THE PHILIPPINE-AMERICAN Academy of Science & Engineering

36th Annual PAASE Meeting and Symposium (APAMS 2016)

July 8-9, 2016

Science and Engineering Hall
George Washington University
800 22nd St NW, Washington, DC 20052
USA
Website: http://apams2016.wix.com/paase

Training the Next Generation of Scientists and Engineers

BOOK OF ABSTRACTS

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Message from Xenia Tigno, President of PAASE (2016)

Xenia Tiglao- Tigno, Ph.D., M.S. (Epid)

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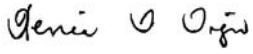
Dear Friends and Colleagues,

On behalf of the current officers and Board of Directors of the Philippine American Academy of Science and Engineering (PAASE), and the local organizing committee of the Annual PAASE Meeting and Symposium, it gives me great pleasure to welcome you to the beautiful and historic city of Washington, the District of Columbia.

Washington D.C. is arguably the political center of world affairs. This year, in addition, it will enjoy the distinction of being the epicenter of discussions related to developments in science and technology as they impact the training of the next generation of Filipino scientists and engineers, and scientists of Philippine descent. Going beyond preparing our youth to meet the challenges of the 21st century, the meeting will also review the far-reaching consequences of scientific and technological progress on the Philippine economy, health delivery, the environment, food security and the political landscape, as well as our preparedness to respond to emerging and unforeseen scientific scenarios. Finally, as we engage in the healthy exchange of ideas, identifying compelling needs, hearing new perspectives, and learning new approaches, we hope to be able to offer recommendations on how to address the most urgent issues, and provide a structure by which partnerships can be fostered, across the seas and cyberspace.

Welcome to Washington!



Message from David S. Dolling, Dean, School of Engineering and Applied Science, George Washington University

David S. Dolling

Title: Dean

Office: 2885A

Address: Science & Engineering Hall
800 22nd St, NW

Phone: 202-994-6080

Email: dolling@gwu.edu

Dear PAASE Symposium Participants:

On behalf of the faculty, staff and students of the School of Engineering and Applied Science of George Washington University I am happy to welcome you the 2016 annual PAASE meeting and symposium. We are delighted and proud to be hosting your meeting and wish you a productive and very enjoyable time. I urge you to come a day or two early, or stay over a day or two, and get to know our beautiful city, Washington DC.

I also hope that while you are here, in our fabulous new building, the Science and Engineering Hall (SEH) that you will have a chance to walk around and explore. We moved in January 2015. The light-filled and open commons spaces, the glass walled studio classrooms and teaching and research labs, all in close proximity to one another, have been designed to encourage collaboration and promote interdisciplinary education and research. These spaces, where our students and faculty teach and learn, discover and invent, are proving to be exactly what we expected of them: the enabler of our ambitions. As you walk around don't be shy about asking questions. Our faculty and students will be happy to tell you about their work.

Today, scientists and engineers are key players in meeting many of the most pressing global challenges from renewable energy to access to clean water to securing cyberspace. Success hinges on attracting the most diverse talent pool into our fields, revitalizing education, changing the societal understanding of what engineering, science and technology is, and infusing innovation and entrepreneurship into all that we do. We must all face and successfully negotiate an information explosion and fierce global competition. You all play a very important role in attaining these goals and I congratulate you, and thank you, on rising to meet these challenges.

Finally, enjoy the meeting. Ask questions, participate in discussions, meet new people and develop new and lasting friendships. Welcome to GW and Washington DC.

David S Dolling, Dean

July 8, 2016 Friday
SEH B1220: Conference Room Basement
Science and Engineering Hall, George Washington University
800 22nd St NW, Washington, DC 20052

8:00 – 8:30 AM	**Registration**
8:30 – 8:45 AM	**Introductory Remarks** Xenia Tigno, 2016 PAASE President
8:45 – 9:00 AM	**Welcome Remarks** David S Dolling, Dean GWU School of Engineering & Applied Sciences
9:00-9:45 AM	**PLENARY LECTURE** **2016 Severino and Paz Koh Lectureship Award in Engineering** Dr. Joel Cuello, The University of Arizona
9:45-10:00 AM	**STRIDE and Training of Scientists and Engineers in the Philippines** Gloria Steele Former USAID Mission Director to the Philippines
10:00-10:15 AM	**Morning Break**
10:15- 12:15 AM	**PANEL DISCUSSION 1** ***Training the Next Generation of Scientists and Engineers*** **Moderators:** Xenia Tigno and Mario Sto. Domingo ***Philippine Panelists:*** Giselle Concepcion (UP) Kathleen Aviso (De La Salle University) Fiorello Abenes, (STRIDE) ***US Panelists :*** Alice Tarun, Alfred State College, SUNY Joost Santos (GWU) Mariluz Mojica-Henshaw, (Touro College of Osteopathic Medicine, NY) ***Reactors :*** Jermelina Tupas (NSF) Philip Padilla (UP Faculty Regent)
12:15 – 1:00 PM	**Lunch Break** **GWU Science and Engineering Hall Atrium**
1:00 –2:00 PM	**POSTER SESSION** **Atrium**

	TECHNICAL SESSION 1. **Space Science and Aeronautics** Chair: Manuel Uy
2:00-2:20 PM	**S1-1** **Small Satellite Programs for Science Missions** Ann Darin
2:20-2:45 PM	**S1-2** **Vision for a Philippine Space Agency** Josefino C. Comiso
2:45–3:00 PM	**S1-3** **Sensing Earth Using Spectral Sensors (SEUSS)** Mark Boies
3:00-3:15 PM	**Afternoon Break**
	TECHNICAL SESSION 2 **Emerging Infections and Response** Chair:Peter Cowen
3:15-3:45 PM	**S3-1** **Zika Virus** Luis Castellanos
3:45-4:00 PM	**S2-2** **Phenotype Clusters of Organ Failure in Critically Ill Children** Vincent S. Faustino
4:00-4:15 PM	**S2-3** **Know Thy Enemy – How Viruses Take Over the Hosts** Anna Serquina
4:15-4:30 PM	**S2-4** **A One Health Primer: What's It All About** Peter Cowen
4:30-4:45 PM	**S2-5** **Improvement of Health Outcomes through the Health Leadership and Governance Program** Philip Padilla
	TECHNICAL SESSION 3 **Entrepreneurship** Chair, Ben de Lumen
4:45-5:05 PM	**S3-1** **My 20-year adventure in technology commercialization in the US and Philippines** Gonzalo Serafica
5:05-5:25 PM	**S3-2** **Experiences in developing fundamental research to start up companies** Carlito B. Lebrilla
5:25-5:45 PM	**S3-3** **Entrepreneurship in Academia** Ben O. de Lumen
6:00- 8:00 PM	**Dinner** **Bestowing of the 2016 Severino and Paz Koh Lectureship Award and Induction of New Members** Atrium

July 9, 2016, Saturday
SEH B1220: Conference Room, Basement
Science and Engineering Hall, George Washington University

8:00 - 8:30 AM	**Late registration / Poster Session Continued**
	PANEL DISCUSSION 2 ***Bt Eggplant in the Philippines: R&D, Testing, Politics and Progress*** **Moderator:** Joel Cuello
8:30-8:40 AM	Joel Cuello - **Overview**
8:40-8:50 AM	Salvador Tarun - **Environmental Safety**
8:50-9:00 AM	Gonzalo Serafica - **Intellectual Property**
9:10-9:15 AM	Joel Cuello - **Challenges Going Forward**
9:15-9:30 AM	**Question and Answer**
	TECHNICAL SESSION 4 Chemistry Chair: Leah Tolosa Croucher
9:30-9:50 AM	**S4-1** **Understanding the glycocalyx interface in host-microbe interactions** Carlito B. Lebrilla
9:50-10:10 AM	**S4-2** **Enzymatic Fingerprinting and Modification of Acetylated Pectins** Connie A. Remoroza
10:10-10:30 AM	**S4-3** **Bio-Inspired Scanning Ion Conductance Microscopy (Bio-SICM) for Simultaneous Conductance and Specific Molecular Imaging** Florika C. Macazo
10:30-10:50 AM	**S4-4** **Characterization of a Novel Turripeptide from *Unedogemmula bisaya* Venom: Structure and Biological Activity** Gisela P. Concepcion
10:50 – 11:00 AM	**Morning Break**

	TECHNICAL SESSION 5 **Biotechnology** Chair: Leah Tolosa Croucher
11:00-11:20 AM	**S5-1** **In-Depth Characterization of Protein Assemblies by Native Mass Spectrometry** Paul Dominic B. Olinares
11:20-11:40 AM	**S5-2** **Analysis of Small Molecule Components in a CHO Cell-Free Protein Expression System** Chariz Peñalber-Johnstone
11:40 AM- 12:00 PM	**S5-3** **A Fiber Optic Biosensor for Non Invasive Transdermal Glucose Sensing Based on the Glucose Binding Protein** Leah Tolosa Coucher
12:00-1:00 PM	**Lunch** Atrium
	TECHNICAL SESSION 6 **Biological/Biomedical Sciences** Chair, Sevilla Detera-Wadleigh
1:00-1:20 PM	**S6-1** **Characterization and Targeting of Melanoma Stem/Initiating Cells** Cynthia M. Simbulan-Rosenthal
1:20-1:40 PM	**S6-2** **The Role of TRAIL in Cancer-Related Fatigue Following Radiation Therapy** Leorey N. Saligan
1:40-2:00 PM	**S6-3** **Targeted Delivery of Antioxidant Peptides to the Pulmonary Arteries in Rodent Models of Pulmonary Hypertension** Leah R. Villegas
2:00-2:20 PM	**S6-4** **Effects of Electromyography Biofeedback Training on Scapular Kinematics** Jun G. San Juan
2:20-2:40 PM	**S6-5** **The RIPping of the veil: discovering new roles for the RIP2 kinase** Justine T. Tigno-Aranjuez
2:40-3:00 PM	**S6-6** **Human Microphysiological Systems: Tissues-on-Chips for In Vitro Efficacy, Safety, and Toxicity Testing** Danilo A. Tagle
3:00-3:15 PM	**Afternoon Break**

	TECHNICAL SESSION 7 **Physics, Mathematics and Engineering** Chair: Danilo Romero
3:15-3:30 PM	**S7-1** **P-graph Approach for Optimizing Operations of Input-Output Systems under Crisis Conditions** K.B. Aviso
3:30-3:45 PM	**S7-2** **Inoperability input-output approach to climate vulnerability assessment of economic systems** K.D.S. Yu
3:45-4:00 PM	**S7-3** **On Playing with Green Materials at Gamers Club** M.A.B. Promentilla
4:00-4:15 PM	**S7-4** **A Comparative Analysis of Moringa Oleifera Protein Adsorption on Carbon-Based Adsorbents** Sheree Pagsuyoin
4:15-4:30 PM	**S7-5** **Characterization of Some Nutraceutical Products (Bee Propolis and Tea Samples) from the Philippines** Elmer-Rico E. Mojica
4:30-5:30	**Business Meeting**
6:00-8:00 PM	**Dinner** **Kennedy Center Café**

