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10TH ANNUAL AND 1ST VIRTUAL CONFERENCE

June 24-25, 2021

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Welcome to the ACMAP conference: Dr. Anait S. Levenson, President of ACMAP, Professor of Cancer Research and Pharmacology, Long Island University

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Thursday, June 24, 2021		
8:30 am	Opening	
9:00-10	Plenary Presentation: ***Advances in Natural Products and Polyphenols for the Preservation of Cognitive and Psychological Resilience*** Dr. Giulio M. Pasinetti, Mt. Sinai School of Medicine, NY, USA	
10:00-10:10	Break	
10:10-11:45	**Session 1 - Grape Derived Polyphenols**	**Session 2 – Field, Greenhouse, and Indoor Cultivation**
	Session Chair: Dr. Andrea Doseff	*Session Chair:* Dr. Gary Stutte
10:10-10:40	*Keynote:* Dr. Dominique Delmas (University of Bourgogne, France) ***Polyphenols Prevent Inflammation and Associated-Diseases Through a Direct Action on Immune Cells***	*Keynote:* Dr. Gary Stutte (SyNRGE, LLC, FL, USA) ***Beyond the Field: Controlled Environment Production of Medicinal Plants***
10:40-11:05	Dr. Cristiana Caliceti (University of Bologna, Italy) ***Grape Pomace as a Sustainable Source of Bioactive Compounds for Cosmeceutical Applications***	Dr. Rao Mentreddy (Alabama A&M University, USA) ***The Potential Uses of Low Temperature Atmospheric Plasma for Forcing Early Sprouting, and Improving Plant Growth and Yield of Turmeric.***
11:05-11:30	Dr. Nihal Ahmad (University of Wisconsin, USA) ***Grape Powder in Skin Cancer Prevention***	Dr. Jeffrey Adelberg (Clemson University, USA) ***Physical Factors Increased Quantity and Quality of Micropropagated Apical Shoots of Cannabis sativa L. in a Repeated Harvest System***
11:30-11:45	Mr. Kevin Tveter (Rutgers University, NJ) ***Grape Polyphenols Improve Glucose Metabolism by Suppressing Intestinal FXR***	Dr. Joseph Chappell (University of Kentucky, USA) ***Evoking Specialized Metabolism in Plants Subjected to Microgravity***
11:45-12:15	Virtual Mixer: Pick your topic	
12:15-12:45 pm	Lunch	
12:45 - 2:20	**Session 3 - Metabolic Syndrome**	**Session 4 – Ethnobotany**
	Session Chair: Dr. Jim Simon	*Session Chair:* Dr. Rodolfo Juliani

12:45-1:15	*Keynote:* Dr. Maria Gloria Dominguez-Bello (Director, Institute for Food, Nutrition and Health (IFNH), Rutgers University, USA) ***Dietary Modulation of the Gut Microbiome in Early Life***	*Keynote:* Dr. Michael Balick (New York Botanical Garden, USA) ***Using Indigenous Knowledge to Improve Healthcare Systems in Developing Countries: Case Studies from Micronesia***
1:15-1:40	Dr. Liping Zhao (Professor, Eveleigh-Fenton Chair of Applied Microbiology, Rutgers University, USA) ***Dietary Modulation of the Gut Microbiota for Metabolic Health***	Dr. Umesh Reddy (West Virginia State University, USA) ***Natural Variation of Phytochemicals in Various Capsicum spp.***
1:40-2:05	Dr. Csanad Gurdon (Distinguished Professor, Plant Biology, Rutgers University, USA) ***Development and Characterization of High Flavonoid Lettuce Varieties***	Dr. Ramu Govindasamy (Rutgers University, USA) ***Marketing of Fresh Market Turmeric***
2:05-2:20	Ms. Esther Mezhibovsky (Rutgers University, USA) ***Grape Polyphenols Attenuate Diet-Induced Obesity and Hepatic Steatosis in Mice in Association with Reduced Microbial Metabolite Butyrate and Increased Intestinal Carbohydrate Oxidation***	Ms. Emily Merchant (Rutgers University, USA) ***Strengthening Vegetable Value Chains for Improved Nutrition in a Kenyan Informal Settlement***
2:20-2:25	Break	
2:25-4:00	**Session 5 - Modern Analytical Techniques in Botanical Research**	**Session 6 - Linking Health and Nutrition to Diet**
	Session Chair: Dr. Josh Kellogg	*Session Chair*: Dr. Sun-Ok Lee
2:25-2:55	*Keynote:* Dr. Josh Kellogg (Penn State University, USA) ***Metabolomic Profiling and Modeling for Botanical Phytochemical Analysis***	*Keynote:* Dr. Sun-Ok Lee (University of Arkansas, USA) ***Health Benefits of Berry Volatiles***
2:55-3:20	Dr. Sonja Knowles (Procter & Gamble, USA) ***Evaluating grape seed (Vitis vinifera) phytochemicals for color protection from UV irradiation***	Dr. Abby Benninghoff (Utah State University, USA) ***Dynamics of the Gut Microbiome in Response to Dietary Intervention with Black Raspberries in the Context of a***

		Standard or Western Type Diet in a Mouse Model of Inflammation-Associated Colorectal Cancer
3:20-3:45	Dr. Bo Yuan (Harvard University, USA) ***African Nightshades: Advances on the Phytochemistry and Potential New Added Value Products***	Dr. Daniel Hoffman (Rutgers University, USA) ***The Use of African Indigenous Vegetables to Prevent Undernutrition to Low-Income Countries***
3:45-4:00	Mr. Lewis Marquez (Emory University, USA) ***Antifungal Activity of Pentagalloyl Glucose Against Drug-Resistant Candida Species***	Dr. Jeremy J. Johnson (University of Illinois at Chicago, USA) ***Considerations for Therapeutic Drug Monitoring and Pharmacokinetics with Phytochemicals***
4:00-6:00	Poster Session	

Friday, June 25, 2021		
8:45 am	Morning Remarks	
9:00-10	Plenary Presentation: ***Data, Myths, and Politics: Perspectives on Cannabinoids in Human Health*** Dr. Jahan Marcu, Co-Founder at Marcu-Arora	
10:00-10:10	Break	
10:10-11:45	**Session 7 – Resveratrol and Analogs**	**Session 8 – Hemp and Medical Cannabis**
	Session Chair: Dr. Fabricio Medina-Bolivar	*Session Chair*: Dr. Connie Pascal
10:10-10:40	*Keynote*: Dr. Fabricio Medina-Bolivar (Arkansas State University, USA) ***Natural Prenylated Resveratrol Analogs: Bioproduction and Biological Activities***	*Keynote:* Dr. Carey Clark (Director of Nursing, Chair of the Medical Cannabis Certificate Program, and Faculty in the Medical Cannabis and Holistic Nursing programs - Pacific College of Health and Science) ***Cannabis Care: From Seed to Need - Connecting Patients with Plant Medicine***
10:40-11:05	Dr. Eric Courot (Université de Reims Champagne-Ardenne, France) ***Grapevine Cell Cultures for the Bioproduction of Bioactive Resveratrol and Derivatives: Some***	Dr. Oliver Kayser (TU Dortmund University, Germany) ***Rare Cannabinoids – Complex Biosynthesis or Simple Chemistry in Cannabis sativa***

	Fundamental and Applied Considerations	
11:05-11:30	Dr. Thomas Netticadan (Canadian Centre for Agri-food Research in Health and Medicine, Canada) ***Resveratrol as a Potential Therapeutic Agent in the Management of Coronary Artery Disease***	Ms. Annie Rouse MA/MBA (Chief Operating Officer at OP Innovates and co-founder of the hemp brands, Overcome and Hemp Mellow; Co-Founder of Anavii Marke) ***Formulating the Most Impactful Cannabis and Hemp Research to Meet the Needs of the Ever-Evolving Supply Chain***
11:30-11:45	Dr. Avinash Kumar (Long Island University, USA) ***Gnetin C: Does Dimer-Resveratrol Offer Twice the Benefit of Chemoprevention in Prostate Cancer?***	Dr. Raul Cabrera (Rutgers University, USA) ***Growth and Cannabinoid Performance of Floral Hemp Cultivars Under Plasticulture and Differential Irrigation***
11:45-12:15	Virtual Mixer: Pick your topic	
12:15-12:45 pm	Lunch	
12:45-1:45	Plenary Presentation: ***Advances in MAP Breeding for Disease Resistance, Aroma and Arthropod Repellency*** Dr. Jim Simon (Rutgers University, USA)	
1:45-1:55	Break	
1:55-3:30	**Session 9 – Genomic Tools and Breeding**	**Session 10 - Dietary Phytochemicals and Disease Prevention**
	Session Chair: Dr. Jeffrey Adelberg	*Session Chair:* Dr. Anait S. Levenson
1:55-2:25	*Keynote:* Dr. Lindsay Caesar (Northwestern University, USA) ***Metabolomic and Genomic Approaches to Explore Uncharted Biochemical Space for Natural Products Discovery***	*Keynote:* Dr. Anait S. Levenson (Long Island University, USA) ***Dietary Stilbenes and the Underlying Mechanisms in Cancer Chemoprevention***
2:25-2:50	Dr. Allison Justice (The Hemp Mine, USA) ***Breeding Hemp for Phytochemical and Horticultural Qualities***	Dr. Yuanyuan (Rose) Li (University of Missouri, USA) ***Time-Dependent Maternal Soybean Genistein Exposure Leads to Later-life Breast Cancer Chemoprevention in Offspring Mice***

2:50-3:15	Dr. Dil Thavarajah (Clemson University, USA) ***Nutritional Breeding for Organic Systems***	Dr. Andrea Doseff (Michigan State University, USA) ***Targeting Chronic Inflammatory Diseases with Flavonoid-rich Diets: Impact on Cancer and Obesity***
3:15-3:30	Millena Cristina Barros Santos (Federal University of State of Rio de Janeiro, Brazil) ***Lipidomics of rice bran reveals complex mixture of bioactive molecules***	Mr. Rokib Hasan (Arkansas State University, USA) ***Anti-inflammatory and Cardioprotective Functions of Prenylated Stilbenoids from Peanut Hairy Roots***
3:30-5:30 pm	Awards and Closing Ceremony	

June 24, 2021

ORAL PRESENTATIONS ABSTRACTS

PLENARY

Advances in natural products and polyphenols for the preservation of cognitive and psychological resilience. Giulio Maria Pasinetti, MD, PhD. Icahn School of Medicine at Mount Sinai, NY, NY

The overall objective of my presentation is to present the ongoing studies in our Botanical Supplements on Biological and Behavioral Resilience Center which was designed to investigate the mechanistic rationale to support the clinical development of a botanical supplement to provide resilience against stress-induced psychological impairment. The studies I will discuss represent a cohesive program of integrated and interdisciplinary research approaches whose principal objective is to provide valuable insight through both pre-clinical and pilot-clinical lines of investigation that may inform a future clinical trial designed to determine if dietary polyphenol supplements can provide resilience against stress-induced psychological impairment. During my presentation, **I will first** emphasize our studies utilizing stress-induced models psychological impairment designed to identify biomolecular systems associated with immune function and neuronal activity that specific bioavailable metabolites of Bioactive Dietary Polyphenol Preparation (BDPP) able to influence to promote resilience to stress. This study leverages on previous evidence suggesting that mitigation of leukocytes derived inflammatory cytokines, in particular IL-6, which we find to promote resilience against physiological pathways elicited by stress that are associated with increased IL-6 activity. **I will proceed** by integrating the outcomes of potentially preclinical studies for decision making of clinical properties of BDPP in humans. Based on this, I will discuss the use of the state-of-the-art cell-specific RNA-sequencing and imaging techniques that will provide target engagement information for clinical association studies being conducted in humans. Ultimately, we will test if BDPP promotes *resilience against upregulation of plasma IL-6 in response to the Trier Social Stress Test* in humans in parallel to experimental model. Together, my presentation will provide critical information of the mechanism of action and the clinical properties of BDPP and its metabolites that fill the most critical gaps in the existing body of data needed to optimally design a future clinical trial to test resilient properties of BDPP in response to stress-induced psychological impairment.

SESSION 1: GRAPE DERIVED POLYPHENOLS

KEYNOTE SPEAKER

Polyphenols prevent inflammation and associated-diseases through a direct action on immune cells. Dominique Delmas. Université de Bourgogne Franche-Comté, INSERM Research Center U1231 and Centre anticancéreux Georges François Leclerc, F-21000 Dijon, France. Email: dominique.delmas@u-bourgogne.fr

Inflammation plays a crucial role in many pathologies such as cardiovascular diseases, autoimmune diseases, age-related diseases or the development of cancers. This inflammatory process is often initiated by the release of pro-inflammatory cytokines from immune cells. Among these, we have been able to show that lymphocytes T helper 17 (Th17) play the main role in an inflammatory and cancerous context. Indeed, these immune cells resulting from the differentiation of naive T lymphocytes, are able to produce a pro-inflammatory interleukin, IL-17. This IL-17 contributes to tumor growth, in particular to the production and secretion of the vascular endothelial growth factor leading to tumor angiogenesis. Thus by blocking the production of IL-17 and the process of differentiation

of naive T lymphocytes into pro-inflammatory Th17 lymphocytes, it would then be possible to decrease tumor progression and reduce the associated inflammation. Among the microcomponents of the diet which can participate in the prevention of inflammation and subsequently to various associated diseases, polyphenols, especially from grapes such as resveratrol, could be good candidates. Indeed, in this presentation, we highlight the potential effect of polyphenols on both interleukins secretion by pro-inflammatory lymphocytes Th17 and on lymphocyte differentiation. In this process, we demonstrate the main role of the NAD-dependent deacetylase, Sirtuin 1, and of the nuclear factor STAT3. These events are associated with a reduction of tumor growth in two models of subcutaneous transplantable tumors in C57BL/6 and Balb/C mice. Moreover, we observed a reduction of VEGF secretion which associated with a significant decrease in the B16F10 metastasis lung tumor model. By this way, polyphenols from grapevines could potentially affect tumor progression through a direct action on the immune cells.

