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Science and Technology-Enhanced
Transformation for Sustainability
and Resiliency (2018-2030)

11-12 July 2018

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*Science and Technology-Enhanced Transformation
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AGRICULTURAL SCIENCES

AS – 01

**AGRO-MORPHOLOGICAL CHARACTERIZATION,
EVALUATION, AND CLUSTER ANALYSIS OF SOYBEAN
(*Glycine max* (L.) Merrill) ACCESSIONS GROWN
UNDER ORGANIC PRODUCTION SYSTEM
IN LA TRINIDAD, BENGUET**

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The study conducted a cluster analysis of 14 soybean accessions to characterize and evaluate their agro-morphological characteristics, determine which soybean accession is most suitable to the organic production system in La Trinidad, Benguet. The 14 soybean accessions varied in qualitative characters except for growth pattern, wing opening, pod dehiscence, pod beak shape, and keel color. All accessions have determinate growth habit, intermediate wing opening, shattering pods, short beak, and pink keel. They also differed significantly in the 36 quantitative characters measured, except for number of days from sowing to emergence. They emerged at 8 days after planting. Bakun was the earliest to flower, set pods, and fill pod. Accessions 2008-05-12A, Tiwala 6, 2008-05-58, and 2008-01-05 were identified as the top yielders that can be grown under organic production system in La Trinidad, Benguet. A cluster analysis was conducted on the 14 accessions based on the 36 quantitative characters. Results showed that there were five distinct clusters. The existence of clusters with three or more accessions indicated high variation among clusters of the accessions, and had high similarities of accessions within a cluster. Clusters with single character and those with two or more characters were distinct from one another. Each cluster of accessions with distinct characters could be used as parents for the development of new improved varieties of soybean.

Keywords: glycine max, characterization, evaluation, cluster analysis, organic agriculture production system

AS – 02

**ANALYSIS OF THE RELATIONSHIP
OF WEATHER VARIABLES ON THE POTENTIAL YIELD
OF *Cocos nucifera* L. IN ZAMBOANGA CITY**

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The study aimed to determine the effects of several weather variables on coconut production in Zamboanga City to further understand the relationship between weather and potential yield of coconut. A total of 30 palms from each of the five experimental blocks (CATD, BAYT, LAGT, RIT and TAGT) in PCA-ZRC were selected. Nut production data were collected from 2015 to 2016 while historical weather data were obtained from PAGASA. Pearson correlation coefficients between nut production data and weather variables during inflorescence opening (12 months earlier) and male and female flower development (24 MP to data collection) were generated using SAS version 9.4. The highest and lowest mean potential yield was observed from TAGT (approx. 149 nuts) and CATD (approx. 75 nuts), respectively. At $\alpha=5\%$, high Rf at 12 MP was strongly associated with high NY (0.9348), whereas NDD was moderately negatively correlated (-0.7618) in TAGT. Contrasting results were obtained for the same variables at 24 MP, with high Rf strongly associated with low NY (-0.9151) and NDD strongly associated with high NY (0.9811). In addition, Tmin at 24 months was negatively correlated with NY (-0.702). NDD and Tmax 24 MP were significantly correlated with NY (-0.7927 and -0.7646 , respectively) in BAYT. Rf and NDD 12 MP (0.8908 and -0.8881 , respectively) and 24 MP (-0.8228 and 0.8920, respectively) were significantly correlated with LAGT NY. Results of this study could serve as basis to further understand the relationship between weather variables and coconut yield. Also, adaptive farm management techniques could be developed with the knowledge on the behavior of yield responses during weather variability 12 and 24 MP to harvest.

Keywords: coconut, correlation, weather, yield

AS – 03

COMPARATIVE YIELD TRIAL OF POTATO PLANTING MATERIALS FROM AEROPONICS AND CONVENTIONAL POTATO SEED PRODUCTION

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Despite the importance of potato as a crop in the Philippines, its production is not high due to limited production area, variety for lowland cultivation, and availability of vigorous planting material. Crop failure in most production areas is due to weak or contaminated planting material. Aeroponics potato seed production is a promising solution to address the need for vigorous and sufficient planting material. To determine the effectiveness of aeroponics-derived planting materials, this study conducted pot and greenhouse experiments using different planting methods. Minitubers from three varieties, namely, Granola, Atlantic, and Astra were grown in pots, whereas different planting materials of Granola were grown in a greenhouse. Yield from each experiment were determined and then compared. The pot experiment using the three varieties of minitubers showed no differences in the number of potato tubers obtained. Similar result was obtained in the greenhouse experiment. Tuber yield difference was attributed to the differences in variety. However, the average weights of the tubers obtained from micro- and mini-tuber were the heaviest, with 20.41 g and 19.52 g, respectively. This was followed by cutting, with 17.67 g; and lastly, by conventional tuber with 12.96 g. With these results, it can be said that using aeroponics derived-planting materials in potato production produces more yield and have higher capacity to generate more tubers as planting materials than using conventional method.

Keywords: aeroponics, conventional, minitubers, microtubers, cuttings

AS – 04

**EFFECTS OF DIFFERENT SOIL MEDIA
ON THE ROOTING AND SURVIVAL
OF ANONANG (*Cordia dichotoma* Forst) CUTTINGS**

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Anonang (*Cordia dichotoma* Forst) stem cuttings were rooted in five different soil media to determine survival and rooting performances. Significant differences among four rooting media came out. Treatment 4 (1:1:1 mixture of top soil, fine sand, and partly decomposed rice hull) had the highest mean survival of 47.5%. This was significantly higher than T2 (partly decomposed rice hull), T1 (top soil), and T3 (1:1 mixture of fine river sand and top soil) with a mean survival of 25%, 10%, and 5%, respectively. The results of the number of adventitious roots formed during the rooting period showed that there were no significant differences among the media used for rooting. Although T4 obtained the highest number of roots with a mean of 2.5, this was not significantly higher than the rest of the media used for rooting. As regards rooting, Treatment 4 resulted in longest roots with a mean length of 15.92cm. This was significantly different those from T2, T1, and T2, which had a mean length of 5.46 cm, 4.43 cm, and 2.28 cm, respectively. Among the five rooting media used in propagating Anonang cuttings, T4 was found to be the best medium in rooting stem cuttings.

Keywords: Anonang, *Cordia dichotoma*, soil media

AS – 05

EVALUATION OF THE AGRONOMIC PERFORMANCE OF TRADITIONAL UPLAND RICE VARIETIES IN RAINFED LOWLAND AREAS OF BATAAC, ILOCOS NORTE

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Diverse traditional upland rice (TUR) is at risk of genetic erosion due to displacement by modern high-yielding varieties and government restrictions on slash-and-burn farming. Many traditional varieties possess favorable characteristics (e.g., good eating qualities, aroma, and pigment), which necessitate the conservation of their genepool. The Mariano Marcos State University conserved 146 accessions *ex situ*, characterized them morphologically, and evaluated them agronomically. The third and last batch of evaluation was conducted in two consecutive years in 2015 and 2016 wet seasons in rainfed lowland areas of Bataac, Ilocos Norte. It aimed to evaluate the agronomic performance and identify high-yielding varieties for cultivation in the rainfed lowlands. Seven accessions were selected based on their growth and yield performances. These include: TUR 123 (Duyduyan), TUR121 (Ginorot), TUR129 (Maliket), TUR116 (Balsamo), TUR111, TUR 134 and TUR 136 (Olandis), with yields ranging from 3.0 to 3.4 tha^{-1} . Selected accessions outyielded the check variety NSIC 146 and surpassed the documented farmers' yield (2.2 tha^{-1}) in the upland areas of Ilocos Norte. Aside from the genetic make-up of these accessions, weather conditions in each evaluation trial contributed to the differences in their growth and yield performance. They were tall, with medium tillering ability, medium panicles, medium to long maturing, and fertile spikelets.

Keywords: traditional upland rice, agronomic evaluation, conservation, rainfed lowland areas

AS – 06

GARLIC BULBILS AS ALTERNATIVE SOURCE OF CLEAN PLANTING MATERIAL IN GARLIC SEED PRODUCTION SYSTEM

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Garlic bulbils serve as an alternative source of clean planting materials in garlic production. Tissue culture technique was the common method used by many institutions, which has been successful. However, in 2014–2017, the Mariano Marcos State University identified and evaluated an alternative source of “clean” planting materials for garlic production. Experiments were conducted to evaluate the performance of bulbil under nursery and field conditions treated with different treatments for optimum growth and quality of garlic seed bulbs. Under nursery condition, G₀ garlic bulbils, spaced at either 3×3×5×5 cm, and 7×7 cm in plastic tray performed well and successfully produced G₁ single-cloved bulbs. A soil mixture of 2:1 ratio of carbonized rice hull (CRH) and organic fertilizer (OF), and 1:1:1 ratio of ordinary garden soil+ OF+CRH were the best media for growing G₀ bulbils and as the media produced multiple-cloved bulbs. G₁ bulbil-derived bulbs under field condition, when planted without fertilizer or with organic or inorganic fertilizers, produced yield of 6.70–7.05 tha⁻¹. Plant spacing of 10 cm x 10 cm and 10 cm x 15 cm gave the highest yield of 5.53 and 5.06 tha⁻¹, respectively. Bigger bulbs were produced as the distance of planting was wider; 91.19% extra large-sized bulbs were obtained from plants spaced at 15 cm x 15 cm. Yield of G₁ bulbil-derived bulbs planted under field condition produced 7.07 tha⁻¹. It was comparable with the yield obtained from G₁ tissue culture-derived bulbs as planting materials. G₂ bulbils are clean planting materials, which were able to provide 10–15 cloves per bulb. With these results, farmers can have alternative sources of planting materials.

Keywords: clean planting materials, G₀ bulbil, G₁ bulbil derived bulbs, planting spacing, alternative source

AS – 07

GIBBERELIC ACID APPLICATION TO INCREASE YIELD OF *Momordica charantia* Var. Bonito F₁

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Various studies have proven that the application of gibberellic acid (GA₃), a plant growth regulator (PGR), improves crop performance. Hence, a field experiment of trellised bittergourd was conducted from December 2016 to May 2017 in the City of Batac, Ilocos Norte, Philippines. The study was conducted to (1) determine the effect of GA₃ on flowering, (2) identify the best concentration that give high yield of the tested crop, and (3) determine the profitability of growing bitter gourd using GA₃. Concentrations of GA₃ (0 ppm, 10 ppm, 25 ppm, and 50ppm) were used and laid out in Randomized Complete Block Design with three replications. A plot size of 20 m² was used with 1.5 m distance between plots and blocks. One plant per hill was done with 1 m between rows and 0.75 m between hills distance. GA₃ was sprayed at 20, 40, and 60 days after transplanting. This PGR application significantly affected the number of staminate flowers, number of fruits per hill, and fruit yield. Treated bittergourd produced more number of staminate flowers than the untreated plants did. Those treated with GA₃ significantly produced more number of fruits/hill and fruit yield per hectare than those without. Higher concentrations of GA₃ concentrations (25ppm and 50 ppm) significantly produced higher yield than those with lower concentration (10 ppm) and untreated plants. Application of GA₃ is more profitable than no application.

Keywords: bitter gourd, plant growth regulator, 10 ppm, 25 ppm, 50 ppm

AS – 08

**GROWTH PERFORMANCE OF *Litsea philippinensis* Merr.
SEEDLINGS AS AFFECTED BY TWO ORGANIC
CONCOCTIONS**

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*The study aimed to evaluate the effects of Indigenous Microorganism, Oriental Herbal Nutrient, vermicast, and inorganic fertilizer to the growth performance of Bakan (*Litsea philippinensis* Merr.) seedlings. The study was conducted using Completely Randomized Design with six treatments, replicated three times. The variables evaluated include root collar diameter, seedling height, number of leaves, percent survival, and disease infections. Results showed that adding complete fertilizer and two organic concoctions significantly increased height, root collar diameter, and percent survival of Bakan seedlings as compared to the control. However, the effects on the number of leaves and disease infection (leaf spot and leaf blight) were statistically not significant. Moreover, the results showed that the two organic concoctions outperformed the inorganic fertilizer in terms of the height of the seedlings. It can be concluded that the two concoctions used could be good substitutes or alternatives to inorganic fertilizer, in which with continued use may incur much more adverse effect to the soil in terms of acidity, compaction, structure, among others. Conversely, using these concoctions may set a good example to indicate that organically based products can yield relatively comparable results as those with inorganic fertilizers.*

Keywords: *Litsea philippinensis*, organic concoctions, vermicast

AS – 09

**IDENTIFICATION AND PRIORITIZATION
OF CLIMATE-RESILIENT AGRICULTURE PRACTICES
AND ADAPTIVE CAPACITY INDICES OF LOCAL
GOVERNMENT UNITS IN ILOCOS SUR, PHILIPPINES**

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This study aimed to assess, target, and prioritize climate-resilient agriculture (CRA) practices and to determine the adaptive capacity indices of local government units (LGUs) in the province of Ilocos Sur, Philippines from August 2016 to July 2017. Data were gathered through survey. Primary data from households and experts were gathered using focus group discussions, key informant interviews, and questionnaires, while secondary data were gathered from reports/documents collected from the LGUs. The Cost-Benefit Analysis Tool developed by the International Center for Tropical Agriculture (www.cbatool.ciat.cgiar.org) was used to analyze the data using Net Present Value and Contingent Valuation Method; adaptive capacity indices were determined using the Capital Approach Method. Results of the study showed that flood and drought were the major hazards in the province that affect the residents' main commodities of rice, corn, tomato, and mango. Out of these commodities, three CRA practices were assessed: (1) improved variety of rice-tomato rotation combined with organic fertilizer, (2) improved variety of rice-corn rotation combined with organic fertilizer, and (3) integrated pest management for mango. All these CRA practices were privately and socially profitable. Vigan City had the highest adaptive capacity index, which could be attributed to its high values on human capital, physical capital, and natural capital. Santa Catalina had the lowest adaptive capacity index, which may due to to its low capitals. This study can provide baseline information that would help in the decision and policy making processes of the different LGUs and communities, particularly in identifying CRA practices and adaptive capacity indices as resiliency measures towards a climate resilient community.

Keywords: adaptive capacity, climate risk, prioritization, resiliency

AS – 10

IDENTIFYING SUITABLE SITES FOR SMALL-SCALE IRRIGATION PROJECTS (SSIP) IN REGION I THROUGH GIS-BASED WATER RESOURCES ASSESSMENT

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Developing small-scale water storage, diversion, and shallow well types of irrigation facilities may be able to address irrigation constraints in areas with small landholding such as in the Ilocos region. In addition, this will help to increase irrigated areas for rice and other crops and to make farmers more involved in its design, implementation, operation, and maintenance. This study aimed to develop a framework based on geographic information system (GIS-based) for use in determining suitable sites for small-scale irrigation projects (SSIP) and for developing a regional/provincial resource map for SSIP planning and development. GIS workflows in determining suitable sites for small farm reservoirs (SFR) and shallow tube wells (STW) were already developed. The factors considered, which were translated into thematic maps, in SFR suitability analysis were rainfall, soil texture, slope, land use, irrigation status, and proximity to water source. The factors used in the STW suitability mapping were the aquifer characteristics, such as static water level, storativity, specific capacity, and transmissivity. The resource maps showing the overall suitability of a certain SSIP were generated using GIS-based technology. The different factors were overlaid using a defined weighing factor for each of the individual factors. Resource maps were produced, which indicate the suitable areas for SFR and STW development for the different provinces in Region I. The existing and proposed SFR and STW locations served as validation points of the maps. The area per suitability rank (i.e., highly suitable, suitable, moderately suitable and not suitable) were likewise calculated. The GIS-based models served as a decision support framework to optimize and to identify the locations where SSIP can be implemented effectively and efficiently. Furthermore, the developed maps provide an efficient decision tool to promote optimal utilization of both physical and financial resources.

Keywords: small-scale irrigation project, water resources assessment

AS – 11

LAND CAPABILITY ASSESSMENT FOR CROP PRODUCTION IN THE QUIAOIT RIVER WATERSHED

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Land capability assessment for general crop production was done in the Quiaoit River Watershed (QRW) to determine the suitability of growing general crops within the watershed. Four factors were used in delineating the suitable areas. These include climate, soil properties, water availability, and topography. For soil properties, soil samples were gathered within the watershed to characterize the physical and chemical properties of the soils. Soil sampling sites were located using GPS. Moreover, point data on the soil physical and chemical properties were interpolated using the ArcGIS software to come up with surface maps of the different soil properties. Finally, different soil properties maps were combined to come up with a soil property suitability map. The water availability factor was based on the previous aquifer characterization made by Utrera et al. (2005). Slope was used as topography, and this was extracted from interferometric synthetic aperture radar digital elevation model. Lastly, the four factors were combined using equal weights to come up with a suitability map for general crop production. Results showed that majority of the areas within the watershed were moderately suitable for crop production. This was attributed to moderately to highly suitable soil property factor, marginally to highly suitable supplementary factor, unsuitable to highly suitable topographic factor, and highly suitable climatic factor. Land cover was also considered; forest class in the mountainous areas was classified as unsuitable for crop production.

Keywords: global positioning system, geographic information system, land capability assessment, crop production, watershed

AS – 12

**PERFORMANCE OF PODDING RADISH (*Raphanus caudatus*)
IN DIFFERENT PLANTING DATES AND RATES
OF ORGANIC FERTILIZER**

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Podding radish is an important indigenous food plant in Ilocos Norte. It can be utilized from vegetative to reproductive stage, has medicinal property for blood purification, and has an anti-cancer component. The dates of planting and fertilizer management influence the success of crop production. Hence, studies were conducted to (1) evaluate the growth and yield performance of two podding radish accessions, (2) determine the possibility of year-long production, and (3) determine the response to different rates of organic fertilizer application. Results showed that podding radish was best planted during the months of September, October, November, and December because they significantly exhibited superior plant and pod characteristics: 12–18 branches, 5.35–6.50 cm pod length, 0.62–0.72 cm pod diameter, and 4–5 seeds per pod. Also, planting during these months produced a yield of 2.38–9.32 tha^{-1} . Growing radish from January to August exhibited severe insect pest damage; however, there was no disease observed. A benefit-cost ratio of 36.81 was obtained with the application of 10–15 tha^{-1} of organic fertilizer, which implies a good return of investment. With this technology, farmers could be guided in planting their radish crop at best planting dates, as well as the proper rate of organic fertilizer to obtain good yield and profit.

Keywords: performance, planting dates, radish accessions, organic fertilizer, benefit-cost ratio

AS – 13

**PRE-GERMINATION TREATMENTS AND EARLY GROWTH
OF ANONANG (*Cordia dichotoma* Forst)
USING DIFFERENT SOIL ENHANCERS**

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Pre-germination treatments were applied to the seeds of Anonang (*Cordia dichotoma* Forst) to hasten germination. Treatments consisted of tap water, lukewarm water, hot water, and sodium chloride; each had a specific duration of soaking that are based on literature. The study was laid out in Completely Randomized Design, with five treatments and three replications. Significant differences between treatments were observed. However, soaking the seeds in tap water appeared to be the best treatment, resulting in 83.3% germination. Seedlings from tap water treatment were transplanted into five potting media, namely, garden soil (T1), (soil-cow manure combination) (T2), soil-coconut coir dust (T3), (soil-decomposed rice hay (T4), and (soil-carabao manure) (T5). Results revealed significant differences in seedling height, stem diameter, number of leaves, leaf area, shoot biomass, root biomass, and total plant biomass. Treatment 4 came out to be the most suitable soil enhancer for Anonang.

Keywords: Anonang, pre-germination treatments, soil enhancers

AS – 14

RESPONSE OF CORN TO BIOCHAR WITH HERBICIDE AND ORGANIC AND INORGANIC FERTILIZERS

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A 2×2×2 factorial pot experiment was conducted at Southern Luzon State University-Tiaong, Quezon, Philippines to determine the response of corn to biochar with herbicide and organic and inorganic fertilizer. Eight treatments replicated five times were arranged in completely randomized design. Biochar made from rice straw and organic fertilizer were applied at the rate of 15 t ha⁻¹. Glyphosate herbicide and inorganic fertilizers were applied following the recommendation from a corn production manual. Results showed that biochar and organic fertilizer increased the amount of organic carbon in the soil and its cation exchange capacity. Organic fertilizer also increased the amount of zinc in soil. Corn planted in soil amended with biochar had heavier plant biomass, biomass and length of roots, and longest corn ear. It would be better if the fertilizer used is organic with or without the application of herbicide. However, applying herbicide greatly impedes the increase in length and weight of corn roots. Such findings confirm the possible contribution of biochar in combination with organic fertilizer to corn production. It also contributes to the knowledge on the effect applying herbicide while using biochar and organic fertilizer. It is recommended to continuously evaluate the effect of applying biochar from different substrates, at different rates, with different organic fertilizers, and with herbicide affinity as affected by biochar and different fertilizers in corn production or in other crops.

Keywords: biochar, organic fertilizer, herbicide, corn

AS –15

RESPONSE OF KALINGA'S HEIRLOOM RICE CULTIVARS TO DIFFERENT LEVELS OF ORGANIC FERTILIZER

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The study was conducted under wetland culture in Tabuk City, Kalinga province using two-factor experiment laid in Randomized Complete Block Design. Three replications were made with the following treatments: (1) Factor A - Heirloom rice cultivars, specifically Chong-ak (a_1) and Ulikan Red (a_2); (2) Factor B - Organic fertilizer, namely, no fertilizer as control [b_1], 100% of the recommended rate of fertilizer (b_2), 75% of the recommended rate of fertilizer (b_3), 50% of the recommended rate of fertilizer (b_4), and 25% of the recommended rate of fertilizer (b_5). The study aimed to determine which of the different fertilizer treatments would give the best result in terms of agronomic characteristics and highest yield of Chong-ak and Ulikan Red cultivars. It also aimed to provide a benchmark data on the profitability of producing the two cultivars. Results revealed that different levels of organic fertilizer, as a single factor, did not significantly affect the yield of the two heirloom rice cultivars. A significant interaction effect between the two factors was obtained in terms of mean number of tillers, mean number of days to maturity, percent filled, and percent unfilled grains. Ulikan Red (a_2) obtained significantly the highest mean on the following parameters: number of days to flowering, height at maturity, number of tillers, days to maturity, and computed yield in tons per hectare. Using Ulikan Red (a_2) cultivar is recommended since it produced significantly higher yield than Chong-ak (a_1) cultivar. Also, applying 25% of the recommended rate of organic fertilizer is recommended as it increased the number of tillers, which is a major determinant of yield in rice.

Keywords: Heirloom rice cultivar, Chong-ak, Ulikan Red, level of organic fertilizer

AS – 16

SOIL APPLICATION OF BIOCHAR AS A RESILIENCY MEASURE IN SALTWATER INTRUSION-AFFECTED AGRICULTURAL AREAS

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Saltwater intrusions caused by sea level rise affect soil properties as it could develop saline or sodic behavior in soils. This type of soil condition adversely affects the growth of most crops and is susceptible to degradation. This study was conducted to assess the influence of biochar application on improving sodic soil properties and to examine its effects on plant growth. Series of pot experiments were conducted at the Agricultural Systems Institute-University of the Philippines Los Baños using corn (*Oryza sativa*) and water spinach (*Ipomoea aquatica*) as 1st crop and 2nd crop, respectively. Different types of biochars (i.e., mahogany tree [*Swietenia macrophylla*] flower receptacles, corn cobs, rice straws and rice hulls) were mixed with chemical and organic fertilizers as replicated treatments. Results showed that all treatments with added biochars produced higher corn biomass yield than treatments with fertilizers alone. Among these biochars, the rice hull biochar (RHB) + chemical fertilizer and RHB + organic fertilizer overyielded other treatments with 21.4% and 35.6% increase over chemical and organic fertilizers alone, respectively. Similar pattern was also observed on the 2nd cropping with 28.6% and 20.9% increase. Moreover, soil organic carbon was significantly higher in soils treated with biochars than with fertilizer alone, specifically the rice straw and water hyacinth biochars for both chemical and organic fertilizer mixes. Results such as these demonstrate the potential use of biochars in the preservation of vegetation and soil and water resources for an environmentally sustainable land use. Where control of salinity and sodicity is paramount, revegetation of high recharge areas and the paradigm shift on the use of biochars is of high priority.

Keywords: biochar, seawater intrusion, resiliency, sodic soils, soil health

AS – 17

SUITABILITY ASSESSMENT OF MAJOR LOWLAND SOILS IN ILOCOS REGION FOR SUSTAINABLE GARLIC PRODUCTION

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Garlic is considered as the white gold of Ilocos. Its productivity is driven by several factors such as day length, temperature, relative humidity, and topography. The area devoted to garlic production has been declining for the past 10 years due to climate variability. This study was conducted to assess major lowland soils in Ilocos Region to identify suitable areas for garlic production that can expand and sustain its production. Soil samples were gathered across the major lowland soils in Ilocos Region and were analyzed for their physical and chemical properties. Secondary data (e.g., climatic data, and water availability for irrigation) were gathered. Matching was done to determine the suitability rating of each land characteristics using the FAO-SYS framework. Variables were grouped into four factors and were assigned corresponding weights: climate (55%), soil properties (15%), water availability (15%), and topography (15%). Geographic information system tools were used to facilitate suitability analysis and mapping. Generally, climate in Ilocos Region is suitable for garlic production, but results revealed that Ilocos Norte has lower minimum temperature from December to February, with 20–21 °C compared to the other three provinces that favor the growth and development of the crop. Most soils in the region have low organic matter content, slightly acidic to acidic, is very deep, have good drainage, and have slopes from 1–8%. Suitability analysis indicated that about 10,000 ha are highly suitable; 133,202 are moderately suitable and 214,821 ha in the region are marginally suitable for garlic production. Ilocos Norte shares about 98% and 41 % of the highly and moderately suitable areas for garlic production due to its more fertile soils and favorable climatic condition. Hence, expansion area should be focused in Ilocos Norte for a sustainable garlic production.

Keywords: suitability assessment, garlic, climatic variability, geographic information system

AS – 18

USE OF BIOCHARS FROM BIOMASS WASTES IN ENHANCING SOIL RESILIENCY TO THE CHANGING CLIMATE

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This study examined the application of biochars to restore degraded sites that are often unproductive and prone to soil erosion due to the changing climate. Two consecutive pot experiments were conducted at the Agricultural Systems Institute-University of the Philippines Los Baños. Sweet corn (*Zea mays*) was used as the test crop grown in an acidic sandy loam soil (*Cumulic Hapludolls*) collected from a degraded upland area in Sariaya, Quezon. The biomass wastes charred to biochars were as follows: corn cobs, rice straws, rice hulls, and water hyacinth (*Eichhornia crassipes*). Results showed that fertilizers alone were outperformed by biochar-fertilizer combination treatments in corn dry matter yield production. The corn cob biochar combined with chemical fertilizer produced the highest dry matter yield, closely followed by water hyacinth biochar-fertilizer mix. When the biochars were mixed to organic fertilizers, the latter produced the highest biomass, followed by rice straw biochar-fertilizer mix. These findings may be due to the chemical and physisorption properties of biochars and the high heterogeneity of its micro- and nano-structures. Biochars are essential not only for modifying soil functions; they also affect various soil properties and microbial transformation of nutrient. Thus, its application may improve the productivity and fertility of degraded soils. Attempts have been made to present biochars as capable of improving the resilience capacity of soil toward sustainability of production without adversely affecting the environment.

Keywords: agricultural wastes, charcoal, soil resiliency, pyrolysis

AS – 19

**UTILIZATION OF COMMON SALT (NaCl)
AS COMPONENT OF FERTILIZER PROGRAM
FOR BR 25 and UF 18 CACAO (*Theobroma cacao* L.) CLONES**

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In some crops, common salt (NaCl) is used to replace a certain rate of KCl fertilizer primarily due to the economic advantage of the former. Hence, this study was conducted to evaluate the growth of two cacao cultivars in response to varying K₂O:NaCl rates and to determine the effects of varying K₂O:NaCl ratios on cacao growth. The experiment was arranged in a 26 factorial in Randomized Complete Block Design with three replications. Cacao cultivars (BR 25 and UF 18) served as Factor A, whereas Factor B was composed of varying K₂O:NaCl ratios (i.e., control, 100% K₂O+0% NaCl, 75% K₂O+25% NaCl, 50% K₂O+50% NaCl, 25% K₂O+75% NaCl, and 0% K₂O+100% NaCl). BR 25 performed better than UF 18 cacao clone in terms of shoots developed at 8MAT and 12MAT and in terms of leaves and branches formed at 12MAT. The varying K₂O:NaCl ratios failed to show significant effects on the growth of the two cacao clones. Moreover, no significant interaction effects were observed between cacao clone and K₂O:NaCl ratio in all the plant growth parameters gathered. D-leaf tissue analysis revealed no significant differences in N, P, K, Ca, Mg, and Na uptake of plants amongst cacao clone, K₂O:NaCl ratios, and their treatment combinations. However, in terms of Na⁺, UF 18 had higher uptake than the BR 25 cacao clone, although the results were not significant. In addition, there was an increasing Na⁺ concentration in cacao plant as higher rate of NaCl was applied in UF 18 cacao clone. The study revealed that cacao clones have had different responses to NaCl fertilization.

Keywords: common salt, NaCl fertilizer, BR 25, UF 18, cacao clones

AS – 20

ASSESSMENT OF THE GARLIC PRODUCTION IN LUZON, PHILIPPINES

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The Philippine garlic industry has been declining for several years now. This study was done to assess the current condition of the different garlic-producing areas in Luzon and to identify the possible reasons for decreasing volume of production and area planted with garlic. The respondents for the study were garlic farmers from 17 municipalities/cities of Regions 1, 2, 3, and 4A. Results showed that extreme weather conditions, pest and diseases, and the market for locally produced garlic are the most commonly encountered problems that garlic farmers across the regions encounter. Continuous heavy rainfall during the planting season caused extreme damage to the crop (cited by 48% of the respondents). Also, infestation of different field and storage pests and diseases of garlic resulted in lower yield (cited by 38% of the respondents). Furthermore, the market for garlic is highly competitive due to the imported garlic varieties that are cheaper than locally produced garlic (cited by 33% of the respondents). Due to these conditions, farmers who used to plant garlic have switched to other crops such as squash. In other cases, they have chosen to sell their garlic as chives as this requires less input, and thus making it more profitable than producing bulbs as experienced in Batangas.

Keywords: garlic production, Luzon

AS – 21

**ALLELOPATHIC IMPLICATIONS OF AQUEOUS EXTRACTS
OF PAPER MULBERRY (*Broussonetia papyrifera* (L.) Vent)
TO THE MORPHOLOGICAL AND PHYSIOLOGICAL
GROWTH OF SUPA (*Sindora supa* Merr.)**

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Allelopathy is a phenomenon in which a plant is able to deter or stimulate the growth of another through releasing organic toxic substances called allelochemicals. This phenomenon is often associated with exotic species, as it was regarded to be one of their enabling mechanisms in bioinvasion. In Mt. Makiling Forest Reserve, one of the most prominent introduced species is *Broussonetia papyrifera*. This experiment determined whether allelopathy is partially responsible for the success of *B. papyrifera* in invading natural stands. Allelopathic potentials of the species were determined through using laboratory bioassays. Leaf extracts were prepared at concentrations 10%, 15%, 20%, and 30%. Their effects on seed germination and elongation were observed on petri dish-grown seeds of *Sindora supa*. Their effects on the morphological growth and physiological processes were observed on four-month old seedlings of *S. supa* by exposing these to extracts for three months. Results showed that the extracts retarded seed germination, root length, and dry weight. Maximum inhibition was observed on the 30% treatment. Germination speed and coefficient of velocity of germination, on the other hand, were found to be insignificant.

Keywords: allelopathy, *Broussonetia papyrifera*, laboratory bioassays *Sindora supa*

AS-22

ESTABLISHMENT OF SEED PRODUCTION AREAS / INDIVIDUAL PLUS TREES IN THE PROVINCE OF LANAOS DEL NORTE, REGION 10

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It is a national obligation to rehabilitate the seriously damaged natural resources of the country, particularly denuded forests. All local government units are mandated to establish nurseries to produce planting materials in support of the National Greening Program of the government. The existing policy requires using only seeds from the identified seed sources. This study was conducted to determine the potential seed production areas in Lanao Del Norte province. A preliminary assessment of the deliberated possible areas was undertaken to determine the species that can be considered as seed sources. The identified species were graded, measured, tagged, and marked following the standard methods and systems. The clusters were delineated for boundary establishment, and silvicultural treatments were undertaken to the selected trees. Five clusters were identified and established to possess the requirements for seed sources: Cluster 1 in CENRO 1B-Kolambugan, with six plus trees; two clusters in Barangay Lapinig, both with Pedada (Perara) *Sonneratia caseolaris*, Kapatagan; Lawiga Datu, Magsaysay with two species; and Barangay Dalama, Tubod, with three plus trees species. Moreover, a total of 12 plus trees were identified in the province. These include Narra (Fabaceae), Molave (Verbenaceae), Katmon (Dilleniaceae), Big Leaf Mahogany (Meliaceae), Ipil (Fabaceae), Banuyo (Fabaceae), Pedada or Perara (Sonneratiaceae), Mangium (Fabaceae), Agoho del Monte (Casuarinaceae), Kamagong or Mabolo (Ebenaceae), Mangkono (Myrtaceae) and Olayan (Fagaceae). The established individual plus trees for Lanao Del Norte can be sources of seeds for industrial and mangrove rehabilitation, propagation of endangered and endemic species, and high-altitude reforestation.

Keywords: clusters, plus trees, reforestation, rehabilitation

AS – 23

**HYDROLOGICAL ASSESSMENT
AND GEOMORPHOLOGICAL CHARACTERIZATION
OF SAWAGA WATERSHED IN BUKIDNON PROVINCE**

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The study aimed to assess the geomorphologic and hydrologic characteristics of Sawaga watershed. The methodology focused on the readings of stream flow during the occurrence and absence of rainfall events. Four rainfall events were considered in the analysis. The highest occurrences of rainfall and stream flow were used to construct the hydrograph of Sawaga watershed. Results revealed that the Sawaga watershed is elongated, highly permeable, and has homogeneous subsoil condition. The said watershed has an average slope of 15.61% and mean elevation of 789.99 m. Most parts of the area are cultivated and planted with corn. Based on the data obtained in the area, the recorded maximum discharge of the watershed is $37.00 \text{ m}^3\text{s}^{-1}$ as against the base flow of $13.42 \text{ m}^3\text{s}^{-1}$ and a lag time of three hours and 30 minutes. This indicates that the hydrograph of the Sawaga River exhibits a high peak discharge and steep rising limb. Findings of the study can help to determine whether or not an evacuation is necessary once intense rainfall events occur in the area.

Keywords: hydrology, geomorphology, Sawaga River, watershed

AS – 24

LAND USE/LAND COVER CHANGE ANALYSIS OF SELECTED WATERSHEDS OF MT. MAKILING FOREST RESERVE USING LANDSAT IMAGES

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Mt. Makiling Forest Reserve (MMFR), an ASEAN Heritage Park, is home to a large number of endemic flora and fauna species. Several watersheds can be found in MMFR, and they drain mostly toward the Laguna de Bay, the largest freshwater lake in Southeast Asia. To properly manage these areas in a long-term scenario, observing the dynamics of its land use/land cover is essential. Hence, this study analyzed the land use/land cover change of selected watersheds in MMFR. Three watersheds are involved: Molawin-Dampalit Watershed (4,166.43 ha), Cambantoc Watershed (1,966.09 ha), and Tigbi Watershed (1,944.61 ha). Different Landsat images were used, namely, Landsat 5 Thematic Mapper™, Landsat 7 Enhanced Thematic Mapper Plus, and Landsat 8 Operational Land Imager. Different periods were also chosen: 1993, 1998, 2002, 2006, 2010, and 2015. Images were preprocessed and classified using the Maximum Likelihood Algorithm. These were further analyzed to determine trends and patterns across different periods. Results showed that there is an increasing trend in built-up areas from 1993 to 2015, and this was mainly concentrated on the northern portions of the watersheds. Likewise, there was a fluctuation in the forest cover within the watershed area. Overall, despite the changes in some of the land cover classes (e.g., built-up and agriculture), forest cover in MMFR did not experience significant decline. The results of the study can be utilized to further enhance the management of MMFR.

Keywords: land use/ land cover, watershed, Landsat, maximum likelihood

AS – 25

SOIL EROSION OF AN ECOTOURISM SITE IN BUKIDNON

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Soil erosion is very common in developing countries where large tracts of forest lands are converted to other land uses. Mt. Musuan, one of the landmarks in Bukidnon province and a promising ecotourism site, is not spared of this phenomenon. Its magnificent beauty will be at risk if its degradation will continue to destroy its landscape. This study was conducted to assess and to quantify the soil erosion rates of the various land cover across its landscape. These are the forest area, grassland, and the agro-ecosystem components. Soil erosion plots were established in various slope gradients of the three vegetative/land cover. Erosion bar method was used in measuring the soil erosion rates. Findings show that agro-ecosystem had the highest soil losses at $41.43 \text{ t ha}^{-1} \text{ yr}^{-1}$, followed by grassland with $26.39 \text{ t ha}^{-1} \text{ yr}^{-1}$, and forest area had the least with $13.98 \text{ t ha}^{-1} \text{ yr}^{-1}$. In terms of slope gradient, although non-significant, the slope greater than 20% had the highest soil loss of $35.37 \text{ t ha}^{-1} \text{ yr}^{-1}$, followed by slope gradient between 10% and 20%, with $29.17 \text{ t ha}^{-1} \text{ yr}^{-1}$. The slope less than 10% had the least soil losses, with $17.35 \text{ t ha}^{-1} \text{ yr}^{-1}$. The soil erosion rates of Mt. Musuan are beyond the tolerable limit, and thus need immediate actions, particularly in the agro-ecosystem. Rehabilitation like planting of perennial crops in these areas needs to be prioritized.

Keywords: infiltration, land cover, Mt. Musuan, soil erosion

AS – 26

PERFORMANCE EVALUATION OF TOMATO
(*Lycopersicon esculentum*)
IN RESPONSE TO VERMI LEACHATE APPLICATION
AT VARYING FERMENTATIONS

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The growing concerns about the adverse effect of chemicals on the environment and on agricultural practices involving organic and environmental-friendly compounds are gaining attention globally. An investigation was conducted in a 2×3 factorial arranged in Randomized Complete Block Design in three replications at the Organic Research Center of Misamis Oriental State College of Agriculture and Technology from Marh to October 2014. The study focused on the effect of vermi leachate application at varying fermentation periods on the growth, yield, and occurrence of Tomato Yellow Leaf Curl Virus (TYLCV). Results showed that vermi leachate application had significant effects on the growth and yield of tomato. Taller plants were observed in treatments that have drench application at 30, 45, and 60 DAT. Tomato plants at 60 DAT and applied with vermi leachate at 2.5 months of fermentation exhibited taller plants. Foliar application of vermi leachate significantly influenced growth in the earlier days of development to 50% flowering. Heavier and more marketable fruits and lesser percentage of TYLCV incidence were recorded. Results showed a greater potential in vermi leachate application in improving the growth and yield parameters of tomato.

Keywords: vermicompost, vermi leachate, drench, foliar application, tomato

AS – 27

DNA FINGERPRINTING OF BENEFICIAL ORGANISMS FOR THE RICE ENVIRONMENT

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The Philippine Rice Research Institute (PhilRice) tests and safeguards the efficacy and purity of promising organisms in the formulations of bioinoculants intended for soil and plant health enhancement (bacteria) and control of rice pests and diseases (fungi). The usual procedure in their production involves identification and mass culture of effective organisms. However, the handling and processing of bioinoculants can affect their purity. *Nostoc commune*, a blue-green algae common to rice paddies, is also being propagated in PhilRice. Accordingly, the institute aims to ensure that only *N. commune* strains that are safe (nuerotoxin-free) for use as food or feed are cultivated. DNA extraction, gene amplification, and DNA sequencing were initially done on the available specimens. In bacteria, the 16S rRNA primer combination 8F and 1492R revealed the true identity of 3R2S-*Bacillus cibi* (previously identified by Biolog) as *Alcaligenes faecalis*, with 99% similarity to *B. cibi*. Moreover, BLAST analysis showed that the putative specimens *Streptomyces mutabilis* and *Bacillus* sp. were 99% matched with their respective references. Initial phylogenetic analysis of *N. commune* using 27F and 1492R primers showed considerable difference among specimens collected from the hills and rice paddies in Ilocos Norte, whereas those collected from rice paddies in Adams and Pasuquin, Ilocos Norte were found to be 100% similar. Using the specific 28S rRNA primers for *Beauveria bassiana* and *Metarhizium anisopliae* revealed 99% similarity to their respective references based on BLAST analysis. With the advent of molecular markers, some limitations of morphological analyses can be solved using DNA fingerprinting technique to effectively determine their identity. Results of this study will be useful in decision making, especially in identifying the most suitable strain of *N. commune* for large-scale on-farm production. Also, this will help to ensure that only effective organisms of true identity will get incorporated in bioinoculant products.

Keywords: *N. commune*, bacteria, fungi, bioinoculant, DNA fingerprinting

EFFECT OF MULCHING MATERIALS IN THE CONTROL OF MAJOR PESTS AND YIELD OF SOLANACEOUS VEGETABLES DURING THE WET SEASON

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This study conducted an experiment at the MMSU, Experimental Farm, Batac City during the wet seasons of 2012–2015 to investigate the effects of different mulching materials in controlling major pests and yield in solanaceous vegetables. Mulching materials like plastic mulch (PM), rice straw (RS), rice hull (RH), carbonized rice hull (CRH), sawdust (SD), and dried grasses (DG) (including unmulched [UM]) were used as treatments. Results showed that tomato plots mulched with RH, CRH, and SD, along with UM plants had the highest weed biomass. Using RS and DG as mulching materials were found to be effective in controlling weeds. However, using PM was the most effective as it showed lesser weed biomass. The common pests observed were fruitworm, leaf curling, and leaf blight. The net return in growing tomato using different mulching materials was highest in plants with PM at PHP 390,350, with an average yield of 27.18 tha^{-1} . This was followed by plants mulched with DG and RS. The least net returns were obtained from the UM plants and in plots mulched with SD, CRH, and RH. Eggplants mulched with plastic sheet had the least weed biomass collected in all evaluation trials. However, this was comparable with the plots mulched with RS, DG and RH. Unmulched plots of eggplant had the highest weed biomass, followed by plots with CRH and SD mulching materials. The net return in growing eggplant using different mulching materials was highest with the use of PM at PHP 243,300, with an average yield of 17.94 tha^{-1} . This was followed by plants mulched with RS, DG, and RH. Unmulched plants and plants mulched with SD and CRH had the lowest net returns.

Keywords: tomato pests weed persistence, mulching materials, yield, cost and return analysis

AS – 29

PESTICIDE RESIDUE MONITORING OF ORGANIC AND CONVENTIONAL VEGETABLES USING THE RAPID TEST KIT (RTK)

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Excessive pesticide residues in food pose major concerns in consumer safety especially in the case of vegetables where its consumption is considered to be vital for human health. The Rapid Test Kit (RTK) developed by the National Crop Protection Center is a rapid, semiquantitative tool to detect organophosphate (OP) and carbamate (CM) residues in vegetables. RTK analysis was done on 74 organic and 143 conventional vegetable samples from selected markets and stalls in Metro Manila, Laguna, Quezon, and other selected areas to monitor whether vegetable farmers comply with the principles of organic farming or adhere to the preharvest interval (PHI) in conventional farming. Results showed that 21.6% (n=74) of organic vegetables were positive for OP and/or CM residues compared with the 28.0% (n=143) positive of the conventional vegetables. Eggplant and bitter melon were identified as the most frequently positive for OP and/or CM residues. Using RTK thus offers a potential for easy monitoring and screening of pesticide residues in vegetables produced by organic and conventional farming.

Keywords: pesticide residues, Rapid Test Kit, vegetables, organic, food safety

AS – 30

PHYTOPLASMA AND PHYTOPLASMA DISEASE OF PAPAYA IN THE PHILIPPINES: A REVIEW

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Several phytoplasma diseases of papaya that are associated to a number of phytoplasma strains have been reported in their papaya-growing countries. In the Philippines, the recent occurrence of a yellow-type disease, characterized by yellowing of young leaves and death of papaya plants, prompted this study to identify the etiology of the disease. Preliminary diagnosis based on isolation of the causal pathogen revealed the absence of plant pathogens such as bacteria and fungi. However, using modern tools for molecular detection suggests a phytoplasma infection of the papaya plants. Results revealed that the causal organism belongs to the phytoplasma group of “*Ca. Phytoplasma aurantifolia*”, which includes the papaya yellow crinkle and papaya mosaic disease. In cross reference to other older reported phytoplasma disease of papaya in the Philippines, only “*Ca. Phytoplasma aurantifolia*” has been identified to cause phytoplasma disease of papaya in the Philippines.

Keywords: detection, papaya, Philippines, phytoplasma, plant disease

AS – 31

**BIOEFFICACY OF *Tasmannia piperita* (Hook.f.)
MIERS LEAF EXTRACTS AGAINST LATE BLIGHT
(*Phytophthora infestans*) (Mont) DE BARY OF TOMATO**

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This research evaluated the bioefficacy of *Tasmannia piperita*, an indigenous plant in the Philippines belonging to the Winteraceae family, against a causative pathogen of late blight of tomato, *Phytophthora infestans*. Results from the study using leaf extracts of *T. piperita* against *P. infestans* by the in vitro poison food technique showed that 1:100,000 dilution was most effective in inhibiting mycelial growth of *P. infestans* on the 3rd, and 6th–9th day after treatment application. Data from this study therefore indicates that aqueous extracts of *T. piperita* leaves is a potential fungicide against *P. infestans*. Utilizing fresh leaf extracts is recommended with the advantage that the leaves can easily be harvested and would require minimal amount of material for effectivity as a fungicide.

Keywords: indigenous plants, *Phytophthora infestans*, poison food technique, Winteraceae

AS – 32

**CHARACTERIZATION AND EVALUATION
OF PHOSPHATE-SOLUBILIZING BACTERIA
FROM CORN (*Zea mays* L.) AND SUGOD-SUGOD
(*Momordica cochinchinensis* Spreng.) RHIZOSPHERES**

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Phosphate-solubilizing bacteria (PSB) play an important role in the phosphorous nutrition of plants; it solubilizes bound phosphate in soil, thereby enhancing its availability. This study focused on three phases that encompassed all the objectives. Phase I was conducted to answer the primary aim, which was to isolate PSB from the rhizospheres of corn and sugod-sugod, and characterize the isolates through morphological and biological tests. Phase II involved evaluating the isolates in terms of their solubilization, efficiency, pH, and tricalcium phosphate tolerance through laboratory scale experiments. Phase III was performed to evaluate the actual performance of the isolates on phosphate solubilization by inoculating the isolates on test plants, namely, corn and tomato. Percent seed germination, plant height, shoot, root, and total biomass were measured. Seven PSB were isolated from the rhizospheres of corn and sugod-sugod. Results showed that there was a significant solubilization efficiency of isolates both from agar and broth assays. Further, the tolerance test revealed that two isolates were tolerant at pH 4, and one isolate was tolerant at pH 8. Meanwhile, the isolates had a significant inhibitory effect on seed germination of corn and tomato. The isolates also had a significant effect on the height of the corn plant, but not on the height of tomato. The biomass was not significant in corn, but was significant in tomato, although it was limited to some factors.

Keywords: solubilization, rhizosphere, phosphate, tolerance, PSB

AS – 33

**DETECTION OF THE ENDOPHYTIC COLONIZATION
OF *Lasiodiplodia theobromae* (PAT.) GRIFF. AND MAUBL.,
CAUSAL ORGANISM OF STEM END ROT
IN “CARABAO” MANGO**

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Stem end rot (SER) is a postharvest disease problem that limits the quality and marketability of mango fruits. The preharvest infection of SER pathogen, *Lasiodiplodia theobromae* (Pat.) Griff. and Maubl., has not been studied in “Carabao” mango. This present study determined the endophytic colonization of the pathogen, which has implication on disease management. Fruit panicles were collected at harvesting stage from bearing mango trees in Laguna. Employing the isolation technique for endophytes, plant tissues were obtained aseptically from each panicle. Initial results suggested that the pathogen colonizes the panicle endophytically. *L. theobromae* was recovered from the base of panicle near the fruit and from the top of the panicle. Pathogenicity test of these isolates revealed typical symptom of SER disease. Fruits from these panicles were incubated and did not show SER symptoms at ripe stage.

Keywords: mango, stem end rot, endophytic colonization

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DEVELOPMENT OF MULTIPLEX POLYMERASE CHAIN REACTION METHOD FOR SIMULTANEOUS DETECTION OF ABACA BUNCHY TOP VIRUS (ABTV) AND BANANA BUNCHY TOP VIRUS (BBTV) GENOME FRAGMENTS

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A polymerase chain reaction (PCR) method that uses one primer set to amplify a region of target viral DNA is currently being used to detect Abaca Bunchy top Virus (ABTV) and Banana Bunchy top Virus (BBTV), two of the most destructive viruses infecting abaca. Efficiency and accuracy of diagnosis of these viruses, however, is reduced by the limited diagnostic capacity of the PCR method resulting in false negative detection. A multiplex PCR technique, a variant of PCR that uses several primer sets in one reaction, was developed to simultaneously detect several genome fragments of bunchy top viruses in one reaction. Primers targeting the coat protein (CP) and cell cycle link protein (C-link) genome fragments of ABTV and the CP and replication initiation protein (Rep) of BBTV were designed and optimized for multiplex PCR reaction. An annealing temperature at 61.9°C resulted in simultaneous amplification of ABTV (CP and C-link) and BBTV (CP and Rep), with the product sizes of 590 bp, 401 bp, 506 bp, and 876 bp, respectively. Results showed heterogeneous detection of the viral genome fragments in each virus. This could have resulted from the multipartite and multicomponent nature of their genome, which is asymmetrically distributed in the host. The developed method allows the detection of several viral genome fragments in one reaction, ensuring stringency and preventing false negative detection.

Keywords: *Musa textilis* Nee, babuvirus, virus detection

AS – 35

EFFECTS OF PLANT EXTRACTS ON THE SEVERITY OF MAJOR FOLIAR DISEASES ON HYBRID CORN

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The experiment was conducted at the Agricultural Experiment Center, Central Mindanao University, Musuan, Bukidnon to assess the effects of plant extracts on the severity of major foliar diseases on hybrid corn (Pioneer P3654YR) and to evaluate its influence on the agronomic characteristics and yield of the hybrid variety. Seven treatments were laid out in Randomized Complete Block Design with three replications: (Control), T₂ (Daconil), T₃ (*Piper betel* “buyo”), T₄ (*Tinospora cordifolia* “panyawan”), T₅ (*Anethum graveolens* “dill”), T₆ (*Morinda citrifolia* “noni”), and T₇ (*Ficus septica* “lagnob”). Results showed that applying different plant extracts on diseased corn significantly affected the percent severity of brown spot (*Physoderma* sp.) at 21, 35, 49, 63, and 91 days after planting (DAP). Moreover, the effect of the plant extracts on the severity of leaf blight (*Stenocarpella* sp.) at 21–77 DAP and of leaf spot (*Curvularia* sp.) at 91 DAP on T₂ (Daconil) was highly significant. T₃ (*P. betel*) showed comparable effects with T₂ (Daconil) on rust (*Puccinia* sp.). Agronomic and yield components were not significantly affected by the application of plant extracts; however, plots sprayed with T₆ (*M. citrifolia*) obtained the highest yield of 7,799.07 kg ha⁻¹ compared with that of T₂ (Daconil), with 7,441.86 kg ha⁻¹. On the other hand, T₄ (*T. cordifolia*) gave the highest percent shelling recovery of 93.62% compared with that of T₂ (Daconil), which obtained 74.06%. The plant extracts used in this study have potential phytochemicals that can be used against foliar diseases of corn.

Keywords: extracts, percent severity, foliar diseases

AS – 36

**FOLIAR ENDOPHYTIC FUNGI
FROM DIKET RED RICE SHOW BIOCONTROL ACTIVITY
AGAINST BACTERIAL LEAF BLIGHT (BLB)
AND HAVE POLYKETIDE SYNTHASE (PKS) GENES**

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Oryza sativa, considered the most important food crop in the Philippines, is frequently attacked by phytopathogens such as *Xanthomonas oryzae*, which causes Bacterial Leaf Blight (BLB). Endophytic fungi have secondary metabolites that yield efficient drugs and, most importantly, possess agricultural potential. One of the known fungal metabolites is the polyketides. Polyketides or Polyketide synthase (PKS) are a class of secondary metabolites, which are known for their therapeutic and agricultural applications. In this study, the potential of ethyl acetate extracts from foliar endophytic fungi present in Diket red rice to produce bioactive antibacterial compound was determined through in vitro antimicrobial activity against *X. oryzae*. Also, the presence of PKS genes was determined using primer pairs KAF1/KAR1 that screened the Ketoacyl synthase (KS) domains, which is highly conserved sequences shared among all PKS. A total of 12 isolates were identified up to species level and belonged three genera: *Aspergillus*, *Penicillium*, and *Cladosporium*. Four isolates, namely, *Aspergillus spelaeus*, *Penicillium steckii*, *Penicillium chrysogenum*, and *Cladosporium oxysporum* significantly reduced the OD 600 absorbances of *X. oryzae* broth cultures, which implies that these isolates had biocontrol activity. *C. oxysporum* obtained the highest antimicrobial activity. PKS genes were observed in six distinct strains. The four foliar endophytes with significant antimicrobial activity and PKS genes may be a source of bioactive compound for biocontrol of BLB in rice fields in the near future.