RE-STRUCTURING PUBLIC HIGHER EDUCATION IN THE PHILIPPINES: A NEW FRAMEWORK FOR 21ST CENTURY RESEARCH, TEACHING, AND LEARNING

Fiorello B. Abenes, PhD
Emeritus Professor, CalPoly University, Pomona, CA 91768
Faculty and Institutional Development Manager, STRIDE, Manila, Philippines

Developing a comprehensive framework for 21st century research, teaching and learning (RTL) requires more than just identifying specific skills, content knowledge, expertise and literacies. The K +12 program, implemented by the Philippine Department of Education in 2016, seeks to achieve mastery of key subjects and themes including world languages, arts, mathematics, economics, science, geography, history, government and civics. But what and how about higher education? What adjustments should higher education make to become purveyors of 21st century RTL and accommodate these more mature, more highly educated high school students entering Public Universities starting 2018? In addition to revamping Baccalaureate and Graduate level curricula, what systems must be created to help students and faculty master the multi-dimensional requirements of 21st Century research, teaching and learning? The California Master Plan for Higher Education can be a model for restructuring public higher education in the Philippines. Three specific ideas are explored, including: (1) establishment of a University of the Philippines System that will have campuses in all 17 Regions of the Philippines as sole providers of PhD and Professional degrees; Philippine State Universities located in all 81 Provinces of the Philippines that will offer degrees up to the Master's level, and Philippine Community Colleges located in all 145 cities of the country offering remedial courses, Associate Degrees and host the Technical Education and Skills Development Authority; (2) Re-structuring the career tracks of faculty in higher education to include a tenure system that addresses de-loading issues; and (3) Re-structuring DOST, ERDT and CHED Graduate Scholarships to create 2000+ new research manpower in the country.

POSTER PRESENTATIONS

	Title	Presenter
P1	**INCORPORATING BIOINFORMATICS AND GENOMICS IN UNDERGRADUATE BIOLOGY- NEW AVENUE FOR INQUIRY-BASED RESEARCH**	Alice Saliba-Tarun
P2	**SCHEIMPFLUG STUDIES ON CORNEAL CLOUDING IN LCAT (LECITHIN-CHOLESTEROL ACYLTRANSFERASE) DEFICIENCY**	Patricia E. Cabrera
P3	**OPTIMIZATION OF PCR PROTOCOLS FOR THE AMPLIFICATION OF COI, ITS, AND 18s GENES IN GREEN MUSSEL, *Perna viridis* (Linnaeus, 1758)**	Philip Ian P. Padilla
P4	**7,8-DIDEOXYGRISEORHODIN C ISOLATED FROM MARINE BACTERIA WORKS SYNERGISTICALLY WITH OXACILLIN AGAINST METHICILLIN-RESISTANT *Staphylococcus aureus***	Gisela P. Concepcion
P5	**SYNERGISTIC CYTOTOXICITY OF RENIERAMYCIN M AND DOXORUBICIN IN MCF-7 BREAST CANCER CELLS**	Gisela P. Concepcion
P6	**MANUAL CURATION IN THE CONSERVED DOMAIN DATABASE**	Noreen Gonzales
P7	**LOW-COST TECHNIQUE IN DEHYDRATING AZEOTROPE ETHANOL** (A Proposed Post-Doctoral Research Study)	Roque Antonio Ulep
P8	**RECOVERY POINT OF YEAST IN FERMENTATION** (A Proposed Post-Doctoral Research Study)	Roque Antonio Ulep
P9	**THE DEVELOPMENT OF A PASSIVE ASSISTIVE LUGGAGE ROBOT**	Paolo Fermin and John Quilty

PLENARY LECTURE
Introduction by: Gonzalo Serafica

2016 Severino and Paz Koh Lectureship Award in Engineering

The Rise of Wiki-Engineering in the Second Great Age of Scientific Convergence: From Space Life Support to Photobioreactor Design to Vertical Farming

Joel L. Cuello

Professor of Biosytems Engineering
The University of Arizona
cuelloj@email.arizona.edu

Abstract

The great confluence from the 18th to the 20th century of the classical practices of science and engineering originating from antiquity – physics, mathematics, engineering, physiology and medicine – gave birth to modern chemistry, biology, all the modern fields of engineering, and the whole array of scientific disciplines that are universally recognized today. This *First Great Age of Scientific Convergence* precipitated unprecedented discoveries and technological advances, fueling successive scientific revolutions, including industrial, agricultural, biotechnological, information, etc., that have worked to reshape irreversibly the human condition.

Meanwhile, this early part of the 21st century constitutes the *Second Great Age of Scientific Convergence* wherein each science and engineering discipline deliberately pulls content (knowledge, technologies, skills, tools) from other disciplines to collaboratively work out theories, approaches and strategies to advance discovery or forge innovative design solutions. In contrast to the earlier age of convergence wherein the intersection of disciplinary domains and contents transpired passively and at a prodigiously glacial pace, catalyzing the exchanges between disciplinary domains today in this current age of convergence happens proactively, collaboratively and swiftly -- rendering 21st-century science and engineering as veritable "wiki-science" and "wiki-engineering." "Wiki" here denotes the deliberate selection and transference of content across disciplinary boundaries in a proactive, collaborative and speedy manner. Indeed, how well a science or an engineering discipline sustains its growth today and over the long term depends on how well it is able to recast itself as a wiki-science or wiki-engineering discipline that operates with a thoroughgoing wiki strategy.

This lecture will elucidate the author's own account of wiki-engineering in three areas of his research over the last 20 years:

- Bioregenerative Space Life Support
- Design of Photobioreactors for Mass Production of Microalgae for Production of Biofuels, Nutraceuticals and other High-Value Products
- Design of a new Paradigm for Vertical Farms

Ultimately, and quite logically, the current age of wiki-convergence in the sciences and engineering results, not only in the present forms of science and engineering disciplines that are by nature collaboratively acquisitive of contents - - but also in the building of entire science and engineering innovation ecosystems. These innovation ecosystems, larger than and transcending the boundaries of established disciplines, patently subsist by deliberately pulling and acquiring contents from disparate sources and -- with intellectual creativity matched with proper financial investments -- create unprecedented and seemingly unbounded economic value through technological innovations for both individuals and entire nations. Built innovation ecosystems constitute the natural aggregate and extension of wiki-convergent science and engineering disciplines in the current *Second Great Age of Scientific Convergence*.

PANEL DISCUSSION 1

Training the Next Generation of Scientists and Engineers

Moderators: Xenia Tigno and Mario Sto. Domingo

Philippine Panelists:
Giselle Concepcion (UP)
Kathleen Aviso (De La Salle University)
Fiorello Abenes, (STRIDE)

US Panelists :
Alice Tarun, Alfred State College, (SUNY)
Joost Santos (GWU)
Mariluz Mojica-Henshaw (Touro College of Osteopathic Medicine, NY)

Reactors :
Jermelina Tupas (NSF)
Philip Padilla (UP Faculty Regent)

POSTERS

P1

INCORPORATING BIOINFORMATICS AND GENOMICS IN UNDERGRADUATE BIOLOGY- NEW AVENUE FOR INQUIRY-BASED RESEARCH

Alice Saliba-Tarun
Physical & Life Sciences, Alfred State College SUNY, Alfred, NY 14802

The science of Genomics and Bioinformatics have revolutionized the field of biological research in the 21st century. The availability of bioinformatics online resources and genomic databases make it possible for teachers to incorporate coursework and activities that allow students to conduct research problems in genomics using bioinformatics tools. I recently developed a project based-learning course on genomics that combined lectures on the science and ethical, legal and social implications (ELSI) of genomics with hands-on lab activities on bioinformatics and DNA analysis. Using bioinformatics tools available at the Microbial Genome Annotation Network (http://www.geni-act.org/), the students gained foundational bioinformatics skills and experience first had the concepts of gene and genome structure by annotating genes from *the bacterium Glaciecola psychrophila,* a novel psychrophilic bacteria isolated from an arctic glacier. The students carried out a *DNA Barcoding project to catalog and identify native trees growing on campus. Lastly, the students isolated their genomic DNA, submitted it for sequencing and analyzed the sequence to determine their maternal genetic ancestry. Future plans for the course are to incorporate analysis of the personal genome of students who are interested in having their genome analyzes and to provide a follow-up independent research course for students to do functional genomics.*

P2

SCHEIMPFLUG STUDIES ON CORNEAL CLOUDING IN LCAT (LECITHIN-CHOLESTEROL ACYLTRANSFERASE) DEFICIENCY

Patricia E. Cabrera MD, Manuel B. Datille III MD, Debbie Payne BS MBA, Rachel J. Bishop MD, J. Fielding Hejtmancik MD PhD, Robert Shamburek MD
National Eye Institute, National Institutes of Health, Bethesda
National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda

Corneal opacification in partial or complete Lecithin:cholesterol acyltransferase (LCAT) deficiency is caused by the deposition of unesterified cholesterol and phospholipid in the cornea. It is commonly the initial presenting symptom of this disease. Corneal densitometry analysis, wherein the amount of backscattered light in the different regions of the cornea is mapped, can be an objective means of detecting and monitoring corneal haze. The purpose of this study is to characterize corneas in LCAT deficiency using Scheimpflug imaging. We studied 5 patients with LCAT deficiency aged 17 to 36 years of both sexes. Complete eye exams and Pentacam Scheimpflug imaging was performed under an NIH-IRB-approved protocol. Tenets of the Helsinki Declaration were followed. Three patients aged 17-18 years had mean corneal densitometry of 43.93 +/- 1.61 pixel units and mean central corneal thickness (CCT) of 499.5 +/- 29.6 um. Two patients aged 35-36 years had mean corneal densitometry of 57.98 +/- 4.11 pixel units and mean CCT of 860.25 +/- 91.73 um. Patients had greater opacification peripherally than centrally and greater opacification anteriorly than posteriorly. Pentacam Scheimpflug measurements showed increasing corneal opacity with aging in LCAT deficiency. Our findings suggest the usefulness of this imaging method to monitor efficacy of LCAT enzyme replacements in possible reversal of the corneal opacities in future clinical trials.