This work was supported by grants from the the Conseil Régional Bourgogne, Franche-Comte, the FEDER and the Bureau Interprofessionnel des Vins de Bourgogne

INVITED SPEAKERS

Grape pomace as a sustainable source of bioactive compounds for cosmeceutical applications. Cristiana Caliceti[1], Emanuele Porru[2], Angela Punzo[2], Chiara Samorì[2], Alessia Silla[1], Mara Mirasoli[2], Paola Galletti2, Emilio Tagliavini[2], and A. Roda[2]. [1]Department of Biomedical and Neuromotor Sciences, Alma Mater Studiorum - University of Bologna, Bologna, Italy. 2Department of Chemistry "Giacomo Ciamician", Alma Mater Studiorum - University of Bologna, Bologna, Italy. E-mail: *cristiana.caliceti@unibo.it*

Food waste is a serious problem for its environmental and economic impact so exploiting new functional applications has been an important area of research. During winemaking, only a minor part of grape phytochemicals are extracted into the wine, leaving the pomace still rich in molecules with high added value, such as polyphenols. Since these compounds exert positive effects on human health, this study aims at optimizing and validating possible routes toward their extraction and further valorization for cosmeceutical applications. Bioactive molecules contained in red pomace were extracted with a "green" process using three different natural deep eutectic solvents (NaDES) formulation, betaine: citric acid (BCA), betaine: urea (BU), and betaine: ethylene glycol (BG). The polyphenol content was determined by HPLC-MS/MS analysis, showing that the formulations had a similar malvidin concentration (51-56 µg/mL). However, BCA showed the highest permeation of malvidin in skin, determined by Franz cells model, so it was further exploited to investigate its biological effects in highly predictive human 3D keratinocytes (HaCat spheroids). Cell viability and cytotoxicity were measured using spectrophotometric techniques, observing that 24 hours of BCA treatment (malvidin range 0.1- 1.1 µg/mL) was safe for HaCat spheroids. Antioxidant and anti-inflammatory activities were analyzed by a cell-based chemiluminescent assay for intracellular H_2O_2 detection and ELISA assay for interleukins (IL) release, respectively. 24 hours treatment of BCA (range in content of malvidin 0.1- 1.1 µg/mL) showed a good intracellular antioxidant activity (IC50 0.6 µg/mL in malvidin) in HaCat spheroids injured with 25 µM menadione. Moreover, BCA pretreatment for 24 hours (malvidin content of 0.6 µg/mL) decreased the release of IL-8 in HaCat spheroids injured with 25 µM of menadione. Thus, BCA formulation is worthy of investigation for use as a cosmetic ingredient to reduce oxidative stress and inflammation, the main causes of skin aging.

Chemoprevention of ultraviolet-B radiation-mediated skin tumorigenesis by dietary grape in SKH-1 hairless mice. Chandra K. Singh[1] and Nihal Ahmad[2]. [1]Department of Dermatology, University of Wisconsin, and [2]William S. Middleton VA Hospital, Madison, WI, USA. E-mail: nahmad@dermatology.wisc.edu

Non-melanoma skin cancers (NMSCs) are the most frequently diagnosed cancer, affecting >3.5 million Americans annually. Solar ultraviolet radiation (UVR) is an established causative factor for ~90% of these cases. Annual cases of NMSCs continue to rise despite efforts aimed at UV protection. Employing multiple protocols, we have found that dietary grape powder (GP) mitigates UVB-mediated skin carcinogenesis in SKH-1 hairless mice. Employing UVB initiation-promotion protocol (180 mJ/cm^2; twice/week for 28 weeks) and male and female mice (in different trials), we determined the effects of GP-fortified diet (3% or 5%) on skin carcinogenesis. GP feeding resulted in marked inhibition in tumor incidence, and delayed onset of tumorigenesis in both male and female mice. *In female mice*, we found that the GP-mediated responses were accompanied by enhanced DNA damage repair, reduced cell proliferation, increased apoptosis, and modulation of oxidative stress. Further, using quantitative global proteomics and Ingenuity Pathway Analysis (IPA), we found that GP feeding modulates proteins involved in protein ubiquitination and acute phase response signaling, among proteins involved in other cellular functions. *In male mice*, we found a marked reduction in malignant conversion of premalignant lesions in GP-treated mice. Additionally, we observed significant decrease in mast cell infiltration and serum IgE and cytokine CCL1 levels. Additional data demonstrated inhibition of P38 phosphorylation, STAT3 activation, and decrease in PCNA, Ki67, and BCL2 levels, in GP-treated tumors. Next, PCR array analyses identified modulation in several important genes related to cellular senescence, DNA damage repair, hypoxia signaling, metabolism, and telomere maintenance, among others. Further studies are ongoing to validate our findings, in additional experiments. Overall, our data suggest that dietary grapes, containing multiple antioxidants, protect against UVB-mediated skin carcinogenesis.

CONTRIBUTING LECTURER

Grape polyphenols improve glucose metabolism by suppressing intestinal FXR. Kevin M. Tveter[1,3], Jose A. Villa-Rodriguez[1,3], Alrick J Cabales[1], Li Zhang[2], Fiona G. Bawagan[1], Rocio M. Duran[1], and Diana E. Roopchand[1*]. [1] Rutgers, The State University of New Jersey, Department of Food Science, Institute for Food Nutrition and Health, 61 Dudley Road, New Brunswick, NJ 08901, USA. [2] Key Laboratory of Genomic and Precision Medicine, Beijing Institute of Genomics, Chinese Academy of Sciences, Beijing, China. No. 1 Beichen West Road, Chaoyang District, Beijing 100101, China. Email: roopchand@sebs.rutgers.edu [3]Authors contributed equally to this work.

Polyphenols are plant-derived compounds that may protect humans from metabolic diseases. Evidence suggests that the beneficial effects of polyphenols are mediated by the gut microbiota. Several gut microbes can modify bile acids (BA), which indirectly modulates glucose metabolism via BA signaling to farnesoid X-receptor (FXR), a nuclear transcription factor. We investigated if polyphenol-induced remodeling of gut microbial communities and glycemic improvements were linked to BA-FXR signaling. Diabetic *db/db* mice were fed low-fat diet (LFD) or LFD supplemented with a proanthocyanidin (PAC)-rich extract of grape polyphenols (GP; LFD-GP) for four weeks. Phenotypic variations, gene expression of metabolic markers, serum BAs, and gut microbiota composition were assessed. Ileal organoids were used to differentiate the effect of GP-induced BA profile on ileal FXR activity. After four weeks, GP-fed mice had superior glucose tolerance concomitant with reduced serum levels of secondary BAs (SBA) and SBA-producing gut bacteria. Gene expression of intestinal FXR-target genes (*Shp*, *Fgf15, Fabp6*) indicated FXR activity was suppressed by GP supplementation, while liver FXR target genes (*Abcb11, Slc51b, Obp2a)* were unaffected. Intestinal FXR suppression is coupled with decreased ceramide synthesis; elevated serum ceramides trigger insulin resistance and metabolic derangements via increased hepatic gluconeogenesis. Consistent with intestinal FXR suppression, GP treated mice had increased *Cyp7a1* expression and decreased expression of ceramide biosynthetic genes. Moreover, GP supplemented mice had lower expression

of hepatic gluconeogenesis and lipogenesis markers. Overall, these data imply that GP improved glucose metabolism by inducing changes in gut microbiota resulting in the modulation of BA profile and suppressed intestinal FXR activity.

SESSION 2: FIELD, GREEN HOUSE, AND INDOOR CULTIVATION

KEYNOTE SPEAKER

Beyond the field: Controlled environment production of medicinal plants. Gary W. Stutte. SyNRGE, LLC, Space Life Science Lab, Exploration Park, FL 32953. Email: gstutte@synrge.com

Controlled environment (CE) technology enables the production of plants and their products inside structures such as greenhouses, growth chambers, and indoor plant factories. Growth conditions are managed to optimize the concentration of high-value phytochemicals, maximize yields, and minimize microbial and insect contamination on a year-round basis. The technology also removes the geographical constraints to production by enabling environmental (temperature, photoperiod, light quality, CO_2) and cultural (rooting media, nutrient composition, irrigation) to be managed and replicated irrespective of location. Advances in CEA technology have the potential to significantly improve the quality and quantity of biologically active compounds in plants. Solid-state LED lighting enables the selective activation and regulation of phytochemical pathways associated with high-value secondary compounds. The application of CE technology has the potential to increase the availability of locally produced medicinally active plants, enhance the quality of product, and ensure the consistency of plant material. There is also a role in ensuring the conservation of threatened species by ensuring an adequate supply of commercial products. CE is widely used to produce vegetable and ornamental species, but the exception of high value, high demand medicinal cannabis, has not been widely adapted for commercial production of medicinal and aromatic plants. These factors include capital costs of production, lack of research on plant responses in CE, and lack of market acceptance. Despite the current lack of widespread use of CE, there is every indication that CE production will increase to meet the demand for high-quality, locally grown, medicinally active plants for individual and commercial use.

INVITED SPEAKERS

The potential uses of low temperature atmospheric plasma for forcing early sprouting, and improving plant growth and yield of turmeric. Srinivasa Rao Mentreddy and Lam Duong. Dept. of Biological and Environmental Sciences, Alabama A&M University, Normal, AL 35762. E-mail: srinivasa.mentreddy@aamu.edu

Low-temperature atmospheric pressure plasmas (LTP), also known as the ‘‘fourth state of matter,’’ are generated by breaking up noble gases by applying high voltage with a dielectric barrier. LTP is rich in *reactive oxygen and nitrogen species* (RONS) with several agricultural applications, including disinfection of seeds, fresh leaf and meat produce, stimulation of seed germination, plant growth, etc. Turmeric (*Curcuma longa*), popularly known as the “Golden Spice,” has proven anti-cancer, anti-inflammatory, and anti-Alzheimer properties, among many other benefits. However, lack of timely sprouting in some of the varieties often results in poor stand establishment. The objective of the two-year study was to assess the effects of LTP on sprouting and plant growth of turmeric varieties known for slow sprouting and poor stand establishment. Four turmeric varieties were each exposed to He gas LTP for 90 s, and the plasma-treated and control rhizomes were planted in seedling trays and assessed for sprouting and plant height in a greenhouse. All plasma-treated rhizomes sprouted six to twenty-eight days earlier

and achieved 100% sprouting a week to 4 weeks earlier than the untreated control. The plasma-treated plants grew faster, and produced taller (37 – 39 cm) plants with more shoots/plant, and yielded twice that of the untreated control. The effects varied with genotype and were consistent over the long term. The study showed that cold or low-temperature plasma offers potential for improving turmeric plant stand establishment and crop performance.

This research was supported by NSF EPSCoR RII Track 1 Grant OIA – 1655280.

A multiple harvest system for *Cannabis sativa* micro-cuttings with ex vitro rooting. Jeffrey Adelberg and Ryan Murphy, Dept. of Plant and Environmental Sciences, Clemson University, Clemson SC, 29634 Email jadlbrg@clemson.edu

Micropropagation is a preferred method to clone clean stock plants, albeit labor-intensive and costly. Hedging in vitro reduces hood labor by cutting the same plant several times. Rooting micro-cuttings ex vitro in the laboratory maintains cleanliness during acclimatization prior to greenhouse transfer. An integrated hedging system with ex vitro rooting was developed with *Cannabis sativa* L. 'US Nursery Cherry 1,' at four different light intensities (25 – 167 μmol m^{-2} s^{-1} PPFD), in vessels with vented or non-vented closures. The numbers of harvested shoot tips increased over four repeated 3-wk cutting cycles without sub-culture, however, there was a decline in number of shoot tips from vented vessels in the fourth cycle due to excessive drying and collapse of the agar matric. The number of shoot tips harvested through repeated cycles was increased with light intensity. The number of leaves per rooted plantlet ex vitro increased with in vitro light intensity. Ex vitro rooting and growth in phenolic foam plugs, in the laboratory under humidity domes with vented surfaces and saturated in Hoagland's medium (0.5x - 2x strength) was observed after two wks. Rooted plugs were then transferred to the greenhouse and grown for another two wks. in 10 cm pots. The rate of ex vitro rooting, leaf area and plant size were modeled to be greatest when micro-cuttings were rooted in Hoagland's 1.5x strength medium. Larger ex vitro rooted plants had increased branching, stem caliper, leaf size, and fresh or dry mass when grown in the greenhouse. Micropropagation labor efficiency was improved by using a multi-cycle cutting process, which allowed the same material to be repeatedly cut from rooted bases instead of sub-cultured. Plant quality was improved by light and nutrient factors. Novel hardware is under current development in our laboratory program to upscale this process for commercial use.

CONTRIBUTING LECTURER

Evoking specialized metabolism in plants subjected to microgravity. Joe Chappell[1], Twyman Clements[2], and Kris Kimel[2]. [1]Department of Pharmaceutical Sciences, University of Kentucky, Lexington, KY and [2]Space Tango, Lexington, KY

It is well established that microgravity conditions, such as those experienced on the International Space Station (ISS), can induce epigenomic changes that can manifest as new traits, characteristics and phenotypes. Loss of geotropic responses, enhanced cell enlargement, changes in leaf morphology, and even changes in transcriptomic profiles are just a few of the examples well documented in plants. But less well examined are changes in metabolites and especially specialized metabolites. We have begun to address this knowledge gap by subjecting different medicinal plants to time on the ISS and returning these materials to earth for growth under rigorous, controlled conditions. The plants we have focused on are periwinkle (*Catharanthus roseus*), valerian (*Valeriana officinalis*), and hemp (*Cannabis sativa*) and their respective alkaloid, terpene and polyketide chemistries. We will review a case study with hemp including novel measures we have developed to uncover unique biosynthetic potential in the cannabinoid class of chemistry.

SESSION 3: METABOLIC SYNDROME

KEYNOTE SPEAKER

Dietary modulation of the gut microbiota in early life. Maria Gloria Dominguez-Bello. Department of Biochemistry and Microbiology, Rutgers University, New Brunswick, NJ 08901, USA. Email: mg.dominguez-bello@rutgers.edu

Mammals start extrauterine life-nourishing from a secretion of the mother until they have developed enough. By the time they start solid, environmental nourishment, their gut, immune system, locomotion, sensorial, and brain capabilities have developed substantially. Microbes are transferred to the neonate, starting at birth and thereafter. Microbial transmission is affected by antibiotics in pregnancy birth mode, lactation mode, time of introduction of solid food. Microbes are selected by diet, and by the evolving host organ, and diet selects microbes. In particular, milk HMOs select certain microbes capable of utilizing these oligosaccharides, and thus, infants lacking breastmilk feeding have lower proportions of these bacteria in their gut, and they also happen to grow bigger, just as happens after early perturbations due to antibiotics or C-section birth. Breastfeeding regulates growth, body weight, and fat deposition during the first year of development.

INVITED SPEAKERS

Predictive trajectory of human health phenotypes in the nutrition-modulated state space of the gut microbiome. Liping Zhao. Department of Biochemistry and Microbiology, Rutgers University, New Brunswick, NJ 08901, USA. Email: liping.zhao@rutgers.edu

Nutrition is a significant environmental factor that could move individuals between a healthy state and a diseased state in the state space of human health phenotypes. Such nutritional modulation of our health phenotypes may be mediated by nutrient molecules' interactions with both our genome and the gut microbiome. With a series of mechanistic clinical trials, we showed that integrating adequate nutrition for the gut microbiome into the intervention diet for a long enough time-shifted the microbiota structure to a new space and concurrently moved obese and diabetic patients from a diseased state space into a healthier space. Transplantation of before and after intervention gut microbiome from the same patients to germ-free mice showed that the microbiome nutrition-modulated gut microbiota causatively contributed to the transition of patients from a diseased state space into a healthier state space. A reference-free, ecologically meaningful analysis of bacterial genomes assembled from metagenomic datasets showed that the trajectories of patient health phenotypes were significantly associated with the varying positions of patients in the state space of the gut microbiome. Identification of key bacterial genomes that were responders to the microbiome-targeted nutrition intervention allowed the establishment of a prototype model to predict how the nutritional shifting of the gut microbiota could move the hosts into a healthier state space. Standardized and quality-controlled clinical and microbiome analytical protocols will accumulate ecologically and physiologically meaningful data to facilitate the assessment, monitoring, and prediction of health-relevant human responses to nutrition and diet, thus opening a new avenue of personalized, predictive, and preventive management of human health.

