan River, gross alpha-beta, gamma, drinking water, water contamination

CMPS - 23

RAPID DETERMINATION OF FIVE ARTIFICIAL SWEETENERS IN BEVERAGES BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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Artificial sweeteners are increasingly used in a wide range of commercial beverages. Most of these sweeteners have a maximum allowable concentration prescribed by international and local standards. Ensuring proper implementation of existing regulations requires reliable quantitative analytical methods to measure sweeteners in beverage matrices. Here, we present the results of a single-laboratory validation of two methods for the rapid determination of five authorized artificial sweeteners in beverages using high performance liquid chromatography with ultraviolet and refractive index detection. The procedure involved extraction of acesulfame-K (ACS-K), aspartame (ASP), neotame (NEO), saccharin (SAC), and sucralose (SUC) with a buffer solution followed by chromatographic analysis. Samples containing ACS-K, ASP, NEO, and SAC were analyzed using HPLC-UV with gradient elution at 220 nm while separation of SUC was achieved by HPLC-RI. The calibration curve was linear in the concentration ranges of: 50 to 500 $\mu\text{g/mL}$ ACS-K, 80 to 800 $\mu\text{g/mL}$ ASP, 15 to 150 $\mu\text{g/mL}$ NEO and SAC, and 100 to 1,000 $\mu\text{g/mL}$ SUC. The limits of detection (and quantification) for ACS-K, ASP, NEO, SAC, and SUC were 8.2 (27.3) $\mu\text{g/mL}$, 13.0 (43.5) $\mu\text{g/mL}$, 2.8 (9.5) $\mu\text{g/mL}$, 3.8 (12.5) $\mu\text{g/mL}$, and 5.5 (18.4) $\mu\text{g/mL}$, respectively. Repeatability and intermediate precision tests showed relative standard deviations and Horrat ratios generally lower than the maximum acceptable values. Analysis of reference materials yielded results that fell well within the acceptable concentration range. Recoveries from samples spiked at low, medium and high concentrations ranged from 99 to 109 percent. The developed in-house methods were found suitable for rapid quantitative determination of five artificial sweeteners in beverages.

Keywords: artificial sweetener, beverage, high performance liquid chromatography, buffer extraction, method validation

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SYNTHESIS AND CHARACTERIZATION OF HYPERBRANCHED AND STAR-SHAPE COPOLYMERS OF POLY(N-VINYLCARBAZOLE) USING A RAFT INIMER

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New materials with complex architectures, such as hyperbranched and star-shape copolymers, continue to be an interesting field of polymer science due to their intriguing properties and complicated synthetic routes. While many researchers have reported the successful synthesis of this type of polymers, there remains a need to develop simpler synthetic procedures that would produce these materials. This study introduces a facile synthesis of star-shape copolymers of poly(N-vinylcarbazole) [PVK] through a two-step process. The first involves the synthesis of a hyperbranched PVK core by polymerizing N-vinylcarbazole with 2-(methacryloyloxy)ethyl 4-cyano-4-(phenylcarbonothioylthio) pentanoate (CPP-HEMA) inimer through Reversible Addition Fragmentation Chain Transfer (RAFT) living radical polymerization. The inimer serves both as an initiator and as a branching point. The second step involves the copolymerization of the hyperbranched PVK core with another monomer N-isopropylacrylamide (NIPAM) using RAFT. The hyperbranched core in this step serves as macroinitiator from which polymer arms consisting of NIPAM would emanate. Successful synthesis of the star-shape polymer was confirmed through ¹H-NMR, Gel Permeation Chromatography, Fluorescence Spectrophotometry, Thermogravimetric Analysis and FT-IR Spectroscopy. The degree of branching for the hyperbranched structure was computed to be 0.65 and the number of polymer arms that emanated from the core was ascertained as 45 per hyperbranched core. Surface morphologies and aggregation patterns of the copolymer in different solvents like were also studied and correlated.

Keywords: hyperbranched, star-shape polymer, RAFT, inimer, PVK

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SOLVENT-FREE SONOCHEMICAL SYNTHESIS AND ANTIFUNGAL ACTIVITY OF 1-ALKYL-3- METHYLIMIDAZOLIUM BROMIDE [RMIM]Br IONIC LIQUIDS

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Opportunistic fungal infections pose a continuous threat to human health and life. In recent years, there has been a considerable increase in occurrence and severity of candidiasis, an infection caused by the fungus *Candida albicans*. Moreover, the widespread and increased use of antifungal drugs has resulted in the development of resistance to these drugs. This has given rise to the challenge of developing novel and promising antifungal agents for clinical use. Azole-based drugs inhibit the enzyme associated in ergosterol synthesis and eventually hinder fungal growth. This study explored the one-pot synthesis of a series of 1-alkyl-3-methylimidazolium bromide [RMIM]Br ionic liquids through a sonochemically-mediated reaction of 1-methylimidazole and alkyl bromides (RBr) under solvent-free conditions. High product yields were obtained for all syntheses (>94%) under mild conditions (2-5 hours at 20-30°C). The success of the synthetic method was confirmed through ¹H-NMR, ¹³C-NMR and FT-IR spectroscopy. All products were tested for antifungal activity against *C. albicans* with clotrimazole and water as positive and negative controls, respectively. At a definite concentration, ILs having C₄, C₆, C₈, C₁₂, and C₁₆ alkyl chain lengths exhibited antifungal activity with antimicrobial indices of 0.1, 0.2, 1.5, 2.3, and 2.5 against *C. albicans*, respectively. No inhibition activity was observed for [C₂MIM]Br. The results showed that an increase in the alkyl chain length corresponds to an increase in the antifungal activity of the ionic liquids.

Keywords: ionic liquid, solvent-free, sonochemistry, antifungal agent, *Candida albicans*, medicinal chemistry

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**BISPHENOL A SENSOR BASED ON
ELECTROPOLYMERIZED MOLECULARLY IMPRINTED
POLYMER (E-MIP)**

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The application of electrochemical impedance spectroscopy in designing a chemical receptor using electropolymerizable terthiophene and carbazole monomers for the imprinting of bisphenol A, a known endocrine disrupting chemical has been demonstrated. The copolymers of bifunctional monomers of –COOH from the carbazole derivative and –OH functional group from terthiophene were found to possess good molecular recognition properties than when these respective monomers were singly electropolymerized. As in any electropolymerized films for sensing applications, a compromise of thickness and efficient formation of pre polymer complexes must be achieved in order to ensure maximum rebinding of the template molecules. Cyclic voltammetry offers a simple means of depositing sensor films directly onto substrate surfaces while the Electrochemical Impedance Spectroscopy (EIS) technique provides a versatile means of measuring the amount of template bound to the polymer matrix. In this study, the EIS has been demonstrated to give extensive information related to the permeability and thickness of the polymer material deposited on the surface that may be used in advancing technologies relating to sensing via reversible surfaces through electric potential control and to development of dynamic surfaces for advanced sensing technology. The E-MIP sensor may have advantages in environmental monitoring of bisphenol A in aqueous analyte/pollutant samples

Keywords: sensing, imprinting, electropolymerization, EIS, copolymer film, bisphenol A

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A NEW METHOD FOR CALCULATING THE ZEROS OF UNILATERAL POLYNOMIALS OVER THE QUATERNIONS AND OCTONIONS

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This paper presents a new method for calculating the zeros of the *unilateral quaternionic (octonionic) polynomial*

$$P_n(x) = \sum_{j=0}^n a_j x^j, a_n \neq 0,$$

with quaternionic (octonionic) coefficients a_j . It consists of forming the real polynomial

$$Q_{2n}(x) = \sum_{i=0}^n \sum_{j=0}^n \bar{a}_i a_j x^{i+j} = \sum_{h=0}^n b_h x^h,$$

where \bar{a}_i is the conjugate of a_i and expressing $P_n(x)$ in polar form as

$$P_n(x) = \sum_{k=0}^n a_k r^k (\cos k\theta + I \sin k\theta), a_n \neq 0$$

in which I is a *generalized* quaternion (octonion) imaginary unit ($I^2 = -1$). Let us denote by $\text{Zero}(P_n)$ and $\text{Zero}(Q_{2n})$ the respective zero-sets of $P_n(x)$ and $Q_{2n}(x)$. Now, the results may be stated as follows:

- (1) If $x_h \in \text{Zero}(Q_{2n})$ is real, then $x_h \in \text{Zero}(P_n)$ (a *real isolated zero*);
- (2) If $x_h \in \text{Zero}(Q_{2n})$ is complex such that $x_h, \bar{x}_h \in \text{Zero}(P_n)$, then $\tilde{x}_h = q^{-1} x_h q \in \text{Zero}(P_n)$ for every non-real $q \neq 0$ (a *non-real spherical zero*); and
- (3) If x_h is complex such that $x_h, \bar{x}_h \notin \text{Zero}(P_n)$, then $\tilde{x}_h \in \text{Zero}(P_n)$ is a *non-real isolated zero* of $P_n(x)$, where \tilde{x}_h is:

$$\tilde{x}_h = \left[\sum_{k=0}^n a_k r_h^{k-1} \sin k\theta_h \right]^{-1} \left[\sum_{k=0}^n a_k r_h^k \sin (k-1)\theta_h \right].$$

Keywords: quaternions, octonions, isolated zeros, spherical zeros, zero-sets, alternativity, and unilateral quaternionic (octonionic) polynomials

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IDEALS OF AG^{**} -GROUPOID

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A *groupoid* is a set associated with a binary operation and a groupoid S satisfying the *left invertive law*: $(ab)c = (cb)a$ for all $a, b, c \in S$ is called an AG -groupoid. If, in addition, an AG -groupoid S satisfies $a(bc) = b(ac)$ for all $a, b, c \in S$, it is called an AG^{**} -groupoid. In this paper, some properties of the ideals in an AG^{**} -groupoid are discussed. More particularly, the quasi-ideals, bi-ideals, interior ideals, and ideals in an intra-regular AG^{**} -groupoid are investigated. The properties of ideals in an AG -groupoid necessitate the existence of a left identity. Every AG -groupoid with left identity is an AG^{**} -groupoid and not every AG^{**} -groupoid contains a left identity. Results on the ideals of an AG^{**} -groupoid without left identity that are parallel to those for AG -groupoid hold.

Let S be an AG^{**} -groupoid. Then the following hold:

1. If I is an ideal of S , then I is a bi-ideal (quasi-ideal, interior ideal) of S .
2. An idempotent subset I of S is a right ideal, if and only if I is an interior ideal of S .

Keywords: groupoid, AG -groupoid, AG^{**} -groupoid, quasi-ideals, bi-ideals, interior ideals, intra-regular ideals, left invertive law

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STRONG CONVERGENCE OF AN ITERATIVE SEQUENCE TO A FIXED POINT OF NONEXPANSIVE MAPPING

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Let K be a closed convex subset of a real uniformly smooth Banach space X and $T: K \rightarrow K$ be nonexpansive mapping. We denote the set of fixed points of T by $Fix(T)$. Here we assume that $Fix(T) \neq \emptyset$.

For a fixed integer m we consider an iterative sequence (x_n) defined by

$$x_{n+1} = \alpha_n^1 u_1 + \alpha_n^2 u_2 + \cdots + \alpha_n^m u_m + \beta_n x_n + \gamma_n T(x_n), \quad n \geq 0$$

where $x_0, u_1, u_2, \dots, u_m \in K$ and $(\alpha_n^1), (\alpha_n^2), \dots, (\alpha_n^m), (\beta_n), (\gamma_n)$ are sequences in the interval $(0,1)$.

In this paper, we will show under some conditions the strong convergence of the above iterative sequence to a fixed point of T .

Keywords: strong convergence, nonexpansive mapping, fixed point, iterative sequence, convex set, Banach space

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THE AVERAGE OF THE m TH POWER OF L_m NORMS OF ZERO- i POLYNOMIALS ON THE BOUNDARY OF THE UNIT DISC

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Let $n \geq 0$ be any integer and let

$$\Gamma_n = \left\{ p(z) = \sum_{j=0}^n a_j z^j : z = e^{i\theta}, a_j = 0,1 \ \forall \ 0 \leq j \leq n \right\}$$

$$Y_n = \left\{ p(z) = \sum_{j=0}^n a_j z^j : z = e^{i\theta}, a_j = 0,1 \ \forall \ 0 \leq j < n, a_n = j \right\}$$

be the collection of zero- i polynomials over \mathbb{C} of degree less than or equal to n and of degree exactly equal to n , respectively. We denote

to be the L_m norm of any polynomial $p(z)$ and $\gamma_n(m)$ and

$\kappa_n(m)$ to be the average of the m th power of L_m norms in Γ_n and Y_n ,

respectively. It is known that the cardinality of Γ_n is 2^{n+1} and the

cardinality of Y_n is 2^n . Hence $\gamma_n(m)$ and $\kappa_n(m)$ is given by:

$$\gamma_n(m) = \frac{1}{2^{n+1}} \sum_{p \in \Gamma_n} \|p\|_m^m, \quad \kappa_n(m) = \frac{1}{2^n} \sum_{p \in Y_n} \|p\|_m^m$$

In this paper we derived the exact formula for γ_n and κ_n for various values of m .

Keywords: zero- i polynomials, norm, average, degree of polynomial, cardinality

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THE AVERAGE OF THE NORM OF THE m th ORDER DERIVATIVE LITTLEWOOD POLYNOMIAL

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Let $n \geq 0$ be any integer and

$$\mathfrak{F}_n = \left\{ P(z) : P(z) = \sum_{j=0}^n a_j z^j \text{ where } a_j = \pm 1 \right\}$$

be the set of polynomials of degree equal to n . The elements of the set \mathfrak{F}_n are restricted polynomials called Littlewood polynomials.

Let $P(z) \in \mathfrak{F}_n$, we denote $\|P^{(m)}(z)\|_k^k$ to be the k th power of the L_k -norm of the m th order derivative littlewood polynomial on the boundary of the unit disc and $\xi_n(k)$ be the average of the k th power of the L_k -norms of the m th order derivative Littlewood polynomial over \mathfrak{F}_n . Then $\xi_n(k)$ is given by:

$$\xi_n(k) = \frac{1}{2^{n+1}} \sum_{P(z) \in \mathfrak{F}_n} \|P^{(m)}(z)\|_k^k.$$

In this research, the author determined the exact formula for $\xi_n(k)$ for k equal to 6.

Keywords: Littlewood polynomials, m th order derivative, L_p -space, norm, average.

**ENGINEERING SCIENCES
AND TECHNOLOGY**

EST - 01

SIMULATING CROWD EGRESS DYNAMICS USING MULTIPLE AGENTS AND SOCIAL COMPARISON THEORY

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The understanding of crowd movement is important to planning and improving shared public places, not only to effectively and efficiently facilitate the comfortable movement of individuals, but also to guarantee the safety of individuals, especially under conditions of danger when quick and orderly evacuation of a mass of individuals is desired. Because data from real evacuation are hard to obtain and conducting replicate experiments on humans is ethically questionable, the characterization of crowd egress dynamics has been confined to simulation and modeling. We introduce a simulation approach that hybridizes multi-agent systems (MAS) with the social comparison theory (SCT) that provides the capability to simulate more human crowd phenomena than the more common social force model (SFM). SFM has been proven to show real world crowd phenonema such as the “faster-is-slower” in escape panic, “arching” and “bursty exit” as side effects to “clogging” on exit ways, “flocking,” “bidirectional lane formation,” and “roundabout formation.” Simulations using our MAS-SCT hybrid are able to exhibit all these phenomena and two more individual behaviors: (1) *Imitation* – where individuals tend to move in groups whose members they think would have the same opinion as theirs; and (2) *Contagion* – where people tend to “adopt” the behavior of others in the same group. Because of these, we propose that our MAS-SCT approach is more akin to modeling humans and real-world objects in very realistic ways, and thus can be used with higher confidence in performing *what-if* scenarios to aid decision makers, designers and researchers.