Keywords: endophytic fungi, polyketide, BLB

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GROWTH AND SPORULATION OF THREE *Colletotrichum* SPECIES AS INFLUENCED BY ORGANIC CHEMICALS

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Colletotrichum species are important pathogens that infect fruits, vegetables, and ornamental crops worldwide. Recently, an outbreak of chilli anthracnose has been observed in Luzon and Mindanao, and polymerase chain reaction analysis revealed three *Colletotrichum* species (*C. acutatum*, *C. gloeosporioides* and *C. truncatum*) are responsible for the outbreaks. With no effective measure available, anthracnose caused by these three pathogens could be devastating to the chilli industry. Chemical fungicides may be valuable, but their use has been discouraged worldwide due to its potential risk. Thus, sustainable chemical approaches to chilli anthracnose management are needed. In this study, the growth and sporulation of *C. acutatum* and *C. gloeosporioides* under the influence of 14 organic chemicals were assessed in potato dextrose agar, individually amended with chemicals at 1% concentration. Growth was rarely inhibited, but sporulation of the two pathogens was variably influenced by the organic chemicals. Polygalacturonic acid, Meso-erythritol, Malonic acid, Maltose, Mannitol, and Glycine inhibited the sporulation of both pathogens. Arginine, Inositol, L-Tyrosine, and Vitamin-B1 inhibited only *C. gloeosporioides*. This study suggests that organic chemicals in vitro can inhibit sporulation, although the two pathogens reacted differently. Future glasshouse and field work underpinning the efficacy of the chemicals that inhibit pathogen sporulation may offer novel chemical control measures against anthracnose of chilli in the country.

Keywords: chilli anthracnose, *Colletotrichum gloeosporioides*, *Colletotrichum acutatum*, *Colletotrichum truncatum*

***Solanum biflorum* AND *Lantana camara* AS POTENTIAL
BIOPESTICIDES AGAINST CABBAGE BLACK ROT
(*Xanthomonas campestris* pv. *campestris*)**

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A study was conducted at Victory, Lantapan, Bukidnon to evaluate the efficacy of different plant parts of *Solanum biflorum*, in combination with *Lantana camara* leaves, as biopesticides against cabbage black rot. Likewise, the study aimed to determine the effects of the different treatments on the yield performance of the crop. The study was laid out in Randomized Complete Block Design, with nine treatments and three replications. The treatments were T₁ (Kocide), T₂ (Distilled Water), T₃ (*S. biflorum* roots + *L. camara* leaves), T₄ (*S. biflorum* leaves + *L. camara* leaves), T₅ (*S. biflorum* fruits + *L. camara* leaves), T₆ (roots of *S. biflorum*), T₇ (leaves of *S. biflorum*), T₈ (fruits of *S. biflorum*), and T₉ (leaves of *L. camara*). T₅ had the least disease severity rating, which is comparable to that of T₁ at 14, 21, and 28 days after transplanting. Highly significant variations were also observed among means on the yield parameters. T₁ had the heaviest heads (average of 8.4 kg), and its mean weight was significantly different from those of the other treatments. This result can be attributed to the less number of infected leaves on T₁ compared with the other treatments with severe infection. On the adjusted yield per hectare, T₁ also had the highest yield of 16,800 kg ha⁻¹. However, among the extracts, T₅ had the highest mean of 9,600 kg ha⁻¹, which is comparable to T₆, with 9,200 kg ha⁻¹. Based on these results, the combination of fruits of *S. biflorum* and *L. camara* leaves proved effective in controlling cabbage bacterial rot.

Keywords: black rot, extracts, heads, disease severity

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SPECIES IDENTIFICATION OF *Xanthomonas* CAUSING BACTERIAL SPOT DISEASE IN PEPPER AND TOMATO USING BIOLOG GEN III MICROPLATE AND PCR

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Bacterial spot disease is one of the most destructive diseases in pepper and tomato, particularly in places where high temperature and frequent rainfall occur. It is caused by four distinct *Xanthomonas* species: *X. euvesicatoria*, *X. vesicatoria*, *X. perforans* and *X. gardneri*. The first two species are the most widely distributed, causing bacterial spot disease both in pepper and tomato. Species identification of the two *Xanthomonas* isolates from pepper and tomato was done using the Biolog Gen III microplate and polymerase chain reaction through species-specific primers used by Araujo et al. (2012). Based on the phenotypic and genotypic characteristics of the isolates, such as positive utilization of acetic acid and the amplification of 173 bp target DNA, the isolates from pepper and tomato were identified as *X. euvesicatoria*. To our knowledge, this is the first report of *X. euvesicatoria* in the Philippines.

Keywords: pepper, tomato, bacterial spot, identification, *Xanthomonas*

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THE EFFECTS OF ORGANIC AMENDMENTS ON THE INCIDENCE OF MAJOR DISEASES AND YIELD OF THREE PEANUT GENOTYPES

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Peanut is an important legume crop in many tropical and subtropical countries. However, farmers experience great losses in its production due to disease, and thus the need to undertake measures to control its incidence. This study investigated the effectiveness of different organic amendments applied on different peanut genotypes to resist major diseases in peanuts. The study was laid out in a split plot experiment arranged in Randomized Complete Block Design. The different peanut genotypes (i.e., NSIC Pn8, NSIC Pn9, and PSB Pn16) represented the main plot, whereas the different organic amendments (vermi compost, chicken manure, carbonized rice hull) represented the subplot. The three peanut genotypes showed different responses to leaf spot and leaf rust infection. Peanut genotype NSIC Pn9 consistently showed the least severity rating, whereas NSIC Pn8 recorded the least severity on leaf rust infection. The application of the different organic amendments on the different peanut genotypes failed to show any significant variations at 35–50 days after planting (DAP). However, significant difference was observed at 58–75 DAP. Peanuts grown in plots applied with vermi compost (B₂) consistently recorded the least percent severity of leaf spot and leaf rust infection. Most of the yield parameters showed higher value when the plants were applied with organic amendments, specifically those applied with carbonized rice hull (B₄). However, a comparable result was observed on the use of other organic amendments.

Keywords: genotypes, severity, amendments, parameters, infection

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**ULTRASTRUCTURAL CHARACTERIZATION,
BACTERIAL ENDOPHYTES, AND EFFECT OF LATEX
ON BACTERIAL GROWTH IN VITRO OF *Erwinia mallotivora*
Goto IN PAPAYA (*Carica papaya* L.) EXHIBITING REGROWTH
FROM CROWN ROT DISEASE**

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Bacterial crown rot is an emerging disease in papaya (*Carica papaya* Linn.) in Southeast Asia. It is caused by a necrotrophic, gram-negative, facultative aerobic bacterium known as *Erwinia mallotivora* Goto. In seedlings, crown rot exhibits a very slow hypersensitive reaction to infection, taking around 5–6 weeks until recovery and until lateral stem regrowth occurs. This study examined the genotypes that exhibited recovery or regrowth from crown rot infection using scanning electron microscopy. Ultrastructurally, *E. mallotivora* or any rod-shaped bacteria were not detected in the regrown tissues, suggesting tolerance to bacterial crown rot. However, bacterial cells are present in non-regrowth plants, suggesting susceptibility to the disease. Culturally, two species of bacteria, namely, *Sphingomonas* sp. and *Microbacterium* sp. were isolated and were thought to be endophytically associated with papaya. Recovery from the disease was also aided by the action of the papaya latex. In in vitro conditions, the water-soluble fraction of the latex was able to totally inhibit bacterial growth within 30 hours of exposure at 80% v/v. This implies the important role of latex against bacterial crown rot during early part of infection.

Keywords: bacterial crown rot, *Carica papaya* L., *Erwinia mallotivora*, latex, regrowth

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UNVEILING THE IDENTITY OF THE EMERGING DESTRUCTIVE STEM CANKER IN DRAGON FRUIT IN THE PHILIPPINES

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Dragon fruit has become increasingly popular in the Philippines due to its claimed health benefits and commercial value. However, this fruit faces different stresses, including biotic stress caused by various diseases. One destructive symptom observed in all of the dragon fruit farms visited by the researchers was the presence of stem and fruit canker, which eventually leads to stem and fruit rotting. This study aimed to identify the causal organism present in this destructive stem canker in dragon fruit and to characterize its life stages. Dragon fruit-growing areas in Silang, Cavite and in Los Baños, Laguna were surveyed for stem canker infection in cladode and fruits. Different symptomatologies were observed and pure culture isolates were produced through tissue plating method on potato dextrose agar. Phenotypic characterization, molecular assay, and pathogenicity test were done. The pathogen was identified to be *Neoscytalidium dimidiatum*. Three common symptoms of stem canker, namely, orange lesions, black erumpent pycnidia, and black canker were inoculated on a healthy cladode. Pathogenicity test revealed that symptoms that present black pycnidia can initiate infection. Black necrotic canker was initially produced, followed by rotting of cladode. The outcome of the study will have significant implications on the development of proper control measures and timing of chemical control for stem canker disease on dragon fruit in the Philippines.

Keywords: dragon fruit, stem canker, *Hylocereus* spp.

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LEVELS OF HEAVY METALS IN SIX AQUACULTURE COMMODITIES COLLECTED FROM VARIOUS LANDING SITES OF MANILA BAY: RELATIONSHIPS WITH SIZE AND SEASONAL VARIATION

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This study determined the levels of heavy metals in Manila Bay landing sites and its relationship with size and with seasonal variation in six aquaculture commodities (i.e., tilapia, milkfish, crab, shrimp, mussel, and oyster). Samples were collected in 11 pre-identified landing sites of Manila Bay for two seasons: dry season in March 2016 and wet season in September 2016. Homogenized flesh samples were digested using microwave digester (ETHOS One) and were determined using Atomic Absorption Spectrophotometer (AA-7000, Shimadzu). All commodities passed the regulatory limit set by the Bureau of Fisheries and Aquatic Resources Fisheries Administrative Order 210 s. 2001 and the European Commission No. 1881/2006 for lead and cadmium. Conversely, 2 out of 98 (2.04%) tilapia and 4 out of 80 (5.00%) shrimp samples collected failed to pass the regulatory limit set for mercury. The comparisons made between metal concentrations and fish size parameters demonstrated negative relationships in most cases, and these are mostly found in cadmium and lead. Positive correlations were mostly found in mercury. Using t-test, the commodities tested had significantly higher level of accumulation during wet season. From the standpoint of food safety, there is a need for risk assessment and regular monitoring of the said commodities.

Keywords: heavy metals, Manila Bay, landing sites, aquaculture commodities

AS – 44

OPTIMIZATION AND VALIDATION OF ANALYTICAL METHOD FOR SENSITIVE ANALYSIS OF HISTAMINE IN FISH USING ULTRA HIGH PRESSURE LIQUID CHROMATOGRAPHY (UHPLC) WITH PRE-COLUMN DERIVATIZATION

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This study optimized and validated a pre-column derivatization ultra high performance liquid chromatographic (UHPLC) for determining histamine in fish. The homogenized samples were extracted with trichloroacetic acid solution and derivatized with o-phthaldialdehyde. Histamine was separated using C18-ODS (250 × 4.6 mm, 5 μm) with low pressure gradient elution, was determined through UHPLC with fluorescence detector, and was quantified through standard addition method. The linear calibration range was 10–60 μg mL⁻¹ with a correlation coefficient of 0.9993. The average recoveries of histamine at different spiking concentration levels were found in samples with greater than 89% and precision smaller than 8.46%. The detection and quantification limit were 2.7 and 8.3 μg g⁻¹, respectively. The uncertainty was estimated to be ±0.45. The performance of the proposed method was checked with a proficiency test sample from the Food Analysis Performance Assessment Scheme as an external quality control. The resulting z-score was -0.2, which was found within the acceptable range of -2 ≤ z ≤ 2. The results indicated that this method was reliable, sensitive, reproducible, and practical for the routine analysis of histamine in fish.

Keywords: histamine, liquid chromatography, method validation, proficiency test

AS – 45

AGUSAN MARSH FINFISH: CURRENT TREND, THREATS, AND SUSTAINABLE MANAGEMENT

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The Agusan marsh is one of the last frontiers in the Philippines due to its unique characteristics. The marsh is used as fishing ground, which produces fish that serve as the major income and food source. A survey of finfishes in Agusan marsh was conducted in November 2012 and January 2013 through actual collection of samples, ocular inspection of the fish being sold, and key informant interviews. Samples were collected in the marshy areas of three municipalities (i.e., Talacogon, La Paz, and Loreto) using locally employed methods. Results revealed a total of 34 species, and showed an increasing number of fish species present in the marsh. Of these, 15 species are native that have scarce population status. The resource and its habitat are threatened by ongoing illegal logging and fishing, improper domestic waste management, and agricultural activities in the area. Overall, the Agusan marsh finfishes call for an effective management plan that should encourage the involvement of the community and the government.

Keywords: Agusan marsh, finfish, native species, conservation status

AS – 46

**ASPECTS ON ECOLOGY AND BIOLOGY FOR THE
DEVELOPMENT OF CAPTIVE BREEDING OF THE WHITE
TEATFISH *Holothuria fuscogilva* (CHERBONNIER 1960)
IN LOPEZ JAENA, MISAMIS OCCIDENTAL**

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The biology and ecology of *Holothuria fuscogilva* (white teatfish) in Capayas Island Marine Reserve is being characterized monthly since October 2014. Transect surveys outside the reserve boundary reflect the demand of trepang, as population density is 7 ind ha⁻¹. However, protection inside the reserve has increased the mean population density to 183 ind ha⁻¹. The species is abundant in shallow seagrass and algal flats in coarse sand or rubble. Body size ranges between 0.016 kg and 2.9 kg. In hatchery conditions, white teatfishes spawn either naturally or induced. In all 10 spawning induction attempts and natural spawning runs, only male white teatfishes release their gametes. Examination of gonads from eviscerated gut showed that females are present in the induced broodstock, as indicated by their visible oocytes through translucent tubules.

Keywords: sea cucumber, white teatfish, biology, and ecology

AS – 47

ASSESSMENT OF POSTHARVEST LOSSES OF SARDINES IN DIPOLOG CITY, ZAMBOANGA DEL NORTE

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Postharvest losses (PHL) in the fishery industry are inevitable due to the highly perishable characteristic of fish. Zamboanga Peninsula is the top producer of sardines in the Philippines, with 516,233.95 MT of combined *Sardinella fimbriata* and *S. lemuru* production from 2013 to 2015. Reports on the quantity of PHL in the Philippines have been largely attributed to physical loss, with limited to no in-depth study as to the nature of losses. Thus PHL of sardines were evaluated in the different supply chain in Dipolog City, Zamboanga del Norte to generate baseline data. The physical, quality, market force, and financial losses in landing, wet and dry market, and processing areas were estimated using a modified method described by Ward and Jeffries (2000) that adopted and incorporated local conditions. The postharvest handling practices were assessed to identify where the highest losses occurs. A total of 219 respondents were interviewed to obtain PHL indicators. Total volume loss from 2016 to 2017 in all the supply chain was recorded at 13% or 270 MT out of 35,991 MT total volume assessed, which is equivalent to PHP 2,041,926.63 in value. PHL were way below the estimated 40% maximum loss indicated in the 2016 Comprehensive National Fisheries Industry Development Plan. The highest average total percentage losses attained were in wet market at 24% and 19.6% in commercial fish landing. Physical loss was the most minimal PHL in the sardine supply chain at a range of 0–2.3%; quality loss was at 0–10% while market force loss at 0–21%. Non-usage of ice and other low temperature preservation techniques, insufficient supply of salt, long trading time, picking method, and use of fine-meshed nets were observed as factors in the occurrence of PHL.

Keywords: sardines, postharvest losses, Dipolog City

AS – 48

BUILDING RESILIENCE AND POVERTY ALLEVIATION THROUGH TILAPIA-BASED SKILLS AND LIVELIHOOD DEVELOPMENT IN NORTHERN MINDANAO

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This project aimed to teach the target beneficiaries skills and to assist them in establishing a tilapia-based livelihood in order to help them build resilience against environmental challenges and alleviate their economic condition. A total of 13 People's Organizations, one LGU, and a fisheries school in Regions 10 and Caraga were chosen as partner-beneficiaries. They were given hands-on trainings on tilapia hatchery operations, tilanggit production, and tilapia grow-out. The project also helped them to start their own livelihoods through applying their acquired skills. Start-up materials were provided: fingerlings, cage materials, feeds, and equipment. The activities engaged the participation of the local government unit, Department of Social Welfare and Development, Department of Trade and Industry (DTI), and Bureau of Fisheries and Aquatic Resources. The beneficiaries were also given trainings on feed formulation, entrepreneurship, bookkeeping, gender and development, and climate change. A total of 104,300 fingerlings and 6,180 breeders were released. Seven organizations are already operating their hatcheries and producing fingerlings for their use and for market. The tilanggit processed by the women have already reached the markets and provincial festivals. Their grown-out tilapia is sold in retail and in bulk. For environmental sustainability, the beneficiaries planted indigenous trees in banks in exchange for free fingerlings. DTI assisted the value-adding of their products and in facilitating linkages to other agencies to scale-up their livelihood activities.

Keywords: resilience, tilapia, tilanggit, livelihood, climate change

AS – 49

CLIMATE CHANGE IN THE PHILIPPINES: VULNERABILITY ASSESSMENT OF CAPTURE FISHERIES AND AQUACULTURE SECTORS

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The fishery sector is one of the sectors in the Philippines that is highly affected by and vulnerable to the impacts of climate change. Sector-based Fisheries Vulnerability Assessment Tool (Fish VOOL) for capture fisheries and aquaculture sectors have been described to evaluate the vulnerability of primary fishery commodities. This study assessed three commodities of capture fisheries, namely tuna, sardines, and blue swimming crab; and three commodities from the aquaculture sector, namely, tilapia, milkfish and seaweeds. In the tuna sector, four provinces were assessed to have low vulnerability, whereas nine provinces have medium vulnerability. In the sardines sector, six provinces have low vulnerability, seven provinces have medium vulnerability, and one province is highly vulnerable. In the blue swimming crab sector, three provinces were assessed to have low vulnerability and two provinces have medium vulnerability. In the milkfish sector, eight provinces have low vulnerability and four have medium vulnerability. In the seaweeds sector, four provinces have low vulnerability and five have medium vulnerability. Lastly, in the tilapia sector, 14 provinces have low vulnerability and 8 provinces have medium vulnerability. Results of the assessment also showed the high vulnerability rating of the sectors was due to their weak adaptive capacity to climate change. Thus, developing programs (e.g., promoting climate change awareness) or support systems on climate change will help to reduce the areas that were assessed to have high vulnerability.

Keywords: climate change, fisheries vulnerability assessment tool, adaptation, capture fisheries, aquaculture

AS – 50

**COMPARATIVE ADVANTAGE OF USING EXTRUDED
FLOATING FEEDS FOR TILAPIA (*Oreochromis niloticus*)
AND MILKFISH (*Chanos chanos*) CAGE CULTURE
IN TAAL LAKE**

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This study was conducted to compare the culture performance of tilapia and milkfish fed with extruded floating feeds with the conventional slow sinking and sinking feeds used in cage farming and to serve as baseline information for cage regulations. This initiative was conducted to support the Taal Volcano Protected Landscape-Unified Rules and Regulations for Fisheries (TVPL-URRF) policy on the use of floating feeds for cage aquaculture as part of good aquaculture practice in Taal Lake. Results of the study showed that floating feed type is more efficient than slow-sinking and sinking feeds in terms of growth, biomass harvest, and feed conversion ratio. Floating feed treatment also had better size distribution at harvest, with 84.07–84.22% of fish attaining target marketable size. Using floating feeds also decreases feed use by 19.64–30.0% and lessens feed cost by 17.91–29.44%. This results in better economic profitability and contributes to the attainment of an ecologically sound lake water environment. The results of the study revealed the comparative advantage of floating feeds over slow-sinking feeds and sinking feeds. This feed type is therefore recommended for cage farming in the lake.

Keywords: extruded floating feeds, slow sinking feeds, sinking feeds, growth performance, cage aquaculture

AS – 51

ENVIRONMENTAL FACTORS AFFECTING DISTRIBUTION AND ABUNDANCE OF LARVAL FISH ASSEMBLAGES IN LAKE TAAL, PHILIPPINES

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Larval fishes are sensitive to environmental changes; hence their abundance and distribution in relation to environmental conditions are crucial in fishery and resource management, ecological monitoring, and establishing fish sanctuaries. This study conducted a monthly sampling of ichthyoplankton and quantification of 15 water parameters in 16 stations in Lake Taal from January 2015 to September 2017. A total of 16,749 fish larvae collected were morphologically identified to nine families, most of which were numerically dominated by Blenniidae (35.02%) and Gobiidae (33.27%). Analysis of variance showed that overall fish eggs and larval abundances, as well as abundance of Blenniidae, Gobiidae, and Atherinidae, differed very significantly among stations. Pre-flexion gobiid and blenniid larvae were ubiquitous in the lake while other larval fish families were present in certain areas only. In terms of temporal distribution, larval fish abundances of the families Gobiidae, Atherinidae, and Syngnathidae varied very significantly among months. Blenniidae, Clupeidae, and Atherinidae showed significant interannual variations. Redundancy analysis revealed that the larval fish assemblages differed significantly among months, and that water temperature is the major environmental factor structuring the larval fish assemblages. This information can be used as basis for establishing a new fish sanctuary in Lake Taal, and can serve as evidence for the potential impacts of climate change (increasing water temperature) to freshwater fisheries.

Keywords: fish sanctuary, climate change, water temperature, ichthyoplankton

AS – 52

**FIRST RECORD OF BLUENOSE LARGE-EYE BREAM FISH
Gymnocranius superciliosus (Sparoidea: Lethrinidae)
IN THE PHILIPPINES**

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The Philippines is known to be the center of marine shore fish diversity in the world and has been the focus of extensive ichthyological studies since the early 1900s. However, there are still a number of fish species that are thought to be unrecorded. The National Fisheries Research and Development Institute has been collaborating with the National Museum of Natural History of the Smithsonian Institution, USA and the Old Dominion University, Virginia, USA since 2011 to inventory and DNA barcode commercially important fish species sold at the markets around the country. Three voucher specimens of Bluenose Large-Eye Bream, Lethrinid, *Gymnocranius superciliosus*, a first record for the Philippines, were obtained in Olongapo City and Tabaco City markets on July 15, 2016 and October 31, 2017, respectively. The specimens obtained were positively identified by P Borsa through our photograph and was further validated through clustering analysis using DNA barcode CO1. These Large-Eye Bream specimens have standard lengths ranging from 22.5 cm to 34.1 cm. Market vendors claimed it was caught in South China Sea and Lagonoy Gulf. This species is so far only known from Southwest Pacific: New Caledonia, Chesterfield Is., and Fiji. The discovery of this species in the Philippines adds to the knowledge and evidence that the country has indeed one of the richest fish fauna on the planet.

Keywords: First Record, *Gymnocranius superciliosus*, Philippines

AS – 53

FISHING GEARS, CRAFTS, AND PRACTICES USED IN APAYAO RIVER

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Fisheries management requires good knowledge on fishing gears, methods, and practices. The Apayao River, which is the major fishing ground in Apayao province, provides indigenous, native, and migratory aquatic species caught through different fishing gears and methods. The study aimed to assess the fishing gears, crafts, and practices that the Apayao fisherfolk have adopted through the years. Survey was conducted from July 2014 to July 2016. Information was collected through focus group discussions in the municipalities traversed by the Apayao River, namely, Pudtol, Sta. Marcela, and Flora. Results indicated that fishers use various types of fishing gears and different fishing methods. There are seven classifications of fishing gears in the Apayao River: the gill net (*sigay*); surrounding net (*sayanggong*); hooks and lines (*banni-it and lawin*); fish traps (*bubu, screen, tubung, and asar*); cast net (*tabukol*); push net; and miscellaneous fishing gears (spear gun and hand picking). Fishing practices include the *rama* and *sirot*. These gears are used at different times of the year depending on the season, weather, discharge of water in the river, topography of the fishing ground, and target species. Fishing is also affected by the agricultural season in Apayao, which allows for natural closed seasons in the fishing grounds and for stocks to replenish. Fishing gears, crafts, and practices in the Apayao River have evolved according to the needs of the fisherfolk. Modifications have been made through time. Some of the gears, crafts, and practices reflect the cultural identities of the Apayao people. Over time, communities along the Apayao River have developed rules and technologies in the use of the river.

Keywords: fishing gears, fishing practices, Apayao River

AS – 54

**FOOD AND FEEDING HABITS OF *Sarotherodon melanotheron*
(BLACK-CHIN TILAPIA) IN SELECTED AREAS
IN MANILA BAY**

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Sarotherodon melanotheron (Black-chin Tilapia) inhabits fresh to brackish water environments (Mireku et al. 2016), and is characterized by extreme euryhalinity. Due to its characteristics that are shared by many successful invasive species, *Sarotherodon melanotheron* can be considered as an invasive species that deserves aggressive intervention. This study determined the food items, food preferences, and feeding patterns of *Sarotherodon melanotheron*. The diets of black-chin tilapia were investigated using frequency of occurrence and numerical method of 295 stomach samples collected over one year. From both percent occurrence and numerical percentage method, results indicated that the most important food items of the *S. melanotheron* obtained from Manila Bay were Diatoms (77.01%) comprised mainly of *Coscinodiscus* (24.55%), followed by *Pseudonitzschia* (16.16%), Cyanobacteria (7.77%), and Dinoflagellates (4.39%). *S. melanotheron* can be considered as a generalist or omnivorous fish that can feed on a wide range of food resources. Its diet is dominated by phytoplankton species and detritus materials.

Keywords: black-chin tilapia, diatoms, *Sarotherodon melanotheron*

AS – 55

**GENETIC DIVERSITY OF *Sepioteuthis lessoniana*
(BIGFIN REEF SQUID) IN ASIA USING
MITOCHONDRIAL DNA CONTROL REGION (CO1)**

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Sepioteuthis lessoniana is one of the most commercially important cephalopods in Asia. In silico analysis was done in this study to generate data using mitochondrial DNA Region (CO1) on the genetic diversity of bigfin reef squid. Genetic variations and population differentiation of this commercially important cephalopod is important for the design and implementation of appropriate fisheries management. Out of 83 sequences from 6 locations, a total of 40 haplotypes were observed. These consisted of 26 unique haplotypes, while the remaining were shared by two or more populations. High haplotype diversity (H_d) with a mean value of 0.956 (π) and mean nucleotide diversity of 0.02 were observed. These indicate that there might be a bottleneck effect due to the overfishing of this cephalopod. High expected heterozygosity was also observed, while mean F_{ST} was 0.34. This indicates that there might be panmixing between populations due to the higher level of gene flow. These squids are highly mobile; they use such large oceanographic features as spawning grounds. There are many other factors to consider on the genetic differentiation of this highly valuable cephalopod.

Keywords: genetic diversity, mitochondrial DNA region (CO1), *Sepioteuthis lessoniana*

AS – 56

**SEED PRODUCTION OF SEA CUCUMBER GROWTH,
DEVELOPMENT AND SURVIVAL
OF *Holothuria scabra* LARVAE AND JUVENILES
IN DIFFERENT REARING TREATMENTS**

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This study investigated microalgal diets, seaweed diets, and water treatments to determine their effects on the seed production of *Holothuria scabra*. Results showed that combined-species feed of *Chaetoceros gracilis* and *Chaetoceros calcitrans* (*Cgr-Cc*) yielded the best survival rate ($3.22 \pm 2.26\%$) compared with single-species feeds. *Cgr* yielded maximum survival rate of $2.84 \pm 2.19\%$, whereas *Cc* yielded $2.12 \pm 1.97\%$. Microalgal concentration of $50,000 \text{ cells mL}^{-1}$ of *Cgr-Cc* rendered remarkable final growth ($3766 \pm 523 \mu\text{m}$) of the larvae; however, survival was minimal in the setup. Larvae were stunted in setups maintained at $10,000 \text{ cells mL}^{-1}$. *Laurencia papillosa* (*Lp*), *Gracilaria bailinae* (*Gb*), and *Sargassum* sp. (*Srg*) were studied as feeds for juveniles. *Lp* rendered the highest survival rate of $56.78 \pm 3.39\%$ in May 2016 and $53.22 \pm 6.85\%$. *Gb* rendered the lowest with $8.87 \pm 1.68\%$ and $19.44 \pm 1.24\%$. The performance of dried seaweeds as feeds were also tested and compared with that of fresh seaweed diets. Survival was higher with fresh seaweeds than with dried seaweeds (fresh *Lp* = $25.33 \pm 1.92\%$ vs dried *Lp* = $16.67 \pm 12.02\%$; fresh *Srg* = $22.33 \pm 4.21\%$ vs dried *Srg* = $21.00 \pm 20.50\%$), although the mean differences in the survival rates were not significant ($p > 0.05$). Feeding rates of seaweeds were also investigated. Results showed that juveniles had better growth and survival when fed with 7.5 Ld^{-1} ($19.00 \pm 0.76\%$) and 9 Ld^{-1} ($18.67 \pm 0.93\%$) than when fed with 4.5 Ld^{-1} ($17.17 \pm 3.44\%$) and 6 Ld^{-1} ($14.50 \pm 1.76\%$). However, the means were not significantly different ($p > 0.05$). Water treatments for larval rearing were also studied. Sand-filtered seawater rendered highest survival rate of larvae ($13.59 \pm 2.89\%$) followed by UV-treated seawater ($4.40 \pm 1.23\%$); chlorinated seawater yielded the lowest survival rate ($2.47 \pm 1.85\%$). The mean survival rates of the three treatments were significantly different ($p < 0.05$).

Keywords: sea cucumber, *Holothuria scabra*, seed production, seaweeds, specific growth rate

AS – 57

**HATCHERY PRODUCTION AND JUVENILE RESTOCKING OF
THE WHITE TEATFISH SEA CUCUMBER, *Holothuria fuscogilva*
(CHERBONNIER 1960)**

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The decline of *Holothuria fuscogilva* due to indiscriminate exploitation demands the urgent development of hatchery techniques in captive breeding to help increase its natural population. The successful spawning induction of broodstock from Lopez Jaena, Misamis Occidental produced juveniles in hatchery conditions. Survival was 0.38% after three months, which decreased to 0.04% after 10 months. Restocking of this cohort of juveniles back to Lopez Jaena showed rapid average growth from 0.76 g during the first month to 11 g after three months.

Keywords: sea cucumber, white teatfish, batchery, production

ICHTHYOPLANKTON ASSEMBLAGES IN MANILA BAY

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Manila Bay used to be one of the major fishing grounds in the Philippines. However, recent studies have determined that fish catches and the succession from valuable to lesser valuable fish being caught in the bay have been declining steadily. Fish larvae collection was carried out in the study to determine the ichthyoplankton assemblages in the bay. Eight established sampling stations were placed throughout the bay, with an average distance of 5–6 nautical miles and were sampled every other month from January to November 2017. A total of 860 fish larvae belonging to 28 families were collected. Results showed that there were more fish eggs and fish larvae during the March 2017 survey, a representative of northeast monsoon, with 530 ind/100m³ fish eggs and 255 ind/100m³ fish larvae. This was followed by the November 2017 survey, also a representative of northeast monsoon, with 529 ind/100m³ fish eggs and 197 ind/100m³ fish larvae. Most fish eggs were found in the northeastern, middle, and eastern part of the bay. Since fish eggs are drifters and move along the surface currents, they can be found throughout the bay. The concentration of fish larvae were mostly found in the eastern part of the bay. Fish larvae showed a shoreward transport, as more fish larvae have been consistently found near the coast, particularly in the eastern and northwestern part of the bay. Small pelagics (e.g., sardines, slipmouths, anchovies, and mullets) dominated the total composition of fish larvae family in Manila Bay. The most dominant fish families were Clupeidae, followed by Leiognathidae, and then Nemipteridae. Other families that complete the top five were Mugilidae and Gobiidae.

Keywords: ichthyoplankton, Manila Bay

AS – 59

MESH SIZE SELECTIVITY OF SURFACE AND MID-WATER GILL NET FOR CATCHING FRESHWATER SARDINES “*SARDINELLA TAWILIS*” (HERRE, 1927) IN TAAL LAKE, BATANGAS

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Technical information on the mesh size selectivity for tawilis fishery in Taal Lake was still largely unknown or undocumented at present and various mesh sizes are employed to exploit the species in a variety range of sizes. The study investigated the mesh size selectivity involving gillnet fishery for *S. tawilis* using four differing mesh sizes (12.5K, 12K, 11K and 10K). Fishing trials were conducted in Taal Lake, Philippines from October 2014 to September 2015. A total of 4,456 *S. tawilis* was caught with the size range (total length) of 8.0-14.0 cm. The seasonal changes in the gonadosomatic index (GSI) showed that *S. tawilis* spawns between March- May and August. Length at 50% maturity (L50) estimated as 11.66 cm, was used as the criterion for selecting desirable mesh size. The optimal length was estimated for each mesh size employing Baranov -Holt method with the model for various mesh sizes. The estimated optimal lengths of *S. tawilis* were estimated at 10.6, 11.08, 13.07 and 14.53 cm for the mesh sizes of 12.5K, 12K, 11K and 10K, respectively. Hence, the desirable gillnet mesh size for *S. tawilis* corresponding to length at 50% maturity was determined to be 11K.

Keywords: optimum mesh size, selectivity, sustainable exploitation, gill net, endemic

AS – 60

**ON CONSERVING ENDEMIC FISH: A CASE ON THE
MORPHOLOGY OF *Glossogobius giuris* (HAMILTON 1882)
IN LAKE MAINIT, NORTHEASTERN MINDANAO**

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Changes in the water quality of any body of water pose threats to the morphological attributes of endemic fishes since such change can create geographic barriers and habitat restrictions. This study collected a total of 526 male and 527 female *pijanga* (*Glossogobius giuris*) from Lake Mainit for morphometric and meristic analyses. Samples were collected quarterly for a year using a modified cast (i.e., *laya/laja*). Results showed that male *pijanga* (mean TL of 147.99 ± 10.67 to 149.30 ± 7.93 mm) were relatively bigger than the females (mean TL of 144.33 ± 14.62 to 145.92 ± 18.18 mm). The morphometric and meristic characters measured were not significantly different, signifying that a relatively similar stock of *pijanga* inhabits the lake. Male and female *pijanga* did not exhibit sexual dimorphism, which signifies that there were no signs of habitat restrictions and geographic isolation within the lake. Likewise, the samples had well-proportioned body structures, which may signify a favourable habitat and available food sources. Hence, the presumed changes in water quality did not adversely affect the morphology of *pijanga*. However, it is still imperative to enforce the regulatory and nonregulatory measures of the local governments surrounding the lake in order to protect and conserve the endemic *pijanga* and the water quality of the lake for intra- and intergenerational equity and benefits, especially for the fishing communities whose survival depend on the lake resources.

Keywords: Lake Mainit, sexual dimorphism, *Glossogobius giuris*

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**REGENERATION AND DEVELOPMENT
OF ENZYMATICALLY-ISOLATED PROTOPLASTS
OF *Kappaphycus* spp. (Solieriaceae, Rhodophyta)**

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The production and quality of *Kappaphycus* seaweeds in the Philippines have been declining since 2007, mainly due to the inadequate supply of good quality seedstocks. Among the strategies pursued to solve the problem is through the production of improved strains from protoplasts or from living cells devoid of cell walls. However, despite development of technology to isolate protoplasts for *Kappaphycus* spp., using protoplasts in seedstock production and in strain improvement is still not possible due to their low regeneration rate. This study was conducted to optimize the conditions for regeneration and subsequent growth of protoplasts isolated from *Kappaphycus* spp. through enzymatic methods. Viable protoplasts from different strains of *Kappaphycus alvarezii* and *Kappaphycus striatus*; different tissue types (medullary, cortical); and ages (apical, basal) were isolated using a two-step enzymatic method. The isolated protoplasts were embedded in droplets of soft carrageenan gel, and then flooded with f/2 medium during the first 2–3 weeks of culture. These were then cultured in lighted shelves at different irradiance levels (i.e., $22 \pm 2^\circ\text{C}$ and 12:12 L:D photoperiod). Protoplasts of subcortical cells obtained from the apical portion of seven farmed and wild strains of *K. alvarezii* regenerated into 5–12 mm germlings (<1 cm plants) after 26–32 days of culture in gel droplets. Regeneration rate was 10–36%, and two regeneration patterns were observed. This resulted in the development of either a dichotomously branched thallus or uniseriate, branching filaments within six months. Results of regeneration in gel droplets with f/2 medium at different irradiance level showed that the different strains had different irradiance requirements.

Keywords: *Kappaphycus* spp., seedstock production, strain improvement

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REPRODUCTIVE BIOLOGY OF BIG EYE SCAD
***Selar crumenophthalmus* (BLOCH 1793)**
FROM MANILA BAY, PHILIPPINES

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This study investigated the biological aspect of *Selar crumenophthalmus* (Bloch 1793) to help raise its protection and conservation in Manila Bay, Philippines. A minimum of 50 fresh samples were randomly collected from 16 selected sites in Manila Bay. The collected samples came from fishing gears such as gillnets (e.g., bottom gillnet, drift gillnet), stationary lift net (SLN), and trawl (T). A total of 728 individuals were sampled from January to December 2017. The total length of *S. crumenophthalmus* ranged from 13–24.6 cm for females and 9.4–24 cm for males. Hence, body weight ranged from 23.79–191.61 g for females and 13.85–225 g for males. The overall ratio between males and females conformed to the expected 1:1 sex ratio. Spawning was observed in various months, with high occurrence from January to March and August to October in females, and from August and December in males. An evident peak of Gonadosomatic index (GSI) in females was observed in February, with accounted mean GSI value of (1.99 ± 0.23) ; and in January in males, with mean GSI value of (3.62 ± 0.60) . The estimated length at first maturity (L_{m50}) in female big-eye scads was at midlength of 20.25 cm and at midlength of 21.25 cm in males. To prevent the overfishing of this species, it is important to study its reproductive biology for management intervention.

Keywords: *Selar crumenophthalmus*, sex ratio, spawning season, gonadosomatic index, length at first maturity, Manila Bay

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REPRODUCTIVE BIOLOGY OF BIGFIN SQUID (*Sepioteuthis lessoniana*) IN WESTERN VISAYAS

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The study investigated the reproductive characteristics of the commercially important squid *Sepioteuthis lessoniana* in Western Visayas in order to assess the status of this species and to generate scientific data that would serve as basis for the development of possible conservation and management measures in the region. A total of 584 squids (293 female and 291 male) from Estancia, Iloilo; Roxas City, Capiz; and Enrique B. Magalona, Negros Occidental were analyzed from February to September 2017. The mantle length size of the samples collected ranged from 7.8 to 34.4 cm. Sex ratio of the samples was not significantly different ($p > 0.05$) from the expected ratio of 1:1, except for those collected during the month of July. Spawning season, as depicted in the maturity stages and in the Gonado-somatic Index (GSI) of the sexes, was between May to July, with peak at June. Mature individuals were observed throughout the months of collection. The reproductive characteristics of *S. lessoniana* showed changes in terms of sex ratio, maturity stages, and GSI; thus, spawning season can be predicted. If overexploitation occurs, then there would be decrease in spawning individual, thereby reducing the reproductive capacity of the population.

Keywords: *Sepioteuthis lessoniana*, reproductive biology, GSI

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SPATIO-TEMPORAL VARIABILITY OF ZOOPLANKTON IN MANILA BAY IN 2017

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Manila Bay is one of the most important bodies of water in the Philippines because of its socioeconomic impact. Zooplanktons are major food source for fishes. Studies have been done on the pollution of Manila Bay, especially on its water quality and harmful algal bloom issues. However, only a very few studies are available on the zooplankton community of the bay. Zooplankton samples and physico-chemical data were collected every two months within one year. Samples were subjected to microscopy. Individual zooplankton was identified to lowest possible taxa. *Paracalanus* sp., *Oithona* spp. and copepod nauplii dominated the zooplankton community in Manila Bay during the sampling period in 2017. The highest concentration of zooplankton was recorded in Station 14 in the month of September, with a density of 610,050 ind m⁻³. The lowest density of zooplankton was recorded during the sampling in May in Station 14, with a density of 5,945 ind m⁻³. Canonical Correspondence Analysis revealed that there is a significant correlation between zooplankton composition and abundance and physico-chemical parameters such as temperature, nitrate, dissolved oxygen, and salinity. A change in the environmental conditions of the bay brought a corresponding change in the zooplankton community.

Keywords: environmental factors, zooplankton community, Manila Bay, canonical correspondence analysis

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STOCK ASSESSMENT OF COMMERCIALY IMPORTANT FISH FAUNA IN MANILA BAY, PHILIPPINES (2012-2015)

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The study aimed to assess the status of Manila Bay, particularly on the commercially important fish fauna, and to determine the extent of their exploitation. Data collection through fish landing information (e.g., total catch per fishing operation, species composition, type of fishing gear, and its specific efforts, size measurements of selected fish species, and total number of fishing boats that landed per sampling day) started from January 2012 to December 2015 from 16 landing sites surrounding the bay. Twenty-seven types of fishing gears were observed. Ring net, trawl, and drift gillnet had the highest production among the gears. Fish catch were composed of 218 species of fish and invertebrates, and these were dominated by small pelagic species: *Sardinella gibbosa*, *S. fimbriata*, *Rastrelliger brachysoma*, and *Portunus pelagicus*. Tilapiine species, *Sarotherodon melanotheron*, were also observed in the landed catch but previous studies showed no record of the species in the bay.

Keywords: Manila Bay, fish fauna, tilapiine, exploitation.

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SUPPLY AND VALUE CHAIN ANALYSIS OF MALIPUTO, *Caranx ignobilis* IN THE PHILIPPINES

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Value chain analysis of *Caranx ignobilis*, a highly prized food and one of the specialty commodities of the Philippines, was conducted from January to December 2017 in nine regions of the country. The study aimed to identify the actors in the chain; evaluate value additions; and identify issues, concerns, and interventions in order to improve its market industry. A semi-structured questionnaire was administered to purposively selected respondents. Despite being a specialty commodity, *C. ignobilis* is simply an incidental catch-based and wild-dependent industry. Moreover, it is not an export commodity; thus, market is limited to domestic consumption, which is less a competitive industry. The key chain actors were fishermen, fish cage operators, and middlemen. Middlemen are further divided into small-scale (local vendors and peddlers) and large-scale intermediaries (commission agents, wholesalers, and restaurants). The study showed that production of *C. ignobilis* is still small, and culture of this species in fish cages needs to be improved so that it can be more profitable. Limited supply of fingerlings and lack of knowledge on how to culture properly limit the production of fish farmers. Most of the intermediaries were small entrepreneurs serving local markets. A wide range of intermediaries contribute to marketing inefficiency rather than adding real value to the product. Moreover, being a potential high-value aquaculture species, the following upgrading strategies are suggested to boost the industry: (1) conduct studies on its breeding to grow-out culture along with its technology transfer; (2) develop programs that increase awareness that *C. ignobilis* is a high-value species; (3) conduct market-to-market matching; (4) introduce *C. ignobilis* culture, especially to regions where it is not practiced to avoid pressure on wild stocks and improve its production; and (5) identify possible export market.

Keywords: *Caranx ignobilis*, value chain analysis, stakeholders

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**TECHNICAL EFFICIENCY ANALYSIS
OF RED TILAPIA AQUACULTURE FARMS IN SELECTED
AREAS IN THE PHILIPPINES AND THAILAND:
AN APPLICATION OF STOCHASTIC FRONTIER ANALYSIS**

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The study analyzed the factors influencing the technical efficiency of red tilapia production in the Philippines and Thailand. Total enumeration of red tilapia cage farms were surveyed using face-to-face interviews. Data were collected through a structured questionnaire; the information was coded and analyzed through descriptive statistics and stochastic production frontier based on the Cobb-Douglass production function. Generally, technical efficiency results showed that all fish farmers in the study areas were operating below the production frontier. Hence, there is need to investigate extensively the sources of inefficiencies in the socioeconomic variables and farm characteristics in order to increase production and efficiency. The maximum likelihood estimation of the stochastic production frontier showed that the mean technical efficiencies in the Philippines and Thailand were 0.32 and 0.78, respectively. Results of the model further revealed that red tilapia cage production in selected areas in the Philippines and Thailand is explained by area, feeds, and dissolved oxygen level. The policy implication is that there are still more opportunities to raise the present level of technical efficiency of red tilapia production in the two countries.

Keywords: technical efficiency, red tilapia, frontier

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WATER QUALITY AND ECONOMIC PRODUCTIVITY OF FISH CAGE OPERATION IN LUMOT LAKE, CAVINTI, LAGUNA

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This paper presents a baseline data of the economic productivity and water quality of Lumot Lake in Cavinti, Laguna. The economic productivity of fish cage operations in the research site was measured through a simple Cost Return Analysis. The yield of fish cage operators in the lake were computed through the data gathered from surveys and direct interview with the respondents. The data obtained from the fish cage operators showed high fish (*Tilapia*) production in the lake. Water quality parameters (i.e., temperature, transparency, pH, dissolved oxygen, salinity) were measured using specific instrument, while water hardness and nitrogenous compound (i.e., phosphate and nitrate) were brought to the laboratory for further analysis. The study further showed that the Lumot Lake's water quality was within the standards set by the Environmental Management Bureau of the Department of Environment and Natural Resources. The above water quality parameters were also analyzed and compared with the water quality requirements of *tilapia*. Results showed that all of these were within the required limits for the growth and survival of this fish species.

Keywords: fish cage productivity, water quality, physico-chemical parameters, economic productivity

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**EFFECTIVENESS OF PREDATOR CONTROL SET-UP
FOR AQUATIC PEST CONTROL IN ORGANIC AND
CONVENTIONAL EARTHEN PONDS FOR EXTENSIVE
CULTURE OF *Penaeus monodon* (Fabricius 1798)**

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To control pest entry in *Penaeus monodon* earthen ponds, this study tested whether using a carnivore fish-based set-up would be more effective in reducing pest infiltration in an organically-prepared pond (“H”) than using fine net barrier at the inlet gate of a conventional, control pond (“J”). To eliminate pests, estuarine water was diverted toward compartments that held 50 5-gram *Lates calcarifer* and 19 300–400-gram *Epinephelus coioides* before entering Pond “H”. After 88 DOC, three pest categories were identified: (1) shrimp predators: *Megalops cyprinoides*; (2) opportunistic feeders: *Tilapia mossambicus*, *Chanos chanos*; and (3) benthic scavengers: *Cerithidea cingulata*. The set-up prevented smaller *T. mossambicus* from entering, but it was ineffective against the larger predators. Wet biomass of fish pests were 1.92 kg and 2.12 kg, while that of *C. cingulata* were 29 kg and 80 kg for Ponds “H” and “J”, respectively. Shrimp harvest was reduced to 3.9 kg in Pond “H” and 0.88 kg in Pond “J”. Shrimp length-frequencies obtained from 30% of the biomass revealed that the independent sample cohorts manifested negatively skewed population curves, having a common range of 111–120 mm. Pond “H” had a smaller skewness value (–10.68) than Pond “J” (–20.64). A significant t-value of –1.39 at $p < 0.10$ and df_{18} at t_{90} indicates that organically-grown shrimps were larger than the controls.

Keywords: earthen pond, organic, *Penaeus monodon*, predator control, extensive

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SUITABILITY OF WATER FROM CALUMPANG RIVER FOR AQUAPONIC SYSTEM

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The study tested the applicability of the Calumpang River water as a media-based Aquaponic System. As an aquaponics system, it utilized two cultures—fish culture (aquaculture) and vegetable production (hydroponics). The water sample was collected near Ferry Road, Brgy. Kumintang Ibaba. It was poured onto a grow bed made of clay pebbles called hydroton, where Pac choi (Pechay) plants were grown and where tilapia were cultured. The quality of the water from the river was tested using an API freshwater test kit that would determine if it could be applied to the system. Four parameters were considered, namely, pH, ammonia, nitrite, and nitrate contents. The changes on the levels of the parameters were recorded for seven days to determine the ability of the water to work on the system and to nitrify nitrite, and thus make it habitable for fishes and plants. River water was sampled on September 16, 2015 and was tested before and after it was applied on the aquaponic system. Data were recorded for analysis and the parameters tested were compared with those prescribed in FAO standards. Result showed that the system reduced the pH and nitrate levels of river water. Ammonia and nitrite content were converted to nitrate through using biological bacteria. Considering FAO standards, it can be said that the water quality of Calumpang River is suitable for aquaponic system.

Keywords: aquaponics, hydroton, nitrification

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DEVELOPMENT OF MICROSATELLITE MARKERS FROM SUGARCANE (*Saccharum officinarum* L.) PHIL 97-3933

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The efficiency of commercial farms can improve through the application of developed technologies such as microsatellite repeats or simple sequence repeats (SSRs) as genetic markers in plant species. This study developed sets of SSRs from Phil 97-3933 variety, a cultivar known to be highly resistant to sugarcane smut and downy mildew. For the library construction, genomic DNA of Phil 97-3933 was extracted and was digested using methyl-sensitive restriction enzymes *Pst*I and *Aat*II, with six base pair recognition sites. A total of 200 sequences were analyzed. Twenty-seven SSR primers were developed from sugarcane CV Phil 97-3933 using BatchPrimer3 (You et al. 2008). Results showed that SGS P20 had similar gene identity to *Saccharum* hybrid cultivar R570 clone BAC 227O17, while SGS P141 had similar gene identity to *S. officinarum* clone LA154P24. Other SSR primers that returned BLASTn similar gene identities were SGS P131 (*Sorghum* hypothetical protein), SGS P76 (*S. officinarum* clone LA34B02), SGS P112 (*Saccharum* hybrid BAC 235G19), SGS P125 (*Sorghum* hypothetical protein), and SGS P139 (*Sorghum* voucher BTx623 locus pSB1123). The rest of the identified primers did not return any BLASTn result. The challenge in a sugarcane sequencing project is the size and complexity of its genome structure, which is highly polyploid and aneuploidy. The highly polymorphic nature of sugarcane represents another challenge.

Keywords: sugarcane, microsatellite markers, genomic library

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GENOTYPIC VARIATION OF VARMIX ROOT SYSTEM UNDER SOIL MOISTURE FLUCTUATION

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The root system is the plant organ directly in contact with the soil; thus, it is the first line of defense for maintaining plant productivity under soil moisture fluctuation (SMF) condition. Varietal Mixture (VarMix) is a well-known approach for disease management. Previous studies have shown that aside from reducing disease incidence, it can also mitigate the negative effects of drought stress condition on yield. This study investigated the mechanisms involved from below ground environment that would scientifically explain why VarMix is comparable to, or even performs better than, its single variety. Thus, the study compared the root system development (RSD) and yield of rice between VarMix and single variety planted under SMF condition. Twelve VarMix combinations and its corresponding single varieties (i.e., NSIC Rc216, Rc298, Rc214, Rc238, Rc300, and PSB Rc82) were used in the study. Treatments were subjected to SMF condition until maturity. Among VarMix combinations, five ratio combinations, namely, NSIC Rc216, Rc298, Rc238, Rc300, and PSB Rc82 showed higher yield under SMF condition. This was attributed to the positive significant relationship between RSD (based on total root length) and yield in VarMix. Results showed that VarMix, depending on varietal mixing, increased yield under SMF.

Keywords: roots, drought, soil moisture fluctuations, Varietal Mixture, yield

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GREENHOUSE EVALUATION OF HIGH-YIELDING SUGARCANE VARIETIES FOR DROUGHT TOLERANCE

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A total of 10 high-yielding sugarcane varieties (HYVs) were evaluated for drought tolerance under greenhouse conditions. The 10 HYVs developed by the Sugar Regulatory Administration (SRA) were subjected to drought by withholding water for 10 days. This was followed by two-month recovery period. Plants were monitored in three-day intervals for chlorophyll content using SPAD 502 chlorophyll meter and for antioxidant content using colorimetric assay. After six months, plants were harvested and were evaluated for their agronomic traits. Antioxidant analysis showed a general trend of peak antioxidant concentration and percent scavenging activity (%SA) at six days after last watering. Phil 00-0791 had the highest antioxidant concentration of 2621.63 $\mu\text{g g}^{-1}$ leaf sample, and Phil 03-1389 had the highest %SA at 25.81%. Agronomic data showed significant variety-water treatment interaction in terms of leaf area; Phil 06-2289 had the highest leaf area under drought condition, with 23% reduction in total leaf area. Further reductions were observed in terms of 25% reduction in millable stalk weight and 24% reduction in total stalk weight. Overall, the 10 HYVs showed significant differences in terms of all agronomic traits, chlorophyll, and antioxidant content across water treatments. This is a good indication that would help to identify the sources of drought tolerance among sugarcane germplasm. Further field evaluation is being done to confirm initial findings.

Keywords: sugarcane, drought, drought tolerance, antioxidant assay, chlorophyll meter

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INBRED MAIZE PLANT RESPONSE TO SIMULATED DROUGHT POT EXPERIMENT

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Maize is second to wheat in terms of area harvested, but first in total production in the world (FAO 2013). Although yellow maize serves as an alternative staple food, it is largely propagated for the feed industry. Drought may be the most important abiotic stress affecting agricultural crops worldwide, and thus screening for corn varieties with drought tolerance is essential to lessen the damage caused by this stress. However, such screening requires considerable land area and time; hence, alternative and rapid drought screening methods must be explored. In doing so, determining the response of plants to certain degrees of drought is essential for the development of this method. In this study, two acquired CIMMYT inbred lines (i.e., CML 161 and CML 551) were subjected to separate simulated drought pot experiments, namely, seedling stage, before flowering stage, and after flowering stage. Initially, seedlings were grown in pots with full watering capacity. Drought was initiated 7 days after germination, 50 days after germination, and after flowering stage. Constant soil sampling was done to determine soil moisture content (MC), and plant behavior was closely monitored. Leaf whorling and browning was observed 4–5 days after subjecting the seedling to drought at 9% soil MC; plant mortality was later observed. Similarly, these symptoms were observed among plants subjected to drought before and after the flowering stage. However, grown plants thrive at 9% MC for two weeks until MC dropped to 2%, leading to plant mortality. These results show the importance of water during the seedling stage, and occurrence of drought at this particular stage of development would lead to less plant survival. Grown corn can manage drought but only up to a certain degree. This result should be accompanied by the development of a quick method for drought screening.