Development and characterization of high flavonoid lettuce varieties. Csanad Gurden and Ilya Raskin. Department of Plant Biology and Pathology. Rutgers University, New Brunswick, NJ 08901, USA.

The flavonoid biosynthetic pathway generates a variety of pharmacologically beneficial compounds in plants. Lettuce (*Lactuca sativa* L.) is one of the most commonly consumed leafy vegetables in the world, yet it is not known for significant quantities of health-promoting phytochemicals. Using tissue culture and mutational breeding approaches we developed green and dark red, true-breeding lettuce varieties that accumulate cyanidins, naringenin chalcone, kaempferol, and quercetin to exceptionally high levels, up to 8% of dry weight. Genomic changes associated with high polyphenol phenotypes, such as point mutations and transposon insertions were also characterized. Accumulation of certain flavonoids in the identified lettuce varieties contributed to the attenuation of post-prandial hyperglycemia and changes in gut microbiota in mice. This work demonstrates how non-GMO approaches can transform a common crop plant into a functional food with possible health benefits.

CONTRIBUTING LECTURER

Grape polyphenols attenuate diet-induced obesity and hepatic steatosis in mice in association with reduced microbial metabolite butyrate and increased intestinal carbohydrate oxidation. Esther Mezhibovsky[1,2], Kim A. Knowles[1], Qiyue He[1], Ke Sui[1], Kevin M. Tveter[1], Rocio M. Duran[1], Diana E. Roopchand[1]. [1]Department of Food Science and [2] Department of Nutritional Sciences Graduate Program, Rutgers University, NJ Institute for Food, Nutrition and Health (Rutgers Center for Lipid Research and Center for Nutrition, Microbiome and Health), 61 Dudley Rd., New Brunswick, NJ 08901 USA. Email: em818@sebs.rutgers.edu; roopchand@sebs.rutgers.edu

A Western Diet (WD) low in fiber but high in fats and sugars contributes to obesity and hepatic steatosis. Supplementation with grape polyphenols (GPs) can improve metabolic health while altering the gut microbiota and its metabolites. We hypothesized that GP-mediated improvements would correlate with altered microbial metabolites such as short chain fatty acids (SCFAs). C57BL/6J male mice were fed a Western-like diet, low in fiber, and high in sucrose and butterfat along with 20% sucrose water, which was supplemented with 1% GPs (WD-GP). Compared to WD-, WD-GP-fed mice had higher lean mass, and lower fat mass, body weight, and hepatic steatosis, despite consuming more calories from sucrose water. Reduced adiposity in GP-supplemented mice was likely due to their greater energy expenditure (EE), which resulted in lower energy efficiency compared to WD-fed mice. GP-supplemented mice had a higher abundance of *Akkermansia muciniphila,* a gut microbe reported to increase EE. SCFA measurements in colon content revealed that GP-supplemented mice had lower concentrations of butyrate, a major energy substrate of the distal intestine, and reduced valerate, a putrefactive SCFA. GPs also reduced the acetate:propionate ratio suggesting reduced hepatic lipogenesis. Higher sucrose consumption and reduced butyrate levels in GP-supplemented mice suggested that enterocytes would metabolize glucose and fructose as a replacement energy source. Indeed, markers for increased ileal glucose and fructose uptake, fructolysis, and glycolysis (i.e. glucose transporter 2/5, ketohexokinase, and hexokinase) suggest increase carbohydrate metabolism. Increased intestinal carbohydrate oxidation was supported by: 1) increased mRNA of duodenal pyruvate dehydrogenase, 2) a decreased ratio of lactate dehydrogenase a (*LDHa)*:*LDHb* in jejunum and colon tissues, and 3) decreased duodenal and colonic lactate concentrations. These data indicate that GP-induced reductions to certain SCFAs protect against WD-induced obesity and hepatic steatosis by increasing intestinal disposal of sugars and diminishing portal delivery of lipogenic SCFAs and sugars.

SESSION 4: ETHNOBOTANY

KEYNOTE SPEAKER

Using indigenous knowledge to improve primary healthcare outcomes in developing countries: case studies from micronesia. Michael J. Balick. Institute of Economic Botany, The New York Botanical Garden, New York, New York, USA. Email: mbalick@nybg.org

It is estimated that 30,000 species of higher plants have been used by different traditional cultures for medicine, mostly for primary health care conditions. In many regions, such as remote Pacific Islands, pharmaceutical medicine is limited in availability, while plant resources used to treat selected conditions can be more easily sourced. As part of our Plants and People of Micronesia project, we developed two manuals for local use that focus on primary health care conditions. Working with local hospitals and ministries of health, physicians, nurses, chemists, botanists, and cultural specialists, this project developed primary health care manuals for Pohnpei State in the Federated States of Micronesia as well as the Republic of Palau. Each manual is organized by condition, for example, chapters on bites and stings, gastrointestinal disorders, wounds, and broken bones, as well as chapters specific to men's and women's health. In the manual from Pohnpei, there is a chapter on culturally specific conditions. Each entry has the local and scientific names of the plant, a photograph to facilitate identification, as well as paragraphs on the description of the species, range, traditional uses, pharmacological properties, and toxicology. One caveat is that the paragraphs on pharmacology and toxicology are limited to what could be found in the literature. In addition, in the Palau manual, two influential physicians prepared sections on health care beliefs from their island nation, providing essential context for use of the book. Also, on Palau, one of the most important medicinal plants, for the treatment of diabetes, was studied for efficacy in a randomized, double-blind, placebo-controlled study, the results of which will be discussed. Copies of these manuals are widely available, have been distributed to Pohnpei and Palau, and other Pacific Islands, and can also be found in local clinics and hospitals. In Palau, the manual has been used for continuing medical education classes as some traditional remedies are prescribed by local health care workers. We hope that health care providers, seeing the importance of plants and the environments in which they are found, will become advocates for ecosystem conservation.

INVITED SPEAKERS

Natural variation of phytochemicals in various *Capsicum spp*. Carlos Lopez-Ortiz[1], Garret Crummett[1], Purushothaman Natarajan[1], Padma Nimmakayala[1] Donald Adjeroh[2], Cristian Sirbu[3] and Umesh K. Reddy[1*]. [1]Department of Biology, Gus R. Douglass Institute, West Virginia State University, Institute, WV 25112, USA. [2]Lane Department of Computer Science and Electrical Engineering, West Virginia University, Morgantown, WV 26506, USA.[3]Charleston Area Medical Center Health Education and Research Institute, Center for Cancer Research, Charleston, WV 25304, United States. Email: ureddy@wvstateu.edu

Diabetes, obesity, and metabolic syndrome are becoming epidemic both in developed and developing countries in recent years. Chili peppers represent an important crop worldwide due to the beneficial properties of their phytochemicals including carotenoids, capsaicinoids, phenolic compounds, vitamins, and minerals. These compounds have been associated with the control of obesity, the reduction in the risk for coronary disorders, diabetes, cancer, osteoporosis, and neurodegenerative diseases. However, a focused research in Drosophila has not yet fully addressed. Thus, this study aims to analyze the effects of pepper containing diet in the transcriptome response of *Drosophila melanogaster* and identify genes that may relate to pathogenesis accompanying an obesity-like state. We used the wild type *D. melanogaster* Berlin-K strain reared on control and 7.5% (w/w)

pepper-containing diets. Experiments were initiated by placing approximately 10 males and 10 females onto vials containing the different diets. Adults were allowed to lay eggs for 72 h before being removed. The larvae were fed and once the adult stage was achieved, these flies were selected for bodyweight, triglyceride, and glucose level determination and RNAseq analysis. We observed a significant weight reduction in female flies on a pepper diet compared with those reared on control diet. Similarly, triglycerides level showed a high reduction at both sexes under pepper treatment. Although glucose levels did not show a significant difference, we noticed a slight reduction in male and female flies. RNA-seq revealed 539 differentially expressed genes between control and pepper diets. Moreover, genes involved in fatty acid and antioxidant metabolism were down-regulated. Likewise, a gene with function glucocerebrosidase 1a (*Gba1a*) associated with Parkinson disease was down-regulated, meanwhile, genes related to obesity such as adipokinetic hormone (*Akh*) and scratch, isoform B (*Kah*) were up-regulated. This transcriptome study provided a comprehensive understanding of various molecular mechanisms underlying pepper diet effects in Drosophila.

Marketing fresh turmeric in the United States: A producer perspective. Ramu Govindasamy[1], Alexandra Kelly[1], Jackie Greenfield[2], Mentreddy Rao[3], Lam Duong[3], Dennis Shannon[4], and Tia Gonzales[4]. [1]Dept. of Agricultural, Food and Resource Economics, Rutgers University, New Brunswick, NJ 08901-8520. [2]Good Scents Herb & Flower Company, NC; [3]Alabama A&M University; [4]Auburn University. E-mail: Govind@sebs.rutgers.edu

A producer survey was administered to current and potential turmeric producers in Alabama (94%) and Georgia (6%) to assess the status of turmeric production in America. The survey also sought to gain information to promote efficient turmeric production and marketing. Ten current producers and six prospective producers participated in the survey. The producers mostly had their farms in rural areas (80%), identified as male (60%), were between the ages of 51-65 (35.71%), possessed an undergraduate degree (71.43%), and identified as part of a minority group (53.33%). For a large majority, 66.67%, farming was not their primary source of income. Of most participants, 93.75% were from Alabama. The total acreage of the producers was relatively small, with 75% of the farms less than 100 acres. Organic production was limited to 25% of the population surveyed. Like total acreage, turmeric acreage was relatively small, with 100% of the producers having 1 acre or less. Most producers, 66% had grown turmeric for three years or less. The participants reported a relatively large amount of diversity in turmeric varieties grown with 16 total varieties listed. Most producers, 75%, either did not answer total units of turmeric produced or did not produce any at the point of the survey. The average price for fresh turmeric ranged between $7-14 per pound but was most common between $10-12 per pound. Training from agricultural extension services had the largest room for improvement as 87.5% of the producers did not have any training from these services. Extension agents were also the most preferred information source for the future, according to the participants. These extension services would be necessary for encouraging the production of turmeric and other crops. Pricing, labor, and marketing were reported as the most significant obstacles to expanding turmeric production in Alabama

CONTRIBUTING LECTURER

Strengthening vegetable value chains for improved nutrition in a Kenyan informal settlement. Emily V. Merchant[1,2*], Alexandra Zivkovic[3*], Thomas Nyawir[4], Daniel J. Hoffman[3,5], James E. Simon[1,2], Shauna Downs[1,3*]. [1]New Use Agriculture and Natural Plant Products Program, Department of Plant Biology, Rutgers University, NJ USA; [2]Center for Agricultural Food Ecosystems, The New Jersey Institute for Food, Nutrition, and Health, Rutgers University, NJ USA; [3]Urban-Global Public Health, Rutgers School of Public Health, Newark, NJ USA; [4]Mirror of Hope C.B.O, Nairobi, Kenya; [5]Department of Nutritional Sciences, New Jersey Institute for

Food, Nutrition, and Health, Center for Childhood Nutrition Education and Research, Program in International Nutrition, Rutgers University, NJ USA. Email: evr.merchant@rutgers.edu; jimsimon@rutgers.edu *authors contributed equally

Informal settlements are characterized by barriers to resources such as nutritious food and water, contributing to high levels of food insecurity. Sack gardening, an urban agricultural method, may help address poor quality diets and food insecurity while providing a source of income. The aims of this study were to assess the implementation of a sack garden intervention among women in Kibera and evaluate the intervention impact relative to food security and dietary diversity. Semi-structured interviews identified barriers and facilitators to the production, consumption, and sale of self-produced African Indigenous Vegetables. Pre- and post-intervention surveys were conducted to evaluate potential intervention impact. Key barriers were insufficient inputs and group work difficulties. Facilitators included positive intervention feedback, participants' self-sufficiency, and resourcefulness, and preference for sack garden vegetables. Participants reported an increase in dietary diversity scores (24% p=0.059); and a decrease in household food insecurity (10% p=0.015). Recommendations for program scale-up include investment in inputs, a water collection/irrigation system, and training as well as placing sack gardens closer to women's homes. Our study suggests that sack gardens may provide partial solutions to improve diet quality.

SESSION 5: MODERN ANALYTICAL TECHNIQUES IN BOTANICAL RESEARCH

KEYNOTE SPEAKER

Metabolomic profiling and modeling for botanical phytochemical analysis. Joshua J. Kellogg. Department of Veterinary and Biomedical Sciences, Pennsylvania State University, University Park, PA. Email: jjk6146@psu.edu.

Botanical samples contain a diverse array of small-molecule structures, which can possess bioactive properties or serve as biomarkers, and are the cornerstone of their agricultural, ecological, nutritional, or medicinal properties. Investigators involved in studies of botanicals face a unique set of challenges as they are typically complex mixtures, for which the identities and quantities of components present may not be fully known, and the composition of which can vary greatly depending on the method of preparation or source material used. Metabolomics represents an untargeted, holistic approach for analyzing this diverse chemistry, and is a powerful analytical platform for integrating chemistry and bioactivity data to discern chemotype differences, adulteration in material, and biomarker discovery. Our work has focused on the development of mass spectrometry-based metabolomic approaches for the analysis of complex mixtures. Here, we present several recent studies highlighting the efficacy and potential of metabolomics in botanical phytochemical analysis.

INVITED SPEAKERS

Evaluating grape seed (*Vitis vinifera*) phytochemicals for hair protection. Sonja L. Knowles, Wei Sheng, Stephanie Davis, Timothy R. Baker, Vincent P. Sica, Christopher J. Pulliam, Lijuan Li, Sherry Tansky, and Jennifer M. Marsh. The Procter & Gamble Company, Mason Business Center, Mason, OH 45040. Email: marsh.jm@pg.com

The use of naturals in the cosmetics industry is increasing rapidly and the desire is to more to botanical extracts that deliver hair protection. Grape seed extract has well-known antioxidant properties, and its overall performance

was measured by oxygen radical absorbance capacity (ORAC) and ferric reducing antioxidant power (FRAP) assays. Twelve grape seed extracts from various suppliers and locations were tested to identify which extracts had the best antioxidant capabilities. A chemometric approach was utilized to ascertain which phytochemicals were linked to hair protection. Principal component analysis (PCA) and other learning models were used to distinguish which phytochemicals present in grape seed extract were linked to ORAC and FRAP activity. This analysis showed that the levels of phytochemicals varied between samples, which allowed for correlation with measured antioxidant performance (ORAC and FRAP) and hair protection.

African Nightshades: Advances on the phytochemistry, and new consumption and utilization with added value. Bo Yuan[1,2,3], David Byrnes[1], Weiting Lyu[1,4], Fekadu F. Dinssa[5], James E. Simon [1], Qingli Wu[1,2]. [1]New Use Agriculture and Natural Plant Products Program, Department of Plant Biology, Rutgers University, New Brunswick, NJ 08901, USA. [2]Department of Food Science, Rutgers University, New Brunswick, NJ 08901, USA. [3]Department of Molecular Metabolism, Harvard University, Boston, MA 02215, USA. [4]Department of Medicinal Chemistry, Rutgers University, Piscataway, NJ 08854, USA. [5]WorldVeg Center, Eastern and Southern Africa, Arusha, Tanzania. Email address: bo_yuan@hsph.harvard.edu; jimsimon@sebs.rutgers.edu; qlwu@sebs.rutgers.edu.