P 3

OPTIMIZATION OF PCR PROTOCOLS FOR THE AMPLIFICATION OF COI, ITS, AND 18s GENES IN GREEN MUSSEL, *Perna viridis* (Linnaeus, 1758)

Philip Ian P. Padilla[1,2], Venice Hulleza[1,2], Mayflor Sibunga[2], and Jane Geduspan[1,2]

[1]Division of Biological Sciences, College of Arts and Sciences, [2]National Institute of Molecular Biology and Biotechnology, University of the Philippines Visayas, Miag ao, Iloilo

Green mussel (*Pena viridis*) production in the Philippines has been lagging behind its Southeast Asian neighbors during the past decade. To further increase its population for increased production, there is a need to better understand its reproductive biology and genetics. Screening for specific genetic biomarkers will be the basis for genetic breeding and selection among all the different strains in the Philippines. This study aims to optimize the PCR conditions for the amplification of three selected genes which include cytochrome oxidase I (COI), 18s rDNA, and the Internal Transcribed Spacer (ITS) region of the rDNA to genetically characterize mussel populations in the Philippines. Genomic DNA was extracted from mantle and gonad tissues of mussels collected from different sites in the country using the standard phenol-chloroform-isoamyl method. The optimum annealing temperatures for the amplification of the three genes were 52°C for COI, 60°C for 18s and 65°C for ITS. The amplicon sizes generated were approximately 2400 bp for 18s and 800 bp for both COI and ITS. The optimized PCR protocols for the amplification of these genes were used in the analysis of mussel samples from different sites. The data on the genetic variation of mussel populations can be useful in developing molecular markers to characterize and identify mussel populations for a selective breeding program.

Keywords: *Pernia viridis (*Linnaeus 1758*)*, Green Mussel, Genetics, Selective Breeding, Biomarkers

P4

7,8-DIDEOXYGRISEORHODIN C ISOLATED FROM MARINE BACTERIA WORKS SYNERGISTICALLY WITH OXACILLIN AGAINST M ETHICILLIN-RESISTANT *Staphylococcus aureus* Gisela P. Concepcion[1], Joshua Rey P. Torres[1], Jortan O. Tun[1], Malem S. Flores[1], Mary Ann Ammon[1], Eric Schmidt[2], Margo Haygood[2]

[1]The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines

[2] Department of Biology, University of Utah, Salt Lake City, UT, USA

Three griseorhodin compounds, griseorhodin C, griseorhodin A and 7,8-dideoxygriseorhodin C were isolated from a *Streptomyces*sp. associated with the marine gastropod, *Truncatella*sp. Anti-methicillin-resistant *Staphylococcus aureus* (MRSA) activity was followed through a series of chromatographic steps and led to the purification of the compounds. HSQC and HMBC data for 7,8-dideoxygriseorhodin C allowed the reassignment of methylene protons at positions 7 and 8 as well as several carbons forming the naphthoquinone, isocoumarin ring and spiroketal center. The 7,8-dideoxygriseorhodin C compound was found to inhibit the growth of MRSA with a Minimum Inhibitory Concentration (MIC; 97-100% inhibition) of 0.16-0.25 µM as determined by the antimicrobial broth microdilution assay. In addition, the compound along with oxacillin acts synergistically against MRSA. When both compounds are combined at their MIC molar ratio, the individual MICs of both compounds are lowered significantly, thus indicating synergism.

Truncatella sp. *Streptomyces* sp.

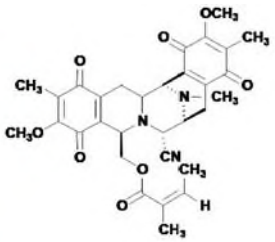
This work is part of the **P**hilippine **M**ollusk **S**ymbiont **I**nternational **C**ooperative and **B**iodiversity Group (**PMS ICBG**) program funded by the US National Institute of Health grant number **U01TW008163,** US Department of Energy and the National Science Foundation.

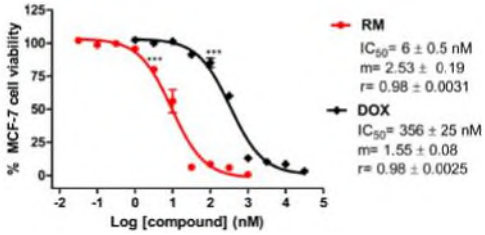
P 5

SYNERGISTIC CYTOTOXICITY OF RENIERAMYCIN M AND DOXORUBICIN IN MCF-7 BREAST CANCER CELLS

Gisela P. Concepcion[1], Jortan O. Tun[1], Lilibeth A. Salvador-Reyes[1], Naoki Saito[2]
[1]The Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines
[2] Meiji Pharmaceutical University, Kiyose, Tokyo, Japan

Renieramycin M (RM) is the major metabolite isolated from a blue *Xestospongia* sp. sponge, with nanomolar $_{IC50s}$ against breast and other cancer cell lines. Our goal is to evaluate its combined effects with the currently used drug doxorubicin (DOX). MCF-7 cells were treated simultaneously or sequentially with various molar combination ratios of RM and DOX for 72 hours. Cell viability was determined using the MTT assay and xCELLigence system. Synergistic cytotoxicity was observed at simultaneous administration of RM and pharmacologically achievable concentrations of DOX (<1000 nM), and was evident at concentrations that kill 95% of the cancer cells, thus, is of clinical relevance. Consequently, the required $_{IC95}$ for RM and DOX after combination were reduced by up to 4-fold and 8-fold, respectively. Cell cycle analysis of the synergistic drug combination revealed an accelerated exit from the G2/M phase, thereby increasing sub-G1 or cell death. Synergistic cytotoxicity is reflected well by the increase in apoptotic induction after combination treatment. This study provides a rationale for extending the evaluation of combination with RM to other antineoplastic agents or targeted therapies not only in breast cancer cells, but also in other cancer cells. It also serves as basis for designing prospective studies in animal models.





This project is an In-house project at the Marine UP Diliman.Science Institute in UP Diliman.

P 6

MANUAL CURATION IN THE CONSERVED DOMAIN DATABASE

Gonzales NR, Chitsaz F, Derbyshire MK, Geer L, Gwadz M, Han L, He J, Hurwitz DI, Lanczycki CJ, Lu F, Marchler GH, Song JS, Thanki N, Wang Z, Yamashita RA, Zheng C, Bryant SH, Marchler-Bauer A.

Computational Biology Branch, National Center for Biotechnology Information, National Library of Medicine, National Institutes of Health, 8600 Rockville Pike, Bethesda, MD 20894, USA

The Conserved Domain Database (CDD) is a collection of multiple sequence alignments that represent ancient conserved domains. One part of the CDD resource is a mirror of publicly available domain model collections, including Pfam and TIGRFAMs, among others. These may be used as starting points for manually-curated conserved domain models (accessions with a “cd” prefix) arranged in a hierarchical structure to reflect evolutionary diversification of ancient protein domain families. Most curated models contain annotation of features that are conserved across the domain family, supported by evidence obtained from 3D structures as well as the published literature. Curated domain family models are also created de-novo for previously uncharacterized families, often identified via novel 3D structures with no conserved domain annotation. Hierarchical classification and curation of protein domains, using our in-house tools CDTree (hierarchy viewer) and Cn3D (structure viewer and multiple alignment editor), have been the focus of our manual curation efforts. In addition, we develop structural motif models (accessions with an “sd” prefix) to represent protein sequence segments such as short repeats, coiled coils, and transmembrane regions. We also manually validate superfamily clusters (accessions with a “cl” prefix), formed by an automated clustering procedure as sets of conserved domain models that generate overlapping annotation on the same protein sequences. Superfamily clustering allows the organization of data within CDD in a non-redundant way, as each data source may have its own model for a specific conserved domain. Cluster validation is aided by using Cytoscape as a visualization tool for the degree of overlap between conserved domain models. More recently, our manual curation efforts are focused on providing functional labels for domain architectures, using an in-house procedure called SPARCLE ("Specific ARChitecture Labeling Engine"). While we are able to assign functional labels to a large fraction of proteins, we have also identified areas of insufficient coverage and resolution of the current protein domain models that comprise CDD. In this poster, we will discuss all aspects of manual curation in CDD. The need for manual curation work always exceeds available resources and we hope to automate hierarchical classifications to some degree in the near future.

Acknowledgement

This research was supported by the Intramural Research Program of the National Library of Medicine, NIH.

P 7

LOW-COST TECHNIQUE IN DEHYDRATING AZEOTROPE ETHANOL

(A Proposed Post-Doctoral Research Study)

Roque Antonio Ulep, Praveen Venkata Vadlani and Fiorello B. Abenes
Bioprocessing and Renewable Energy Laboratory, Kansas State University

A mixture that exists as 95% ethanol and 5% water obtained through simple distillation is considered as an azeotrope ethanol. The bond between the ethanol and water in the mixture is physical in nature, but further distillation is not possible to obtain higher concentration. Higher concentrations of ethanol may be obtained by introducing a ternary compound that will attract the water and can be distilled to leave absolute ethanol. Other techniques will include the use of desiccants such as calcium oxide or molecular sieves such as zeolites and membrane filtration to increase the ethanol concentration. All of these methods increase the cost of producing absolute ethanol. The importance of removing the 5 % water in azeotrope ethanol will support the Philippine Biofuels Act of 2006 (R.A. 9637) which specifies the use of anhydrous ethanol in gasohol blends

In this study, 95% hydrous ethanol will be subjected to dehydration to produce absolute ethanol using common nails as dehydrating agent. Applying the principle of “Excess and Limiting Reagents”, it is believed that the water present in the ethanol-water mixture will be removed. The ethanol will be considered as the excess reagent and the amount of common nails to be added will be in excess in the dehydration process. The amounts of the two reactants will be based on the stoichiometric ratio of ethanol and water. In this study, experimental trials will be conducted and the following parameters will be measured and monitored periodically; a) concentration of ethanol, b) volume of H_2 liberated during the reaction, and c) initial and final volume of the mixture. After dehydration, the ethanol mixture will be purified by separating the residue that will include the Fe_2O_3 and the unreacted common nails in the mixture. The dehydrated ethanol will be characterized to determine its purity.

This proposed post-doctoral research is sponsored by USAID through STRIDE.

P8

RECOVERY POINT OF YEAST IN FERMENTATION
(A Proposed Post-Doctoral Research Study)

Roque Antonio Ulep, Praveen Venkata Vadlani and Fiorello B. Abenes
Bioprocessing and Renewable Energy Laboratory, Kansas State University

The conversion of sugar to ethanol via fermentation process requires the intervention of yeast, which, in the fermentation process, is not considered as a reactant but as a catalyst. The yeast is added to enhance the fermentation process and assumed to be expended during the process but retains its amount and identity after completing the reaction. Theoretically then, the recovery of yeast for further use will certainly result not only in a considerable amount of savings but also in the further optimization of fermentation protocol.

Phase I of the study will be conducted to determine the recovery point of yeast in fermentation process. Specifically, the following questions will be answered; a) what is the optimum level of yeast during fermentation in a mixture that will contain limited and excess amount of sugar?; b) after fermentation, what is the effect of sugar added into a mixture with no unreacted sugar?; a) after fermentation, what is the effect of yeast added into a mixture with unreacted sugar?; d) is there a significant difference between the rates of fermentation of a mixture with no unreacted sugar and a mixture with unreacted sugar?,

Phase II of the study will be the recovery of yeast in fermentation. The yeast will be separated from the mixture before its dormant stage and it will be based on the data obtained in Phase I. The setup used in Phase I will be duplicated and fermentation process will be performed. When the recovery point of the yeast is attained in the different trials, fermentation process will be terminated and recovery of the yeast will be conducted employing gravity flow technique. The yeast will be washed with distilled water, oven dried and will be weighed. The percent recovery will then be determined and it will be characterized.