Keywords: maize, soil moisture, drought, plant response, CIMMYT

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MORPHOLOGICAL AND PHYSIOLOGICAL SCREENING OF RICE (*Oryza sativa* L.) FOR SALINITY TOLERANCE AT SEEDLING STAGE

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The study generally aimed to screen rice (*Oryza sativa* L.) accessions under the Rice Diversity Panel (RDP) tolerant to salinity at seedling stage using morphological and physiological parameters. Specifically, it aimed to compare the growth and physiological responses of the different accessions under RDP to salinity stress, determine which are considered tolerant or susceptible, and assess which physiological characters best contribute to salinity tolerance. Morphological screening was based on modified Standard Evaluation System (SES) scores of visual salt injury at seedling stage. The samples were exposed to Yoshida's solution supplemented with sodium chloride to obtain a final electrical conductivity of 12 dS m⁻¹. The physiological screenings done were vigor test, biomass test, chlorophyll content determination, and sodium-potassium ratio measurement. Morphological screening showed that out of the 324 rice accessions assessed, 87 rice accessions (27%) were classified as highly tolerant to salinity. M 202, MINGHUI 63, ECIA76-S89-1, and MING HUI showed the highest degree of tolerance. About 195 (60%) accessions were considered as tolerant, while 36 (11%) were moderately tolerant. Four (1%) accessions were classified as susceptible, and only two accessions (C57-5043 and WC4419) were highly susceptible. Among the physiological parameters used, vigor seedling growth and root biomass did not correlate with the morphological SES scores. Shoot biomass, chlorophyll content, and sodium-potassium ratio correlated with the morphological result. These indicate that the three latter physiological parameters must be considered for future studies in developing rice for salinity tolerance.

Keywords: Rice, salinity, Standard Evaluation System (SES), Yoshida's solution, physiological parameters

MORPHOLOGICAL, GROWTH, AND YIELD RESPONSES OF RICE GENOTYPES TO POTASSIUM APPLICATION AND REPRODUCTIVE DROUGHT STRESS

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Low yields of 1.5–0.5 tha^{-1} have been reported in drought-prone rainfed lowland rice areas in the Philippines. Given the scarcity of water resources, irrigation is not a practical option in most rainfed areas. Hence, genetic and agronomic management strategies need to focus on using available soil moisture. Field studies at the Philippine Rice Research Institute were conducted on Maligaya clay soil to assess the morphological, growth, and yield responses of rice genotypes NSIC Rc282, NSIC Rc222, and NSIC Rc418 to fertilizer management and to 20-day reproductive drought stress by withholding irrigation from 60–80 days after transplanting (DAT). In combination with equal amounts of N and P, two levels of K fertilizer were applied: (1) 120-40-60 and (2) 120-40-120 kg NPK ha^{-1} . At 14 DAT, 1/3 of N and K and all P fertilizers were applied. At 40 DAT, the remaining 2/3 of N and K were applied. Drought stress development was characterized by the decrease in soil moisture content to 9.4% and increase in soil strength to 2.5 MPa. Compared with the other genotypes, NSIC Rc282 had slower progression of leaf rolling and higher leaf area with 120-40-120 kg NPK ha^{-1} than with 120-40-60 kg NPK ha^{-1} . With 120-40-120 kg NPK ha^{-1} , grain yields of NSIC Rc282, NSIC Rc222, and NSIC Rc418 were 4.3, 4.2, and 3.6 tha^{-1} , respectively, following reproductive drought stress and rewatering. Based on the well-watered control treatment, the average percent yield reductions were 15% with 120-40-120 kg NPK ha^{-1} and 28% with 120-40-60 kg NPK ha^{-1} . With higher level of K fertilizer application, production of proline could have increased and peroxidase and catalase activities could have been enhanced, thereby maintaining photosynthesis during drought stress and minimizing yield reduction (Zain et al. 2014; Wang et al. 2016).

Keywords: potassium application, drought, rice genotypes

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MORPHO-PHYSIOLOGICAL CHARACTERIZATION AND PROTEIN ANALYSIS OF MUNGBEAN GENOTYPES SCREENED FOR WATERLOGGING TOLERANCE

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Waterlogging causes adverse effects on mungbean productivity. Thus, screening for the most promising genotypes with waterlogging tolerance is essential to improve its potential as a rotational crop for rice. A split-plot experiment in Randomized Complete Block Design was conducted to evaluate 16 mungbean genotypes for waterlogging tolerance based on their morpho-physiological characteristics and crude protein content (CPC) under prolonged waterlogging duration. Tukey's HSD was performed for traits that showed significant variations based on ANOVA. Pearson's Product-Moment Correlation indicated strong positive association with seed yield by weight of 100 seeds, pod length, plant height at 30 days after planting (DAP), and number of seeds per pod, which ranged from $r=0.82^{**}$ to $r=0.85^{**}$. Tolerance to waterlogging was positively correlated with fresh weight, duration of flowering, days to first flowering, and days to first priming; the last parameter had the highest correlation coefficient ($r=0.70^{**}$). Using regression analysis, the relationship between seed yield and CPC to the duration of waterlogging was expressed as $y=10.371-0.4315x$ ($R^2=0.982$) and $y=23.648-0.7453x$ ($R^2=0.9725$), which estimated a yield reduction of 0.43 g and 0.75% decrease in CPC for every day of exposure to waterlogging stress.

Keywords: soybean, waterlogging tolerance, waterlogging stress, crude protein content, yield reduction

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**QUANTITATIVE FRUIT CHARACTERIZATION
OF THE COCONUT (*Cocos nucifera* L.)
CATD × (LAGT × WAT AN17) MAPPING POPULATION**

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Various studies have been undertaken to boost the coconut industry through breeding of new varieties with high-yield and high-quality copra oil. A three-way cross of the LAGT and WAT and CATD coconut varieties were utilized in improving the coconut productivity and copra oil yield and quality. A total of 85 progenies from the CATD × (LAGT × WAT AN17) population and their parents were analyzed for horti-morphological characterization. Nut samples were collected in each progeny for the two periods: dry season (DS) and wet season (WS) from 2015–2017. The samples were evaluated for the following fruit components: whole nut, husked nut, husk, split nut, meat, shell, water and copra. Moreover, percent dry matter content and fruit quality value were also derived. The mean whole nut weight of the mapping population was 1089.10 g, which is relatively comparable to its parents CATD (1,197.57 g) and LAGT × WAT (1,451.25 g). Among the progenies, 1912 had the highest whole nut weight with 1875.00 g. Moreover, the meat, which remained the most economically important part of the coconut, varied differently in the two seasons. The mean meat weights were 376.71 g and 322.67 g for DS and WS, respectively. The copra weight during DS was heavier with a mean weight of 226.40 g than that in WS with 215.47 g. This study provides the phenotypic data for eventual analysis and identification of markers associated with coconut productivity and copra oil high yield and quality.

Keywords: coconut, three-way cross, fruit component analysis

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RESILIENCE OF *Senna tora* (L.) Roxb. IN DROUGHT AND WATERLOGGED CONDITIONS AT VEGETATIVE STAGE

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The sustainability of agriculture, food and nutrition security, and sustained income of small farmers may depend on either the identification or development of climate-resilient crops that are tolerant to environmental stresses. *Senna tora* in Bukidnon, although still largely regarded as a leguminous weed, is reportedly being used by some locals for food, feed, and medicine. The leaf and seed protein concentrations of some Bukidnon ecotypes are also better than that of the common mungbean. A 3×10 factorial experiment in Randomized Complete Block Design was conducted in this study from April to June 2017 in a screen house. The study aimed to (1) determine the morphological, physiological, and biochemical responses of 10 *S. tora* ecotypes (Factor B) to 16 days of drought and waterlogging stresses (Factor A) at vegetative stage; (2) identify traits associated with tolerance to either or both stresses; (3) estimate phenotypic diversity under each stress; and (4) identify ecotype(s) with potential tolerance to either or both stresses. Stressed plants were allowed to recover for a week before final data were measured/recorded. In general, ecotypes were more sensitive to waterlogging than to drought. A total of 20 morpho-physiological characters were affected by stress imposition as per ANOVA. Four traits showed interaction between ecotypes and water stresses. Phenotypic diversity estimates showed moderate to high diversity for 14 of the 15 quantitative traits across water stresses. Plant stress tolerance was highly correlated with number of leaflets ($r=0.63$) and leaf area ($r=0.62$). None of the ecotypes were sensitive only to drought, but three were sensitive only to waterlogging. Another three ecotypes showed no sensitivity to both stresses, which may have potential dual tolerance or perhaps resistance to both stresses at vegetative stage.

Keywords: abiotic stress, drought, *Senna tora*, stress tolerance, waterlogging

AS – 80

**SCREENING OF TOMATO (*Lycopersicon esculentum* Mill.)
FOR WATERLOGGING TOLERANCE
UNDER GREENHOUSE CONDITION**

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Tomatoes are highly sensitive to environmental stresses such as drought and waterlogging. This study evaluated 24 tomato accessions from the breeding group for waterlogging tolerance under greenhouse condition to identify possible sources of waterlogging-tolerant accessions. The 24 tomato accessions were evaluated using seedlings grown in plastic bags that were placed inside 10-liter capacity plastic pails filled with water at approximately 5 cm above the soil surface for seven days at flowering stage. Waterlogged treated plants were allowed to undergo recovery period of seven days while the control plants were watered regularly. Plant samples were processed and measured for different agronomic parameters. Results showed significant reductions in the morphological characteristics (e.g., biomass partitioning, root traits, and relative leaf greenness) of the 24 tomato accessions due to waterlogging, with reduction values ranging from 1–60%. Percent survival ranged from 25–83%, with TM 10167-2 having the highest survival rate. The top five performing tomato accessions were identified based on the ranking on percent reduction for each plant character measured and on the correlation coefficient of the character in relation to total shoot dry matter. The identification of top-performing tomato accessions under waterlogged condition indicates the possibility of finding sources of tolerance for waterlogging.

Keywords: Tomato, waterlogging, waterlogging tolerance, greenhouse screening

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STRESS PHYSIOLOGY OF PSB Rc68 AND NSIC Rc222 UNDER PROGRESSIVE DROUGHT CONDITION

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Drought stress significantly affects the growth and development of rice plants, and one of the best strategies to mitigate the effects of drought on rice production is to use drought-tolerant rice varieties. This study aimed to generate information on the drought tolerance mechanism of PSB Rc68 and NSIC Rc222 at vegetative stage under progressive drought conditions. These varieties are improved, high-yielding, and drought-tolerant cultivars. Pre-germinated seeds were grown in a pail filled with 8 kg soil and were subjected to well-watered (controlled condition) and in drought-stress conditions. The imposition of drought stress was started 14 days after sowing when the soil moisture content (SMC) reached 12%. The progressive drought stress was maintained until the test genotypes reached the vegetative stage. Comparing PSB Rc68 and NSIC Rc222 in well-watered and drought stress environment, PSB Rc68 showed -39.9% reduction in shoot dry weight, whereas NSIC Rc222 showed -42.1%. The less reduction of PSB Rc68 shoot dry weight was attributed to the increase in its total root length of 2.7% compared with that of NSIC Rc222 (-18.0% reduction). The PSB Rc68 increased total root length was attributed to higher water use efficiency, which led to higher shoot dry weight under water limiting condition.

Keywords: drought, rice, root, shoot, water use

AS – 82

**SURVEY AND CHARACTERIZATION OF LANDRACES
OF WINGED BEAN (*Psophocarpus tetragonolobus* L.)
IN ILOCOS NORTE**

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Winged bean (*Psophocarpus tetragonolobus* L.) is an economically important leguminous crop known for its versatility and adaptability to various environmental conditions. Most of the cultivars grown in Ilocos Norte are landraces and demonstrate wide morphological differences, all of which remain fully undocumented. Thus, a field survey was conducted to document the existing cultural management practices of farmers. Germplasm materials were collected for crop establishment and were characterized morphologically using the Descriptors' List for winged bean (Biodiversity International 2007). Phenotypic diversity was estimated using the standardized Shannon-Weaver's Diversity Index (H'), and clustering was done in Numerical Taxonomy and Multivariate Analysis System. Winged bean is basically grown basically as a subsistence crop in Ilocos Norte, with minimal cultural management practices employed. Results showed that phenotypic diversity of the 33 accessions was high. Both the qualitative and quantitative morphological characters accounted for the high variability, with H' of 0.88 and 0.83, respectively. Clustering procedures grouped the accessions into long-podded (>20 cm) and short-to-medium podded accessions (<15–20 cm). Several accessions appeared as duplicates of one or the other. Based on the characteristics, some of the accessions have potential for commercialization and (eventually) for registration as a variety. Thus, research results are necessary for subsequent varietal selection, conservation, and development.

Keywords: landraces, phenotypic diversity, morphological characterization, cluster analysis, germplasm collection

AS – 83

VARIETAL EVALUATION OF YELLOW CORN HYBRIDS, OPEN-POLLINATED, AND GLUTINOUS CORN VARIETIES IN ILOCOS REGION, PHILIPPINES

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This study was conducted at the Mariano Marcos State University Experimental Farm from 2015 wet season to 2016 dry season under the San Manuel and San Fernando Soil Series. It aimed to (1) evaluate the performances of corn hybrids, open pollinated varieties (OPVs), and glutinous corn for yield and other agronomic characteristics and (2) recommend to the National Seed Industry Council (NSIC) the corn varieties for national and regional commercial releases. Results of the study revealed that most of the varieties performed well under the Ilocos condition. Significant variations were also observed on the agronomic and yield characteristics of the different entries evaluated. During the wet season trial, two yellow corn hybrids (i.e., KK 1616 and BIO 9780) outyielded the check varieties. On the other hand, during the dry season trial, six varieties (i.e., TCT 1709, PP 8107, P 3774R, PP 8301, PP 8101, and PP 8302) performed better than the check varieties. In terms of the white and yellow OPVs, MMSU Glut2 produced higher yield than the check variety did during the wet and dry season trials. Other varieties that performed better than the check varieties were IES Cn 7, USM NCH 35, USMARC TC 109, IES 10-04, USMARC 1413, USMARC 308, TCT 159, and CVRC 15-10. All of the entries evaluated were resistant to corn borer and foliar diseases. Due to the good performance of these varieties, the Corn and Sorghum Technical Working Group recommended to the NSIC the varieties PP 8001 and PP 8102 for seed increase in Luzon, and PP 8107 for Luzon and Visayas. Other entries like TCT 1709, PP 8101, P 4097 R and P 3774 R were also recommended for commercial release in Luzon, whereas PP 8301 was recommended for Luzon and Visayas. MMSU Glut2 was also recommended for commercial release in Visayas and USMARC 1413 (a yellow OPV) was recommended for Visayas and Mindanao.

Keywords: glutinous corn, hybrid corn, open-pollinated corn varieties

AS – 84

YIELD AND GROWTH OF MUNGBEAN UNDER PARTIAL SHADE

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Intercropping coconut with mungbean is an alternative method of increasing mungbean production and farm income. However, partial shading by coconut reduces the quantity and quality of light received by intercrops. Thus, screening for partial shade tolerance is a good strategy to increase mungbean productivity under shade condition. A replicated field trial evaluated the performance of 14 selected mungbean entries under full sunlight and artificial shade structures with 50% and 70% partial shade levels. Mungbean entries were evaluated in terms of yield and other agronomic traits. Genotypic differences were observed in terms of internode distance, plant height, nodulation, and relative leaf greenness across growing condition. Yield reduction was observed to increase with the increase in shade level. The range in yield reduction among entries was 27.5–66.3% and 49.7–79.6% for 50% and 70% shade, respectively. Pag-asa 5 had the highest yield under both shade levels, with potential yield of 1.33 and 0.93 tha^{-1} for 50% and 70% shade, respectively. Pag-asa 5 also ranked first in terms of number of pods under 70% shade. The trial conducted showed the differential response of mungbean to partial shading and the superiority of Pag-asa 5 over other mungbean entries in terms of yield. Thus, this can be recommended as stop gap variety for partial shade condition.

Keywords: partial shade tolerance, intercropping, mungbean, artificial shade, nodulation

AS – 85

**EVALUATION OF ANTI-ANGIOGENIC PROPERTY
OF *Senna alata* (L.) ETHANOLIC EXTRACT IN DUCK
(*Anas platyrhynchos*)**

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Angiogenesis, as a vital process of embryonic development, is the formation of new blood vessels from preexisting vessels. It plays a key role in cell migration, tube formation, and proliferation. This study determined the anti-angiogenic property of ethanolic extract of *Senna alata* (L.), which is a medicinal plant in duck (*Anas platyrhynchos*) embryos. Obtained ethanolic extracts from *Senna alata* were treated to the duck eggs on the 10th day of incubation. The setups were composed of retinoic acid as positive control, distilled water as negative control, and *Senna alata* extracts in 1 mg mL⁻¹, 5 mg mL⁻¹, and 10 mg mL⁻¹ concentrations. Morphometric evaluations and vasculature densities from CAM assay were analyzed using univariate analysis of PAST software. Results showed that branching of capillaries was irregular and that veins were thin in the treated samples. Ethanolic extract of *Senna alata* inhibited greater angiogenesis at 5 mg mL⁻¹ than in 1 mg mL⁻¹, and 10 mg mL⁻¹ concentrations. There was a significant difference in crown-rump length in the control and treated samples. The findings of the study indicate that *Senna alata* extract might have a promising antiangiogenic potential. However, further in-depth study is required to reveal specific details involved in angiogenesis inhibition.

Keywords: *Anas platyrhynchos*, angiogenesis, CAM assay, *Senna alata*

AS – 86

GENETIC IMPROVEMENT OF BOVINE POPULATIONS IN ILOCOS NORTE THROUGH PHENOTYPES, MOLECULAR MARKERS, AND GENE DYNAMICS ANALYSIS

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This study generated a holistic strategy in genetically improving bovine populations in Ilocos by considering growth-related genes and characteristics such as expected progress from one generation to another through evaluating the shifts in gene and genotype frequencies. Phenotypic characteristics of 230 cattle population were evaluated using the FAO guidelines. Growth performance was associated with growth hormone (*GHI* and *GH2*), and growth hormone-receptor (*GHR*) genes. Phylogenetic analysis showed genetic differences of the cattle population across location. *GHR* was found to be monomorphic, indicating and that this gene cannot be a potential molecular marker. Three genotypes were observed for both *GHI* and *GH2*, which were found to be associated with body weight (BW) having correlation coefficient of +0.110 and +0.251, respectively. Complete dominance exist between the alleles for *GH2*, where the homozygous dominant (*PP*) and the heterozygous animals (*PJ*) had higher BW (+0.1346 and +0.1817) than the mean performance of the population. In *GHI*, codominance was observed, and the favored genotype is the heterozygous (*PJ*). In the interest of addressing the declining growth rate of local genetic groups, it is very important to consider these molecular markers. A shift in the growth performance is projected if the homozygous or heterozygous genotype for *GH2*, along with the heterozygous for *GHI*, would be selected as parents for the next generation.

Keywords: cattle, growth hormone genes, SNP, genetic diversity, population

AS – 87

CONSTRUCTION OF ENRICHED MINI-GENOMIC LIBRARY IN SUGARCANE (*Saccharum officinarum* L.) VMC 87-599

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Enriched mini-genomic libraries of sugarcane variety VMC 87-599 were constructed by genome filtering approach using methylation-sensitive restriction enzymes (*Pst*I and *Aat*II) in order to facilitate microsatellite marker discovery, which has various applications in plant breeding and genetics. Plasmid DNA containing sugarcane DNA fragments were isolated and were sequenced using vector-based primers. Trimmed sequences were analyzed in Basic Local Alignment Search Tool (BLASTn) for putative gene identities. A total of 517 quality sequences were obtained. Sequence homology search using Blastn of combined genomic library characterization showed similarities with *Saccharum officinarum* (22%), *Sorghum bicolor* (12%), *Zea mays* (12%), *Setaria italica* (2%), *Oryza sativa* (1%), and other grass species (2%). No significant hits accounted for almost half (49%) of the total sequences. Also, combined libraries contained 3.6% organellar sequences, of which 1.9% were chloroplastic and 1.7% were mitochondrial. Nuclear gene sequences comprised 12.7% of the total sequences, and 6.9% were hypothetical/uncharacterized proteins. Characterized enriched libraries provided a preview of the complex genomic constitution of a sugarcane genome.

Keywords: sugarcane, enriched genomic mini-library, methylation-sensitive restriction enzymes, bioinformatics

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GENETIC VARIATION OF SELECTED PHILIPPINE RICE VARIETIES FOR VARMIX TECHNOLOGY

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To date, no single varieties have the capacity to lessen the effect of biotic and abiotic stresses. Thus, this study evaluated the capability of using Varietal Mixture (VarMix) system to mitigate stresses. The strength of VarMix lies on its distinct genetic variation, and thus identifying diverse rice varieties is important to develop VarMix combination. A total of 36 Philippine inbred rice varieties were determined in this study using 42 polymorphic simple sequence repeats markers. A total of 128 alleles were detected, with an average of 3.05 alleles per locus. Cluster analysis was performed using the UPGMA method based on simple matching and Roger and Tanimoto (R and T) similarity coefficients. Two major clusters were identified, and the six selected varieties (i.e., PSB Rc82, NSIC Rc214, NSIC Rc216, NSIC Rc238, NSIC Rc298, and NSIC Rc300) formed distinct subgroupings. The subgroupings of these six varieties signify their genetic variation, in which their genetic similarity contributed to express more diversified functions to both above and below ground environment, thus, expressing mechanism for reducing disease intensity and increasing yield and yield stability.

Keywords: genetic diversity, SSR markers, VarMix, UPGMA

AS – 89

MORPHO-PHYSIOLOGICAL AND ANATOMICAL CHARACTERISTICS OF SMOOTH NARRA (*Pterocarpus indicus* Willd. forma *indicus*) SUBJECTED TO SALT STRESS

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Pterocarpus indicus Willd. forma *indicus* (Fabaceae) is an indigenous species in the Philippines. This study was conducted with the tree species available in Mt. Makiling Forest Reserve (MMFR). The study assessed the status of the species by analyzing its morphological, physiological, and anatomical characteristics. Two pot experiments were conducted, namely, (1) response of seeds soaked to varying NaCl concentrations and (2) response of seedlings to application of varying NaCl concentrations. Based on the results, *P. indicus* forma *indicus* grew significantly in terms of height, number of leaves, leaf area, root collar diameter, root nodules, and root-shoot ratio under the control. It showed near responses to 100 mM NaCl. On the other hand, the growth of the species is suppressed under 300 mM NaCl. Its physiological characteristics (i.e., germination, survival, and photosynthetic rates) were higher in the control than in the NaCl treatments. In terms of seed anatomical characteristics, no radicle cells were damaged and its cell number was higher and its cell length was longer in the control treatment. Therefore, the species can thrive under moderate saline soils only. Thus, adaptation of the species still depends on the type of environment. Further research on the species' physiological and anatomical responses to salinity in the soil is recommended.

Keywords: anatomy, morphology, physiology, salinity, *Pterocarpus indicus*

AS – 90

NURSERY MANAGEMENT TECHNIQUES OF FOUR INDIGENOUS PREMIUM TIMBER SPECIES PROPAGATED THROUGH WIDLINGS

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The lack of quality seed supply and quality planting stocks are among the major impediments in scaling-up the rehabilitation of denuded forests. Wildlings can be used as a potential source of planting material; however, its survival rate in the nursery is very low. Hence, a study was conducted (1) to determine the best propagation techniques that could enhance root growth potential (RGP), seedling quality index (SQI), and survival using wildlings and (2) to assess the economics of producing quality planting material (QPM) by adopting the best management techniques. Four timber species were used: *Hopea plagata*, *Anisopthera thurifera*, *Shorea guiso*, and *Sindora supa*. Three nursery techniques were evaluated using different parameters: (1) IBA concentrations and dipping time (DT), (2) potting media combinations, and (3) applications of GA₃ and fertilizer treatments. Results showed that growth and RGP of *A. thurifera* and *H. plagata* were maximized by 10 seconds DT in 50 ppm IBA. Wildlings of the four timber species grown in ordinary garden soil (OGS)+river sand (RS) at 2:1 ratio obtained higher height and diameter growth, RGP, and survival rate than the other potting media combinations used. Moreover, height and diameter growth of *S. supa* and *S. guiso* were also enhanced by the application of GA₃. However, survival rate of *S. guiso* was higher without GA₃ application. Likewise, the application of 5 g 14-14-14 increased growth, RGP, SQI, and survival rates of both species. At a selling price of PHP 15.00 seedling⁻¹, a net return of PHP 1.65–3.03 could be realized for every peso invested. It can be deduced that 10 seconds DT in 50 ppm IBA is ideal to enhance root development and growth of potted *H. plagata* and *A. thurifera* wildlings. The four premium timber species could be raised in the nursery using OGS+RS at 2:1 ratio. The application of 5 g 14-14-14 is also essential to promote growth, RGP, SQI and survival rates of *S. supa* and *S. guiso*.

Keywords: wildlings, quality planting material, root growth potential, shoot-root ratio, seedling quality index

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PHYTOCHEMICAL AND ANTIMICROBIAL PROPERTIES OF SOME PHILIPPINE BAMBOO SPECIES

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The study aimed to screen the phytochemical components of ethanolic and aqueous extracts of Kauayan Tinik, Kauayan Kiling, and Bolo. The bamboo leaf extracts were also evaluated for their antimicrobial activity against *Pseudomonas aeruginosa* PNCM 1335 and *Escherichia coli* PNCM 1634 strain. Results indicated K. tinik, K. killing, and Bolo contains the essential phytoconstituents, which are potential therapeutic agents. Likewise, the bamboo leaf extracts exhibited two 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging property. All leaf extracts have antimicrobial activity against *P. aeruginosa* and *E.coli*.

Keywords: phytochemicals, antimicrobials, bamboo, DPPH,

AS – 92

**BREEDING STRATEGY FOR GENETIC IMPROVEMENT
OF PHILIPPINE NATIVE CORN POPULATIONS
FOR WATERLOGGING TOLERANCE**

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The native corn populations in the Philippines have adapted to different environmental stresses, one of which is waterlogging or flooding stress. Thus, native corn populations could have an armory of stress adaptation genes, which can be utilized in developing new varieties, hybrids, and inbred lines. In this study, 48 native corn populations were screened under flooded conditions; from these 15 populations, 5 colored and 10 white colored lines were selected using survival and yield as the basic criteria. These 15 lines were selfed resulting in S1 lines or populations. The first and second synthetic populations with waterlogging tolerance were generated through intermating (chain sibbing) the white and colored S1 lines, respectively. The seeds produced from the chain sibbing were balanced bulk and were planted in isolation to allow random mating. The ears produced from random mating comprised Cycle 1 of waterlogging tolerant half-sib synthetic populations (214 half-sib lines). Cycle 1 populations were then assessed under waterlogged conditions in two consecutive field trials, wherein it was shown that some lines can yield as much as 2–3 tha^{-1} under prolonged period of flooding. This population was submitted to the National Corn Trials for evaluation and for varietal recommendation for regions/areas that often experience flooding. Further improvement is recommended (Cycle 2) to create a more homogenous genetic pool with waterlogging tolerance.

Keywords: native maize, waterlogging tolerance, synthetics, inbred

AS – 93

**CLASSIFICATION OF THE SINGLE NUCLEOTIDE
POLYMORPHISMS (SNPs) IDENTIFIED
BY GENOTYPING-BY-SEQUENCING OF “CARABAO” MANGO
(*Mangifera indica* L.) ACCESSIONS**

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Understanding the genetic background of agronomically important crops is essential in the conservation of favorable traits. Genotyping-by-sequencing (GBS) is a sequencing technique for reduced or filtered genomes; it identifies the genotypes of individuals through their single nucleotide polymorphisms. Single nucleotide polymorphisms (SNPs) can be associated with important traits and may be used as genetic markers. In this study, 341 mango accessions from different locations in the Philippines were genotyped by sequencing. The GBS generated 31,208 SNPs, which was imputed to 15,604 sequences. Homologs of these sequences were identified through the Basic Local Alignment Search Tool. The results collected were classified into different groups based on plant families, protein function, and whether the sequence codes for genes that govern significant mango traits of interest. Initial findings showed the presence of genes that confer carrier proteins, disease resistance proteins, structural proteins, and various enzymes. Primarily, SNPs for desired mango traits for resistance to anthracnose, red blush color expression, and thick peel will be validated on at least 100 genotypes.

Keywords: “Carabao” mango, genotyping-by-sequencing, single nucleotide polymorphism

AS – 94

**VARIABILITY IN FRUIT CHARACTERS OF GUAVA
(*Psidium guajava* Linn.) ACCESSIONS
FROM LUZON, PHILIPPINES**

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Guava is a minor fruit crop in the country. Owing to its health benefits and processing potential, it faces a brighter prospect for increased utilization. It is usually consumed fresh, but is also utilized by the processing industry, particularly for juice cocktail and instant soup base. The Institute of Plant Breeding is developing guava varieties both for fresh consumption and for the processing industry. Just like in any crop improvement program, success largely depends on the available germplasm. Hence, collection was done to enhance existing germplasm, and fruit evaluation was performed to assess the different quantitative and qualitative fruit traits. A total of 55 guava accessions were collected for germplasm enhancement in the form of fruits, seeds, or grafted seedlings. Thirty-five accessions were evaluated for different fruit characteristics. The quantitative characters were very variable, with fruit weight ranging from 18.2–457.0 g, equatorial diameter of 3.1–8.9 cm, longitudinal diameter of 3.7–10.5 cm, flesh thickness of 0.5–2.1 cm, and TSS of 5.2–13.5°B. Likewise, qualitative traits showed high variability. Flesh color varied from white, yellow, pink, red, to dark red/purple; and fruit color from greenish yellow, light yellow, dark yellow, to dark purple. Fruit shapes were high round, round, oblong, ovoid, to pyriform, while skin texture ranged from very rough to very smooth. The taste/flavor was recorded from very sour to very sweet, with mild to strong aroma. Clustering analysis based on quantitative characters revealed four major groups. Twelve promising accessions were selected as potential parents for breeding activities.

Keywords: cluster analysis, crop improvement, germplasm, guava

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GENETIC DIVERSITY ANALYSIS OF PHILIPPINE “CARABAO” MANGO (*Mangifera indica* L.) ACCESSIONS BASED ON SINGLE NUCLEOTIDE POLYMORPHISMS

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Genetic diversity of the Philippine “Carabao” mango (*Mangifera indica* L. cv. “Carabao”) is important in identifying possible genetic groups as source of important genes for varietal improvement and breeding. Genotype-by-sequencing was used to obtain 31,208 single nucleotide polymorphisms (SNPs) imputed to 15,604 sequences from 341 mango accessions from different regions in the Philippines, including 14 varieties from the National Seed Industry Council (NSIC). Principal component analysis using the correlation of variances of the SNPs was performed to provide genetic clustering of individuals. Principal component analysis showed eight clusters based on “Carabao” phenotype, peel color, and origin of tree based on the 30% of SNP variations. Non-“Carabao” NSIC varieties clustered with other non-“Carabao” genotypes in cluster 1, while NSIC varieties Sweet Elena and Guimaras Super clustered with most “Carabao” accessions in Cluster 6. Cluster 7 consisted of individuals with red blush, such as NSIC Corcino and foreign cultivars Kensington and Tommy Atkins, while other NSIC varieties were found isolated in Cluster 8. Clustering of individuals provided information for breeding intra-clustered individuals of physiologically important traits. Despite the high density of individuals and SNPs, consistent clustering of the “Carabao” and non-“Carabao” accessions was not observed among the genetic groups. Instead, a gradient of the phenotype was observed, which indicate close relatedness among individuals and possible cross-breeding of hybrids.

Key words: Carabao, mango, principal component analysis, SNPs, GBS

AS – 96

HETEROSIS AND COMBINING ABILITY: DESIRABLE TRAITS IN HYBRID RICE BREEDING

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Evaluating the combining ability of hybrid rice is essential in hybrid rice breeding, especially when considering a large number of potential parental lines. The study was conducted (1) to determine the general combining ability (GCA) and specific combining ability (SCA) of 14 parent lines for quantitative characters and (2) to measure the level of heterosis, and (3) identify the heterotic hybrids generated. A total of 33 hybrids were generated from the cross of three cytoplasmic male sterile lines and 11 restorer lines, following the line×tester mating design. Genotyping of parents was also done at this stage. Test entries also include Mestiso 19 and PSB Rc82 as yield checks. For standard heterosis, 51% of the hybrids had yield advantage of at least 15% over Mestiso 19. The top three highest yield were obtained by PR47775H (11.4 tha⁻¹), PR47774H (10.6 tha⁻¹) and PR477794H (10.5 tha⁻¹). Positive and negative significant effects of mid-parent heterosis were shown in different traits. GCA values were generally lower than those of SCA for different characters, indicating predominant roles of additive gene effects for different characters. Moreover, components of variation due to interaction of line×tester were found to be significant only to days with 85% maturity, plant height, and spikelet fertility. Selections can be assembled among the parents to produce new untested testcrosses with expected relatively high SCA effects. Alternatively, lines with high GCA effects can also be endorsed to develop superior inbred lines. Relative to the performance estimates using yield and morpho-agronomic traits, the resulting high genetic similarity among parent lines may have caused relatively low heterosis levels of the testcrosses. This suggests the need to utilize more diverse parent lines.

Keywords: hybrid rice, heterosis, general combining ability, specific combining ability

AS – 97

**MOLECULAR CHARACTERIZATION OF PEDIOCIN GENES
(Ped PA-1/AcH) AND PLASMID TRANSFER INTO *Bacillus
subtilis* VIA ELECTROPORATION**

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Pediocin, a Class IIa bacteriocin of *Pediococcus acidilactici* (S3, K2A2-3, and 3G3) has been known to inhibit various strains of listerial species. Gene modification in strains to be used for fermentation and pediocin production was proposed as a strategy to develop competitive commercial biopreservatives. The *pap* genes (*papABC*) of the pediocin operon responsible for the production of pediocin were amplified using published and designed primers. BLASTn homology analysis using the *papB* sequences was found to be most similar to *P. acidilactici* K10 (Accession No. AY705375.1) and *P. acidilactici* pSMB74 (Accession No. UO2482.2) by 98–99%. The predicted protein structures generated via bioinformatic tools revealed the ligand-binding sites reinforcing possible functions of PedA, PedB, and PedC proteins. *Bacillus subtilis* NRRL B-3749 served as the competent host for the plasmid transfer encoding the *pap* genes. Analysis of variance verified that the putative transformant BS235 produced better inhibition zones (13.83mm) than the control strains *P. acidilactici* S3 (13.17mm) and *B. subtilis* B-3749 (7.33mm) did in spot-on-lawn assays.

Keywords: pediocin, *pap* genes, plasmid, transformation

MORPHO-AGRONOMIC CHARACTERIZATION OF PHILIPPINE TRADITIONAL RICE VARIETIES

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Assessing agro-morphological diversity among rice germplasm is an important endeavor in any genetic resources management and crop improvement. Likewise, determining the desirable traits of traditional rice varieties (TRVs) and incorporating them in rice breeding efforts would greatly benefit rice farmers. It would help them to mitigate the effects of and better manage rice production under changing environmental conditions. This study (1) identified the morphological characteristics of the TRVs used to establish each accession's genetic identity, (2) identified varieties with desirable traits for direct utilization and potential donors for crop improvement, and (3) assessed the extent of genetic diversity of the collections. A total of 199 TRVs were planted during the wet cropping season of 2014–2017 for morpho-agronomic characterization using 58 traits following the standard descriptors list for cultivated rice. Morpho-agronomic traits were analyzed using multivariate statistical analysis. The mean Shannon-Weaver diversity indices were $H' = 0.52$ for all qualitative traits and $H' = 0.81$ for quantitative traits. An overall genetic diversity was $H' = 0.66$, indicating a medium level of genetic variation among these TRVs. The rice collections that exhibited longest panicle (>32 cm) were *Sto. Nino*, *Speaker*, *Sampukoy*, *Salumanay*, *Putan-Kapa*, *Palaweña*, *Palawan*, *MalagkitKapa*, *Madya*, *Ilon-ilon*, *Gobierno*, *Galo* and *Canadal*. Collections *Tulloy*, *Salumanay*, *Pah-nga*, *Malagkit Kapa*, *Malagkit Black*, *Malagkit black*, *Kayasakas*, *Diko*, and *Bulgar* produced the heaviest grain (>35 g). Several traditional rice germplasm collections had desirable attributes. These should be further explored for direct utilization of these germplasm for varietal improvement programs.

Keywords: diversity, genetic resources, *Oryza sativa*, Shannon-Weaver diversity index

AS – 99

PREDICTING SINGLE-CROSS HYBRID RICE PERFORMANCE USING BEST LINEAR UNBIASED PREDICTION (BLUP)

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Performance prediction of untested hybrids is an alternative to test crossing for identifying superior hybrids. In this study, the performance of untested single-cross hybrids was predicted through BLUP. A total of 33 hybrids were generated using the line by tester mating design from 11 restorer and 3 cytoplasmic male sterile (CMS) lines. Parent lines were genotyped with Infinium 7K SNP chip, and relationship was analyzed as per Queller and Goodnight's Model. Performance of hybrids was evaluated. Yield and other important agronomic traits such as maturity (MAT), plant height (PH), tiller number (TN), grain number (GN), fertility (FT), and thousand-grain-weight (TGW) were gathered. Prediction was performed as $\hat{Y}_U = C_{UT}C_{TT}^{-1}\hat{Y}_T$ where: \hat{Y}_U = predicted performance of untested hybrids; C_{UT} = covariance between untested and tested hybrids; relatedness, V_{GCA}, V_{SCA} ; C_{TT}^{-1} = inverse of C_{TT} as phenotypic covariance among hybrids; \hat{Y}_T = performance of tested hybrids (SCA). Two sets were used for cross-validation with 9 (2 untested) and 15 hybrids (3 untested) for the 1st and 2nd set, respectively. Prediction for the 1st group had an average deviation of 1.56 for yield ranking from actual values, and the Pearson's correlation between actual and predicted values for effects and yield was 82.45%, with 81.66% for yield ranking. High prediction accuracy with correlation $\geq 80\%$ between actual and predicted values was obtained in GN (98.8%), TGW (86.7%), and PH (80.6%). Prediction for the 2nd group showed an average value of 1 for rank deviation and correlation between actual and predicted values for effects and yield was 91.67% with 95.68% for yield ranking. High prediction accuracy was obtained in TGW (98.9%), MAT (92.9%), PH (91.5%), and GN (82.7%). Results showed BLUP's efficiency in predicting performance of untested hybrids, which can help to improve the efficiency and cut expenses and efforts in hybrid rice breeding programs.

Keywords: best linear unbiased prediction, rice

AS – 100

SEARCHING FOR SALINITY TOLERANT RICE GENOTYPES AMONG HYBRID PARENTAL LINES

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Salt stress negatively affects crop growth and agricultural productivity. To counter abiotic stress such as salinity, hybrid rice may be used because of its known genetic plasticity. In this study, the salinity response profile was revealed through salinity tolerance screening at seedling stage (SALTSSS). Using SALTSSS, the selected genotypes was evaluated through their salinity reaction using Modified Standard Evaluation Score. Na^+ and K^+ accumulated in shoot and roots were quantified through ion content determination using Atomic Absorption Spectroscopy. Results showed that three cytoplasmic male-genetic sterile, seven restorer, 15 maintainer, and 10 elite lines had tolerant to moderately tolerant genotypes for salinity. There were genotypes that had comparable, and even greater, total root length, nodal root length, lateral root length, and shoot and root biomass, as compared with the tolerant check (FL478). Also, high Na^+ accumulation in shoots and roots was observed in some genotypes with moderate tolerance and also exhibited less minimal injury in their leaves. The determined salinity tolerant rice genotypes can be used as parents in the future to develop superior F_1 hybrids adapted to saline environment.

Keywords: salinity, SALTSSS, hybrid parental lines, CMS, F_1 hybrids

AS – 101

**VARIABILITY OF FRUIT AND NUT ENDOSPERM
CHARACTERS OF SUGAR PALM
(*Arenga pinnata* (Wurmb) Merr.)**

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Sugar palm or Kaong (*Arenga pinnata* (Wurmb) Merr.) is a type of indigenous palm in the Philippines that has high economic importance. It is often used as desserts and sweets. Despite its economic potentials, this crop is considered under researched. This study evaluated the fruit and endosperm variability of sugar palm. About 2,500–4,000 samples were randomly collected from eight towns in Cavite. Four fruit characters and six endosperm characters were evaluated. Shannon-Weaver Diversity Index was used to determine fruit and nut diversity, while correlation coefficients of selected character combinations were computed following PROC CORR (SAS System 1985). Results showed wide variability in the fruit length, fruit weight, fruit diameter, fruit color, number of endosperm, weight of endosperm, pH, and percent edible portion. Narrow variability was exhibited in the endosperm color, endosperm shape, and endosperm tenderness. Meanwhile, strong positive correlations were found between fruit weight and fruit diameter and between endosperm weight and percent edible portion. Results further showed that the eight towns showed differences in fruit and nut characters. For example, samples from Indang had higher fruit weight and fruit diameter, while those from Mendez were longer than those collected from the other locations. Furthermore, nut endosperm pH from Tagaytay City, Amadeo, and Silang were less acidic, while tenderness of nut endosperm and percent edible portion were superior in General Emilio Aguinaldo. The results of this study serve as benchmark information for sugar palm selection and future breeding activities.

Keywords: sugar palm, variability, Cavite, *Arenga pinnata*

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**INSIGHTS FROM THE GENOME-WIDE RESISTANCE
GENE ANALOGS OF DURIAN: CHARACTERIZATION,
PHYLOGENETIC ANALYSIS, AND RGA-LINKED
SSR MARKER DEVELOPMENT**

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Durian (*Durio zibethinus*), widely known in Southeast Asia as the “King of fruits”, has recently gained an economic importance due to its increasing demand in the global market. The recent publication of the durian genome has paved the way for the comprehensive analysis of the set of genes tightly associated to several agricultural traits, thus, maximizing durian’s production potential. We present the first-ever report of the in-depth genome-scale analysis of resistance gene analogs (RGAs) in durian through state-of-the-art bioinformatics pipeline. We identified 1,164 RGA candidates using the RGAugury bioinformatics toolkit from a pool of 44,794 durian gene models downloaded from the public repository. Among other sequenced agricultural crop genomes, durian has the highest number transmembrane-coiled-coil (TM-CC) and coiled-coil-nucleotide binding site-leucine rich repeat (CNL)-containing domain RGAs. Using the information of the physical location of the RGAs and GMATA pipeline, we designed 1,642 RGA-linked SSR markers. Molecular evolutionary analysis of the core set of candidate RGAs using MEGA7 revealed conserved clustering of gene models characterized with a specific RGA domain. The molecular phylogeny constructed in this study, in addition to the RGA-linked SSR markers developed, will provide a framework for the effective gene pyramiding approach to breed for increased resistance of durian against wide range of pathogens and insect pests.

Keywords: durian, resistance gene analogs, molecular phylogeny, SSR markers

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MOLECULAR ANALYSIS OF SELECTED TRADITIONAL RICE VARIETIES USING *tsv1*-LINKED SSR MARKERS

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The tremendous information that can be sourced from a vast Genebank reservoir is on the availability of shared information about the germplasm stored in one. In order to support the breeding of superior rice varieties in terms of yield and ability to combat various stresses, the genebank would still require fundamental characterization, which includes phenotyping and genotyping of its germplasm. This paper aimed to provide preliminary evaluation of a small randomly selected germplasm using *tsv1*-linked simple sequence repeat markers. Markers consisted of di-tetra repeat motifs with 5–24 repeat numbers. Expected sizes ranged from 123 to 465 with polymorphism information content ranging from 0.23 to 0.73. Cluster analysis showed six major clusters at 50% genetic distance coefficient. Three clusters (Clusters A, B, and C) had individual germplasm, one cluster (Cluster D) with three germplasms, another cluster (Cluster E) had 55 germplasms, and lastly, another cluster (Cluster F) had 42 germplasms. PCoA showed groupings of the germplasm into three distinct groups, which could infer possible resistance, moderate resistance, and susceptibility among the entries. Confirmatory induced screening could be performed to validate this finding. In general, the materials consisted of selected germplasm resulted in presence of alleles linked to the *tsv1* gene. These rice germplasms could be source of resistance to rice tungro spherical virus if further validation is completed. Furthermore, molecular markers could be useful to accelerate screening of vast genetic resources in terms of various biotic and abiotic stresses.

Keywords: biotic stresses, evaluation, germplasm, tungro, SSR

AS – 104

**SUSTAINING RICE GRAINS QUALITY:
THE ARSENIC CONCENTRATION
OF SOME RICE (*Oryza sativa* L.) VARIETIES IN MINDANAO**

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The alarm has been raised on inorganic arsenic (As) content found in some rice-based foods and drinks intended for infants and children. The inorganic form is more toxic than the organic form and could become carcinogenic. Groundwater contamination of As in Bangladesh, China, Thailand, Taiwan, and Vietnam has already been reported. This study followed up on the investigation of Duldulao in 2012. We collected seed samples of some rice varieties available in Mindanao, and quantified them for arsenic (As) concentration. In December 2014 to February 2015, seed samples of upland rice varieties from Zamboanga del Sur (n=5), lowland rice varieties from Bukidnon (n=5), and imported rice (n=5) were sourced out, morphologically characterized for seed traits, and quantified for As concentration of rice grains at the Fast Laboratories in Cagayan de Oro City. China's standard is maximum of 0.15 mg kg⁻¹ As. All 15 samples had safe As levels, which ranged from 0.0006 µg g⁻¹ to 0.067 µg g⁻¹. However, Bukidnon varieties had numerically higher concentrations. Hence, from April to May 2016, seed samples (n=32) of recently harvested lowland rice varieties in four major rice-growing areas of Bukidnon were also morphologically phenotyped for seed traits before analysis for As concentration. All grain samples had safe levels of arsenic concentration. Mean values ranged from -0.580 µg g⁻¹ (note: negative values accordingly cannot be accurately determined) to 0.070 µg g⁻¹. Numerically, those from Valencia City had the lowest concentration, whereas those from Maramag had the highest. Assessment of As concentration in rice grains for food consumption and for processed foods in the country must continue and Philippine standards on As concentration must be set for regulation. However, As analysis is expensive and the need for cheap, accurate, and efficient tests are prominent.

Keywords: arsenic, toxicity, rice, *Oryza sativa*, Bukidnon

AS – 105

CHEMOMETRIC DIFFERENTIATION OF LOCAL AND IMPORTED AROMATIC RICE (*Oryza sativa L.*) VARIETIES BY ELECTRONIC NOSE

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Aromatic rice has gained greater popularity recent years, and has commanded higher costs in the market. Traditional and locally bred aromatic rice varieties are marketed or cultivated to cater to the demands of quality-conscious consumers for premium rice, which includes imported aromatic rices. To investigate the variation between local and imported aromatic rice varieties, the volatile component patterns were monitored using an electronic nose measurements and chemometric data analysis. The headspace generated from separately weighed (2 g) sample was injected into the electronic nose system via an autosampler. An array of 18 metal oxide sensors in the detection system detects with partial specificity the volatile compounds in the sample headspace. The sensors' responses were assessed by principal component analysis (PCA), and agglomerative hierarchical clustering (AHC). Visual patterns from the PCA prove that the electronic nose was able to precisely classify (95.59%) the samples into different varieties. Reducing the number of sensors based on the generated loading plot further improved the differentiation resulting in a total variation of 96.32%. On the other hand, AHC generated three separate clusters: Group I–Basmati; Group II–*Dinurado*, *Milagrosa*, and *Jasmine*; and Group III–NSIC Rc148 (*Mabango 2*), and NSIC Rc218 (*Mabango 3*). The result demonstrated that the electronic nose can be used to differentiate local and imported aromatic rice varieties based on the generated volatile compounds from the samples.

Keywords: aromatic rice, volatile compounds, electronic nose, headspace, chemometrics

**DISCOVERY OF NUTRIGENETIC MARKERS CORRELATED
WITH VITAMIN D NUTRITION IN DIFFERENT LIFESTYLE
GENES AMONG ADULT RESPONDENTS OF THE 2013
NATIONAL NUTRITION SURVEY**

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With vitamin D implicated in a wide range of multiple health outcomes, a fuller understanding of the determinants of vitamin D status is needed, and this must include consideration of its inherited characteristics. The study determined the relationship between genetic variations in lifestyle-related genes and serum vitamin D levels among adult respondents. The study followed a cross-sectional research design. A total of 187 adult respondents, aged 21 years old and above, of the 2013 National Nutrition Survey were analyzed. Anthropometric, biochemical, clinical, and dietary data were generated through validated questionnaires, physical examination, and laboratory analyses. Total serum 25-hydroxyvitamin D (25OHD3) was determined using electro-chemiluminescence binding assay method. Genomic DNA was used for massively parallel sequencing of lifestyle-related genes. Of the 187 subjects, 90 were classified as low serum 25OHD3 concentration ($<50 \text{ nmol mL}^{-1}$) and 97 were high serum 25OHD3 ($>50 \text{ nmol mL}^{-1}$). 25OHD3 was associated with triglyceride and systolic blood pressure. At least 10 genetic variations showed statistically significant difference in serum vitamin D concentration across genotypes. These genes were previously shown to have contributed to cardiovascular diseases, diabetes, osteoporosis, iodine deficiency, stress response, and drug metabolism. This study serves as a pilot study that provides additional evidence-based information on the putative contribution of genetic variants on optimizing vitamin D nutrition for overall health. Understanding how genetic variations interact with environmental factors, especially nutrition, may hold the key to better prevention and management of diseases, particularly nutrition-related diseases.

Keywords: next generation sequencing, nutrition, vitamin D

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ASSESSMENT OF SELECTED PHILIPPINE MAIZE VARIETY (CGUARD N39) FOR HIGH STARCH AS AN ALTERNATIVE TO RICE-CORN BLEND

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In 2008, the Institute of Plant Breeding introduced rice-corn blend using an improved maize variety. The Department of Agriculture recently launched the rice-corn blend to gradually reduce rice importation in the country. Maize in the Philippines is genetically diverse and commercially available. Thus, high nutritive value can be easily explored and improved in corn. A farmer's collected variety, CGUARD N39, was observed to have a high-starch value and can be an alternative maize variety to blend with rice. The CGUARD N39 was improved through full-sib recurrent selection to increase the favorable alleles including starch. The starch content of improved (Cycle 1) and original (Cycle 0) population of CGUARD N39 were compared to see if the nutritional value of Cycle 1 has been improved. The results showed that Cycle 1 had a higher average total starch content (Cycle 0: 82.67%; Cycle 1: 89.62%) than Cycle 0. The proximate compositions of Cycle 0 and Cycle 1 were also compared. The results showed that Cycle 1 had a higher average crude fat (Cycle 0: 6.60%, Cycle 1: 8.71%); higher average crude fiber (Cycle 0: 2.70%, Cycle 1: 2.88%); and higher average crude protein percentage (Cycle 0: 10.43%, Cycle 1: 12.90%). The total ash content of Cycles 0 and 1 were both 0.60%. Overall, the nutritional value of CGUARD N39 improved after one cycle. Continued cycles of selection can be conducted until the desired gain from recurrent selection is achieved. Ultimately, improved CGUARD N39 would increase crop productivity and quality and would make it a good alternative to rice-corn blend.

Keywords: Philippine maize variety, high starch maize, rice-corn blend, proximate components

AS – 108

**GENETIC VARIABILITY AMONG FULL-SIB PROGENIES
OF ORANGE-PIGMENTED SEGREGANT
OF PHILIPPINE MAIZE ACCESSION**

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Biofortification to improve provitamin A content of maize is becoming a consideration in maize breeding. This study evaluated the genetic variation and heritability for carotenoid-related compounds of the orange segregant of a Philippine maize accession, UPLBCnN68. Entries used for the experiment included yellow varieties (IPB Var 9, IPB Var 11, and IPB Var 13); UPLBCnN68(C0); and 44 full-sib progenies. ANOVA for total carotenoids and beta-carotene contents showed highly significant differences ($P < 0.01$) among entries. Broad-sense heritability was observed to be high for beta-carotene (77.7%) and low for total carotenoids (27.5%). The experimental procedure to measure total carotenoids may need to be refined to improve estimates of heritability. Positive genetic gain is expected for total carotenoids and beta-carotene when these traits are selected simultaneously at 25% selection intensity. Hence, the genetic variability among full-sib progenies of the orange pigmented segregant of UPLBCnN68 showed potential to improve and develop a maize cultivar with high carotenoid contents.