African indigenous nightshades (AIN) are a group of high-priority leafy vegetables that provide food security, nutrition and dietary diversity, and economic opportunities in sub-Saharan Africa, especially in the rural areas. Consumption of AIN leaves and tender stems, however, has long been plagued with the potential existence of toxins that typically exist in the *Solanum* genus that African nightshades belong to, and thus impairs their recognition by the seed and vegetable industry. In addition, AIN berries, despite their prolific production, are generally considered inedible and remain an underutilized agricultural resource. Recently, systematic phytochemical profiling was performed on AIN leaves and berries from different genetic sources (*Solanum* species of *nigrum*, *scabrum*, *americanum* and *villosum*, including a total of 15 accessions) and cultivated in varied geographical regions (Kenya and USA), facilitated by liquid chromatography-mass spectrometry methods and related techniques, and have unveiled insights into the AIN toxicity, nutrition and consumption value, and potential new use with added-value. Glycoalkaloids (GA) and saponins (SA) were identified as major antinutritive factors in AIN. Leaves from all investigated AIN, regardless of genetic and cultivation sources, contained sufficiently low toxic levels of GA and SA, and supported their safe consumption status. In addition, leaves presented a high amount of free amino acids and total crude protein level and therefore could be a valuable vegetable-based protein source for household consumption and for industrial new food formulation. Berries, especially when unmatured, generally contained a high amount of toxic GA and repelled consumption. Berries from certain genetic sources, however, were identified to be deficient in GA and meanwhile highly enriched in beneficial polyphenols, and therefore could serve as a potential new food supply. In summary, the new knowledge in the phytochemical profile of AIN would provide guidance for safe and nutritious consumption and provoke new thoughts for innovative use and application.

CONTRIBUTING SPEAKER

Antifungal activity of pentagalloyl glucose against drug resistant *Candida* species. Lewis Marquez[1], Joan Shang, François Chassagne[2] and Cassandra Quave[1,2,3]. [1]Molecular and Systems Pharmacology Program, Laney Graduate School, Emory University, Atlanta, Georgia, USA and [2]Center for the Study of Human Health, Emory University, Atlanta, Georgia, USA and [3]Department of Dermatology, Emory University, 615 Michael St., Whitehead 105L, Atlanta, Georgia 30322. Email: lewis.marquez@emory.edu; cquave@emory.edu

The emergence of antifungal drug resistance among multiple *Candida* species is a growing threat to the public health. Infections by the newly emerging multidrug-resistant *Candida auris* (MDR- *C. auris*) are noted as being extremely virulent with mortality rates between 35-60%. To address the need for new antifungal compounds, we screened a collection of plant extracts traditionally used in the treatment of infectious and inflammatory skin disease against drug-resistant *Candida albicans* (*C. albicans*). From this, we found that an extract made from the leaves of *Schinus terebinthifolia* displayed >90% growth inhibition against multiple strains of drug-resistant *C. albicans*. In this study, we sought to identify and isolate the bioactive small molecules in this extract responsible for the antifungal activity. We utilized bioassay-guided fractionation, nuclear magnetic resonance, and mass spectroscopy to identify and isolate the active antifungal compound, pentagalloyl glucose (PGG). We then tested the effectiveness of PGG against MDR- *C. auris* and related drug-resistant *Candida* species (*C. albicans, C. glabrata, C. parapsilosis*). Here we show that PGG has an IC50 of 0.53-4.25 µM against two clinical strains of MDR- *C. auris* and an IC50 of 0.26-1.1 µM against a panel of drug-resistant *Candida* species.

SESSION 6: LINKING HEALTH AND NUTRITION TO DIET

KEYNOTE SPEAKER

Health benefits of berry volatiles. Sun-Ok Lee Cindi Brownmiller and Inah Gu. Department of Food Sciences, University of Arkansas, Fayetteville, AR 72704, USA. E-mail: sunok@uark.edu

Berries are one of the most consumed fruits in our diet and have received much attention due to their protective effect against a number of chronic diseases including various types of cancer, heart disease and stroke, and metabolic syndrome. The major phytochemicals found in berries are phenolic compounds including flavonoids, tannins, and phenolic acids. Berry polyphenols are thought to be responsible for positive health benefits due to their antioxidant, anticancer, and anti-inflammatory properties. Berries also produce an array of volatile compounds which are responsible for their unique aroma and flavor. However, there is limited information available on the health-promoting properties of berry volatiles. The study was conducted to isolate phenolic and volatile fractions from six common berries (blackberry, black raspberry, blueberry, cranberry, red raspberry, and strawberry) and investigate the anti-inflammatory effect of berry phenolics and volatiles using a lipopolysaccharide (LPS)-stimulated RAW264.7 cells by measuring levels of cytokines and the nuclear factor-kappa B (NF-κB). Results showed that berry phenolics and volatiles significantly inhibited the LPS-induced nitric oxide (NO), prostaglandin E_2 (PGE_2), cyclooxygenase-2 (COX-2), interleukin-6 (IL-6), and tumor necrosis factor-α (TNF-α). The findings showed that berry volatiles had comparable anti-inflammatory activities as berry phenolics, suggesting that berry volatiles may play an important role in health-promoting benefits.

INVITED SPEAKERS

Dynamics of the gut microbiome in response to dietary intervention with black raspberries in the context of a standard or Western type diet in a mouse model of inflammation-associated colorectal cancer. Abby Benninghoff[1], Daphne Rodriguez[1], Korry Hintze[2], Eliza Owens[1], Sam Vassar[1], Ashley Bartlett[1], Emily Mortensen[1], Abbey Horrocks[1]. [1]Department of Animal, Dairy and Veterinary Sciences, Utah State University, 4815 Old Main Hill, Logan, UT, 84339. [2]Department of Nutrition, Dietetics, and Food Sciences, Utah State University, 8700 Old Main Hill, Logan UT, 84339. Email: abby. benninghoff@usu.edu

Anti-inflammatory bioactives in black raspberries (BRB) have been shown to have protective effects on the colon epithelium and may influence gut microbiome. The goal of this study was to determine the effects of dietary

intervention with BRB on the dynamic composition of the gut microbiome composition in mice. Using a 2x2 factorial design, C57BL/6J male mice were fed the standard AIN93G diet or the total Western diet (TWD) for 16 weeks with or without 10% (w/w) whole, freeze-dried BRB powder. The azoxymethane + dextran sodium sulfate model of inflammation-associated colorectal cancer was employed to assess the dynamic response of the gut microbiome to basal diet and BRB treatment prior to, during, and after active colitis and at the study end. Microbiome composition was determined using 16s rRNA sequencing followed by diversity analyses (alpha and beta) and identification of discriminating taxa by with linear discriminant analyses by effect size (lefse). Alpha diversity was markedly reduced during colitis for mice consuming either AIN93G or TWD, with some improvement noted by the recovery phase. Of note, consumption of BRB for two weeks significantly increased alpha diversity measures, and BRB improved alpha diversity in mice fed the AIN93G diet during colitis. Alternatively, BRB appeared less effective in mice fed TWD. Beta diversity was also significantly affected with notable clustering of microbiomes by BRB treatment during and after colitis. Consumption of BRB affected the relative abundance of several key taxa over the course of colitis and recovery from gut injury, including Erysipelotrichaceae, Bifidobacteriaceae, Streptococcaceae, Rikenellaceae, Ruminococcaceae, and Akkermansiaceae, among others. Dietary supplementation with BRB shifted the composition of the gut microbiome during colitis and recovery from gut injury, though the effects were inconsistent with respect to the basal diet consumed.

The use of African indigenous vegetables to prevent undernutrition in low-income countries. Daniel J. Hoffman. Department of Nutritional Sciences, Program in International Nutrition and New Jersey Institute for Food, Nutrition, and Health, Center for Childhood Nutrition Research, Rutgers, the State University of New Jersey, New Brunswick, NJ USA. E-mail: dhoffman@sebs.rutgers.edu

Growth from conception through age 2 years is important for the long-term health of the growing fetus and child and is influenced by several factors including breastfeeding and complementary feeding. Low- and middle-income countries (LMICs) face a complicated array of factors that influence healthy growth, ranging from high food insecurity, poor sanitation, limited prenatal or neonatal care, and high levels of poverty that exacerbate the "vicious cycle" associated with the inter-generational promotion of growth retardation. The period prior to conception, both maternal and paternal health and diet, plays an important role in fetal development, giving rise to the concept of the "First 1,000 Days+". One sustainable approach to improving both maternal and infant nutrition that protects against micronutrient deficiencies is the introduction of nutrient-dense African Indigenous Vegetables (AIVs). Supporting programs to include AIVs will ensure widespread consumption of these vegetables that are rich in micronutrients that support growth and health. This presentation will discuss fundamental aspects of human growth that are associated with disease risk in adulthood. As well, key approaches to using AIVs in LMICs will be discussed as a means to interrupt the vicious cycle of poverty and malnutrition, especially in light of global climate change and the impact of the COVID-19 pandemic on food security and nutrition in the poorest regions of the world.

CONTRIBUTING SPEAKER

Considerations for therapeutic drug monitoring and pharmacokinetics with phytochemicals. Jeremy James Johnson. Department of Pharmacy Practice, University of Illinois at Chicago College of Pharmacy, Chicago, IL 60612. E-mail: jjjohn@uic.edu

The optimal dosing of phytochemicals and highly characterized plant extracts possibly represents one of the more challenging aspects when moving a promising study agent from the bench to the clinic. The lack of information

on optimal dosing of these phytochemicals has led to an overwhelming majority of efficacy studies utilizing super physiological dosing relative to normal dietary physiological dosing. Unfortunately, the approach of "more is better" has led to a significant disconnect when analyzing high dose clinical trials designed to evaluate efficacy with epidemiological results from low dietary exposure used to develop the original hypothesis that the phytochemical has health-promoting properties. In addition to evaluating the pharmacology of phytochemicals in cancer and inflammatory conditions, our research group has been evaluating the pharmacokinetic properties of phytochemicals from a variety of plants including the mangosteen (*Garcinia mangostana*), rosemary (*Salvia rosmarinus*), and green tea extract (*Camellia sinensis*) in pre-clinical and clinical studies. Based on our results as well as others, it is evident that the assumption of "more is better" with regard to phytochemical dosing needs to be reconsidered. Specifically, we will discuss animal to human dose translation, individual phytochemicals versus highly characterized extracts, dosage forms, metabolic conversion, absorption enhancers, non-linear biological activity, and how acute versus chronic dosing of phytochemicals may modify key pharmacokinetic and pharmacological parameters in a human clinic setting.

June 15, 2021

PLENARY

Data, myths, and politics: perspectives on cannabinoids in human health. Jahan Marcu. Marcu & Arora. www.marcu-arora.com; E-mail: jahan@marcu-arora.com

The popularity of cannabis and cannabinoid products continues to rise. These products are available to purchase for most of the adult population in the United States as easily as alcohol. As we peek into the looking glass, federal agencies continue to view cannabis as a dangerous, illicit drug with toxic effects and no medicinal properties; at the same time, being legally available for clinicians to treat adult and pediatric patients with varying conditions. Looking closer, the regulation of cannabinoids such as cannabidiol (CBD) and Delta8 THC is, at best, contradictory, poorly understood, overly complex, and without a scientific basis. Many states have approved programs and research licenses; however, these activities and the products all remain federally illegal and severely limited in scope. Upon reflection, a possible solution may be for the United States to offer multiple pathways for national product approval that adapts to the diversity of the products and the needs of the consumer. Multiple pathways for market approval would protect the public's health, whether the public is using cannabis and cannabinoids as a medicine, a wellness product, or as a recreational substance.

SESSION 7: RESVERATROL AND ANALOGS

KEYNOTE SPEAKER

Natural prenylated resveratrol analogs: bioproduction and biological activities. Fabricio Medina-Bolivar, Ph.D. Department of Biological Sciences and Arkansas Biosciences Institute,
Arkansas State University, Jonesboro, AR 72401, USA. E-mail: fmedinabolivar@astate.edu

Stilbenoids are phenolic compounds produced in a limited number of plant species as a defense mechanism against biotic stress. Resveratrol, the most studied stilbenoid, has been associated with several bioactivities important to human health. Interestingly, the peanut (*Arachis hypogea*) plant produces several prenylated stilbenoids, such as the arachidins, which are not found in other resveratrol-producing plants. The limited availability of prenylated stilbenoids has prevented their study in different bioassays. To address this issue,

hairy root cultures of peanut and their wild relatives *A. duranensis* and *A. ipaensis* were developed as a bioproduction platform for prenylated stilbenoids. To induce the production of these compounds, the cultures were co-treated with methyl jasmonate, cyclodextrin, hydrogen peroxide, and magnesium chloride. Levels above 750 mg/L of prenylated stilbenoids were detected in the culture medium of the peanut hairy root cultures after 192 hours of treatment. Semi-preparative high performance liquid chromatography was used to obtain the prenylated stilbenoids arachidin-1, arachidin-2, arachidin-3 and arachidin-5 with levels of purity higher than 95%. The purified prenylated stilbenoids have shown antioxidant, anti-inflammatory, and anticancer activity in vitro. To elucidate the biosynthesis of prenylated stilbenoids in planta, a combined transcriptomic, metabolic, and RNAi-interference approach was used to identify the first stilbenoid-specific prenyltransferase involved in the prenylation of resveratrol. The peanut hairy root culture demonstrated to be a reliable and sustainable platform for the production of prenylated stilbenoids. In addition, high levels of prenylated stilbenoids and stilbenoid-rich extracts could be obtained using this scalable bioproduction system to study their biological activities.

INVITED SPEAKERS

Grapevine cell cultures for the bioproduction of bioactive resveratrol and derivatives: some fundamental and applied considerations. Eric Courot[1], Jérôme Crouzet[1], Aziz Aziz[1], Nicolas Borie[2], Jane Hubert[2], Jean-Hugues Renault[2], Michel Tarpin[3], Laurent Martiny[3], Carole Lambert[4]. [1] RIBP, [2] ICMR, [3] MeDyC: University of Reims Champagne Ardenne, Moulin de la Housse, BP1039, 51687 Reims cedex 2, France, [4] Givaudan France SAS Active Beauty, 51110 Pomacle, France. E-mail: eric.courot@univ-reims.fr

Plant cell cultures offer the ability to produce valuable specialized metabolites and among them, grapevine cells from *Vitis labrusca* (Concord) are studied by our group in order to understand and optimize the biosynthesis and the bioproduction of stilbenoids. Using elicitors like methyljasmonate and cyclodextrins, we were able to produce several g/L of resveratrol and hundred of mg/L of derivatives like δ-viniferin, ε-viniferin and pallidol in stirred bioreactors from 2L to 20L pilot bioreactor. A dereplication strategy combining centrifugal partition chromatography to C-13 NMR was used to identify the diversity of other stilbenoids including leachianols (F and G) and a new dimer, called labruscol. which was shown to exert a high inhibition on cell viability and invasion of human skin melanoma cancer cell line HT-144. Based on the consideration that 95% of resveratrol produced was excreted in the medium of cell culture, we followed the kinetics of resveratrol accumulation and excretion through the cell wall by UV and confocal microscopy. These observations led us to study how resveratrol was released in the medium. By a combination of elicitation with MeJA and resveratrol himself and using an ITRAQ (Isobaric tags for relative and absolute quantitation) approach, we found that ABC G transporters could be involved.