Phase III of the study will be the utilization and measurements of the performance of the recovered yeast. This proposed post-doctoral research is sponsored by USAID through STRIDE.

P 9

THE DEVELOPMENT OF A PASSIVE ASSISTIVE LUGGAGE ROBOT

Paolo Fermin, John Quilty West Potomac High School

Disabled or elderly people often have difficulty carrying luggage or other heavy items through airports. The proposed solution is a robotic luggage cart, programmed to track the user's movement with ultrasonic sensors, and to follow the user by driving two electric scooter motors differentially. This cart shall be called the Passive Assistive Luggage, or PAL. The tracking process uses three ultrasonic sensors - one worn by the user, and two mounted on the PAL. The time it takes for an ultrasound wave to travel from the user's transmitter to the PAL's two receivers is stored as two values in microseconds. The difference between these two values determines how the motors are driven relative to each other. Driving the motors at different rates pivots the device towards the user. This process is repeated multiple times per second for continuous, precise movement. To achieve this concept in practice, the researchers decided upon an approach that used a combination of Arduino microcontroller processing and external circuitry in order to capture data from the ultrasonic sensors and convert it into motor movement. Possible applications for the PAL range far beyond just carrying luggage. A simple and cheap method to track a user without cameras or smartphones opens up many possibilities, from public consumer usage to military applications

Session 1. Space Science and Aeronautics

Chair: Manuel Uy

S1-1.

SMALL SATELLITE PROGRAMS FOR SCIENCE MISSIONS

Ann Darrin
Space Exploration Sector, Johns Hopkins University Applied Physics Laboratory
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Is the dream of affordable science observations from small sats, in particular cubesats, viable? What is the science potential of these small satellites?

CubeSats have emerged as a space-platform defined in terms of (10 cm x 10 cm x 10 cm)- sized cubic units of approximately 1.3 kg each called “U’s.” These have generally been used as education projects at US and European Universities to train students to the challenges of real-world engineering practices and system design. There spread has been to government and commercial entities.

This talk will focus on the scientific potential of small satellites for Earth and Space Science including an overview of the RAVEN science demonstration at the Johns Hopkins University Applied Physics Laboratory (Advancing Climate Observation: Radiometer Assessment using Vertically Aligned Nanotubes (RAVAN)). What are the limitations of these very small satellites in terms of size, power and aperture? Where might we achieve scientific observations on a very small budget? Hundreds of CubeSats have been launched to date and seven nations are providing Launch capabilities.

The talk will close by summarizing the recent National Academies report on Achieving Science with CubeSats and address the opportunities for smaller nations to access Earth Observing Science Missions.

S1-2.

Vision for a Philippine Space Agency

Josefino C. Comiso
NASA Goddard Space Flight Center, Greenbelt, MD

Concerns about environmental and climate change have caused a shift in the thinking of many decision makers in several countries towards greater utilization of space technology. The currently observed negative impacts of climate and environmental changes are expected to become even worse in the future and have made many countries to invest heavily in promoting their own space program and have a system dedicated to the unique needs of their country. The recent launch of Diwata satellite is a manifestation of the recognition of the Philippine government that space technology is also needed by the country to be more effective in managing its resources, monitor changes in the environments and more accurately forecast weather and impending extreme events. The country is currently planning to establish a space agency tailored to the specific needs of the Filipinos. Investments required for space technology are very high and before such investments are made there is a need to have a good understanding of the scientific and economic merit of the various options that are available and affordable to optimize returns that benefits the country. This talk will emphasize on my vision for such a space agency based on my experiences and observations as a senior scientist at NASA for several years. The vision would ensure a good balance of near-term versus long-term needs and the ability to take advantage of data and technical resources that are already made available by other countries.

S1-3.

Sensing Earth Using Spectral Sensors (SEUSS)

Mark Boies[1], O. Manuel Uy[2], and Josefino Comiso[3]

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A unique opportunity exists for the development and deployment of a remote sensing platform on the International Space Station (ISS). The sensor suite will consist of Multi- and Hyper-Spectral Imagers (MSI & HSI), a high-resolution panchromatic imager (PCI), and a Mid-wave Infrared (MWIR) Imager used for forest fire monitoring. This sensor suite will be used by Southeast Asian universities and governments to augment crop yield estimates, marine health, and disaster assessment. Philippine Universities will have access to the data to perform research on climatology, marine and agricultural science. The mission will be a cooperative effort between the US and multiple SE Asian countries. The payload will optimally be deployed on the JAXA exposed facility on the ISS. It will have $\pm$30 degree unobstructed view of the Earth and will be capable of monitoring any point in the Philippines every 3-6 days. This viewing rate is significantly higher than the Landsat revisit rate (every 16 days) and will have similar or better ground sample distances.

SESSION 2. Emerging Infections and Response

Chair: Peter Cowen

S2-1

Dengue, Chikungunya, Zika and other vector-borne diseases (VBD): surveillance and response in Latin America and the Caribbean: the role of the Pan American Health Organization

Luis G. Castellanos, MD, PhD, MPH
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Neglected, Tropical and Vector-borne Diseases
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This goal of this lecture is to explain the role of the Pan American Health Organization (PAHO) in support of the prevention, control and elimination of vector-borne diseases in the American continents.

PAHO can be considered a coalition encompassing 30% of Earth's land mass and 14% of the world's current population. With 28 country offices in 35 countries, PAHO's scope has also continued to grow. The initial focus on controlling epidemic diseases has broadened to non-communicable diseases, better health education, health systems and services, essential medications, mental health and many other fields that include environmental improvements designed to help all populations, especially communities in need.

The Pan American Health Organization (PAHO) is the world's oldest international public health agency continuously working for the public health and wellbeing of the Americas. Vector borne diseases (VBD) have been a historical public health challenge to the Americas and they continue to be a significant threat. Noteworthy, the evolving changes of the world and the current dynamics of migration, trade and commerce have facilitated the speed and spread of VBD. Arboviruses like dengue, chikungunya, zika, yellow fever and west Nile virus represent the current most challenging public health concern among VBD in the Americas.

Countries in the Americas have also historically been leaders in preventing, controlling and eliminating vector-borne diseases as public health problems, great examples of this are malaria in the Caribbean, yellow fever in the Region and most recently onchocerciasis from Colombia, Ecuador, Mexico and Guatemala.

PAHO has been instrumental, supporting countries in preparedness, prevention, control and elimination of vector-borne diseases, always in collaboration with governments and partners. Vector-borne diseases will continue to be a dynamic public health threat to countries in the Americas; therefore, the commitment and financial support from governments and international stakeholders to prevent further spread and strive for elimination is essential.

S2-2.

PHENOTYPIC CLUSTERS OF ORGAN FAILURE IN CRITICALLY ILL CHILDREN

E. Vincent S. Faustino, MD, MHS
Section of Pediatric Critical Care Medicine, Yale School of Medicine, New Haven, CT

Multiple organ dysfunction syndrome (MODS), defined as simultaneous occurrence of =2 organ system failures, occurs in 3-90% of children admitted at the pediatric intensive care unit (PICU). It is associated with 10-94% hospital mortality. MODS occurs in children with severe sepsis, trauma, and after cardiopulmonary bypass. With improvements in the care of critically ill children, the aim of this study is to identify phenotypic clusters of critically ill children based on the trajectories of organ failure. Identification of these clusters may provide novel insights into the pathophysiology and treatment of MODS, and improve prognostication in critically ill children.

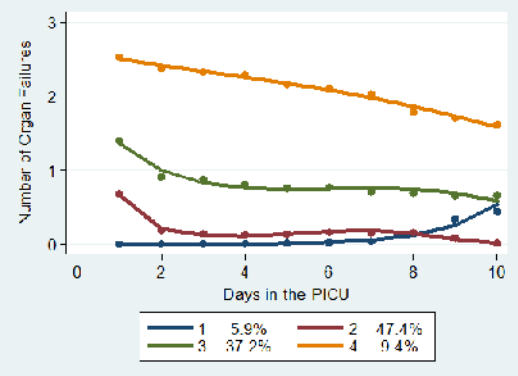

Figure. Clusters of critically ill children based on trajectories of organ failure. The percentages correspond to the proportion of children in each cluster.

We analyzed 3,628 children <18 years old who were admitted at the PICU of Yale-New Haven Children's Hospital from January 1, 2011 to December 31, 2015. Using organ failure as defined in the Pediatric Logistic Organ Dysfunction score and group-based trajectory modelling, we identified 4 clusters with different trajectories of organ failure (Figure). Cluster 1 had no organ failure on admission but developed organ failure while admitted. Clusters 2 and 3 had organ failure on admission, which seemed to improve. The number of organ failures was higher in cluster 2 than in cluster 3. Cluster 4 had MODS on admission and continued to have organ failure while admitted. The characteristics and outcomes are different among clusters (Table).

In summary, we identified 4 clusters of critically ill children based on trajectories of organ failure. Clusters are likely different in developing countries, such as the Philippines, and should be studied.

***Figure**. Clusters of critically ill children based on trajectories of organ failure. The percentages correspond to the proportion of children in each cluster.*

Table. Characteristics of children in each cluster

Characteristics	Cluster			
	1	2	3	4
Age (months)	62.6	71.7	67.3	53.0
Sepsis (%)	0	1.1	5.8	12.6
Trauma (%)	0	7.5	5.6	7.6
Bypass (%)	0	5.5	9.6	9.1
Mortality (%)	20	0.1	1.4	19.8

S2-3.

Know thy enemy - How viruses take over the host

Anna Serquiña
HIV and AIDS Malignancy Branch
National Cancer Institute, National Institutes of Health

Viruses are intracellular parasites comprised of genetic material and a protective protein core. They subvert the host machinery to supply whatever function they lack in propagating themselves. The study of cellular factors targeted by viruses is a rational approach in discovering novel therapeutic targets for antiviral drug development. In this talk, I will present studies on two different viruses and how they co-opt the host cellular machinery.

Human Immunodeficiency Virus Type 1 (HIV-1) is the causative agent of Acquired Immunodeficiency Syndrome (AIDS), currently the leading cause of death from infectious diseases. Apolipoprotein B mRNA editing enzyme catalytic subunit 3G (APOBEC3G) is from the family of cytidine deaminases known to keep endogenous retroviruses and retrotransposons at bay to maintain stability of the human genome. APOBEC3G targets Vif-deficient HIV-1 particles and renders them noninfectious, partially through deaminase-dependent hypermutation of the provirus during reverse transcription. APOBEC3G largely localizes in mRNA processing (P) bodies, cytoplasmic structures involved in RNA metabolism. Here we explore the significance of APOBEC3G localization in P bodies. We found that disrupting P bodies does not affect virion incorporation of endogenous APOBEC3G, implying that the APOBEC3G fraction in P bodies is not directly involved in the production of nascent, non-infectious particles. We also study UPF1, another host protein encapsidated by HIV-1. It is an essential protein mainly studied for its role in nonsense-mediated decay (NMD) pathway and belongs to the same helicase superfamily as MOV10, a recently identified antiviral factor. We found that UPF1 is incorporated in HIV-1 virions in a nucleocapsid-dependent manner and is required for singlecycle infectivity at an early, post-entry step of the viral life cycle. This novel function of UPF1 most likely does not involve NMD since depletion of UPF2 does not affect viral infectivity.