Keywords: maize, carotenoids, beta-carotene, provitamin A

AS – 109

DESIGN AND DEVELOPMENT OF KITCHEN-TYPE BROWN RICE HULLER

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The government promotes brown rice as staple food to achieve food self-sufficiency in the country. However, brown rice starts to deteriorate in three weeks. To address the short shelf-life of brown rice, this research developed and evaluated a “just in time hulling technology”, a small capacity brown rice huller that can mill the brown rice requirement of households for three weeks. This research covered the design, fabrication of the prototype unit, and testing of the technology in the laboratory following the method of tests prescribed by the Philippine Agricultural Engineering Standard for rice mill. The developed brown rice huller has an input capacity of 80 kg hr^{-1} , with total length of 0.45 m, width of 0.23 m and height of 0.86 m only. The technology features eight impeller blades and a rubber lining to remove rice hull from the rice grain. The huller is powered by 0.50 hp single-phase electric motor. The brown rice and hull are separated through the innovative aspirator of the machine. The two major components of the brown rice huller, such as the huller and the aspirator, can be easily fabricated by local manufacturers. The technology provides milling recovery of 74–76% with head rice recovery of 75–80%, which is comparable to commercial modern rice mills. The technology is appropriate for household use, providing brown rice just in time for their needs, and thereby resolves the problem for its short shelf-life.

Keywords: brown rice, brown rice huller, rice mill

**PHENOLIC ANTIOXIDANTS
FROM AGRICULTURAL BY-PRODUCTS
FOR FUNCTIONAL FOOD AND COSMETICS APPLICATIONS**

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The use of synthetic antioxidants in food and cosmetics has been considered as an efficient method for preventing lipid oxidation. However, safety of these synthetic additives has been an issue due to some reports of their adverse effect on consumers. This stimulated the interest of researchers to evaluate naturally occurring compounds that have similar antioxidant effects. The phytochemical composition of the agricultural by-products was studied using thin-layer chromatography. The presence of steroids, anthraquinones, flavonoids, and phenols were determined. Total phenolic content (TPC) analysis of selected agricultural by-products revealed that vodka was the most effective solvent and that *M. indica* peelings (38.88 mg AAE/g DW) had the significantly highest amount of total phenolics. This was followed by *C. microcarpa* peelings (21.38 mg AAE/g). In terms of antioxidant activity, *M. indica* peelings can neutralize 50% of DPPH radicals at the concentration of 96.60 mg L⁻¹ followed by *C. microcarpa* with effective concentration (EC₅₀) of 332.1 mg L⁻¹. Product development was done, incorporating phenolic agricultural by-products into food and cosmetics. Cosmetic products like lotion, soap, and lip balm were made. Food products such as pasta, cookies, and bread were also made. The effects of the extracts on the shelf-life of various products were assessed using sensory, microbial, and chemical methods. The results indicate that alcoholic beverages like gin can be an alternative, food-compatible solvent for the extraction of phenolic antioxidants from natural sources. *M. indica* fruit peel contains phenolic substances that exhibit strong antioxidant properties and can be used as substitute for synthetic antioxidants in enhancing the quality of food or cosmetic products.

Keywords: total phenolic content, antioxidant activity, products

AS – 111

UTILIZATION OF SHRIMP HEAD INTO POWDER FORM

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Shrimp head discarded as waste in processing plants is a good source of marine protein and oils. When improperly disposed, however, it can contribute to environmental problems. This study developed a processing method of utilizing shrimp head into powder form using cabinet-type drying. Developed powder was cooked for two hours at 90°C with moisture content of 51.46%. Drying temperature for cooked shrimp head was 70°C for 16–18 hours until moisture content and water activity reached <10% and <0.3, respectively. Dry-cooked shrimp head were pulverized and sieved using 212 µm mesh sieve. Physical characteristics, microbiological load, and chemical composition of the final product were analyzed in triplicates. The product had a percentage yield of approximately 20% final weight. Shrimp head powder was refined, orange brown in color, and had a strong flavor. Odor of the shrimp were evaluated as “like very much”. The peroxide value of the samples was 4.36 meq kg⁻¹, which indicates the freshness of the product. Laminated aluminum pouch was used for packing the product with a shelf life of six months.

Keywords: shrimp head powder, cabinet-type drying, utilization of shrimp head

AS – 112

**PHYSICOCHEMICAL PROPERTIES
AND GRAIN PIGMENTATION OF SPECIAL RICE GENOTYPES
GROWN UNDER IRRIGATED LOWLAND CONDITION**

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Six special rice varieties were evaluated to determine the physicochemical properties and to measure the degree of grain pericarp pigmentation. Six rice genotypes were evaluated during the dry season (December 2016 to April 2017) under lowland irrigated condition at the Central Luzon State University. Grain quality analysis was done at the Rice Chemistry and Food Science Division, Philippine Rice Research Institute, Central Experiment Station. Results revealed that most of the genotypes had intermediate amylose content (17.1–22.0%) and gelatinization temperature (70–74°C). High crude protein was noted from Blonde Red at 9.5%. Soft gel consistency was observed from CL-1 while the rest of the genotypes were hard gel consistency. Anthocyanin content was high in Dujali Black and Porac-1 due to their purple pigments in the bran. *L value of CL-1 was found lighter while Dujali Black and Porac-1 were noted to have darker grains. Unpolished grains of Luna Red and Blonde Red obtained the highest positive *a value while CL-1 was found to have a negative *a value, indicating toward greenness. On the other hand, *b value of unpolished and polished grains of CL-1 exhibited the highest content, indicating toward yellowness. Results of this study could serve as baseline information for developing improved genotype of special rice with superior grain quality and could provide a better understanding of their potential uses for the health conscious consumers.

Keywords: *L value, *a value, anthocyanin, genotypes, special rice

AS – 113

PHYTOCHEMICAL CONTENT AND ANTIOXIDANTS CAPACITY OF LOCALLY CULTIVATED VEGETABLES IN THE PHILIPPINES

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The body of epidemiological evidence suggests the association between high intake of vegetables and fruits and lowered risks of life-threatening diseases. However, consumption of vegetables among Filipinos remains low. Establishing the antioxidant profiles of locally grown plant foods is essential in recommending measures for maintaining or improving the health status of Filipinos. This work assessed the phytochemical content and antioxidant capacity of locally cultivated vegetables in raw and edible forms. The vegetables were evaluated for their total phenolic content (TPC) and antioxidant capacities using the 2,2-diphenylpicrylhydrazyl (DPPH) and 2,2-azinobis (3-ethylbenzothiazoline-6-sulfonic acid)-diammonium salt (ABTS) assays. The levels of phenolic compounds, namely, chlorogenic acid (CGA), quercetin, and cyanidin-3-glucoside (C3G) were assessed for vegetables with high TPC, DPPH, and ABTS values. The TPC of raw vegetables ranged 1.04–55.30 mg gallic acid equivalents g^{-1} , while antioxidant capacities ranged 0.58–380.57 μmol Trolox equivalents (TE) g^{-1} and 1.38–180.88 μmol TE g^{-1} for DPPH and ABTS, respectively. Boiling generally reduced the antioxidant capacities, but red coral lettuce, water spinach (lowland), and chili leaves consistently displayed the highest TPC and antioxidant capacities (raw or boiled). Red coral lettuce contained 12.78 mg g^{-1} CGA and 0.37 mg g^{-1} C3G, while chili leaves had detectable levels of quercetin (≤ 0.03 mg g^{-1}). These vegetables can serve as dietary sources of antioxidants to maximize intake by Filipinos for health promotion and disease prevention.

Keywords: ABTS, antioxidant capacity, DPPH, total phenolic content, vegetables

AS – 114

**EFFECTIVE STORAGE METHOD FOR SHALLOT ONION,
Allium cepa L. var. *Ascalonicum***

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Shallot (*Allium cepa* L. var. *ascalonicum*) is a multiplier type of onion commonly grown in Ilocos. Farmers prefer to use the bulb, rather than the true seeds, as planting material. Thus, shallot farmers have to store their planting materials through hanging and piling for the next cropping season. This has become a problem to farmers because their practice is not effective in keeping the bulbs from deteriorating. The Mariano Marcos State University evaluated different storage methods in shallot and assessed the quality of shallot stored for 2–5 months. Results showed that hanging and piling were effective for two months, but using paper box with rice straw was effective for five months. Using paper box with rice straw was effective in prolonging the shelf life of shallot onion. After five months of storage, the bulbs had 55.17% bulb weight recovery, 9.49% rotting, minimal sprouting (3.94%), and VQR of 7 (minimal deterioration). The technology of storing shallot using paper boxes with rice straw is recommended for small-scale storage. This technology is useful to shallot onion farmers, who keep their bulbs for planting materials. Through this technology, the problem of shallot farmers in keeping their seed materials can be addressed.

Keywords: shallot onion, storage method, rice straw, storage practice, bulb recovery

AS – 115

HEAT TRANSFER ANALYSIS OF CARABAO MANGO (*Mangifera indica* L.) FRUIT DURING POSTHARVEST HOT WATER TREATMENTS

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Thermal modeling of “Carabao” mango fruits, when subjected to different hot water treatments, was done in this study using the ANSYS CFD Software. The 3D mango fruit model, consisting of the peel, pulp, and seed, was meshed into finite control volumes. The energy equation for three-dimensional unsteady heat transfer was discretized and solved iteratively for each control volume, which resulted in the approximation of transient temperature values within the mango fruit model and in the heat flux at the model boundary. The heat transfer problem solved was a heat conduction problem; it has boundary condition of the third kind, which is a fixed parameter in the form of an estimated value of the convective heat transfer coefficient and a free stream temperature equal to the temperature of the heating medium. Experiment was also conducted to validate numerical results. Results showed that the simulation was able to accurately predict temperatures with a MTD of 0.50, 0.45 and 0.69°C for the conventional hot water treatment, rapid heat treatment, and extended hot water dip, respectively. This indicates good agreement between the simulated and actual temperature values. T-tests also showed no significant differences between the data sets. Heat flux, which is important in designing heaters and in estimating operational costs of a heat treatment facility, was also numerically estimated. Dimensionless parameters describing transient heat transfer, such as θ as the non-dimensional temperature parameter and Fourier number, were also derived. Computer modeling and simulation can be used to simulate various processing operations. Also, the use of ANSYS software can be explored in other areas of research.

Keywords: Carabao mango, thermal modeling, heat flux, ANSYS software

PILOT-SCALE PROCESSING SYSTEM FOR THE PRODUCTION OF PECTIN FROM MANGO PEELS

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The Philippines is totally dependent on imported pectin, valued at PHP 52 million, for the production of food, cosmetics, and pharmaceuticals. In 2012, PHilMech and ITDI-DOST developed a laboratory-scale pectin processing system from mango peels with UM Registration No. 22013000466. The present study verified the technical requirements, performance, and financial viability of the technology at a bigger scale. The technical performance was assessed based on the physico-chemical properties of the produced pectin and on the acceptability of mango pectin-based food products in terms of sensory attributes. The produced pectin met the United States Pharmacopeia specifications, indicating its superior quality. The physico-chemical properties remained stable for at least one year. Functional attributes were highly acceptable based on sensory evaluation of pectin-based food products. It contains 60–77% total dietary fiber, wherein 53% correspond to soluble dietary fiber, and thus provides many health benefits. Financial indicators showed that an upscale pectin production from mango peels was viable with a benefit-cost ratio of 2.12 and internal rate of return of 36.82. Therefore, the developed mango pectin processing system is ready for promotion and commercialization.

Keywords: pectin, mango peels, United States Pharmacopeia

BIOLOGICAL SCIENCES

BS – 01

**BIRD COMPOSITION, DIVERSITY, AND RICHNESS
IN CANTICOL, DOÑA TELESFORA, TUBAY,
AGUSAN DEL NORTE, PHILIPPINES**

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The birds in the forested areas of Canticol, Brgy. Doña Telesfora, Tubay, Agusan del Norte was assessed on November 13–19, 2017. This study is part of the Protected Area Suitability Assessment (PASA) toward the establishment of the Lake Mainit Protected Area implemented by the Center for Research in Environmental Management (CREME) in collaboration with the Department of Environment and Natural Resources (DENR) Caraga. A participatory resource assessment using a 2-km transect walk done at 5–9 a.m. and 3–6 p.m. detected 48 species from 25 families. Of these, 75% (38 species) are endemic to the Philippines and 21% (10 species) are restricted to the Mindanao faunal region. Eight species fall are listed as threatened in the IUCN Red List. These results provide an update to those recorded by Paz et al. (2008) with 31 Philippine endemics, of which four are threatened, and three Mindanao-endemic, of which one is threatened. The existence of these birds, however, are continuously threatened by human activities. Forest clearings due to wild abaca harvesting are apparent while timber cutting to support gold mining tunnels in the nearby ridge is evident. The presence of unique and threatened species of birds signify the importance of Canticol as a key biodiversity area essential in the establishment of the protected area.

Keywords: birds, richness, endemic, threatened, protected area

BS – 02

CANOPY DYNAMICS OF TYPHOON-DISTURBED MAHOGANY STAND IN THE MT. MAKILING FOREST RESERVE

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The study was carried out to analyze the bio-invasiveness and coexistence of big-leaf mahogany (*Swietenia macrophylla*) with native species after a typhoon disturbance in the Permanent Forest Laboratory Area 3 in the Mt. Makiling Forest Reserve. The study was conducted by strategically laying five 10-m×10-m quadrats. Canopy gaps were measured using hemispherical photographs with different exposure settings. Normalized difference vegetation index (NDVI) was employed as a prediction model to determine the silvicultural pathways. The five plots yielded a total of 293 individuals of 23 tree species which represent 21 genera under 15 families. Mahogany is the most dominant (93.4) and the most ecologically important (171.95) species. Seven new species were observed to coexist with mahogany plantation. These are narra (*Pterocarpus indicus*), amamali (*Leea aculeata*), Pará rubber (*Hevea brasiliensis*), lanutan (*Mitrephora lanotan*), tambalau (*Knema glomerata*), kapulusan (*Nephelium ramboutan-ake*), and magabuyo (*Celtis luzonica*). The mahogany population structure shows a reverse J-shaped population curve, which reveals that future communities may be sustained. Hemispherical photographs revealed that light can still penetrate because the forest canopy is not totally closed, such that understory layers composed of seedlings and saplings may grow abundantly. *Arenga pinnata* serves as intermediate subcanopy. NDVI findings showed a drop in vegetation cover in 2006 and 2014, which can be attributed to typhoons Milenyo and Glenda. Recovery of vegetation after the disturbance is attributed to natural recruitment and regeneration. This study provides scientific understanding of natural canopy dynamics and silvicultural pathways, which may aid in forest management and conservation of the mahogany stand.

Keywords: bio-invasiveness, coexistence, silvicultural pathways

BS – 03

CHANGES IN PLANT COMMUNITY STRUCTURE OF SUCCESSIONAL AND MATURE SECONDARY FOREST IN MT. MAKILING FOREST RESERVE AFTER TWO DECADES

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To date, an estimated 875 studies have been conducted in the Mt. Makiling Forest Reserve (MMFR) but most were either short term in nature or without follow up studies. In this study a 4-ha long-term monitoring plot established in 1992 through the collaboration of the College of Forestry and Natural Resources, UPLB and the Japan International Research Center for Agricultural Sciences was re-surveyed for trees (>10 cm diameter at breast height) tagged in 1992 and those that recruited beyond, including current regenerations. This was done to determine community dynamics of component tree species and assess recruitment strategies of forest trees in MMFR. Growth parameters, in terms of standing volume, as well as change in species diversity are discussed. Over time, the composition of the MMFR was consistently formed by numerous non-dipterocarp tree species, maintaining a species-rich secondary tropical rainforest. The three most occurring taxonomic families were Cannabaceae, Meliaceae, and Rubiaceae, while *Celtis luzonica* (Cannabaceae), the most dominant species recorded in 1992, is still the dominant species present in the standing canopy vegetation and regeneration. The smaller presence of dipterocarp species, which were the dominants in the original flora, indicated that the species have suffered heavy utilization in the past, with the result that numerous non-dipterocarp tree species now form the species-rich secondary tropical rain forest. This study is useful in understanding the dynamics of a particular forest ecosystem over time.

Keywords: community dynamics, non-dipterocarp, plant community structure

BS – 04

**CHARACTERISTICS OF THE SOIL SEED BANK
OF A LONG-TERM MONITORING PLOT
IN MT. MAKILING FOREST RESERVE**

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In this study the characteristics of the seed bank of a relatively undisturbed 4-ha long-term monitoring plot in the Mt. Makiling Forest Reserve (MMFR) and its relationship with its immediate standing vegetation was investigated. Whereas several related studies have been conducted in many tropical forests, limited investigation has been conducted in Philippine rainforests. This study revealed that the long-term monitoring plot had poor soil seed bank despite its high species diversity. There was generally very weak relationship, in terms of species composition, between the seed bank and its immediate standing vegetation (regeneration and trees). The standing vegetation in the long-term monitoring plot did not reflect the characteristics of its soil seed bank, and vice versa. Therefore, the standing vegetation does not necessarily shape the structure of a seed bank. Across soil layers, the highest seed abundance and species richness was the 0–10 cm layer, suggesting that the richness of the soil seed bank in MMFR is limited to this soil layer. However, since the species generally found in the seed bank were not tree species, intervention may be needed to restore the standing vegetation in the future.

Keywords: 4-ha long-term monitoring plot, seed bank

BS – 05

CHARACTERIZATION OF MANGROVE FORESTS OF SURIGAO DEL SUR

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Mangrove forests are important in carbon sequestration and other vital ecosystem services, such as protection from strong typhoons and storm surges. Studies have also revealed that a decrease in the mangrove area was observed in different parts of the globe. This study assessed the trends and characterize the diversity of mangrove forests in Surigao del Sur. Change analysis was employed using Landsat images in 1996, 2000, 2015, and 2017. Municipalities with persistent mangrove forests were also visited and transect lines were established covering three major zones: seaward (0–100 m), midward (101–300 m), and landward (beyond 300 m). In each zone, two 30 m × 30 m plots were set up and the number of mangrove trees were recorded. These data were used in the computation of relative frequency, relative abundance, relative density, and importance values. Consequently, biodiversity indices (i.e., Shannon, Simpson) and evenness were also obtained. Based on the analysis, mangrove areas in Surigao del Sur have decreased in 1996–2000 and 2015–2017 periods but increased in the 2000–2015 period. It was found that in 2015–2017 around 1,418.12 ha of mangrove forests persisted, located in San Agustin, Hinatuan, Lianga, Lingig, Carrascal, and Bislig City. In terms of biodiversity, it was found that around 11 species from seven families were present in the area. *Rhizophora apiculata* (99%) and *Rhizophora stylosa* (81%) have the highest importance values. The landward zone in Caguyao, Bislig City turned out to have the highest Shannon (1.54) and Simpson indices (0.75). Results of the study can be used in improving the management of mangrove forests and in identifying critical areas that may need immediate intervention in the province.

Keywords: mangrove, change analysis, quadrat sampling, diversity

BS – 06

CHARACTERIZATION OF MANGROVE FORESTS USING REMOTE SENSING AND FIELD SAMPLING IN ZAMBALES, PHILIPPINES

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Similar to global trends, the mangrove forests of Zambales have declined over the years despite their importance to coastal communities. This study characterized the mangroves of Zambales using remote sensing and field survey. The mangrove extent was estimated using Landsat images for four periods (1996, 2005, 2015, and 2017). Mangrove diversity was characterized using quadrat sampling. Two 30 m×30 m quadrats were established and surveyed in each site in the municipalities of Palauig, Masinloc, and Santa Cruz. The number of individuals for each quadrat was noted and used to compute for importance values. Diversity indices (Shannon, Simpson's, and Evenness) were also computed. Results from remote change analysis showed that the mangrove extent had a decreasing trend until 2015, but slightly increased in 2017. The estimated mangrove area in 2017 is about 297.10 ha. In the 2017 classification and field survey, the midward and landward zones are already denuded and only the seaward zone is left to protect the coastal areas. The findings of the field survey also revealed that Zambales mangrove forests are composed of 12 mangrove species from five families. *Rhizophora apiculata* and *R. stylosa* have the highest importance values. Meanwhile, Santa Cruz has the highest values for both Simpson's and Shannon, while Masinloc, the municipality with the lowest number of species, obtained the highest evenness index. Palauig has the lowest values for all the diversity indices. In general, results of this study showed that immediate actions are needed to prevent further degradation and rehabilitate the mangroves of Zambales.

Keywords: mangroves, remote sensing, quadrat sampling, change analysis

BS – 07

**DIVERSITY AND ABUNDANCE OF AQUATIC MACROPHYTES
AND ITS RELATIONSHIP WITH NUTRIENTS LEVELS
IN LAKE MAINIT, CARAGA, PHILIPPINES**

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Aquatic macrophytes are the key members of wetland communities and their distribution and growth are greatly affected by nutrient enrichment. This study aims to examine the diversity and abundance of aquatic macrophytes and their relationship with the level of nitrogen and phosphorus in the substrate and water in Lake Mainit. Four stations were established using belts transect to determine the diversity and abundance of aquatic macrophytes. Percent cover and abundance were evaluated using the DAFOR scale (d for dominant, a for abundant, f for frequent, o for occasional, r for rare). Total nitrogen and total phosphorus in the substrate and water were analyzed using the Kjeldahl and Vanadomolybdo phosphoric acid method. Diversity measurement revealed that Tapian station had the highest diversity ($H'=1.411$) while Bansayang station has the lowest diversity ($H'=0.503$). Correlation analysis unveiled that aquatic macrophytes diversity are positively highly correlated with nitrogen in the substrate and negatively correlated with the nitrogen in water. Similarly high correlation pattern was noted between aquatic macrophyte abundance and nitrogen level in the substrate. Based on the findings of the study, nitrogen concentration in the substrate could greatly influence the diversity and abundance of aquatic macrophytes.

Keywords: macrophytes, diversity, nutrient enrichment, wetland ecosystem

BS – 08

**DIVERSITY AND ECHOLOCATION CALLS OF BATS
IN MT. GUITING-GUITING NATURAL PARK,
SIBUYAN ISLAND**

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Insect-eating bats emit high-frequency sounds which they use to navigate and locate their insect prey. These calls are typically species-specific and can be used to identify species. This study determined the diversity of echolocating insect bats in Mt. Guiting-Guiting Natural Park, a protected area in the center of Sibuyan Island in Romblon province. In October–November 2016 and May–June 2017, bats were collected using mist nets and harp traps. Captured bats were then released in a tent to record their respective echolocation calls using a Pettersson M500 bat detector. A total of 87 bats were recorded, representing 11 species: *Hipposideros antricola*, *H. obscurus*, *Kerivoula whiteheadi*, *Murina cyclotis*, *Myotis muricola* A, *M. muricola* B, *Pipistrellus javanicus*, *P. tenuis*, *Rhinolophus arcuatus*, *R. virgo*, and *Scotophilus kuhlii*. On the basis of echolocation call, two different types of *M. muricola* (A [maximum frequency=107 kHz, peak frequency= 7 kHz] and B [maximum frequency=67 kHz, peak frequency=50 kHz]). *K. whiteheadi* also represents a new record for Sibuyan Island. Species identification was based on the current taxonomy of groups but further taxonomic studies may result in a split of species complexes (i.e., *R. arcuatus* group) into several distinct species.

Keywords: bats, Sibuyan, echolocation

BS – 09

**DIVERSITY AND STATUS OF BATS IN SELECTED
WATERSHED AREAS IN LAKE MAINIT,
SURIGAO DEL NORTE, PHILIPPINES**

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Bats are known to be effective pollinators and seed dispersers that aid in shaping forest ecosystems. This study was conducted to assess the diversity and status of bat species in selected watershed areas (Camp Edward, Alegria, Surigao del Norte; Sitio Canticol, Tubay, Agusan del Norte) in Lake Mainit as input to protected area suitability assessment. Sampling was done using mist netting method with the use of 40 6×12-meter mist nets to determine species diversity of bats in two sampling sites. The external metrics of captured bats were immediately recorded after retrieval from the nets. There were 260 bats captured, representing 13 species belonging to three families (Pteropodidae, Hipposideridae, and Rhinolophidae). Of these, 54% were endemic species while 46% were resident species. *Megaerops wetmorei* are listed in the IUCN Red List as vulnerable and *Eonycteris robusta* as near threatened while the other species are listed as of least concern. The presence of vulnerable and near threatened species indicates that the watershed areas of Lake Mainit varied in terms of availability of food and other environmental attributes useful in determining an area's potential for conservation and protection. To validate the existence of other bat species, it is suggested that additional sampling and persistent monitoring of the watershed areas in Lake Mainit, Mainit Surigao del Norte, Philippines.

Keywords: bats, endemic, resident, ecological importance

BS – 10

DIVERSITY OF BIRDS IN MT. MALINDANG RANGE NATURAL PARK-HOYOHOY SITE, TANGUB CITY

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Mt. Malindang Range Natural Park (MMRNP) serves as a watershed supporting various life forms and providing sanctuary to numerous and unique wildlife species. However, Mt. Malindang is threatened by anthropogenic activities, hence Mt. Malindang needs maximum protection. This study assessed the diversity of birds in the MMRNP-Hoyohoy Site in Tangub City. line transect count and mist-netting were used to record and collect birds. A total of 47 species of birds belonging to 12 orders and 31 families were recorded in the site. Passeriformes had the most number represented by nine families. Of the species observed, 46.5% endemism was recorded. Certain bird species, such as *Otus gurneyi* and *Buceros hydrocorax* are listed as vulnerable species. These two species of birds need to be given high conservation priority along with other forest endemics. The value for species diversity was $H' = 3.499$ and evenness was $e^{\wedge} = 0.7875$. Results of this study can be used to come up with better strategies for conservation as well as in the development of information, education and communication (IEC) for behavior change materials that would contribute toward the protection of Mt. Malindang.

Keywords: conservation, endemism, threatened, Passeriformes

BS -11

ICHTHYOFAUNA OF LUMBO CREEK, VALENCIA CITY, BUKIDNON, PHILIPPINES

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This study was conducted in Lumbo Creek in Mt. Musuan, Bukidnon, which is one of the Long-term Ecological Research (LTER) sites in Mindanao. For two years (2013–2015), seasonal samplings were done along the creek length (upstream, midstream, and downstream). Lumbo Creek is a tributary of Pulangui River, which is part of the longest river in Mindanao. Land cultivation has caused soil erosion, which has led to the deterioration of stream water quality and siltation. This study assessed the fish fauna species in Lumbo Creek. Fish collection using electric fishing and seining yielded a total of 549 adult and juvenile individuals representing 11 species from eight families. The fishes were generally small in size and no endemic species were found. The most commonly collected (38%) species was the native line spotted-barb (*Puntius binotatus*) (38%) from Cyprinidae, whose population was dense in the upstream area. This was followed by an introduced species of guppy (*Poecilia reticulata*) (24%) from Poeciliidae, which was commonly distributed in upstream and downstream areas. Other species collected were *Clarias gariepinus* (16%), *Trichogaster trichopterus* (1.5%), *Pterygoplichthys disjunctivus* (0.36%), *Cyprinus carpio carpio* (0.36%), *Oreochromis aureus* (0.36%), *Anabas testudineus* (0.36%), *Channa striata* (0.36%), *Clarias* sp. (0.18%), and *Chagunius chagunio* (0.18%). The wide distribution of introduced fishes and the occurrence of the invasive janitor fish may indicate the disturbed state of the creek although these fish species have shown resilience to the adverse environment brought about by land cultivation.

Keywords: ichthyofauna, resilience, long-term ecological research site

BS – 12

**LEAF LITTER FALL PRODUCTION OF NATURAL
AND REFORESTED MANGROVE FOREST
OF *Sonneratia alba* (Sm.) IN BARANGAY WHITE BEACH,
PAGADIAN CITY, ZAMBOANGA DEL SUR**

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Mangrove forests serve as natural barriers in coastal communities like Barangay White Beach, Pagadian City and play a vital role in ecosystem productivity because of their leaf litter fall. This study assessed the daily leaf litter production of a mixture of natural and reforested mangrove forest of *Sonneratia alba*, which is the most dominant species in the area. This study also serves as a formal documentation of the mangrove species composition of the area. Litter fall data were collected for 31 days (Sept–Oct. 2011) in a natural mangrove forest (remnant of old growth trees about <50 years old) and a reforested mangrove forest (<20 years old) of *S. alba* using nylon litter traps (2-mm mesh) set-up randomly in three zones of each forest type: Z1 (seaward), Z2 (between Z1 & Z2), and Z3 (landward). The content of the litter traps were collected daily, sorted, dried, and weighed. A higher rate of leaf litter production was observed in the natural forest with a mean of 109.25 g oven dry weight per m² (ODW/m²) compared to the reforested area (58.49 ODW/m²) with a total mean of 83.87 ODW/m². The natural and reforested forest of *S. alba* showed significant difference in terms leaf litter production. However, leaf litter production between zones were not significantly different. In terms of species composition, nine mangrove species were recorded: *Avicennia marina*, *Rhizophora apiculata*, *Rhizophora mucronata*, *Ceriops tagal*, *Bruguiera gymnorhiza*, *Sonneratia caseolaris*, *Sonneratia alba*, *Nypa fruticans*, and *Acrostichum aureum*. Of these, all nine mangrove species were found in the natural mangrove forest while only five (*A. marina*, *R. apiculata*, *S. alba*, *N. fruticans* and *A. aureum*) were found in the reforested mangrove forest.

Keywords: leaf litter fall, productivity, mangrove forest

BS – 13

MALACOFAUNAL DIVERSITY OF LUBAYAT RIVERINE ECOSYSTEM IN REAL, QUEZON PHILIPPINES

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This study aimed to identify and determine the malacofaunal diversity of the Lubayat riverine ecosystem in Real, Quezon. Physico-chemical parameters (i.e., temperature, pH, turbidity, dissolved oxygen, biological oxygen demand, total suspended solids, nitrate, and phosphate) were also assessed. Findings revealed 24 species of mollusks. Species from the family Neritidae, such as *Clithon corona*, *Clithon* sp., *Nerita* sp., and *Septaria porcellana* were the dominant species. *Nertina* sp. was the most abundant species. The Shannon-Wiener diversity (H') index, which varied based on monthly field surveys, ranged from 2.21 to 2.78. The Sorensen index of similarity in the three established sites was calculated as 63.75% (site 1 and site 2), 93.9% (site 2 and site 3), and 57.7% (site 1 and site 3). Based on the IUCN Red List, the identified species belong to the not evaluated (NE) category. Some parameters of water quality in the Lubayat riverine ecosystem were within the standard for Class C surface freshwater, except for nitrates and phosphates. The study also found that there was no significant difference in the physico-chemical parameters vis-à-vis the abundance of malacofaunal species. Conservation efforts must focus on protecting the Lubayat riverine ecosystem to guarantee the continuous existence of mollusc species.

Keywords: malacofaunal diversity, physico-chemical parameters, Shannon-Weiner index, Sorensen index of similarity, Lubayat riverine ecosystem

BS – 14

MICROBIAL INOCULATED PLANTS TO BRING BACK GREEN COVER AND LIVE SOIL ENVIRONMENT IN BARREN MINE TAILINGS?

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To bring back green cover and dead soil to life, a barren mine tailing area that had been abandoned for three decades in Brgy. Capayang, Mogpog, Marinduque was planted with tree legumes. Aseptically pre-germinated two-week old narra (*Pterocarpus indicus*) and *Acacia mangium* were inoculated with biofertilizers (mycorrhizal fungi and nitrogen fixing bacteria) during transfer into individual polybags. Plant growth response to biofertilizers was positive three months after inoculation. In the field, lime, compost, and NPK fertilizer were applied to all seedlings. After 15 months, mycorrhizal narra seedlings had height increases ranging from 98–139% and stem diameter increases from 67–87% relative to the control (78 cm). Narra planted without any amendments had 50% seedling survival and height of 36 cm versus 78 cm with lime and vermicompost but no biofertilizers. MYKORICH[®] inoculated seedlings were more than 200 cm tall. On the other hand, the biggest stem diameter was obtained from BioN[™]-, MYKOVAM[®]-, and Mykorich+BioN-inoculated plants with increases ranging from 17–19% relative to the control (5.79 cm). On *A. mangium*, BioN and Surigao isolate increased height by 28%. Seedling survival was 98% in narra and 95% in *A. mangium* one year after planting. Fungal population was highest ($9.9 \pm 5.5 \text{ CFU} \times 10^4 \text{ g soil}^{-1}$) in MYKORICH-inoculated narra versus $0.82 \pm 0.17 \text{ CFU} \times 10^4 \text{ g soil}^{-1}$ in the control plants. BioN+Surigao isolate-inoculated *A. mangium* had the highest ($65.5 \pm 5.5 \text{ CFU} \times 10^4 \text{ g soil}^{-1}$) fungal population versus the control ($1.12 \pm 0.26 \text{ CFU} \times 10^4 \text{ g soil}^{-1}$). Bacterial population was highest in *A. mangium* inoculated with Bio-N ($28.26 \pm 0.93 \text{ CFU} \times 10^4 \text{ g soil}^{-1}$) while the lowest was in the control ($0.5 \pm \text{CFU} \times 10^4 \text{ g soil}^{-1}$). Biofertilizers promoted plant growth, survival, and soil microbial build up in an abandoned mine tailing area in Brgy. Capayang, Mogpog, Marinduque, thus, bringing back green cover and a living soil environment.

Keywords: *Acacia mangium*, *Pterocarpus indicus*, microbial population

BS – 15

RISK ASSESSMENT OF ALIEN AMPHIBIANS: GUIDING PHILIPPINE BIOSECURITY PROGRAMMES FOR SUSTAINABILITY AND BIODIVERSITY CONSERVATION

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The negative ecological, evolutionary, and socio-economic impacts of invasive alien species have prompted the world's nations to develop and implement sound biosecurity programs in response to current and future biological invasions. Here, we assessed the risk of invasion of currently occurring alien frogs in the Philippines, as well as potential amphibian invaders. By analyzing geographical and historical data, the invasion history of the six currently occurring alien frogs was reconstructed and their current status and distribution updated. Invasion hotspots were mapped and the geographic risk of key conservation areas was assessed using an ensemble of ecological niche models. Potential amphibian invaders were horizon scanned using three factors of invasion success: history of invasion elsewhere, climate match, and propagule pressure. The origin and pathways involved in alien frog introductions into the Philippines were identified. Geographical distribution maps showed that all major Philippine islands, except for islands in Batanes Province, have been invaded by at least one alien frog. The invasion hotspot map showed that most key conservation areas are at risk of invasion, with eight in the hottest of invasion hotspots. Horizon scanning showed that 138 alien amphibian species pose high risk of invasion into the Philippines. Our study provided the much-needed science-based information that can help guide the development and implementation of sound biosecurity programs for amphibian invasions, contributing to the Philippines' international commitments to sustainability (Target 9-Aichi Biodiversity Targets) and biodiversity conservation (Goal 15-Sustainable Development Goals).

Keywords: invasive alien species, invasion history, geographic distribution, ensemble modelling, horizon scanning

BS – 16

SEASHELLS TAKEN AND SOLD IN THE BEACHES OF BABAK, SAMAL ISLAND, DAVAO DEL NORTE

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This research focused on identifying rare, threatened, and endangered seashell species taken or sold in the beaches of Babak, Samal Island, Davao del Norte. This is to provide information to policy makers to locally strengthen conservation measures, especially because of accelerating negative impacts of population growth and tourism on the aquatic biodiversity of the island. Two research areas were established (i.e., the coastal village area and a souvenir shop of a well-known beach resort) on the island. Seashell species were documented and their conservation statuses were identified in accordance with existing conservation laws. Results revealed that three threatened shell species (*Tridacna squamosa*, *Tridacna gigas*, and *Cassis cornuta*) are found in the village area and consumed as food and used as ornaments. One rare species (*Lyncina aurantium*) was found in the souvenir shop, which was used as raw material for shell crafts. There must be strict conservation measures and monitoring in coastal village communities as well as in souvenir shops. Particularly, seashell monitoring in the community is very crucial as they serve as the frontliners of biodiversity conservation of seashells and shell-dependent organisms.

Keywords: seashells, Samal Island, threatened species, biodiversity

BS – 17

**SEASONAL VARIATION IN THE DIVERSITY AND SPECIES
RICHNESS OF PHYTOPLANKTON
IN A TROPICAL OLIGOTROPHIC LAKE:
AN UPDATE IN LAKE MAINIT, PHILIPPINES**

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Phytoplankton diversity and species richness was carried out in the dry and rainy seasons in Lake Mainit, a tropical oligotrophic lake shared by Agusan and Surigao del Norte in the Philippines. Species richness and diversity (Shannon-Wiener, H') were measured at two-month (September and November 2016) intervals in four stations within the lake. Results show the presence of 36 phytoplankton species. Bacillariophyta (diatoms) dominated the phytoplankton species composition (47%) followed by Chlorophyta (17%) and Cyanophyta. The diatom *Aulacoseira granulata* and the green algae *Botryococcus braunii* were the most abundant species, comprising 30.29% and 28.3% respectively, of the total phytoplankton biomass. A higher phytoplankton density and diversity was observed during the wet season for all stations, of which a rise in phytoplankton density was significantly pronounced in Station 7 and Station 8. The diatom *A. granulata* is a known species to dominate eutrophic waters whereas *B. braunii* is a known macroalgae that often causes algal blooms with elevated dissolved phosphorus. About 53 phytoplankton species from four phytoplankton groups were reported in a 2004 limnological assessment. While this previous assessment had similarity to this study's results in the major algal group composition, some species were noticeably absent or different from what were identified in this study. There is a necessity to closely monitor the biomass of plankton in the lake while keeping track of other physico-chemical parameters as the higher phytoplankton density during the rainy season was dominated by *B. braunii*—a chlorophyte known to cause algal blooms and fish kills.

Keywords: algal bloom, algae, fish kills

BS – 18

SELECTION PRESSURE: ITS INFLUENCE ON THE SIZE, CARAPACE SHAPE, AND GENETIC DIVERSITY OF *Scylla* sp. IN SELECTED AREAS OF THE PHILIPPINES

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The biological attributes of an organism are influenced by selection pressure. Exploitation may affect not only the size but also the genetic diversity, shape, and abundance, among other biological features, of organisms and populations. To test this concept, the size, abundance, phenotypic diversity, and genetic diversity of *Scylla* sp. in selected areas of the Philippines were examined using information from secondary sources, geometric morphometrics, and genetics. Samples of the three species of crabs (*S. serrata*, *S. tranquebarica*, and *S. olivacea*) were collected from Panguil Bay, Bislig Bay, Sibuyan Sea (Roxas City), and Lingayen Gulf. Owing to its distinct taste and larger size compared to the other two species, *S. serrata* is highly preferred and subjected to high fishing pressure because of high demand in the local and export markets. The volume of catch and size of *S. serrata* in Bislig Bay declined in a span of 10 years. Among the three species, *S. serrata* had the least carapace shape variation and the lowest haplotype and nucleotide diversities. Unsustainable artificial selection pressure might have caused the decreasing size, declining volume of catch, less carapace shape variation, and low haplotype and nucleotide diversities of *S. serrata*. Further investigation and implementation of management intervention is imperative to conserve *S. serrata*.

Keywords: geometric morphometrics, cytochrome oxidase I, haplotype diversity, nucleotide diversity, Bislig Bay

BS – 19

SPECIES COMPOSITION AND SIZE-STRUCTURE RELATIONSHIPS OF ICHTHYOFAUNA IN LAKE MAINIT, PHILIPPINES

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Lake Mainit is an important shared resource of Agusan Norte and Surigao del Norte, distinguished as the deepest and fourth largest lake in the Philippines. Lake Mainit supports a high diversity of aquatic fauna and a thriving freshwater fishery resource. The lake and river fisheries, however, are rapidly being depleted due to unsustainable or destructive fishing practices, overfishing, and lack of enforcement of key fisheries and environmental policies. The last comprehensive fishery assessment was in 2008. Updated information to guide the decision making of resource managers is integral for sustainable fisheries management. This study reports the species composition and length-weight relationships (LWRs) of 24 fish species collected using six types of fishing gear from October to December 2017 from four municipalities bordering the lake—a 39% decline in fish species from the previous 2008 assessment. The species collected belong to 15 families and were mostly introduced to the country. One fish species is vulnerable (*Cyprinus carpio*) and another species (*Neothethus thessa*) is endangered according to the IUCN Red List. The “b” values in the LWR $W = aL^b$ ranged from 2.22 to 3.88. This study shows that introduced species (60%) have dominated the species composition of the lake and majority of these introduced species were utilized as a major part of the diet of lake residents and most of the fish-eating public of Agusan Del Norte and Surigao del Norte. The size structure and inventory of fishes show a decline in species composition and are an important update to the comprehensive profile on the status of the lake and riverine fisheries in the area.

Keywords: protected areas, biodiversity, ichthyofauna

BS – 20

**DIVERSITY OF AMPHIBIANS AND REPTILES
IN AGUSAN DEL SUR STATE COLLEGE OF AGRICULTURE
AND TECHNOLOGY**

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Amphibians and reptiles (herpetofauna) are an abundant and diverse component of many terrestrial and freshwater ecosystems contributing to a diverse range of ecological functions. This study, which rapidly assessed the amphibians and reptiles present in the area, was conducted during the summer class of academic year 2016–2017 for two nights along a 1-km transect walk (ground distance) in the river area of ASSCAT campus. Collected specimens were picked by hand and pitfall trapping was established close to feeding grounds and possible pathways so that surface-active reptiles would fall into the trap in the ground. The study revealed a total of seven species belonging to six genera and four families, five of which were amphibians and two were reptiles. Results of the assessment showed one vulnerable species (*Cuora amboinensis* Riche in Daudin, 1801), one data-deficient species (*Fejervarya moodiei* Taylor, 1920), and five species of least concern (*Fejervarya vittigera* Wiegmann, 1835; *Lithobates catesbeianus* Shaw, 1802; *Limnonectes leytensis* Boettger, 1893; *Polypedates leucomystax* Gravenhorst 1829; and *Eutropis* sp.).

Keywords: species richness, amphibians, reptiles, assessment

BS – 21

**SPECIES RICHNESS, ENDEMISM, AND THREATENED
AMPHIBIANS AND REPTILES IN MT. MALINDANG RANGE
NATURAL PARK (MMRNP) -HOYOHOY SITE**

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Amphibians and reptiles are among the most ecologically essential bioindicators in the ecosystem, but these are also under threat due to some anthropogenic activities that have adverse impacts on natural ecosystems. This study was conducted to determine the species richness, endemism, and threatened status of amphibians and reptiles on Mt. Malindang Range Natural Park (MMRNP)-Hoyohoy Site. Standards methods (i.e., modified strip transect sampling, live-trapping with pit-fall, and glue-board traps) and purposive sampling were conducted. Results show that the MMRNP-Hoyohoy Site had a total of 15 herpetofaunal species, composed of eight amphibians and seven reptiles. Out of the eight herpetofauna families, Scincidae and Colubridae had the highest species richness. Of the species recorded, 10 are Philippine endemic, which indicates overall endemism of 66.67%. Two of the total number of endemic species (*Megophrys stejnegeri* and *Philautus acutirostris*) are classified as vulnerable. The presence of these endemic and vulnerable species is an indication of the need to protect the MMRNP-Hoyohoy Site as an important habitat for these herpetofaunal populations.

Keywords: bioindicators, families, herpetofauna, vulnerable

BS – 22

SPORE CULTURE OF THREATENED AND ECONOMIC SPECIES OF POLYPODIACEAE USING MODIFIED CULTURE MEDIA

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The increasing demand for the commercial uses of economic ferns has resulted in the decline of the population of ferns in the wild. To alleviate the threat on the availability of fern resources and their loss in its natural habitat, the development of methodologies using spores for ex situ conservation is encouraged. This study was conducted to monitor the spore germination, gametophyte and sporophyte development, and conserve the threatened and economically important *Aglaomorpha heraclea* and *Platyserium grande* using modified media (pure ground clay pot, ground adventitious roots of tree fern, mixture of ground clay pot with adventitious roots of tree fern or with soil). The two species germinated within seven days after culture and obtained 100% germination within 7–28 days. Regardless of the culture media, spores of the two species continued to grow mature gametophytes exhibiting *Drynaria* type of prothallial development. Antheridial formation was observed 5–13 weeks after culture while the archegonia were formed at 9–16 weeks. Formation of sporophytes differed in two species but was observed 12 weeks after culture in *A. heraclea* and longest in *P. grande* (22 weeks). Mixture of ground clay pot with adventitious roots of tree fern was found to be the best medium for propagation. Out-planted individuals showed 100% survival, which indicating the efficacy of using modified media for ex-situ conservation of threatened and economic ferns.

Keywords: propagation, fern, spore germination, gametophyte, sporophyte

BS – 23

**DINOFLAGELLATE CYST DISTRIBUTION ALONG
THE COASTS OF TACLOBAN CITY IN INNER
SAN PEDRO BAY, LEYTE, PHILIPPINES**

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A baseline study of the abundance of dinoflagellate cysts in surface sediments of inner San Pedro Bay that included San Juanico Strait in Leyte, Philippines is presented in this paper. Sediment samples were collected from 11 stations in the study area on March 2015. Dinoflagellate cyst densities were determined and expressed as cysts per gram of dry weight (cysts g⁻¹ DW). Dinoflagellate cyst taxa were sparse with relatively low occurrence and were sporadically distributed in relatively low densities in all sampling stations of the study area. A total of six cyst species from six stations were found and identified to be members of three dinoflagellate groups: Gonyaulacoid, Gymnodinoid, and Protoperidinoid. No cysts of *P. bahamense* var. *compressum* were detected. Cell density only had an average of >1 cysts g⁻¹. Factors, such as organic content, dry bulk density of sediments, depth-affected cyst distribution, and density in Inner San Pedro Bay, Leyte were also determined.

Keywords: dinoflagellate cysts, Gonyaulacios, Gymnodinoid, Protoperidinoid, inner San Pedro Bay

BS – 24

**ALLELIC DIVERSITY OF SELECTED PHILIPPINE NATIVE
MAIZE (*Zea Mays* L.) POPULATIONS RESISTANT
AND SUSCEPTIBLE TO CORN BORER**

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Corn borer infestation is a serious constraint in maize production. Assessment of allelic diversity of maize populations will provide relevant information essential for maize resistance breeding strategies. To date, no study on allelic diversity of resistant and susceptible populations to corn borer has been done on Philippine native maize populations. This study aimed to assess the allelic diversity of simple sequence repeat (SSR) loci linked to corn borer resistance. Two SSR markers associated with corn borer resistance (CBR) were used to evaluate the three susceptible and three resistant Philippine native maize populations. SSR markers IPBSSR013 and IPBSSR752 were utilized to assess corn borer resistant and susceptible lines. Five alleles were identified from IPBSSR752 and six from IPBSSR013, with an average allele frequency of 0.167 and 0.143, respectively. A total of 182 alleles were found in IPBSSR752 and 239 from IPBSSR013. Three alleles were found to be unique in highly susceptible lines and exhibited a more diverse set of alleles using IPBSSR013. Two distinct alleles only found in highly resistant lines and one allele only found in highly susceptible lines were identified using IPBSSR752. A dendrogram was constructed at 0.73 similarity coefficient wherein nine clusters were generated. Cluster 1 was the largest group and consisted mostly of the highly resistant lines and Cluster 5 consisted of populations that are highly susceptible. A unique individual, which is only 45% similar to the rest of the samples evaluated, was identified from a highly susceptible population collected from Bukidnon. The SSR markers can be used to distinguish and screen pest-resistant maize lines.

Keywords: allelic diversity, Philippine native maize populations, SSR analysis, corn borer, downy mildew

BS – 25

DEMONSTRATION OF MICROBIAL BIOTECHNOLOGY MEDIATED FOREST PARK IN CALIRAYA SPRINGS, CAVINTI, LAGUNA

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Many tourists visit the Caliraya Springs for leisure purposes, particularly sports. The area had been scraped and the soil is a sub-soil which is very hard to work on. Growth of plants previously planted by the developer did not survive. Experiments were established along the road in an open area covered with creeping grasses to demonstrate a biotechnology-mediated forest park in Caliraya Springs, Cavinti, Laguna using plant growth-promoting microbes, such as mycorrhizal fungi and nitrogen-fixing bacteria, inoculated into indigenous and endangered tree species in the Philippines. The experiment was an excellent demonstration of the effectiveness of nitrogen-fixing bacteria and mycorrhizal fungi on narra (*Pterocarpus indicus*), bani (*Pongamia pinnata*), ipil (*Intsia bijuga*), and batino (*Alstonia macrophylla*). Results after five years showed that, narra, ipil, bani, and batino grew very well in the area. Mycorrhizal inoculants coded as M6, Surigao (from mine tailing in Surigao, Mindanao) isolate and MYKOVAM[®] (BIOTECH-UPLB's biofertilizer) promoted the biggest stem diameter for bani, G49 for batino, and M6 for ipil. Seedling mortality in ipil (control) was 67% compared with 40–57% in their mycorrhizal counterparts. Sporulation in the rhizosphere of narra and bani was highest if inoculated with MYKOVAM[®] (100 and 131 spores per 20 g soil, respectively), whereas in batino, those inoculated with M6, Surigao gave the highest (131 spores per 20 g soil) spore count. The results imply the importance of selecting the best microbial inoculants that can adapt and reproduce in a particular environment. Microbial biofertilizers-inoculated narra, bani, and batino can be recommended in the rehabilitation of the red acidic soil in Cavinti, Laguna.

Keywords: arbuscular mycorrhizal fungi, MYKOVAM[®], narra, bani, ipil, batino, mycorrhizal root colonization and sporulation

BS – 26

GERMINATION AND GROWTH OF DIFFERENT NATIVE ORCHID SPECIES

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Many native orchid species are considered jewels of the Philippines. While they are disappearing in the wild, they need to be multiplied in vitro for future use in plant breeding work. The germination and growth of different native orchid species that were self-pollinated were tested using three media formulations. Germination experiment of three different native species of orchids (*Dendrobium* sp., *Phalaenopsis aphrodite*, and *Grammatophyllum* sp.) was done using three tissue culture media formulations. *Dendrobium* sp. germinated 41 days after inoculation in Knudson C plus NAA, 61 days in hormone-free Knudson C, and 82 days in Knudson C plus GA₃. Another experiment subcultured the different germinated native orchid species in three different media formulations. Fifteen weeks after subculture, the growth of *Spathoglottis* sp., *Vanda* sp., and *Cattleya* sp. were promoted in hormone-free Knudson C, Knudson C plus NAA, and Knudson C plus GA₃, respectively. Hundreds of whole plants of the different native orchid species with complete root and shoot were recovered and potted-out. It was observed that tissue-cultured *Spathoglottis* sp. flowered earlier by one year and a half after potting-out.

Keywords: *Cattleya*, *Dendrobium*, *Grammatophyllum*, *Phalaenopsis*, *Spathoglottis*, *Vanda*

BS-27

**PLANTS USED BY THE SUBANENS IN TREATING
LIVESTOCK AND POULTRY DISEASES AND MALAISE
IN MISAMIS OCCIDENTAL AND ZAMBOANGA DEL SUR**

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Plants with medicinal properties serve as a potent medicine for curing various diseases in humans and in animals. Filipinos, particularly those in rural and isolated areas, practice ethnoveterinary medicine due to the high cost of commercial drugs. Plants used in ethnoveterinary medicine are cheaper, locally available, and easily accessible. However, ethnoveterinary practice has not been given enough attention and may face the risk of disappearing altogether. This practice has been passed on from generation to generation through word of mouth and lacking proper documentation. Plants used by the Subanen in treating livestock and poultry were surveyed and documented in Misamis Occidental and Zamboanga del Sur by convenience-purposive sampling through semi-structured questionnaire and key informant interviews. A total of 71 respondents aged 30–94 years old, of which four were key informants (herbalist and tribal leaders), were interviewed. There were 45 and 38 medicinal plant species documented in Misamis Occidental and in Zamboanga del Sur, respectively. Leaves were the most frequently used plant parts, which are mostly prepared through pounding and applied topically in Misamis Occidental while it is prepared as a decoction and administered orally in Zamboanga del Sur. The family Fabaceae had the highest number of plant species used in both provinces. *Blumea balsamifera* (L.) DC. and *Tinospora crispa* (L.) Hook. f. & Thomson had the highest relative frequency of citation (0.48) and cultural index (0.10) observed in Misamis Occidental. In Zamboanga del Sur, *T. crispa* (L.) Hook. f. & Thomson was observed to have the highest relative frequency of citation (0.42) while *Sansevieria trifasciata* Prain., *Psidium guajava* L., *T. crispa* (L.) Hook. f. & Thomson, and *Ormosia calavensis* Blanco had the highest cultural index (0.06). Diarrhea was the most encountered problem in both areas during the wet season.

Keywords: ethnoveterinary, medicinal plant, botanical practices

BS-28

**CHLOROPLAST AND NUCLEAR DNA EXCHANGE AMONG
BEGONIA SECTION BARYANDRA SPECIES (BEGONIACEAE)
FROM PALAWAN ISLAND, PHILIPPINES,
AND DESCRIPTIONS OF FIVE NEW SPECIES**

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The Philippine island of Palawan is highly biodiverse. During fieldwork in 2011 and 2014, five unknown species in the large genus *Begonia* were discovered. The species were similar in their rhizomatous stems, four-petaled flowers, inferior two- or three-locular ovaries with bilamellate placentas, and were assignable to *Begonia* sect. *Baryandra*. Studies of relevant literature, herbarium specimens, and living plants support the recognition of the five new species endemic to Palawan: *B. elnidoensis*, *B. gironellae*, *B. quinquealata*, *B. tabonensis*, and *B. tenuibracteata* which are described here. The five new species were added to phylogenies-based Bayesian analysis of nrDNA (ITS) and chloroplast DNA (*ndhA*, *ndhF*–*rpl32*, *rpl32*–*trnL*, *trnC*–*trnD*), along with 45 other allied ingroup species. A majority of the species show incongruent positions in the two phylogenies, with evidence of prevalent chloroplast capture. Models show chloroplast capture is more likely in plant populations with high levels of inbreeding following a reduction in selfing rate after hybridization. We suggest that this is a possible explanation for the massive amount of chloroplast exchange seen in our phylogeny, as *Begonia* species often exist as small isolated populations and may be prone to inbreeding depression. Our data also indicate a level of nuclear genetic exchange between species. The high prevalence of hybrid events in *Begonia* is potentially an important factor in driving genomic change and species evolution in this mega-diverse genus.