Resveratrol as a potential therapeutic agent in the management of coronary artery disease. Thomas Netticadan. Canadian Centre for Agri-Food Research in Health and Medicine, Winnipeg Canada. Email: tnetticadan@sbrc.ca

Despite the success of existing therapies, coronary artery disease (CAD) remains to be a major cause of mortality worldwide. It is caused by the narrowing of coronary arteries resulting in restricted blood flow to parts of the heart. Myocardial infarction (MI) commonly referred to as a heart attack is the manifestation of CAD, wherein the affected area of the heart dies due to limited blood supply. If left untreated, MI transitions into heart failure. It is therefore important to explore new strategies to manage CAD; one such avenue may be exploring the potential of food-derived compounds. We have examined *in vivo* the ability of resveratrol (found predominantly in foods

such as grapes and peanuts) to prevent the development of MI and heart failure utilizing a well-established animal model of CAD. MI was induced in Sprague Dawley rats by ligating the left anterior descending coronary artery; sham-operated animals which did not undergo ligation served as controls. A sub-group of MI rats were administered low-dose resveratrol for 8 weeks post-surgery. Echocardiography and biochemical assessments were performed in all animals. In these studies, we also compared the effects of resveratrol on heart structure and function with drugs prescribed for CAD patients such as angiotensin-converting enzyme inhibitor, angiotensin receptor blocker (ARB), and an ARB/neprilysin inhibitor. Lastly, we examined the effects of resveratrol in male versus female MI rats given the well-documented impact of sex on heart structure and function. The mechanisms underlying the effects of resveratrol were examined in blood and heart tissue collected from the animal studies, as well as, in an *in vitro* cell culture model of CAD. The results from our studies as well as those from other groups will be discussed and reviewed in the context of resveratrol as a potential therapeutic agent in the management of CAD.

CONTRIBUTING LECTURER

Gnetin C: does dimer-resveratrol offer twice the benefits in prostate cancer? Ketaki Gadkari[1], Kshiti Dholakia[1], Urvi Kolhatkar[1], Rutu Hemani[1], Gisella Campanelli[1], Qing Cai[1], Gabriela Sikorska[1], Avinash Kumar[1], Anait S Levenson[2]. [1]Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, Brooklyn, NY 11201, USA; [2]School of Veterinary Medicine, Long Island University, Brookville, NY 11548, USA. E-mail: avinash.kumar@liu.edu; anait.levenson@liu.edu

In our previous studies, we have extensively reported on the metastasis-associated protein 1 (MTA1)-targeted chemopreventive and therapeutic properties of the stilbenes, resveratrol (Res) and its potent analog pterostilbene (Pter) in prostate cancer (PCa). Gnetin C, a dimer Res, is found abundantly in melinjo (*Gnetum gnemon*) plant widely cultivated in Southeast Asia; its seeds and fruits are common ingredients in Indonesian culinary. Gnetin C has not been studied as an anticancer agent in PCa. Using DU145 and PC3M PCa cells treated with stilbenes, we demonstrated that Gnetin C downregulates MTA1 more potently than Res and Pter and shows significant MTA1-mediated effects on inhibition of cell viability, clonogenic survival, and migration as well as induction of cell death compared to Res or Pter. Using PC3M subcutaneous xenografts treated with stilbenes, we demonstrated that Gnetin C inhibits tumor growth, cell proliferation, and angiogenesis and induces apoptosis more potently than Res and Pter. Taken together, we demonstrated, for the first time, that Gnetin C is a lead compound among stilbenes for effectively blocking PCa progression. In conclusion, our findings implicate the potential of Gnetin C in PCa chemoprevention and therapy.

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SESSION 8: HEMP AND MEDICINAL CANNABINOIDS

KEYNOTE SPEAKER

Cannabis care: From seed to need - connecting patients with plant medicine. Carey Clark
Pacific College of Health and Science. www.pacificcollege.edu E-Mail: cclark@pacificcollege.edu

In this presentation, researchers will gain an understanding of patients' use of medical cannabis, and how cannabis care nurses coach and guide patients through the process of using medical cannabis and hemp products safely and effectively. The presentation reveals what worries medical cannabis patients and nurses regarding whole-plant

medical cannabis and hemp products and examines the cannabis-care specific concerns of nurses. In addition, this presentation discusses areas of future research that cannabis-care nurses have identified as being important.

INVITED SPEAKERS

Rare cannabinoids: complex biosynthesis or simple chemistry in *Cannabis sativa.* Oliver Kayser. TU Dortmund University, Technical Biochemistry, Emil-Figge-Strasse 66, 44227 Dortmund, Germany. E-mail: oliver.kayser@tu-dortmund.de

Cannabinoids are important terpenophenolics in *Cannabis sativa* L. and found at high concentration in trichomes. Trichomes are glands located on the epidermis and consist of stem cells, exudating gland cells, and an extracellular oil container sealed by the cuticula where cannabinoids are stored. Today, we know about 130-150 compounds being structural variants of THC, CBD, and CBC. Half of them are structurally very close to the parent cannabinoids THC, CBD, and CBC and modifications can be explained by oxidation, oxidative degradation, rearrangement, 2+2 addition, and dimerization. So far, no order of chemical reactions has been identified to explain cannabinoid diversity. The main hypothesis is random chemical modification driven by temperature, oxygen supply, and light. It is obvious that main reactions follow thermodynamic rules and substrates for enzyme biocatalysis are maybe products of previous chemical reactions and CBGA is the main substrate for almost all following reactions. In this talk, I will discuss to what extent chemical diversity in cannabis trichomes is ruled by enzymatic biocatalysis and non-aqueous biocatalysis will be presented as a little-known contribution to the formation of cannabinoids.

Formulating the most impactful cannabis and hemp research to meet the needs of the ever-evolving supply chain. Annie Rouse[1,2]. OP Innovates[1] and Anavii Market[2]. www.opinnovates.com[1] and www.anaviimarket.com[2] E-mail: annie@thinkhempythoughts.com

Whether hemp or cannabis-derived, over the last ten years the newly established cannabinoid market has shocked the agricultural sector and thus opening doors to both new and existing farmers. But under their current agricultural conditions, how will the growth in the cannabinoid markets be affected by the increasing consumer demands for plant-based proteins, like those derived from the hemp grain? This presentation will cover the current agricultural methods for growing cannabis and hemp across the United States as compared to the European markets. It will then answer important questions regarding the challenges the future cannabinoid markets face, the potential solutions that will push the crop into commodity markets, and how your research can play a pivotal role in the success of this projected $100 billion market.

CONTRIBUTING LECTURER

Growth and cannabinoid performance of floral hemp cultivars under plasticulture and differential irrigation. Raul I. Cabrera[1,2]*, Christopher Holton[1], Ariane Vasilatis[2], Nimmi Rajmohan, Anthony Lockhart[2], Harna Patel[2], James Simon[2], Andrew Wyenandt[1,2], Thomas Gianfagna[2], and Eric Petit[1,2]. [1]Rutgers Agricultural Research & Extension Center, Bridgeton, NJ 08302 and [2]Department of Plant Biology, Rutgers University, New Brunswick, NJ 08901. cabrera@njaes.rutgers.edu

Floral hemp (for cannabidiol, CBD and cannabigerol, CBG) plants were field-grown under plasticulture conditions (1.8m x 1.8m spacing; 2,990 plants/Ha) and differentially irrigated with a drip system. Four CBD clonal cultivars ('Cherry Wine', 'BaOx', 'Mango Mountain' and 'TrumpT1') and one seed-propagated CBG

cultivar ('CBGenius') were transplanted on 17 June and harvested 21 September to 9 October, 2020. The plants were subjected to either a "wet" or a "dry" irrigation treatment, tracked with soil tensiometers (targets of 10-40 kPa and 40-70 kPa, respectively). Fertigation with a complete water-soluble formulation provided a nitrogen total of 105 Kg/Ha. Most CBD cultivars produced dry flower yields (trimmed buds + extractable biomass) comparable or higher than the industry standard of 1,680 Kg/Ha, with 'Mango Mountain' and 'Cherry Wine' averaging 2,491 Kg/Ha and 'TrumpT1' the lowest at 1,414 Kg/Ha. The 'CBGenius' cultivar had the lowest yields (1,007 Kg/Ha). The "dry" irrigation treatment reduced flower yields in all cultivars, by 9 to 34% with respect to the "wet" treatment, except for 'Mango'. Regulatory (NJ Dept. Agriculture) and in-house (Rutgers University) cannabinoid analyses were performed several times close to harvest. In early September THC concentrations were below the 0.3% legal limit, but within two-three weeks most cultivars exceeded this limit (0.37 to 0.86%), except for 'Mango Mountain' and 'CBGenius'. Average CBD concentrations at harvest ranged from 9.0% to 15.7%. The CBD:THC ratios in harvested flower tissues averaged close to 20:1 across all CBD cultivars, confirming previous reports from neighboring hemp growing regions. In contrast, the CBG+CBD to THC ratios in 'CBGenius' exceeded 70:1, and its THC levels were under the regulatory limit. Results suggest that cultivars with CBD:THC ratios approaching 30:1, and CBG cultivars, should be strongly considered to reduce potential to exceed regulatory THC limits at harvest and maximize CBD and CBG contents.

PLENARY

Advances in MAP breeding for disease resistance, aroma, and arthropod repellency. James E. Simon[1,2]. [1]New Use Agriculture & Natural Plant Products Program, Department of Plant Biology, and [2]Center for Agricultural Food Ecosystems, New Jersey Institute for Food, Nutrition & Health, Rutgers University, New Brunswick, NJ 08901, USA.

This presentation will highlight our journey in developing genetic resources for selected MAPs. Case studies in the advances and challenges in plant breeding for developing culinary herbs for disease resistance, aroma, and insect repellents will be featured. Specifically, the development of sweet basil for downy mildew resistance and fusarium wilt resistance resulted in the release of several commercial new cultivars. Our breeding program has also developed chemotypes rich in specific aroma compounds. In the search for natural products as insect repellents to improve global health, we have been developing new genetic resources focusing primarily on catnip (*Nepeta cataria)* as a natural source of arthropod repellent compounds against mosquitos that transmit the Zika and Dengue virus and plasmodium that causes malaria as well as ticks and bedbugs, each of which can also transmit diseases to humans and livestock.

SESSION 9: GENOMIC TOOLS AND BREEDING

KEYNOTE SPEAKER

Integration of metabolomic and genomic approaches to explore uncharted biochemical space in fungi. Lindsay K. Caesar, Matthew T. Robey, Fatma A. Butun, Navid J. Ayon, Michael Mullowney, David Dainko, Milton T. Drott, Paul M. Thomas, Jin Woo Bok, Nancy P. Keller, Neil L. Kelleher. Northwestern University, Illinois, USA.

Humans have long utilized Nature as a source of medicine for the treatment of various diseases, and compounds from nature (and those inspired by them) represent the majority of small molecule drugs on the market today. Fungal natural products, in particular, represent a hyper-diverse and vastly understudied resource for novel

bioactive metabolites. Despite the plethora of bioactive chemicals known to be produced by fungi, recent studies have shown that a mere 3% of secondary metabolites in fungi have yet been identified. The genomics era has ushered in a wealth of information exposing the untapped biosynthetic potential of fungi, and recent analysis of over one thousand fungal genomes suggests that tens of thousands of fungal natural products await discovery. To unleash this untapped potential, we are leveraging recent advances in genomics, metabolomics, and bioinformatics into an integrated 'metabologenomics' platform, enabling correlation of biosynthetic 'genotypes' (genome sequences) to metabolomic 'phenotypes' (mass spectral profiles) across populations of fungi. In a preliminary analysis of just 50 strains, we have detected a promising metabolite/gene cluster pair that is undergoing targeted study. In tandem, this approach is being scaled to 250 fungal strains, enabling us to better chart fungal biosynthetic space, potentially uncovering hundreds of natural products for future discovery.

INVITED SPEAKERS

Breeding hemp for phytochemical and horticultural qualities. Allison Justice. The Hemp Mine. Fair Play, SC 29643. Email: Allison@thehempmine.com

In the year 1937, Congress passed the Marijuana Tax Act which pushed the cultivation of hemp into prohibition. Marijuana production and breeding continued to thrive in the black market and states early to adapt Medical Marijuana production, yet the secondary metabolite production goals were very different than that of hemp. In 2014, hemp was permitted on an experimental basis reigniting the selection and breeding of industrial hemp. Today, seven years later, hemp has exploded in the USA and the industry has split into multiple facets including the production of fiber, cannabinoids, terpenes, seed oil, and grain. The journey of traditional breeding in any of these facets has been exciting and frustrating. The Hemp Mine (THM) has been breeding hemp for cannabinoid and terpene production for over four years. With such unique sexual morphology the cannabis plant portrays, for cannabinoid production, THM has decided to only breed with dioecious plants in order to avoid seed production. Hermaphroditic tendencies are still expressed in some varieties during stress. Thus, those varieties which do express other highly valued traits must be stabilized over time. Additionally, as pesticide use is extremely limited, selection for disease resistance is imperative. Another aim for breeding is the selection of higher terpene concentrations and non-myrcene dominant cultivars. This session will summarize THM's journey in the hemp industry and discuss current breeding goals.

Nutritional breeding of pulse crops towards global human health. Dil Thavarajah. Plant and Environmental Sciences, Pulse Quality and Nutritional Breeding, 113 Bio Research Complex, 105 Collings St, Clemson University, Clemson, SC 29634, USA.

Recent data indicate that the world's food systems cannot end hunger and all forms of malnutrition. In 2019, 690 million people were undernourished, and with the added impact of the COVID-19 pandemic, an additional ~130 million people may also become malnourished in 2020. Food systems are failing to address food security, malnutrition, and diet-related non-communicable diseases. New challenges, including pandemics, demographic changes, climate change, and globalization, further add to the complexity of the food system. Pulse crops have been a staple food in communities around the world for centuries. Pulses have high concentrations of protein (~30%) and prebiotic carbohydrates (10-15%), are low in fat (1-5%), and phytic acid. Pulse crops provide moderate energy and are rich in iron (Fe), zinc (Zn), selenium (Se), folates, and carotenoids. Biofortification of pulse crops through conventional breeding and modern biotechnology to achieve target levels of nutrients is possible. This presentation will share Clemson University's biofortification efforts of three major pulse crops

(lentil, field pea, chickpea) in terms of nutritional breeding efforts and biofortification challenges to improve human health and combat obesity and malnutrition.