Kaposi's Sarcoma-associated Herpesvirus (KSHV, Human Herpesvirus-8) alters the metabolism of latently infected cells, resulting in increased aerobic glycolysis (Warburg effect), increased fatty acid synthesis, and increased glutaminolysis. KSHV modulates host pathways partly through utilization of its viral microRNAs (miRNAs), short noncoding RNAs that are encoded in the latency locus. Recently, we reported that KSHV miRNAs repress HMGCS1 (3-hydroxy-3- methylglutaryl-CoA synthase 1), an enzyme in the mevalonate pathway, which is an important metabolic pathway that includes cholesterol biogenesis and isoprenoid synthesis, which results in prenylation of proteins for membrane localization. Reports from other groups have shown that infection by several viruses (such as hepatitis C virus, murine cytomegalovirus, measles) suppresses the mevalonate pathway, causing decreased cholesterol. Whether this is part of an antiviral response, or induced by the virus, has been the subject of ongoing work by several groups. Here, I will discuss our progress in finding and validating additional host targets of KSHV viral miRNAs in the mevalonate/cholesterol biogenesis pathway and understanding why this oncogenic virus modulates this pathway.

S2-4.

A ONE HEALTH PRIMER: WHAT'S IT ALL ABOUT

Peter Cowen

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One Health embraces the notion that a holistic approach to recalcitrant problems in health and the emergence of disease will yield better solutions if the whole spectrum of the epidemiology of occurrence is taken into account and the disease is studied in humans, in animals and for its impact on ecosytem health. In reality, One Health suggests in the words of Rudolf Virchow that "between animal and human medicine there is no dividing line nor should there be. Their object is different but the experience obtained constitutes the basis of all medicine." Human and veterinary medicine has always depended on a common pool of knowledge drawn from observations on the anatomy, physiology, pathology and cause of disease in all species. Such a broad view will be increasingly helpful as we tackle the thorny issues of emerging disease, climate change and food security. This paper will provide a brief sketch of what One Health is, how it has been usefully applied over the last twenty years and an overview of the history of One Health in North America and in the Philippines. Examples of the usefulness of One Health will include an examination of the epidemiology and outbreak pattern of progression for West Nile Virus in New York City, Rabies in North Carolina and Avian Influenza globally. Applications of the One Health concept to Oncology research, food security and emergency preparedness for disasters of all kinds will also be discussed. A brief introduction to electronic One Health approaches to surveillance and monitoring of emerging diseases will be provided.

S2-5.

Improvement of health outcomes through the Health Leadership and Governance Program (HLGP) in Iloilo: The experience of ten Iloilo local government units

Philip Ian P. Padilla[1], Alice P. Carolino[2], Josephine T. Firmase[2], Melanie R. Sartorio[3], Sami Clarisse T. Juanico[4], and Czarinnah G. Araneta[5]

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The Health Leadership and Governance Program (HLGP) was developed and field tested by the Zuellig Family Foundation (ZFF). Under HLGP is the Municipal Leadership and Governance Program (MLGP). It adopts the Health Change Model and Bridging Leadership Framework which is premised on the fact that better health outcomes are achieved if the people have better access to effective and affordable services. Access will be made available if institutional arrangements are made responsive by a committed local executive leadership. With effective and pro-active health leadership, ownership, co-ownership, and co-creation are institutionalized in the local government units bringing in sustainable gains in the health sector. The bases for evaluation of each LGU are its respective local health score cards before and after each of the two modules (MLGP modules 1 and 2 with 6 month practicum period after each module for a total of one year). There was also coaching and monitoring during the one year period. The plan is anchored on the WHO recommended six building blocks of a resilient local health system; leadership and governance, health financing, health human resource, access to medicine and technology, health information system and health service delivery. Each building block has a set of indicators to guide decisions of LGUs, which are reflected in the health score card that serves as a technical roadmap. The health score card utilizes RYG (Red, Yellow and Green) colors tracking the health indicator performance of the LGU. Red means better health outcomes have not been met at all. Yellow signifies the need for improvement. And green signifies good performance since the municipality was able to meet the indicators. Results of the consolidated health score card of the ten municipalities reflect significant changes in the six building blocks. On leadership and governance, the average rating of 1.15 red before MLGP improved to 2.30 yellow after one year. On health human resource, the average rating from 1.43 red improved to 2.18 yellow. On access to medicines, there is a considerable improvement from 1.87 to 2.60. Health information system also improved from 1.67 to 2.40 Yellow. Significant changes are also seen in local health financing as well as in health service delivery that changes from 1.95 yellow to 2.41 yellow. In general, all health outcomes significantly improved through the MLGP. This health leadership model, therefore, should be replicated to the rest of the LGUs in Iloilo.

SESSION 3. Entrepreneurship and Science

Chair : Ben de Lumen

S3-1

My 20-year adventure in technology commercialization in the US and Philippines

Gonzalo Serafica

The presentation is about the author's personal perspective on technology commercialization based on his 20 year experience starting as a graduate student at Rensselaer Polytechnic Institute (Troy, NY, USA) to co-founder of a microbial cellulose company, Xylos Corporation (Langhorne, PA, USA). The various roles of the scientific/technical founder may play as the company evolves and utilizes its technology will be described. Activities in various areas including product development, regulatory compliance, intellectual property expansion, manufacturing and marketing, that contributed to the commercialization of the company's products will be described briefly. In conclusion, a method of analysis (i.e. TRIM) to be used as a guide for decision-making in commercializing a technology (such as microbial cellulose) will be proposed. A brief summary of his efforts to promote technology commercialization and working with entrepreneurs in the Philipine universities and research institutions will also be presented.

S3-2.

Experiences in developing fundamental research to start up companies

Carlito B. Lebrilla

A common goal of all fundamental research is to have a lasting impact on human society by producing a product that can improve human life. The path between the two points is long and often the researchers expertise in one does not necessarily extend to expertise in the other. The differences in culture between the two areas, academic research and product development, can be large with their unique specific goals. In this presentation, the experience of one scientist is described in the development of two technologies that became two companies. The scientific foundations of the two companies are solid and have resulted in a large number of publications that were published in the best journals. Patents were also produced focusing on cancer and disease biomarkers for one and on infant nutrition on the other. Although the two companies went through two similar paths, only one has made it through the so-called "valley of death" for startups.

S3-3

Enterpreneurship in Academia

Ben O. de Lumen, PhD
Professor Emeritus
UC Berkeley
Founder and CEO
Narra Biosciences, LLC

The anti-cancer peptide lunasin (from the Tagalog word "*lunas*" for cure) was discovered in our laboratory about 17 years ago. There are now 81 publications on lunasin listed in Pubmed. Lunasin intellectual property (IP) is owned by UC Berkeley and licensed exclusively to Narra Biosciences, LLC (www.narrabio.com). UCB and the state of California promote the commercialization of technologies discovered and developed at UCB through the IPIRA (Intellectual Property and Industry Research Alliance) office. Lunasin IP is protected by various US patents and several trademarks have been filed by Narra Bio. Commercialization strategies such as sublicensing, distributorship and partnership with other companies will be presented.

PANEL DISCUSSION 2

Bt Eggplant in the Philippines: R&D, Testing, Politics and Progress

Moderator: Joel Cuello

Panelists:

Joel Cuello - **Overview**

Alice Tarun - **Human Safety**

Salvador Tarun - **Environmental Safety**

Gonzalo Serafica - **Intellectual Property**

Joel Cuello - **Challenges Going Forward**

PAASE Statement of Support for the Resumption of Research and Development and Field Testing of Bt Eggplant in the Philippines Under the New DOST-DA-DENRDOH-DILG Joint Department Circular No. 1, Series of 2016 The Philippine American Academy of Science and Engineering (PAASE)1 expresses its strong support for the prompt resumption and continuation of research and development and field testing of Bt eggplant (or Bt talong) in the Philippines under the newly enacted DOST2 -DA2 - DENR2 -DOH2 -DILG2 Joint Department Circular No. 1, Series of 2016, titled Rules and Regulations for the Research and Development, Handling and Use, Transboundary Movement, Release into the Environment, and Management of Genetically-Modified Plant and Plant Products Derived from the Use of Modern Biotechnology. Eggplant, the leading vegetable crop in the country in terms of both volume and area of production, is a valuable source of income for Filipino farmers. Eggplant production in the Philippines covers approximately 22,000 hectares, yielding a volume of about 220,000 metric tons annually, valued at about PhP 2.6 B.

SESSION 4. Chemistry
Chair: Leah Tolosa Croucher

S4-1

Understanding the glycocalyx interface in host-microbe interactions

Carlito B. Lebrilla, University of California, Davis USA

Host mammalian cells are covered by an extensive array of carbohydrate structures that act as the last barrier to infection. Understanding the role of the glycocalyx has been limited by the lack of specific and sensitive analytical tools for characterizing the individual glycans. New analytical tools have been developed employing advanced chromatographic separation and accurate mass spectrometry to determine the glycan structures on cell surfaces allowing unprecedented view of cell surface glycosylation during transformation and during infection. Structures of the glycans change dramatically during transformation from naive to fully mature cells. Similarly, pathogens such as Salmonella can dramatically vary cell surface glycosylation allowing other cells to be more easily infected. The changes in cell glycosylation can also increase cell permeability and decrease cell enzyme functions. Conversely, commensal bacteria appear to leave cell surfaces in tact. This research provides a new perspective on host-microbe interactions allowing better understanding of how the microbiota in the gut interacts with the host.

S4-2.