Keywords: chloroplast capture, hybridization, taxonomy, phylogenetics, biodiversity hotspot

BS – 29

DETECTION AND VARIATION OF PUTATIVE EFFECTOR SIX GENES OF *Fusarium oxysporum* F. sp. *ubense* PHILIPPINES ISOLATES

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The soil-borne fungus *Fusarium oxysporum* f. sp. *ubense* (Foc) is an important pathogen of banana (*Musa* ssp.). The pathogen can be classified based on pathogenicity in specific varieties corresponding to physiological races and vegetative compatibility grouping (VCG). Studies have revealed that the same VCG could belong to different races. This led to the development of molecular diagnostic tools, such as the use of molecular loci to distinguish Foc isolates. Among the molecular loci used, a prospective result was observed using putative effector genes, known as SIX (secreted in xylem) genes. To further understand the pathogenicity of Foc isolates, a correlation of races and VCGs was done. Furthermore, SIX genes were used to differentiate Foc isolates representing different races and VCGs. Sequencing of PCR products and sequence analysis were done and phylogenetic relationships of the different isolates were determined. The results showed that sequence differences exist among and between isolates. Furthermore, results indicated that SIX genes can be used to differentiate race 4 from race 1.

Keywords: pathogenicity, race, vcg, SIX genes

BS – 30

DNA BARCODING AS A TOOL FOR ACCURATE SPECIES IDENTIFICATION

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Because an important component of combating illegal trade of aquatic species is the ability to accurately identify species in whatever form they are traded, DNA barcoding offers an effective identification tool that has proven to be useful in the fight against illegal trade. Here we present the results of the project FishCODES highlighting four studies that use DNA barcoding for species identification in collaboration with other government agencies. It was found that dried seahorse from a sack confiscated by the Philippine Coast Guard was actually *Hippocampus comes*, commonly known as the tiger tail seahorse, which is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna (CITES) and assessed as vulnerable (VU A2bd+4bd) in the IUCN Red List. Another is the identification of shark's fin confiscated by the National Bureau of Investigation as *Carcharhinus falciformis*, which is listed as near threatened in the IUCN Red List. Another is the discovery of the identity of an assumed "mameng" species as *Bolbometopon muricatum*, known as green humphead parrotfish. Finally the project was able to refine the identification of a stranded carcass of a marine mammal in the island of Dinagat in Surigao del Norte as *Physeter catodon* or sperm whale.

Keywords: DNA barcoding, *Hippocampus comes*, *Carcharhinus falciformis*, *Bolbometopon muricatum*

BS – 31

DNA BARCODING OF COMMERCIAL FISHERY PRODUCTS FOR EXPORT IN THE PHILIPPINES

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The demand for more accurate and responsible identification and labeling as a precautionary measure to ensure health safety in fish and fishery products consumption is taken seriously in global trade operations, which necessitates that exported products of the country be at par with international standards. To assess species identity and authenticity, this study tested the utility of DNA barcoding as one way to address issues of species identification and authenticity testing and as a baseline approach to illegal, unreported, and unregulated fishing. Samples were collected from participating BFAR-accredited export companies in three project sites: Manila, Cebu, and General Santos City. DNA barcoding results of 179 samples showed that 96% of the initial identification information indicated in the product label were correct based on clustering analysis conducted on the retrieved DNA sequences of the samples. These results revealed that most of the frozen, dried, and fillet products exported are authentic and comply with international standards on correct species labeling. Furthermore, the results provide an initial reference on the actual species of the fishery commodities being exported by the country.

Keywords: DNA barcoding, IUU “yellow card”, labeling

BS – 32

**FINDING STRESS GENES: GENE EXPRESSION ANALYSIS
OF THE RESISTANT LESION MIMIC
AND EARLY SENESCENCE RICE (*Oryza sativa* L.) MUTANT**

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Differential gene expression analysis in lesion mimic and early senescence mutant (*lms*) in rice (*Oryza sativa* L.) was conducted to identify genes that are up- and down-regulated relative to wild type. Pooled RNA from 20 biological samples grown for 21 days in 1.5 in diameter and 8 in depth containing soil were used. The cDNA libraries were sequenced using HiSeq 2,500 (100-bp reads). Reads alignment was done using TopHat (v2.1.1) while downstream quantification of expression was done using Cuffdiff software (v2.2.1). There were 126 genes that showed up-regulation and 737 genes were down-regulated. Up-regulated genes are involved in terpene synthase, serine-type endopeptidase activity, and protein kinase activity while down-regulated genes are involved in biosynthetic, peptide biosynthetic process, and RNA metabolic process. Mutation in *lms* mutant affects the different genes involved in many biological and molecular processes. The *lms* mutant in this study is a very important material to decipher other mechanisms in plants that respond to environmental cues affecting plant growth.

Keywords: stress genes, *lms* mutant, RNA-seq, biotic stress, abiotic stress

BS – 33

GENETIC DIVERSITY ANALYSIS AND POPULATION STRUCTURE OF PHILIPPINE TRADITIONAL PIGMENTED RICE

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Pigmented rice possesses exceptional nutritional qualities and health benefits. There are several traditional pigmented rice varieties in the Philippines. However, knowledge about their population structure and genetic diversity is limited. Here we explore genetic diversity and population structure of Philippine traditional pigmented rice. The collected accessions (696) were genotyped with the 6K and 7K Infinium SNP array. Non-redundant markers (1,686) were retained for downstream analyses after filtering and linkage disequilibrium pruning. Accessions of unknown origin (92) were removed from the collection. The model-based clustering substantiated by principal component and phylogenetic analyses revealed the presence of two main clusters, *indica* and *japonica*. Duplicated samples were recorded (282) and excluded. Diversity parameters assessed using 322 unique accessions revealed a moderate diversity of *indica* ($He=0.26$), and *japonica* ($He=0.21$) group. Across regions, diversity was higher ($He=0.28$ to 0.35). Genetic differentiation between *indica* and *japonica* groups was very high ($F_{st}=0.51$). At the regional level, no differentiation ($F_{st}=-0.007$) and significant differences ($F_{st}=0.30$) between groups were observed. The Philippine accessions were genetically distinct from Indian and Chinese accessions, but show a high genetic connectivity with accessions from Taiwan. This unique resource is a valuable asset for genetic dissection of nutritional components and identification of valuable genes, which will contribute to the improvement of the nutritional value of modern rice.

Keywords: diversity, germplasm, pigmented, population structure, rice, SNPs

BS – 34

**MULTIPLE MOLECULAR MARKERS
(ITS, *rbcL*, AND *trnT-F*) REVEAL THE PHYLOGENY
AND HISTORICAL BIOGEOGRAPHY OF PHILIPPINE
Neonauclea Merr. (Rubiaceae)**

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With the advent of innovative molecular techniques, numerous scientists have employed this advantage in biodiversity and evolutionary research. This study explored the evolutionary relationships and history of Philippine *Neonauclea* Merr. (Rubiaceae) using the nuclear region *ITS* and plastid regions *rbcL* and *trnT-F*. Our reassessment of the genus present a strong support for its monophyly in contrast to its earlier proposed parphyly with its closely allied genera *Myrmeconuclea* and *Ludekia* (Razafimandimbison et al. 2005). The 18 new accessions of Philippine *Neonauclea*, however, did not form a monophyletic clade, which reveals its polyphyletic nature. The molecular analyses of the relationships within the widespread endemic *N. formicaria* individuals suggest that its species concept needs to be re-evaluated. Results from S-DIVA propose a profound phylogeographical history for *Neonauclea*, with its recent divergence across the Philippine archipelago involving numerous intra-island radiations and recolonization of several lineages, which appear to have originated from the Indomalayan-Australian eco-regions. The study highlights the importance of genetic material as a tool for evaluating evolutionary relationships and elucidating biogeographical patterns of Philippine biota.

Keywords: DNA markers, historical biogeography, *Neonauclea*, Philippines, phylogeny

BS – 35

IDENTIFICATION OF MICROBULBIFER AGARILYTICUS FROM
MUCUS OF SOFT CORAL *Clavularia* sp.
USING 16S rRNA

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The coral mucus is known to be inhabited by diverse bacterial populations. Many bacteria associated with corals particularly those in mucus layer have been found to possess antimicrobial property and bioactive secondary metabolites. This study is focused on the isolation, characterization and identification of pigmented bacteria from *Clavularia* sp. A mucus sample was plated in sterile Marine Agar and incubated at 28°C for 24 to 48 hours. Results show that only one pigmented bacterium was able to grow and survive in the medium used. The isolate is Gram negative coccus and its colony form is irregular, elevation is umbonate and margin is undulate. The growth under slant growth type is arborescent and with all over liquid growth type. Isolate is positive for protease and hemolysin tests. It is also considered as halophile tolerating up to 42% salt. The isolate is observed to grows at pH 5 up to pH 11 and pigment secretion is observed from pH 8 to 11. It can also grow and secrete its pigments at 24°C up to 37°C temperature at certain pH used. The isolate was identified as *Microbulbifer agarilyticus* using 16S rRNA. This is known to be an agar degrading bacterium, *Microbulbifer* is a genus of *Proteobacteria* that is found in high-salt environments. Results indicate the possibility for it to be further explored for its biotechnological and industrial applications.

Keywords: pigmented bacteria, *Microbulbifer agarilyticus*, 16S rRNA

BS – 36

ASSESSMENT OF MARINE MACROFOULING COMMUNITIES IN NAVAL BASE HERACLEO ALANO, CAVITE CITY

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The naval base Heracleo Alano in Cavite City is a potential habitat of non-indigenous foulers. It is surrounded by Manila Bay and Canacao Bay. The study determined the presence of macrofouling communities in the base's pier. Foulers collector design was adapted from the North Pacific Marine Sciences Organization (PICES). Collectors were deployed and retrieved after submersion periods of 39 days and 86 days. A total of 6,203 organisms belonging to eight phyla and nine classes were collected. Common macrofoulers were bivalves, polychaetes, decapods, amphipods, and barnacles. Shannon-Wiener index values ($H^1=1.7346$; $H^2=1.5392$; $H^3=1.6199$; $H^4=1.7602$) as well as species evenness ($E^1=0.5611$; $E^2=0.6001$; $E^3=0.5605$; $E^4=0.7000$) were relatively consistent. Values of the Simpson's index ($D^1=0.7744$; $D^2=0.7436$; $D^3=0.7376$; $D^4=0.7980$) indicated the presence of a dominant species, which is *Balanus* sp. The Kruskal-Wallis test showed no significant differences across the sampling sites. The macrofouling community had seven non-indigenous species (*Mytella charruana*, *Brachidontes* sp., *Mytilopsis sallei*, *Hydroides* sp., *Stylochus* sp., *Sabella* sp., and *Membranipora membranacea*). The macrofouling organisms present in the area may cause financial losses because of damage to submerged equipment. More importantly, the non-indigenous species may also be potential threats to the local ecosystem. Two species (*M. sallei* and *Brachidontes* sp.) are known to be invasive, although their abundance shows otherwise. There is a need to monitor these invasive species as *M. sallei* (origin: Caribbean) has been reported to be in huge numbers in the Indo-West Pacific region, particularly in Singapore, Hongkong, Thailand, India, Taiwan, China, Malaysia, Japan, and Australia while *Brachidontes* sp. (origin: Indo-Pacific) has spread to the Mediterranean and the Red Sea.

Keywords: macrofouling, aquatic, diversity, non-indigenous, invasive

BS – 37

OFF BOTTOM CULTURE OF DAKDAKAN (*Codium geppii*, Smidt 1925) AT THE MARINE WATERS OF NORTHERN POBLACION, SAN FRANCISCO, CEBU, PHILIPPINES

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Codium geppii and *Codium edule*, locally known as dakdakan, are usually eaten by fisher folk as marine vegetable salad and the natural stocks of these marine vegetables have declined. This study was conducted to find out the growth performance of these two species in different levels of water and at different culture sites. This study used the complete randomized design (CRD); four areas (site 1= grassy, site 2=muddy, site 3=rocky, and site 4= culture site) were selected for the experimental set up. The experimental set up consisted of three layers (treatment 1=surface, treatment 2=midlayer, and treatment 3= bottom layer). All the experimental cages were set in the mariculture site of the Cebu Technological University, San Francisco Campus. Survival and mortality rates were observed and the physico-chemical aspects of the area were also taken. Results show that the grassy area site topped in terms of growth increment of 3-kg increase equivalent to 150% for the three-month culture period; followed by the culture area site (140% increment); followed by muddy site (125% increment) then the rocky site (75% increment). As for the water layers, the surface layer in the grassy site topped (150% increment), followed by the surface layer in the culture site (140% increment), the surface layer of the muddy site (125% increment) and the middle layer in the rocky site (10% increment). Results further show that the bottom layer of the muddy site had the highest growth rate (9%) followed by the rocky site (8%). The grassy and culture sites, on the other hand, had negative increment (-98.8%).

Keywords: *Codium edule*, plastic screen, off bottom culture

BS – 38

**ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF
Escherichia coli AND *Salmonella* spp. ISOLATED
FROM STREET-VENDED FOOD IN MANILA**

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Street vended foods on R. Papa Street, Manila, colloquially known as “hepalane”, are displayed under unhygienic conditions and are exposed to insects, polluted air, and contaminated water, which could influence the outbreak of foodborne diseases. Using culture detection technique, the presence of common foodborne pathogen, such as *Escherichia coli* and *Salmonella* spp., were detected on 25 samples of quail eggs, chicken intestines, pork dumplings, calamari, and fried hotdogs. A total of eighteen *E. coli* and eight *Salmonella* isolates were confirmed positive through polymerase chain reaction amplifying the uidA and invA gene, and were subjected to Kirby-Bauer disk diffusion to determine their antimicrobial resistance using 10 different antibiotics. Remarkably, 88.46% of the isolates were multidrug resistant (MDR) and were mostly resistant to tetracycline and penicillin group. In addition, 88.89% of the *E. coli* isolates exhibited an antimicrobial pattern of CIP-AUG-LEV-DXT-MN-AP-AK while 11.11% were resistant only to AK. For *Salmonella* spp., no prominent pattern was observed. It can be concluded that street vended food at the “hepalane” are hazardous to the health of the consumers as the presence of MDR foodborne pathogen were observed.

Keywords: antimicrobial resistance, foodborne pathogen, multidrug resistance, polymerase chain reaction

BS – 39

SEED DISPERSAL PATTERS OF TWO SELECTED FOREST TREES, WITH VARYING MODES OF DISPERSAL IN MT. MAKILING FOREST RESERVE

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Seed dispersal is one of the major ecological processes shaping plant community development. In this study, seed dispersal patterns of two selected forest trees with varying modes of dispersal in the Mt. Makiling Forest Reserve (MMFR) were evaluated. Using the inverse modelling approach, 36 seed traps were established inside a 4-ha long-term monitoring plot in MMFR. Seed collection was conducted weekly for four months. The species studied were chosen from among the trapped seed species because they met the criteria set in the beginning of the data collection: the seeds of each species landed in at least 10% (approximately 4) of the seed traps and had sufficient number of seeds (at least 30 seeds) for observation. Of the twelve collected species, *Planchonella duclitan*, classified as animal-dispersed, and *Spathodea campanulata*, recognized as wind-dispersed, met these criteria. Using Pearson and Kendall's rank correlation analyses, both species showed significant negative association between the distance of the trap from the parent tree and the density of the seeds caught by the seed traps. The computed rho values for *P. duclitan* and *S. campanulata* are -0.9534 ($p < .05$) and -0.9000 ($p < .05$), respectively. The target species had their seed shadows concentrated within 5 m for *P. duclitan* and 10 m for *S. campanulata*, suggesting that *S. campanulata* has a wider range of dispersal than *P. duclitan*.

Keywords: inverse modelling approach, Pearson and Kendall's rank correlation analysis, seed dispersal pattern, seed shadow

BS – 40

PHYTOCHEMICAL SCREENING AND ANTIMICROBIAL ACTIVITY OF *Eucalyptus deglupta* LEAF EXTRACT

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Eucalyptus deglupta Blume (Myrtaceae) commonly known as *bagras* or *kamarere*, which is its trade name in the lumber industry, is a type of eucalyptus species abundant in the Philippines. For this study, the phytochemical and antimicrobial activity of leaf extract fractions of *E. deglupta* was carried out. Phytochemical screening was carried out using thin layer chromatography (TLC) while antimicrobial activity of *E. deglupta* against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Aspergillus niger* was carried out using agar-well diffusion method. Phytochemical screening of the extracts revealed the presence of flavonoids, phenols, steroids, and tannins. Results of the antimicrobial analysis shows that the ethanolic extract demonstrated pronounced activity against *E. coli* (26 mm; n=3) while the hexane extract (14 mm; n=3) and ethyl acetate extract (13 mm; n=3) had moderate activity. Ethyl alcohol also showed moderate activity against *S. aureus* (13 mm; n=3) while both the hexane (11 mm; n=3) and ethyl acetate (12 mm; n=3) extracts had partial activity. The three solvent extracts were resistant to *P. aeruginosa*, *C. albicans*, and *A. niger*. The secondary metabolites found in the extract has antimicrobial activity against different microorganisms. The extract was also subjected to compatibility study with a cosmetic cream base using Fourier-transform infrared spectroscopy (FTIR). Results showed that the ethanolic extract was compatible with the formulated cream base. To the authors' best knowledge, this is the first antimicrobial study of *E. deglupta* leaf extract. The activity of the ethanolic extract at 5% concentration shows that *E. deglupta* can be a potential source of active ingredient and antibacterial preservative for cosmetic products.

Keywords: phytochemical, antimicrobial screening, *Eucalyptus deglupta*

BS – 41

**BIOCHEMICAL CHARACTERIZATION
OF MARINE PIGMENTED BACTERIAL ISOLATES
FROM THE MUCUS OF SOFT CORAL *Clavularia* sp.**

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Pigmented bacteria have awakened the interest of many researchers because of their industrial applications. The isolation of pigmented bacteria could be one of a new safe and effective way to produce natural colorants. A total of 11 pigmented bacterial isolates with varying colors were obtained in this study, and these were morphologically and biochemically characterized. Isolates exhibited almost all forms of the colony types. Most of the isolates were cocci, while the others were bacilli. Some of the isolates were positive for protease, starch, and hemolysin tests. They were considered as halophiles because of their high salt tolerance. The bacterial isolates were neutrophiles as to the pH tolerance, and mesophiles as to their maximum tolerance to temperature. Almost all of the isolates secreted their pigments in the liquid media. The predominating pigment produced by these isolates was carotenoids. One pigment secreting isolate was subjected through Vitek 2 system and 16S rRNA sequence analysis. The result of the first identification system used identified the bacteria as *Vibrio alginolyticus* while the 16S rRNA identified the isolate as *Vibrio* sp. The isolated pigmented bacteria from the mucus of *Clavularia* sp. have the potential as pigment producers; as a result, they could be explored further as colorant sources in industry.

Keywords: pigmented bacteria, mucus, *Clavularia* sp.

BS – 42

**BIOLOGICAL ACTIVITIES AND MINERAL COMPOSITION
ANALYSIS OF *Enhalus acoroides* (L.F.) Royle
SEEDS AND FLOWERS**

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Enhalus acoroides' substantial utility not just for environmental purposes but also in a variety of uses, such as medicine and food, leads to the need to investigate its biological activity and nutritive value. The ethanol extracts of the plant's flowers and seeds collected from Laguindingan, Misamis Oriental were analyzed for its antimicrobial and antioxidant activities. Both extracts were active against *Staphylococcus aureus* (MIC at 512 $\mu\text{g mL}^{-1}$) and showed significant antioxidant property (IC₅₀ at 212.80 \pm 21.73 and 229.41 \pm 15.99 $\mu\text{g mL}^{-1}$) with DPPH radical scavenging assay. Analysis of its mineral composition using inductively coupled plasma optical emission spectrometer (ICP-OES) showed significant concentrations of macro- and microelements for nutrition. Potassium (2729.52 \pm 78.14 mg per 100 g DM) content was high in the seeds whereas sodium (5947.16 \pm 598.68 mg per 100 g DM) content was high in the flowers. Most of the minerals were at concentrations satisfactory in providing recommended dietary allowances. Toxic elements were also detected but were within food standards. These findings established the inherent value-added minerals in *E. acoroides* flowers and seeds, which is a safe and vital food resource.

Keywords: Antioxidant activity, *Enhalus acoroides*, in vitro antimicrobial, minerals, seagrass

BS – 43

DEVELOPMENT OF ARC-LAMINATED BAMBOO LUMBER FOR FURNITURE AND HANDICRAFTS

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Arc-laminated bamboo lumber (ALBL) from bamboo splits using the middle portions of the culms of Kauayan tinik (*Bambusa blumeana* Schult.f.) and Bolo [*Gigantochloa levis* (Blanco) Merr.] were developed. Arc lamination of quarter split culm was employed instead of the rectangular machine bamboo slats. Polyvinyl acetate (PVAc) and polyurethane (PUR) adhesives with glue spreads of 80, 120, and 160 g m²⁻¹ were used. Mechanical press with an arc mold was used in the lamination. Conditioned laminated samples were tested following ASTM and PNS procedures. Results showed that arc-laminated *B. blumeana* had better physical properties than *G. levis* as shown by the former's lower radial and tangential swelling for both PVAc and PUR adhesives, regardless of glue spread. The mechanical properties and delamination tests showed that best glue spread is 80 g m²⁻¹ for both bamboo species. This implies that glue spread can be lowered up to 80 g m²⁻¹ for ALBL to reduce glue consumption. ALBL creates a distinct grain design that resembles the prominent annual growth ring of temperate wood species when viewed at cross-section. Designers can create various geometrical patterns that can be made from ALBL to highlight its decorative applications in furniture and handicrafts.

Keywords: arc-segment lamination, e-bamboo, furniture, handicraft

**ENGINEERING SCIENCES &
TECHNOLOGY**

EST – 01

ADAPTATION OF POWERS' MODEL IN PREDICTING THE DEGREE OF HYDRATION OF ORDINARY PORTLAND CEMENT (OPC) PASTE

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Powers' model is a simple approach for estimating the relative volumes of hydratin products, porosity, and chemical shrinkage present in Portland cement paste as a function of its starting water-to-cement ratio (w/c) and current degree of hydration. It forms an important link among cement composition, microstructure, and performance, which are necessary for modeling cement-based systems. Previous researchers have adapted Powers' model for inert fillers to illustrate their effects on the hydration, porosity, and chemical shrinkage of blended cements. However, it is well-documented that limestone is not, in fact, an inert filler, but rather participates in cement hydration through both chemical and physical processes. This study investigates the applicability of Powers' model to modern Portland cements containing up to 15% (by mass) finely divided limestone. The results demonstrate that the modified Powers' model is insufficient for predicting the influence of finely divided limestone additions on the chemical shrinkage of both ordinary Portland cement pastes and Portland limestone cement pastes. Possible explanations for the discrepancy are discussed and a plausible source is proposed. This was used to compute optimum OPC products with varying water-to-cement ratios and curing temperatures. The OPC from Japan was used in making cement paste. The cement was mixed with deionized water using the rotary mixer at a constant speed for at least 3 mins in water/cement ratio (w/c) of 0.40. The test samples were casted in 50 mm diameter×100 mm height cylindrical stainless steel mold and covered with parafilm for 24 hours at room temperature to avoid water evaporation. The test samples were demolded and cured separately in a water bath for three days at 20°C and 40°C. Results showed that the relative volumes of hydration products, chemical shrinkage, and gel water content increase (in contrast with the capillary water content and unhydrated cement particles) as the degree of hydration approaches to optimum value both cured at 20°C and 40°C.

Keywords: ordinary Portland cement, powers' model, degree of hydration

EST – 02

ADSORPTION STUDIES ON THE REMOVAL OF ORGANIC POLLUTANTS BY THE USE OF ZEOLITE DERIVED FROM MT. PINATUBO EJECTA

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Synthetic dyes, such as methyl orange, methylene blue, and fuch sine were removed from aqueous solutions through the use of zeolite, which was synthesized from Mt. Pinatubo ejecta via hydrothermal technique. The structure of the zeolite was further studied using Fourier-transform infrared spectroscopy (FT-IR) and X-ray diffractometry (XRD). Atomic force microscopy (AFM) and scanning electron microscopy (SEM) were used to analyze the surface morphology of the zeolite. The adsorption capacities of zeolite, in mg dye g⁻¹ zeolite, were 9.138 for methyl orange, 19.256 for methylene blue, and 16.412 for fuch sine. The values obtained were from the optimum incubation time of 24 hours. The adsorption capacities were also found to increase as the dye initial concentration increases while the opposite trend was observed when the amount of adsorbent used was increased. Furthermore, the adsorption capacity for methyl orange, methylene blue, and fuch sine decrease with increasing pH.

Keywords: zeolites, adsorption studies, methylene blue

EST – 03

CANOPY GAP DETECTION AND CHARACTERIZATION FOLLOWING A TYPHOON DISTURBANCE USING UAS IMAGERY

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The use of unmanned aerial systems (UAS) imagery is explored in characterizing changes in canopy gap following a typhoon disturbance within a 2-hectare long-term ecological research (LTER) plot. UAS provide on-demand imaging that supplements satellite imagery, which offers more limited temporal resolution. Orthorectified UAS imagery over dense vegetation provides snapshots representing canopy condition when the imagery is taken. Images were captured in July 2014, August 2014, and January 2017 representing the LTER plot condition before, immediately after, and long after typhoon Rammasun (locally known as Typhoon Glenda) devastated portions of the Mount Makiling Forest Reserve (MMFR), respectively. Object-based image analysis allowed for the creation of visually homogenous areas within orthorectified images called segments. Visual qualities including brightness and darkness of segments were used to identify canopy gaps. Analysis shows that prior to the typhoon, there were 0.36 ha of perceived canopy gaps within the LTER plot. This was increased to 0.62 ha immediately after the typhoon. Gaps decreased to 0.27 ha two years after, indicating recovery of the forest canopy. Spatial reconfiguration of canopy gaps was observed across the three time periods owing to the disturbance generated by the typhoon event.

Keywords: canopy gap, aerial imagery, UAS, long term ecological research plot, object-based image analysis

EST – 04

CARBON-BASED SUPERCAPACITORS UTILIZING ELECTROSPUN NANOFIBERS OF IMIDAZOLE-BASED IONIC LIQUID/POLYMER BLENDS

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With the limited supply of fossil fuels and rapid energy consumption, there has been an increasing and urgent demand for exploring highly efficient, green, and sustainable energy storage systems. At present, all solid-state polymer electrolytes (SPEs) have been receiving much attention for high-performance energy storage devices, such as supercapacitors due to their unique characteristics (i.e., no leakage, low flammability, excellent processability, good flexibility, wide electrochemical stability window, high safety, and superior thermal stability). In this study, a novel supercapacitor assembly following an electrical double-layer capacitor configuration fabricated by sandwiching electrospun polyacrylonitrile (PAN) nanofibers doped with 1-methylimidazolium acetate (MIMOAc) and 1-ethyl-3-methyl-imidazolium bromide (EMIMBr) between two activated carbon/graphite composite electrodes is presented. The morphological and structural properties of the ionic liquid/polymer blends were evaluated by SEM, AFM, and FT-IR studies. Furthermore, the capacitive behaviors of MIMOAc-PAN and EMIMBr-PAN SPEs were investigated using cyclic voltammetry, which showed the lack of any redox peaks implying a pure electrostatic attraction in the electrode-electrolyte interface as supported by the corresponding Nyquist plots generated using EIS studies. These significant results compared well to the data obtained when using the conventional 1M KOH_(aq) as electrolyte. These solvent-free electrolytes, based on conducting nanofibrous electrospun polymers, pose a potential avenue for next-generation supercapacitors in place of liquid electrolytes that are prone to leakage and electrode degradation.

Keywords: supercapacitor, electrospinning, ionic liquids, carbon/graphite, polyacrylonitrile

EST – 05

**COMPARATIVE STUDY ON THE OPTIMIZATION
OF PRETREATMENT PARAMETERS
OF ENGINEERED BAMBOO INDUSTRY (EBI) WASTE
FOR CELLULOSE FIBER PRODUCTION**

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The high utilization rate of fossil resources for the manufacture of some products, such as fuel- or petroleum-derived products like synthetic fiber, has a direct impact on the economy and the environment. Hence, an alternative resource to decrease today's rapid consumption of fossil resources is necessary. A potential alternative solution to this problem could be utilization of lignocellulosic biomass as an alternative fiber source. Dilute acid hydrolysis and alkaline pretreatment of cellulosic materials in the production of cellulose fiber for textile applications was studied. Engineered bamboo industry waste was utilized as the cellulosic material. Pretreatment concentration, pretreatment temperature, and pretreatment time were optimized based on percent yield. Results show that the optimum conditions for acid hydrolysis was 4 wt %, 150°C, and 50 minutes; for alkaline pretreatment it was 4 wt %, 120°C, and 100 minutes. Using ANOVA ($p < .05$) to determine the best pretreatment method, results show that there is no significant difference in the two pretreatment methods although the alkaline pretreatment method obtained a higher percent yield of cellulosic fiber compared to dilute acid pretreatment. The properties (i.e., elongation at break, moisture absorption, and density) of the cellulose fiber produced were compared to the standard properties of a cellulose fiber commercially available and only the density was within the standard.

Keywords: hydrolysis, bamboo, cellulose fiber, biomass

EST – 06

**NANOFLUIDS: THE NEW GENERATION
COOLANT COMPUTATIONAL FLUID DYNAMICS (CFD)
ANALYSIS OF THE HEAT TRANSFER AND FLUID FLOW OF
COPPER (II) OXIDE-WATER NANOFLUID IN A SHELL AND
TUBE HEAT EXCHANGER**

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Numerical analysis of the thermal and flow behavior of CuO-water nanofluid under turbulent regions in a shell and tube heat exchanger was conducted using ANSYS Fluent software. In this study 29-nm CuO nanoparticles, with water as base fluid, were used. To study the effects on heat transfer coefficient, pressure drop, and nanofluid thermal and hydrodynamic behavior, the nanofluid was simulated at different particle loading (ranging from 0.1% to 1% volume), and under three sets of Reynolds number (ranging from 17,000 to 71,000). Increasing the particle loading and the Reynolds number was found to enhance both the heat transfer rate and pressure drop. A maximum of 48% enhancement in the heat transfer was observed at the highest particle loading, but with the consequence of doubled pressure drop. Performance indices greater than 1 were attained for particle loading below 0.25% volume, regardless of the Reynolds number. The conditions that produced the highest performance index were at the lowest particle loading and the lowest Reynolds number. No significant difference in the flow behavior between water and CuO-water nanofluid was observed. However, the thermal profiles for 0.1% volume CuO-water nanofluid highlighted the enhancements in heat transfer along the shell and tube heat exchanger.

Keywords: CuO-water nanofluid, Reynolds number, heat transfer coefficient, pressure drop, shell and tube heat exchanger

EST – 07

DETERMINATION OF TURBIDITY IN WATER USING UV-VIS SPECTROPHOTOMER (IN-HOUSE METHOD)

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Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted. Nephelometry is the standard method for the determination of turbidity, which measures the scattering of light in the sample. In this in-house method, transmitted light is measured by a UV-Vis spectrophotometer at 400 nm using a 50 mm quartz cell. A calibration curve was created using a Formazin standard suspension. The correlation coefficient (r) was 0.9998 with a linear range of 0.25–32 nephelometric turbidity units (NTU) and instrument detection limit of 0.034 NTU. The method achieved a z-score of -0.25 in ERA proficiency testing (Water Supply for Drinking Water Round 231) and recoveries of 97–102% using a certified reference material (ERA Lot No S231-699). This in-house method is a proposed alternative for the determination of turbidity in the absence of a nephelometer.

Keywords: turbidity, water, UV-Vis spectrophotometer

EST – 08

**ESTIMATING EARTHQUAKE RISKS:
THE USE OF RAPID EARTHQUAKE DAMAGE ASSESSMENT
SOFTWARE IN ILOCOS NORTE**

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One of the country's modest attempts to mitigate disasters that arise from earthquakes is the development of the Rapid Earthquake Damage Assessment System (REDAS), a software used to provide quick and near real-time simulated earthquake hazard map information as well as integration with exposure data and risk elements to determine the extent of potential damage caused by seismic hazards. This study used the REDAS software to evaluate the possible effects of an earthquake in Ilocos Norte. Specifically, it aimed to develop an earthquake exposure database, estimate risks, and calculate loss due to earthquake, and to provide local executives and legislators guidelines for policy formulation toward sound disaster risk reduction and climate change initiatives. Exposure databases were developed using surveyed data. The risk and impact assessments were based on the magnitude 6.5 earthquake that occurred in Ilocos Norte on August 17, 1983. The earthquake had a depth of 28 kilometers and its epicenter was located in Vintar (at 18.29° latitude and 120.83° longitude). Based on the simulation, a 6.5 magnitude earthquake will cause a total physical damage of 7,711,637 m² of floor area and will affect 53,861 buildings. Majority of the possible physical damage are slight and moderate damage although some buildings are also expected to suffer extensive and complete damages. Moreover, an economic loss of PHP 22.9 billion is likewise projected for the entire province. Majority of the projected physical damage are concentrated in Laoag City where most of the commercial areas are located and where built-up areas are larger compared with other municipalities. The earthquake is also expected to leave casualties, including 479 slight injuries and four non-life threatening situations. It can be recalled that the magnitude 6.5 earthquake, on which the simulation is based, left 16 people dead and 47 injured.

Keywords: REDAS, earthquake assessment, earthquake simulation, disaster risk management

EST – 09

BIOACCUMUMATION OF PHARMACEUTICALLY ACTIVE COMPOUNDS (PHACS) IN TH ENVIRONMENT ESTIMATION OF DIFFUSION COEFFICIENTS OF DIFFERENT BRANDS OF LOPERAMIDE IN WATER AT INFINITE DILUTION USING CONDUCTANCE METHOD

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The diffusion coefficients of different local brands of loperamide, namely Diatabs[®], Imodium[®], Lomotil[®], Lormide[®], and RiteMED[®] Loperamide, were investigated to provide information on the behavior of the ions in water systems. Data were determined from the electrolytic conductivities of the systems, which were measured at different concentrations (infinite dilute region) and temperatures, ranging from 293.15 K to 313.15 K with 5 K increments, each done in three replicate runs considering the given conditions, and adjusted accordingly with calibration results. The molar conductivities were calculated and plotted as a function of concentration that fitted better in the modified Robinson-Stokes equation than the Kohlrausch equation with an acceptable absolute average deviation of 4.36%. Using the calculated data from this model, the infinite dilution diffusion coefficients (D_B^o) and self-diffusion coefficients at infinite dilution (D_{ion}^o) were estimated using the Nernst-Haskell equation and Nernst-Einstein equation, respectively. In addition, other parameters were calculated by utilizing the available correlations, Arrhenius equation was used to calculate activation energy (E_a) and pre-exponential factor (A) and the Stokes-Einstein equation was used to calculate hydrodynamic radii of the ions. Through data interpretation and graphical analysis, the theories involved were supported. Findings showed a direct linear relationship between conductivity and temperature due to ionic mobility and extent of ionization. Generally, the estimation of diffusion coefficients of loperamide at infinite dilution through valid correlations was attained in this study.

Keywords: loperamide, infinite dilution, conductivity, diffusion coefficient, hydrodynamic radius

EST – 10

FABRICATION OF ZIRCONIA NANOTUBES FOR LEAD ADSORPTION

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Zirconia (ZrO_2) exhibits numerous interesting properties, including good ion exchange capability, high chemical and thermal stability, and excellent biocompatibility. Recently, ZrO_2 nanotubes have been gaining attention due to their numerous potential applications in gas sensing, photoelectronics, photocatalysis, and biomedicine. However, due to their excellent chemical and thermal stability, ZrO_2 nanotubes are also potential adsorbents for wastewater treatment. In this work, ZrO_2 nanotubes were prepared by anodization of zirconium (Zr) foil at varying voltages and temperatures. Increasing the voltage from 30 V to 40 V resulted in ZrO_2 nanotubes with larger average pore diameter and longer nanotube length. On the other hand, anodization at higher temperatures produced ZrO_2 nanotubes with large pore diameter of about 56.3 nm. Then again, the ZrO_2 nanotubes showed shorter lengths of about 21.09 μm due to enhanced fluoride etching. Batch adsorption test showed that lead (Pb) adsorption increased with time while adsorptive capacity decreased with higher Pb concentration.

Keywords: ZrO_2 , nanotubes, Pb, adsorption, anodization

EST – 11

MODEL-BASED SYNTHESIS AND MONTE CARLO SIMULATION APPROACH TO PLANNING BIOCHAR-BASED CARBON MANAGEMENT NETWORKS

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Biochar-based carbon management networks (CMNs) are systems that can potentially achieve negative emissions via the net transfer of atmospheric carbon into the ground. Mathematical programming can be employed to effectively optimize these networks. Integer cuts of mixed integer linear programming model can be used to generate optimal and near-optimal solution alternatives and the Monte Carlo simulation can then be used to evaluate the system performance of these CMNs. This approach can be used to evaluate the robustness of a network considering the uncertainties in model parameters. A case study is explored to illustrate the applicability of the developed methodology. The result reveals that model-based synthesis and Monte Carlo simulation of biochar-based CMNs allow the determination of robust system which is valuable for practical decision-making.

Keywords: integer-cut constraints, biochar-based carbon management networks, carbon, mathematical programming

EST – 12

OCCUPANCY DETECTION USING BLUETOOTH LOW ENERGY ENABLED DEVICES

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Occupancy detection and monitoring has a wide variety of applications, from event attendance tracking to the optimization of energy use in buildings/rooms. Current solutions for occupancy detection provide fairly accurate results, however, most solutions require costly external hardware, complex processing and computations, or manual labor. To address this problem, this project utilizes Bluetooth low energy (BLE), an emerging wireless technology designed specifically with low-power applications and short-range applications in mind. An application for BLE-enabled android smartphones was developed using Android Studio 3.0. The application has two modes: central mode, where it detects occupancy of a location, and peripheral mode, where it acts as a beacon that broadcasts data to the central mode. The application has also been equipped with controls for varying signal strength, range, and frequency, along with a proximity estimation mechanism to show how these can affect occupancy detection via BLE. This study proves that the use of BLE devices as a means for occupancy detection is feasible.

Keywords: occupancy detection, Bluetooth low energy, Android

EST – 13

PHYSICOCHEMICAL CHARACTERIZATION OF SAN NICOLAS CLAY FOR IMPROVED CERAMIC PRODUCTION

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San Nicolas clay has been used by local potters even in the early years of pottery production. However, they used this clay without preliminary processing and without controlling its properties, resulting in inconsistent and poor product characteristics. Likewise, consistency in the amount of additives (e.g., sand) in the mixture is not yet established. This study investigated the physicochemical characteristics of San Nicolas clay for improved ceramic production. Physical properties such as residue, total linear shrinkage (TLS), loss on ignition (LOI), and casting properties were obtained. Thermal behavior of the clay was examined using thermogravimetric analysis (TGA) technique. Phase identification and chemical analysis were also examined using x-ray diffraction (XRD) and x-ray fluorescence (XRF) techniques. The residue obtained at 325 mesh sieve is 16.36%. The TLS and LOI results using electric furnace at 900°C were 13.05% and 12.40%, respectively. The TGA curve showed two endothermic reactions at 81°C and 496.65°C with a total weight loss of 12.86%, which was close to the obtained LOI. Based on the XRD spectra and XRF analyses, the dominant minerals present in the clay were vermiculite ($(\text{Mg,Fe}^{++},\text{Al})_3(\text{Si,Al})_4\text{O}_{10}(\text{OH})_2 \cdot 4\text{H}_2\text{O}$), quartz (SiO_2), anorthite ($\text{CaAl}_2\text{Si}_2\text{O}_8$), and rutile (TiO_2). These physicochemical characteristics obtained from the San Nicolas clay are very helpful in improving the quality and maintaining the consistency of the ceramic products.

Keywords: clay, x-ray diffraction, x-ray fluorescence, ceramics

EST – 14

**PILOT STUDY ON THE DEVELOPMENT
OF A LOCAL CANDIDATE REFERENCE MATERIAL
FOR AEROBIC PLATE COUNT IN FLOUR**

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Aerobic plate count (APC) is a microbiological indicator test used to determine the level of microorganisms in a food product and is usually indicative of its sanitary conditions during processing. Several food reference materials (RMs) are available to be used for proficiency testing (PT) in order to assess the competence of a laboratory in terms of accuracy of measurement results. Philippine laboratories participate in proficiency testing provided by other countries as these RMs are not locally available. This pilot study focuses on the development of a local RM-APC for flour, which utilizes its naturally occurring microbial population. A standard procedure for the preparation of the candidate RM was established to ensure that the microbial cells were evenly distributed. Seventy units of candidate RM was produced and was tested both for homogeneity and stability at 4°C. The homogeneity test was conducted to verify that there is no significant difference in the APC between units. Ten units were tested for APC and evaluated using Cochran's test for outliers and analysis of variance. The stability test was conducted to verify that there is no significant change in the APC of units at a specified time and storage condition. Two units were tested for APC at different days and evaluated using regression analysis. Results of homogeneity test showed that no analytical outliers were observed among units and were statistically equal across all subsamples and replicates. The results of the stability test showed that the candidate RM is stable at 4°C for 120 days. Given the short-term stability of the candidate RM-APC in flour, it has the potential to be used as PT material.

Keywords: aerobic plate count, food reference material, proficiency testing

EST – 15

**DATA MINING MAP FOR PROPERTY PREDICTORS
PREDICTION OF DENSITY, VISCOSITY, AND REFRACTIVE
INDEX OF BINARY MIXTURES (IONIC LIQUIDS +
ALCOHOLS [METHANOL, ETHANOL, PROPAN-1-OL])
USING SUPPORT VECTOR REGRESSION**

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Although the potential of ionic liquids (ILs) had been recently discovered, its applications and the study of its properties are still limited. As more ILs are being synthesized, the reduction in experimentation on their properties is necessary. This study presents a method of predicting the density, viscosity, and refractive index of binary mixtures of ILs and alcohol (methanol, ethanol, propan-1-ol) using support vector regression (SVR). Based on the input variables (temperature, mole fraction of IL, number of carbon atoms in cation, number of atoms in anion, number of hydrogen atoms in anion, and the number of carbon atoms in alcohol), the parameters were determined and used in creating models. The data used in this study were taken from the Ionic Liquids Database – ILThermo (v2.0), screened, and the properties were normalized. The optimal combination of all the properties tested was $C=10000$, $\varepsilon=0.01$, and $\gamma=10$. The average absolute percent deviations and root mean squared deviation (AAPD and RMSD) obtained were 0.2373% and $0.09088226 \text{ kg m}^{-3}$, respectively. Results of the other properties were: 3.3070% and 0.000248669 Pa-sec for density, 0.0365% for viscosity, and 0.0000343782 for refractive index. It was observed that as the input variables changed, the properties also changed while variations in C , ε , and γ have effects on the number of support vectors, AAPD, and RMSD. The resulting model satisfactorily predicted the considered binary systems and can be used in solving similar systems precisely.

Keywords: density, ionic liquid, refractive index, support vector regression, viscosity

EST – 16

PREPARATION AND CHARACTERIZATION OF LEAD IN WATER IN-HOUSE REFERENCE MATERIAL

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Reference materials (RMs) are vital to evaluate the performance of laboratories. It is also useful for the quality control of analytical procedures. However, RMs are not locally available and are expensive. Therefore, preparation and initial characterization of an in-house RM containing significant amount of lead (Pb) in water was conducted. Expired Pb standards and previously used Pb calibration curve solution were collected, homogenized, poured into acid-washed Nalgene™ bottles, and stored at 2–6°C. For the homogeneity study, 10 bottles selected through stratified random sampling were analyzed in duplicates and the results were interpreted using Cochran's test and tests for sufficient and adequate homogeneity. The calculated assigned value was 177.28 mg L⁻¹. The in-house RM will be used as QC for analyzing Pb in water and wastewater samples. Stability test were conducted quarterly for two quarters and will be continued for two years to ensure stability. The prepared in-house RM were found stable for three months after statistical evaluation.

Keywords: in-house reference material, homogeneity, lead

EST – 17

PROCESS DESIGN OF VIRGIN COCONUT OIL (VCO) PRODUCTION USING LOW-PRESSURE OIL EXTRACTION

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Virgin coconut oil (VCO) has become one of the most prominent high-value coconut products in coconut-producing countries because of its versatility. In this study, the low-pressure oil extraction method was used to produce VCO and a centrifuge was used to reduce the settling time of the oil after extraction, which usually takes 1–2 weeks. Different parameters, such as drying temperature, centrifuge speed, and centrifugation time were varied and analyzed. The experiment's results show that the best setting of VCO production using the modified method is at a drying temperature of 70°C and at 2,700 rpm and 60 minutes of centrifugation, as it produced the clearest oil with a yield of 92.84% v/v and a recovery of 18.43%. The produced VCO was tested for free fatty acid (FFA), moisture, and volatile matter, color, peroxide value, and iodine value and the results are 0.03%, 0.11%, 0R/0.3Y, 0, and 5.77, respectively, which all passed the Philippine National Standards for VCO.

Keywords: centrifugation, fresh dry process, low pressure oil extraction, settling time, virgin coconut oil (VCO)

EST – 18

PRODUCTION AND CHARACTERIZATION OF CELLULOSE NANOCRYSTALS FROM *Ceiba pentandra* (L.) Gaertn.

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This study dealt with the potential of *Ceiba pentandra* (L.) Gaertn. or kapok fibers as a source of cellulose nanocrystals (CNC). The fibers were pre-treated with chloroform and hot water to remove the extractives. Holocellulose and alpha-cellulose were then produced using 20% (w/v) sodium chlorite and 17.5% (w/v) sodium hydroxide, respectively. Cellulose nanocrystals were then isolated through acid hydrolysis by varying the sulfuric acid concentration (46% and 50% v/v), reaction time (30 min and 45 min), and temperature (40°C and 50°C). The effects of the different combinations of the parameters on the yield was determined. Morphological characteristics of the CNC were observed using atomic force microscopy (AFM). Chemical transformations of raw kapok to CNC were analyzed using Fourier transform infrared spectroscopy. Results of the experiment showed that treatment combination of 46% acid concentration, 45 min, and 50°C gave the highest yield of 53.64% among the samples. Results of the spectroscopic analysis indicate that nanocrystals were obtained from kapok. Results of the AFM revealed that the average length and width of CNC with the highest yield were 105.50 nm and 27.22 nm, respectively.

Keywords: acid hydrolysis, nanocellulose, AFM, FTIR

EST – 19

SOLID STATE SYNTHESIS OF BULK LITHIUM LANTHANUM TITANATE LITHIUM ION CONDUCTING SOLID ELECTROLYTE

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Lithium lanthanum titanate (LLTO) $\text{Li}_{3x}\text{La}_{(2/3-x)}\square_{(1/3-2x)}\text{TiO}_3$ bulk sample with $x \approx 0.12$ was synthesized via solid state reaction and initially investigated for its potential as a lithium-ion conducting solid electrolyte for an all solid state Li-ion battery application. Thermogravimetric differential thermal analyzer (TG-DTA) was used to examine the thermal behavior of the as-prepared sample via LLTO powders. Structural properties of the sintered LLTO samples were examined using x-ray diffraction (XRD) technique. As seen from the XRD spectra, a pure LLTO phase with cubic perovskite Pm3m space group structure. Scanning electron microscopy was used to examine the morphology of the sintered LLTO samples and a high-density bulk pellet sample was observed. Using electrochemical impedance spectroscopy analysis, LLTO's potential as a Li-ion conductor was investigated. The prepared LLTO with $x \approx 0.12$ in this study exhibited a high total ionic conductivity compared to those reported in previous literature. The total conductivity (σ_T) obtained was about $1.7 \times 10^{-03} \text{ S}^{-1}$ at room temperature.

Keywords: lithium lanthanum titanate, solid electrolyte, solid state sintering, conductivity

EST – 20

SWAT MODELING IN MT. MAKILING FOREST RESERVE – ASEAN HERITAGE PARK

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Most watersheds in the Philippines are ungauged, making it difficult to model the water yield. Using the semi-distributed SWAT model, the study estimated the streamflow of three ungauged watersheds of the Mount Making Forest Reserve-ASEAN Heritage Park (MMFR-AHP). Model regionalization using spatial proximity approach was employed to compensate for the absence of observed data for calibration. Simulated streamflow for Molawin-Dampalit, Cambantoc, and Tigbi watersheds were $0.065 \text{ m}^3\text{s}^{-1}$, $0.036 \text{ m}^3\text{s}^{-1}$, and $0.001 \text{ m}^3\text{s}^{-1}$, respectively. Rainfall and streamflow correlation yielded R-squared values of 0.599 and 0.514 for Molawin-Dampalit watershed and Cambantoc watershed, respectively. Meanwhile, the R-squared value generated for Tigbi watershed is 0.128. The simulated streamflow in Molawin-Dampalit and Cambantoc watersheds showed relatively moderate variation in response to changes in rainfall. The results are indicative of the hydrologic trends but future calibration using observed data is still imperative.

Keywords: SWAT model, ungauged watershed, Mount Makiling, regionalization, streamflow

EST – 21

**SYNTHESIS AND CHARACTERIZATION
OF TRANSITION METALS AND METAL OXIDES
AS POTENTIAL ELECTROCATALYSTS FOR HYDROGEN
AND OXYGEN EVOLUTION REACTION**

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Electrochemical water splitting is an effective way of producing hydrogen fuel. Platinum (Pt) group metals are commonly used as electrodes for hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). However, its high cost limits the use of the material in the said applications. In this study, metal oxides (MnCo_2O_4 , CuCo_2O_4 , and NiCo_2O_4) were prepared using hydrothermal method followed by annealing as catalysts for OER. Pure metallic nickel (Ni) and cobalt-nickel (Co-Ni) were grown on carbon fiber paper via an in situ chemical reduction method as catalysts for HER. SEM analysis showed that NiCo_2O_4 and MnCo_2O_4 have a spherical morphology with an average diameter of 3 μm and 2 μm , respectively. Needle-like morphologies were observed for CuCo_2O_4 with an average diameter of 77 nm and length of up to 2.53 μm . Ni particles with an average diameter of 2 μm were observed after in situ chemical reduction method, while Co-Ni particles had an average size of 0.263 μm . The morphologies of the as-prepared samples can provide a large electrochemical surface area for gas evolution reactions which can be used as electrodes for electrocatalysis.

Keywords: electrocatalyst, nickel, copper, cobalt, manganese

EST – 22

THE USE OF MICRONEEDLES IN GLUCOSE BINDING PROTEIN-BASED FIBER OPTIC BIOSENSOR ON MONITORING TRANSDERMAL GLUCOSE

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In previous work, a painless, noninvasive method of collecting glucose passively diffusing through the skin was developed. The transdermal glucose (TG) collected in this way has a concentration in the micromolar (μM) range, thus a sensitive glucose biosensor that can measure glucose at these levels was developed. The fiber optic biosensor for μM glucose was based on the glucose binding protein (GBP) labeled with BADAN in the H152C position and immobilized on Ni-NTA agarose beads via metal-histidine interaction. GBP is highly specific and sensitive to glucose at μM concentrations. Microneedles are used in transdermal drug delivery studies. In this study, microneedles were used to facilitate a faster diffusion of transdermal glucose. A Franz cell with porcine skin as a membrane was employed as the main setup for in vitro passive diffusion studies. Real time monitoring of the diffusion of glucose was done using a fiber optic biosensor with GBP immobilized on Ni-NTA agarose beads as sensing membrane. Three glucose concentrations that mimic the hypo-, normo- and hyperglycemic conditions in the neonate (2, 5, and 20 mM, respectively) were investigated against porcine skin with microneedles and uncompromised skin. Results showed faster (about 10 \times) diffusion rates with the use of microneedles compared with uncompromised skin and the TG concentrations were also increased. This showed that microneedles could be a promising tool for noninvasive transdermal glucose sensing, in terms of faster diffusion rates.

Keywords: microneedles, transdermal glucose, fiber optic biosensor

EST – 23

UTILIZATION OF RICE HULL SILICA AS FILLER IN CERAMIC BODY FORMULATIONS

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Silica (SiO_2) is an indispensable material in many industries, including ceramic manufacturing. Ceramic body formulations consist mainly of three major components: clays as binder, SiO_2 as filler, and feldspar as flux. Silica obtained from a quarry is most commonly used in industries but it can also be sourced from agricultural wastes, such as rice hull (RH). In this work, the physical properties of local ceramic body formulations utilizing RH SiO_2 as filler was investigated. Five varying ratios of local white clay (55 wt. %), RH SiO_2 (10–30 wt. %), and local feldspar (15–35 wt. %) were prepared. Ten test specimens per formulation were formed and fired at $1,100^\circ\text{C}$. Physical properties, such as total linear shrinkage (TLS), water absorption (WA), apparent porosity (AP), bulk density (BD), and strength by modulus of rupture (MOR) test were determined following ASTM standard test methods. Test results show that the mixture containing 55 wt. % local white clay, 10 wt. % RHS, and 35 wt. % local feldspar exhibited the best performance in ceramic artware body application. The following trends were also observed: % TLS decreases and % WA and % AP increase with increasing amounts of SiO_2 ; and BD and MOR increase with increasing amounts of feldspar against silica in the formulations. Generally, the resulting properties exhibited by the specimens and the ceramic artware prototypes that were formed using local materials suggest that the rice hull, an agricultural waste, RH can be an alternative source of SiO_2 for ceramic body formulations.