CONTRIBUTING LECTURER

Lipidomics of rice bran reveals complex mixture of bioactive molecules. Millena Cristina Barros Santos[1,2]; Nathalie Barouh[3], Erwann Durand[3], Pierre Villeneuve[3]; Valérie-Lullien[4], Claire Bourlieu-Lacanal[4], Mariana SimõesLarraz Ferreira[1,2] and Elizabeth Ryan[5].[1]LabBio - Laboratory of Bioactives, Food and Nutrition Graduate Program - PPGAN, Federal University of State of Rio de Janeiro – UNIRIO, Rio de Janeiro, Brazil. [2]IMasS-LBP - Center of Innovation in MS-Laboratory of Protein Biochemistry, UNIRIO, Rio de Janeiro, Brazil. [3]CIRAD, UMR QualiSud, F-34398 Montpellier, France. [4]IATE, Univ Montpellier, INRAE, Institut Agro, Montpellier, France. [5]Department of Environmental and Radiological Health Sciences, College of Veterinary Medicine and Biomedical Sciences, Colorado State University, Fort Collins, CO, 80523, USA. E-mail: barrosmillena@gmail.com; barouh@cirad.fr; erwann.durand@cirad.br; pierre.villeneuve@cirad.br; valerie.lullien-pellerin@inrae.fr; claire.bourlieu-lacanal@inrae.fr; mariana.ferreira@unirio.br and e.p.ryan@colostate.edu

Rice is the most consumed cereal by humans worldwide and the global processing results in millions of tons of rice bran produced annually. However, it is typically wasted or sold as low-value feed to livestock due to its short shelf-life. Rice bran has shown a potential opportunity as a novel food product based on human health benefits due to its richness in bioactive compounds. Rice bran showed an important content in lipids and the bioactivity is usually associated with Gamma-oryzanol and other phytosterols but non-targeted lipidomics relatively non-existent. We screened the rice bran lipidome to identify novel rice bran lipids. This study characterized by omics approaches 17 stabilized rice bran from different varieties. Globally, 163 lipids were identified: 118 lipids were present in all varieties – not differ by variety and growing conditions, and 45 lipids not in common - associated with genotypic and environmental diversity. The rice bran lipidome includes 13 sub-group chemical classifications of lipids. Phospholipids (34%) are a larger diversity of lipids identified in rice bran. Phosphatidylcholines are the phospholipids most abundant in rice bran (35%). Three important classes, due to their potential bioactivity, were identified: galactolipids (7%), oxilipins (3%), and sphingolipids (2%). Oleic, linoleic, palmitic, and stearic acids were the most abundant lipids identified with the oxylipin 13-HODE+9-HODE. These lipids were identified in all varieties. Multivariate analyses were applied to show the difference between the varieties of rice bran. Oxylipins, free fatty acids, phospholipids, and glycerolipids were the responsible class to discriminate one cultivar from another. The lipidomic approach revealed novel chemical lipid sub-groups and an important presence in bioactive lipids. Minor lipids can be associated with genotypic and environmental diversity but the rice bran reveals a core lipidome: not differ by variety or growing conditions.

SESSION 10: DIETARY PHYTOCHEMICALS AND DISEASE PREVENTION

KEYNOTE SPEAKER

Dietary stilbenes and the underlying mechanisms in the cancer chemoprevention. Anait S Levenson. Department of Biomedical Sciences, College of Veterinary Medicine, Long Island University, Brookville, NY 11548, USA. E-mail: anait.levenson@liu.edu

Cancer is one of the more prevalent diseases affecting men and women worldwide. Although chemotherapeutic medicines have reduced cancer mortality in the last 25 years, their adverse side effects are a major concern. The development of natural chemopreventive drugs that effectively target neoplastic transformation and tumor progression will reduce the incidence and progression of cancer and mortality from this disease. Polyphenols found in food and plants, particularly stilbenes, have gained increased importance in cancer prevention due to their potent biological properties including anti-inflammatory, antioxidative, antiproliferative, and proapoptotic effects. The molecular mechanisms of inflammation-associated carcinogenesis, oxidative stress, and the complex crosstalk between various mediators and oncogenic/tumor suppressor signaling can be modulated by natural stilbenes. A large volume of preclinical evidence shows that stilbenes produce anticancer responses in a variety of cell lines and animal models of different types of cancer, including breast, prostate, ovarian, colorectal, lung, and liver adenocarcinomas, melanomas, and glioblastomas among other solid tumors as well as hematological malignancies. Due to the heterogeneity of cancer and the uniqueness of the pathophysiology of each organ, I will discuss the anticancer effects of stilbenes in organ-specific cancers and, particularly, in prostate cancer. In addition, an overview of human clinical trials with resveratrol, pterostilbene, and Gnetin C will be presented.

INVITED SPEAKERS

Time-dependent maternal soybean genistein exposure leads to later-life breast cancer chemoprevention in offspring mice. Yuanyuan Li. Department of Obstetrics, Gynecology & Women's Heath, Department of Surgery, University of Missouri School of Medicine, Columbia, MO 65212, USA. E-mail: ylgrk@missouri.edu

Breast cancer is the most common type of cancer and the second leading cause of death among women in the United States. Early-life nutritional status has a significant impact on the uterine environment and subsequent fetal development, predisposing the developing fetus to different health or disease outcomes in adult life. During critical timing of susceptibility including maternal pre-pregnancy, pregnancy, and lactation periods, certain dietary exposure may change breast cancer risk later in life. Alterations of the maternal diet have shown to induce modifications in the fetal epigenome. The vulnerability to maternal nutrition status during the critical developmental stage provides an excellent opportunity to re-program epigenetic profiles that may lead to a beneficial outcome such as cancer prevention in the offspring. The bioactive dietary component, genistein (GE) enriched in soybean products, is an important epigenetic modulator that can prevent breast cancer *in vitro* and *in vivo*. Our study focuses on potential mechanisms of maternal dietary GE exposure during specific timing in preventing breast cancer in adult life. In this study, we included multiple exposure windows of maternal GE diet to further determine the efficacy of these strategies on transplacental chemoprevention of breast cancer in the progenies of two spontaneous breast cancer transgenic mouse models. Our pilot study indicates a time-dependent effect of maternal GE exposure on early-life breast cancer development in these breast cancer mouse models. We also integrated transcriptome and methylome data and identified several candidate genes such as *Trp63* gene in response to maternal GE treatment that may play important roles in the regulation of development and tumorigenesis. These results suggest that an appropriate exposure window to soybean dietary GE could be a key factor for the prevention of human breast cancer and epigenetic mechanisms may involve in dietary GE-induced *in utero* breast cancer intervention.

Targeting chronic inflammatory diseases with flavonoid-rich diets: impact in cancer and obesity. Andrea I. Doseff. Department of Physiology, Department of Pharmacology and Toxicology, Michigan State University, East Lansing, MI, 48824, USA. E-mail:doseffan@msu.edu

Flavonoids are the largest class of dietary phytochemicals, adding essential health value to our diet and emerging as key nutraceuticals with anti-tumor and anti-inflammatory activities. How dietary flavonoids affect therapeutic outcomes is poorly understood. We developed a novel implementation of phagedisplay-coupled with next-generation sequencing (PD-Seq) to identify human cellular targets of flavonoids with differential affinity. The identification of these targets revealed that the flavonoid apigenin associates with RNA binding proteins, triggering changes in alternative splicing that affect the expression of the aberrant functional proteome. Molecular characterization of these mechanisms using a celery-based food rich in apigenin (CEBAR), that increases flavonoid bioavailability, in preclinical models of breast cancer and obesity, identified the gene regulatory networks modulated by apigenin using RNAseq analysis. Our studies revealed that apigenin reduces inflammatory immune cells found in tumor sites and in obese conditions, resulting in decreased tumor growth and metastasis, while reducing weight in obese conditions. Our results provide a new framework to understand how medicinally active phytochemicals result in their recognized health benefits. These findings may impact the clinical use of flavonoids in the prevention and treatment of chronic inflammatory diseases.

CONTRIBUTING LECTURER

Anti-inflammatory and cardioprotective functions of prenylated stilbenoids from peanut hairy roots. Rokib Hasan[1,2], Sankalpa Chakraborty[1,2], Maria Elena Gonzalez Romero[1], Viswanathan Rajagopalan[1,2,3,4] and Fabricio Medina-Bolivar[1,2,4].[1]Arkansas Biosciences Institute, Arkansas State University, Jonesboro, AR 72401, USA. [2]Molecular Biosciences Graduate Program, Arkansas State University, Jonesboro, AR 72401, USA. [3]Department of Basic Sciences, New York Institute of Technology-College of Osteopathic Medicine, Jonesboro, AR 72401, USA. [4]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: fmedinabolivar@astate.edu

Stilbenoids are a non-flavonoid class of polyphenols that are important for their potential medicinal applications. Resveratrol is one of the well-studied stilbenoid and several studies have described its anti-inflammatory, antioxidant, and cardioprotective activities. Resveratrol derivatives, such as the prenylated stilbenoids arachidin-1 and arachidin-3, are produced in peanut and are potentially more bioavailable than resveratrol. However, the molecular mechanisms underlying the bioactivities of prenylated stilbenoids remain unclear. To address this issue, we have used lipopolysaccharide (LPS)-treated RAW 264.7 mouse macrophages to understand the anti-inflammatory molecular mechanism of arachidin-3 in vitro. In order to understand the cardioprotective effects of a peanut hairy root extract enriched in arachidins and purified arachidins, we have used H_2O_2-treated H9c2 rat heart cells as a model for oxidative stress. We have also conducted a pilot study with rats treated with propylthiouracil (PTU) to investigate the cardioprotective properties of these extracts. Our results suggest that arachidins are not toxic to the cells at low micromolar concentrations. Arachidin-3 pre-treatment reduced IL-6 production in LPS-treated RAW 264.7 cells. Furthermore, cell imaging assays showed that arachidin-3 acts by inhibiting LPS-induced NF-κB activation and attenuating high mobility group box 1 (HMGB1) protein signaling in RAW 264.7 cells. Both the extract and arachidins pre-treatment offer protection against oxidative stress. Additionally, the in vivo study showed that the peanut hairy root extracts may help to reduce cardiac injury in PTU-treated rats. These studies will increase our understanding of the anti-inflammatory and cardiac function of arachidins and carry important translational implications for the application of prenylated stilbenoids for inflammation and cardioprotection.

POSTER ABSTRACTS: ALPHABETICAL ORDER BY POSTER TITLE

1. Acacia seyal gum: methanolic crude extract and its antiproliferative effect on human breast cancer cells.
Ahmed A.M. Elnour[1,2,3] and Mohamed E.S. Mirghani[3]. [1]Bioenvironmental Engineering Research Centre (BERC), Biotechnology Engineering Department, Kulliyyah of Engineering, International Islamic University Malaysia (IIUM), Gombak, 50728 Kuala Lumpur, Malaysia; [2]International Institute for Halal Research and Training (INHART), International Islamic University Malaysia (IIUM), Gombak, 50728 Kuala Lumpur, Malaysia; [3]Institute of Gum Arabic & Desertification Studies (IGADS), University of Kordofan, Elobied, Sudan. Email: ahmedrashma@gmail.com

Acacia seyal gum (ASG) is a natural secondary metabolite conventionally used in folk medicine, and it is considered an important source of polyphenolic compounds. This study aimed to determine the antiproliferative effect of methanol crude extracts of ASG compared to that of commercially available Prebio-T (PTC) on human breast cancer cells (MCF-7 cell line). The antiproliferative effect was determined using sulphorhodamine (SRB) assay. The extracts were analyzed carefully using gas chromatography-mass spectrometry (GC-MS/MS). The antiproliferative effect of ASG was IC_{50}=9.56µg/mL, and that of PTC was IC_{50}=8.97µg/mL (significant difference, $p \leq 0.5$). The main bioactive compounds in ASG were isovitamin C (42.37%), crypton (5.86%), and hydroquinone (4.86%), and in PTC was isovitamin C (24%), crypton (4.23%), and hydroquinone (5.15%). Accordingly, ASG has an antiproliferative effect on breast cancer cells but less than that of the commercially available PTC.

2. Antioxidant activity of commercial products of *Minthostacys verticillata* and *Vernonia amygdalina* plant extracts.
Anna Miller[1], Ebube Michael[2], and Adolfina Koroch[3]. [1]Columbia University School of General Studies, New York, NY, USA; [2]Maximizing Access to Research Careers (MARC) at Brooklyn College, The City University of New York, NY, USA; [3]Science Department, Borough of Manhattan Community College, The City University of New York, NY, USA. E-mail: akoroch@bmcc.cuny.edu

Herbal medicines have been traditionally used in various parts of the world. *Minthostacys verticillata* (Lamiaceae) is a native shrub from South America typically consumed as a tea infusion. It is used as a home remedy for those with illnesses of the respiratory and digestive systems and protects against pests. *Vernonia amygdalina* (Asteraceae) is a widely grown shrub in Africa consumed as a vegetable with high medicinal value. In traditional medicine, it is used to treat diabetes, hypertension and protect against bacterial, parasitic, and viral infections. The role of medicinal plants in the inhibition and prevention of oxidative stress-related diseases is an area of growing interest. The remarkable ability of these plants to cause a decline in the rate of formation of Reactive Oxygen Species (ROS)—both *in vivo* and *vitro*—has been linked to the presence of a group of phytochemicals, known as polyphenols. The objective of the study was to investigate the total phenolic content and antioxidant capacity of commercial samples using leaves of *M. verticillata* and *V. amygdalina.* Dry materials were ground and dissolved in water, then boiled for 15 minutes. Total phenolics content was quantified using the Folin-Ciocalteu method, and antioxidant activity was quantified using the ABTS radical scavenging assay. Extracts that exhibited high total phenolic content were associated with high antioxidant capacity. These results support the traditional and medicinal uses of these plants. This research is part of educational experiences in an urban community college setting, enabling students to acquire the critical thinking and research skills necessary to pursue a baccalaureate degree in a science-related discipline.

3. Antioxidant and immunomodulatory activities of *Vaccinium floribundum* berries fermented with *Lactobacillus plantarum*. Luisa Marracino[1*], Angela Punzo[2*], Francesca Camponogara[1], Rosane Nganwouo Tchoutang[1], Francesca Dalessandro[1], Francesca Fortini[3], Francesco Vieceli Dalla Sega[3], Donato Calabria[2], Emanuele Porru[2], Aldo Roda[2], Paolo Severi[1], Cristiana Caliceti[4] and P. Rizzo[1,3]. [1]Department of Translational Medicine and Laboratory for Technologies of Advanced Therapies (LTTA), University of Ferrara, Via Fossato di Mortara 70, 44121 Ferrara, Italy; [2]Department of Chemistry "Giacomo Ciamician" Alma Mater Studiorum, University of Bologna, Via Selmi 2, 40126 Bologna, Italy; [3]Maria Cecilia Hospital, GVM Care & Research, Cotignola, Italy; [4]Department of Biomedical and Neuromotor Sciences, Alma Mater Studiorum, University of Bologna, Bologna, Italy. E-mail: mrrlsu@unife.it; cristiana.caliceti@unibo.it

High consumption of natural antioxidants promotes health by reducing oxidative stress and modulating inflammation. Similarly, Lactic Acid Bacteria as food supplements modulate the immunological, digestive, and cardiovascular functions. We investigated the antioxidant and immunomodulatory activity of *Pushgay* and *Mullaca* berries (*Vaccinium floribundum*, family *Ericaceae*) fermented with *Lactobacillus plantarum*. Polyphenols content was assayed by Folin-Ciocalteu and HPLC-MS/MS analysis. Intracellular antioxidant activity was evaluated in Human umbilical vein endothelial cells (HUVECs) treated with extracts of berries for 24 hours by a cell-based chemiluminescent probe for the detection of intracellular H2O2 production. Levels of Heme oxygenase-1 (HO-1) and Monocyte Chemoattractant Protein-1 (MCP-1) mRNA were evaluated by RT-qPCR in HUVECs cells treated with berries extracts for 24 hours followed by treatment with Tumor Necrosis Factor (TNF) α for 16 hours. Cell proliferation was determined by Trypan Blue in macrophage RAW264.7 cell line treated with berries extracts for 24 and 72 hours. Immunomodulatory activity was evaluated by quantifying inducible nitric oxide synthase (iNOS), TNFα, and Notch ligand Jagged1 by RT-qPCR in RAW264.7 treated with berries extracts for 24 hours in the presence or absence of IFNγ. We found that i) *Mullaca* has the highest content of polyphenols, particularly quercetin, ii) *Mullaca* and *Pushgay* induce proliferation of RAW264.7 cells 72 hours after fermentation, iii) fermentation of *Pushgay,* but not *Mullaca,* enhances antioxidant activity, iv) fermentation of *Pushgay* and *Mullaca* increases expression of iNOS, TNFα and Jagged1 mRNA in RAW264.7 cells in the presence of interferon γ (IFNγ), v) *Mullaca* and *Pushgay* induce HO-1 in the presence of TNFα independently of fermentation, vi) fermentation of *Pushgay* and *Mullaca* reduces MCP-1 expression in the presence of TNFα. Taken together, our results show that lactic acid fermentation of *Vaccinium floribundum* berries increases their antioxidant and immunomodulatory properties, thus confirming their efficacy for the production of functional food.