Keywords: simulation, crowd egress dynamics, MAS, SFM, SCT

EST - 02

**USING DATA RETRIEVALS FROM CALIPSO AND
AERONET: CASE STUDY OF AEROSOL OPTICAL
THICKNESS OVER THE PHILIPPINES AND
THE EAST ASIAN REGION**

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The utilization of aerosol data from satellite measurements has the advantage of identifying pollution episodes in places where there are minimal to no data measurements. Such applications are available from satellite sensors polar-orbiting the earth on a regular basis, called the A-train. This study uses the vertical feature mask from the Cloud-Aerosol LiDAR and Infrared Pathfinder Satellite Observations (CALIPSO) to determine the vertically-resolved aerosol quality over the Philippines. On the ground, data from the Aerosol Robotics Network (AERONET) station in the Manila Observatory was used to quantify the Aerosol optical depth (AOD). From a selected time frame of satellite data for the whole month of November 2011 it was observed that the AOD on the ground level reached as high as 3.3 during the afternoon of November 2, 2011. Severe cases of pollution from East Asia, specifically from China, were also evident during the study period. Satellite data retrievals have shown their applicability for aerosol studies in the Philippines when technologies for depth comparison of aerosol levels with the neighboring Asian countries are not available.

Keywords: A-train, aerosol optical depth, satellite constellation, Philippines, CALIPSO, AERONET

EST - 03

MODELING THE FATE AND TRANSPORT OF PESTICIDES IN AN IRRIGATED RICE AREA

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For fast, effective, and economical assessment and continuous monitoring of the concentration of pesticides in an irrigated rice area, the use of models plays a very important role. This study aimed to assess the extent of pesticide contamination of water in the paddy field and drainage channel and to develop a model that can be used to determine the fate and transport of pesticides in an irrigated rice area. Three 144 square meter experimental paddy plots planted with MS 16 variety of rice and applied with Lambda cyhalothrin insecticide was used in the study. A computer-based transport model was developed that was used to simulate the concentration of pesticide residues in the ponded water and drainage channel by mathematically tracking the total mass of chemical residues from the loading point to the drainage stream in terms of mass balance. Results of the model simulation predicted that the concentration of Lambda cyhalothrin insecticide applied in the paddy field would diminish at the rate of 42.38% on the first day, 90.64% on the second day, 98.26% on the third day, 99.10% on the fourth day, to almost nil concentration on the fifth day. As indicated by the correlation analysis and test of significance between the observed and predicted data, the model can accurately simulate the actual pesticide concentration in the ponded and drainage water. The model can be enhanced by taking into consideration the advection process in the drainage stream and by linking of the model to other available models by either using the input/output of the model as an input/output to the other model or vice versa.

Keywords: modeling, fate and transport, irrigated rice area, insecticide concentration, Lambda cyhalothrin

EST - 04

**POINT TO SURFACE MAPPING OF SELECTED
SOIL PROPERTIES USING DIFFERENT
INTERPOLATION TECHNIQUES**

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Three spatial analysis algorithms, namely, inverse distance weighted (IDW), kriging, and spline, were used to interpolate soil pH and soil texture properties from sample point data. A systematic sampling method was employed to collect soil samples for laboratory analysis. Interpolation was carried out in ArcGIS 10. Root mean square error was calculated to evaluate the relative precision of the interpolation methods. IDW had the lowest RMSE for pH, OM, clay, and sand while kriging had the lowest RSME in silt and the spline had the highest for all of the four properties. Lower RMSE implies a better interpolation result. While the relative precision results appeared to be consistent, the analysis of variance revealed that the three interpolation methods were not significantly different ($p>0.05$) from each other. In addition, soil map generated through kriging had the least visual appeal among the three methods. The major outputs of the interpolation are surface maps (continuous data) of the five soil attributes. These maps are important for decision making regarding land use, soil-plant compatibility, yield analysis, and soil improvement activities. Future research should take into account the topographic factors, existing vegetation and other important site properties.

Keywords: soil interpolation method, soil mapping, IDW, kriging, spline

EST - 05

**TOWARDS A FILIPINO-CENTRIC DESIGN FOR DIGITAL
INPUT DEVICES THROUGH AUTOMATED HAND
ANTHROPOMETRY**

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We conducted an anthropometric survey of the hands of 91 respondents coming from different parts of the Philippines. Our purpose was to come up with an initial profile of the Filipino hand that may be used to design computer keyboards, and other digital input devices that will fit the Filipino groups based on gender, age, and the type of location of origin (rural or urban). To provide solution to the time, consistency and accuracy problems brought about by following a meticulous process in manual anthropometry, we developed a computer-based process by combining techniques in machine vision and digital image processing to furnish anthropometry researchers a fully automated system that is fast, yet provides consistent and accurate body measurements. The result was the anthropometric data of the hands of Filipinos based on gender, type of location of origin, age group, height and weight. We compared the anthropometric data with the mean dimension of standard desktop computer keyboards, products which are usually imported and may have been optimally designed for other nationalities. We found out that the Filipinos whose hand measurements fall below the 25th percentile will not be able to comfortably make several key combinations. Because of this, we recommend that product designers and importers use the anthropometric profile of the Filipino hand so that they will be able to provide the Filipinos with fit, useful, comfortable, and safe digital input devices.

Keywords: hand anthropometry, Filipino-centric keyboard, machine vision, digital image processing, automation

EST - 06

**DEVELOPMENT OF AN OPTICAL DETECTION DEVICE
FOR AMMONIA IN WATER**

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The objective of this study is the fabrication of a handheld, simple to use optical detection device which detects and quantifies ammonia contamination in water. The sensor is based on irreversible color changes that occur subsequent to the reaction of the Rochelle salt and Nessler's reagents with ammonia which gives off a flesh color. The sensor uses LED light source shining on an LDR which is connected to a circuit supplying a constant voltage. When the colorimetric reaction has taken place, light shines through a vial containing the sample, and onto a light-sensitive circuit. A clear tube of water is the BLANK and has zero absorbance. A fraction of the incident light that is blocked by the sample can be used for quantitative determination of ammonia in water. The ammonia concentration is related to the absorbance reading, following Beer's law. The amount of incident and transmitted light are expressed in voltage units, by a voltmeter. The sensor shows outstanding response over the range of 0.1 to 10 ppm concentrations of ammonia. Excellent sensitivity and linearity ($R^2=0.91$) has been achieved using the sensor, working with 5 replications per particular concentration. The practicality of the sensor has been demonstrated by using it for the field determination of ammonia in water from different sites in Aklan. The other features of the sensor include: ease of manipulation, low cost, ruggedness, versatility, and adaptability for use for other analytes for as long as there is a color change after the analyte-reagent reaction.

Keywords: sensor, ammonia, LED, voltage, detection device

EST - 07

ENHANCING THE USE OF INDIGENOUS IRRIGATION SYSTEMS AND PRACTICES

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This study was conducted to identify existing indigenous irrigation structures and practices of the farmers in Ilocos Norte during the wet and dry seasons of 2012 to document these practices, to explore the importance of such practices to water conservation and management, and to design an enhancement program for the use of such systems. The study areas considered were upland and coastal barangays of Pasuquin, Ilocos Norte. Farmer leaders and senior citizens within the identified study areas were interviewed regarding the existence and use of water conservation practices and its importance to water management. Ocular inspection and documentation were done on the identified structures. Results showed that: 1) there exists traditional irrigation systems used by farmers in the study areas. Irrigation structures such as earthen canals, farm reservoirs lined by rocks, and earthen reservoirs within the farm itself were built and used generations back; 2) farmers employed both natural and man-made structures to impound and use water during both the rainy and dry seasons; and 3) water management practices included the use of mud to control water from the farm ditch to the field in the absence of gate valve structures. Enhanced productivity of these systems can relieve pressure on surrounding areas. The sustainability of indigenous irrigation systems is thereby directly linked to the environmental sustainability of the watersheds of which they form a part. From a social and cultural perspective, the institutional arrangements embedded in traditional irrigation systems are important both to the political stability of the immediate region, and for the cultural integrity of the people whose land is to be irrigated.

Keywords: traditional, modern, irrigation systems, practices, Ilocos Norte

EST - 08

**CALAMANSI (*Citrus microcarpa*) SEED CHARCOAL
AS WATER FILTER**

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Rain water is one of the potential sources of water supply at Cebu Technological University. However, the water is contaminated with fecal coliform due to bird and rodent wastes. Calamansi seed charcoal filter improved the quality of rainwater based on biological parameters, in particular, total bacterial count and total coliform count, as well as physico-chemical parameters including alkalinity, total suspended solids, total dissolved solids, salinity and turbidity. The water sample filtered using calamansi seed charcoal had the least bacterial count and fecal coliform compared to the rain water samples before filtering, which were comparable to the quality of commercial bottled water. The rain water samples filtered with calamansi seed charcoal reduced the levels of alkalinity, total dissolved solids and turbidity. Verification studies on filtered rain water using calamansi seed charcoal will be conducted for liquid hand wash diluents.

Keywords: *calamansi* seed, charcoal, filter, rain water

EST - 09

**CRYSTAL QUALITY DEPENDENCE ON THE
NONVOLATILE RESISTANCE SWITCHING IN 3C-SiC
THIN FILM GROWN BY GAS-SOURCE MOLECULAR
BEAM EPITAXY USING MONOMETHYLSILANE**

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For the next-generation of nonvolatile memory (NVM) devices, 3C-SiC/Si based NVM devices are attracting much attention because of its superior mechanical, thermal, and electrical properties. In this study, the resistive switching (RS) characteristics of the resistive random access memory (ReRAM) device based on 3C-SiC epilayer grown using monomethylsilane gas-source molecular beam epitaxy (GSMBE) were investigated. Results reveal that the growth temperature of the 3C-SiC epilayer plays a vital role for the two-terminal nonvolatile RS property of the Au/SiO₂/3C-SiC/Si/Al device. We found that there is a linear relationship between 3C-SiC epilayer degradation and electronic hysteresis. The RS behavior of the 3C-SiC epilayer was highest when the growth temperature was 800°C and this was demonstrated by applying bias on the Au and Al electrodes. *I-V* characteristic showed a bipolar switching behavior with a memory window of 2.1 V and a threshold voltage of 1.8 V under a minimum applied sweeping voltage of ±5V. *C-V* characteristic indicated a counterclockwise hysteresis direction which signifies a tunneling capture of free charges. Endurance test gave a typical rewriting cycle of about 10⁵ cycles. These observations suggest that 3C-SiC/Si based NVM devices may be well suited for ultrahigh-density memory applications.

Keywords: crystal quality dependence, nonvolatile resistance switching, 3C-SiC thin film, gas-source molecular beam epitaxy, monomethylsilane

EST - 10

CONSOLIDATED BIOPROCESSING OF SUGARCANE (*Saccharum officinarum*) BAGASSE TO ETHANOL USING RUMEN FLUID

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Cellulosic ethanol is an environmentally friendly and renewable transportation fuel produced from a wide array of feedstocks, including non-food plant materials, such as agricultural wastes, dedicated energy crops such as switchgrass, sugarcane bagasse, and wood products. This study was conducted to determine the potential of sugarcane bagasse as a substrate for ethanol production in Single Stage Consolidated Bioprocessing (SSCBP). Specially, it sought to determine: 1. the biodegradation activity of rumen fluid microorganisms in the major biomass fractions (hot water extractives, lignin, hemicellulose and cellulose) of sugarcane bagasse, 2. the deconstruction of cellulose to glucose with time, and 3. the fermentability of 2nd generation sugar from bagasse to bioethanol. Glucose released and ethanol produced were monitored from day 1 to day 12. Three concentrations of rumen fluid – 1% 10%, and 20% - were used in the experiment. The positive degradation effect of the different concentrations of rumen fluid was very evident. Hot water extractives, lignin, hemicellulose and cellulose were reduced to 29.33%, 13.33%, 33.33%, and 58.67%, respectively. Glucose content after rumen fluid treatment decreased with time. At day 6, it yielded 2.33% on dry biomass and was progressively reduced to 1.17% in day 12. Saccharification efficiency was highest from day 6 to day 8 at 4.57% - 5.56%. The results indicate the potential of rumen fluid microorganisms in SSCBP for the biodegradation of sugarcane bagasse for cellulose ethanol production.

Keywords: consolidated bioprocessing, cellulosic ethanol, biomass constituents, cellulosic biomass, saccharification, lignocellulosic biomass

EST - 11

**PRELIMINARY STUDY ON THE PRODUCTION OF FUEL-
GRADE ANHYDROUS ETHANOL USING ACTIVATED
ZEOLITE AS DEHYDRATING AGENT**

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A 5-stage column, packed with activated Zeolite, was successfully used to produce absolute ethanol from reflux-distilled hydrous ethanol. This study was a follow up on our successful exploratory experiments to produce azeotropic ethanol from first and second generation feedstocks. We sought to develop a column to produce anhydrous ethanol in order to comply with the Philippine National Standards (PNS) as prescribed in the Biofuels Act of 2006. Our initial attempts in this process included the use of non-polar solvents to form a ternary azeotrope for reflux distillation, and the use of various desiccants, none of which proved satisfactory in the absolute dehydration of hydrous ethanol. We report here the successful production of anhydrous ethanol from an assembled 5-stage column packed with 100 grams of activated zeolite as dehydrating agent. Three phases of operations of the column was performed. In Phase I, 500-ml of reflux-distilled ethanol with 89 % v/v ethanol is poured into the column and 446 ml with 96.2 % v/v ethanol was collected. In Phase II, the same column was used and packed with the same dehydrating agent. A 500 ml feedstock with 95 % v/v ethanol was poured into the column and an average of 475.2 ml was recovered with 99.5 % v/v ethanol. In Phase III, the recovery of absorbed ethanol in the column was attempted. To do this, a 150 ml of distilled water was poured into the column and 102 ml was recovered with 12.2 % v/v ethanol. The preliminary results of these studies indicate that the improvised 5-stage dehydrating column is effective, more economical and easier to operate than ternary azeotropic distillation as well as the use of other dessicants. The simplicity of the system enables less supervision of technicians working in the lab.

Keywords: ethanol, absolute, azeotrope, hydrous, anhydrous

HEALTH SCIENCES

HS - 01

A SYSTEMS VIEW OF THE HOX-OME

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In mouse and humans, the correct location of body parts along the A-P axis is specified by the expression boundaries of 39 Hox genes. Regulated in a spatial and temporal fashion, these genes, dubbed as ‘master genetic switches’, instruct embryonic cells on a particular route of morphogenesis. Focusing on Hoxc8, we have established its first network map from the results from our previous genome-wide screening for Hoxc8-associated molecules using a combination of CHIP-based screening and cloning and 2-DGE proteomics screening. Together with available literature data on the transcriptome and proteome of Hoxc8, the predominant signaling pathways were identified. The molecular networks and interaction of diverse signaling pathways revealed the important and overlapping roles played by Hoxc8 during both embryonic development and carcinogenesis.

Keywords: Hoxc8, cancer, embryogenesis, systems biology, molecular networks

HS - 02

**ALLELIC DISCRIMINATION FOR SINGLE NUCLEOTIDE
POLYMORPHISM IN INTERLEUKIN 28B GENE USING
5' NUCLEASE ASSAY**

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With the development of single nucleotide polymorphism (SNP) genotyping assays and the availability of fluorogenic probes that anneal specifically to its complementary sequence, it is now possible to use real-time PCR to detect SNP alleles in purified genomic DNA samples. DNA was extracted from peripheral blood of patients clinically diagnosed with chronic hepatitis B or C using the Taqman sample-to-SNP kit. Real-time PCR was performed on the Rotor-Gene 3000 instrument (Corbett Research) with a SNP genotyping assay for rs8099917. The rs8099917 G to T polymorphism on chromosome 19, located near IL28B gene which encodes interferon- λ 3 has been shown to be associated with sustained virologic response in patients with chronic hepatitis C treated with pegylated interferon- α plus ribavirin. Recently, it has also been shown that the G allele of rs8099917 was associated with higher rate of response in chronic hepatitis B patients treated with interferon- α . Thus, a reliable method for the accurate identification of IL28B SNP is important for the management of chronic hepatitis. Allelic discrimination was performed using the Rotor-Gene 6.1 software. The allele frequencies in Hardy-Weinberg equilibrium among cases were 0.75 for the T allele and 0.25 for the G allele. Fifty six per cent was identified as homozygous for the wild-type T/T genotype, 38% was identified as heterozygous for the G/T genotype, and 6% was identified as homozygous for the G/G variant genotype. Overall, the 5' nuclease assay provides a rapid and automated method for detecting SNP in the IL28B gene.