Keywords: agricultural waste, rice hull, ceramic, silica, formulations

HEALTH SCIENCES

HS – 01

**ANTIBACTERIAL ACTIVITY OF A DEVELOPED
LEMONGRASS (*Cymbopogon citratus*) MOUTHRINSE
PREPARED AT DIFFERENT CONCENTRATIONS**

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This study determined the antibacterial activity of a developed lemongrass mouthrinse containing 25% and 50% lemongrass oil concentration against *Aggregatibacter actinomycetemcomitans*. Lemongrass was dehydrated using a multi-commodity heat pump dryer and hydrodistillation method was used to extract the oil from the dehydrated lemongrass. Mouthwash was prepared at 25% and 50% lemongrass oil concentrations based on guidelines of the American Dental Association Council on Dental Therapeutics and Remington's *Pharmaceutical Science*. The Kirby Bauer disk diffusion susceptibility test was used to determine the antibacterial effect of the developed mouthrinse. Results were analyzed using the 2007 United States Pharmacopeia biological reactivity test in vitro. Results showed that the zones of inhibition brought about by 50% lemongrass oil concentration mouthwash against *A. actinomycetemcomitans*, had a mean diameter of 35 mm as compared to 23.6 mm diameter in chlorhexidine and 20.3 mm in the 25% lemongrass oil treatment. The negative control had a mean diameter of 8 mm. Reactivity scores revealed that the 50% lemongrass oil concentration mouthrinse has Grade 4 severe reactivity as compared to the 25% lemongrass oil concentration as well as the positive and negative control. The Tukey test results also showed that of the four treatments, *A. actinomycetemcomitans* is more susceptible to the 50% lemongrass oil mouthwash than the rest of the treatments.

Keywords: antibacterial, hydrodistillation, biological reactivity test, Kirby Bauer disk diffusion susceptibility test, zones of inhibition

HS – 02

**ALKENYLATED PHENOLIC NATURAL PRODUCTS
VALIDATE THE CLAIMED ANTI-CANCER PROPERTY
OF *Syzygium lineatum* (“Lubeg”)**

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Syzygium lineatum or “*lubeg*” is a popular nutraceutical plant in the Apayao region known for its traditional antioxidant and cancer-healing properties. In this study, a bioassay-guided approach was undertaken to investigate anti-cancer principles from *lubeg*. Thus, crude extraction of the air-dried leaves followed by fractionation afforded three sub-extracts. Cytotoxicity screening by MTT assay revealed a substantial improvement of antiproliferative and cytotoxic activities from the crude extract to the petroleum ether and DCM sub-extracts. Purification of the most active fractions resulted in the isolation, and spectroscopy-aided identification (ESI-MS and NMR) of mono- and dihydroxylated alkenylbenzenoid derivatives. The alkenylated resorcinol conferred a highly selective antiproliferative activity against human chronic myeloid leukemia cells compared to the phenolic congener. Thus, an increase in hydroxyl functionalization is important for better and safer anti-cancer alkenylated phenolic natural products. In conclusion, our results validate the purported traditional use and add to the nutraceutical value and impacts of our very own *lubeg* as a sustainable source of Philippine medicinal plant products with cancer healing properties.

Keywords: *Syzygium lineatum*, anti-cancer, antiproliferative, cytotoxic

HS – 03

**ANTI-FATIGUE EFFECTS OF GLUTINOUS RICE
(*Oryza sativa* L. var. *Glutinosa* (Lour.) Körn) IN WHITE MICE
(*Mus musculus domesticus* L.)**

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This study evaluated the anti-fatigue effects of glutinous rice in white mice by determining levels of blood lactate dehydrogenase (LDH), blood urea nitrogen (BUN), and hemoglobin after weight-loaded forced swim test (WFST). The increase in blood lactic acid is one of the reasons for fatigue during physical exercise, which is also true for urea nitrogen (Wei et Al. 2010; Wang et al. 2008). Three different dosages of glutinous rice were tested (T1=3.75 g, T2=2.62 g, T3=4.82 g, control [regular feeds]=3.75 g) per 100 g body weight. The mice were fed with pelleted glutinous rice for seven days and subjected to a WFST prior to the last day of feeding. After the swim test, the mice were allowed to rest for 30 minutes before composite blood samples were withdrawn. Results revealed that different dosages of glutinous rice showed significant anti-fatigue effects in mice. High dosage (T3) of glutinous rice prolonged swimming time up to 117 minutes compared to 48 minutes for the control. Meanwhile, normal dosage (T1) lowered blood LDH levels (240.27 U L^{-1} ; control= 399.90 U L^{-1} , $p < .05$) and at the same time reduced BUN levels (10.5 mg dL^{-1} ; control= 22.8 mg dL^{-1} , $p < .05$). Furthermore, higher blood hemoglobin content (164.67 g L^{-1} ; control= 137 g L^{-1}) was observed in mice under low dosage (T2).

Keywords: anti-fatigue, glutinous rice, weight-loaded forced swim test, blood test, mice

HS – 04

**ANTIHYPERGLYCEMIC ACTIVITY OF ANAHAW
(*Livistona rotundifolia*) SHOOT EXTRACT IN ALLOXAN-
INDUCED HYPERGLYCEMIC RATS**

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The Philippines is one of the emerging diabetes hotspots in the world today. This study was conducted to determine the antihyperglycemic activity of *Livistona rotundifolia* shoot extract in alloxan-induced hyperglycemic Sprague-Dawley rats. Phytochemical screening and acute oral toxicity test were done to determine the contents and safety dose of *L. rotundifolia* shoot extract on the test animals. The antihyperglycemic bioassay was done using 15 male Sprague-Dawley rats divided into five groups with three rats per group. Blood glucose level (BGL) was measured using a glucometer at 2, 4, and 6 hrs after treatment administration. Data obtained were analyzed using analysis of variance for complete randomized design and mean values were subject to least significant difference test ($p=0.05$). *L. rotundifolia* shoot extract contains flavonoids, saponins, fixed oil, alkaloids, proteins, and condensed tannins. The oral administration of the extract is safe and non-toxic within the dose of 300–2,000 mg kg⁻¹. Results of the antihyperglycemic assay indicate that 6 hrs after treatment, the BGL of rats treated with the 2,000 mg kg⁻¹ dose lowered to 320.33 mg dL⁻¹, which is significantly lower than other treatments, and after 4 hrs continued to lower to 311 mg dL⁻¹. At 6 hrs however, the BGL of rats treated with 2,000 mg kg⁻¹ dose with 232.33 mg/dL was now comparable to the normal rats and the Glibenclamide-treated rats with 94.67 mg dL⁻¹ and 338.33 mg dL⁻¹, respectively. Thus, 2,000 mg kg⁻¹ dose of *L. rotundifolia* shoot extract has potential in lowering the BGL of hyperglycemic rats.

Keywords: antihyperglycemic, diabetes mellitus, alloxan, toxicity, *Livistona rotundifolia*

HS – 05

**ANTI-INFLAMMATORY ACTIVITY OF METHANOL
EXTRACT FROM *Broussonetia luzonica* (Moraceae) Blanco
STEM BARK ON CARRAGEENA-INDUCED EDEMA
IN SPRAGUE-DAWLEY RAT PAW
AND ITS CYCLOOXYGENASE INHIBITION**

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Pieces of evidence from scientific studies strongly recognize the correlation between inflammation and chronic diseases. Suppressing inflammation prevents the emergence of these diseases. In search for cost effective treatment, this study determined the potential anti-inflammatory activity of the methanol extract from *Broussonetia luzonica* stem bark in vitro and in vivo. Acute toxicity test was done to determine the approximate lethal dose of the extract. An in vitro cyclooxygenase inhibition of the extract was the preliminary test for anti-inflammatory potential. To confirm this pharmacologic activity, the methanol extract of stem bark at concentrations 400 mg kg⁻¹, 1,000 mg kg⁻¹, and 2,000 mg kg⁻¹ was given orally to Sprague-Dawley rats with carrageenan-induced edema on their right hind paw. Results revealed that the approximate lethal dose of the extract is greater than 2,000 mg kg⁻¹. Results also show a higher percent inhibition of cyclooxygenase 1 and cyclooxygenase 2 than that of the positive control, indomethacin ($p < .005$). The highest inhibitory effect was exhibited by the extract at 2,000 mg/kg dose because there was no significant increase in paw size. The optimum anti-inflammatory effect was observed 4 hours after the initial induction of rat paw edema. Mean paw measurements taken after 4 hours were significantly different ($p < .005$). The methanol extract of the *B. luzonica* stem bark showed significant anti-inflammatory activity.

Keywords: anti-inflammatory, cyclooxygenase, carrageenan

HS – 06

APTAMER BASED PIEZOELECTRIC QUARTZ CRYSTAL DENGUE VIRUS BIOSENSOR

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A new approach for aptamer selection was developed by employing a PQC (piezoelectric quartz crystal) biosensor to offer an early detection of the dengue virus. The aptamer was selected by binding it with a NS1 (nonstructural protein 1)-PQC biosensor. From a DNA library of random sequences, the aptamer was selected through a PQC-based systematic evolution of ligands by exponential enrichment (PQC-SELEX) and the candidate oligonucleotides were amplified. PQC-SELEX, which is a highly efficient affinity method, was used for partitioning. PQC-SELEX also facilitated the monitoring of bulk affinity of enriched libraries at every step of partitioning and screening of individual clones for their affinity to the target. This method allowed all clones to be screened prior to sequencing to ensure that only clones with suitable binding parameters were sequenced. The aptamer was immobilized on a quartz crystal for detecting NS1². The aptamer-PQC sensor showed a working range between 20 ng mL⁻¹ to 20,000 ng mL⁻¹ and the developed piezoelectric aptamer sensor was shown to have sufficient sensitivity to detect nanogram quantities of NS1 in serum.

Keywords: piezoelectric quartz crystal, aptasensor, aptamer, dengue, NS1

HS – 07

BACTERIAL DETERMINATION OF CRUDE HYDROALCOHOLIC EXTRACTS OF SELECTED PHILIPPINE PLANTS

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This study determined the bacterial property of selected Philippine plants as potential source of antibacterial drugs. Microbial assay was done using paper disc diffusion method and the method of extraction used was maceration, wherein 80% alcohol was used as solvent. Hydroalcoholic extracts were subjected to a confirmatory test using color test method and revealed the presence of tannins, alkaloids, carbohydrates, flavonoids, and the absence of saponins. *Staphylococcus aureus* and *Bacillus subtilis* were used as test microorganisms. Results revealed that leaves of *Bixa orellana* had the greatest zone of inhibition (40 mm) against *S. aureus*, followed by *Mangifera indica* leaves (35 mm), *Punica granatum* leaves (30 mm), *Tamarindus indica* leaves (30 mm), *Carica papaya* leaves (27 mm) and *Cymbopogon citratus* leaves (27 mm). *B. subtilis* also showed sensitivity to *P. granatum* leaves (35 mm), *B. orellana* (30 mm), *T. indica* (25 mm), *M. indica* (25 mm), and *C. papaya* (23 mm). Penicillin was used as positive control (60 mm) and NSS as negative control (0 mm). Results showed that hydroalcoholic extracts of the said plants were sensitive to *S. aureus* and *B. subtilis*.

Keywords: Bacterial determination, crude hydroalcoholic extracts

HS – 08

BLOCKADE OF GROUP V PHOSPHOLIPASE A₂ CAUSES REDUCTION OF TGF- β 1-INDUCED FIBROSIS AMONG DIABETIC RATS

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Hyperglycemia caused by diabetes upregulates TGF- β 1 further activating fibrosis. This study investigated the pancreatic and cardiac changes in vivo to determine the effects of metformin (MET) and MCL-3G1, a neutralizing antibody against group V phospholipase A₂ (gVPLA₂). Sprague Dawley rats were injected intraperitoneally with either 0.5 M citrate buffer (vehicle) or 45 mg kg⁻¹ streptozotocin (STZ). Intraperitoneal injection of 250 mg kg⁻¹ MET or 10 μ g total protein of the antibody were administered to diabetic rats and monitored for two weeks. STZ-treated animals showed marked hyperglycemia (326.8 ± 67.08 mg dL⁻¹), decreased insulin levels (22.72 ± 1.594 μ IU mL⁻¹) with upregulation of TGF- β 1 at 771.3 ± 152.1 pg mL⁻¹, which were significantly different from baseline ($p < .05$). Histopathological examination showed severe islet damage and cardiac fibrosis. With MET treatment, blood glucose level was 79.57 ± 1.403 mg dL⁻¹ comparable to baseline (77.97 ± 1.712 mg dL⁻¹). The amount of TGF- β 1 also decreased to 52.28 ± 2.015 pg mL⁻¹ with both pancreatic and cardiac tissues having less damage and fibrosis. However, MET did not improve insulin level (19.94 ± 0.5207 μ IU mL⁻¹). MCL-3G1 mAb treatment resulted in normal blood glucose (100.2 ± 10.27 mg dL⁻¹), higher insulin (111.5 ± 9.186 μ IU mL⁻¹), and downregulation of TGF- β 1 levels (53.36 ± 2.990 pg mL⁻¹). Islet damage and cardiac fibrosis were not noted. It was observed that MET and MCL-3G1 mAb regulated blood glucose and TGF- β 1 levels, however, only MCL-3G1 mAb blocked the process of islet damage and cardiac fibrosis. The data obtained from this study were the first demonstration showing that blockade of gVPLA₂ by MCL-3G1 mAb attenuates TGF β 1-induced fibrosis in diabetic rats.

Keywords: diabetes, fibrosis, TGF- β 1, metformin, gVPLA₂

HS – 09

DEVELOPMENT OF A CAYENNE (*Capsicum annuum*) DENTAL BALM

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This study was conducted to develop a dental balm using *Capsicum annuum*. Specifically, it verified the secondary compounds of cayenne through phytochemical analysis and determined the susceptibility of cayenne extract against *Candida albicans* and *Streptococcus mutans*. The cayenne was collected in its pure form and dried using a multicommodity heat pump dryer at an ideal drying condition of 50°C and 10% relative humidity. The dried cayenne was submitted to the Standards and Testing Division of the Department of Science and Technology for phytochemical analysis. The extract was tested for antimicrobial susceptibility using the Kirby Bauer test. Results revealed that the cayenne extract has the following secondary compounds: sterols, tannins, glycosides, alkaloids, flavonoids, and saponins. The Kirby Bauer test on *C. albicans* showed a zone of inhibition (ZOI) of 10 mm, 19.38 mm for the positive control, and 0 mm for the negative control (sample-free disc). Both the cayenne extract and the control had complete inhibitory activities. When tested against *S. mutans*, the cayenne extract presented a total ZOI of 10.67 mm, compared to chlorhexidine (Orahex) at 11.67 mm. However, both have the same complete inhibitory activities. It is possible to use cayenne extract as a natural inhibitor to control oral infections caused by *C. albicans* and progression of carriers against *S. mutans*. Thus, a dental balm with bees' wax, essential oil, vitamin E, and cayenne extract mixed at low constant heat was developed.

Keywords: *Capsicum annuum*, dental balm, zones of inhibition

HS – 10

DIETARY FIBER CONTENT AND ANTI-LIPIDEMIC ACTIVITY OF ARROWROOT (*Maranta* sp.) FOOD PRODUCTS

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Food with dietary fiber high content of has shown to have health benefits. In this study, the amount of dietary fiber and lipid-lowering activity of locally-grown arrowroot plant and its bakery products (flour, starch, and cookies) were tested. The total dietary fiber, insoluble dietary fiber, and soluble dietary fiber of arrowroot and its bakery products were measured using the enzyme-gravimetric method as described in AOAC 991.43. To investigate lipid-lowering activity, six groups of ICR mice were fed with cholesterol for six weeks and were treated with the products for two weeks, with distilled water serving as the negative control and simvastatin as the positive control. Body weights were recorded before and after cholesterol induction and after arrowroot treatments. Serum lipid profile (total cholesterol, HDL, LDL, VLDL, triglycerides) was measured and livers were dissected and evaluated for histological changes. Results showed that the total dietary fiber content of arrowroot bakery products ranged from 2.46–23.15% with the arrowroot flour having the highest fiber content. The products were shown to contain high insoluble dietary fiber. Among the treatments, arrowroot starch lowered the total cholesterol in serum and reduced the ballooning of hepatocytes, lipid inclusion, and portal inflammation in the liver induced by high cholesterol feeding, suggesting the lipid-lowering activity of arrowroot starch.

Keywords: arrowroot, arrowroot food products, *Maranta* sp., anti-lipidemic, hypercholesterolemia

HS – 11

**EFFECTS OF 2,3,5,6-TETRAMETHYLPYRAZINE
ON ALCOHOL-INDUCED INJURY IN LIVER CELLS
AND ON THE EARLY LIFE STAGES OF ZEBRAFISH
(*Danio rerio* Hamilton 1822)**

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Alcohol liver disease (ALD), which is the collection of liver damage caused by excessive alcohol intake, is a major health problem. This study assessed the hepatoprotective effects of 2,3,5,6-Tetramethylpyrazine (TMP) against ALD using histopathological analysis of adult zebrafish livers. TMP is a compound, which has been mainly used for the treatment of cardio- and cerebrovascular diseases. Three concentrations (40, 60, and 80 mg L⁻¹ TMP) were used. Results showed that TMP was able to dose-dependently decrease mean scores for the four parameters diagnostic of ALD—steatosis, inflammation, cell death, and ballooning degeneration. These scores were comparable to those of the untreated group (no ethanol+no treatment) and positive control (ethanol+Hepasil DTXTM), with all groups' scores being statistically different from those of the negative control group (ethanol+no treatment) ($p<.05$). Other anomalies, namely, cholestasis, vessel congestion, and hemorrhage were noted only in the ethanol group, but not for other groups. These imply the high efficacy of TMP in terms of hepato-protection. Its toxicity to the early development of embryos was evaluated using the zebrafish embryotoxicity test (ZFET), which suggested that TMP is also non-toxic or non-teratogenic at concentrations used for liver treatment. Percent mortalities in the TMP groups (20–100 mg L⁻¹), as assessed by lethal endpoints (i.e., coagulation, non-detachment of tail, non-formation of somites, and non-detection of heartbeat), were minimal and not statistically different from that of the negative control (reconstituted water) but were statistically different from the positive control (3.5% ethanol). The occurrences of sublethal endpoints (i.e., yolk sac edema, pericardial edema, spinal curvature, abnormal heart rate, and body length) were generally comparable to those in the negative control and statistically different from the positive control. These results show that TMP is non embryotoxic and is reasonable as a hepatoprotective compound against ALD.

Keywords: alcohol liver disease (ALD), zebrafish embryotoxicity test (ZFET), Tetramethylpyrazine (TMP)

HS – 12

GUT MICROBIAL DIVERSITY OF BALB/C MICE FED DIFFERENT CULTIVARS OF *Indica* RICE

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Recent research findings suggest that gut microbiota impact the overall health of the host. In this study, the potential effects of unpolished rice in modulating the intestinal bacterial population in Balb/c mice were examined. Five-week-old male Balb/c mice (n=5–6) were fed for 30 days with a synthetic diet of AIN-93G or diet supplemented with any of the unpolished forms of three Philippine *indica* rice varieties differing in pericarp color (*Ittum*, Black; *Saluyaw*, Red; NSIC Rc188, White). Three mice were selected from each group and their intestinal microbiota were analyzed by 16S pyro-sequencing. After the extraction of DNAs from the cecal contents, a 250-bp region from the V4 region of the 16S rRNA gene was amplified. Sequencing was performed and reads from all samples were clustered (at 97% sequence identity) into operational taxonomic units (OTUs), then aligned to the Greengenes bacterial reference tree. The cecal microbiota of all mice were composed of 562 OTUs from eight distinctive bacterial phyla, with four phyla (Firmicutes, Bacteroidetes, Defferibacteres, and Proteobacteria) accounting for more than 90% of all the obtained sequences. Alpha-diversity analysis showed that cecal microbiota compositions were less diverse in AIN-fed mice than in rice-fed mice. Principal coordinate analysis and hierarchical clustering using unweighted pair group method with arithmetic mean suggested distinct clustering of each group. The Firmicutes/Bacteroidetes ratio was significantly different between the AIN and colored-rice groups. Abundance of Prevotellaceae was higher in the cecal content of rice-fed mice when compared with AIN-fed mice, while that of Bacteroidales S24.7 tended to be lower in colored rice-fed mice. This work demonstrated that diets containing unpolished rice resulted in shifts in the composition of intestinal microbiota of Balb/c mice.

Keywords: gut, microbiota, rice

HS – 13

**IN VITRO ANTICOAGULANT POTENTIAL
OF *Caesalpinia pulcherrima* (Caballero) LEAF METHANOLIC
CRUDE EXTRACT IN SELECTED FILIPINO INDIVIDUALS
USING PROTHROMBIN TIME ASSAY**

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Anticoagulants are compounds used to treat patients with cardiovascular diseases by reducing the coagulation of blood and preventing formation of new blood clots through inhibition of the coagulation cascade. Long-term use of Warfarin, a widely used anticoagulant, has many adverse effects. This study focused on confirming *Caesalpinia pulcherrima* as potential source of natural coumarin, a known chemical substance that inhibits blood coagulation. Human plasma of 30 healthy individuals ranging from 18 to 25 years old were collected and subjected to three different concentrations of *C. pulcherrima* extract: 10 mg mL⁻¹, 30 mg mL⁻¹, and 50 mg mL⁻¹ diluted in normal saline solution. In vitro analysis using prothrombin time (PT) assay was performed and international normalized ratio (INR) values were obtained. Results were then compared with the range of 1.6–2.6 (Wang & Chiang, 2013) to determine whether the extract is a decent anticoagulant. The values obtained for PT were 16.25s (±1.63s), 17.48s (±1.29s), and 19.17s (±1.65s) for 10 mg mL⁻¹, 30 mg mL⁻¹, and 50 mg mL⁻¹ extract concentrations, respectively. This indicates that there was a direct proportional relationship between the treatment and the PT. The INR values were observed to be increasing per concentration which indicates that the extract is a good anticoagulant. The results showed that the plant extract is effective for prolonging the blood coagulation process based on the PT assay. This study demonstrated that the extract may be a potential source of natural coumarins.

Keywords: anticoagulant, Caballero, prothrombin, extract, coumarin

HS – 14

**INDUCTION OF APOPTOSIS BY EXTRACTED
Hylocereus polyrhizus IS DEPENDENT ON DOWNREGULATION
OF Akt PHOSPHORYLATION AND SUBSEQUENT
ACTIVATION OF CASPASE 3 EXPRESSION
IN HUMAN LIVER CANCER CELLS (HepG2) IN VITRO**

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The antioxidant-rich nature of *Hylocereus polyrhizus*, commonly known as dragon fruit, has beneficial effects on the human liver. This study determined the potential cancer-inhibiting activity of *H. polyrhizus* against cultured human liver cancer cell lines (HepG2). By Western Blot analysis, the mechanism of action(s) by which *H. polyrhizus* lessened the proliferation of HepG2 cells were examined and its effect on Akt phosphorylation and Caspase 3 activation were measured. The phytochemical profile of methanolic extract of *H. polyrhizus* was evaluated using ultraviolet spectrophotometry and liquid chromatography with mass spectrometry (LC-MS). Extracted *H. polyrhizus* exhibited significant suppression of HepG2 liver cancer cell growth. The minimum inhibitory concentration 50 (IC₅₀) of *H. polyrhizus* extracts against HepG2 liver cancer after 16 hours treatment was IC₅₀=62.31±0.89 µg mL⁻¹ extract. *H. polyrhizus* extract caused downregulation of constitutively expressed phosphorylated Akt. By contrast, *H. polyrhizus* extract upregulated the expression of Caspase 3, a marker of DNA fragmentation and apoptosis. Phytochemical screening showed that each gram of extract contains 78.75±5.67 mg phytosterol, 20.86±1.04 mg phenolics, and 14.78±2.84 mg flavonoids. LC-MS analysis confirmed the presence of phytosterol (bofutaline, 2-monopalmitin), cyanogenic glycoside (lotaustralin), and mostly alkaloids (corypalline, trigonelline, N-Methylisopelletierine and plakohypaphorine). Our study is the first demonstration that *H. polyrhizus* possesses potential anti-proliferative property against liver cancer cells, and that it can serve as functional food for chemoprevention of liver cancer disease.

Keywords: phosphorylated Akt, caspase 3, DNA fragmentation, western blot and liquid-chromatography with mass spectrometry

HS – 15

**IN-VITRO AND IN-VIVO ASSESSMENT OF PHILIPPINE
Pandanus SPECIES (Pandanaeae) AS POTENTIAL
ANTI-INFLAMMATORY AGENTS**

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Pandanus amaryllifolius Roxb. and *Pandanus tectorius* Parkinson ex Du Roi (Pandanaeae) have been ethnomedically used in the treatment of inflammatory diseases, however, this claim is yet to be scientifically established. This study aimed for in vitro and in vivo assessment of methanolic and aqueous leaf extracts from these species as potential anti-inflammatory agents. Metabolite profiling was done on the extracts via liquid chromatography-mass spectroscopy (LC-MS). In vitro assessment on the extracts was conducted through cyclooxygenase (COX)-1 and COX-2 inhibitory screening assays. The result showed that only *P. tectorius* aqueous leaf extract showed a remarkable COX-1 (86.04%) and COX-2 inhibitory effects (79.07%) comparable to the positive control Indomethacin ($p > .05$). Acute toxicity testing was also performed on *P. tectorius* aqueous leaf extract based on OECD Guideline 425 and showed that the extract is non-toxic in rats at 2,000 mg kg⁻¹. These findings imply that aqueous extract of *P. tectorius* leaves possesses COX inhibitory property that could serve as the basis for its anti-inflammatory activity. Determination of anti-inflammatory activity in vivo is currently being done.

Keywords: anti-inflammatory, *Pandanus amaryllifolius*, *Pandanus tectorius*, cyclooxygenase, metabolite profiling

HS – 16

**METABOLITE PROFILING
AND COX INHIBITORY AND CYTOTOXIC PROPERTIES
OF *Lasianthus trichophlebus* Hemsl. (Rubiaceae)**

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The Rubiaceae family of plants has been known to display different pharmacological activities. This study determined the cyclooxygenase (COX) inhibitory and cytotoxicity of the methanolic, hexane, chloroform, and aqueous extracts of the dried leaves of *Lasianthus trichophlebus* Hemsl. Metabolite profiling using liquid chromatography-mass spectroscopy (LC-MS) was also done to determine the secondary metabolites which could be responsible for their activity. The in vitro COX-1 and COX-2 inhibitory assessment on the extracts showed that *L. trichophlebus* MeOH extract exhibited COX-1 (52.64%) and COX-2 (57.12%), while the CHCl₃ extract exhibited COX-1 (60.49%) and COX-2 (54%) inhibition. Acute toxicity testing of the MeOH extract using the OECD Guideline 425 showed non-toxicity up to 2,000 mg kg⁻¹ BW. MTT assay is currently being done to determine the cytotoxicity of the extracts.

Keywords: *Lasianthus trichophlebus*, LC-MS, cyclooxygenase, Rubiaceae

HS – 17

**NEPHROPROTECTIVE EFFECT OF THE ETHANOLIC
EXTRACT OF *Caulerpa racemosa* (Forsskal) J. Agardh
AGAINST GENTAMICIN-INDUCED NEPHROTOXICITY
IN SPRAGUE-DAWLEY RATS**

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The nephroprotective property of the ethanolic extract of *Caulerpa racemosa* (Forsskal) J. Agardh, a green algae abundant in Philippine shorelines, was investigated. *C. racemosa* was desalted in distilled water, cleansed, then dried. The dried plant was subjected to percolation to obtain the ethanolic extract. Total phenolic content (TPC) and total flavonoid content (TFC) were determined. In vivo nephroprotective activity of the extract was performed for eight days on Sprague-Dawley rats through Gentamicin-induced nephritis. Nephroprotective activity of the extract at different concentrations (250 mg kg⁻¹, 500 mg kg⁻¹, and 1,000 mg kg⁻¹) were assessed through blood assays (blood urea nitrogen and creatinine), which were performed at the onset and at the end of the experiment. One kidney was incised for histopathological testing. Silymarin (50 mg kg⁻¹) served as the positive control, and Gentamicin (80 mg kg⁻¹, in sulfate form) was used to induce nephritis. Total flavonoid and phenol content determination showed that the extract contains 1.00±0.003 mg QE (quercetin equivalent) g⁻¹ sample and 0.800 ± 0.04 mg GAE (gallic acid equivalent) g⁻¹ sample, respectively. Nephroprotective evaluation based on hematologic and pathophysiologic parameters showed that the extract protected rat kidneys against gentamicin-induced renal tubular alterations and rises in blood urea nitrogen and serum creatinine. Extracts at different concentrations showed significant difference compared with the negative control, however, it was not dose-dependent. The 500 mg kg⁻¹ extract ameliorated Gentamicin-induced nephrotoxicity.

Keywords: nephroprotective, gentamicin-induced nephritis, green algae

HS – 18

PHYTOCHEMICAL AND FTIR ANALYSIS OF THE ISOLATED POLYPHENOLIC COMPOUNDS OF *Morus alba* L. LEAVES AND ITS EFFECT ON THE BLOOD UREA-CREATININE RATIO OF NEPHROTOXIC RATS

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Morus alba L., commonly known as white mulberry serves as a source of bioactive constituents and is usually used in phytopharmacy and in functional food formulation. The isolated polyphenolic compounds of *Morus alba* L. leaves were subjected to FTIR testing, phytochemical tests, and *in vivo* testing for nephroprotective potential. Thirty-six male Sprague-Dawley Rats were randomly selected and were assigned into six groups namely, the Normal control, Nephrotoxic-untreated, Cilostazol-treated, 100 mg/kg BW, 250 mg/kg BW and 500 mg/kg BW Mulberry treated groups. The study was carried out for 10 days, and the blood urea nitrogen/creatinine ratio (BCR) showed that Mulberry Treated groups (100 mg/kg, 250 mg/kg and 500 mg/kg) were considered to be lower than those of nephrotoxic-untreated and Cilostazol-treated. A blood urea nitrogen/creatinine ratio of 45.6 (100 mg/kg BW), 34.6 (250 mg/kg), and 48.2 (500 mg/kg BW) were said to signify a probable nephroprotective potential.

As a conclusion, it can be inferred that isolated polyphenolic compounds of *Morus alba* L. leaves with doses of 250 mg/kg BW (Urea: p= 0.516; Creatinine: p=0.999) and 500 mg/kg BW (Urea: p= 0.959; Creatinine: p=1.000) showed a significant difference on the blood urea-creatinine ratio of the nephrotoxic Sprague-Dawley rats as compared to the nephrotoxic-untreated, and cilostazol-treated group.

Keywords: *Morus alba*, nephroprotective, phenolic compound

HS – 19

**PHYTOCHEMICAL SCREENING, ANTIOXIDANT,
AND HEPATOPROTECTIVE ACTIVITY OF COMMON FIG
(*Ficus carica* L.) LEAF ETHANOLIC EXTRACT
IN MALE WISTAR ALBINO RATS (*Rattus norvegicus* B.)**

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Fig (*Ficus carica* L.) is an excellent source of minerals, vitamins, and dietary fiber because it is free from fat and cholesterol and contains a high amount of amino acids. Since there is no accounted research about the plant in the Philippines, this study was conducted to determine the phytochemical constituents present in common fig leaf ethanolic extract (CFLEE); evaluate the antioxidant property using the 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) assay; and compare the hepatoprotective property of CFLEE-treated albino rats with that of silymarin-treated and untreated albino rats through enzyme marker and histological liver examination. The CFLEE results showed that the extract contained alkaloids, carbohydrates, saponins, phytosterol (diterpenes), phenolic compounds, flavonoids, and proteins. The concentration of CFLEE that scavenges 50% of free radical DPPH is 24,600 $\mu\text{g mL}^{-1}$. The initial serum glutamine pyruvic transaminase (SGPT) levels of the male rats assigned to the three treatments were not significant. After the induction of paracetamol hepatotoxicity, the final SGPT level obtained from the male rats treated with silymarin and CFLEE were not significantly different, however, the untreated rats had significantly higher SGPT level.

Keywords: Ficus, phytochemical, antioxidant, hepatoprotective, DPPH

HS – 20

PREPARATION, CHARACTERIZATION, AND ANTIBACTERIAL ACTIVITY OF GENTAMICIN-LOADED CHITIN NANOGEL

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Antimicrobial resistance (AMR) is one of the most serious health problems experienced worldwide. One solution is to create a novel drug delivery that enhances the antibacterial activity of a drug through the use of “nanoantibiotics”. In this research, gentamicin, a broad spectrum antibacterial drug, was encapsulated in a nanogel prepared from chitin and tested for its activity against resistant and non-resistant strains of *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Chitin nanogel (CNGs) were prepared through freeze-thawing method using KOH and then regenerated with methanol followed by ultrasonication. Gentamicin-loaded chitin nanogel (GCNGs) were prepared by incubating gentamicin with CNG. Particle size analysis revealed that CNG and GCNGs had an average particle size of 501.53 nm and 801.4 nm, respectively. Zeta potential analysis of CNGs and GCNGs indicated a charge of +24.6 mv and +21.76 mv, respectively. For the antibacterial testing, the prepared GCNG produced a lower minimum inhibitory concentration (MIC) of 0.125 mcg mL⁻¹ compared to that of gentamicin which produced an MIC of 0.25 mcg mL⁻¹ against *P. aeruginosa* based on broth microdilution assay. The prepared GCNG also produced an MIC of 16 mcg mL⁻¹, which is better than the MIC of gentamicin alone at 32 mcg mL⁻¹ tested against methicilin-resistant *S. aureus*. These results indicate that CNG is a good candidate carrier for gentamicin since it can increase the activity of the gentamicin against *P. aeruginosa* and the methicilin-resistant *S. aureus*.

Keywords: gentamicin, chitin, nanogel, MRSA

HS – 21

PRESUMPTIVE DETECTION OF ANTIBIOTIC RESIDUES IN RAW MEAT OF *Bos taurus* (Bovidae) AND *Sus scrofa domesticus* (Suidae) OBTAINED FROM THE PUBLIC MARKET OF LAS PIÑAS CITY, PHILIPPINES

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This study was carried out to detect antibiotic residues in raw meat of *Bos taurus* (Bovidae) and *Sus scrofa domesticus* (Suidae) obtained from the public market of Las Piñas City. Three batches were collected from the public market and examined for the occurrence of antibiotic residues. It was observed that pork had the greatest zone of inhibition in all the groups of antibiotics. Samples were positive for the presence of penicillin type (61 mm), tetracycline type (61 mm), sulfonamides (53 mm), aminoglycosides type (49 mm), and macrolides (17 mm). Beef also contained penicillin type (56 mm), tetracycline type (56 mm), sulfonamides (46 mm), aminoglycosides type (42 mm), but did not contain macrolides (0 mm). The presence of antibiotic residues in raw meat carcasses poses a health risks, such as antibiotic resistance, teratogenicity, carcinogenicity, and hepatic and renal failure, to consumers. This study showed that a considerable contamination of antibiotic residues in raw meat was found in both samples.

Keywords: Antibiotic residues, raw meat, *Bos taurus*, *Sus scrofa domesticus*

HS – 22

QUALITATIVE DETERMINATION OF ANTIBIOTIC RESIDUE USING FOUR PLATE TEST (FPT) IN COOKED AND UNCOOKED CHICKEN MEAT

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This research focuses on the antibiotic residues present in uncooked and cooked chicken meat samples, particularly the breast and thigh parts. The antibiotic residue was determined quantitatively by four plate test (FPT). *Bacillus subtilis* and *Micrococcus luteus* were the bacterial species that the researchers utilized during the experimentation. Three samples were collected from Cavite and were tested for the presence of β -lactams, aminoglycoside, macrolides, and tetracyclines. The results showed that the cooked thigh part chicken sample had the largest zone of inhibition for macrolides type antibiotic residue (32 mm) while the cooked breast part of the chicken meat sample was positive for β -lactams group (33 mm). Tetracycline type and aminoglycoside group of antibiotics obtained both the smallest zone of inhibition in the cooked thigh part of the chicken (10 mm) and cooked breast part (10 mm). In the uncooked thigh part, tetracycline type of antibiotic had the least measurement of inhibition (17 mm). In the uncooked breast part, aminoglycoside type of antibiotic had the least zone of inhibition (22 mm). The greatest zone of inhibition in the uncooked thigh part was β -lactams group (30 mm). Lastly, breast part sample had the widest zone of inhibition (38 mm). Results confirmed that there is antibiotic residues in chicken meat samples that were collected in Cavite.

Keywords: antibiotic residue, chicken meat, breast and thigh part, four plate test

HS – 23

SCREENING OF LOVASTATIN PRODUCTION IN FIVE SELECTED MUSHROOM SPECIES

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One medically important compound found in mushrooms is lovastatin, a secondary metabolite that is essential for lowering blood cholesterol. The study was carried out to detect the potentiality of *Lentinula edodes*, *Pleurotus sajor-caju*, *Trametes gibbosa*, *Schizophyllum commune*, and *Coprinellus disseminatus* to produce lovastatin. Mushroom species were collected from different sources and were isolated on potato dextrose agar (PDA). The mycelial cultures were then subjected to double submerged fermentation. Crude extracts were obtained after the fermentation process and were subjected to characterization, mycochemical analysis, and lovastatin screening through UV-visible spectrophotometry. All mycelial cultures exhibited growth in the production medium. Among the five species, *S. commune* showed optimal growth with 1.55 ± 0.090 g mycelial biomass. Crude extracts of all the mushroom species were black-brown, water-soluble, and neutral in pH. Results of the mycochemical screening revealed the presence of flavonoid, saponin, tannins, glycosides, anthraquinones, alkaloids, and terpenoids. On the other hand, results of the lovastatin screening showed that all of the five mushroom species were lovastatin producers. *C. disseminatus* gave the highest value for lovastatin concentration among the five with 17.17 ± 0.007 mg L⁻¹, followed by *S. commune*, *T. gibbosa*, and *P. sajor-caju*. *L. edodes* conferred the lowest lovastatin concentration at 2.02 ± 0.019 .

Keywords: lovastatin, *Coprinus disseminatus*, UV-visible spectrophotometry

HS – 24

SYNTHESIS OF *N*-ACYLATED LACTAM DERIVATIVES WITH SELECTIVE CYTOTOXIC AND ANTITUBERCULAR ACTIVITIES

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The exploration of pharmacophore-inspired drug targets allow the simplification of preparing template scaffolds, making the discovery of future hit compounds accessible and sustainable. In this study, 13 new *N*-acylated lactam derivatives inspired from cytotoxic *Piper* alkaloids were prepared synthetically using standard acylating conditions. According to the results of the MTT assay, the crotonylated and fluorinated cinnamoyl valerolactam and the crotonylated and nitro-containing cinnamoyl derivatives were the most antiproliferative against human myeloid leukemia cancer cells. On the other hand, anti-TB susceptibility testing using MABA showed the dimethacrylated, crotonylated, and nitrocinammylated butyrolactam derivatives with strong inhibition against *Mycobacterium tuberculosis* H37Rv (MIC 1–3 $\mu\text{g mL}^{-1}$). When assessing the overall chemotherapeutic profile of a compound, selectivity to cancer cells or pathogen (over normal cells) must be taken into high consideration. The fluorocinnamylated butyrolactam and nitrocinnamylated valerolactam derivatives displayed high selectivity on chronic myeloid leukemia cancer cell-lines, and the dimethacrylated and crotonylated butyrolactams against *M. tuberculosis* H37Rv over HUVEC and VERO cells (with SIs greater than 10). Our results show the high pre-clinical potential of *N*-alkenoylated derivatives to treat leukemia and tuberculosis.

Keywords: *N*-acylated butyrolactam, antiproliferative, cytotoxic, antitubercular

HS – 25

**SYNTHESIS-DRIVEN DISCOVERY OF NOVEL,
HIGHLY SELECTIVE ANTITUBERCULAR,
AND ANTI-PROLIFERATIVE *NOR*-SECURININE
DERIVATIVES WITH PRE-CLINICAL POTENTIALS**

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The sustainable use of natural products and their derivatives in developing future hit compounds to treat tuberculosis and cancer are among the priorities in present day drug discovery. In this study, nine novel derivatives of the *Securinega* alkaloid, *nor*-securinine decorated with acyl and chlorine atoms, were prepared by an easy-to-carry-out strain-release promoted nucleophilic addition reactions in a single step. All derivatives were unambiguously characterized using HR-ESIMS, NMR, and single-crystal X-ray diffraction experiments. Among the nine derivatives, the *N*-chlorocinnamylated derivative conferred the highest antitubercular activity with a minimum inhibitory concentration of 0.6 $\mu\text{g mL}^{-1}$ and good selectivity over VERO cells with selectivity index greater than 100. On the other hand, the *N*-lauryl derivative showed approximately two-fold selectivity to chronic myeloid leukemia and HeLa cancer cells over HUVEC cell. Compared to *nor*-securinine, the latter compound had better enhanced anti-proliferative and cytotoxic activities. Our results show the promise of decorating natural products with electrophilic moieties to discover future pre-clinical chemotherapeutic candidates against tuberculosis and cancer.

Keywords: *nor*-securinine, antiproliferative, cytotoxic, antitubercular.

HS – 26

**THE EFFICACY OF *Lavandula angustifolia* Mill.
ESSENTIAL OIL AS A NANOEMULSION IN PILOCARPINE
DRUG-INDUCED SEIZURES SWISS MICE MODEL**

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Lavender (*Lavandula angustifolia* Mill.) has been widely known for its use in aromatherapy and for its therapeutic and medicinal activity. One of the recent studies in lavender oil is its medicinal effect in neurological disorders, mainly in epilepsy. However, there are no studies regarding lavender oil formulations. In this study, the pure essential lavender oil was formulated into a nanoemulsion in order to investigate the preventive antiepileptogenic property in pilocarpine drug-induced seizures in mice model. The seizure activity was analyzed through a seizure scoring scale. Results showed that the seizure score of the negative control was significantly the least ($p < .001$). The seizure score of the mice induced but not treated (Group 2) was significantly higher than the negative control ($p < .001$) but significantly less ($p = 0.031$) than those in the positive control. Those induced and treated with lavender nanoemulsion (Group 3) did not differ from the valproic acid, positive control ($p = 0.144$). Based on experimental seizure model and histopathological studies, the formulated lavender nanoemulsion is effective and comparable with valproic acid as a preventive antiepileptogenic agent.

Keywords: lavender, pilocarpine, nanoemulsion, epilepsy, seizure, valproic acid

HS – 27

TOTAL SYNTHESIS OF DIAPORTHEONE A**Mario A. Tan**¹, Peter Patrik Züger², Silvio Roggo²¹Research Center for the Natural and Applied Sciences
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Chromones are benzoannulated γ -pyrone heterocyclic class of natural products which are widely distributed in nature. Secondary metabolites with the chromone structure showed diverse pharmacological properties. Their structural diversity and synthetic accessibility have made the compounds with chromone scaffold excellent targets in organic synthesis and play an important role in drug discovery and medicinal chemistry. Diaportheone A, a natural product chromone, was previously isolated from the endophytic fungi *Diaporthe* sp. P133. To determine the absolute configuration and for biological evaluation, total synthesis was done. The process utilized cyclization and in situ thermal syn-elimination of a β -ketosulfoxide as key steps. Diaportheone A was successfully synthesized in four steps with 46% overall yield. The absolute configuration was determined using X-ray crystallography.

Keywords: chromone, Diaportheone A, total synthesis, x-ray crystallography, endophytic fungi

HS – 28

α -GLUCOSIDASE INHIBITORS FROM ENDOPHYTIC FUNGI DERIVED FROM *Pandanus simplex* LEAVES

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Endophytic fungi, organisms that live inside plant tissues, are relatively underexplored sources of natural products. For example, diverse endophytes previously isolated from the leaves of *Pandanus amaryllifolius* Roxb. led to the discovery of new compounds such as the two new benzopyranone, diaportheone A and B, from *Diaporthe* sp.; the new isocoumarin, guignardiol from *Guignardia* sp.; and the new macrolide, colletotriolide from *Colletotrichum* sp., all with interesting bioactivities. In this study, the anti-diabetic potentials through α -glucosidase inhibition activity of leaf inhabiting endophytic fungi isolated from *Pandanus simplex* were studied and explored. *Annulohypoxyton stygium*, one of the 21 isolated fungal endophytes from the host plant, had high α -glucosidase inhibition and was selected for bioassay-guided isolation. A naphthalene derivative, 8-methoxynaphthol, and mixture of unsaturated fatty acid glycerides were obtained and identified with $68.50 \pm 0.50\%$ and $69.31 \pm 6.85\%$ α -glucosidase inhibition, respectively. This study is the first on the isolation of the above metabolites from *A. stygium*. The results demonstrated that endophytic fungi from *P. simplex* is a sustainable source of secondary metabolites that can be further explored as alternative chemical entities to alleviate diabetes.

Keywords: endophytic fungi, *Annulohypoxyton stygium*, α -glucosidase inhibitors, 8-methoxynaphthol, unsaturated fatty acids.

**MATHEMATICAL AND PHYSICAL
SCIENCES**

MPS – 01

ASSESSMENT OF GROUNDWATER SYSTEM IN ANGELES AND CLARK, PAMPANGA USING ISOTOPE AND CHEMICAL TECHNIQUES

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The cities of Angeles and Clark in the Pampanga River Basin (PRB) are among of the groundwater critical areas in the country identified by the National Water Resources Board (NWRB). A quantitative hydrological assessment is therefore needed to serve as basis for better water resource management. The use of isotope techniques in hydrological studies has been known to be an efficient approach in performing hydrological assessments. In May 2017, 26 groundwater samples—one from shallow well (12 mbgl) and 25 from deep boreholes (50 to 250 mbgl) —were collected in Angeles City and Clarkfield. The surface geology was characterized by recent volcanic deposits from the 1991 Mt. Pinatubo eruption. The geological cross-sections were simple with two aquifers separated by a clay layer. Hydrogeochemistry showed a mixed cation-bicarbonate type of water while the water stable isotopes plot ($\delta^{18}\text{O}$ vs $\delta^2\text{H}$) revealed little to no pronounced evaporative enrichment, which suggests a relatively rapid recharge rate. The $\delta^{18}\text{O}$ values of groundwater samples ranged from -7.4‰ to -8.7‰ , which were typical isotope signatures of rainfall in these areas during the onset of the monsoon. Furthermore, most of the samples had measurable tritium concentrations, which ranged from 0.7 to 1.2 tritium units (TU). The cosmogenic tritium input of the Philippines is about 1–2 TU with an average value of about 1.5 TU. Groundwater mean residence time (MRT) was estimated to be about 1–12 years in most areas but MRT of more than 30 years was also found in Angeles.

Keywords: Pampanga River Basin, water stable isotopes, tritium

MPS – 02

ASSESSMENT OF THE CATALYTIC ACTIVITY OF IRON Pincer COMPLEXES IN THE REDUCTIVE CLEAVAGE OF C-O BOND IN LIGNIN MODEL COMPOUND

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Lignocellulosic biomass, mainly composed of cellulose, hemicellulose, and lignin, is considered one of the most promising solutions to produce renewable energy, fuel, and chemicals. This study developed a catalytic system employing pincer complexes as catalysts that may enable the conversion of lignin into commodity chemicals. Due to the complex structure of lignin, a model compound was used to represent the linkages present in actual lignin. Pincer ligands, namely pyridyldiimine and benzyldiamine, were synthesized via condensation reaction of an aldehyde/ketone with 2,6-disubstituted anilines with percent yields ranging from 28–56%. The pincer complexes were then formed by reacting the synthesized ligands to different Fe precursors in 1:1 stoichiometry. These complexes were used in the in situ catalysis of anisole as the substrate and different hydrogen sources. Results from thin layer chromatography suggested cleavage of C-O bond in anisole yielding phenol as the main product, as compared with the commercially available sample. Evaluating different hydrogen donors revealed that acetic acid is the most effective, giving 30% percent yield of phenol.

Keywords: lignin, pincer complexes, C-O bond cleavage

MPS – 03

BINDING OF NANOCERAMICS WITH SERUM ALBUMINS

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Metal oxide nanoparticles are widely used in products in automotive vehicles, biochemical engineering, electronics and communication technologies, medicine, and day-to-day consumer products, like food and cosmetics. These metal oxides, otherwise known as nanoceramics, adopt a number of structural geometries with an electronic structure that can exhibit metallic, semiconductor, or insulator character. Previous studies have shown interactions between nanoparticles and biological molecules, which raise concerns about their effect on human health. In this study, the interactions of four nanoceramics (i.e., aluminum oxide, silicon oxide, titanium oxide, and zinc oxide) with serum albumin (human and bovine) were monitored using UV-Vis spectroscopy, fluorescence spectroscopy, and circular dichroism. Results showed the reduction of absorbance and fluorescence for both serum albumins added with nanoceramics. The reduction was more pronounced with aluminum oxide. Circular dichroism (CD) analysis showed a change in conformation of serum albumins added with nanoceramics. These changes only mean that changes in the serum albumins' structure and conformation upon addition of these nanoceramics could affect the functions of the serum albumins in the biological systems.

Keywords: nanoceramics, serum albumin, absorbance, fluorescence, circular dichroism

MPS – 04

CHEMICAL SYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE-POLYPYRROLE NANOCOMPOSITES AS POTENTIAL PHOTOCATALYST

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In this study, zinc oxide (ZnO) nanoparticles were synthesized from zinc acetate via sol-gel method. The ZnO nanoparticles were functionalized with polypyrrole (PPy) via chemical polymerization with FeCl₃. Both ZnO and ZnO-PPy were found to be highly crystalline. The synthesized ZnO nanoparticles agglomerated and formed no distinct morphology, whereas ZnO-PPy was found to have spherical structural morphology with particle radius of around 200 nm. The experimental band gap energy of ZnO was 3.40 eV compared to the literature value of 3.37 eV. It was also found that polymer capping with PPy reduced the band gap to 2.52 eV. The polymer interaction of PPy with ZnO was electrostatic in nature. Photodegradation efficiency was improved upon PPy capping from 1.78% to 3.78% per hour.

Keywords: zinc oxide, polypyrrole, nanomaterials, chemical polymerization, photocatalysis, methyl orange

MPS – 05

DEVELOPMENT OF POLYANILINE-MODIFIED CARBON ELECTRODE FOR ELECTROCHEMICAL DETERMINATION OF ASCORBIC ACID

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In this research, a facile electrochemical determination of ascorbic acid based on polyaniline-modified carbon electrode (PANI-MCE) was developed. The sensing membrane was synthesized via *in-situ* chemical oxidation process. The spectral and morphological properties of PANI-MCE membrane were characterized using Fourier transform infrared (FTIR) spectrometer and a scanning electron microscope (SEM), respectively. Using optimal preparation conditions, the fabricated PANI-MCE exhibited a high sensitivity of 18.7 $\mu\text{A mM}^{-1}$ ascorbic acid. A linear relationship ($r=0.997$) was determined between the anodic peak current and ascorbic acid concentration in the range of 2–8 mM ($n=4$). Moreover, an RSD of <10% implies the sensor's high repeatability and reproducibility demonstrating the potential of PANI-MCE as a good candidate for ascorbic acid determination.

Keywords: conducting polymer, electrochemical sensing, ascorbic acid

MPS – 06

DISSOLUTION OF CELLULOSE IN 1-BUTYL-3-METHYLIMIDAZOLIUM ACETATE

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Cellulose is the most abundant biorenewable material on earth with derivatives that have a wide range of applications. Various studies were conducted to determine a viable solvent for cellulose and found that ionic liquids (ILs) were reusable and environmentally-safe solvents of cellulose. In this study, 1-butyl-3-imidazolium acetate, [BMIM] Ac, was synthesized and was used for the dissolution of cellulose. [BMIM] Ac was synthesized using a two-step method: synthesis of [BMIM] Br using a solvent-free sonochemical preparation and synthesis of [BMIM] Ac using a simple ion-exchange method. The ILs were characterized using FT-IR, ¹H-NMR, and ¹³C-NMR. The dissolution of cellulose was done under an inert atmosphere and was aided by constant stirring at 100°C. Cellulose was regenerated by the addition of water as an anti-solvent. The reusability of the IL as a solvent was evaluated. It was determined that the maximum weight % of cellulose that can be dissolved in [BMIM] Ac was 12 wt%. The reusability of the IL was confirmed by the comparison of the IR spectra of the unused and used IL, showing no significant difference.