4. Antiviral activity of *Aframomum melegueta* against severe acute respiratory syndrome coronaviruses. Oneil Mahoney[1*], Claudia Melo[2*], Anthony Lockhart[3], Nadjet Cornejal[2], Sahar Alsaidi[4], Qingli Wu[3], Jim Simon[3], H. Rodolfo Juliani[3], Thomas M. Zydowsky[5], Christine Priano[1], Adolfina Koroch[1], José A. Fernández Romero[1,5]. [1]Science Department, Borough of Manhattan Community College, The City University of New York, NY, [2]Maximizing Access to Research Careers (MARC) at Brooklyn College, The City University of New York, NY, [3]Rutgers University, Newark, NJ, [4]Lehman College, The City University of New York, NY, [5]Center for Biomedical Research, Population Council, New York, NY. Email: jfernandezromero@bmcc.cuny.edu *Equal first author

The use of plant-based antivirals has been documented against different viral infectious diseases. Plant-based compounds with antiviral properties against severe acute respiratory syndrome coronaviruses (SARS-CoV-1 and SARS-CoV-2) have been identified in *Aframomum melegueta* through computational models (Omotuyi et. al,

2021). We prepared ethanolic extracts of six commercial samples of *A. melegueta* fruits. To confirm the efficacy of the extracts, we determined the therapeutic index (TI) using the XTT cytotoxicity assay and a cell-based pseudoviral model (antiviral assay). Four different pseudoviruses (PsVs) were used in the antiviral assay, including SARS-CoV-1 PsV, SARS-CoV-2 PsV with the original Wuhan strain spike protein (2019-nCov), the D614G mutant spike, and the K1417N/E484K/N501Y mutant spike (includes the receptor-binding domain mutations found in the strains recently identified in the U.K. (501Y.V2), South Africa (B.1.351) and Brazil (P1)). Gingerols and other non-volatile components were detected in the fruit extracts using an Agilent 1290 UPLC equipped with a DAD, in tandem with an Agilent 6546 QTOF-MS. Quantification of the compounds was performed with Quantitative Analysis software using a dihydrocapsaicin calibration curve for reference. Our results show selective antiviral activity with TI values between 2.8 and 13.1. Fifteen gingerols were identified in the chromatographic analysis, with 6-gingerol being the dominant component in each fruit extract. We confirmed the antiviral activity of *A.melegueta*, predicted through computational models, but identified a different compound, 6-gingerol, as a potential active ingredient. Future studies will test the antiviral activity of 6-gingerol and other ingredients and investigate their potential synergistic relationships.

5. Assessing the anti-proliferative capacity of *Sargassum* extracts in a metastatic colorectal cell line. Kariana Feliciano López[1]*, Yolimar Cintrón Hernández[1]*, Riccardo Correa Rodriguez[1], Juan Negron Berrios[1], Alok Arun[1], Angel Núñez Marrero[1]. [1]Institute of Sustainable Biotechnology, Inter American University of Puerto Rico, Barranquitas, Puerto Rico, USA. *equal contribution. Emails: anunez@br.inter.edu; karianafeliciano@BRInter.onmicrosoft.com

Colon cancer is one of the most frequent cancers in the United States and Puerto Rico. It is also one of the leading causes of cancer-related deaths. Traditional treatments against cancer, such as chemotherapy, can treat colon cancer but are not always effective and may cause significant side effects. Marine macroalgae have been found to contain promising compounds with medical properties, such as antimicrobial, antioxidant, and antitumor. The aim of this research was to evaluate the effects of *Sargassum* extracts collected from the southeast region of Puerto Rico in the proliferation of the metastatic colorectal cancer cell line HCT-116. The cells were cultured in appropriate conditions and were exposed to alga extracts for 24 hours, 48, and 72 hours. MTT assay was performed to evaluate HCT-116 proliferation and viability rates. The results obtained at this stage suggest a viability reduction for the HCT-116 cells after 24 hours. This completed an initial preliminary work that will need to be broadened in the future to continue assessing the potential anti colorectal cancer effects of *Sargassum*.

6. Biofortification of essential fatty acids in chickpea (*Cicer arietinum* L.). Amod Udayanga[1] and Dil Thavarajah[1]. [1]Dept. of Plant and Environmental Sciences, Clemson University, Clemson, SC 29634, USA. E-mail:mudayan@g.clemson.edu; dthavar@clemson.edu

Linoleic (ω-6; LA) and linolenic (ω-3; ALA) acids are essential fatty acids (EFAs) that are polyunsaturated. When consumed through diet at recommended levels, LA and ALA are metabolized into eicosanoids that help the human body function. Chickpea (*Cicer arietinum)* is a good source of protein (20-25%), low digestible carbohydrates, and fats (~ 4- 10%), including EFAs with a range of micronutrients. This study evaluates the EFA content in current chickpea cultivars in production to incorporate into global chickpea biofortification programs to develop chickpea cultivars with a significant amount of EFAs. Commercial kabuli and desi chickpea cultivars were used in this study to measure EFAs using Gas chromatography with mass detection (GC-MS). Mean LA and ALA's

concentrations are ~2302.9 and ~247.4 mg/100g, respectively. The most abundant fatty acid in chickpea is LA, followed by oleic, palmitic, and linolenic acids. The consumption of EFAs affects the ω-6/ ω-3 ratio in the body, improving human health. Our study results indicated that the experimental value of ω-6/ ω-3 ratio for chickpea closer to the recommended levels, and chickpea is a good source of essential fatty acids. Genetic biofortification of EFAs in chickpea is possible by selecting a diverse population with diverse environments and incorporating genome-wide association studies.

7. Biomass yield and essential oil composition of four mountain mint (*Pycnanthemum virginianum*) varieties grown in north Alabama. Lam Duong[1], Trang Pham[1], Cuong Nguyen[2], William N. Setzer[2], and Srinivasa Rao Mentreddy[1]. [1]Department of Biological and Environmental Sciences, Alabama A & M University, Huntsville, AL 35811, USA; [2]Department of Chemistry, University of Alabama Huntsville, Huntsville, AL 35899, USA. Email: lduong@bulldogs.aamu.edu; srinivasa.mentreddy@aamu.edu

Mountain Mint (*Pycnanthemum virginianum*) is a peppermint-flavored, aromatic herb of the Lamiaceae family and is mainly used for culinary, medicinal, aromatic, and ornamental purposes. North Alabama's weather is conducive for growing mint for oil that can be used in confectionery and medicinal products. There is a need for varieties that are adapted for production in North Alabama. Thus, the objective of this study was to evaluate four varieties (M1, M2, M3, & M4) for growth, leaf biomass production, and oil composition at three harvest times of 135, 155, and 170 days after planting (DAP) in a replicated field trial. Thirty-day-old greenhouse-grown plants of the four varieties were transplanted on raised beds at the field of Alabama A&M University. At 135 DAP, the variety M1 with a fresh biomass yield of 488.37 g/plant was superior to M2, M3, & M4 by 31.1, 75.0, and 58.0%, respectively. At 155 DAP, M1 had the highest yield (489.4 g/plant). At 170 DAP, M3 (282.6 g/plant) out-yielded M1, M2, and M4, by 56.5, 41.1, and 45.1%, respectively. Overall, the M1 variety had the highest mean yield of 423.9 g/plant across the harvesting times. At the 1st harvest, the essential oil ranged from 0.76% for M3 to 1.15% for M1. The isomenthone concentrations in M1 were 19.93, 54.7, and 69.31% at 135, 155, and 170 DAP, respectively. A similar increasing trend through the season was observed in M3 (1.81, 48.02, and 65.83%, at 135, 155, and 170 DAP, respectively). Such a trend was absent in M2 and M4. The thymol concentration in M2 and M4 were higher than in M1 and M3. The study showed that mountain mint offers potential for production in North Alabama. Two varieties, M1 and M3, merit further studies to determine yield stability, essential oil yield, composition, and development of cultivation practices.

8. Cannabidiol reduces inflammation and bone loss in a murine model of female post-menopause. Ke Sui[1], Fiona Gaile Bawagan[1], Kevin Tveter[1], Patricia Buckendahl[2], Isaac Seelenfreund[1], Esther Mezhibovsky[1], Rocio M. Duran[1], Sue Shapses[3], and Diana E. Roopchand[1]*. [1]Department of Food Science, NJ Institute for Food Nutrition and Health (Rutgers Center for Lipid Research and Center for Nutrition Microbiome and Health), Rutgers, The State University of New Jersey, New Brunswick, NJ, USA; [2]Molecular Imaging Center, Rutgers, The State University of New Jersey, New Brunswick, NJ, USA; [3]Department of Nutritional Science, NJ Institute for Food Nutrition and Health (Center for Human Health and Performance), Rutgers, The State University of New Jersey, New Brunswick, NJ, USA. Email: ks1307@sebs.rutgers.edu

The predominant form of estrogen, 17β-estradiol (E2), declines during menopause resulting in an increased risk of gastrointestinal disorders, cardiometabolic disease, and osteoporosis. Hormone replacement therapy can alleviate menopausal symptoms and increase the risk of cancer and heart disease; therefore, safer treatment

options are needed. Cannabidiol (CBD) has been reported to have anti-inflammatory effects beneficial to gut and bone health; therefore, we investigated whether it could improve the consequences of estrogen deficiency in ovariectomized (OVX) C57BL6/J female mice. At 12 weeks of age, mice underwent ovariectomy (n= 24) or sham surgery (SS, n= 24) followed by peroral administration of CBD (25 mg/kg) or vehicle (VEH, sesame oil) for 18 weeks. CBD treatment increased oxygen consumption and energy expenditure in OVX mice but did not reduce weight gain or fat accumulation. Compared to VEH-treated mice, CBD-treated OVX and SS groups had lower colonic gene expression of IL-6 and TNFα, indicating decreased gut inflammation. Compared to VEH-treated OVX mice, CBD-treated OVX mice had increased mRNA levels of tight junction protein ZO-1, suggesting an improved gut barrier. 16S rRNA amplicon sequencing analysis revealed the fecal microbiota of CBD-treated OVX mice had increased relative abundance of *Lactobacillus*, a genus associated with reduced bone loss and inflammation. Dual-energy X-ray absorptiometry showed that compared to VEH-treated OVX mice, CBD-treated OVX mice had increased whole-body bone mineral density (BMD) and bone mineral content (BMC) as well as increased femur bone mineral density. High-resolution micro-computed tomography (micro-CT) scans showed that CBD treatment improved trabecular thickness and bone volume/trabecular volume (BV/TV), indicating lower bone resorption. Receptor activator of nuclear factor factor-kappa-B ligand (RANKL) stimulates osteoclastic bone resorption by binding to RANK on the surface osteoclast precursor cells, and inhibition of RANKL-RANK signaling has become an important therapeutic target for the treatment of osteoporosis. Compared to the vehicle-treated OVX group, femurs of CBD-treated OVX mice had lower expression of IL-6 and RANKL, indicating reduced inflammation and bone loss. Overall, these data suggest that CBD may be helpful in post-menopause for alleviating intestinal inflammation and bone loss induced by estrogen deficiency.

9. *Capsicum annum* sp. in the prevention of lifestyle induced hepatotoxicity. Moumita Das[1,2] and Gouriprosad Datta[1]. [1]Department of Physiology, Rammohan College, Kolkata, India; and [2]Department of Applied Nutrition and Dietetics, Sister Nivedita University, Kolkata, India. Email: dattagp@yahoo.co.in; gpdphysio@rammohancollege.ac.in

Diet has become an important facet in the present post-pandemic scenario. Lifestyle-induced diseases are on the rise, and relying on nutraceuticals is the demand of the hour. Bell peppers (*Capsicum annum sp.*) though native to America, are cultivated globally today. There are several varieties of Capsicum available in the market, and all the varieties are equally popular in almost all global cuisines. Although capsaicin, the active component of capsicum, is gaining importance in research, other components also contribute to the synergistic effect. The present study investigated the role of capsicum extract in preventing ethanol-induced hepatic injury and inflammation. In the present study, two capsicum varieties (green and yellow) were initially selected for comparative analysis of their total phenolic and flavonoid content. Ascorbic acid and α-tocopherol content of both the varieties were also determined. Green, the variety with greater anti-oxidant potential, was selected for further in-vivo study in an albino rat model. Hepatic injury was induced in a rat model using 40% v/v ethanol, administered at 2g/kg body weight (i.p.). Administration of hydro-ethanolic extract of green capsicum at a dose of 250mg/kg body weight significantly ($p<0.01$) prevented ethanol-induced alterations in serum parameters like AST, ALT, ALP, serum protein, and pro-inflammatory cytokines. Alteration in lipid profile was also significantly ($p<0.01$) vetoed compared to the ethanol treated group. H-E stained sections also confirmed the ameliorative effect of the extract against ethanol-induced histopathological changes. TUNEL assay also suggested the anti-apoptotic role of the extract. Thus, it can be concluded that liver cirrhosis arising due to excessive consumption of alcohol can be prevented using the spice capsicum. This hepatoprotective role of capsicum can be attributed to the antioxidant potential, anti-inflammatory, and anti-apoptosis activity of several components present in

capsicum. Henceforth, the popularization of a capsicum-rich diet might relieve the society of alcohol-induced hyperlipidemia and hepatic injury.