Keywords: 5' nuclease assay, chronic hepatitis, interleukin 28B gene, single nucleotide polymorphism

HS - 03

ANTIPROLIFERATIVE ASSESSMENT AND MECHANISTIC PROBING OF THE PROMISING ANTI-CANCER BISINDOLE ALKALOID GLOBOSPIRAMINE FROM *Voacanga globosa*

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Globospiramine, a new bisindole alkaloid from the Philippine endemic Apocynaceae plant *Voacanga globosa* was observed to possess potent antituberculosis and anti-Alzheimer's activity. As part of a continuing study to elaborate the biological potency of globospiramine, investigations directed towards its anti-cancer activity were undertaken. Cell viability assays (MTT and SRB) showed globospiramine to be cytotoxic to various cancer cell-lines at very low microgram/mL or micromolar concentration ranges (HUVEC GI_{50} = 5.4 μ g/mL; K-562 GI_{50} = 1.4 μ g/mL; HeLa CC_{50} = 6.1 μ g/mL; T47D IC_{50} = 1.11 μ M; MDA-MB-231 IC_{50} = 1.17 μ M; PC-3 IC_{50} = 1.77 μ M). Reporter assay on T47D cells lines transfected with pHRE-luc plasmid showed no effect on HIF activity at low concentrations but had a significant inhibitory effect at concentrations greater than 5 mM under both chemical and physical hypoxia. In the mitochondrial respiration assay, globospiramine showed increased mitochondrial respiration rate slightly at 0.1 mM indicating little mitochondrial uncoupling activity. In the anti-tubulin polymerization assay, globospiramine appeared to have a different mechanism of action revealing total non-specific cell death with crenated shrunken cells and at some point, may have led to loss of microtubules during apoptosis or via calcium entry – a behavior not seen in related anticancer alkaloids, vincristine and vinblastine.

Keywords: globospiramine, *Voacanga globosa*, bisindole alkaloids, anti-cancer, mitochondrial cytotoxicity, anti-tubulin polymerization.

HS - 04

**APOLIPOPROTEIN E ϵ 4 AS A FACTOR IN THE
EVALUATION OF THE GENETIC RISK OF ALZHEIMER'S
DEMENTIA IN FILIPINOS**

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In the Philippines, there are 3.8 million people above 65 years old who are at risk of developing Alzheimer's dementia. This report presents the results of a cross-sectional study to determine the genotypic distribution of *ApoE* in affected and unaffected groups of Filipinos, who either consulted in the hospital for Alzheimer's dementia or were screened in a community setting. Peripheral blood was collected from a total of 600 subjects, composed of 124 patients who consulted at the Memory Center of St. Luke's Medical Center, Quezon City, and 476 individuals who participated in a community-based cohort. DNA from the buffy coat was analyzed for *ApoE* genotype by PCR-RFLP (Hha I) method. The most frequent genotype for both groups was ϵ 3/ ϵ 3: 51.6% for the hospital group and 66.6% for the community group. The clinical profile of all the subjects is: 96 with Alzheimer's dementia, 110 with mild cognitive impairment, 369 with no dementia, and 25 with diagnoses other than dementia. In this group of Filipinos, the *ApoE* ϵ 4 allele was significantly associated with risk for Alzheimer's dementia, compared with the no dementia group, with a p-value of 0.0481 and an odds ratio of 1.611. The frequencies of the risk ϵ 4 allele were as follows: 14.1% for those diagnosed with Alzheimer's dementia, 9.1% for those with mild cognitive impairment, 9.2% for those with no dementia, and 6.0% for those with diagnoses other than dementia. These results suggest that the detection of the presence of the *ApoE* ϵ 4 allele could be a useful tool for the assessment of genetic risk for Alzheimer's dementia in Filipinos when integrated with the patient's clinical data and family history.

Keywords: Alzheimer's disease, dementia, apolipoprotein E, PCR-RFLP, genetics

HS - 05

ASSOCIATION OF ANGIOTENSIN CONVERTING ENZYME DD GENOTYPE WITH INCREASED RISK OF SEVERE CORONARY STENOSIS IN THE FILIPINO POPULATION

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The evidence supporting the association of the angiotensin converting enzyme (*ACE*) and the susceptibility to coronary artery disease (CAD) across other populations remains debatable. In this study, the association between *ACE* I/D polymorphism and the development of severe stenosis was determined among Filipinos who underwent coronary angiography in St. Luke's Medical Center, Philippines. A total of 215 patients aged 18-85 years of age were enrolled for the study with 166 patients with e"70% angiographically established stenosis (severe stenosis) and 49 with <70% stenosis as controls. The *ACE* I/D polymorphism was assessed by polymerase chain reaction wherein primer binding sites flanked the 287 bp *alu*-sequence deletion, hence discriminating the I and D alleles with difference in PCR amplicon sizes in an agarose gel electrophoresis. The *ACE* I/D polymorphism showed concordance with Hardy-Weinberg Law with allele frequencies of 0.61 and 0.39 for the I and D alleles, respectively. Multiple logistic regression analysis after adjustment with several potential confounders showed that DD genotype poses a higher risk of developing severe stenosis when compared with to the II genotype with an OR of 4.37 (p value 0.033, CI 1.13-16.9). A univariate analysis with a larger sample size (n=500, e"70% stenosis = 382, <70% stenosis = 118) was also performed for several other genes related to CAD. The homozygosity to angiotensinogen Thr235 in reference to having at least one Met235 allele (MetMet + MetThr) also showed significant association to e"70% stenosis with an OR of 3.38 (p value 0.033, CI 1.16-9.84). In conclusion, this study supports previous findings indicating that the RAS pathway may play a role in the pathogenesis of coronary artery disease.

Keywords: Coronary artery disease; Stenosis; Angiotensin converting enzyme; Angiotensinogen; Cardiovascular genomics

HS - 06

**ASSOCIATION OF LIPOPROTEIN LIPASE HINDIII
POLYMORPHISM WITH CORONARY ARTERY DISEASE
IN FILIPINO PATIENTS**

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The Genomics and Cardiovascular Medicine Initiative is a research program aimed at elucidating the genetic basis of cardiovascular disease in Filipino patients seen at the Heart Institute of St. Luke's Medical Center. One of the gene polymorphisms studied is the Lipoprotein lipase (LPL) HindIII T>G and has been associated with coronary artery disease (CAD) in a number of ethnic groups including Asians and Caucasians. To determine genotype and allele frequencies and establish disease association of the LPL HindIII polymorphism in Filipino CAD patients, we performed PCR-RFLP genotyping of DNA samples from patients who underwent coronary angiography. Out of 1,271 patients enrolled (mean age=58.50), 880 (69.2%) were males, and severe stenosis (>70%) was seen in 848 (66.7%) patients (from St. Luke's Cardiovascular Disease Information System). Genotype frequencies were as follows: TT=830 (62.9%), TG=237 (18.6%), and GG=234 (18.4%). The T allele frequency was 0.72. Chi-square test revealed a significant association between LPL HindIII and obesity ($p=0.009$) but not with other risk factors. Adapting a case-control association study using % stenosis as parameter, genotype frequencies of normal patients, deviated from Hardy-Weinberg equilibrium but several significant associations were established. In normal patients, LPL HindIII variant was associated with obesity ($p=0.031$) and myocardial infarction ($p=0.044$). The T allele in normal patients had a high OR (2.638, CI: 1.098-6.348) for obesity and low OR (0.425, CI: 0.209-0.866) for myocardial infarction, indicating that in normal individuals the presence of the allele could mean increased susceptibility to obesity and/or protection from myocardial infarction.

Keywords: lipoprotein lipase, CAD, Filipino, allele frequency, PCR-RFLP

HS - 07

**ASSOCIATION OF URINARY IODINE EXCRETION LEVEL
TO PHYSIOLOGICAL STATUS OF FILIPINO WOMEN**

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Urinary iodine excretion (UIE) is currently the most practical biochemical marker for iodine nutrition. For this biomarker, international groups have recommended school-aged children as useful target group for surveillance because of their combined high vulnerability, easy access, and applicability to a variety of survey activities and as an acceptable proxy for the iodine status of the general population. But the relevance of this group to others, especially among pregnant and lactating women, is not well established. In the present study, UIEs of 442 pregnant and 830 lactating women were compared to UIEs of 1272 age- and BMI-matched non-pregnant, non-lactating women covered in the Biochemical Phase of the 7th National Nutrition Survey conducted by the Food and Nutrition Research Institute, Department of Science and Technology. Among pregnant women, median UIE was 100 µg/L (adequate \geq 150 µg/L) with 26.4% having values <50 µg/L. Median UIE among non-pregnant women, on the other hand, was 142 µg/L with only 17.5% having values <50 µg/L. Likewise, median UIEs among lactating and non-lactating women were 78 µg/L and 141 µg/L, respectively. Median UIEs for both pregnant and lactating women indicate insufficient iodine status. Further, median UIE levels for the 1st, 2nd and 3rd trimesters of pregnancy were 113, 107 and 89 µg/L, respectively. Iodine nutrition among non-pregnant, non-lactating women was optimal based on median UIE (\geq 100 µg/L) and the percentage (<20%) of women having UIE <50 µg/L. In conclusion, physiological status such as pregnancy and lactation possibly increases the demand and utilization of iodine. In pregnancy, this may also be true as gestation progresses. To achieve optimal nutrition in these vulnerable groups, an increase in dietary intake is recommended. In addition, monitoring of their iodine status, as well as supplementation during pregnancy and lactation should be considered.

Keywords: iodine, urinary excretion, biomarker, pregnancy, lactation

HS - 08

DEVELOPMENT OF A PANEL OF PROTEIN DIAGNOSTIC BIOMARKERS USING NANO-LC-ORBITRAP MS/MS IN URINARY PROTEOME BEFORE RADICAL PROSTATECTOMY OF PATIENTS WITH PROSTATE CANCER

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Global analysis of protein structures *via* nano-LC/MS/MS provides a wealth of information. Bioinformatics allows simultaneous identification of all the contributing proteins in a disease. Given the limitations of PSA test for prostate cancer, these developments in instrumentation, the facile and non-invasive acquisition of urine as a source of proteins similar to blood can provide an alternative for the discovery of novel protein biomarkers. This research aims to identify the protein biomarkers for the early detection of prostate cancer using gradient SDS-PAGE followed by LC-MS/MS analysis aided by Protein Prospector, SwissProt and XCalibur. Transthyretin, hemoglobin alpha and beta were the three protein biomarkers identified in patients with prostate cancer. They are linked to high TNM stage and Gleason scores. Uromodulin and mannan binding lectin protease 2 can distinguish BPH from prostate cancer. These proteins belong to acute phase response proteins like C-reactive proteins which are associated with inflammation and oxidative stress. Hemoglobin alpha and beta as carriers of oxygen justify them as excellent biomarkers. Novel mutations due to oxidation and their reaction mechanism are also shown and discussed. Using a high-throughput method, a panel of biomarkers was identified simultaneously making it possible to differentiate urine of the normal controls from the patients with prostate cancer and another panel of protein biomarkers to distinguish benign prostate hyperplasia from prostate cancer.

Keywords: panel of biomarkers, transthyretin, hemoglobin subunit alpha and beta, uromodulin, mannan binding lectin protease 2, TNM stage, Gleason score, BPH, prostate cancer

HS – 09

ASSESSMENT OF HEAVY METAL (ARSENIC, CADMIUM, LEAD AND MERCURY) CONTENTS OF COMMONLY-CONSUMED SEAFOOD AND PRODUCTS BY FILIPINO ADULTS IN METRO MANILA

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Fish consumption is the main route of heavy metal exposure to humans which poses health risks if taken in large amounts. This study aims to validate methods of analysis for heavy metals, to prepare in-house food reference materials, and determine exposure assessment of commonly consumed seafood and products in Metro Manila. Validation data showed that the methods for analysis of heavy metals (arsenic, cadmium, mercury and lead) are fit for intended use. Mean correlation coefficients for heavy metals detection were between 0.99943 – 0.99977. Mean limits of detection were 0.3470 ppb, 0.1043 ppb, 1.8099 ppb and 0.2970 ppb for As, Cd, Hg and Pb, respectively. The Horwitz ratio was used for the test of method precision. The data showed that the method precision was less than the recommended Horwitz ratio (d^2). Highest levels of heavy metals were found in dried Indian sardine (9.282 ug/g As) and dried anchovy (0.273 ug/g Cd, 0.154 ug/g Hg, and 0.208 ug/g Pb). On the other hand, lowest levels were found in tilapia (0.044 ug/g As), shrimp (0.0003 ug/g Cd), canned sardines 1 (0.007 ug/g Hg), and mussel (0.028 ug/g Pb). Heavy metal contents of seafood and products were lower than the provisional tolerable weekly intake. The target hazard quotients for all the seafood and products also showed values less than 1, which suggests that health risks were insignificant. In conclusion, analysis of the heavy metal contents of seafood and products revealed that the values were below the provisional tolerable weekly intake by these metals indicating that no risk is posed by the consumption of fish most commonly eaten by Filipino adults.

Keywords: heavy metals, validation, target hazard quotient, provisional tolerable weekly intake, arsenic, cadmium, lead, mercury

HS – 10

**LIPIDEMIC EFFECTS OF KAMIAS (*Averrhoa bilimbi* L.)
FRUIT EXTRACT ON MALE WISTAR RATS**

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Kamias (*Averrhoa bilimbi* L.) is a tropical fruit known for its many medicinal properties. The present study investigated the effects of fruit extracts on the lipidemic profile of male Wistar rats. Different concentrations of aqueous and ethanolic fruit extracts were fed and the rats were tested for blood cholesterol, high-density and low-density lipoproteins, and triglycerides. Rats were given high-fat diet for fourteen days using rat pellets amended with egg yolk. A control group with normal diet was also maintained. Extracts were administered through oral gavage once a day for fourteen days at different treatment concentrations: 25%, 50%, 75% and pure concentrations. Simvastatin and water were used as control treatments. Blood samples were taken through the tail vein during the initial and final phases. Results processed using Analysis of Variance (ANOVA) and Duncan Multiple Range Test (DMRT) show significant reduction in cholesterol, low-density lipoprotein and triglycerides among rats treated with pure extracts. This reduction is seen to be directly associated with concentration of treatments. As treatment concentration increases, effects on lipidemic parameters were greater. Further, the results are comparable to Simvastatin, a commercially – available drug used to lower blood cholesterol. Cholesterol level of rats given pure and 75% fruit extracts were at 85.22 and 88.46 mg/dL of blood respectively, significantly better than Simvastatin's 98.91 mg/dL. The study concludes that Kamias is a potential natural cholesterol control and can significantly replace statin drugs. It is recommended that a thorough chemical analysis be done on the fruit for better drug applications.

Keywords: Kamias, *Averrhoa bilimbi* L, cholesterol, lipidemic, Simvastatin

HS – 11

ROLE OF SEX AND *SORTILIN-RELATED RECEPTOR 1* VARIANTS IN FILIPINOS WITH COGNITIVE IMPAIRMENT

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This study investigated the association of 6 *sortilin-related receptor 1* (*SORL1*) variants with cognitive impairment. *SORL1* SNPs 8, 9, 10, 13, 19 and 23 were genotyped using TaqMan® SNP Genotyping Assays in 484 Filipinos: 335 females and 149 males). One hundred had Alzheimer's disease (AD), 109 who had mild cognitive impairment (MCI), 18 who had other types of cognitive impairment, and 257 who had normal cognitive functions. Cognitive impairment (CI), which includes AD, MCI and other cognitive impairment cases, was associated with SNP 23 ($p=0.041$). None of the *SORL1* variants was associated with AD. SNPs 8, 9, 10 and 23 were associated with MCI, ($p=0.028$, $p=0.034$, $p=0.034$ and $p=0.025$, respectively). Based on these results, *SORL1* may be used as a biomarker in the early detection or diagnosis of cognitive impairment and other dementias. The role of sex in the association of *SORL1* variants and cognitive impairment was also evaluated. The results suggest that the SNP 23 may have a significant association with CI in females. The results showed association between SNP 23 ($p=0.033$) and the female sex in the MCI group. For males, all six *SORL1* variants did not show any association with the CI groups. This suggests that *SORL1* may affect cognitive impairment and the interplay of sex-specific risk factors, sex-specific disease course, and sex-specific survival of a disease, through a female-dependent mechanism. *SORL1* plays a crucial role in the formation of amyloid plaques – the primary cause of AD. Although no association was observed between the variants and AD, the findings provide evidence that *SORL1* may predispose individuals to CI. Further evaluation of the usefulness of *SORL1* variants as predictors of progression of CI to AD needs to be done.