ENZYMATIC FINGERPRINTING AND MODIFICATION OF ACETYLATED PECTINS

Connie A. Remoroza[1], Martin Wagenknecht[2], Hans Christian Buchholt[3], Henk Schols[1]

[1]The Laboratory of Food Chemistry, Wageningen University, The Netherlands
[2]Department of Plant Biology and Biotechnology, Westphalian Wilhelms-University of Münster Germany
[3]Dupont Nutrition Biosciences, Brabrand, Denmark

To reveal the ester distribution patterns in acetylated pectins, an enzymatic fingerprinting method using a combined endo-polygalacturonase II (endo-PGII) and pectin lyase (PL) treatment followed by hydrophilic interaction liquid chromatography coupled to electrospray ionization ion trap mass spectrometry with evaporative light scattering detection was developed. This method paved the way for the development of the new quantitative parameters degree of hydrolysis by PG (DH_{PG}) and degree of hydrolysis by PL (DH_{PL}). These parameters distinguished the methylester and acetyl group distribution patterns within different sugar beet pectins (SBPs). A pectin acetylesterase (*Bli*PAE) and a pectin methylesterase (*Bli*PME) from *Bacillus licheniformis* DSM13 were produced, purified and biochemically characterized. The mode of action of *Bli*PAE and *Bli*PME towards acetylated pectins was revealed using the newly developed enzymatic fingerprinting method. It was concluded that *Bli*PAE specifically deacetylates the *O*-3 linked acetyl groups of nonmethylesterified galacturonic acid residues in the homogalacturan of pectin. *Bli*PME efficiently de-methylesterifies lemon pectins (DM34-76 -* DM 0) and SBPs (DM 30-73 -* DM 14) in a blockwise manner. *Bli*PME is quite tolerant towards the acetyl groups present within the SBPs. For the first time, a comprehensive experimental characterization was directed to enzymes from *B. licheniformis* having a PAE and a PME activity.

This research was financially supported by the Commission of the European Communities within the 7th Framework programme for research and technological development, Grant agreement No. 222628.

S4-3

BIO-INSPIRED SCANNING ION CONDUCTANCE MICROSCOPY (BIO-SICM) FOR SIMULTANEOUS CONDUCTANCE AND SPECIFIC MOLECULAR IMAGING

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Successful reports on the utility of nanopore sensing and scanning ion conductance microscopy (SICM) in studying physiological systems are great motivations to pursue studies involving coupling of these two techniques to encompass broader applications. In this study, we combined the imaging ability of SICM with the sensitivity of protein nanopore sensing to develop a new, bio-inspired protein channel-based scanning ion conductance microscopy (bio-SICM) technique capable of quantitatively mapping specific molecular flux across membranes. We established the framework of this analytical platform using α-hemolysin (αHL) as a representative protein nanopore to map the presence of I3-cyclodextrin (I3CD) across a synthetic membrane. We fabricated αHL-based probes and used an in-house bio-SICM to generate approach curves employing the distance-dependent current response as feedback. Continuous monitoring of the current fluctuations suggests successful detection of I3CD binding events as evidenced by typical current blockades (60 – 80%) for a single αHL channel inserted into a lipid bilayer. To demonstrate specific molecule mapping, we raster-scanned the αHL-based probe over a single 25-μm pore glass substrate, while recording the lateral positions and current-time trace showing the spatial localization of I3CD single binding events occurring at a single αHL pore. When further optimized, we believe that this will provide a simple analytical methodology that is generalizable, which will lay the groundwork for pursuing other molecular flux-related studies especially in the areas of neuroscience and biology (e.g. mapping ATP flux from astrocyte cells).

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S4-4

CHARACTERIZATION OF A NOVEL TURRIPEPTIDE FROM *Unedogemmula bisaya* VENOM: STRUCTURE AND BIOLOGICAL ACTIVITY

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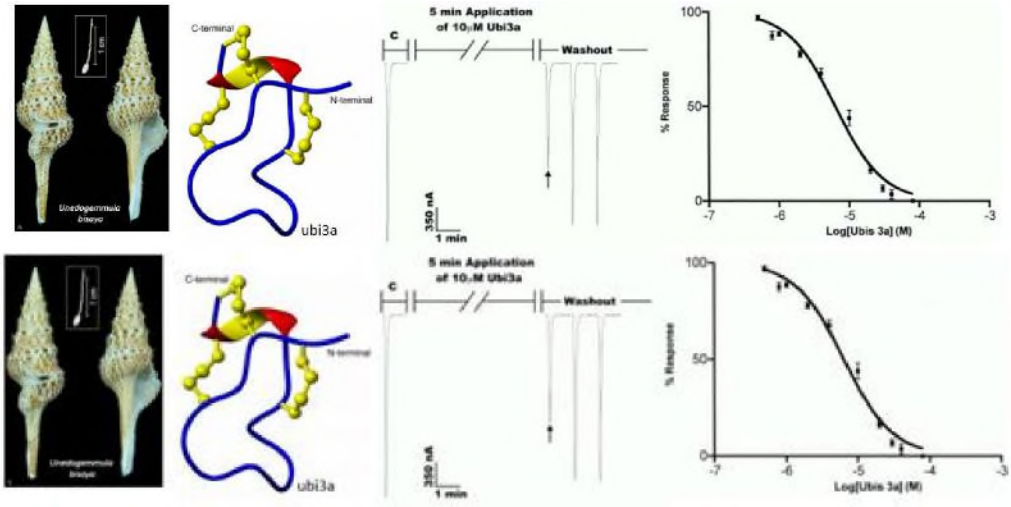
The turripeptide, ubi3a, was isolated from the venom of *Unedogemmula bisaya* by bioassay-guided purification; both native and synthetic ubi3a induced prolonged tremors when injected intracranially in mice. The sequence of the peptide, DCCOCOAGAVRCRFACC-NH2 (O = 4-hydroxyproline) follows the framework III pattern (CC-C-C-CC) for cysteines in the M-superfamily of conopeptides. The three-dimensional structure determined by NMR spectroscopy indicated a disulfide connectivity that is novel for peptides with the cysteine framework III: C1-C4, C2-C6, C3-C5. Both inhibitory and enhancing effects on the response to depolarization were observed in different subclasses of dorsal root ganglion neurons in the presence of either native or synthetic ubi3a. The peptide inhibited the activity of the α9α10 neuronal subtype of the human nicotinic acetylcholine receptor, albeit with relatively low affinity (IC50, 6.3 µM).



This work was funded by grants from the Department of Science and Technology (DOST) Philippine Council for Aquatic and Marine Research and Development through the Philippine PharmaSeas Drug Discovery Program and from the National Institute of General Medical Sciences (GM 48677 and GM103362).

SESSION 5. Biotechnology

Chair: Leah Tolosa Croucher

S5-1

IN-DEPTH CHARACTERIZATION OF PROTEIN ASSEMBLIES BY NATIVE MASS SPECTROMETRY

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Most cellular processes are accomplished by assemblies of macromolecules. Structural and functional characterization of these assemblies requires knowledge of their subunit stoichiometry and intersubunit connectivity. One of the most direct means for acquiring such information is so-called native mass spectrometry (nMS), wherein the masses of the intact assemblies and parts thereof are accurately measured. One major advance in nMS instrumentation involved the modification of an Orbitrap-based MS instrument to detect large macromolecular assemblies. nMS analysis using this instrument exhibited exceptional desolvation efficiency enabling mass measurements of intact protein assemblies at high resolution and high sensitivity. To illustrate, nMS analysis of antibody samples using the modified Orbitrap instrument enabled comprehensive elucidation of the respective glycoform distributions.

In addition, it is of utmost interest to apply nMS to the study of endogenous protein assemblies—those isolated from their natural cellular milieu with the component proteins expressed at normal physiological levels. We present here a robust workflow that couples efficient affinity capture of endogenous protein assemblies with sensitive nMS measurement. This workflow involves a single-step affinity capture using magnetic beads followed by nondenaturing elution, depletion of elution reagent, buffer exchange and subsequent nMS analysis. We tested our workflow on several protein assemblies essential to budding yeast, namely the heterotetrameric GINS complex (131 kDa), the homotrimeric Ctf4 complex (314 kDa), the heterohexameric Nup84 assembly (443 kDa) and the 10-membered exosome complex (403 kDa). These assemblies are involved in DNA replication, nucleocytoplasmic transport, and RNA processing. We anticipate that this workflow will facilitate routine nMS analysis of endogenous protein assemblies, particularly those that are not highly abundant in the cell.

S5-2.

ANALYSIS OF SMALL MOLECULE COMPONENTS IN A CHO CELL-FREE PROTEIN EXPRESSION SYSTEM

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An *in vitro* cell-free expression system derived from CHO (Chinese Hamster Ovary) cells was used for rapid protein synthesis. Here, we present the details of optimizing turbo green fluorescent protein (tGFP) expression in CHO by tracking small molecule components. For obvious reasons such as rapid and high-throughput expression, cell-free protein synthesis (CFPS) is currently the ideal platform for protein production. However, bioreactor design remains a critical consideration.

In this report, three dialysis mode bioreactor designs namely, dialysis cup, float-a-lyzer, and microdialysis device configurations, were characterized against a batch mode process. A real-time tGFP optical sensor was incorporated in the system to monitor the product. Important substrate and by-product components such as nucleoside triphosphates (NTPs), creatine phosphate (CP), and inorganic phosphate (Pi) were characterized. Mass transfer of these components in the bioreactors across a 10-kDa MWCO membrane were calculated.

Results showed that tGFP product yields were negatively affected when mass transfer in the bioreactor was limited. Specifically, we found that NTPs were completely depleted after 3 hours of expression in the dialysis cup configuration. The most efficient synthesis was observed in the microdialysis device. Additionally, using 24-well plate format experiments, the effect of creatine phosphate and direct ATP addition, as well as Pi accumulation to the expression was investigated. Addition of up to 40 mM CP in the *in vitro translation* (IVT) system, increased yields by up to ~60% relative to the controls. Direct ATP addition, as opposed to CP addition, negatively affected the expression. Pi accumulation below 30 mM, did not significantly affect yields but Pi concentration above 30 mM, led up to ~50% yield reduction. Overall, data presented in this report serves as a valuable reference to optimize the CFPS system for next-generation bioprocessing.

The authors acknowledge the DARPA Biologically-derived Medicines on Demand (Bio-MOD) program for support.

S5-3.

A FIBER OPTIC BIOSENSOR FOR NONINVASIVE TRANSDERMAL GLUCOSE SENSING BASED ON THE GLUCOSE BINDING PROTEIN

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The ability to measure glucose levels is an important requirement for good clinical care in the intensive care unit. Current technologies for glucose measurement are enzyme-based sensors that work well in the mM glucose range of blood and interstitial fluid. These sensors require breaking the skin, which can be painful to the patient. Noninvasive monitoring of glucose could facilitate a more effective management of hyperglycaemic and hypoglycaemic episodes. Our group developed a painless, noninvasive method of collecting glucose that has passively diffused through the skin. Biofluids like transdermal glucose collected in this way has a concentration in the μmolar range so there is a need to develop a reliable glucose sensor that could measure glucose at these levels. Thus, we developed a fiber optic biosensor for glucose that is based on the glucose binding protein (GBP) H152C. GBP is highly specific and sensitive to glucose at μM concentrations. GBP-labeled with Badan was immobilized in Ni-NTA agarose beads via metal-histidine interaction. The portable, low-cost biosensor system consists of an optical fiber with the immobilized beads were trapped on one end, and appropriate optics and electronics. The control software and the visual interface for the optical sensor is designed and implemented in LabVIEW and runs on tablet. The biosensor exhibited a stable response to the blank and with 10 μM glucose for >16 hours. Glucose responses are also reversible when washed with phosphate-buffered saline solution. Measured voltages resulting from fluorescence were recorded and the response time of the biosensor for 6 μM glucose was approximately 50 s. A linear relationship (r^2=0.9882) was observed between the sensor response and glucose standard solutions from 4 to 20 μM. This fiber optic sensor can be used to measure transdermal glucose in model skin and samples from healthy adults.