Keywords: ionic liquids, [BMIM] Ac, cellulose dissolution

MPS – 07

EFFECT OF PH, LIGHT, AND TEMPERATURE TO THE ANTHOCYANIN EXTRACT FROM *Clitoria ternatea* FLOWERS

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Previous research suggest that synthetic colorants are detrimental to human health. *Clitoria ternatea* (blue ternate) is a possible source for natural colorants replacing the commercially available synthetic colorants. However, studies are needed to fully determine the potential of natural-based pigments. Thus, this study determined the effect of pH, light, and temperature on the anthocyanin from *C. ternatea*. The flowers were subjected to aqueous extraction and anthocyanin extraction using acetone followed by chloroform partitioning. The aqueous extract was tested for phytochemical analysis and the anthocyanin content was analyzed in UV-spectrophotometer at 520 nm and 700 nm. The absorbancies of anthocyanin extract at pH 1.0–11.0 under the temperature of 4–50°C (stored in light and dark areas) were measured at 527 nm. The total anthocyanin content was also determined. The aqueous extract contains leucoanthocyanins, flavonoids, and 137 mg L⁻¹ monomeric anthocyanins (cyanidin-3-glucoside). The color of *C. ternatea* anthocyanin extract solution turned red in acidic environment (pH 4.0) and purple at higher pH values (pH 11.0). Temperature and light also affected the anthocyanin content of the *C. ternatea* flowers with the solution stored at 4°C in dark area having the highest total anthocyanin content of 18.33 mg L⁻¹. The solution stored in 50°C yielded the lowest anthocyanin content with 0.09 mg L⁻¹. These results show that *C. ternatea* extract is pH-, light-, and temperature-labile. However, further studies on encapsulation of the pigments should be explored to protect the pigment for food and cosmetic application.

Keywords: anthocyanins, blue ternate flowers, *Clitoria ternatea*

MPS – 08

**ELECTROCHEMICAL CHARACTERIZATION
OF 1-METHYLIMIDAZOLIUM ACETATE
AND ITS EFFECT ON THE PROPERTIES
OF ELECTROSPUN POLY(VINYL ALCOHOL) FIBERS**

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Ionic liquids (IL) are a special class of compounds which have been explored in a variety of applications ranging from green solvents to materials for energy storage devices. Their utility stems from their amenability to facile functionalization that is tailored for a specific function. In recent years, ILs have been studied for their potential as electrolyte for batteries and supercapacitors. This is due to their wide potential window, thermal stability, low vapor pressure, and high conductivity. In this study, we report the synthesis and electrochemical characterization of 1-methylimidazole acetate (MIMOAc) and its effect on the structure of electrospun poly(vinyl alcohol) (PVA) fibers, a commonly studied separator membrane for supercapacitors. MIMOAc was synthesized by sonicating a 1:1 mixture of 1-methylimidazole and glacial acetic acid. After purification, the IL was subjected to cyclic voltammetry analysis to identify its electrochemical properties at a scan rate of 100 mV s⁻¹ at different voltage ranges. Furthermore, the IL was used as dopant for the electrospinning of 7.5% PVA solution at 15 kV. Results showed that MIMOAc did not exhibit significant oxidation or reduction at a voltage range of -4V to + 4V, hence making it an excellent candidate as electrolyte for batteries and supercapacitors. In addition, SEM and AFM characterization of the MIMOAc-doped PVA revealed that the fibers produced are thinner than that of the pristine PVA, thus allowing more surface area for ion mobility.

Keywords: ionic liquid, fiber, electrospinning, poly(vinyl alcohol)

MPS – 09

**ELECTROCHEMICAL DETECTION
OF HYDROGEN PEROXIDE USING COPPER OXIDE (CuO)
NANOPARTICLES MODIFIED MULTIWALLED
CARBON NANOTUBE PASTE ELECTRODE**

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Hydrogen peroxide (H_2O_2), a strong oxidant, is used widely as oxidant, disinfectant, and bleaching agent. Determination of H_2O_2 in different industries, such as pulp and paper industry, is important both in quality control and from an economic perspective. An electrochemical sensor for H_2O_2 was fabricated in this study. The sensor consisted of copper oxide (CuO) nanoparticles electrodeposited on anodized multiwalled carbon nanotube paste electrode (ACPE). Chronoamperometry was used as the electrodeposition technique both for Cu deposition and for oxidizing the Cu to CuO. The CuO layer was found to react with H_2O_2 which leads to discernable voltammetric response towards H_2O_2 . Different parameters were optimized including Cu deposition time, Cu oxidation time, and equilibration time of electrode with H_2O_2 solution. Differential pulse voltammetry was used as the sensing technique for CuO/ACPE. A linear relationship was found between H_2O_2 concentration and peak current (I_p) between 40 μM to 1,200 μM with sensitivity of $0.0181 \pm 0.0003 \mu A \mu M^{-1}$. The limit of detection (LOD) was calculated to be 11.69 μM . The fabricated sensor has a potential to be used as electrochemical sensor for H_2O_2 in bleaching effluents in pulp and paper industry.

Keywords: copper oxide, hydrogen peroxide, multiwalled carbon nanotube, carbon paste electrode

MPS – 10

ELECTROSPUN POLY(1-HEXYL-3-VINYLMIDAZOLIUM BROMIDE)/POLY(VINYLENEDIFLUORIDE) NANOFIBERS AS SUPERCAPACITOR SEPARATOR MEMBRANE

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Energy storage devices, such as supercapacitors, play a vital role in creating sustainable energy systems to attain the world's daily reliable electricity supply. Studies on ionic liquids as liquid electrolyte for supercapacitors and batteries have been done. However, there have been no studies on the use of polymerized ionic liquids as solid electrolyte for such devices. In this work, a poly(ionic liquid)-poly(vinylidene fluoride), (PIL-PVDF), nanofiber composite was produced through electrospinning. The PIL of interest, poly(1-hexyl-3-vinylimidazolium bromide), was synthesized through sonochemical solventless reaction followed by free radical polymerization. Characterization of the synthesized ionic liquid monomer and polymer was done through FT-IR, $^1\text{H-NMR}$, and $^{13}\text{C-NMR}$ spectroscopy. The conductivity and hydrophobicity of the electrospun nanofibers were also determined through water contact angle (WCA) measurement and linear and cyclic voltammetry. A supercapacitor prototype containing the synthesized nanofiber composite as the separator membrane was fabricated. The electrospun PIL-PVDF nanofibers exhibited hydrophobicity, which may be attributed to the inherent hydrophobic nature of both polymers. Fiber diameters ranging from 120 nm to 180 nm were acquired through atomic force microscopy.

Keywords: ionic liquids, polymers, nanofibers, supercapacitors, electrolyte

MPS – 11

ETHANOL VAPOR SENSING WITH THERMALLY REDUCED GRAPHENE OXIDE FOR POTENTIAL APPLICATION IN BREATH ALCOHOL DETECTION

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The monitoring of ethanol in breath is important in the prevention of accidents due to drunk driving. A sensor based on a thermally reduced graphene oxide (rGO) layer deposited on gold interdigitated electrodes was explored for sensing ethanol vapor. GO was deposited in an interdigitated electrode using the Langmuir-Blodgett method and was thermally reduced to rGO. The electrical resistance of the rGO layer was responsive to the presence of ethanol. This response was found to be dependent on the concentration of ethanol. Parameters such as flow rate and volume of the sensing chamber also influenced the sensor response. The sensor could detect ethanol vapor concentration ranging from 53.5 ppm to 178.5 ppm with a sensitivity determined to be $1.49 \times 10^{-4} (\Delta R/R) \text{ ppm}^{-1}$ and a linearity of 0.977. This concentration range corresponds to the allowable levels of ethanol in breath. Concentrations higher than this range indicate intoxication and can be used as a ground for imprisonment. The sensor demonstrates a simple and straightforward detection of ethanol using reduced graphene oxide which exhibit good potential for application in alcohol breath monitoring system.

Keywords: reduced graphene oxide, gas sensor, ethanol, chemiresistor, interdigitated electrodes

MPS – 12

FABRICATION OF MIP-BASED ELECTRODE FOR THE POTENTIOMETRIC DETERMINATION OF CHLORAMPHENICOL AND METHOD VALIDATION

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Chloramphenicol (CAP) is an antibiotic used in both human and veterinary medicine, which may induce aplastic anemia and bone marrow suppression in humans. Due to its toxicity, the use of CAP in food-producing animals had been banned in many countries. In this study, a molecularly imprinted polymer (MIP)-based electrode was fabricated for the detection of trace amounts of CAP. Commercially available MIP-CAP was characterized via Fourier-Transform infrared spectroscopy and spectrophotometric binding studies. The MIP had a maximum binding capacity of 10.1 ± 0.6 mg CAP gram^{-1} MIP with an imprinting factor of 2.25. The MIP was highly selective to CAP and was verified via binding studies with structural analogs of CAP, salbutamol (SAL), and clenbuterol (CLB). The maximum binding capacity of the MIP towards SAL and CLB were 1.5 ± 0.4 mg SAL and 5.5 ± 0.4 mg CLB gram^{-1} MIP. The membrane was prepared in a poly(vinyl chloride) (PVC) matrix consisting of the MIP-CAP, sodium tetrakis[3,5-bis(trifluoromethyl)phenyl]borate (NaTFPB), and 2-nitrophenyl octyl ether (NPOE). The fabricated electrode was connected to a digital multimeter to determine the amount of CAP in sample solutions. The concentration determined by the modified electrode was close to that determined using high-performance liquid chromatography (HPLC).

Keywords: chloramphenicol, molecularly imprinted polymer, poly(vinyl) chloride, high-performance liquid chromatography

MPS – 13

INTRODUCTION OF THE HYPOCHOLESTEROLEMIC PEPTIDE, LPYPR, TO THE MAJOR STORAGE PROTEIN OF MUNG BEAN [*Vigna radiata* (L.) Wilczek] THROUGH SITE-DIRECTED MUTAGENESIS

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The LPYPR peptide was successfully introduced into three different variable regions (VR-1, VR-2, VR-5) of 8S α globulin of mung bean. Mutated protein (MP) had 96.69% structural homology to that of the wild type (WT) protein. Protein expression was carried out in *E. coli* HMS174(DE3) with 40.66% expression for MP, which is 144.42% higher compared to that of WT. WT and MP had molecular weights of about 48.4 and 48.7 kDa, respectively. These samples were purified using HIC and hydrolyzed at different digestion times using trypsin as the digestive enzyme. UPLC analysis of the tryptic digests of MP showed successful release of the LPYPR. MP had increasing trends of cholesterol-binding capacity (mg g⁻¹ sample) with the 24-hour digests showing the highest % bound cholesterol of 380.76 \pm 6.61% and 434.44 \pm 10.88% for crude and purified MP, respectively. The sodium taurocholate binding capacity was also found to have increasing trend for the tryptic digests of MP with the 24-hour digests also showing the highest % bound sodium taurocholate of 59.75 \pm 0.30% and 61.95 \pm 0.51% for crude and purified MP, respectively.

Keywords: mung bean, 8S α globulin, site-directed mutagenesis, cholesterol-binding capacity, sodium taurocholate binding capacity

MPS – 14

INVENTORY OF ATMOSPHERIC POLLUTANTS IN THE PHILIPPINES FROM 1970 TO 2010

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A long-term emission inventory of selected air pollutants in the Philippines was accomplished to aid in air pollution studies. From the Emission Database for Global Atmospheric Research (EDGAR version 4.3.1 and 4.3.2), the sources of several gaseous (SO₂, NO_x, and CO) and particulate (PM_{2.5} and OC) air pollutants and a major greenhouse gas (CO₂) in the Philippines from 1970 to 2010 were determined. Plots of regional concentrations for each pollutant in the Philippines were generated and the time series of atmospheric pollutant emissions in the country for the same period were analyzed. From the results, the highest emissions of CO₂ in the 40-year period were from stationary sources (building or facility emitting any air pollutant, e.g., manufacturing, chemical plants), with a total of 1.2 million tons; the lowest were from area sources (relatively large areas of specific activities generating significant amounts of air pollutants, e.g., open burning, agricultural activities) at only 209,000 tons. Highest SO₂ emissions were also from stationary sources, amounting to 14,000 tons. Majority of CO, PM_{2.5}, and OC emissions were from area sources while NO_x emission was primarily from mobile sources (combustion of carbon-based or other fuel in vehicles). Among the regions in the Philippines, Metro Manila is the leading contributor to the emission of all six studied atmospheric pollutants. Generally, emissions from stationary and area sources have increased over the 40-year period, however, emissions from mobile sources abruptly increased in the early 1990s and significantly decreased in early 2000s.

Keywords: air pollutants, inventory, emission, sources, time series

MPS – 15

**ION-EXCHANGED PHILIPPINE BENTONITES:
PREPARATION, CHARACTERIZATION,
AND PHENOL ADSORPTION PROPERTY****Camille Mendoza¹, Mel Bryan L. Espenilla¹, Xandr Uboan², Carlo A. Arcilla²
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Modified Philippine bentonites were prepared by ion-exchange with sodium chloride, a surfactant cetyltrimethylammonium bromide (CTAB), a pillaring agent (aluminum hydroxy polycation), and a hybrid inorganic-organic bentonite derived from a combination of CTAB and the metal polycation. The presence of intercalated modifiers and structural variations on the modified clay materials were monitored by spectroscopic techniques. Thermal analysis and in-situ high temperature XRD investigation of Philippine bentonites provided initial data on the structure-adsorption property. Adsorption properties in the removal of organic pollutants, such as phenol, from aqueous solutions were assessed through batch adsorption tests. The modified bentonites were all shown to have enhanced physical and chemical properties compared to the native bentonite. The results showed that the Philippines bentonites modified with CTAB and the CTAB/Al-combination were the most efficient towards sorption of phenol compared to the other bentonite materials. As the sorbent concentration increased, the removal percentages of phenol were shown to be increasing for the two organo-modified Philippine bentonites. Also, XRD results showed that the increased interlayer spacing of the bentonites modified with CTAB is one of the factors for high uptake of phenol. The results of the study showed that the enhancement of the physicochemical properties of bentonite makes them attractive alternative adsorbents of organic pollutants for wastewater treatment.

Keywords: Philippine bentonite, ion-exchange, phenol adsorption

MPS – 16

MASS BALANCE APPROACH FOR PURITY ASSESSMENT OF ORGANIC MATERIALS: HISTAMINE DIHYDROCHLORIDE CASE STUDY

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The traceability of chemical measurement results to the International System (SI) of units is the most important key for the achievement of compatibility and reliability in chemical measurements and this has been a great concern not only in the chemical metrology communities but also in the routine laboratories. Traceability can be ensured by calibration or verification of measurement results against proper certified reference materials (CRMs), which are traceable to SI, reported with a credible statement of measurement uncertainty, and are provided by authorized bodies (usually National Metrology Institutes or NMIs), or accredited CRM producers that link traceability to NMI's standards. In the Philippines, the Metrology in Chemistry (MiC) Project at the Industrial Technology Development Institute, Department of Science and Technology (ITDI-DOST) is establishing the capability for purity assessment of organic compounds to support the CRM needs of local laboratories. In this study, purity assessment of histamine dihydrochloride was conducted using mass balance approach. This is one of the most critical steps to link traceability of chemical measurements to SI units. The organic impurities (0.002%) were evaluated using high performance liquid chromatography with fluorescence detector (HPLC-FLD). Water content was determined to be 0.23% using Karl-Fischer (KF) coulometer with oven transfer. Volatile (0.25%) and non-volatile matter (3.6%) were detected by thermogravimetric analysis (TGA). The purity of histamine dihydrochloride pure substance was initially assigned to be 96.18% with measurement uncertainty of 3.62%.

Keywords: purity assessment, histamine dihydrochloride, reference material, traceability, Karl-Fischer coulometry

MPS – 17

ORAL DRUG DELIVERY SYSTEMS FROM HYPERBRANCHED METHACRYLIC ACID AND POLY(ETHYLENE GLYCOL) COPOLYMER NANOCARRIERS

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The most preferred method of drug delivery is oral administration of pharmaceuticals because it is economical, convenient, and non-intrusive. However, a drug compound may be susceptible to degradation or precipitation along the upper gastrointestinal tract before it can be absorbed in the small intestine. To this end, pH- and thermo-responsive hyperbranched copolymers poly(methacrylic acid-co-ethylene glycol dimethacrylate)-b-poly(di(ethylene glycol) methyl ether methacrylate) and poly(methacrylic acid-co-ethylene glycol dimethacrylate)-b-poly(poly(ethylene glycol) methyl ether methacrylate) were synthesized by RAFT polymerization. The hyperbranched copolymers were produced with high molecular weights and low polydispersity. The copolymers underwent phase transitions at pH 5.7 and temperatures above 30°C, allowing them to behave differently under specific environments. Encapsulation of ibuprofen as a model drug produced drug carriers with a loading capacity of up to 14.47% and encapsulation of up to 72.35%. In *in vitro* drug release studies in simulated stomach pH conditions, protonation of the MAA core of the drug carriers increased its hydrophobicity. There, drug release was inhibited to release as low as 27% of the encapsulated drug within 5 hours. At simulated intestinal pH however, the MAA core was ionized. Dissolution of the MAA core facilitated a burst drug release wherein up to 85% of the encapsulated drug was released within 5 hours. The results of the study showed that the stimuli-responsiveness of the copolymers served as a switch to encapsulate or release a drug depending on the external environment. This property gives the copolymers potential as oral drug delivery agents.

Keywords: RAFT, hyperbranched, polymer, drug, delivery

MPS – 18

RESISTANT STARCH CONTENT AND IN VITRO STARCH HYDROLYSIS INDEX OF SELECTED PHILIPPINE RICES WITH VARYING APPARENT AMYLOSE CONTENT

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Resistant starch content (RS) and in vitro starch hydrolysis index (HI) were determined in four Philippine rice varieties differing in apparent amylose content (AC). Starch digestibility pattern and kinetics were also studied in relation to AC and reported glycemic index (GI) of the rices used. Brown and milled rice samples of Improved *Malagkit Sungsong 2* (waxy with 1.7% AC), NSIC Rc160 (low-AC with 13.3% AC), IR64 (intermediate-AC with 17.6% AC), and PSB Rc10 (high AC with 24.0% AC), were cooked via beaker-double boiler method using pre-determined water-rice ratio related to AC. This resulted in similar cooked rice hardness values for all samples as verified by Instron 3343 texture analyzer, prior to starch hydrolysis experiments. RS of cooked milled rices ranged from 0.15% to 0.99% with the highest RS noted for the high-AC variety PSB Rc10. Their corresponding brown rices had RS ranging from 0.24% to 1.61%. In vitro HI were calculated from the ratio of the area under the curve (AUC) of the starch hydrolysis rates of the milled rices relative to the AUC of the reference food, white bread. HI varied from 59.3% to 102.2% with the highest HI noted for waxy rice Improved *Malagkit Sungsong 2*. Significantly lower HI values were recorded for their corresponding brown rice samples spanning 49.2–66.9%. Previously reported GI values of the same set of samples were highly correlated with the HI values obtained in this study.

Keywords: apparent amylose content, brown rice, digestibility, milled rice, in vitro hydrolysis index, starch

MPS – 19

PRODUCTION OF REFERENCE MATERIAL FOR BENZOIC ACID ANALYSIS IN BANANA KETCHUP

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An important tool in the quality assurance of analytical measurement is the use of reference materials. A reference material (RM) for benzoic acid in banana ketchup was developed, produced, and assessed according to ISO Guide 35 using previously validated high performance liquid chromatography with diode array detector (HPLC-PDA) and gravimetric sample preparation technique. Candidate banana ketchup, purchased from a local market, was homogenized, spiked with the desired benzoic acid content, and pasteurized before packaging into individual bottles. Analysis of variance (ANOVA) was used to determine the homogeneity of the analyzed samples ($n=11$) at 95% confidence level. The calculated F , $F_{\text{calc}}=2.09$ is less than the critical F , $F_{\text{crit}}=2.29$. Furthermore, the absence of bottling trend and outliers were confirmed by regression analysis and Cochran's test, respectively. Short-term stability test ($n=20$) showed that transport condition is suitable up to 40°C for 3 weeks. On the other hand, long term stability ($n=12$) over a period of six months at 4°C was achieved. This was tested by regression analysis that showed that the slope is not significantly different from zero at 95% confidence level. The results of statistical evaluation carried out demonstrated that the developed RM is appropriate for accuracy-based proficiency testing schemes and for use by local testing laboratories for method validation and as quality control material in the analysis of benzoic acid in food products.

Keywords: reference material, benzoic acid, banana ketchup

MPS – 20

MECHANOCHEMICAL SYNTHESIS OF UREA-POTASSIUM SODIUM TARTRATE EUTECTIC SYSTEM

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There is now a growing concern on the use of common organic solvents due to their high volatility and toxicity. A green chemistry approach is to substitute these solvents with eutectic systems with low freezing points by combining different components, with preference to substances that are easily decomposed in the environment. In this study, a eutectic system of urea and potassium sodium tartrate was synthesized through a series of steps including grinding, sonication, and heating. A binary solid-liquid phase diagram was constructed from cooling curves of the mixture of varying mole ratios of the components. It was found that the eutectic composition is 2:1 mole urea to potassium sodium tartrate and the eutectic freezing point is 18.3°C.

Keywords: eutectic system, eutectic composition, eutectic freezing point

MPS – 21

**A FAMILY OF CONGRUENT NUMBER ELLIPTIC CURVES
WITH RANK ≥ 2 DERIVED FROM DIFFERENCE
OF BIQUADRATES**

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It is widely known that a positive integer n , which can be written in the form $a^4 - b^4$, for integers a and b , is the area of some right triangle with rational side lengths. Equivalently, the congruent number elliptic curve $E_n: y^2 = x^3 - nx$ has rank of at least 1. This study attempts to increase the bound on the rank by considering positive integers $n = a^4 - b^4 = d^4 - c^4$, which are positive integers that can be written as a difference of two fourth-powers in two distinct ways. To do so, we utilize a result by Euler which provides a parametrization for positive integers of such form to show, via method of two-descent, that the infinite family of congruent number elliptic curves E_n has rank at least 2 over \mathbb{Q} .

Keywords: elliptic curves, congruent numbers, Euler, biquadrates, two-descent

MPS – 22

DEVELOPMENT OF A PATROLLING SCHEME FOR BRGY. TATALON, QUEZON CITY USING VERTEX WEIGHTED GRAPH, GRAPH NOMINATION AND GRAPH PARTITION

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Brgy. Tatalon is located in District 4 of Quezon City. Tatalon is a highly populated area and has both commercial and residential areas. Just like any barangay in the Philippines, the leadership has patrolling personnel known as barangay tanod. As of March 2016, there were only 18 tanods who should patrol the barangay's 21 streets at different times of the day. In this study, a patrolling scheme for the barangay was developed using graph domination, graph partition, and simple statistics. The map of the area was represented by a graph, with streets being the vertices; edges were determined if two streets had an intersection. Instead of giving weights to the edges, weights were assigned to vertices. The weights correspond to the average crime rate per day, which were provided by the local police station covering Brgy. Tatalon. Graph domination is then used to find a dominating set. A procedure was then developed to determine the number of tanods to be assigned to each shift. It was decided that three shifts be used and that an average of 22 barangay tanods must patrol the barangay during every shift.

Keywords: graph, weighted graphs, graph domination, patrolling scheme

MPS – 23

AN ANALYTICAL APPROACH IN SOLVING A SYSTEM OF NONLINEAR DIFFERENCE EQUATIONS

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We consider the system of difference equations given by

$$x_{n+1} = \frac{x_{n-(2k-1)}}{\varepsilon + \delta x_{n-(2k-1)} y_{n-(k-1)}}, \quad y_{n+1} = \frac{y_{n-(2k-1)}}{\rho + \sigma y_{n-(2k-1)} x_{n-(k-1)}},$$

where $\varepsilon, \delta, \rho, \sigma \in \{-1, 1\}$ and $k \in \mathbb{N}$, with the real initial values $\{x_n\}_{n=-(2k-1)}^0$ and $\{y_n\}_{n=-(2k-1)}^0$ such that $\delta x_{m-(k-1)} \neq -\varepsilon$ and $\sigma y_{m-(2k+1)} \neq -\rho$ for all possible values of m and k . Several special cases of the above systems of nonlinear difference equations have been examined by many authors by focusing on their closed-form solutions. In previous works, however, the solution forms were merely established through the principle of mathematical induction. Such methodology can obviously validate the structure of their solutions, but it does not provide much information on how these formulas appear in such structure. To fill this gap, this study presents an analytical approach to derive the closed-form solutions of such cases by completely solving the above general system through appropriate transformations coupled with the method of differences. This, in turn, will provide readers a complete theoretical explanation why the above system is solvable in closed-form and how its solution forms appear in such compact forms.

Keywords: nonlinear difference equation, system of difference equations, closed-form solution

MPS – 24

CONSTRUCTION OF 3-, 4-, 5-, AND 8-CLASS ASSOCIATION SCHEMES FROM THE CORE OF A CONFERENCE MATRIX

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Denote by I , J , and C , the respective identity matrix, all-ones matrix, and the core of a conference matrix, which are all of the same order n . Let $E = J - I$, and let $C' = E - C$, be the complement of C . Form the following Kronecker products of these matrices:

$M_0 = I \times I,$	$M_1 = C \times C,$	$M_2 = C' \times C',$
$M_3 = C \times C',$	$M_4 = C' \times C,$	$M_5 = I \times C,$
$M_6 = C \times I,$	$M_7 = I \times C',$	$M_8 = C' \times I.$

For $i, j, k \in \{0, 1, 2, 3, 4, 5, 6, 7, 8\}$, define the matrices $M_{ij} = M_i + M_j$ and $M_{ijk} = M_i + M_j + M_k$. Then, each of the following eight classes of matrices gives the adjacency matrices of a certain n -class association scheme, specifically, we have for:

1. $n = 8,$
 $A_1 = \{M_0, M_1, M_2, M_3, M_4, M_5, M_6, M_7, M_8\};$
2. $n = 5,$
 $A_2 = \{M_0, M_1, M_2, M_{37}, M_{45}, M_{68}\},$
 $A_3 = \{M_0, M_5, M_7, M_{14}, M_{23}, M_{68}\},$
 $A_4 = \{M_0, M_6, M_8, M_{13}, M_{24}, M_{57}\};$
3. $n = 4,$
 $A_5 = \{M_0, M_5, M_7, M_{136}, M_{248}\},$
 $A_6 = \{M_0, M_6, M_8, M_{145}, M_{237}\};$
4. $n = 3,$
 $A_7 = \{M_0, M_{57}, M_{136}, M_{248}\},$ and
 $A_8 = \{M_0, M_{68}, M_{145}, M_{237}\}.$

Keywords: association scheme, conference matrix, Kronecker product

MPS – 25

**INSTRUCTIONAL PRACTICES OF SECONDARY
MATHEMATICS TEACHERS AND PREDICTORS OF SCHOOL
ACHIEVEMENT ON MATHEMATICS:
A BASIS FOR A TEACHER DEVELOPMENT PROGRAM**

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This study examined the instructional practices of secondary public school teachers of mathematics in Nueva Vizcaya and the achievement of the schools where the respondents were teaching, and conceptualized a Teacher Development Program for the teachers. The study utilized the descriptive-correlation type of research and used several techniques in the gathering of data (i.e., questionnaire, interviews, and review of literature). Results of the study showed that there was a positive correlation ($r=0.239$, with alpha level= 0.008) between the teachers' level of professional development and school achievement; and a positive correlation ($r=0.353$, with alpha level= 0.001) between the level of awareness and practice of recent developments in math education and school achievement in the Division Achievement Test (DAT) and National Career Assessment Exam (NCAE). After finding out that there was a positive correlation between DAT and some of the instructional practices, and a positive correlation between NCAE and some instructional practices, a rundown of instructional practices that were "not much practiced" and "never practiced" was compiled, which served as basis for the Teacher Development Program.

Keywords: instructional practices, teacher development program, mathematics, Division Achievement Test, National Career Assessment Exam

MPS – 26

ON THE ALTERNATING SUMS OF THE RECIPROCAL OF SQUARES OF THE FIBONACCI NUMBERS

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This paper is about establishing interesting identities concerning the Fibonacci numbers. Fibonacci sequence is defined by the linear recurrence relation $F_n = F_{n-1} + F_{n-2}$ for $n \geq 2$, where F_n is the n th Fibonacci number with $F_0 = 0$ and $F_1 = 1$. Recently, mathematicians take an interest in the study of the reciprocals of Fibonacci numbers. Wang et al. (2017) showed that the alternating sums of the reciprocal Fibonacci numbers $\sum_{k=n}^{mn} \frac{(-1)^k}{F_{ak+b}}$ where $a \in \{1,2,3\}$ and $b < a$. In this paper we establish a closed-form solution of the alternating sums of the squares of reciprocal Fibonacci number $\sum_{k=n}^{mn} \frac{(-1)^k}{F_k^2}$ where $m \geq 2$ and $n \geq 3$.

Keywords: Fibonacci numbers, alternating sums

MPS - 27

ON THE EXPONENTIAL DIOPHANTINE EQUATION

$$3^X + b^Y = (b + 1)^Z$$

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The solutions of exponential Diophantine equations of type $a^X + b^Y = c^Z$ (Equation 1) have been studied for many different variations of a , b , and c . Particularly, Jesmanowicz investigated it when (a, b, c) are Pythagorean numbers, and he conjectured that if a , b , and c satisfies $a^2 + b^2 = c^2$, then (Equation 1) has only the positive integer solution $(X, Y, Z) = (2, 2, 2)$. As an analogue of Jesmanowicz's conjecture, Terai proposed that if $a, b, c, p, q, r \geq 2$ are fixed positive integers satisfying $a^p + b^q = c^r$, with $\gcd(a, b) = 1$, then (Equation 1) has only the positive integer solution $(X, Y, Z) = (p, q, r)$ except for a handful of triples (a, b, c) . Many special cases have been proven but the problem is still unsolved. The main goal of this paper is to study the exponential Diophantine equation (Equation 1) when $a = 3$ and $c = b + 1$. We completely determined its solution in the set of positive integers when b is odd. We also present results when b is even. As a result, we confirm some special cases of Terai's conjecture and of the Jesmanowicz conjecture.

Keywords: exponential Diophantine equation, complete solutions, Terai's conjecture, Jesmanowicz's conjecture

MPS – 28

PERFORMANCE EVALUATION OF SOME PHILIPPINE FOOD TESTING LABORATORIES THROUGH PROFICIENCY TESTING SCHEME ON PROCESSED MEAT

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Proficiency testing (PT) is an effective tool for the determination of participants' performance through interlaboratory comparison and demonstration of the validity of the analytical results for global acceptability. The Food and Nutrition Research Institute, being the only ISO/IEC 17043:2010-accredited food PT provider in the Philippines, provides assistance to local testing laboratories in generating quality and reliable data through organization of PT schemes. A PT scheme on proximates (moisture, fat, protein, ash); minerals (calcium, sodium, potassium); saturated fatty acids; and cholesterol in a "sufficiently" homogenous and stable processed meat proficiency test item was provided to 28 registered government and private local testing laboratories. The assigned values (x_{pt}) were derived as consensus of PT participants' results, calculated as the robust average (x^*) from algorithm A or median ($med(x)$) of the participants' results considering the number of data, based on ISO 13528:2015. PT participants' performance were evaluated based on z or z' -scores depending on the suitability of the consensus value. The x_{pt} (per 100 g) and the percentage of laboratories with "satisfactory" performance (i.e., $|z/z'$ -score $|\leq 2.0$) were: moisture at 72.96 g (88%); fat at 5.20 g (80%); protein at 9.83 g (78%); ash at 4.37 g (82%); calcium at 13 mg (47%); sodium at 1,343 mg (81%); potassium at 262 mg (80%); saturated fatty acids at 2.18 g (50%); and cholesterol at 24 mg (83%). Participants that obtained "warning" and "action" signals were encouraged to conduct self-investigation and perform preventive and/or corrective actions to prevent recurrence of the problem and improve their performance.

Keywords: proficiency testing, interlaboratory comparison, assigned value, proximates

MPS – 29

THE WHITE NOISE PATH INTEGRATION APPROACH TO THE INVERTED OSCILLATOR WITH CONSTANT FRICTION

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In this study, the propagator of the inverted oscillator with constant friction as described by its Lagrangian of the form,

$$L = \left(\frac{1}{2} m \dot{x}^2 + \frac{1}{2} m v^2 x^2 \right) \exp(\gamma t),$$

with mass m , angular frequency v , and damping coefficient γ , was solved using the mathematically well-defined approach to the Feynman path integral, the white noise analysis by Hida and Streit. This method is a novel approach to infinite dimensional analysis and has the basic idea of taking the collection of many infinitely random variables and treating them as the coordinate system of an infinite dimensional space. The process starts by parametrizing the path in terms of Brownian motion, then taking its correspondence and lastly, fixing the endpoint. Then, the T-transform of the obtained white noise functional was used to evaluate the path integral resulting in the propagator of the inverted oscillator with constant friction written as,

$$K(x, t|0,0) = \sqrt{\frac{m v_\gamma}{2\pi i \hbar \sinh(v_\gamma t)}} \exp \left[\frac{i m v \cosh(v_\gamma t + \varphi)}{2 \hbar \sinh(v_\gamma t)} x^2 + \frac{\gamma t}{4} \right]$$

where $v_\gamma = \sqrt{v^2 + \frac{\gamma^2}{4}}$ and $\varphi = \tanh^{-1} \left(\frac{\gamma}{2v_\gamma} \right)$. In conclusion, white noise analysis can be an effective tool in solving propagator of certain systems.

Keywords: inverted oscillator, propagator, white noise analysis, Feynman path integral

MPS – 30

DATA MINING USING CLUSTERING TECHNIQUE AS A BASIS IN DEVELOPING A GAMIFIED LEARNING SYSTEM

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Gamification, or the integration of game rudiments into a non-gaming environment, is becoming popular in education as a way to promote engagement and motivation in the learning environment. However, if gamified learning systems are to be used in schools, developers should have a good understanding of target users. This study applied data mining using clustering technique for knowledge extraction from the results of the National Career Assessment Examination (NCAE) in the Division of Quirino. The NCAE is an examination given to all Grade 9 students in the Philippines to assess their aptitudes in the different domains. Clustering the students is helpful in conceptualizing and developing a gamified learning system. With the use of the RapidMiner tool, clustering algorithms such as density-based spatial clustering of applications with noise (DBSCAN), k-means, k-medoid, expectation maximization clustering, and support vector clustering algorithms were analyzed. The silhouette indexes of the said clustering algorithms were compared and the result showed that the k-means algorithm with $k=3$ and silhouette index equal to 0.196 is the most appropriate clustering algorithm to group the students. Three groups were formed with 477 students in the determined group (cluster 0), 310 proficient students (cluster 1), and 396 developing students (cluster 2). The data mining technique used in this study is essential in extracting useful information.

Keywords: data mining, clustering technique, gamified learning system

MPS – 31

ABOVEGROUND BIOMASS DENSITY OF CAPISAAN LANDSCAPE ESTIMATED USING LANDSAT 8 DATA

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The study employed remote sensing data and field measurement in estimating the aboveground biomass (AGB) of the Capisaan landscape in Kasibu, Nueva Vizcaya, which features many different land uses and land cover types. Its land cover is predominantly dipterocarp forest and karst forest interspersed with citrus orchards and patches of vegetable gardens. AGB densities were estimated using regression models whose independent variables consist of Landsat 8 bands, vegetation indices, and band ratios. Two sets of Landsat 8 data were used because of cloud contamination; hence, two sets of models were derived. The best two models, based on RMSE, have either Band 1 and Band 6 or Band 1 and Band 3 as predictors. The landscape contains around 285,140 tons of aboveground biomass translating to 200 tons ha⁻¹. The bulk of this total AGB is found in dipterocarp forest, as expected. The large proportion of low-biomass land uses and land cover types such as citrus orchard, cultivated area, betel pepper gardens, and grassland, pulled down the average AGB density of the entire landscape relative to that of the dipterocarp and limestone or karst forests. Tree crown closure is significantly correlated to most of the Landsat 8 bands, vegetation indices, and band ratios, implying that Landsat 8 can be used to estimate the tree crown closure of varying land cover types. On the other hand, percent ground cover is significantly correlated to a smaller number of spectral variables.

Keywords: above ground biomass, AGB density, Landsat 8

MPS – 32

BIOSYNTHESIS OF SILVER NANOPARTICLES (AGNP'S) USING STARCH ISOLATED FROM *Nypa fruticans* (NIPA) SEEDS

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In persistence of synthesizing silver nanoparticles by “green method”, here arises another biosynthesis of AgNPs that is a more efficient and economical alternative for large-scale resolves. Starch isolated from *Nypa fruticans* seeds collected from Catarman, Northern Samar ministered the synthesis of AgNPs as both a reducing and capping agent in this study. Prior to the synthesis proper, the nipa starch underwent a series of tests for its properties and the following results were obtained: an average % yield of 0.35%, foam capacity of 7.25%, emulsion capacity of 38.89%, gelatinization temperature at 84.33⁰C, water holding capacity of 0.92 mL bound by 0.5 g starch, an increasing swelling power in increasing temperature, pH of 5.06, and browning and charring temperatures at 193.33°C and 266.67°C, respectively. The tests on the data were conducted in triplicate and the average values were obtained. All the parameters were comparable with the commercial corn starch, which proves the successful isolation of starch from *N. fruticans*. Thereafter, the synthesis of AgNPs through reduction method was done in a 30-minute reaction period and the synthesized AgNPs were further characterized through ultraviolet-visible spectroscopy and scanning electron microscopy (SEM). This study shows a new way of synthesizing AgNPs which can further be applied to various applications and more importantly a potential breakthrough for the field of nanotechnology.

Keywords: starch, *Nypa fruticans*, silver nanoparticles, SEM

MPS – 33

CHARACTERIZATION OF PHILIPPINE TEKTITES USING X-RAY METHODOLOGIES

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The elemental composition and other characteristics of tektites reveal information about these glassy objects which are often found in strewnfields across the Earth's surface. In this study wavelength dispersive x-ray fluorescence spectrometry (WD-XRF), in conjunction with physico-chemical parameters, was used to characterize tektite samples collected in the Philippines. Bulk analyses showed major element composition (Ca, Al, Si, Fe, Mn), which can be deemed to be part of the natural crustal soil matrix. The accessions were calcareous and siliceous and some were anomalies observed in the major composition of a few samples. Statistical analyses further revealed groupings of samples and the data strongly suggest the possible presence of ejecta rays in the Philippines, having two major groups with two ungrouped samples and three present rays. The mass percentage differences in elemental composition can be due to different distances of the tektites from their source crater. The variation in the contents of CaO also indicates that there are different amounts of limestone that were involved during the formation. Scanning electron microscopy was used to produce photomicrographs of glass spherules which can give indication of the strewnfield origin of the tektites.

Keywords: tektites, wavelength dispersive x-ray fluorescence spectrometry, scanning electron microscopy

MPS – 34

EGGPLANT DYE-COMPLEXED TITANIUM DIOXIDE THIN FILM AS A COLORIMETRIC pH GAS SENSOR

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This paper reports the development of a colorimetric sensor for the detection of ammonia. The sensor consists of titanium dioxide thin film sensitized by eggplant dye as the sensing layer. Anthocyanin, from eggplant (*Solanum melongena* L.) dye, was extracted by absolute ethanol. Pigment-sensitized TiO₂ gas sensor was successfully prepared by immersing the glass solidified TiO₂ thin films in anthocyanin-alcohol solution for 48 hours in the dark. To test the sensors' response to ammonia (NH₃) vapor, the resulting film was fastened onto an enclosed beaker containing concentrated NH₃ for 15 mins. The color of the film changed from greenish to yellowish color after exposure to ammonia vapor. From the transmittance spectra, the initial film showed maximum transmittance of 0.025 at around 630 nm while the exposed film showed maximum transmittance 0.07 at around 610 nm. Furthermore, a substantial change in the transmittance spectra of the dye before and after containing a drop of ammonia was observed. The developed colorimetric sensor presented good sensitivity, thus, it can be a low cost and easy-to-use alternative ammonia detector.

Keywords: titanium dioxide, anthocyanin, colorimetric, ammonia, transmittance

MPS – 35

RAW VEGAN DRIED SABA BANANA (*Musa sapientum* Linn. var. *Compressa*) USING THE AUTOMATED MULTI-COMMODITY HEAT PUMP DRYER (AMCHPD)

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Musa sapientum Linn. var. *Compressa* is a banana variety unique to the Philippines and is abundant year-round. Aside from being eaten raw, it can also be consumed boiled or prepared as banana cue, banana chips, and many others. This study determined the drying characteristics of the commodity using AMCHPD. It also identified the drying cycle (% moisture content, drying time, and weight loss) when subjected to a drying temperature of 500°C and 10.0% relative humidity. Fresh bananas (100 kg) were bought, peeled, and sliced uniformly and immediately loaded to the AMCHPD without the addition of any form of chemical (e.g., salt or sugar). Drying temperature and relative humidity was set at constant, while drying time and weight loss were monitored precisely using Raspberry pi and a Python-based program. Data were recorded every five seconds. Results revealed that bananas were dried for 12 hours at 15.0% moisture content with weight loss per hour of 0.046 kg hr⁻¹. Moreover, the dried bananas retained color appropriate for secondary processing and can also be eaten as dried, and nutritious snacks.

Keywords: automated multi-commodity heat pump dryer, Saba banana nutritional value, drying cycle

MPS – 36

SPACE AND TIME TRANSFORMATION FACTOR

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Lorentz formulated a transformation due to the invariance of Maxwell's equation when transformed from the aether to a moving frame.

$$t' = \gamma \left(t - \frac{vx}{c^2} \right)$$

$$x' = \gamma (x - vt)$$

Lorentz did not fully understand the equation and Einstein interpreted it as time dilation and length contraction. However, Einstein always assumed that in time dilation, x is always equal to zero in the time transformation. If the value of x in time transformation is not zero, it is difficult to say that time and space have the same factor and the time transformation is dependent on the position in space. So, the time transformation becomes relative to the position which is not the case because time dilation is dependent only in a moving frame. This study aimed to find a transformation factor without assuming x is equal to zero. In this way, we can find another perspective in understanding the transformation of space and time. We derived the transformation factor when we assumed that $x = ct$. It is the length traveled by light at time t . In the result, the Lorentz transformation become simpler.

$$t' = t \sqrt{\frac{c-v}{c+v}} \rightarrow t' = t e^{\tanh^{-1} v/c}$$

$$x' = x \sqrt{\frac{c-v}{c+v}} \rightarrow x' = x e^{\tanh^{-1} v/c}$$

The factor that we derived is the inverse of the relativistic doppler effect factor, which is more general than the Lorentz factor.

Keywords: Lorentz transformation, Lorentz factor

MPS - 37

SYNTHESIS AND CHARACTERIZATION OF Mg DOPED ZnO MICRO RODS CAPPED WITH PVP POLYMER DEPOSITED ON COVERSLIP SUBSTRATE VIA HYDROTHERMAL METHOD

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This study successfully deposited ZnO microrods doped with different magnesium (Mg) concentrations on coverslip substrate via hydrothermal method. The influence of the different Mg concentrations and capping polymer polyvinylpyrrolidone (PVP) on the microrods' morphology and crystal structure was determined using scanning electron microscope (SEM) and x-ray diffraction (XRD) analysis, respectively. Mg-doped ZnO capped and uncapped samples of different ratios (8:0, 8:2, 8:4, 8:6, and 8:8) were also characterized using UV-Vis spectrophotometer to obtain optical band gap through Tauc plot method. SEM images revealed that increasing the Mg content increases the length of microrods while capping with PVP smoothens the surface of the microrods thus passivating the defects. XRD revealed that there is no observed related peak for Mg, which indicates that the observed peaks have almost no difference with that of the bare ZnO illustrating that the radii of Mg^{2+} and Zn^{2+} are very close. XRD also shows that PVP have an effect on the crystallinity of Mg-doped ZnO by decreasing the value of full width at half maximum (FWHM) and increasing the value of lattice parameters a and c . The UV-Vis spectra show that there is a blue shift with increasing Mg concentrations. It was found that Mg-doped ZnO has a wider bandwidth with increasing Mg content while decreasing its optical band gap when capped with PVP.

Keywords: zinc oxide, Mg doping, microrods, Hydrothermal method

MPS - 38

WIND RESOURCE ASSESSMENT USING WEATHER RESEARCH FORECASTING MODEL

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To aid the campaign to move from a coal-dependent country toward green energy, this study utilized weather research forecasting (WRF) modeling and geographic information system (GIS) to assess the wind resource potential of the province of Ilocos Norte. The province has three operational wind energy development projects in the municipalities of Burgos, Bangui, and Pagudpud. Data were obtained from the National Center for Atmospheric Research's Research Data Archive (NCAR-RDA). FNL weather data for the year 2008, 2010, 2014, 2015, and 2016 were downloaded and processed using WRF modeling. WRF output files were further processed and extracted using the WRF Extraction (v.4) software developed by UP Diliman's Phil-LiDAR 2 REMap team. Extracted numerical data were subjected to GIS processing to map the wind speed and wind density of Ilocos Norte at 80 m and 100 m on a 5-year annual average. Wind speed results were validated. Results of the study showed that the municipalities of Burgos, Pagudpud, Bangui, Dumalneg, Vintar, Carasi, and Nueva Era have wind speeds greater than 8 m s^{-1} at a height of 80 m and 100 m from the ground. Portions of these municipalities have average wind speeds greater than 9.5 m s^{-1} . The municipalities of Pasuquin, Burgos, Bangui, Pagudpud, Dumalneg, Adams, Vintar, Piddig, Carasi, Solsona, and Nueva Era have 5-year annual average wind power density greater than 800 W m^{-2} at 80 m and 100 m. Results show that the Ilocos Norte is a rich wind resource and has potential for other wind energy development projects.

Keywords: wind resource assessment, wind-energy, weather research forecasting model, geographic information system

SOCIAL SCIENCES

SS – 01

PRE-DEPLOYMENT-RELATED STRESS AND VICARIOUS TRAUMA AMONG MILITARY RELIEF AND DISASTER RESCUERS

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The role of military volunteers in disaster response operations is immense, but oftentimes neglected. Several studies have examined the impact of disasters, mainly focused on clinical outcomes of victims or survivors, such as post-traumatic stress disorder (PTSD). However, psychological risks of deployment exposure of military rescuers have been given little attention. This study examined the relationship of military relief and disaster rescuers' pre-deployment-related stress to their vicarious trauma. A total of 178 military rescuers from various brigades assigned to a selected military camp were chosen. These respondents completed the Pre-deployment Related Stress Questionnaire (PRSQ), and Traumatic Stress Institute Belief Scale (TSI-BS) to measure their pre-deployment related stress and vicarious trauma, respectively. Results indicate a significant positive relationship between the military rescuers' pre-deployment related stress and their experience of vicarious trauma. Specifically, the more the respondents' experience behavioral, emotional, and work stress, the more likely they experienced vicarious trauma. Implications on the findings of this study enhance understanding of the nature of vicarious trauma and its impacts on our military rescuers and offer suggestions on how to improve their psychological well-being, which is essential in performing their functions as the nation's first responders in disaster and relief operations.

Keywords: pre-deployment related stress, vicarious trauma, military relief and disaster rescuers

SS – 02

**ACADEMIC PERFORMANCE, BENEFITS DERIVED,
AND PROBLEMS ENCOUNTERED BY RECIPIENTS
OF PROJECT E.A.S.E. (EFFECTIVE ALTERNATIVE
SECONDARY EDUCATION)**

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With its large population, Solano High School is vulnerable to having a high drop out and low completion rates. To address this problem, Project EASE (Effective Alternative Secondary Education) was implemented to cater to the needs of students at risk of dropping out (SARDO). Most students in this category belong to the marginalized sector of society with incomes ranging from PHP 5,000 to PHP 10,000 monthly. This study was conducted during school year 2015–2016 with 51 respondents. A validated researcher-designed questionnaire was used to gather pertinent data. Frequencies and percentages were used in presenting the data; mean and standard deviation were used to describe both extent of benefits derived and problems encountered by the recipients. Simple correlation analyses were used to test the relationship between variables while categorical regression analysis was utilized in determining the relationship of profile variables. The level of academic performance of the recipients of Project EASE decreased from “approaching proficiency” in school year 2013–2014 to “developing” in the succeeding school year. The recipients greatly benefitted from Project EASE socially, educationally, and personally/financially. Also, it was found that recipients encountered great personal, mental, and educational problems and moderate social problems while enrolled in Project EASE. Project EASE recipients whose mothers have higher educational attainment derived higher personal/financial benefits from Project EASE while sex was found to be a strong predictor of the extent of benefits derived by the recipients. The profile variables did not correlate with the problems they encountered while enrolled in the program and none of the profile variables is a predictor of the extent of problems encountered by the recipients of Project EASE.

Keywords: Project EASE, students at risk, drop out, intervention

SS – 03

ADOPT-AN-ESTERO PROGRAM: THE MISAMIS UNIVERSITY EXPERIENCE

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Ecological Strengthening through Environmental Rehabilitation and re-Orientation (ESTERO) Program is an initiative developed by the Misamis University Community Extension Program (MUCEP) in response to the Adopt-an-Estero program of the Department of Environment and Natural Resources (DENR) in partnership with the local government unit of Ozamiz City. ESTERO aimed to come up with a comprehensive action toward the promotion and maintenance of cleanliness and preservation of the Carangan Creek for a better and healthier local environment. The program had three main components: research and information, education, and communication (IEC) materials development; regular clean-up; and community mobilization. Research studies found that the water quality of Carangan Creek has been deteriorating downstream due to the relatively high discharge of organic wastes associated with a dense population. The responsibility of waste disposal was tasked to mothers. Although residents were knowledgeable and concerned, their initiative and cooperation were not enough. Through the environmental classes for children (ECC) and environmental classes for mothers (ECM) conducted with the help of ESTERO partners, children aged 5–16 years old and mothers from 283 households were educated on the importance and functions of creeks and the ways to rehabilitate it. Moreover, Misamis University received four consecutive recognitions granted by the DENR-Environmental Management Bureau Region 10 for its valuable contribution to the protection and enhancement of the water quality of Carangan Creek.

Keywords: creek, environmental classes, recognition, water quality

SS – 04

**ASSESSING SCIENTIFIC ARGUMENTATION
OF GRADE 10 STUDENTS FROM WESTERN BICUTAN
NATIONAL HIGH SCHOOL (WBNHS) GENERATED USING
THE GENERATE-AN-ARGUMENT INSTRUCTIONAL MODEL**

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Numerous studies have underscored the potent role of scientific argumentation in deepening student's understanding of the lesson, increasing investigative competency, and developing critical thinking and communication skills. This study assessed the scientific arguments that were formed by students using the generate-an-argument instructional model. This argument-driven inquiry model promotes learning by doing; trains students to develop, understand, and evaluate scientific explanations; and promotes the basic values important in scientific research. This is a descriptive type of research involving 12 Grade 10 students from the Western Bicutan National High School (WBNHS) using four data gathering instruments: survey, class observations, students' written arguments, and semi-structured focused group discussion. The following results were observed: (1) student's learning experiences showed strong alignment to good communication skills and scientific attitudes; (2) majority of the formed arguments belong to Level 2 and Level 3 (includes claim, data, and warrant) indicating that students can already link data to support their claims; (3) changes in attitude toward argumentation and science were also seen after the implementation of the model; and (4) post-test scores increased after the implementation of the model. This study is the first of its kind in the Philippines and it provides an initial set of data, although at a limited scale, regarding the effectivity and usefulness of this model in addressing the goals of the K to 12 basic education curriculum.

Keywords: constructivism, argumentation, K to 12 BEC, scientific communication, generate-an-argument

SS – 05

BASIC ORAL HEALTHCARE KNOWLEDGE OF PRIMARY HEALTH WORKERS APPRAISAL: BASIS FOR MISAMIS UNIVERSITY COLLEGE OF DENTISTRY ORAL HEALTH EDUCATION PROGRAM

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Oral health is one of the most neglected areas of public health, which has led to an increase in the emphasis on developing global policies in oral health promotion and oral disease prevention. The primary healthcare workers of the local government units in the barangays, locally known as the barangay health workers (BHWs), are the primary health care service providers. This study determined the basic oral health care knowledge among BHWs using the descriptive survey method. Results revealed that majority of BHWs had no proper oral health training in the last five years. They are knowledgeable about the relationship and effects of oral health to general health, structures and functions of the oral cavity, and screening and recognition of observable oral disease and disorders. However, BHWs had low knowledge of basic oral hygiene and the necessity and practices of a dental visit. Statistical analysis showed that the number of years of service of BHWs affects their knowledge on the relationship and effects of oral health to general health and necessity and practices of a dental visit. Educational attainment affects their knowledge of basic oral hygiene and necessity and practices of a dental visit. Also, when BHWs know the relationship of oral health to general health, they can recognize any observable oral disease and will lead them to recommend a dental visit or consult directly with dental practitioners. The high knowledge of BHWs should be reinforced with training so that they will acquire the competency, or the necessary skills and approaches needed to deliver basic oral health care messages and referral services.

Keywords: barangay, health messages, referral services

SS – 06

AuthenTIC: DEVELOPMENT OF CONTEXTUALIZED AUTHENTIC ASSESSMENT TOOLS FOR GRADE 8 BIOLOGY (BIODIVERSITY MODULE) OF THE K-12 CURRICULUM

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This study developed contextualized authentic assessment tools for selected Grade 8 Biology topics under the biodiversity module and evaluated the authenticity of the assessment developed. The assessment tools were developed based on the nine criteria of assessment authenticity by Frey et al. (2012) and were assessed by three teachers and 38 students from the University of the Philippines Rural High School using a survey instrument (with an internal reliability coefficient of $\alpha=0.946$) developed by the researcher using the nine criteria for assessment authenticity. In the study, eight assessment tools were compiled into a booklet, covering the following topics: archaeobacteria, eubacteria, protista, fungi, non-vascular and seedless vascular plants, gymnosperms and angiosperms, invertebrates, and biogeochemical cycles. Evaluation of the assessment tools revealed that the teachers mostly agreed and strongly agreed with all of the components of authenticity for all of the eight assessment tools indicating that the developed assessment tools were authentic. Furthermore, the teachers also noted that the assessment tools can be of great aid to science teachers who need alternatives to traditional pen and paper tests. Results of the evaluation revealed that 80% of the students who answered the survey saw differences between the authentic assessment and the assessments they are used to taking, and reported that the authentic assessments were more fun and enjoyable, easier, and includes group collaboration. Moreover, the students most liked the create and collaborate part of the assessment tool for gymnosperms and angiosperms with two components, the *World Without Plants* and *Plants vs. Zombies*, wherein students were given the chance to work in groups and to showcase their creativity. With the eight authentic assessment tools developed, the researcher recommends the use of such tools to increase student participation, to enhance student learning, and to prepare students for the real-life setting outside school.