Keywords: Cognitive impairment, *sortilin-related receptor 1*, SNPs

SOCIAL SCIENCES

SS - 01

FARMER-LEVEL EVIDENCES OF THE IMPACTS OF CLIMATE CHANGE: OBSERVATIONS AND COPING MECHANISMS OF RICE GROWING FARMERS ALONG THE PADSAN RIVER BASIN IN ILOCOS NORTE

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The impacts of climate change on rice-based production and ex-ante and post-coping mechanisms of rice farmers were documented in this study. Farmers' perception of climate change and level of technical assistance or institutional support that are being provided by local agencies and organizations were highlighted. A structured interview was administered to 150 rice farmers, randomly selected from 27 barangays of seven municipalities in Ilocos Norte. Key informant interviews and focus group discussions were done to validate the data gathered. Description and analysis of data were carried out using frequency counts, percentages and means; coping strategies were qualitatively described. Changes in rainfall patterns, increase in temperature, more intense and frequent typhoons and floods, and water scarcity were the farmers' perceptions of climate change and variability. Almost 90% mentioned low yields and low quality of palay seeds as major impacts followed by occurrences of unusual pests/diseases and weeds. To cope with these, the traditional "panagarbeng" or collectively repairing and maintaining of the irrigation system as a "sanjera" was a major strategy, followed by borrowing of money, farm inputs, fertilizer and seeds from private companies and farm suppliers. Farmers' experiences and knowledge in coping with climate change must be considered in policy formulation as basis to improve rice-based production.

Keywords: impact, climate change, perception, coping, sanjera

SS - 02

A MENTORING PROGRAM FOR TEACHER INDUCTION: A FIELD TEST

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This research assessed the need and effectiveness of a mentoring program for teacher induction following the research and development method. A preliminary survey was undertaken through a combination of quantitative and qualitative techniques using the interview and document analysis. The respondents in the study were college instructors without preparation for teaching. Subsequently, the results were the basis for the design of a mentoring program. The results showed that the initial year of new teachers was a period of survival and recovery. They encountered problems or difficulties which they kept mostly to themselves. These were: lack of knowledge about teaching method; preparation of lesson plan and syllabi; lack of self-confidence and stage fright; inability to communicate well; poor classroom management; lack of instructional materials/references/laboratory facilities; and inability to associate well with the members of their respective departments. To be able to cope with these difficulties, a mentoring program was developed for teacher entrants with or without professional education preparation to ensure a smooth transition into the teaching profession. The mentoring program explains what mentoring is, who can be a mentor and how he should relate to the mentee, the guidelines necessary in undertaking the program and the specific activities that can be undertaken in each mentoring stage (sponsoring, coaching, and supervising) in three areas: the institution and its policies, instructional processes, and personality development. Significantly, high differences between the mean pretest (1.87 to 2.56 : fair to satisfactory) and mean post-test scores (4.16 to 4.40: very satisfactory) on the overall performance of the dyads were obtained at 0.01 probability level through the implementation of the work orientation of mentoring program.

Keywords: mentoring, teacher induction, mentor, mentee, coaching

SS - 03

FINDING A NICHE: TRAINING NEEDS ASSESSMENT FOR FILIPINO INVENTORS

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The Science and Technology Information Institute (STII) was commissioned by the Technology Application and Promotion Institute (TAPI) to conduct a study to: (1) gather information on the appropriate training needs of Filipino inventors to help them improve their inventions and their commercialization efforts; and (2) identify training needs per region and per sector. A focus group discussion (FGD) was conducted with 15 inventors representing inventor organizations nationwide accredited by TAPI. They were divided into two groups. Eight pre-programmed questions were used as guide in the discussion. The FGD revealed the following: huge gap between the ‘haves’ and ‘have-nots’ among their ranks; their needs were not being addressed by TAPI and other concerned government agencies; the DOST regional offices were hardly a factor in inventor assistance; inventors were aware that they were partly to blame for their current fractured state; and, presence of knowledge gaps in the technical, entrepreneurial, marketing, and personality aspects. However, results also showed that FGD alone was not enough to come up with a complete list of trainings as inventors were not fully aware of the skills and knowledge they need for personal and product/invention development. Further study is needed to enhance understanding of the inventors to determine the specific training needs. Other recommendations were: TAPI should develop specialized training modules in key areas such as quality control, product packaging, and craftsmanship on the technical side; and marketing strategy, business plan development, and entrepreneurship for commercialization; holding regular dialogues with the inventors’ organizations; close coordination with DOST regional offices; and intervention on eventual reconciliation of the various groups under one umbrella organization.

Keywords: FGD, Training Needs Assessment, inventors, TAPI

SS - 04

CONSUMERS' ATTITUDES AND KNOWLEDGE LEVEL ON ORGANIC PRODUCTS IN REGION I AND CAR

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This study focused on the assessment of consumers' attitudes and level of knowledge towards organic products in Region I and CAR, including factors that are associated to these. Results of interviews revealed that consumers are generally aware of organic products. They have moderate knowledge on the socio-economic and health attributes and have a favorable attitude towards it. Health benefit is the most significant motivation of consuming organic products. However, there are consumers who have doubts and reservations on the actual health and environmental benefits derived from it. Most consumers signified willingness to shift consumption from non-organic to organic products. However, consumption is still low in the regions because of the unavailability of such in the local market. If there are, these are sold along with non-organic products because there is no established organic market yet in most of the areas in both regions. Likewise, there is no assurance that such product is organic unless certified by existing certifying bodies. With these realities, government must strengthen its advocacy effort in encouraging farmers to adopt organic farming in order to meet consumers' organic product demand. Likewise, support services such as market and organic certification must also be given equal importance. More effort is also needed in information, education and communication campaign (ICE) on matters regarding organic products in order to give consumers the proper view regarding the long term and significant benefits of organic product consumption. Through this, consumers can develop a more positive attitude regarding organic products.

Keywords: IEC, organic products, attitudes, knowledge, consumers

SS - 05

**ENVIRONMENTAL KNOWLEDGE, AWARENESS,
AND PERCEPTIONS OF TERTIARY STUDENTS ON
CLIMATE CHANGE**

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Climate Change is now the concern of the country as it is attributed directly or indirectly to human activities. This study determined the environmental knowledge, awareness, and perceptions of college students on climate change. A Climate Change Questionnaire (CCQ) was administered to 50 students (40% male and 60% female). The majority of the students were concerned about the environment. They are most concerned with global warming and climate change, and they were least concerned with radioactive contamination and loss of habitat of wildlife. Results of the CCQ revealed that students are knowledgeable and aware (95%) of concepts and issues of climate change. Sources of their knowledge are newspapers, books, and television. A high percentage of students (75%) showed a positive attitude towards tree planting, public transport, walk and bike, and saving electricity to improve the quality of the environment and mitigate climate change. The results of this study will serve as baseline information on the integration of global environmental issues, such as climate change in tertiary level environmental education and climate sciences.

Keywords: environmental knowledge, climate change, global warming, environmental education, tertiary students

SS - 06

**KNOWLEDGE OF OL TRAP USERS ON MOSQUITO,
DENGUE, AND OL TRAP AS BASIS FOR COMICS
DEVELOPMENT TO PROMOTE OL TRAP USE**

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The study sought to determine the knowledge of community members about dengue and the Ovicidal-Larvicidal (OL) Trap that was used as a basis in developing a comic magazine as an information material for the nationwide promotion of the OL Trap, an innovation by the Industrial Technology Development Institute. The OL Trap is one of the government's multi-pronged actions to fight the spread of the deadly dengue virus. The study surveyed 265 people from five communities (Brgy Zone I and Brgy Zone II, Digos City, Davao Del Sur; Brgy Pico, La Trinidad, Benguet; Brgy Bata and Brgy Taculing, Bacolod City, Negros Occidental) using survey questionnaires, community meetings, and personal interviews. The said barangays were recipients of the OL Trap. The study found that most of the respondents did not have the correct idea about *Aedes aegypti* and dengue. Most of them knew how the dengue-carrying mosquito looked like but did not know that it was a daytime insect. Most were aware that only female mosquitoes bite and lay eggs only on clean water, but were unaware of the mosquito's preference for dark, moist places. The majority knew that dengue was fatal but preventable. On the OL Trap, most respondents knew how it worked and how it was used but they had to be taught on proper disposal of contents with mosquito eggs and larvae. Most also said that P15.00 for an OL Trap kit was reasonable and P6.00 per month for pellets was affordable. Many suggested that OL Trap kits be sold in drugstores and barangay halls. Most believed that the OL Trap was effective and that they would recommend its use. A minority could not yet give an opinion whether the OL Trap was effective or not. The survey results were used in developing 'Ang Komiks' that carried for its maiden issue the story 'Ang OL Trap sa Barangay Madengue' which was published in seven major Filipino languages: Tagalog, Bisaya, Iloco, Bikol, Pampango, Hiligaynon, and Waray-Waray.

Keywords: OL Trap, *Aedes aegypti*, dengue, comics, knowledge

SS - 07

POTENTIAL ROLES OF THE ACADEME AND RELIGIOUS INSTITUTIONS IN SUSTAINING THE GAINS OF THE PEACE PROCESS IN SOUTHERN PHILIPPINES

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The Government's roadmap to peace is not without obstacles as both biases and wrong notions on the on-going negotiations can be potential spoilers that can derail the entire peace process. This paper is an attempt to determine common misconceptions people have on the negotiations between the Philippine Government and the Moro Islamic Liberation Front (MILF). To do this, a total of 300 respondents were asked to complete a 53-item questionnaire regarding the peace process. The responses were analyzed using descriptive and multivariate statistical analyses. Results showed that the respondents lack knowledge on key aspects of the agreement, such as on the extent of the territory of the Bangsamoro and the rights of its inhabitants. Some misconceptions include the belief that non-Muslims will not be guaranteed their rights and that they will be driven away back to Visayas and Luzon. Moreover, Canonical Correspondence Analysis of the data point to the possibility that religion may have been helpful in shaping the hearts and minds of the people towards the agreement and the entire peace process. This lack of understanding and the proliferation of personal biases amongst people imply the need to organize massive information dissemination campaigns designed to clarify issues vis-à-vis the peace agreement via a multiplier effect. The results of this study also point to the potential roles that the academe and religious institutions may play in dispelling these wrong notions in order to help sustain the gains of the peace process in Southern Philippines.

Keywords: peace process, Bangsamoro, Academe, Religion, Framework Agreement on the Bangsamoro, Moro Islamic Liberation Front

SS – 08

**STRENGTHENING COMMUNITY RESILIENCE OF
BARANGAY PULA, KANLAON CITY, NEGROS ORIENTAL:
UNDERSTANDING RESIDENTS' PERCEPTIONS AS BASIS
FOR COMMUNICATING HAZARDS AND RISKS**

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An understanding of residents' perceptions about hazards and risks is important in designing a disaster risk reduction-related communication strategy. People's perceptions about hazards and risks, however, are influenced by knowledge about these specific hazards, disaster history of the area, and one's direct experience of an event or the lack of it. The case study of Brgy. Pula focused on: (a) identifying the general perceptions about volcanic risk of people living close to Kanlaon; (b) looking into previous experience, education, attitude and beliefs as factors that influenced perceptions; and (c) identifying communication strategy that best fit the need for the pilot community to take steps toward strengthening resilience. The goal is to promote awareness about hazards from Kanlaon that would lead to observable emergent positive actions towards preparedness, with the long-term goal of reducing risk. Field interviews with residents and local officials and small group discussions were conducted between 2010-2011. Findings show limited knowledge of historical eruptions due to narrow timeframe of actual experience. Based on this, a series of barangay-level activities were conducted with carefully selected methods that would be used for series of community-based activities. The activities aimed to: (1) identify information needs and develop materials that would persuade the target audience; and (2) facilitate discussions towards planning for volcano-related disasters. Observed positive actions of officials and residents noted after implementation of the communication plan include community-initiated information campaign for each *purok*, design and installation of early warning device (*batingting*) for each *purok*, communication-test of the emplaced system and a volcano evacuation drill in July 2012.

Keywords: perceptions, hazards, risks, preparedness, awareness

SS – 09

**THE HISTORICAL ANALYSIS ON THE CHANGES
OF THE TRADITIONAL BELIEFS SYSTEM OF SUBANEN
IN LABO BANWA, MISAMIS OCCIDENTAL**

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This paper is a study on the traditional beliefs system of the Subanen in Labo Banwa in the province of Misamis Occidental. Labo Banwa is interior area located at the periphery of the city of Ozamiz in the southern part of Mt. Malindang. As they sheltered themselves in some of the ranges of the mountain, it is interesting to know whether their beliefs are preserved through years in the face of the ever increasing development of the city. This paper attempts to understand the continuity and change of their beliefs. However, it is limited to the basic life cycle of Subanen such as birth, marriage, cultivation, and death. As a descriptive study, this employs key informant interviews, observation, and visitation in the area and analysis of archival materials as the primary sources of information. Findings showed that the Subanen claimed to have their traditional beliefs observed/preserved through years, however, it is also noted that among the younger generations, these traditional beliefs are not fully observed and they are slowly losing knowledge about them.

Keywords: Subanen, Labo Banwa, Traditional Beliefs System, Mt. Malindang, Misamis Occidental

SS – 10

PROFITABILITY ANALYSIS OF ORGANIC VEGETABLE PRODUCTION IN REGION I

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This study analyzed the profitability of organic vegetable production in Region I. It determined the costs incurred and the benefits derived by the farmers. The farmers were classified by farm type: full organic (FOFT), in conversion (ICFT) and conventional (CFT). There were 159 farmers interviewed in Ilocos Norte, Ilocos Sur, La Union, and Pangasinan. The “pinakbet” vegetables were included in this study. Data were analyzed descriptively with profitability, partial budget, and price analysis, including yield sensitivity analysis. Generally, material and labor costs were higher in FOFT and ICFT than in CFT. However, net incomes were higher in the two organic farm types. Farmgate prices of FOFT were also higher except for finger pepper and okra which were higher in CFT and ICFT, respectively. Ampalaya, finger pepper and okra yielded highest in FOFT; eggplant, pole sitao and squash in ICFT. The partial budget analysis showed that except for finger pepper, higher net benefits were obtained from vegetables grown under FOFT than CFT. The added benefits more than compensated the added costs. Hence, production of organic “pinakbet” vegetables is highly remunerative. More intensive information dissemination and aggressive advocacy campaign are necessary to promote organic farming.

Keywords: organic farming, organic vegetables, sustainable crop production, profitability, soil and environmental conservation

SS – 11

WOMEN'S ACTIVITIES IN THE GATHERING AND MARKETING OF SEAWEEDS IN ILOCOS NORTE

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Women's activities have been treated as separate activities and the complimentary and conflicting roles and relations between women and men have been given little attention. Studies show that coastal communities have a vital role to play in the development process of many coastal communities. This study was conducted on the seaweed gathering and marketing industry in four coastal towns of Ilocos Norte from January 2011 to February 2012 using descriptive analysis of data from gatherers and sellers. The results show that there are variations that highlight men's and women's access to, and control over, the seaweed resources. There are specific roles, as well as common roles of women with men that were identified to improve the economic condition of the coastal people. It is recommended that men and women in seaweed gathering and marketing be trained with appropriate drying methods and packaging skills in order to enable alternative livelihood projects.

Keywords: women's activities, seaweed gathering and marketing, socio-economic characteristics, coastal resources

SS – 12

HOUSEHOLD PARTICIPATION OF CEBU RIVERS CLEAN UP

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Household wastes pollute the San Roque creek in Cebu City. This study investigated the role of households in cleaning up the riverbanks of the towns of Argao and Carmen, Cebu province, and barangays Usmadcatang, Cantumog and San Roque in Cebu City. Fifty six respondents provided their awareness on attitudes towards environment and water utilization. Married women of Argao and Carmen are the ones who are mainly responsible for the housekeeping with part-time sources of income. The main environmental issues that the respondents were concerned about were: climate change, water pollution, loss of biodiversity, water pollution, growing waste and depletion of natural resources. The responses of respondents regarding the environment were: correct disposal of hazardous household products at home, proper maintenance of septic systems, contacting public officials, and attending public hearings to encourage the community to support laws and programs to protect water resources. CTU researchers coordinated with the LGU of San Roque in river clean-up and raised household awareness towards the environment.