SESSION 6. Biological/ Biomedical Sciences
Chair: Sevilla Detera- Wadleigh

S6-1.

Characterization and Targeting of Melanoma Stem/Initiating Cells

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High-risk melanoma is a lethal cancer with high recurrence rates and variable disease-free intervals, due to tumorigenic cell populations that are resistant to treatment. Studies by our lab and others suggest that Melanoma Initiating Cells (MIC), a CD133+ population that forms xenograft tumors, may represent an intermediate stage in the acquisition of stable drug resistance. Prominin 1 (CD133), a putative stem cell marker in a number of cancers, is expressed in cells that possess greater tumorigenicity, motility, self-renewal, and is overexpressed in late-stage metastatic melanoma, showing its potential as a marker of a resistant cell population. We determined the effect of CD133-expression and drug resistance in metastatic melanoma cells harboring difficult-to-treat mutation signatures by focusing on the two main downstream cascades of MAPK and PI3K/AKT/mTOR. Trametinib (GSK1120212), a MEK inhibitor and Dabrafinib (GSK2118436), a BRAF inhibitor, are targeted kinase inhibitors approved by the FDA now widely used for treatment of melanoma. We tested the differential resistance of CD133+ and CD133-cells to these agents, and explored potential mechanisms underlying these differences. Four primary human melanoma cell lines with different kinase mutation profiles were exposed to increasing concentrations of trametinib, dabrafenib or in combination, either before or after separation into CD133+ and CD133- populations. Cells were then assayed for cell viability and CD133-positivity. Microarray, as well as comparative genomic hybridization array analysis, was performed on CD133+ and CD133- cells to explore potential differences in gene expression profiles. In all parental cell lines, the percent of CD133+ cells increased significantly in the resistant population after high-dose drug treatment. The presorted CD133+ MIC population exhibited significantly higher IC50s both for single and combination treatment. Microarray analysis revealed a significant ($P<0.001$ >1.5-fold) difference in expression of 265 genes in CD133-positive cells, including putative oncogenes such as POU5F1, NPM1, NES and MYC. In addition, 10 of 18 ABC drug transporter genes were significantly ($P<0.05$) up-regulated in the CD133+ MIC population. Both purified and mixed population-derived CD133+ cells were more resistant to the single or combined kinase inhibitors. Since upregulation of ABC transporter genes appears to contribute to chemoresistance of CD133+ MICs, pre-treatment with the ABCG2 inhibitor elacridar significantly sensitizes these cells to the targeted kinase inhibitors. Our recent results also reveal that triple combination therapy using mebendazole (a repurposed anthelmintic BRAF inhibitor), trametinib (MEK inhibitor) and metformin (repurposed anti-diabetic mTOR inhibitor) synergistically reduces cell viability of $NRAS^{Q61K}$ melanoma cells when compared with mebendazole, trametinib or metformin alone. Further, the surviving fraction from monotherapy was highly enriched for CD133+ cells. Thus, the multi-kinase inhibitor trametinib, along with repurposed anthelmintic and anti-diabetic drugs may inhibit MAPK and PI3K/AKT/mTOR pathways, potentially representing an effective therapy targeting resistant MIC subpopulations in patients with recurrent melanoma.

S6-2

The role of TRAIL in cancer-related fatigue following radiation therapy.

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Chronic fatigue is one of the most common and debilitating side effects of cancer and cancer treatment, and yet its etiology remains elusive. The goal of this study is to understand the underlying inflammatory mechanism and identify co-occurring symptoms of chronic fatigue in non-metastatic prostate cancer men following radiation therapy (RT) completion. The initial investigation included 40 men scheduled to receive RT at the National Institutes of Health, Bethesda, Maryland. Data were collected before RT (T1) and one year after RT (T2). Fatigue was assessed using the Functional Assessment of Cancer Therapy-Fatigue questionnaire (FACT-F). Whole genome microarray and cytokine multiplex panel examined fatigue-related transcriptome and serum cytokine changes, respectively. The significantly changed cytokine from the initial investigation was validated using sera from 46 men two years after completing RT (T3) for prostate cancer at Georgetown University Hospital, Washington, DC. Further in vitro validation determined the effect of the significantly changed cytokine on cell viability as quantified by MTT assay. Tumor necrosis factor-related apoptosis-inducing ligand (TRAIL) and TRAIL decoy receptor, *TNFRSF10C* (TRAIL-R3), were significantly upregulated (fold change=1.4, p=2.5x10^{-5}) in fatigued subjects (n=15) at T2. Cognitive deficits were also observed in fatigued subjects at T2. Further, TRAIL correlated with fatigue at T3 in a separate cohort. TRAIL caused selective cytotoxicity in neuronal cells, but not in microglial and muscle cells, in vitro. Late-onset inflammation directed by TRAIL may play a role in chronic fatigue pathogenesis in prostate cancer survivors. Selective vulnerability of neurons to TRAIL may contribute to chronic fatigue-related cognitive deficits.

Acknowledgements: This study is fully supported by the Division of Intramural Research of the National Institute of Nursing Research of the NIH, Bethesda, Maryland

S6-3.

Targeted Delivery of Antioxidant Peptides to the Pulmonary Arteries in Rodent Models of Pulmonary Hypertension

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Introduction: Pulmonary hypertension (PH) is a multifaceted disease characterized by high blood pressure in the lungs, a life-threatening complication with no cure but with ongoing research to develop better treatments. Two important pathophysiological mechanisms in PH are oxidative stress and inflammation. In rodent models of hypoxia- and carbohydrate-induced PH, we have shown that the development of PH is promoted by reactive oxygen species (ROS) and NLRP3 (NACHT, LRR and PYD domains-containing protein 3) inflammasome activation in the lungs. Using these disease models, this project focuses on development of optimized antioxidant therapies that target the pulmonary arteries. A strategy often used in the drug development process is the identification of new therapeutic candidates from botanical sources. Botanicals and their extracts, which contain thousands of compounds, are widely used for both traditional medicine and pharmaceutical development. Importantly, bioactive peptides isolated from botanical sources have been shown to have strong antioxidant activities. However, although there are a variety of known and potential antioxidant therapies, their ability to protect against the progression of PH are limited by suboptimal therapeutic levels in the lungs. To address this limitation, we are also developing a targeted drug delivery approach to allow biodistribution of therapeutic antioxidants specifically into the pulmonary arteries. Methods and Results: In addition to hypoxia-induced PH in mice (a well established and common animal model), we have shown initial evidence that high carbohydrate intake also plays an important pathophysiological role in the pulmonary circulation, and is linked to oxidative stress and NLRP3 inflammation. To develop the antioxidant therapies to be tested in these rodent models, we used our in-house botanical library, consisting of over 300 different plants, which provided a diverse pool of potential bioactive peptides. We developed methods for total protein extraction and peptide production. The peptide extracts were then screened using several antioxidant activity assays. We identified the top peptide extracts with the highest potency or efficacy: total antioxidant capacity (ED50 = 0.03 ug), ROS inhibition/scavenging (ED50 = 0.136 ug), and catalase activity (248% stimulation). Evaluation of antioxidant protective effects in mice provided a proof of concept and showed approximately 10% reduction in pulmonary vascular medial wall thickening, more than 10 mmHg reduction in pulmonary artery pressure and 20% reduction in right ventricular hypertrophy. To develop the therapeutic delivery vehicle, we tested peptide-functionalized liposomes that target upregulated receptors expressed on pulmonary artery endothelial cells. These novel targeting peptides demonstrated high binding affinity to cell surface receptors (Emax = 2.48 uM; EC50 = 0.878 uM), and 80% increased uptake in injured pulmonary artery endothelial cells. We initially demonstrate that the targeted vehicles are preferentially distributed to the pulmonary arteries in the lungs of hypoxic mice. Conclusions and Future Studies: We have thus far identified antioxidant peptide extracts with high therapeutic potential to be tested further in our rodent models of PH. These extracts will undergo further bioassay guided fractionation, isolation and identification of specific antioxidant peptide sequences. In addition, the in vivo delivery of candidate antioxidant peptides will be optimized by using liposomes that target the pulmonary arteries

S6-4.

EFFECTS OF ELECTROMYOGRAPHY BIOFEEDBACK TRAINING ON SCAPULAR KINEMATICS.

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INTRODUCTION. Electromyography (EMG) biofeedback training has become a more useful tool with rehabilitation of subacromial impingement syndrome. PURPOSE. The aim of this study was to investigate the effects of changes in muscle activation patterns during EMG biofeedback in scapular kinematics. METHODS. Nineteen healthy subjects volunteered for the study. To measure EMG, a Noraxon Telemyo DTS was utilized. Electrodes were placed on the upper and lower trapezius, serratus anterior, and lumbar paraspinals. A Polhemus Fastrak magnetic tracking device was utilized to measure scapular kinematics. Subjects underwent scapular kinematic testing before and after biofeedback training that consisted of humeral elevation in the scapular plane. A two-way repeated measure ANOVA was used to compare scapular kinematics before and after the scapular stabilization exercises. Alpha level was set to 0.05. RESULTS. There was a statistically significant difference at all humeral elevation angles during scapular external rotation ($p < 0.004$) between times. After the exercises, the scapula was in a more externally rotated orientation with a mean difference of 6.8 degrees.
CONCLUSIONS. A more externally rotated scapula may increase the subacromial space which could be beneficial in preventing shoulder pain cause by subacromial impingement.

S6-5.

The RIPping of the veil: discovering new roles for the RIP2 kinase

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RIP2 is a dual-specificity kinase which functions downstream of the peptidoglycan sensors NOD1 and NOD2. NOD1 and 2, as well as RIP2, have been shown to be important in the control of many pathogens such as *Listeria*, *Salmonella*, *Mycobacteria etc.,* and loss-of-function polymorphisms of NOD2 are still the leading genetic risk factor for development of Crohn's Disease. Interestingly, overactivation of this pathway also precipitates other inflammatory disease such as Blau Syndrome and inflammatory arthritis, highlighting the fact that signaling though this pathway requires tight regulation.

We have previously shown that in vivo pharmacologic inhibition of the RIP2 kinase is efficacious in various models of inflammation which is likely mediated through normalization of excessive proinflammatory cytokine release in macrophages. Given this, there has been intense pharmaceutical interest in developing and testing inhibitors against RIP2. In my presentation, I will propose novel, non-NOD2 mediated, clinically relevant pathways, potentially modulated by RIP2. This work will not only open new avenues for therapeutic intervention, but also bring awareness to potential unanticipated side-effects as the development of RIP2 targeted therapies move forward. This work is supported by UCF start-up funds and NHLBI grant R00HL122365-01 to J.T.T-A.