Keywords: assessment, authentic, contextualized, real-life setting

SS – 07

AWARENESS AND PRACTICE OF CABULAY HIGH SCHOOL STAKEHOLDERS OF BARANGAY ORDINANCE ON UNDERAGE DRIVING

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Underage driving still persists in spite of existing laws on the international age standard for driving permit that allows one to legally drive any vehicle, which is 18 years old and above. This study measured the level of awareness and practice of stakeholders of Cabulay High School on the barangay ordinance on underage driving. It utilized the quantitative-descriptive type of research design. The research instrument had three sections (licensing, registration, stickers, and plates; road rules and safety; and teaching teens to drive) and was administered in the school with 30 respondents that included teachers, students, parents, and barangay officials. Findings revealed that in general, respondents' awareness of the Do's (3.94) was relatively similar with their practice (3.84) and their awareness of the Don'ts (3.84) corresponds with their practice (3.23), which is sometimes. Between the two, practice needs to be further improved. In terms of Do's, findings show that barangay officials, who are supposed to be the most knowledgeable about the ordinance, have the least awareness (3.52) and teachers have the highest (3.95). When it came to practice, however, barangay officials obtained the highest rating (3.90). In terms of Don'ts, results show that students have the lowest rating on awareness (3.31) while parents have the highest (4.21); barangay officials had the highest rating (3.84) in practice while teachers had the lowest (3.16). Based on the results, one could infer that barangay officials and parents have the greatest weaknesses in implementing the ordinance, when they are supposed to be the implementing arms of the ordinance. Crafting of school policies to support the ordinance is highly recommended to raise the awareness and practice of the students, who are the end clients of the barangay ordinance.

Keywords: ordinance, licensing and registration, road rules, teen driving

SS – 08

CLIMATE CHANGE-RELATED SURVIVAL STRATEGIES OF PEOPLE IN AN URBAN FISHING VILLAGE IN LA PAZ, SAN NARCISO, ZAMBALES, REGION 3 OF THE PHILIPPINES

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The paper presents a profile study on the socioeconomic status and preparedness of people to climatic changes in an urban fishing village in La Paz, San Narciso, Zambales. Collection of data was through a pretested interview schedule involving household leaders (17 male and 16 female) using randomized block sampling design. Seventy percent of the families in the fishing village were not engaged in fishing activities; unemployment and underemployment were higher than 60%. Decreasing fish catch, heavy downpour of rain, heat waves, and decline in diversity of cultivated crops was among the reported perceived impacts of climate change in La Paz. Natural hazard risks assessment involved the description and categorization of potential hazards and the vulnerability of exposed elements. Access to storm surge maps and data were almost nil. The proximity of the village to a volcanic area exposes the community and critical infrastructure elements to higher risk from volcanic activities. Problems on water supply and sanitation is affecting almost 90% of households. Public access to information and advisories is low. The study concludes that the community is highly vulnerable to the effects of climate change and that the vulnerability of the community to natural hazards can be reduced by imparting education. The findings can be used as basis for policies to mitigate the effects of climate change.

Keywords: climate change, urban fishing village, San Narciso, Zambales

SS – 09

COMMUNICATING HAZARDS AND TAAL VOLCANO DISASTER RISK REDUCTION: BARANGAYS GULOD AND BUSO-BUSO, LAUREL, BATANGAS, PHILIPPINES

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This study aims to assess the existing disaster risk reduction strategies for volcanic hazards of the local government units (LGU) of two pilot sites, Gulod and Buso-buso, Laurel, Batangas. Both were affected by the 1965 eruption of Taal Volcano. Analysis of the socio-demographic profiles, existing documents, such as disaster risk reduction plans and contingency plans, gathered during preliminary preparations, and interviews suggest that there is a need to update the Barangay Disaster Risk Reduction and Management (BDRRM) plans for both barangays to include the most recent volcanic hazard maps, community evacuation plan, and information education and communication (IEC) campaigns specific for volcano hazards. Communicating hazards information and warning about volcanoes needs to be effective so that these are well understood and will propel people to prepare for emergencies. It is important to disseminate timely and accurate information and warning to the general public, LGU, and the media, who all play vital roles in the effective management of disaster response and recovery activities. Communicating risk to inform residents in a specific area about the potential hazards that may impact themselves and their properties will help them make informed decisions when there is a threat from volcanic eruption. The results of this study are expected to contribute to the enhancement of the disaster risk reduction plans for the two pilot sites.

Keywords: risk communication, communication strategies, volcanic hazards

SS – 10

COMMUNITY-BASED TOURISM AT BANTAY LAKAY: OPPORTUNITIES AND CHALLENGES AS PERCEIVED BY THE LOCALS AT CALAOCAN, CABARROGUIS, QUIRINO

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Community-based tourism (CBT) has been a trend since Murphy described it in 1985 (as cited by Lusby and Eow 2015). CBT has been practiced in India, Bhutan, and Thailand, to name a few, vesting the tourism development to community members who, in return get remunerated from the social capital they invest. In the Philippines, particularly in mountain tourist destinations (e.g., Mt. Pulag in Bokod, Benguet), CBT has been an opportunity for community members to generate income while showcasing cultural heritage and promoting environmental protection. The Quirino State University-Cabarroguis Campus, in cooperation with the Provincial Tourism Office, Department of Environment and Natural Resources, and SUKISOK Quirino Outdoor Club, have gone into CBT development at Calaocan, Cabarroguis, Quirino, the proposed home of the first established mountain trail in Region II, the Bantay Lakay. This study was conducted to elicit the perceptions of community members on opportunities and challenges in CBT. It is qualitative in its design with 25 participants who were selected purposively. The results show that community members are likely to participate in the CBT and see income generation opportunities, which include homestay, tour guiding, among others. Moreover, they perceive CBT as beneficial to the environment and its conservation. On the other hand, the participants pointed out a lack of assurance of cooperation from nearby communities and limited skills needed as challenges to CBT.

Keywords: CBT, opportunities, challenges, locals

SS – 11

**CONCEPTUAL DEVELOPMENT OF A GIFTEDNESS
PROGRAM TO ADDRESS SOCIO-EMOTIONAL NEEDS
OF UNDERACHIEVING GIFTED STUDENTS IN SELECTED
PHILIPPINE SCIENCE HIGH SCHOOL CAMPUSES**

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This research study was aimed to assess the profile (gender, scholarship categorization, and year level) and the socio-emotional needs (identity, autonomy, intimacy, achievement, overexcitability) of underachieving gifted students (UGS) and the support systems that are available to them in selected Philippine Science High School (PSHS) campuses. The study also aimed to conceptualize a giftedness program for the underachieving gifted students of PSHS. A descriptive-correlation approach and purposive sampling were used in this study. The underachieving gifted students, their parents, and their class advisers or former teachers or confidantes were the respondents. There were three tools used in data gathering; (1) a researcher-designed checklist of the socio-emotional needs of the student-respondents, (2) gifted Checklist for the parents, and (3) the teacher nomination form. Results of the study showed that there is no significant difference in the socio-emotional needs of underachieving gifted students when they are grouped by gender, scholarship categorization, and year level. The giftedness program developed cut across all year levels, gender, and scholarship categorization and was based on the identity formation model and school-wide enrichment model.

Keywords: giftedness, socio-emotional needs, underachievement

SS – 12

EATING ATTITUDE AND BODY SATISFACTION OF OVERWEIGHT AND UNDERWEIGHT ADOLESCENTS

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The study focused on the differences between overweight and underweight individuals in terms of their eating attitude and body satisfaction. This research involved 104 respondents from selected localities in the province of Quezon. The respondents were 11–20 years old and were proportionately categorized as overweight and underweight based on their school medical records. The variables of the study were gauged using the eating attitude test and body shape questionnaire. Results revealed that out of 52 overweight respondents, 22 were at risk of eating disorders in the area of dieting; 18 for bulimia and food preoccupation; and 12 for oral control. Among 52 underweight respondents, 15 were at risk of eating disorders in the aspect of dieting; 24 for bulimia and food preoccupation; and 22 for oral control. In terms of body satisfaction, overweight respondents, results showed that 4 respondents were markedly concerned; 15 were mildly concerned; and 18 were moderately concerned about their body shape. Among underweight respondents, 8 were mildly concerned and 2 were moderately concerned about their body shape. Statistical analysis using *t*-test identified differences in the respondents' eating attitude in the areas of dieting ($t=2.119$; $p=.037$), oral control ($t=2.456$; $p=.016$), and body satisfaction ($t=6.118$; $p=.0005$) between the two groups. Further analysis indicated that in dieting, overweight respondents have higher risk ($M=8.807$) while in oral control, underweight respondents have higher risk ($M=4.846$) of developing an eating disorder. Meanwhile, overweight respondents were more concerned about their body satisfaction ($M=102.173$) compared to their underweight counterparts ($M=65.307$). This study recommends psycho-educational approaches for adolescents who are at risk of developing eating disorders and those who show excessive concern for their body shape.

Keywords: adolescents, eating attitude, body satisfaction, eating disorder

SS – 13

EXTENT OF INFORMATION AND COMMUNICATION TECHNOLOGY AMONG SOLANO HIGH SCHOOL STUDENTS: A REVIEW

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The information and communication technology age has developed 21st century skills essential for students to have access to advancement. Computers, cellphones, and other gadgets have become indispensable to everyday needs and commonly utilized by everyone. This study aimed to determine the extent of use of these technologies among students in school, in the society, and at home. Survey questionnaires and focused group discussions were used to gather data from 2,634 students comprising 61 sections from Grade 7 to 11. Descriptive-qualitative analysis was employed in the study. Results revealed that 7 out of 10 students bring their cellphones to communicate with their parents and had Facebook accounts as their avenue of leisure. About 6 out of 10 students admitted to playing offline games using their gadgets as well as online games in computer shops near the school. The abovementioned results were from grade 8 students who were more technologically inclined than other grade levels on this aspect. Two out of 10 students use computers for research and assignments and only one of these two has internet connection. The extent of using information and communication technology for leisure is very high while using these technologies for educational purposes is quite low.

Keywords: extent, information, communication technology

**FINANCIAL PERFORMANCE OF PUBLICLY LISTED
COMPANIES ON THE PHILIPPINES YEARS 2013 TO 2016:
DETERMINING THE ROLES OF CEO
AND CORPORATE REPUTATION**

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A company's reputation may be distinguished by its corporate and CEO reputation, with both considered as drivers of success, value, and performance of the company as a whole. While previous literature has covered the positive effects of corporate and CEO reputation on financial performance, most studies have taken reputation as a one-dimensional aspect, and none have been conducted in the Philippines. Highlighting the separate impacts of corporate and CEO reputation grants assurance on the use of reputation as an indicator of value, thus providing investors and firms with sound information that will allow them to make better asset management decisions. Through panel data econometrics, this study identified and explained the impacts of corporate and CEO reputation on the financial performance of a firm, as measured by its profitability ratios (ROA, ROE, and EPS). Based on data from the top 131 PSE-listed companies from 2013–2016, only CEO reputation, as proxied by industry-adjusted return on assets, has a statistically significant and positive effect on a firm's financial performance. The CEO's operating and managerial abilities drive his reputation and translate into significantly positive growth for the firm's financial performance. A CEO's good reputation had a significantly positive effect on financial performance, regardless of the company's corporate reputation. However, this was not the case when the CEO had a poor reputation. It was found that a company's good reputation cannot significantly improve financial performance, nor can it improve the already good financial performance brought about by the CEO's good reputation. This suggests that in building reputation to improve financial performance, company management should prioritize choosing a good CEO, as the CEO sets the tone at the top and positively affects corporate culture and reputation, financial performance, and stakeholder relations.

Keywords: corporate reputation, CEO reputation, financial performance, resource management and decision-making, organizational studies

SS – 15

FORMULATION AND VALIDATION OF A SPECIALIZED ANTI-DRUG ABUSE HEALTH EDUCATION PROGRAM AIMED TO INSTIL ANTICIPATORY SOCIALIZATION IN THE YOUTH

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The paper reports the preparation and validation of an anti-drug abuse health education module aimed to enhance the basic organizational, judgemental, and perfunctory skills of adolescents to make anticipatory decisions regarding use and misuse of recreational drugs and drugs of abuse. A health module on drug abuse education and prevention was prepared and validated using a pool (N=120) of Grade 6 pupils randomly selected as test respondents. The module was anchored on a continuum ranging from the cognitive through the affective to the behavioural domain of health education. The validation of the module was made by using it in actual classroom courses. Pretest and posttest were used as the instruments of the study. The experimental group (n=60) used the module while a control group (n=60) was not given the module. The same pretest was administered as posttest to the test subjects, except that the arrangement of items in the pretest was rearranged in the posttest. The arithmetic mean of the test scores in the experimental group was statistically different (using equal variances 2-sample *t*-test, Stat 500 software) and higher compared to the arithmetic mean of the test scores from the control group ($t=-4.5$; $t_{crit}=\pm 2.34$). The module was very useful and relevant to facilitate learning in classroom instruction on drug abuse prevention education for Grade 6 pupils.

Keywords: anti-drug abuse, anticipatory socialization, module

**FROM IMITATION TO INNOVATION:
THE COMPLEXITY OF GLOBAL INNOVATION CAPACITY
IN AN OPEN MODEL OF TECHNOLOGICAL CHANGE**

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The advent of the Network Age has increased the premium placed on technological capacity, making it imperative for laggard economies to improve national innovative capabilities. To study the determinants of national innovative capacity, this paper marks a departure from previous works in its analysis of the multinational patterns of technological specialization using a Neo-Schumpeterian approach—i.e., with the common innovation infrastructure framework, cluster-specific innovation environment framework, and the open model of technological innovation. Moreover, it accounts for the spillover effects generated by a nation's inward foreign direct investment (FDI) as well as the legal institutions surrounding innovation such as the intellectual property regime (IPR) and rule of law. In line with this, using data from the World Bank, the Fraser Institute, and the USPTO, this study uses Poisson panel regression analysis on a global panel and subsets of leading innovators, emerging innovators, and laggard nations, in order to examine the key drivers of innovative capacity for each subset. Globally, it was found that knowledge stock, a strong rule of law, excellent university-to-industry collaboration, and FDI inflows have the most significant effect on innovative capacity. For leading countries, intertemporal spillovers take precedence over international spillovers. For emerging countries, legal institutions, a weak IPR regime (imitation to innovation), and cluster-specialization are most beneficial. Lastly, for laggard nations, legal institutions and public education policy are the most beneficial for innovation. In conclusion, strengthening academe-industry linkages, as well as fostering the enablers of growth: sound institutions, good education, and robust international linkages are recommended.

Keywords: innovation economics, technological change, complexity theory, economic complexity index, national innovative capacity

SS – 17

GENDER PARTICIPATION IN THE FISHERIES SECTOR OF LAKE TAAL, PHILIPPINES

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Fisheries has always been considered as men's domain and women's participation is often overlooked. This study started with gathering of data on socio-economic characteristics of fisherfolk and was followed by the documentation of gender roles in the fisheries sector of Taal Lake. Further, the project identified and implemented livelihood projects for the fisherfolk that will help uplift their living conditions. Fishers in Taal Lake 31–40 years old with low education. The roles of both men and women in fisheries were categorized into three sectors: capture, postharvest, and aquaculture. Both genders are engaged in all sectors but men dominate open fishing and aquaculture while women play a great part in trading and activities that ensure the reproduction of labor force. Most of the fisherfolk in Taal Lake, if given a chance, would like to engage in other types of livelihood or to start their own business. The top three livelihood programs suggested by the respondents are additional fishing gears/equipment, livestock, and processing equipment. Livelihood trainings were conducted but it is recommended that additional support be given to fisherfolk to ensure the sustainability of the program. In conclusion, this study showed that men and women have equal level of participation in the fisheries sector in Lake Taal.

Keywords: gender role, fisheries, livelihood program

SS – 18

GOOD MANUFACTURING PRACTICES OF FOOD CATERERS IN NORTHERN CEBU, PHILIPPINES

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Catering services are one of the livelihoods of Northern Cebu residents. This study assessed the good manufacturing practices and hazard analysis critical control point implementation of food caterers in Northern Cebu, Philippines. This study utilized the descriptive method of research using a questionnaire with 30 respondents for the period of six months. Half (50%) of the respondents were male and 50% were female aged 27 years old and above (30%), 24–26 years old (30%), 21–23 years old (20%), and 20 years old and below (20%). The level of good manufacturing practices, especially hand washing before and after serving food, and hazard analysis critical control point implementation during catering services were observed by the food caterers in the northern part of Cebu. Good manufacturing practices were fully implemented, and hazard critical control point observation was moderately implemented during catering services. Hence, crew in these food catering services need to be upgraded in terms of hazard analysis critical control point aspect.

Keywords: food safety, catering services, sanitation

SS – 19

DIFFICULTIES IN RESEARCH WRITING OF FACULTY MEMBERS

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The strategic direction of the institution influences the level of concentration on each task given to faculty members. Indeed, faculty members are mandated to engage themselves in research endeavors. Thus, this qualitative study employing the descriptive method of research aimed to identify and assess the problems encountered by faculty members in writing research. A total of 25 participants were randomly selected to take part in an individual open-ended and in-depth interview. It was noted that various themes emerged, such as: overloaded with subject preparations, unequal distribution of research training opportunities, fear of statistics, collaborative research is not institutionalized, research writing is added burden, and only the best papers are given recognition and incentive during in-house reviews. On the other hand, to address the identified difficulties, a proposed enhancement program will be initiated, which focuses on strengthening the campus' culture of research, increasing the university's research activity, and identifying research collaborations in the campus' research focus areas. Thus, faculty members' concerns in the conduct of research blended with their inner drive, positive disposition, high level of knowledge and skills, and the University's conducive research environment may improve QSU Cabarroguis Campus' research productivity.

Keywords: training opportunities, glitches and hitches, collaborative research, research writing, qualitative approach

SS – 20

HOLDING ON AND LETTING GO: EXPERIMENTAL EVIDENCE ON REDUCING THE DISPOSITION EFFECT THROUGH VARYING LEVELS OF INFORMATION SALIENCE

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The disposition effect is the tendency of investors to exhibit behavioral bias in selling their winning shares prematurely and in holding on to their losing shares for too long—cutting future gains and incurring further losses, respectively. Previous literature has covered the causes of disposition effect, but only few were dedicated to decreasing this phenomenon. Exploring the effects of differing levels of information saliency on the disposition effect provides knowledge on which information to utilize in devising optimal strategies and financial advice for investment decisions. For this study, the experiment was conducted in a laboratory environment simulating actual investment situations with groups exposed to varying levels of information salience. Qualitative response models were used to measure the incidence of disposition effect and to relate this with the returns across different groups. Male investors, risk-seeking investors, and investors exposed to high levels of purchase price saliency and low levels of financial ratio saliency were more susceptible to the disposition effect. Individuals with disposition effect exhibited the lowest returns, proving that it is a financially detrimental behavioral bias common among investors (evidenced by 79.33% of the sample). When experiencing gains, highly salient financial ratio information and the absence of purchase price decreases the risk-aversion of the respondents, allowing them to optimally let go of winning shares and increase gains; while for losses, the presence of purchase price and financial ratios decrease the riskiness of investors, allowing them to sell their losing stocks optimally and cut capital losses. As investors treat capital gain as a major determinant in their decision to sell, the results imply that investors may be advised to consider different information when experiencing gains and losses to yield better returns.

Keywords: disposition effect, behavioral finance, individual investors, experimental economics, financial wealth

SS – 21

**HOUSEHOLD'S WILLINGNESS TO PAY FOR RESTORATION
AND CONSERVATION OF FISH SANCTUARY IN BARANGAY
TAGPANGAHYOY, TUBAY, AGUSAN DEL NORTE,
PHILIPPINES**

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Ecosystem services provide livelihoods for millions of people, many of whom are poor, and make a significant contribution to the economy. However, the world's ecosystems have dramatically declined over the past 50 years. This study assessed households' willingness-to-pay (WTP) for the restoration and conservation of the fish sanctuary in Brgy. Tagpangahoy, Tubay, Agusan del Norte, Philippines. The contingent valuation method (CVM) by stated preference was used in the study by asking the respondents their maximum willingness to pay. Descriptive analysis and multi-linear regression analysis were used to determine WTP of the respondents and the factors affecting it. Majority of the respondents were willing to contribute to ensure the success of the fish sanctuary. Ninety-four percent (94%) of the respondents approved the restoration and believed that the fish sanctuary was helpful to improve their fish harvest, which is beneficial to the residents, especially to the fishers. However, only 89.6% were willing to pay. The willingness to pay of the household is PHP 61.89 per month, which is dependent on educational attainment, which affects the WTP of the respondents positively. The high degree of support for fish sanctuary will be conducive to the formulation of policies that will improve, conserve, and restore the barangay's fish sanctuary.

Keywords: willingness-to-pay, contingent valuation method, fish sanctuary conservation

IS IT ENOUGH? A FISCAL ANALYSIS OF THE EFFECTS OF TAXES AND TRANSFERS ON THE 4PS BENEFICIARIES IN THE PHILIPPINES

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Tax burdens on the poor are tolerable if they are associated with sufficient transfer programs. Previous studies have shown that although tax and transfer systems are depicted as poverty-reducing and progressive, they still contribute to poverty as a substantial portion of the poor are made poorer (or non-poor made poor). This study aims to analyze the effects of tax, specifically VAT, and the 4Ps in the Philippines using empirical and theoretical models of fiscal incidence. In implementing a series of tests for the measurement of fiscal incidence, the authors have considered at least two factors: income and taxes. The researchers aggregated the FIES dataset to create consumption shares of the different goods and services such as food, clothing, education, utilities, housing, and transportation. Essentially, the method consists of allocating taxes and transfers to derive four income concepts (i.e., market income, disposable income, consumable income, and final income). It then assesses the impact using different models of inequality and poverty reduction such as the Lorenz curve, Gini coefficient, headcount index and poverty gap. Results showed that the poorest decile are the ones who benefit most from the transfers, which means that the 4Ps program is deemed as pro-poor. On the other hand, the Philippines' direct taxation on Filipino households is more concentrated among the top 20%. Taxes however shows that the poorest experience more burden on indirect taxes while the richest experience more burden on direct taxes. From these results, it can be observed that there is a trend wherein the Gini coefficient, headcount index and poverty gap increased with the presence of a direct and indirect tax, and decreased when there were subsidies, transfers, and in-kind transfers. This goes to show that the tax system of the Philippines really hurts the poor and the conditional cash transfer program (4Ps) has a minute contribution to poverty reduction.

Keywords: fiscal incidence, 4Ps, inequality, poverty, taxation

SS – 23

LD'S DREAM (DEVELOPING READING ENTHUSIASTS AND MASTERS)

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Solano High School is one of the largest institutions in Nueva Vizcaya, comprising more than 2,300 students. Fifty students from Grade 7–10 were identified to have reading disabilities. They have common special learning needs in communication, particularly reading and comprehension, that eventually affects the transfer of information from written text, which has led to difficulties in learning. Thus, the researchers examined the capabilities of students with reading disabilities involving reasoning, understanding, and reading and crafted instructional materials for such students. The study employed qualitative approach using observations, descriptions, recording, narrative reports, and photo documentation. The learners were enrolled in tutorial sessions, which is an hour every day after their regular classes. The researchers noted their observations during the conduct of tutorial sessions. After 20 regular tutorial sessions, specific reading disabilities were observed: tracing with fingers, word windows, audio assist, slow decoding attack, low spelling strategies, word repetition, first three letters attack, stop on unfamiliar words, uncontrollable eye movements, tired of long passages, and picture reading. These reading disabilities were addressed immediately by giving them appropriate strategies in accordance with the abovementioned observations. After the tutorial sessions, the researchers observed that there was a slight improvement pertaining to respondents' basic reading ability, like scanning independently, reading short passages with fewer instructions, and ability to answer questions at the literal level leading to instructional level. The learners, therefore, need more sensible activities to address their reading disabilities.

Keywords: strategies, decoding, reading, instructional materials

MAYON VOLCANO RESIDENTS' CONSTRUCTION OF ERUPTIONS: A PHENOMENOLOGICAL STUDY OF RISK COMMUNICATION

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This study aimed to understand risk communication through the lens of the phenomenological tradition of communication theory that theorized communication as experience of self and others through dialogue. The study was undertaken to gain in-depth understanding of shared lived experiences. The fieldwork conducted during the 2014 Mayon Volcano eruptive episode opened the opportunity to engage in dialogue with residents about their stories of eruptions. The study focused on reading and re-reading, and making sense of the transcribed interviews of six selected participants. In the stories shared, emergent are the three dimensions of participants' views of their eruption experiences—as seen, as heard, and as felt. The participants have shared meaning structures and view eruptions as gradational. The gradational view of eruptions is constituted by the participants' expressed language of their experience and knowledge. These include articulations of observed progression of changes whether visual—by the color of smoke or thickness of ash, auditory—by the loudness of sound that is heard, and strength of shaking that is felt. When this gradational view of eruptions is translated into action, two typologies emerged: evacuation and non-evacuation. Phenomenological research studies in disasters specifically focused on understanding risk communication in a volcano setting, is relatively an uncharted field, and based on the results of this work, shows potential to contribute to knowledge generation if further pursued.

Keywords: phenomenology, risk communication, Mayon Volcano, meaning making

SS – 25

ONLINE GAMES ADDICTION OF COLLEGE STUDENTS

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Playing online games is a common interest among students nowadays. However, too much engagement in online games may result in its addiction. The main thrust of this study is to determine the status of online gaming addiction and to identify the symptoms of addictions and its effects on the respondents. The study utilized descriptive research methods, while sample was selected through random sampling. A total of 85 respondents participated in the study, and were composed of college students from Calamba City, Laguna. The data were collected through survey and face-to-face interviews. Online gaming addiction was determined using the six core components developed by Griffiths (2014), which also serve as the framework for this study. Findings showed that the percentage of male online game players is much higher than that of female players. Social and achievement factor and emotion-content satisfaction appeared to be the main reasons for causing online games addiction. The symptoms found were preoccupation, craving for playing, mood modification, and conflict. It also revealed that engagement in online games did not affect much of the student's academic performance; the effect was more on the respondents' emotions. Thus, students must be well-guided by their parents and must be advised to put some limitations and restrictions in their online gaming habit.

Keywords: online games, game addiction, college students, ICT, online gaming effects

**PERCEIVED FREQUENCY AND INTENSITY
OF ACADEMIC STRESS OF THE SENIOR HIGH SCHOOL
STUDENTS OF SOLANO HIGH SCHOOL**

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Senior high school students' life is packed with frustrations, deadlines, and demands, which they consider as stress. Stress is usually described as a negative idea that can affect one's health. The study aimed to determine the frequency and intensity of academic stress in the following categories: subject, schedule, teacher, classmate, and school facilities of the 217 senior high school students both enrolled in Academic and Technical-Vocational and Livelihood Track. Survey questionnaires and focused group discussions were used to gather data. Descriptive-qualitative and quantitative analysis were employed. Students' frequency of academic stress was "sometimes" in all the categories. The intensity of stress commonly scaled as "mild" for all the categories. However, using t-test, only the frequency and intensity of stress on the subjects and schedule had significant differences between students under Academic Track and Technical-Vocational and Livelihood Track. The findings were traced from the varied specialized subjects in both tracks. Furthermore, thematic clustering was done in the specific responses of the students. The students in Academic track were more open and generous in expressing their sentiments than those in Technical-Vocational and Livelihood track. The subjects in Senior High School were found to be "difficul" due to huge amount of researches and projects. Schedule was very hectic due to the shifting scheme applied. Teachers were revealed to be very strict in the class and inconsiderate. Their classmates were also irresponsible, noisy, and disrespectful with one another. Issues in school facilities include lack of comfort rooms, lack of classrooms, and limited outlets of school canteen. Hence, the frequency and intensity of the academic stress depends on the track chosen by the senior high school student. The school, being their second home, needs to continuously improve to have a child-friendly, gender-sensitive, safe, and motivating learning environment.

Keywords: academic stress, frequency, intensity, senior high school

SS – 27

PERCEPTUAL LEARNING STYLE PREFERENCES OF PSHS-CVC STUDENTS

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This research was conducted to respond to the need to maximize the learning potentials of students. It assessed and mapped out the perceptual learning style preferences of the subject students when grouped according to some none-intellective (gender, year level, and scholarship categorizations) and intellective (year level weighted average) variables. The research employed the descriptive-normative, survey, comparison-research design, in which the scores of the respondents in the four elements of perceptual learning style preferences (auditory, visual, kinesthetic and tactile) were compared in terms of selected intellective (year-level weighted average) and non-intellective (gender, year level, and scholarship categorization) variables. The results of the study showed that the (1) typical *auditory* students are fourth-year females, enjoying the special scholarship categorization, and whose YLWA is within 1.51–2.00; (2) typical *kinesthetic* students are first-year females, enjoying the Partial 2 scholarship categorization, and whose YLWA is within 2.51–3.00; (3) typical *tactile* students are first-year males, enjoying the Partial 1 scholarship categorization, and whose YLWA is within 2.01–2.50; and (4) typical *visual* students are fourth-year females, enjoying the Special scholarship categorization, and whose YLWA is within 1.51–2.00.

Keywords: student potential, scholarships, learning styles

**PERSONALITY, SOCIOECONOMIC BACKGROUND,
AND PUNISHMENT MECHANISMS AS DETERMINANTS
OF COOPERATION AND FREE-RIDING BEHAVIOR**

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Although economic theory predicts that voluntary provision of public goods leads to suboptimal results because free-riding is the dominant strategy, previous studies have provided evidence that individuals contribute non-zero amounts; total free-riding is not always observed. With the knowledge that observations are mostly foreign, we were inspired to focus more on the Philippine setting through conducting experiments that involved the students of the University of the Philippines School of Economics. This study tested a variation of a public goods game with punishment mechanism, which has been shown in previous studies to reduce free riding. We tested if punishment would continue to induce cooperative behavior under different conditions. Test of means was used to check if there were differences in the contributions among players, while regression analysis was done to dissect the effects of different factors in cooperation and free-riding behavior in the game. Age showed positive effect on cooperative behavior while some factors related to academic background seemed to encourage free-riding behavior. It was observed that personality traits, such as neuroticism, had a negative effect on cooperation while agreeableness had a positive effect, but only under certain conditions. Exclusion as a punishment was highly effective in reducing free-riding, but this observation did not hold when higher thresholds were introduced.

Keywords: public goods, free-riding, cooperation, personality traits

SS – 29

PRIVACY ISSUES AND CONCERNS IN THE USE OF SOCIAL MEDIA

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Social networking sites (SNS) are the fastest growing entity on the internet. Social media are now used by more than half a billion users around the world and have become a major platform for communication and interaction between users. The variety of personal information being shared has led to the success and advancement of social interaction. At the same time, however, it raised much critique and concerns with respect to users' privacy. This study is identified the issues and concerns of the respondents on the use of social media. It also identified the effects of social media on the respondents and the actions they took to overcome the negative effects. A survey questionnaire was used as the main data gathering instrument. The respondents were selected students from Junior High School of Calamba City, Laguna. The results showed that respondents were still not aware of the risks associated with uploading their information on social media. In addition, the negative effects of privacy issues moderately affect them. The researchers conclude that proper guidelines and deeper knowledge of privacy concerns and issues should be initiated to improve the use of social media. Along with this, this topic should be further studied since social media interaction has become increasingly popular components of our everyday lives in today's globalizing society.

Keywords: social media, privacy concern, social networking sites, technology

SS – 30

**PROGRAMMING SKILLS OF THE BSIT STUDENTS FROM
THE POLYTECHNIC UNIVERSITY OF THE PHILIPPINES –
STO TOMAS BRANCH A.Y. 2017-2018:
BASIS FOR DEVELOPMENT OF ICAPS (I CAN ACQUIRE
PROGRAMMING SKILLS) MOBILE APP**

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Programming is one of the hardest skills to develop in the field of information technology. It requires a lot of time and effort to learn different programming language syntax and operations. Thus, this study assessed the programming skills of the BS Information Technology (BSIT) students from the Polytechnic University of the Philippines-Sto. Tomas Branch. The study also determined the problem encountered by the respondents and accordingly designed a solution through a mobile app that will help them to easily learn programming. The study utilized descriptive research method while prototyping method was used to design the mobile app solution. Respondents were selected using stratified random sampling. Findings showed that the overall ratings of BSIT students were in an upward direction, which means that students' programming skill level were improving. Lack of hardware and availability of software tool contributes to their difficulty in learning programming. The researchers recommend using the existing devices of students may help to improve their programming skills. They also recommend using applications and software tools, such as the ICAPS mobile app, are necessary to aid their learning process and be competent in programming.

Keywords: programming, programming skills, skill acquisition, skill development, skills enhancement prototype.

SS – 31

RESILIENCY OF ZANJERAS: ITS IMPACT ON RICE-BASED PRODUCTION IN ILOCOS NORTE

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Rice-based farming in Northern Philippines requires substantial irrigation. Zanjeras or farmer groups that operate on a communal, indigenous, self-governing irrigation systems sustain this farming need. This case study attempted to document and expand understanding on how “Zanjera”, as an institution, persistently respond to episodic disturbances of extreme typhoon, flooding, drought, and economic downturns in relation to their rice-based farming activities. Key informant and semi-structured interviews and focus group discussions were used to characterize the resiliency and adaptive capacity of Zanjeras. Qualitative analysis was used to interpret the narrative contents of secondary data. The success and survival in rice farming of the Zanjeras of San Juan and Maan-anteng in Solosona, Ilocos Norte is deeply rooted in the century-long credo that has been passed on from past generation to present. In overcoming the effects of climate change and variability, the cooperative and *bayanihan* spirit of farmer-members in communally governing water resources speaks of their resiliency. The dominant social capital factor is attributed to culture, shared ideas of cooperation, and sociality of Zanjera-farmer members. There is, however, an urgent need to strengthen this adaptive capacity through providing the needed irrigation infrastructure. The traditional “arbeng”—diverting the water to their farm parcels—no longer work unlike in the past. Moreover, the economic losses during calamities need to be augmented with lower prices of input materials and better market prices.

Keywords: Zanjera, resilience, indigenous, communal

RISKY BEHAVIOR ON SOCIAL NETWORKING SITES AND SELF-ESTEEM AMONG FILIPINO COLLEGE STUDENTS

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Research in the Philippines have shown that about 30% of Filipinos, which also include college students, are frequent users of social networking sites (SNS). This finding is quite alarming due to the negative effects of SNS usage. Thus, this study identified the risky behaviors of college students on their usage of SNS and its relation to their self-esteem. Data came from 1,070 college students aged 15–25. The researchers utilized self-constructed questionnaire, with domains of shared information, post composition, and activities with strangers. The last part of the instrument was the Rosenberg’s Self-esteem scale. Data were analyzed using descriptive statistics (e.g., means, standard deviation, Pearson Moment Correlation). Results revealed that participants had high risky behavior in terms of the information shared on their profile (e.g., personal cellphone numbers and addresses). Moreover, they also had high post composition activities, in which they may be vulnerable to information phishing and identity theft. Furthermore, there is significant positive relationship between risky behavior (shared information and post composition) and self-esteem. This means that as these risky behaviors increase, their self-esteem also increases. This infers that the gratifications (e.g., connection with their friends) that college students get from SNS create a positive view of themselves. However, these positive experiences overshadow their risky behaviors. Thus, college students may not be aware about the danger of using social networking sites.

Keywords: risky behavior, social networking sites, self-esteem

SS – 33

**SOCIOECONOMICS AND FAMILY DYNAMICS ANALYSIS
OF AGTA INDIGENOUS PEOPLE (IPs) FARMERS
IN ALBAY, BICOL REGION FOR *Palayamanan* SYSTEM**

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A baseline characterization of the indigenous people (IPs), ethnolinguistically classified as Agta, was done in this study to formulate policy recommendations and serve as reference for researchers and development managers eyeing for potential interventions. Agtas are involved in upland and unfavorable rainfed lowland rice farming in Tiwi and Polangui, Albay. Socioeconomic characterization and family dynamics studies were utilized in the analysis of this project. The socioeconomic component described the social conditions and the production and income forces of the communities, and a study on family dynamics revealed factors affecting their family decisions. The researchers found that farming in Danao, Polangui, located in the uplands-maximized rice production, was still on hold due to its limited resources but conducive for diversified crops. The site in Tiwi covering barangays Misibis, Joroan, and Mayong had very low rice production in the uplands, but had thrived in abaca production. The family dynamics analysis in both sites revealed that Agta IP farming families have closed family system due to demographic and cultural aspects, which made it challenging to introduce new things, such as the *palayamanan* systems. However, this should not limit effective development interventions to help them. Overall, the communities' geographical conditions, rice and agri-based farm practices, disposals, market access, beliefs, and family-knits have affected their way of living, agricultural practices, and decision making.

Keywords: socioeconomic, family dynamics, indigenous peoples, *palayamanan*

STUDENT ENGAGEMENT OF FRESHMAN COLLEGE STUDENTS IN THEIR ENGLISH CLASSES

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The study aimed to determine students' level of physical engagement in terms of positive body language, consistent focus, verbal participation and student confidence, level of mental engagement, relationship between their level of physical engagement to their level of mental engagement, and the factors affecting such. Levels of different engagement were measured using the Likert's scale. Direct interviews to students were done to gather the needed data. The descriptive-qualitative method was employed in order determine and interpret the data gathered. Results showed that students generally had high level (3.72) of physical engagement. Specifically, students exhibit average level (3.27) of positive body language, high level (3.97) of consistent focus, average level (3.37) of verbal participation, and very high level (4.27) of student confidence. In terms of the level of mental engagement, 1.8% had very high level, 6.6% had high level, 22.4% had average level, 42.6% had low level, and 26.6% had very low level. Furthermore, the results revealed that there was a significant relationship between students' level of physical engagement and their level of mental engagement. The factors affecting the level of physical engagement of student include teacher factor, environmental factor, and student factor. The factors affecting the level of mental engagement include student factor, exam, and learning process. With these findings, teachers should develop activities that will actively engage their students to improve their academic performance. Likewise, students should also actively participate in the activities designed by the teachers.

Keywords: student engagement, physical and mental engagement

SUBJECTIVE WELL-BEING, JOB SATISFACTION, AND RESILIENCE OF MARRIED WORKING MOTHERS

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Different studies have found out that subjective well-being and resilience is correlated to one another (Diener and Ryan, 2009). However, studies are still lacking on the major relationship between these two variables and job satisfaction, specifically on working mothers. Thus, the study focused on exploring the levels and interrelationship of subjective well-being, job satisfaction and resilience among married working mothers. The study utilized correlational design and analyzed, using Pearson r , 50 working mothers. The standardized scales used were (1) Satisfaction with Life Scale [SWLS] by Pavot and Diener; Positive Affect; (2) Negative Affect Scale [PANAS] by Watson, Clark and Tellegen; (3) Job Satisfaction Survey by Spector; and (3) Resilience Scale by Wagnild and Young. Results revealed that working mothers had high level of Subjective Well-being (SWB), specifically on their positive emotion and satisfaction with life. They also had high levels of job satisfaction and very high level of resilience. Job satisfaction was significantly correlated with subjective well-being domains, i.e., positive emotion ($r=.47$, $p=.03$) and satisfaction with life ($r=.56$, $p=.041$). Moreover, scores on resilience scale was significantly correlated with positive emotion ($r=.58$, $p=.032$) and satisfaction with life ($r=.66$, $p=.026$). Results revealed that when working mothers have high SWB, their satisfaction towards their job also increases and the likelihood to have high level of resilience to buffer different challenges also increases.

Keywords: risky behavior, social networking sites, self-esteem

SS – 36

SUPPLY AND DEMAND AND KEY PLAYERS OF GARLIC (*Allium sativum*) IN ILOCOS REGION, PHILIPPINES

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Garlic (*Allium sativum*) is an indispensable ingredient in any food preparation. This study analyzed the supply chain of this high-value commodity to understand and determine the presence or absence of inefficiencies in the system. The respondents were composed of garlic farmers, members of cooperatives, households, and institutional buyers. Primary data were gathered through focus group discussions and key informants interviews using structured interview schedule. Secondary data on the macro level sourced from the Philippine Statistics Authority 2015 data were also used in this study. Data were analyzed using descriptive statistics and supply chain analysis. The province of Ilocos Norte has the highest hectarage planted and production that accounts 94% and 95%, respectively (1,1933 ha and 6,934.49 MT), and only about 6% of the area planted and 5% of the production are shared by the provinces of Ilocos Sur and Pangasinan. La Union did not produced garlic. Ilocos Region remains the top producer of garlic in the country, however, production showed a decreasing trend. Garlic produced in Ilocos Region accounts the biggest share (69.7%) nationwide. The domestic supply can meet the requirements of the region with a surplus of 75.53 MT, but there is a shortage of 133,989.92 MT throughout the country. Monthly price of garlic was highly variable. The key players in the supply chain performed their activities independently from one another. There were inefficiencies in the supply chain.

Keywords: garlic, inefficiency, supply and demand, supply chain

SS – 37

THE DEVELOPMENT OF ACADEMIC SELF-EFFICACY SCALE (ASES) FOR FILIPINO JUNIOR HIGH SCHOOL STUDENTS

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Realizing the importance of self-efficacy as a determining variable of academic performance (Hermita and Thamrin 2015) and given the limited published academic self-efficacy scale for Filipino junior high school students and the non-existence of published and established academic self-efficacy scale in Philippine context, this study sought to develop and validate a self-efficacy scale in the academic setting. Test Development anchored on Classical Test Theory was used as design. The respondents comprised of 4,759 junior high school students from selected 20 public and private schools in Nueva Ecija. The initial 240 items were validated by four expert judges (one psychologist, one educational psychologist, one guidance counselor, one high school principal). Results showed using Lawshe CVR and Intra Class Correlation that the expert validators highly agreed on the items of ASES. Moreover, UL-LL method, Cronbach alpha, split half method, item to total correlation, and Confirmatory Factor Analysis were also utilized to test the validity and reliability of test items. The factor structure verified the four iterations, which include Perceived Control (PC), Competence (C), Persistence (P), and Self-Regulated Learning (SRL) domains. The final form after the reliability and validity analyses consists of 62 items. Results of the study revealed that the ASES for K to 12 junior high school students is a reliable and valid measure of Academic Self-Efficacy. Future trend of the scale may use as instrument of assessment and intervention for Filipino students in the different facets of their academic life.

Keywords: academic self-efficacy, test construction

THE EFFECT OF DIRECT INSTRUCTIONAL APPROACH TO VOCABULARY PERFORMANCE OF GRADE 7 STUDENTS OF SOLANO HIGH SCHOOL

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An individual's capacity for comprehension depends on the availability of vocabulary. The richer the storehouse of vocabulary, the more one is able to understand a variety of concepts. The study aimed to enhance the vocabulary performance of the Grade 7 students of Solano High School by determining which approach is more effective in developing their vocabulary performance—the direct instructional approach or the common instructional approach. The study utilized the experimental correlation method to ascertain the effectiveness of direct instructional approach in enhancing the vocabulary performance of Grade 7 students in terms of their profile variables: age, gender, grade in first grading, number of siblings, monthly income of parents, birth order, father's highest educational attainment, mother's highest educational attainment, and reading materials available at home. The qualitative part of the study made use of post-self-evaluation-questionnaire modified from Schmitt's (1997) Vocabulary Learning Strategy Questionnaire (VLSQ), which divided into three items: word meaning, word parts, and context. The questionnaire is designed to gather information about how students go about English vocabulary learning. It was noted that in the field of education, no language teachers could afford to remain at a standstill. Language teachers should keep up with new findings, new materials, and teaching-learning experiences of the researcher for the development of the vocabulary performance of the students. From the findings of this study, the activities and instructional materials would motivate other language teachers to formulate materials that have direct relevance to the unique language teaching-learning situation. Teaching vocabulary to the K to 12 BEC using direct instruction has been proven effective. It is worthwhile, therefore, for other language teachers to make use of direct instruction to teach vocabulary in implementing the K to 12 BEC.

Keywords: Vocabulary, direct instructions, language teaching, strategy

SS – 39

THE EFFECTS OF DOMESTIC AND INTERNATIONAL REMITTANCES ON THE CONSUMPTION PATTERNS OF FILIPINO HOUSEHOLDS

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This study evaluated the impact of cash remittances on the consumption behavior of Filipino middle-income class households under several expenditure categories. In this regard, evaluating the difference among households' budget, by comparing household recipients to household non-recipients, would demonstrate whether remittances resulted into a welfare gain for these Filipino families. The data utilized in this paper were the merged file of 2012 Family Income and Expenditure Survey and 2013 Labor Force Survey, consisting of 42,397 Filipino households. Propensity score matching (PSM) method was utilized in this study. It is commonly used in impact evaluation, in which the main goal is to estimate the average treatment effect (ATT) by matching the treatment group with the control group according to their similar characteristics. This treatment effect, expressed in real values, indicates the average annual increase or decrease in spending of a consumption category in relation to the receipt of the treatment variable. Three treatment variables form part in this study: receipt of international remittances, receipt of domestic remittances, and receipt of both forms of remittances. Findings from empirical analysis provided three key results: (1) there is an overall significant increase in the consumption of households receiving external remittances. ATT=P11, 054.77 (food), P1, 935.66 (health), P2, 680.20 (education), P7, 630.06 (housing and utilities), P44.95 (alcohol); (2) the highest percentage increase in consumption after receipt of remittances are attributed in health and education with 52.25% and 41.05% average increase, respectively; (3) international remittances augments Filipino households' income, and domestic remittances act as an insurance or safety net for future negative shocks. This paper suggests that remittances are beneficial not only for the national economy but also for the *social welfare development of the households* receiving it. It is also good to note that the findings relate to the idea that *long-term investments are highly prioritized* by Filipino households given their increased spending power.

Keywords: propensity score matching, average treatment effect, remittances, consumption patterns

SS – 40

**THE LEVEL OF AWARENESS, COMPLIANCE,
AND IMPLEMENTATION OF ANTI-SMOKING ORDINANCE
NO. 165, S. 1994 AMONG THE STAKEHOLDERS
OF SOLANO HIGH SCHOOL, SOLANO, NUEVA VIZCAYA**

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The information campaign on anti-smoking has advocated the message that smoking is bad for the health of every individual. Local government units have adopted national laws and formulated ordinances to strengthen the campaign. The study determined the level of awareness, compliance, and implementation of the Anti-Smoking Ordinance No. 165 s. 1994 among the stakeholders of the school. A survey questionnaire, composed of 20 items multiple choice set, was administered to the respondents. Descriptive-qualitative method, with focus group discussions, was utilized. The study revealed that students had high level of awareness of the latest national laws but had very low awareness of the municipal ordinance. There was also poor compliance of the said ordinance, as reflected on the varied cases caught in school and seen along the streets and stores. Discussion also brought out daily encounters of people who freely smoke without any hesitation. The absence of consistent implementation had led people to frequently violate the ordinance. Hence, strict compliance and implementation among the authorities must be evident. The school, being one of the implementing units, should strengthen its campaign on anti-smoking policies in order to provide a more child-friendly, safe, and motivating environment.

Keywords: anti-smoking, awareness, compliance, implementation

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TRADITIONAL USE OF RICE AS MEDICINE IN RIZAL, PALAWAN

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This study, conducted in 2016, investigated the different traditional rice varieties (TRV) commonly used for medicinal purposes in the town of Rizal, Palawan. This aimed to determine the existing local knowledge and practices on the medicinal value of TRVs. Using qualitative research methods of data collection (i.e., key informant interviews and focus group discussions), the researchers gathered data from community members, community-recognized herbalist, and barangay health workers. The knowledge level of younger generation was also surveyed among the high school students in the community. Seven TRVs were recognized as medicinal. The method of treating diseases varied and did not necessarily require eating the rice grain. Other parts of the plant, such as leaves and roots, were also used for medicinal purposes. The sicknesses being treated with TRVs include simple colds and fever, urinary tract infection, and other types of allergies. Some also use rice bran for aesthetic purposes, particularly in treating pimples, which appears to be the only familiar medicinal value among the younger ones. The common diseases treated by these rice varieties were also the recorded common causes of morbidity in the area. Further laboratory analysis is required to probe the potent components and healing properties of these TRVs. Nevertheless, the medicinal value of rice further denotes the cultural significance of these rice varieties and the continuous propagation of these rice cultivars.

Keywords: ethnobotany, rice, medicine, local knowledge

VALUING THE HINATUAN ENCHANTED RIVER UNDERWATER CAVE SYSTEM USING THE TRAVEL COST METHOD

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The Zonal Travel Cost Method was used to estimate the economic value of the Hinatuan Enchanted River Underwater Cave System, which is one of the prime tourist destinations of Surigao del Sur. It was assumed that visitors take the trip for a single purpose of wanting to visit the said recreational site. A total of 84 zones were identified based on the country's geographic division by province. The data of the total travel cost per trip for zones were analyzed using the regression analysis in the SPSS software. The equation that relates the visits per capita to travel cost has been depicted as $\text{visits}/1000 = 1.468 - 0.0000632 * (\text{Travel Cost})$. Using the equation, the demand function for the average visitor per added value to the travel cost was estimated starting from an addition of PHP 1,000.00, which can stimulate 63,738 visits. An addition of PHP 23,300 to the travel will cause the total loss of tourist visiting the site. The consumer surplus was calculated using the spandrel formula given as $(a/b)/3$ resulting in a total estimate of economic benefits. The result revealed that in a span of eight months (March–October 2017) after the reopening of the Enchanted River for its recreational uses, the total estimate of economic benefits from the site was PHP 465,730,850 or PHP 9,196 per visit (PHP 465,730,850.00/50,643). This reveals that despite its closure for more than two months and despite the new policies implemented, the site still has high recreational value and continues to generate economic activities through the tourism industry.

Jeywords: Zonal Travel Cost Method, Hinatuan Enchanted River Underwater Cave System, tourism

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VULNERABILITY OF QUIAOIT RIVER WATERSHED (QRW) COMMUNITIES TO COMMON VULNERABILITY AND EXPOSURES (CVEs)

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This study was conducted to assess the vulnerability of communities to common vulnerability and exposures (CVEs) in the Quiaoit River Watershed (QRW), Batac City, Ilocos Norte. The assessment was done through direct household surveys using the Livelihood Vulnerability Index-Intergovernmental Panel on Climate Change (LVI-IPCC) framework. Considering the diversity of socioeconomic and environmental conditions in the watershed, vulnerability analyses were done across three geographical locations (upstream, midstream, and downstream). The LVI-IPCC scale used was from -1.0 (least vulnerable) to +1.0 (most vulnerable). Results showed that communities in all the three geographical locations had negative value ranges in adaptive capacity and exposure, which indicate that they are less vulnerable. However, they would have been more vulnerable if sensitivity was considered, with a positive range from 0.43 to 0.96. Overall, downstream communities in the watershed were the most vulnerable (0.67). This is attributed to their higher sensitivity and low adaptive capacity, which is notably influenced by the high dependency ratio of both young and old population (77.54%). Midstream communities were moderately vulnerable (0.47) while upstream communities were the least vulnerable. Results clearly showed the contributory factors to vulnerability. It could be adaptive capacity, sensitivity, or exposure. Most notable factor/s must be given consideration in any effort to strengthen the communities or lessen their vulnerability to CVEs.

Keywords: vulnerability, exposure, sensitivity, adaptive capacity

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CLIMATE RISK VULNERABILITY ASSESSMENT OF MUNICIPALITIES IN ILOCOS SUR

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This study assessed and mapped the agricultural vulnerability of the province of Ilocos Sur to climate change from July 2016 to July 2017. The researchers used modeling and statistical analysis of climate impacts, climate variability, and socioeconomic variables. Four major commodities were included in the study: rice, corn, mango, and tomato. This study followed a standard framework developed by International Center for Tropical Agriculture and considered the following; (1) sensitivity index; (2) hazard index; and (3) adaptive capacity index (i.e., economic, natural, social, physical, and institutional). The weighting used for each indicator was 15% for exposure, 15% for sensitivity, and 70% for adaptive capacity. Results showed that the municipalities of Santa Catalina and San Esteban were had very high vulnerability to the impacts of climate change or climate risks. High vulnerability was observed in these municipalities, where there is a divergence of high exposure to hazards, high loss of climatic suitability in the future, and low adaptive capacity. On the other hand, the cities had lower vulnerability, where they typically ranked high among the five capitals of adaptive capacity like Vigan City and Candon City. Different capitals for the different municipalities should be increased to cope up with the hazards and to increase adaptive capacity, thereby reducing vulnerability. The identified climate resilient agricultural (CRA) practices in Ilocos Sur should likewise be applied to the highly vulnerable areas. Such CRA practices include using (1) improved variety of rice-corn rotation combined with organic fertilizer, (2) improved variety of rice-tomato rotation combined with organic fertilizer, and (3) integrated pest management for mango should be applied to highly vulnerable areas.

Keywords: vulnerability assessment, sensitivity, hazard, adaptive capacity, climate risk