Keywords: household, clean-up, river, environment, participation

SS – 13

**SOLI-SOLI (*Typha latifolia*) AS AN INDUSTRY AND AS A
FESTIVAL EMBLEM OF PACIJAN ISLAND, CEBU,
CENTRAL PHILIPPINES: ITS STATUS, PROCESSING AND
PROPOSED CONSERVATION OPTIONS FOR
SUSTAINABILITY**

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Soli-soli (*Typha latifolia*) a plant found abundantly in Lake Danao, San Francisco, Cebu, was studied as an industrial resource, its processing and a festival emblem of the fiesta celebration of Pacijan Island. This is a descriptive study where a questionnaire was used as a tool for gathering the data given to the weavers of solisoli, festival organizers, LGU officials, selected inhabitants and tourists of Pacijan Island. Results showed that soli-soli plant was converted into bags, belts, caps, and mats where tourists usually buy them because of their unique material. The soli-soli was processed by harvesting the young soli-soli plant. Then this is dried under the sun for 2 to 3 days. They are then cleaned, made into strips, tanned with different colors and woven to the desired articles. Gender composition on the soli-soli industry is dominated by the females (60%) and males (40%). Marketing of the soli-soli products is done locally and some were brought to nearby provinces like Cebu City and Ormoc City. Mats topped among the saleable articles followed by bags, hats, fans, slippers and ropes. Results showed that soli-soli festival is done every third Sunday of March in San Francisco where it depicts the soli-soli plant which abounds around Lake Danao and a freestyle street dancing competition using the soli-soli plant as the dominant material for the costumes of the participants. Extraction of soli-soli is most active from January to June due to the preparation of articles for the fiesta and summer tourism in Camotes Islands. Problems of soli-soli industry are: limited marketing, financing, and product development.

Keywords: Soli-soli, *Typha latifolia*, festival emblem, Pacijan, industry

**EXECUTIVE SUMMARIES OF
PLENARY PAPERS**

DEVELOPMENT PROGERIA: MALADY AND REMEDY

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In this paper, we employed the concept ‘development progeria’ first proposed by Fabella and Fabella (2011) to put in perspective the sad plight of the Manufacturing sector, in particular, and of the Tradables sector, in general, in the Philippines. We showed that in the last quarter century, the Services sector share in total value added rose rapidly while those of the Industry and in particular the Manufacturing sectors retreated. While this is a normal feature of high-income mature economies, it is an anomaly for income-poor countries struggling to catch up. We call less developed economies displaying such feature development progeriacs. We showed that indeed less developed economies in a sustained rapid growth trajectory (convergent trajectory) display the opposite feature: the Services sector share retreats in the face of gains in the shares of the Industry and the Manufacturing sectors. We showed that the trajectory of the employment shares of the Industrial sectors mimics that of the value added shares: Industry and Manufacturing shares fall while that of the Services sector advance. We showed that development progeria is endemic in Latin America.

We then enquired into the wherewithal of development progeria in the Philippines. We argued that policy option, rather than fate, is at the root of development progeria. Our contention is that while there are other factors—notably weak institutions and governance—the Philippines’ pursuit of a strong peso was contributive to the retreat of Tradables in general and manufacturing in particular. We revisit two policy episodes in our history in the last quarter century both related to the Philippine central bank. The first was the effort to support the appreciating peso in mid-1990s leading to the encouragement to local business and banks to source their financing requirements from abroad, which resulted in heavy dollar exposures and currency mis-matches. It created bubbles in the stock and real estate which made for artificial prosperity. The Asian Financial Crisis exposed the unsustainable and dangerous nature of the strong peso strategy which, in turn, effectively aborted the promising Ramos recovery. The second was the attempt to snatch the strong peso from needed depreciation in mid-1980s, which involved the use of the infamous *Jobo Bills* that administered

the ‘interest rate cure’. This effectively shrank the real economy in order to fit the massively mis-aligned Philippine peso. What was a disaster for the economy was, however, a boon for Philippine banks which bought the Jobo bills. The interest rate cure and the strong peso effectively aborted the prospect of the Aquino recovery. In this environment, given other entrenched institutional drawbacks, there was no room for new investments in Tradables and Manufacturing.

We then reviewed the evidence on the relation between weak currencies in stimulating growth. There is now strong evidence that weak currencies (undervalued currencies) make for higher growth. The reason advanced by Rodrik (2008) is that weak currencies compensate for many institutional failures which tend to negatively affect Tradables more than they do Non-Tradables. This levels the playing field for investment in Tradables. Another market failure that undervalued currencies remedy is the public good character of forex reserve: everybody benefits (e.g., the state can borrow at a lower interest rate) with a healthy forex reserve but which mostly private forex earners cannot appropriate.

Finally, we confront the question of shifting from a strong peso stance to a weak peso stance. In the last 25 years, advocates of the weak peso policy have repeatedly been rebuffed. But the times they are a-changing. The new BSP is now less tethered to the interest of the banking sector, more receptive to ideas anathema to the old monetary orthodoxy (exemplified by the SNB’s since 2011) and, in general, more flexible. The Philippines since 2002 has now become a lender to the world rather than being perennially a beggar to the world chained to IMF conditionalities. The Philippines can now say “no” not only to credit offers but also to the worldviews imbedded in them. There is now a greater awareness among the business community of the dangers of the strong peso, the vitality of the Services sector (banking, real estate and retail) now more than ever being tied to the well-being of Tradables (say, the BPO industry demand for office space) and OFW households (demand for low cost housing). There is now a greater awareness of the protective effect of the weak peso especially in deterring smuggling.

Development progeria is not in the genes unlike its physical counterpart. It can be reversed with the right policies. But even with the ideal set of policies it will heal only slowly. The fruits will be harvested by our children. Our reward is that we started the healing process. Let’s get busy today.

FOOD AND WOOD MANUFACTURING: CURRENT STATUS, ISSUES AND RECOMMENDATIONS

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This paper summarizes the current status, issues, and recommendations on food and wood manufacturing in the Philippines. It aims to identify, assess, and offer solutions for the gaps in the manufacturing sector, particularly on the access and use of modern technology. We also hope to identify a technology-explicit road map for the processed food and wood products in collaboration with both the concerned private and government sectors.

The Food Manufacturing Sector

The manufacturing sector is a significant part of Philippine economy because it is the largest sector and generates the most revenue, accounts for 85 percent of all Philippine exports (NSO, 2009), and is a major employer and source of foreign exchange. Moreover, it also provides many opportunities for the processing of local raw materials into value-added products that have tremendous local and foreign markets. Philippine food manufacturing includes the production, processing and preserving of meats, fish and other marine products, fruits and vegetables; the manufacturing of vegetable and animal oils and fats, dairy products, grain mill products, bakery products, sugar and confectionery, food condiments and seasoning, snack food, food ingredients and animal feeds (PSIC).

The food manufacturing industry remains to be one of the most dominant industries in the country, with a sustained average annual growth of 8.5 percent within 2009-2012. The sector also continuously grows with local and international avenues opening up more opportunities for trade such as the ASEAN Economic Community and government efforts to invite foreign investments, enhancing local food manufacturers' capacities to be more competitive.

Issues

NAST-sponsored round table discussions on food manufacturing identified interrelated concerns which threaten the sector's competitiveness and thus inhibit it from reaching its full potential.

The first concern is ensuring an inexpensive and reliable **supply of raw materials**, especially in terms of quality, quantity and time of delivery. Importation, buying from independent growers and contract growing are among the ways the sector acquire raw materials, and each has its own concerns, but it is deemed that the best option is thru consolidation of small farm holdings. Second is the availability of appropriate **technology** to effectively produce the desired products such as improved processed products and agricultural farming practices and labor-saving machineries for automation especially for big food companies. Third is the compliance of food manufacturers to national **food safety** regulations such as Good Manufacturing Practices (AO 153). Concerned agencies are observed to be inadequate in their enforcement, while consumers are not actively asserting their rights to safe and quality food.

Recommendations

1. Improve the transfer of existing technologies to the farmers. Agricultural success of Asian neighbors (i.e. Taiwan and Japan) relies heavily on the effective movement of advanced technologies from the research institutions to the farmer, as well as farmers' highly-disciplined, entrepreneurial, active participation, and the government's sincerity, support and strong political will.
2. Strong collaborations should be forged among government institutions and private business sector. Government should act as regulator, liaison and educator to the sector; it should, among other things, establish a local standard comparable to the export market; liaise with the importing government on behalf of the exporter; regularly inspect producers' facilities; continue to search for new technologies and conduct educational programs, study trips, trainings and meetings. The private sector meanwhile should comply with the standards and requirements of the importing country and local governing body; gain international accreditation; closely communicate with concerned government sectors; form organizations to negotiate, win concessions and upgrade standards; and uphold quality for cost, convenience or position and take initiative for its continuous improvement. The

government and private sector as well as other stakeholders should also go hand in hand in identifying the problem areas in which science and technology can be used to advantage.

3. Concerned regulatory agencies such as the Food and Drug Administration (FDA), Department of Health (DOH), Department of Trade and Industry (DTI), National Meat Inspection Service (NMIS), Bureau of Fisheries and Aquatic Resources (BFAR) and others should strictly enforce food safety regulations while consumers should be encouraged to be vigilant and actively participate in reporting safety and quality standards violations of food companies.
4. Industry partners should provide research and scholarship funds to supplement the meager funds allocated by government. This could serve for training of new food scientists and continuing education of both big and small players on capacity enhancement to improve the quality of products produced. They can also be tapped to develop new products/innovations to especially assist the small players who are not capable of establishing their own product development unit.

The Wood Manufacturing Sector

Philippine wood manufacturing sector is classified into upstream and downstream. Lumber, veneer and plywood are the primary products of the upstream subsector and are used directly in housing and other types of construction, as well as inputs for the downstream subsector including furniture and furnishings and manufactured articles of wood such as doors, door jambs, windows, moldings, balusters, stairs and railways, shingles and shaker, assemble parquets and shuttering for concrete construction and others (Angeles et al., 2012). Products of this subsector are internationally called secondary processed wood products or SPWP.

Current status

Whereas the food manufacturing industry grew by an annual average of 8.5 percent between 2009 and 2012, the wood manufacturing industry has continued to decline. Data from the Philippine Forestry Statistics cited by Angeles et al. (2012) and Aggangan (2012) showed a very alarming situation of the sector. According to them, in the last four decades, our local production of lumber declined by about 80 percent, veneer 55 percent and plywood 46 percent. In summary, their total production was 70 percent (from a yearly average of 2,548,999 cubic meters in the period 1973-1978 to 790,000 cubic meters, in the period 2009-2011).

Consequently, the Philippine has been forced to import them yearly. For example, from a negligible value in early 1990's, imported veneer peaked between 1994 and 2003 at an annual average of US\$99 million and US\$22 million, respectively. Plywood, on the other hand valued at US\$99 million from 2009-2011, largely due to the influx of China-made plywood. The aggregate annual imports averaged at 355,000 cubic meters valued at US\$112 million.

Moreover, the Philippine exports of these primary products declined. From an annual peak of 1,157,000 cubic meters valued at US\$275 million in 1979-1983, it fell to 109,000 cubic meters valued at only US\$ 18 million. In 2004-2008, there was a modest recovery.

Issues

Stakeholders involving scientists, farmers, entrepreneur, non-government workers and managers who participated in the preparation of PA 2020 agreed that the main issue besetting the upstream sector, which will affect the downstream sector, is the scarcity of materials such as timber and logs. Consequently, availability of secondary processed products for local and export markets will further decline. Contributory to this issue are: further rise of illegal logging that has now encroached into the licensed forest areas closed by EO No. 23; difficulty importing from abroad due to non-tariff restriction policies and other restrictions by exporting countries; influx of cheaper wood products, especially from China and dearth of both local and foreign investments in forest/tree plantations and mill modernization (Angeles et al., 2012 and Aggangan, 2012).

Recommendations

1. A reiteration of NAST previous resolutions to enact into law the Land Use Policy Act and the Sustainable Forest Management Act (to replace PD 705).
2. Use science and technology, and economics in promulgating investment-friendly policies to attract both local and foreign investments.
3. As in the food manufacturing sector forge strong collaboration among government institutions and business sector on all areas i.e.

science and technology, capacity development both human and facilities, upgrading of standards etc for robust development of the wood manufacturing sector.

4. Strict enforcement of forest protection i.e. illegal logging, poaching, smuggling of secondary products by the concerned government agency
5. Adopt recommendations expressed in PA 2020 such as put under supervised sustainable management one million hectares of second growth forests suitable for selective logging; establish 500,000 hectares of quality forests thru plantations both in private and public lands; establish 100,000 hectares of bamboo plantations; organize upland and forest land communities, for mobilizing investments and credit, adopting modern technologies for production and processing, assurance markets for as their produce as well as in biodiversity and ecological conservation and mobilizing and empowering of 2,182 people organizations and 496,165 households holding the stewardship contracts of CBMFA's into a more productive competitive and sustainable partnership in forest development.

PROSPECTS FOR AQUATIC HIGH VALUE PRODUCTS BIOFACTORIES IN THE PHILIPPINES

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The Philippines is reported to be the center of species diversity for many marine taxa. Marine biodiversity is a valuable national asset that provides various goods and services to our people. The primary aquatic biodiversity-based industry is fisheries. In 2010, the Philippines was the 5th highest fish producing country in the world with a total production of 5.16 million metric tons of fish, crustaceans, mollusks, and aquatic plants which constitutes 3.06 percent of the total world production of 168.4 million metric tons worth 10.8 billion US dollars. The fishery production and processing sectors also provide employment and contribute a huge percentage of the national income. Moreover, aquatic species are major sources of protein in the Filipino diet and critical for domestic food security. Aside from providing food and income, marine organisms are sources of pharmaceutical and nutraceutical products, and materials for biofuel production. This paper provides an overview of the prospects for production of high value products from finfish waste, seaweeds, and marine invertebrates.

Finfish Discards

The shortage of raw material is one of the primary problems in the fish processing industry in the country. However, there are opportunities for the development of high value products from fish wastes derived from the top cultured (e.g., bangus, tilapia) and wild (e.g., tuna) finfish species. Utilization of fish waste would also reduce the environmental costs associated with disposal. Many pelagic fishes are rich in oil such as mackerel, herring, tuna, sardines and anchovy. Although they are primarily processed as food, other high-valued by-products have been derived from fish wastes such as intestines, head, gill, and bones. In general, fish wastes are nutritionally rich in valuable oils (i.e., omega 3), minerals and bioactive compounds that have many alternative uses in food, pharmaceutical, nutraceutical, agricultural, aquaculture and industrial applications (Sharp and Mariojous, 2012). For instance, fish oil being rich in omega-3 has been

known to reduce the risk of heart-related dysfunction and improve brain development. Fish oil can also be converted into biodiesel (e.g., Pinyaphong et al., 2011) which have higher cloud point, cetane number and better stability. Chymotrypsin produced from fish discards such as tuna has many applications in the food industry, leather production, chemical and medical industry (Zhou et al., 2011). In addition, fish scales are utilized for pearl essence which is an additive for lipsticks, nail polish, ceramic glazes and other cosmetic products to make them shimmery. Bangus and tilapia scales may be potential local sources of pearl essence. In addition, fish bone has also been found to be a potential source of calcium. Other important products that can be obtained from fish waste (e.g., tilapia) by-products include collagen, gelatin.

Seaweeds

Seaweed farming is the most successful mariculture industry in the country. It is mostly a small grower industry at the production side which provides livelihood for coastal communities. The Philippines was the 3rd largest producer of seaweeds in 2010 with a total production of 1.8 million metric tons worth USD 256.7 M. This constitutes 9.5 percent of the total seaweed world production of 19 million metric tons (BFAR-Philippine Fisheries Profile 2011). The Philippines is considered one of the world's leading producers of *Kappaphycus* and *Eucheuma*. These seaweeds are of great demand because they produce carrageenan which is widely used as stabilizer, gelling agent, binder, thickener and additive for various dairy products, pet food, meat processing, beer bottling industries. It is also utilized in cosmetics and pharmaceuticals. The brown algae, *Sargassum* which is common in rocky intertidal and shallow subtidal areas of the Philippines and is often cast up in large quantity in shore and beaches has a lot of high value natural products.. It is a source of fucoidans, an anti-inflammatory and an excellent antioxidant (Thin et al., 2013) and the pigment fucoxanthin, a slimming agent and has anti-cancer properties. Other studies also showed that *Sargassum* is an effective anti-allergen. Crude and diethyl ether extracts from *Sargassum polycistum* were found to be effective as an insecticide, a potential plant hormone and a basic emulsifier for bath soap.