S6-6

Human Microphysiological Systems: Tissues-on-Chips for In Vitro Efficacy, Safety, and Toxicity Testing

Danilo A. Tagle, Ph.D. – Associate Director for Special Initiatives, National Center for Advancing Translational Sciences, National Institutes of Health, USA

Advances in basic and preclinical science continue to fuel the drug discovery pipeline, however only a small fraction of compounds meet criteria for approval by the FDA. More than 30% of promising medications have failed in human clinical trials because they are determined to be toxic despite promising pre-clinical studies in 2-D cell culture and animal models, and another 60% fail due to lack of efficacy. The challenge of accurately predicting drug toxicities and efficacies is in part due to inherent species differences in drug metabolizing enzyme activities and cell-type specific sensitivities to toxicants. To address this challenge in drug development and regulatory science, the NIH in partnership with DARPA, FDA, and more recently the pharmaceutical industry has invested in the Tissues-on-Chips program to develop alternative approaches that would enable early indications and potentially more reliable readouts of toxicity and efficacy.

The goal of the tissue-on-chips program is to develop bio-engineered microdevices that represent functional units of the 10 major human organ systems: circulatory, respiratory, integumentary, reproductive, endocrine, gastrointestinal, nervous, urinary, musculoskeletal, and immune. The opportunities for significant advancements in the prediction of human response to drug toxicities through the development of microphysiological systems, requires a multi-disciplinary approach that relies on an understanding of human physiology and anatomy, stem cell biology, microfluidics, material sciences and bioengineering. Since the inception of this program in 2012, several unique and novel *in vitro* platforms have demonstrated human organotypic physiological functions and relevant response to drug exposure ensuring that safe and effective therapeutics are identified sooner, and ineffective or toxic ones are rejected early in the drug development process. These microfabricated devices have also proven to be useful for modeling human diseases and may prove to be sufficient alternatives to the use of animal testing. It is anticipated that the availability of these systems to a broader research community will foster a multitude of new research applications including, but not limited to studies in precision medicine, environment exposures, reproduction and development, infectious diseases, cancer, countermeasures for chemical warfare, immune responses and neuro-inflammation.

SESSION 7: Physics, Math and Engineering
Chair: Danilo Romero

S7-1.

P-GRAPH APPROACH FOR OPTIMIZING OPERATIONS OF INPUT-OUTPUT SYSTEMS UNDER CRISIS CONDITIONS

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The onset of climate change has resulted in various sustainability issues and concerns. Resources like food, energy and water for example are expected to become scarcer as a result of continued population growth and adverse shifts in climate conditions. These resources are vital inputs to agricultural, industrial, economic and other interdependent human systems, and thus strategies for modeling the impact of system perturbations resulting from resource scarcity are needed. Input-output (IO) analysis, which was initially developed for understanding the behavior of economic systems, provides a framework for modeling the interdependence between interacting system components. It is able to account for both direct and indirect effects resulting from a system perturbation such as those arising from crisis conditions. Furthermore, IO based optimization models have been developed to identify what the optimal system performance or strategic response should be in order for a system to best cope with a perturbation.

This work presents the use of a graph theoretic approach known as Process graph (P-graph), which was initially intended for process network synthesis, for optimizing interdependent systems in crisis conditions. The similarity in structure of IO systems and process networks enables the development of IO based optimization models in the P-graph framework. Our work on initial P-graph applications to IO systems include the optimal allocation of energy or water in supply chains and industrial networks, polygeneration systems, and city- or national-scale economic systems. The most recent extension applies the framework to organizational IO models in which disastrous events reduce available manpower. P-graph models have the advantage of providing a graphical representation and identifying not only the optimal network solution, but also near-optimal solutions to the problem. Both of these features facilitate use of P-graphs for practical decision-making.

S7-2.

Inoperability input-output approach to climate vulnerability assessment of economic systems

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The input-output model is used to represent interdependencies in linear systems such as those that exist between sectors in an economy, departments in a firm, or processes in a production line, among others. The most well-known application is the use of I-O models for economic forecasting applications. Recent work has demonstrated the use of I-O extenions to model the propagation of disruptions through out a system. Disruptive events may result from climate change which exposes systems to numerous risks, including reduced agricultural production, electric power supply shortages and human resources. These disruptions are inevitable, hence there is a need to incorporate optimization strategies to design policy options that will achieve minimum losses. Cases implemented range from aluminum industrial complex in a water shortage scenario, a hypothetical hospital case in a pandemic scenario and a drought-induced electricity shortage for the Philippine economy.

S7-3.

ON PLAYING WITH GREEN MATERIALS AT GAMERS LAB

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This paper presents our on-going research at the Geopolymer and Advanced Materials Engineering Research for Sustainability (GAMERS) laboratory, De La Salle University (DLSU). Our recent works focus on developing alternative construction materials from indigenous materials while providing a potentially sustainable solution for waste management. In this study, industrial waste such as coal ash and red mud waste, and agricultural waste such as rice hull ash were used as alumino-silicate resource to produce geopolymer. Utilization of such wastes as a sustainable construction material is proposed to be a viable solution not only to the pollution problem but could also be an economical option in the design of green materials. Geopolymer, also known as alkali activated cement, is an inorganic polymer binder formed from the alkaline activation of reactive alumino-silicate materials resulting in 3-D polymeric network. In contrast to Portland cement-based binders, the geopolymer binder relies on minimally processed natural minerals and industrial by-products or wastes to provide binding agents with potential energy savings and CO_2 emission reduction in the construction sector. Further work is required though to improve the product development in order to reduce the environmental footprint and strengthen its potential for commercial applications. Further investigations will thus be conducted on its engineering properties and microstructure characterization to understand its long-term performance as a sustainable construction material.

S7-4.

A COMPARATIVE ANALYSIS OF MORINGA OLEIFERA PROTEIN ADSORPTION ON CARBON-BASED ADSORBENTS

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This paper presents findings from an international collaborative research on low-cost water treatment using Moringa-functionalized adsorbents. Moringa oleifera (MO) is an abundant and indigenous tree in many tropical regions in Africa and Asia. Its seeds contain cationic proteins that are known to exhibit coagulant and antimicrobial properties; however, wide-scale application in water treatment is hampered by the corelease of organics from the seeds, which causes storage problems for the treated water. In this study, we perform a comparative analysis of the selective adsorption of MO proteins on three carbon adsorbents: commercial activated carbon, rice husk ash (RHA), and carbon-ceramic beads made from RHA and nanoclay. Results indicate that the MO protein binds strongly to carbon adsorbents, with the highest sorption capacity observed for activated carbon (42±2 mg/g) and lowest for ceramic beads (28±3 mg/g). In all sorbents, protein adsorption follows pseudo-second order kinetics, and the Freundlich model. The protein sorption was also studied under a confocal laser microscope (CLM) by tagging the protein with a fluorescent dye. CLM images indicate the abundance of multi-layer protein clustering on the carbon surface, likely due to the interactions between organic moieties (amino acids) from the protein and the active sites on the carbon. With respect to its potential application in water treatment, MO-functionalized carbon adsorbents lower the total organic carbon (TOC) in solution by over 99% compared to the traditional method of dissolving whole MO seeds in water at the equivalent MO protein dose. The MO protein is also tightly bound even after several washings, as confirmed via TOC and CLM measurements. Overall, these findings demonstrate that the adsorption of MO protein onto carbon adsorbents presents a potential solution to the water storage problem associated with the use of Moringa in water treatment. **This work was partially funded by the Grand Challenges Canada and the UMass Lowell Office of Research. We thank the DLSU Food & Water Institute for lab support

S7-5.

CHARACTERIZATION OF SOME NUTRACEUTICAL PRODUCTS (BEE PROPOLIS AND TEA SAMPLES) FROM THE PHILIPPINES

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Nutraceuticals are products form food sources that offer health and medical benefits to consumers. The Philippines owing to the existence of its vast natural flora and fauna have a lot of products that said to be of health benefits. In this paper, bee propolis and tea samples from the Philippines are characterized to support the claim of health benefits obtained from these products. The phenol content and antioxidant properties of the water extracts of seven commercial fruit and medicinal plant based teas from the Philippines were evaluated and compared to one another. The total phenolic content, determined by the Folin-Ciocalteu method varied from 23.2 mg/g (bitter melon) to 91.49 mg/g (Pito-pito dried herbal tea) mg of gallic acid equivalent/g dry tea. The antioxidant properties were evaluated using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay and 2,2-azinobis (3-ethyl-benzothiazoline-6-sulfonic acid (ABTS) assay and results showed that all tea samples exhibited antioxidant properties. These properties were also observed in bee propolis samples used. In addition, the composition of the bee propolis samples was also determined by GC-MS.

AN OPTIMIZATION MODEL FOR BIOCHAR-BASED CARBON SEQUESTRATION NETWORKS

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Negative emission technologies (NETs) may prove to be necessary to stabilize atmospheric CO_2 concentration to safe levels during the course of the 21st Century. Biochar-based carbon sequestration systems offer a potentially scalable, “low technology” option for achieving negative emissions. Biochar is the carbon-rich solid fraction produced along with syngas and bio-oil from the pyrolysis of biomass. The application of biochar to agricultural land has the net effect of sequestering biomass carbon (which in turn is fixed from the atmosphere via photosynthesis) as recalcitrant carbon in soil.

The deployment of biochar-based systems at commercially significant scales can be framed as a supply chain problem that involves matching biochar sources (i.e., pyrolysis plants) with biochar sinks (i.e., farms) and selecting intermediate modes of handling, transport and storage. Process Systems Engineering (PSE) approaches can thus be applied to ensure the effective planning and operation of such systems. In this work, an optimization model based on a multi-period linear programming (LP) source/sink framework is developed for biochar systems. The model maximizes total net carbon sequestration for a given system, taking into account the (a) production capacities and operating lives of biochar sources, (b) application rates and storage limits of biochar sinks and (c) transportation carbon emission penalties for potential source-sink pairs. A hypothetical but plausible case study is solved as proof of concept.

SPATIAL ANALYTIC HIERARCHY PROCESS FOR REGIONAL SITE SELECTION OF ALGAL INDUSTRY IN THE PHILIPPINES

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The Philippines is considered as the geographic epicenter of tropical algae biodiversity in the Pacific. Algae biomass is composed of various high-valued compounds such as carbohydrates, protein, pigments, and lipids which can be converted to profitable products. Among the industry which can benefit from the commercialization of algal products are animal feeds, pharmaceuticals, and energy. With the archipelagic geography of the Philippines, a regional site selection on the cultivation of microalgae must be established with respect to natural resources availability, social acceptance, costs, and present industry establishment. An analytic hierarchy process approach is proposed to recommend a preferred a regional site for the establishment of various algae industry in the Philippines. Results show the spatial map of the Philippines with the preferred regions in darker color. The developed decision structure aims to aid policy and decision makers in the commercialization of algal products in the country.