There is growing interest in the potential of seaweeds as sources of biofuels and ethanol because of its high sugar content. The process also does not require pretreatment for ethanol production. Seaweeds are relatively easier to harvest than microalgae and can be harvested up to six times a year in

warm climates. Obvious advantages of seaweed biofuels include the lack of competition with arable lands and limited or no needs for the use of freshwater and external fertilizers or phytosanitary products. The higher capacity of these marine plants to absorb airborne carbon than land-based plants is also cited as an advantage of mass production of seaweeds.

Invertebrates

The Philippines is the epicenter of diversity of major invertebrate taxa (e.g., corals, molluscs, crustaceans). Shrimps, cephalopods (squid, cuttlefish, octopus); crabs and sea cucumbers are high-value export commodities. Other invertebrates gleaned from nearshore areas are the primary source of protein on poor coastal households. While the aquaculture production of the four widely cultured invertebrates (i.e., oysters, mussels, shrimps/prawns, mudcrab) in the country has steadily increased in the past decade, culture production of invertebrates is still generally low relative to the fish and seaweed production.

Several studies have shown that various invertebrate taxa are major sources of bioactive compounds with potential for drug development, clinical treatments, and nutraceuticals. In the US, powdered coral skeleton is considered as a calcium supplement. Bioactive compounds extracted from marine invertebrates have also been widely used in medicine as anti-inflammatory, anti-hypertension, anti-tumor and anti-cancer drugs (e.g., dolastatin from sea hares, bryostatin from bryozoans). Chitin and chitosan oligomers obtained from crustaceans have also been found to possess antitumor and wound healing properties. Studies on conotoxins from various species of the marine snail *Conus* led to the development of the drug Prialt which is an alternative to morphine. Another group of very diverse gastropods, the turrids, are part of a major drug discovery program (PHARMASEAS). Several bioactive compounds can be derived from a single species. Given the hundreds of species of conus and turrid shells, thousands of potential bioactive compounds can be derived just from these two groups.

Biologically active compounds isolated from echinoderms have been evaluated for their cytotoxicity against tumor or cancer cells, antiviral, antifungal, or antimicrobial activity, among others. Some species also serve as experimental model for studies on tissues or organ regeneration and physiological processes have inspired engineering innovations. Recently, a nickel catalyst to capture carbon dioxide from the atmosphere was developed based on the discovery that sea urchins use nickel to convert the CO₂ to

calcium carbonate for their exoskeleton (Bradbury and Siller, 2013). Sea urchin tests have been reported as potential sources of anti-oxidants. The development of high-value species culture technologies for sea urchins (*Tripneustes gratilla*) and sea cucumbers (*Holothuria scabra*, *Stichopus horrens*) also provides opportunities to develop non-traditional products and add economic value to current traditional fishery products. For *T. gratilla*, crude extracts of its different organs exhibit anti-microbial activity and peroxysterol was found to be effective against tumor cell lines (Liu et al., 2011). In Malaysia, extracts from different species of *Stichopus* are made into ointments to treat wounds and added to toothpaste to treat gingivitis or early stages of periodontitis. Various health supplements and cosmetic products were developed from gamodulin extracts from *Stichopus* sp. Carotenoids in *H. scabra* were also found to be a potential source of natural antibiotics (Ibrahim, 2013) aside from other medically important bioactive compounds. On the other hand, the crown of thorns starfish (*Acanthaster planci*), is a good source of protein and was found to be non-toxic to animals, making it a potential ingredient for animal feeds. Maybe this is an opportunity to add value to conservation efforts to manage outbreaks and further degradation of coral reefs.

Within an integrated framework for sustainable development, development of pharmaceuticals nutraceuticals, and other value-added products from aquatic species can provide incentives for increased public and private investments in improving the management of fishery resources, including responsible mariculture practices which will increase production to support the development of marine biotechnology based industries.

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INCLUSIVE GROWTH THROUGH THE COCOCHEMICAL INDUSTRY: FROM COCONUT TO HIGH-VALUE PRODUCT¹

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The Philippine Development Plan 2011-2016 boldly set for the administration of Pres. Benigno S. Aquino, III, the objective of attaining “inclusive growth” which it defined as “growth that is sustained, that massively creates jobs, and reduces poverty.”

The Philippines can only reduce poverty by addressing the root of poverty, and one of the sectors that is among the poorest is the coconut sector. At the same time, the coconut sector has the potential to provide the jobs, agricultural development, and industrial growth that are sustainable.

However, a comprehensive roadmap requires a strategy that combines social, economic and political reform, together with scientific and technological savvy. Institutionally, this effort needs the leadership from the Presidency, which will coordinate all of the agencies of government, the active support from the private sector, and most importantly, the engagement of the most affected sector, the coconut farmer.

The Philippine Development Plan 2011-2016 acknowledged that inclusive growth “is an ideal which the country has perennially fallen short of, and this failure has had the most far-reaching consequences, from mass misery and marginalization, to an overseas exodus of skill and talent, to political disaffection and alienation, leading finally to threats to the constitution of the state itself.” (NEDA, 2011)

¹This paper is based on the presentation of Norio Usui (Asian Development Bank) during the NAST roundtable discussion (RTD) “Development Progeria” held at Traders Hotel, Manila, on January 17, 2013, and the presentations by Dr. Jose Romero, Jr. (former Administrator, Philippine Coconut Authority); Mr. Carlos Carpio (Deputy Administrator, PCA), Mr. Dean Lao, Jr. (Managing Director, Chemrez Technologies), and Ms. Evelina Patiño (COO, United Coconut Chemicals Inc.), during the roundtable discussion “Philippine Coconut Industry’s Cocochemical Sector: Quo Vadis?” held at the Hyatt Hotel, Manila, on May 28, 2013.

Norio Usui advanced the treatise that the main reason behind the low growth performance of the Philippines relative to our neighbors is our stagnant industrialization. To achieve inclusive growth, the Philippines needs to strengthen an industrial sector that creates productive job opportunities.

The Philippines today is faced with the twin challenges of attaining inclusive growth and being globally competitive. The first challenge is rooted mainly in agriculture, while the second challenge requires a competitive industry. The Coconut Sector is the most strategic sector that can address both challenges of attaining inclusive growth and global industrial competitiveness, and science and technology – if properly focused and supported – can support the drive for both inclusive growth and global competitiveness.

Any discussion of the Coconut sector will not be complete without considering the heavy yoke that weighs down on its socio-economic and political status. The coconut sector has a long history, starting from the Spanish and American rule, to the Marcos era of being subjected to iniquitous conditions. The current controversy on the use of the Coconut Levy Fund should be addressed in the light of the decrees and issuances during the Marcos rule that essentially drew wealth from the coconut farmer and transferred this to the control of private individuals.

The Coconut industry should diversify horizontally by effective intercropping and integrate vertically by improving upstream raw material production and downstream high-value products. However, at the center of these efforts of vertical integration and horizontal diversification is the coconut farmer. In addition, the copra-based industry should be phased out and replaced with technology that can effect the full value recovery of the coconut.

Achieving these measures will require coordination among several agencies of government, the private sector, the local communities, and the farmers. A number of coconut federations and industry groups have proposed that the Coco Levy Funds be used for the revitalization of the Coconut sector.

The shift away from copra towards integrated processing will enable full processing of the coconut and higher quality of product. However, this will require larger investments in processing centers which should be strategically located for cheaper transport of coconuts from the farm, as well as transport to downstream factories. The costs of transport and logistics have to be considered.

The Coconut Industry can be grouped into three major sub-sectors: cocochemicals, biofuels and food. Each sub-sector has its own needs and dynamics. Although the cocochemicals sub-sector shares some overlaps with the Biofuels sector, the external conditions which drive demand for cocochemicals and coconut biofuels are different. In particular, the demand for biofuels is driven by the Biofuels Act of 2006 which mandates the use of coconut methyl esters (CME).

The basic steps in the production process of cocochemicals include splitting (hydrolysis) of the coconut oil to yield the fatty acids and crude glycerine. The value-adding processes for fatty acids and methyl esters should be promoted to raise earnings from the coconut. (see Table 1)

Table 1. Value-adding processes for fatty acids and methyl esters and examples of chemical products.

| PROCESS | PRODUCT OR APPLICATION |
|---------------------------|---|
| Fractionation | Partial separation into fatty acids or fatty methyl esters; C8 and C10 for MCT oil. |
| Distillation | Pure fatty acids or fatty methyl esters |
| Amidation | <ul style="list-style-type: none"> • Amides for use as non-ionic surfactant • Cocoamidopropyl betaine: special surfactant used for its foam property and solubility. |
| Hydrogenation | Fatty alcohols: chemical intermediates |
| Ethoxylation | Non-ionic surfactants, wetting agents, emulsifier, foam boosters, humectants |
| Sulfonation | Coconut fatty alcohol sulfate: biodegradable detergent |
| Saponification | Soaps |
| Amination | Cationic surfactants: shampoos, specialty soaps |
| Esterification | <ul style="list-style-type: none"> • Reaction with glycerol: medium chain triglycerides (MCT oil) for medical and nutritional use; monolaurin • Reaction with various alcohols: plasticizers |
| Quaternization | <ul style="list-style-type: none"> • Dispersants, corrosion inhibitors, cationic surfactants • Ester quats are a family of cationic compounds used in fabric softeners and hair conditioners. |
| Amidation and Sulfonation | Sodium methyl cocoyl taurate: an anionic surfactant used in specialty foaming face cleansing formulations. |

Source: (Patiño, 2013; Lao, 2013).

One of the major byproducts from the splitting of coconut oil is glycerine which accounts for about 10 percent of the weight of coconut oil. New uses of glycerine must be developed.

The challenge now is how the Philippines can revive its cocochemical industry and make it globally competitive, and at the same time use it as a vehicle for inclusive growth. The strategy for the Philippine coconut industry must be comprehensive and must consider measures at various levels: the coconut farmer, the local level, the oil mills and processors, the cocochemical industry, government intervention and support, and S&T initiatives.

The Coconut Industry is probably the best opportunity for the current administration of President Benigno Aquino to attain inclusive growth that is sustained, that will massively create jobs and reduce poverty, and is globally competitive. No other administration has achieved these.

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AN INTEGRATIVE APPROACH FOR DEVELOPING OUR FLEXIBLE AND SUSTAINABLE MANUFACTURING INDUSTRY

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In many countries, manufacturing is seen to play a critical role in the economy. For example, statistics from the World Bank show that in China, value-adding manufacturing industry contributed an average of 31.67 percent of the GDP for the years 2008 to 2010. For the same time period, the average contribution of manufacturing industry to Malaysia's GDP was 24.67 percent. For Vietnam, where manufacturing GDP was seen to have striking growth specifically within the period 1994-2004; the average contribution of manufacturing to the GDP for the years 2008 to 2010 was 20 percent. Furthermore, for the Philippines, where in recent months analysts have said Japanese manufacturers are predicted to move to because of high-quality labor with lower cost and more stable growth compared to China or Vietnam (Olchondra, R. 2012), the average contribution of manufacturing to the GDP for years 2008 to 2010 was 21.67 percent. Just early in June 2013, it was reported that the growth of 7.8 percent GDP of the Philippines for the first quarter of 2013 was due largely to the growth of industry of 10.9 percent (Batungbakal, B. 2013). According to the National Statistical Coordination Board, manufacturing grew by 9.7 percent in the first quarter of 2013, an improvement to the 6 percent growth of the same quarter in 2012.

The figures above show the importance of manufacturing from the standpoint of economics, specifically as a contributor to the GDP. From the social science, science and engineering perspectives, various literatures have pointed out that the positive effect of manufacturing goes beyond the output and the employment that it creates. In addition to these direct results of manufacturing, there is an indirect impact specifically in terms of supporting the jobs in the other sectors (Ettlenger, M. and Gordon, K. 2011). As economists Stephen Cohen and John Zysman (1988) stated, the manufacturing sector does not just include the group of employees who work on

the factory floor. Instead, the manufacturing sector has “direct linkages” to high-level service jobs throughout the economy: product and process engineering, design, operations and maintenance, transportation, testing, and lab work, as well as, sector-specific payroll, accounting, and legal work. The importance of the manufacturing sector is, moreover, reflected in the finding of the Philippine Institute for Development Studies, that in the Philippines for 2009, the ratio of the productivity (i.e., real value added per worker) of the manufacturing sector was 2.5 times that of the service sector (Yap, J. 2012).

With the foregoing discussion on the importance of manufacturing from many perspectives, all with the aim of developing manufacturing for national progress and economic prosperity, the next question pertinent to explore is, “what will it take for a country to have a competitive and sustainable manufacturing industry?”

The main proposition of this research is to look at the manufacturing industry as analogue of managing its smaller counterparts of manufacturing organizations. Specifically, this research proposes:

1. To manage our country’s manufacturing industry as a large chain of institutions and organizations that have the aim of providing products or component goods to the local and global market;
2. To structure the internal chain within the manufacturing industry such that the industry will possess the characteristic of flexibility to arrive at different products that will be demanded by the market at any time; and
3. To highlight that the manufacturing industry should be “self-supporting” which can be done if the profits or rewards of manufacturing at the different points of the supply chain can be re-invested for generating scientific and practical knowledge that will be the seed resource, i.e., raw material, for future manufacturing.

The composition of the institutions and organizations this research proposes is critical. This research primarily refers to the chain of institutions and organizations that will develop strategic capability of the manufacturing industry: the human resource (Pralhad, C. K.1983).

Managing the Manufacturing Industry as a Large Chain of Institutions

To manage this large chain, an analogue can be made with the Supply Chain Management (Houlihan, J. B. 1983) of business organizations. Just like the management of the supply chain of business organization, the manufacturing industry supply chain must have the following characteristics:

- A total supply chain: “In business, from purchased material to delivery to customer is treated as a single entity.” The supply chain of the human resource from primary school to the secondary school to tertiary school then public and/or private training centers must be treated as a single entity. To have a competitive manufacturing industry, each point of this supply chain must work towards the common goal of producing human resource for the manufacturing industry. Each sub-entity, e.g., primary school, must add value to the human resource by making the human resource “ready” for the next sub-entity. All must contribute so that ultimately, the end product of the chain, i.e., after secondary education at least, the human resource is ready for the manufacturing industry. Furthermore, for each sub-entity to sufficiently contribute, it must be able to provide a “critical mass” of human resource that will be ready for the next sub-entity to process. This can be likened to the “critical level of inventory” to sustain production systems.
- The approach to direct and indirect logistics functions is to integrate them horizontally along the supply chain. The knowledge, i.e., both explicit and implicit (Shibazaki, Hiroshi and Steven H. Kim. 1989), to be learned at a sub-entity should build on the knowledge imparted by the previous sub-entity.
- Integrate vertically the three principal levels of management of logistics functions – the strategic, planning and operational levels. Long-term plans of the manufacturing industry must be established. Medium term plans and short-term activities must be in accordance with the longer-term plans.

The aforementioned common characteristics of good supply chain management are said to provide a good framework for balancing conflicting functional objectives in manufacturing supply chains, more so if information sharing is high among the sub-entities of the supply chain.

However, the analogy between managing the supply chain of the whole manufacturing industry with the supply chain of a single business entity is not simple. One may ask, “Which of our country’s products’ supply chains should we focus on?” This question actually goes back to “which products should we manufacture at this time?”, for which proposals such as setting target products, e.g., nearby products (Usui, N. 2012), have been provided by other researchers.

Structuring the Chain to Possess Flexibility to Arrive at Different Products Demanded by the Global Market

The objective of this research is to provide a proposal for a sustainable manufacturing industry. Given the fast-changing local and global market, forecasting the kind of products that will be in demand in the future is a big challenge. Thus, instead of forecasting the products and producing those that will be predicted to have high demand, the proposal of this research is to develop a critical mass of human resource that will be deeply knowledgeable and skilled in basic manufacturing processes, including basic machine operation and machine maintenance, as well as the efficient use of energy that power the machines. This research recognizes that machines are resources that improve productivity in the manufacturing industry since the Industrial Revolution (Carlsson, B. 1984).

Basic or common industrial trade knowledge and skills must be developed early in education, i.e., primary, secondary, up to tertiary, and product-specific knowledge and skills must be given after that. This is analogous to the supply chain concept of postponement. In manufacturing management, the concept of postponement can reduce marketing cost, risk and uncertainty costs that are tied to the differentiation of goods. Differentiation can be postponed to the latest possible time, nearer to the time of purchase by the market. In the foregoing discussion of the supply chain for the manufacturing industry, perhaps if the human resource will be developed progressively from primary school, secondary school and the tertiary level education, to have the basic knowledge and skills pertaining to common manufacturing processes, common machine operation and maintenance (note: it will be ideal if knowledge and skills on how to make the machine will also be learned), then later the specific private or government organizations that will employ them can build on this deep but common knowledge and provide them the differentiated knowledge and skills specific to the products to be manufactured by the organization. Products can rapidly change and the dynamic nature of the market that we anticipate to characterize the future will pose a great challenge. However, the deep knowledge of the common manufacturing processes will provide flexibility to sufficiently deal with this challenge of dynamic market.

The Manufacturing Industry as Self-Supporting

The third proposal of this research is to provide mechanisms by which the industry can be self-supporting. This proposition is based on the

general business principle of reinvestment for growth. The manufacturing industry should plan for and pursue activities that do not just have making profit as objective but of reinvesting part of the profit or rewards of the industry to make the industry grow. Specifically, activities that can lead to reinvestments in making human resource knowledge and skills grow for the continued development of the manufacturing industry must be pursued. Plans should be iterative, i.e., beginning with the investment in primary education and ending in the growth of the industry per iteration. The growth of the industry, after each iteration, must feed again to a reinvestment in the primary education again with that iteration's objective of contributing to the growth of the industry. This will ensure that the growth of the industry will benefit not only the current human resource generation but also the future generations.

The aforementioned three points are the proposals of this research that advocates for an integrative approach for developing our flexible and sustainable manufacturing industry. Some case studies of countries that have the characteristics reflective of the proposals, can be cited to have manufacturing industries to have successfully contributed to their national development.

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HOW DO YOU ANALYZE THE MARKET FOR IMMEDIATE NEW PRODUCT SUCCESS?

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This paper presents survey research data and specific cases supporting the proposition that the ultimate source of immediate new product success is a function of two successive steps.

The first is the identification of unserved and underserved market segments. An unserved market segment consists of consumers who have not purchased, tried or used the product category where the new product belongs. On the other hand, the consumers making up an underserved market segment have purchased, tried or used the product category where the new product belongs but are inadequately satisfied with the experience. The paper then differentiates a new product into 3 types: a “breakthrough” product (one that is totally new to the market and the industry), a second generation product (one that is new to the industry but not the market), and a redeveloped product (one that is an improved existing product). The supporting data for this first step will come from my 3rd quarter, 2012 nationwide survey on “consumer coping behavior.”

The second step follows the first and directs its analysis to uncovering the unserved need or needs of the identified unserved market segment whose satisfaction will propel the new product to an immediate market success. If the concern is with an identified underserved segment, then the analysis is to uncover the underserved need or needs whose satisfaction will lead to the new product’s immediate success. Specific cases from my market research consulting experience will provide the necessary support for this step.

The paper ends with a set of specific prescriptions answering the question in the paper’s title.

ARE OUR WORKPLACES SAFE AND HEALTHY?

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Safety and Health of the Filipino workers has been a paramount policy of the Department of Labor and Employment. Upholding labor laws and occupational safety and health standards (OSHS) are non-negotiable instruments to ensure that workers rights and their welfare shall never be compromised by their work.

This paper reports on the current safety and health practices in establishments based on the results of the 2007/2010 BLES Integrated Survey (BITS). The BITS is conducted every two (2) years by the Bureau of Labor and Employment Statistics (BLES) in coordination with the DOLE Regional Offices. It aims to generate integrated data sets on employment of specific group of workers, occupational shortages and surpluses, safety and health practices, occupational injuries and diseases and labor cost of employees. It covers non-agricultural sample establishments employing 20 or more workers nationwide.

This presentation provides the latest statistics on accidents and illness in the major industrial sectors of the country. This also includes data on a key employment generator which employs more than 500,000 workers at present, the BPOs or Business Process Outsourcing establishments.

It may be worthwhile mentioning that injuries and accidents decreased in the latest 2010 BITS survey. Occupational accidents in 2009 reached 36,455, lower by 18.6% than the 44,800 accidents in 2007. Similarly, occupational injuries that resulted from these workplace accidents declined by 15.0%, from 46,570 to 39,587. The highest share in occupational injuries in 2009 was observed in manufacturing industry (59.5% or 23,548), lower than the 66.1% or 30,790 recorded in 2007.

In the documentation of occupational diseases of the 2009/2010 BITS, *occupational disease* is defined as an abnormal condition or disorder other than one resulting from an occupational injury caused by exposure over a period of time to risk factors associated with work activity such as contact with certain chemicals, inhaling coal dust, carrying out repetitive

movements, etc. In 2009, a total of 71,894 cases of occupational diseases were reported in non-agricultural establishments employing 20 or more workers. Manufacturing industry accounted for the biggest share of occupational diseases at 47.4%. Far second was real estate, renting and business activities which posted 9.9% of the total cases of occupational diseases.

The data from the business process outsourcing in the Philippines covered a total of 481 establishments with 20 or more workers as of June 30, 2010 – the bulk were engaged in computer-related activities (267) and call-center activities (180). There were 157 cases of occupational injuries reported in the business process outsourcing (BPO) industry in 2009. Dislocations, sprains and strains accounted for almost two-thirds (69.4%) of cases of occupational injuries in the BPO industry. Peptic ulcer was the most common case of occupational disease among workers in this industry wherein one out of every four workers (24.8%) suffered from this disease. Essential hypertension came second at 18.6% of the total cases.

Statistics will continue to guide policy-makers and the government in looking at effectiveness of programs or, if deficient, creation of policies to address the need for additional safety and health measures. The data generated from this survey provides a useful guide in strengthening government's efforts towards the achievement of OSH objectives.

**EXECUTIVE SUMMARIES OF
TECHNICAL PAPERS**

STATUS OF THE CROCODILE (*Crocodylus porosus*, Schneider) INDUSTRY IN THE PHILIPPINES

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All 23 species of crocodiles in the world inhabit a restricted range of wetland habitat in rivers, lakes, marshes, mangrove swamps, and estuaries in tropical and subtropical regions of the world. Crocodilians are considered “keystone species” as they play an important ecological role in aquatic environments; they are involved in nutrient cycling and, because of their large biomass, they produce large amounts of nutrients which have been hypothesized to result in increased fishery production in wetland ecosystems. Loss of any crocodilian species in an area is expected to cause a significant loss of biodiversity and ecosystem stability that translates to economic loss.

In the Philippines, there are two species of crocodiles known to exist: the Indo-Pacific Crocodile or Estuarine Crocodile (*Crocodylus porosus*) and the endemic Philippine Crocodile (*Crocodylus mindorensis*). These species used to be widespread throughout the country but are now restricted in distribution mainly because of agricultural activities. Both species are included in the list of threatened species of the International Union for the Conservation of Nature (IUCN) and both are categorized as Appendix 1 of the Conservation on International Trade of Endangered Species of Wild Fauna and Flora (CITES) based on their present conservation status. The IUCN and the CITES ensure that utilization and international trade of crocodilian species do not threaten their survival in the future.

Legal Framework

The crocodile farming industry in the Philippines is strictly regulated by CITES for the use of *Crocodylus porosus* in closed-cycle breeding upon production of second or F2 generation, making commercial international trade of their product less regulated. With the establishment of the Department of Environment and Natural Resources (DENR) RP-Japan Crocodile Farming Institute (CFI), Palawan in 1988 (renamed “Palawan

Wildlife Rescue and Conservation Center, PWRCC), a farming technology of crocodiles in the Philippines was developed. This technology has been transferred to Philippine private entities which passed through a stringent screening process.

Thus, in 1999, the DENR issued the Department Administrative Order (DAO) 99-45 or the Rules and Regulation on the SALE AND FARMING OF SALTWATER CROCODILE. This legal framework defined the stringent selection process for choosing competent private poultry and piggery farms that would utilize their original *Crocodylus porosus* founder stock from the Philippine government CITES registered facility for the leather industry and direct trade for animals produced in commercial farms.

Inception of crocodile farming

In 2000, six (6) commercial farms out of nearly 80 applicants successfully passed the evaluation process conducted by the Philippine government. These six farms pioneered this non-traditional industry and participated in commercial crocodile farming to develop local capability on Saltwater Crocodile farming. This was the birth of the crocodile industry in the Philippines. There were three farms in Luzon and three farms in Mindanao.

Crocodile farmers or “Cooperators” (DAO 99-45), obtained young crocodiles from the government for grow-out until commercially available size. After 2-3 years of try out rearing, the skin quality was judged substandard by the international industry due to inappropriate rearing facility for producing quality, Class “A” skins. The “Cooperators” had no choice but to retain the stocks and convert to close system breeding in order to utilize rapidly maturing crocodiles. They became “accidental” crocodile breeding farms.

Industry development and economic contribution

In order to strengthen ties between crocodile breeding farms, the *Crocodylus Porosus* Philippines Inc. (CPPI), a coalition of the six (6) legitimate crocodile farms, was created. In coordination with the Philippine Government, CPPI pioneered the crocodile skin industry in the Philippines. CPPI likewise aims for conservation through sustainable use and management or value-driven conservation of the two crocodile species in the Philippines. Commercial farms were developed by integrating large scale supply of culled layer, grower chickens and unwanted mortalities

from piggeries and poultry operations as crocodile feeds, converting operational loss into cash commodity and ensuring non-competition with humans for food consumption.

After eight years of high capital expenditures on infrastructure development and painstaking husbandry consultation to resolve farm issues and some capital errors, CPPI farms have obtained the most current and “State of the Art” technology. CPPI has significantly advanced the local crocodile farming industry to the extent of bringing in new technology and research outcomes on farm designs, innovations on husbandry practices, provisions of slaughterhouses, CITES recognition, introduction of meat products, and the near perfection of leather industry, bringing it closer to the achievement of international standards for crocodile farming and conservation.

To date, CPPI associated farms have approximately 25,000 crocodiles housed in a variety of facilities depending on their needs. Crocodile breeding cycle consists of four stages: breeding, incubation and hatching, nursery, and two phases of grow-out for skin production.

Commercial utilization of *Crocodylus porosus* for the production of valuable skins is the primary product of the industry. Of secondary importance is the introduction of crocodile meat as protein source for humans. Philippines crocodile farms started its contribution to the world crocodilian trade in 2008. With this small developing industry of six registered farms, two of which have processing facilities, there were about 4,000 *C. porosus* skins that have been exported from 2008-2012 for the leather industry. At present, frozen and processed meat products are slowly contributing to the local economy, an average of almost a ton of meat per month, equivalent to 45 percent of annual meat productions are consumed for domestic use. Other by-products (such as crocodile oil and blood) are being developed for pharmaceutical purposes. It is projected that a total of 10,000 *C. porosus* salted raw skins will be exported by CPPI associated farms in the next five years.

Support for conservation

Crocodile Farming Industry in the Philippines is not mainly geared towards generating income for individual farms. CPPI is also working towards the conservation of two species of crocodile in the wild, focusing primarily in three priority sites in Mindanao: (1) Siargao Island Protected Landscape and Seascape in which 36 *juvenile Crocodylus mindorensis*

have been released back to natural habitat; (2) Agusan Marsh Wildlife Sanctuary where it aims to provide a long-term management plan that will address issues on human-crocodile coexistence; and (3) Ligawasan Marsh Game Refuge & Wildlife Sanctuary where it targets further research and the development of a conservation action plan to uphold the possible increase in the population of both species. With these efforts, CPPI recognizes that the commercial crocodile industry in the Philippines has a responsibility to the Filipino people and its future generations to help conserve these two species of crocodiles in their natural habitat.

Finally, it is recommended that the government support CPPI's attempt to access more competitive technology for skin production, increase social acceptability of crocodile meat as alternative protein source, support for the development of by-products for therapeutic use, provide the legal framework and necessary documentation for the sale of products. An increase in government support for conservation research would provide direct benefits to the Filipino people through community-based ecotourism as source of livelihoods for local communities. The increase in the wild population of crocodiles would also increase the productivity of wetlands, thus benefiting those fishing villages with crocodiles in the wild.

This highly regulated industry can be a model for commercial and conservation partnership.

STRATEGIC SOURCING OPTIONS TOWARDS ENSURING RAW MATERIAL SUPPLY FOR THE PHILIPPINE FOOD MANUFACTURING SECTOR

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Food manufacturing is the biggest component of the Philippine manufacturing sector accounting for 8 percent of the GDP and 45 percent of the total manufacturing sector's share. Although growing at an increasing rate of 12.2 percent as compared to the 9.7 percent growth of the total manufacturing in the first quarter of 2013, the food manufacturing sector is challenged with several issues relating to food safety standards, quality control, costs and more importantly raw material sourcing.

Raw Materials in the Food Manufacturing Sector

Raw materials are essential or integral components of industrial production. This is an important component of any growth strategy of a company (Tajani, 2012).

Unstable agricultural production, coupled with volatile prices of raw materials have potential detrimental effects on the operations of Philippine food manufacturing companies as they will not be able to produce finished products and meet customer demands in a timely manner.

The Philippine food manufacturing sector is beset with issues related to raw material sourcing. On the production side, the agricultural raw material base is underdeveloped which leads food manufacturing companies to rely on raw material importation (Palabyab, 2013). It is because of this low agricultural base that raw material sourcing is considered as the Achilles heel of the Philippine manufacturing sector (Dy, 2013).

There is an increasing pressure on the Philippine food manufacturing sector to secure good quality raw material supply due to tightening competition and increasing costs of sourcing. In addition to these, the drive towards environment protection and health push manufacturing companies to use ecologically safe raw materials and supplies and to strengthen ties with raw material suppliers for better raw material quality control.

Raw Material Sourcing Practices of the Food Manufacturing Sector

Contract farming has been one of the successful models adopted by the food processing industry. This is practised in the different sectors of food manufacturing such as meat, vegetables, and fruits. Contract buying or contract marketing is also one of the ways by which raw materials are sourced and is adopted by food manufacturers and fresh food exporters. Also, a common strategy to ensure raw materials by food manufacturing companies is contracting preferred suppliers and agents from different parts of the country (local multiple sourcing). There are also companies that have their own farms (intra-sourcing) to supply their raw material needs. However, many food processing enterprises are relying heavily on the importation not only of their major raw materials but also key ingredients and condiments in food processing. In any of the above cases, the food industry's sourcing depends to a great extent on the specification of raw materials required by their end customers.

Raw Material Sourcing Issues in the Philippines

The Philippine food manufacturing sector is beset with issues related to raw material sourcing. The weakness of the production sector as indicated by its lack of capability to produce the volume, price, time and quality requirements downstream prompts the food manufacturing industry to fill up the gap through importation of raw materials.

Trade or importation of raw materials is inevitable especially in cases when the processed products are for export. Importing countries are very strict in terms of what goes into the manufacturing process. The food manufacturing sector requires manufacturing grades of raw materials while many of the farmers produce table grades of agricultural produce.

Basic trade theory suggests that importation of goods, both intermediate and final, is mainly driven by their lower price relative to locally produced equivalent. This is evident in the case of the Philippine food manufacturing industry which significantly contributes to its continued dependence on imported raw materials. The lack of competitiveness of local raw materials, depicted by the higher price, can be explained by the low agricultural productivity and high production costs, inadequate and outdated post-harvest and storage facilities, lack of basic infrastructures, long and multi-layered logistics chain, and the failure to capture economies of scale especially by small-scale farms. However, equally important are other factors that force local food manufacturers to source out from other countries

such as (1) unavailability of local raw materials (wheat and some varieties of fruits, nuts and vegetables), (2) limited local production capacity to supply the necessary volume to manufacturing firms (milk, pork, beef, coffee and processed potatoes), and (3) inability of local suppliers to comply with particular specifications and needs of processing firms (tomato paste and sugar derivatives). Also, MNCs typically acquire food ingredients from established local and foreign partners to maintain control over price and quality.

Strategic Options and Directions

Strategic sourcing of raw materials should be embedded in the companies' overall strategy and should not only be considered as part of everyday operations.

The current sourcing strategies such as contract growing and contract buying are still viable for food manufacturing companies and although there are associated problems, these strategies are more likely to be practiced in the long-run.

The trend is towards sustainable sourcing which may also be considered as an important part of the corporate social responsibility (CSR) of food manufacturing organizations. For a long-time, CSR programs of food manufacturing companies focused mostly on the customers and not on the suppliers or producers of raw materials. There is an opportunity to include farmers or producers in their CSR activities as sustainable farm production would also translate to sustainable raw material supply and subsequent long-term profitability of the food industry while at the same time heeding the call for environmental consciousness. This move will also result in the inclusion of farmers in the overall growth of the economy as they take more active roles in the global food supply chain. Fair trade insourcing has been adopted by some foreign companies. A number of companies operating in the Philippines have already adopted this strategy by having farmers or producers as partners in their food manufacturing operation and buying from them as fair trade producers.

The challenges in the country's food manufacturing industry seem to point on the need for greater investments in the agriculture sector. Factors that drive up the price of local raw materials show lack of investments in increasing productivity and traceability, enhancing farm diversification and improving agricultural facilities and infrastructure necessary to cater for the specific needs of the different food manufacturing sectors. Development

in this area would also generate the capacity to attain the quality and volume that the food manufacturing industry requires to reduce dependence on imported raw materials. Ensuring the availability of raw material supplies can partly shield domestic food manufacturers from uncertainty of foreign exchange fluctuations and global market shocks.

Government Imperatives

More research and development efforts towards increased production and quality produce as a way of strengthening the agricultural production base should be implemented by concerned government institutions. The food manufacturing sector requires not only regular supply of specified volume of raw materials but also those that meet their quality and time specifications. More technologies in producing higher quality farm produce should be given attention.

The government should also hasten and enhance GAP certification efforts to produce quality products and meet food safety requirements. The country has been lagging behind its neighbors in GAP certification. Thailand, Malaysia and Vietnam have certified thousands of their farms while the number of farms certified in the Philippines has not even reached 20. While many of the food manufacturing companies have already been GMP certified, efforts have to be intensified in GAP certification to support GMPs in food manufacturing. A prerequisite in reversing the decline in the food manufacturing sector is to ensure growth in the production sector to increase the agriculture base.

Finally, all these efforts must be integrated in a master plan amidst a global supply chain framework. Beyond the government's drive towards looking at and addressing commodity-specific problems relative to raw material supply in a fragmented manner or merely focusing on a few crops, strides must be made in terms of rationalizing the country's farm resources to meet the demands of the downstream players in the food manufacturing industry. The government should recognize and address raw material supply issues in the context of supply chain network problems and not just as problems of one supply chain sector.

LANTHANIDE-BASED DIAGNOSTIC MEDICAL CONTRAST AGENT DEVELOPMENT

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The early diagnosis of disease is important for effective therapy. Lanthanide-based medical contrast agents have found widespread application in both in vivo diagnostic imaging and in-vitro biochemical assays. For instance, several Gd³⁺-based complexes, proven to be stable and non-toxic in vivo, have received FDA approval and are routinely used in the clinic for Magnetic Resonance Imaging (MRI) of the blood pool in order to detect vascular occlusion and other physiological phenomena associated with vascular disease. The strong, unparalleled paramagnetic character of the Gd³⁺ ion makes it ideal for the generation of MRI images with enhanced contrast, permitting the visualization of circulatory vasculature up to millimetre resolution. On the other hand, lanthanides such as Eu³⁺, Tb³⁺ and Yb³⁺ have been found to exhibit strong photon emission lines of red, green and near infrared, respectively, which are long-lived, ranging from micro- to millisecond lifetimes, in comparison with conventional organic fluorophores which exhibit broad emission lines with only nanosecond lifetimes. Hence, emissive lanthanide complexes are quickly gaining application in in-vitro assays for the detection of biochemical analytes associated with particular disease states, such as the over-expression of transmembrane receptors characteristic of particular cancers.

As a young faculty member of the UP Diliman Institute of Chemistry, I am currently establishing a laboratory whose primary activities are directed towards lanthanide-based contrast agent development. Current projects include:

1. The development and optimization of simple colorimetric assays for the detection of free lanthanide ions in solution. Lanthanide ions are small, hard cations which, when present in plasma, may substitute endogenous ions in their natural physiological roles, such as in signal transduction cascades or in structural roles (ex. bone). In lanthanide-based contrast agent development, simple colorimetric assays involving classical uv-vis

absorption spectroscopy are useful in monitoring the successful formation of stable complexes.

2. Ligand synthesis, structure elucidation, thermodynamic and kinetic stability studies. Macrocyclic ligands have been found to form more stable lanthanide complexes than acyclic ligands due to the rigidity of the resulting complex. We have synthesized a variety of macrocyclic ligands based on a cyclen backbone, elucidated their structures using 1-D and 2-D $^1\text{H}/^{13}\text{C}$ NMR techniques, used them to form complexes with different lanthanide ions, and employed the colorimetric assays described above to determine thermodynamic and kinetic complex stability under a variety of experimental conditions.

3. Synthesis of lanthanide-labelled neuroactive bacterial peptides as potential optical probes in neurophysiology. Recently, a family of bacterial peptides isolated as secondary metabolites from mollusc-associated symbiotic bacteria were found to inhibit the action of capsaicin on neuroreceptors implicated in the sensation of heat and pain. We have successfully undertaken the total synthesis of the most active of these peptides, and labelled it with lanthanides towards the development of a targeted molecule probe which will permit the direct optical visualization of the peptide-neuroreceptor binding event.

4. Synthesis of macromolecular MRI contrast agents with enhanced water solubility. Enhanced MRI contrast is achieved by increasing the molecular weight of the contrast agent, thereby increasing its rotational correlation time in plasma. To this effect, we are investigating the use of a polyamidoamine (PAMAM) dendrimer co-labeled with polyethylene glycol (PEG) as a platform for the synthesis of a multi-metallic Gd^{3+} -based MRI contrast agent which will potentially exhibit even further MR contrast enhancement, in addition to improved pharmacokinetic properties.

CARBON DIOXIDE CAPTURE: THERMOPHYSICAL PROPERTIES AND PROCESS DESIGN (The Taiwan Experience)

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In general, the paper talks about, carbon dioxide capture research and in particular, the involvement of thermophysical properties characterization and process design simulation as the major areas to explore in this research area. The presenter used his personal research experience in Taiwan in discussing the various components of his talk.

Initially, the reasons why carbon dioxide needs to be captured both as an economic and moral issue will be discussed. Here, the story of Ex-Vice President Al Gore of USA and the Intergovernmental Panel on Climate Change (IPCC) efforts on disseminating information on global warming, which also qualified them as winners of Nobel Peace Prize in 2007 will be highlighted. With the background being set, the discussion of greenhouse gas emissions will follow with emphasis on carbon dioxide concentrations and the observed effects on a global scale. At this point, the concentration values of carbon dioxide discharge per country and per person will be compared and the top ten will be specified. Also, the predicted specific effect of global warming to Taiwan will be discussed briefly. Then, the overall carbon dioxide emissions reduction plans from short term to long term plans with specific applications to Taiwan will be discussed. The comparison of feasible process for carbon dioxide reduction is followed by concluding which of the available technologies is most likely to be applied and appreciated in the next years to come. Here, the absorption process is still the most feasible process to employ. The next part of the discussion will talk about the details of the absorption process and how the two main parameters (key components) will affect the research area of carbon dioxide capture. The key components of the absorption process are (1) the selection of absorbent and (2) the design of the absorption process. In the assessment of the best possible solvent systems for carbon dioxide capture, the presenter will discuss the guiding principles and try to compare the existing solvent systems against the alternatives. For the absorption process design, the

rationale and the overall design framework will be discussed. The important properties needed for the absorption design will be mentioned along with the possible equipment for their measurements. The talk will also feature the research components of a thermodynamics research laboratory in relation to carbon dioxide capture research. Lastly, some sample research works on property characterization and correlation development will be shown.

STEM CELL THERAPY IN THE PHILIPPINES: A CHANGING LANDSCAPE

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The Department of Health recently released guidelines on Stem Cell and Cell-based Therapy known as the Administrative Order 2013-0012, Rules and Regulations Governing the Accreditation of Health Facilities Engaging in Human Stem Cell and Cell-based or Cellular Therapies in the Philippines. This was motivated by the massive proliferation of clinics or laboratories taking advantage of vulnerable uninitiated patients. If unabated, this unregulated procedure may harm people and impact on the development of stem cell technology. Basic queries that will guide a prospective stem cell patient will be presented. To date, there are four hospitals that are recognized by the Department of Health. These hospitals are Makati Medical Center, The Medical City, National Kidney and Transplant Institute and the Lung Center of the Philippines. This communication will focus on the current laboratory safety and monitoring practices done at the Cellular Therapeutics Laboratory of Makati Medical Center. The Cellular Therapeutics Laboratory is classified as ISO 14644-1 clean room ISO 5 class facility. The presentation will also feature laboratory standards such as autologous Cell Transplant release criteria and critical quality control tests. The future of Stem Cell Therapy will be profoundly influenced by the clinicians, scientists, regulatory offices, media and society who are in a position to distinguish the difference between science and fiction. Patients who are left with limited clinical options are often entangled; wading through the investigative and controversial scientific breakthroughs is a tight walk.

ERRATA

Although we endeavored to make the 2012 NAST Transactions, Volume 34, Issue No. 1 - ABSTRACTS of PAPERS Presented during the 34th NAST Annual Scientific Meeting with the theme “Philippine Water 2050”; 11-12 July 2012 as error free as possible, corrections/mistakes were still found. These were:

Page Correction

109 BS-71 - the corrected title is given below together with the original abstract:

**STRUCTURAL AND ULTRASTRUCTURAL
CHARACTERISTICS OF THE TESTES OF THE
INVASIVE SUCKERMOUTH SAILFIN CATFISH
Pterygoplichthys spp. Gill 1858
(SILURIFORMES:LORICARIIDAE) FROM THE
MARIKINA RIVER SYSTEM, PHILIPPINES**

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The structural and ultrastructural features of the testes of the highly invasive suckermouth sailfin catfish *Pterygoplichthys* spp. Gill 1858, rapidly proliferating in Marikina River, Philippines were characterized during the fish’s annual reproductive season. Transmission electron micrographs show that the germinal compartment of the testes was composed of anastomosing tubules with cysts undergoing synchronous development. Spermatogenic cells were along the length of the testes indicate it to be of the unrestricted spermatogonial type. The spermatozoon is classified as type 1 ect aquasperm devoid of acrosome, has rounded nucleus, and a long flagellum—characteristics necessary for external fertilization. Male *Pterygoplichthys* was reproductively active during half of the year-long study with peak spawning during the rainy months (June to August), and has overlapping regression and recrudescence during the cold months (December to January), and prolonged recrudescence during the dry months (February to May). This is the first study to describe in detail the testicular characteristics and the dynamics of the male reproductive seasonality of this invasive species.

Keywords: loricariidae; janitor fish; reproductive biology; Marikina River

Page Correction

148 HS-02 - the title and corrected text of the abstract should be:

**ASSESSMENT OF DISTAL GUT MICROBIAL DIVERSITY
AMONG FILIPINO CHILDREN OF DIFFERENT
NUTRITIONAL STATUS THROUGH THE rRNA GENE**

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and Evelyn Mae Tecson-Mendoza³**

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One of the millennium development goals (MDGs) is to reduce child mortality and this can be addressed by good health and nutrition programs. However, recent studies suggest that host genetics and gut microflora also affect nutritional status. Since malnutrition cannot be addressed solely by dietary interventions, it remains a perennial concern in our country and worldwide. To contribute in understanding the role of the gut microflora in malnutrition, this study determined the distal gut (colon) microbial diversity of nourished and malnourished Filipino children. The distal gut microbial profile of 2-11 year-old nourished and malnourished children was obtained through PCR and denaturing gradient gel electrophoresis (DGGE) of the ribosomal RNA gene (rDNA) of bacteria and archaea (16S rDNA) and eukarya (18S rDNA). The microbial profile was analyzed using Sorensen's index of similarity and the microbial community members separated by DGGE were identified through rDNA sequencing and phylogenetic analysis. There is high diversity in the microbial profile of nourished, moderately malnourished and severely malnourished children, which means that different microorganisms characterize different nutritional states. In terms of gut bacterial diversity, members of Phylum Bacteroidetes dominate, while Firmicutes phylotypes decrease, in the malnourished groups. In archaea and micro-eukaryae, there is greater diversity in the moderately malnourished group but this declines in the severely malnourished group due to the decrease in Euryarchaeota and Methanobacteria phylotypes, as well as micro-eukaryal enteropathogens, in severe malnutrition. These findings suggest potential microbial biomarkers that can characterize a nutritional state, as well as key players in terms of food metabolism and immune functions in different nutritional states. Moreover, these findings open up new directions in studying gut microbial community dynamics in different nutritional states.

Keywords: malnutrition, rDNA, DGGE, bacteria, archaea, micro-eukarya

This abstract was inadvertently omitted in the **2012 NAST Transactions, Volume 34, Issue No. 1 - ABSTRACTS of PAPERS Presented during the 34th Annual Scientific Meeting**

BS-73

dsRNA-MEDIATED RNA INTERFERENCE (RNAi) TO ELUCIDATE INTERACTION OF WHITE SPOT SYNDROME VIRUS (WSSV) WITH A WSSV HOMOLOG FOUND IN *Macrobrachium rosenbergii*

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The participation of White Spot Syndrome Virus (WSSV) in the high mortality rate of commercial shrimps had been extensively studied. WSSV contains a large circular double-stranded DNA (~300 kb) and encodes 181 open reading frames (ORFs); such ORFs are the subject of several studies conducted regarding the interaction of the virus to its host, usually crustaceans. However, the attempt to identify which genes in the shrimp's genome are directly involved in the interaction with WSSV infectivity is still unknown. This study focused on contig23 (c23), which was recognized to be a WSSV homolog. Utilizing dsRNA-mediated RNAi, the study examined if c23 is involved in the infectivity of WSSV in *Macrobrachium rosenbergii*. Three set-ups were prepared, two served as the controls and an experimental, each set-up consisted of twenty-two shrimps. Ten shrimps were used for the survival data while twelve shrimps were utilized for gene expression. Injection of synthesized dsRNAs (c23 and GFP), followed by WSSV challenge, showed delayed and reduced shrimp mortality in contrast with PBS-treated shrimp which showed high mortality. One hundred (100%) survival rate was observed in dsRNA-treated shrimps while PBS-treated shrimps showed only 20%. The difference between the set-ups: PBS vs. GFP-dsRNA and PBS vs. c23-dsRNA are statistically significant based on paired t-test, $p < 0.05$, except for GFP-dsRNA vs. c23-dsRNA which did not show significant difference. Three shrimps were collected on day 0, 1, 3 and 10 post-challenge for gene expression analysis using RT-PCR. Gene expression analysis showed silencing of both WSSV and c23 day 3 post-WSSV challenge. Therefore, this study showed that c23-dsRNA has a protective effect on WSSV challenged shrimps and highlights its involvement in the infectivity of WSSV in *M. rosenbergii*.

Keywords: RNAi, WSSV, homologs, dsRNA, shrimps

This abstract was inadvertently omitted in the **2012 NAST Transactions, Volume 34, Issue No. 1 - ABSTRACTS of PAPERS Presented during the 34th Annual Scientific Meeting**

BS-74

DETERMINATION OF THE GENOTOXIC EFFECTS OF *Jatropha curcas* Linn. SEED EXTRACTS USING THE STANDARD *Allium* TEST

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Tracts of land have been converted to *Jatropha* plantations in many parts of the country. The dwindling enthusiasm and apparent non-sustainability of the program created an oversupply of *Jatropha* biomass and wastage of investment. This study presents an evaluation of the biological activity of *Jatropha* seed extracts for possible alternative applications. *J. curcas* seed extracts were obtained using CO₂ supercritical fluid extraction (SFE) at 200 and 300 atm (atmosphere). Extracts were tested for cytotoxicity and genotoxicity at various concentrations using standard *Allium* Test, one of the methods of choice in drug screening. Mitotic Index (MI) and chromosomal aberrations were used as indicators of bioactivity. ANOVA and Scheffe Test were employed in data analysis. Significant reduction in MI was exhibited by the seed extracts obtained at two pressures, in a concentration-dependent fashion, indicating anti-mitotic activity. Chromosomal aberrations observed were concentration-dependent except in the 10⁻⁵M concentration where there was no significant difference compared to control. No significant differences were observed between the extracts obtained at 200 and at 300 atm showing that both have similar potency. Once the significantly reduced MI in the *Allium* Test is corroborated by animal model studies and other parallel bioassays, the specific active component can then be further characterized as candidate for drug development.

Keywords: *Jatropha curcas*, genotoxicity, anti-mitotic, *Allium* Test, SFE

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