10. Characterization of content and antibacterial properties of *Microsorum scolopendria* extracts in a model of epithelial damage caused by opportunistic pathogens. Cristóbal Balada[1], María-José Marchant-Lillo[1,2], María-Fernanda Argaluza[1], Claudia Fassio[2], Paula Molina[2], Miriam Montecinos[2], Mónica Castro[2], Leda Guzmán[1]. [1]Laboratorio de Biomedicina y Biocatálisis, Instituto de Química, Facultad de Ciencias, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile; and [2]Laboratorio de Propagación, Escuela de Agronomía, Facultad de Ciencias Agronómicas y Alimentos, Pontificia Universidad Católica de Valparaíso, Valparaíso. E-mail: criss.tbc@gmail.com

In Chile, plants or natural extracts are used for therapeutic purposes based on ancestral knowledge but without a solid scientific basis as the chemical composition, biological activity, or adverse effects. In Rapa Nui, preparations based on a *Microsorum scolopendria* (*MS*) are used by native people to treat several diseases as skin infections. To scientifically support its potential medicinal and sustainable use in Rapa Nui, the aim of this work is to determine the phenolic content of *MS* extracts and evaluate their biological potential in a model of epithelial damage produced by opportunistic pathogens that cause skin conditions. The *MS* plant was collected from Rapa Nui and the metabolites were extracted from leaves and rhizomes using ethyl acetate, generating two extracts: leaves (AEL) and rhizome (AER). Liquid chromatography coupled to negative and positive electrospray ionization (ESI) tandem mass spectrometry (MS/MS) was employed. The effect of the extract on cell viability was evaluated on HDFa cells by MTS, the antioxidant properties of extracts were evaluated by DPPH and ORAC assay, and its protective -anti-reactive oxygen species (ROS) and antibacterial capacity were evaluated on cellular model of human epithelial (HFDa) damage generated by *S. aureus* and *S. epidermidis.* Additionally, we analyzed the extracts' anti-inflammatory properties through inhibition enzymatic methods on cyclooxygenase 1 and 2. The results by RP-HPLC-MS/MS showed that extracts have 1000 compounds. Our findings suggest that *MS* has a good antioxidant, showing an EC50 for DPPH lower for the AER than AEL and an ORAC value 63% more effective than the TROLOX control. The extracts are not cytotoxic on HDFa cells and have a good antioxidant capacity when the cells are pre-incubated for 24 hours with the extracts, showing a 50 % decrease in ROS formation compared to the untreated cells.

11. Chemoprevention of prostate cancer by dietary Gnetin C: A preclinical study. Anand Puaar[1], Avinash Kumar[1], and Anait S. Levenson[2]. [1]Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, Brooklyn, NY 11201, USA; [2]College of Veterinary Medicine, Long Island University, Brookville, NY 11548, USA. E-mail: anand.puaar@my.liu.edu; anait.levenson@liu.edu

According to the American Cancer Society, prostate cancer (PCa) is the most common cancer in men and accounts for approximately 30% of newly diagnosed cancers in the US. There is a major clinical need to identify and target molecular drivers at the early stage of PCa progression, such as prostatic intraepithelial neoplasia (PIN), a known PCa precursor. Nontoxic and cost-effective preventive strategies, including dietary compounds, have been shown to account for the beneficial effects on PCa with relatively few adverse effects. In our previous studies, we reported on the metastasis-associated protein 1 (MTA1)- targeted chemopreventive and therapeutic efficacy of stilbenes including resveratrol (Res), pterostilbene (Pter), and Gnetin C. Gnetin C, a Res-dimer, is found abundantly in melinjo plant (*Gnetum gnemon*), which is used in Indonesian culinary. Based on our previous

experiments that comparative MTA1-mediated anticancer effects of Gnetin C were more potent in a panel of PCa cells and PCa xenografts, we sought to test the chemopreventive capacity of Gnetin C in a transgenic mouse model. We have developed prostate-specific MTA1-knocked in transgenes on the background of *Pten* heterozygosity (R26$^{Mta1/Mta1}$; *Pten*$^{+/f}$; *Pb-Cre*$^{+}$) and randomized mice into four groups fed various diets *ad libitum*: 1) mice on control AIN-76A phytoestrogen free diet (Ctrl-Diet); 2) mice on Gnetin C low-dose supplemented diet (GnetinC$_{ld}$-Diet); mice on Gnetin C high-dose supplemented diet (GnetinC$_{hd}$-Diet), and mice on Pter supplemented diet (Pter-Diet). After 4-5 months of feeding corresponding diets, mice will be sacrificed, and prostate tissues will be isolated for histological, immunohistochemical, molecular analysis, and functional analysis. Blood and urine will also be collected and investigated for pro-inflammatory cytokines and miRNAs as potential prognostic and predictive biomarkers.

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12. Cloning catnip farnesyl diphosphate synthase to alter its essential oil pathway. Kirsten Allen[1], Rong Di[1], and James Simon[1]. [1]New Use Agriculture and Natural Plant Products Program and the Center for Agricultural Food Ecosystems, Department of Plant Biology, Rutgers University, NJ, USA. E-mail: kaa184@rutgers.edu; jimsimon@sebs.rutgers.edu

Catnip, *Nepeta cataria*, an aromatic herb, is known to exhibit strong insect-repellent properties due to the presence of nepetalactone, a monoterpene iridoid secondary metabolite. Production of the plant for essential oil is constrained as it accumulates very low yields relative to other aromatic plants such as mint and basil, making commercialization challenging. It is predicted that through genome editing, the essential oil production in catnip could be increased by performing a gene knockout of the farnesyl diphosphate synthase (*FPPS*) gene responsible for synthesizing sesquiterpenes. Seeds of the catnip cultivar 'CR9' were sterilized, plated on MS (Murashige and Skoog) medium, and allowed to germinate. The first true leaves were collected, and RNA was extracted by the PureLinkTM RNA Mini Kit and used as the template for the synthesis of single-strand cDNA using the High-Capacity cDNA Reverse Transcription Kit. The partial sequence of *NcFPPS* was amplified based on the predicted coding sequence of *FPPS* in catnip (*NcFPPS*) via PCR. PCR products were gel purified and cloned into the pGEM-T Easy vector. Plasmid DNA was transformed into DH5-Alpha *E. coli* cells using the heat-shock method. Colonies were selected on LB agar plates, and the plasmids were purified by the PureLink™ Quick Plasmid Miniprep Kit. Restriction enzyme digest was performed using EcoRI to confirm the target DNA site. Lastly, the plasmid samples were sent for further sequencing to identify the generated sequence. Future steps involve selecting sgRNA target sequences for editing *NcFPPS* using CRISPR/Cas9.

13. Comparative assessment of antioxidant activity of stilbenoid-rich extracts from hairy root cultures of three cultivars of peanut. Gaurav Gajurel[1] and Fabricio Medina-Bolivar[1,2]. [1]Arkansas Biosciences Institute and [2]Dept. of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: gaurav.gajurel@smail.astate.edu; fmedinabolivar@astate.edu

Over-production of reactive oxygen species (ROS) induces oxidative stress by damaging lipids, membranes, proteins, and DNA at the cellular level. This phenomenon results in several pathogenesis i.e. cardiovascular diseases, cancer, neurodegenerative disease, and aging. Stilbenoids and their derivatives possess antioxidant activity and act upon these ROS, thereby alleviating oxidative stress. However, the antioxidant capacity of these stilbenoids is yet to be explored in depth. This project aimed to assess the antioxidant capacity of stilbenoid-rich

extracts from hairy root cultures of peanut cultivars Hull, Tifrunner, and Georgia Green using the DPPH (2,2-diphenyl-1picrylhydrazyl) assay. Hull and Georgia Green hairy roots were previously established whereas Tifrunner hairy root cultures were established in this investigation using *Agrobacterium rhizogenes*-mediated transformation. To produce the stilbenoid-rich extracts, hairy root cultures were co-treated with methyl jasmonate, methyl-β-cyclodextrin, hydrogen peroxide, and magnesium chloride for 168 hours. Different levels of resveratrol and prenylated stilbenoids were detected in the ethyl acetate extracts by high-performance liquid chromatography analysis. Upon reaction with DPPH, the Tifrunner stilbenoid-rich extracts had exhibited significantly higher antioxidant activity at the lower concentration of 6.25 µg/mL and 3.125 µg/mL when compared to extracts of the other two cultivars. The IC-50 values were 6.004 µg/mL, 7.768 µg/mL, and 8.147 µg/mL for Tifrunner, Georgia Green, and Hull extracts, respectively. The stilbenoid-rich extracts from peanut hairy roots may provide an antioxidant formulation for nutraceuticals to promote human health.

14. Development of a natural, sustainable, and antibacterial hemp fabric. Sheri Elsaker[1], Fayha Khan[1], Lydia Lo[1], Carmen Phu[1]. [1]Industrial and Systems Engineering, Rutgers University, NJ, USA. Email: se299@scarletmail.rutgers.edu; fk194@scarletmail.rutgers.edu; lpl33@scarletmail.rutgers.edu; ctp54@scarletmail.rutgers.edu

Bacteria are found everywhere. Thus, hygiene has become an essential part of human lives, especially since the COVID19 pandemic started. It is necessary to clean surfaces to ward off bacteria and ensure a safer living environment. Some service industries, such as airplanes and hotels, do not follow proper cleaning protocol for their fabrics, which causes bacteria to spread. When the following individual encounters the fabric, they are at risk for exposure to bacteria that may be harmful to their health, which may cause illnesses. To reconcile this risk, the objective of this paper is to document an all-natural antibacterial coating for hemp fabric. Hemp is biodegradable, which also solves a secondary problem of textile waste in landfills. Since all the coating ingredients are natural, there is no harm to the environment upon disposal. To create the formula, factorial experiments were conducted over multiple phases that led to the coating that worked harmoniously with hemp fibers: lime juice, garlic, and vinegar. Each design experiment ran for five days with daily pictures of bacterial growth. Then Python was used to process these images into black and white equivalents and returned a count of the number of colonies. Values for total daily colonies provided insight on growth rates. The formula applied to hemp fibers repeatedly proved best at limiting growth compared to other fabrics. With a natural formula coated onto hemp fabric, we hope to provide a sustainable product that protects the consumer and gives them peace of mind.

15. Development of a protocol for the in vitro propagation of *Microsorum scolopendria* from spores. María Marchant[1,2], Paula Molina[2], Miriam Montecinos[2], Leda Guzmán[1], Cristóbal Balada[1], Claudia Fassio[2], and Mónica Castro[2]. [1]Laboratory of Biomedicine and Biocatalysis, Institute of Chemistry, Faculty of Sciences and [2]Propagation Laboratory, School of Agronomy, Faculty of Agronomic Sciences and Food. Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile. E-mail: marchant.mariajose@gmail.com; monica.castro@pucv.cl

Microsorum scolopendria, better known as "Matu'a pua'a" is an important medicinal fern on Rapa Nui Island and other islands in Polynesia. Nowadays, the use of this species has drastically increased due to its medicinal properties. High amounts of ecdysteroid (active compound) generate pharmacological effects in mammals/humans, e.g., anabolic, hypoglycemic, hypocholesterolemic, tonic, hepatoprotective, antidepressant, and purgative effects. Propagation of *Microsorum* is possible by spores and by rhizomes, but both methods show

relatively slow growth. Therefore, the aim was to establish an *in vitro* propagation protocol from spores obtained from *M. scolopendria*. The collected spores were classified according to the Munsell color table, obtaining three colors: 10YR 7/10, 10YR 6/8, and 5YR 6/12. The germination medium MS + 20 g L-1 sugar + 7 g L-1 agar and pH 5.7 was used. The flask with spores was incubated for 90 days at 23ºC, with a photoperiod of 16 hours light day-1. Differences in germination were observed according to color. Spores of 5YR 6/12 color germinated 100%. However, the spores of the color 10YR 7/10 did not germinate. When analyzing a germinated 5YR 6/12 colored spore under the microscope, the presence of small leaves and gametophytes was observed. In addition, it was possible to witness the capsule of the spore that remains after germination. The germination of spores and their maturation to gametophytes were successful. From them, it will be possible to generate mature fern of *M. scolopendria*.

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16. Differential expression of terpene synthase genes and analysis of emissions of volatiles in tomato (*Solanum lycopersicum*) under heat stress. Kirill Musaev[1], Sanjeevi Nagalingam[2], Alex Guenther[2], and Chhandak Basu[1]. [1]Dept. of Biology, California State University, Northridge and 2Dept. of Earth System Science, University of California, Irvine. 118111 Nordhoff St., Northridge, CA, 91330, USA. [2]University of California, Irvine, Irvine, CA 92697, USA. E-mail: chhandak.basu@csun.edu; kirill.musaev.911@my.csun.edu

Compounds found in tomatoes (*Solanum lycopersicum*) are associated with health benefits. Lycopene, an antioxidant, has been linked to a lower risk of cardiovascular disease (CVD). Other studies indicated that consumption of tomato products aids in protection against harmful effects of ultraviolet (UV) light and has a weak protective effect against prostate cancer. Tomato is also an economically important crop, with 170 million tons produced globally in 2014. However, *S. lycopersicum* plants are highly sensitive to heat; temperatures above 38°C can limit crop yields after even a short exposure. Consequently, tomato production deteriorates in some regions during times of hot weather, resulting in shortages. One response to heat exposure in *S. lycopersicum* is differential emission of terpene compounds, which are linked to thermotolerance in some plants. In this study, we propose to measure the potentially differential expression of genes related to terpene synthesis in *S. lycopersicum* plants exposed to 42°C heat stress environment. Currently selected genes, whose expression was measured by qPCR, are phellandrene synthase 1 (PHS1) and neryl diphosphate synthase 1 (NDPS1), which are both identified as terpene synthases. Variation was observed in the expression of the genes among biological replicates. Gene expression data will be compared to the emission profiles of 8 terpene volatiles from *S. lycopersicum* at the same heat stress temperature, as measured by gas chromatography-mass spectrometry (GC-MS), establishing potential correlations between the pathways and their products. This approach will identify either 1) candidate terpene compounds for induction of thermotolerance or 2) gene targets to manipulate heat stress response in *S. lycopersicum*. Furthermore, terpene compounds possess pharmacological properties, and upregulation of terpene synthases due to heat stress or artificial induction will potentially increase the yield of terpenes in tomato crops.

17. Effective plant tissue culture method for sustainable production of 20-hydroxymaytenin as a main bioactive metabolite from *Maytenus heterophylla*. Thanet Pitakbut[1], Michael Spiteller[2], and Oliver Kayser[1]. [1]Technical Biochemistry Laboratory, Faculty of Biochemical and Chemical Engineering and [2]Instutitute of Environmental Research (INFU), Department of Chemistry and Chemical Biology, Technical University Dortmund University, 44227, Dortmund, Germany. Email: thanet.pitakbut@tu-dortmund.de; oliver.kayser@tu-dortmund.de

Maytenus heterophylla is one of the most popular medicinal plants from South Africa, and it has been used in traditional medicine against infection and inflammatory diseases. Maytenus plants are also known to be a valuable source for quinone-methide triterpenoids (QMTs). These QMTs metabolites are an attractive pharmaceutical substance since they exhibit an excellent anticancer property. However, QMTs metabolite can be obtained through extraction from a plant only. There is no effective tissue culture method to obtain 20-hydroxymaytenin (one of the QMTs metabolites) from *M. heterophylla*. Therefore, this study's main aim was to set up an effective culture protocol for this purpose. As a result, the combination of two phytohormones (IBA and NAA) showed a high percentage success rate of more than 80% in the callus initiation step. The biomass from the cell suspension culture was increased approximately 1-fold every week for five weeks long. Later, 20-HM was detected and isolated from the cultivated cells. Based on the isolation, the accommodation of 20-HM in our cells was much higher than in the natural habitat. In conclusion, our established protocol proves to be an effective tissue culture method to produce 20-HM sustainably.

18. Elicitation of prenylated stilbenoids in hairy root cultures of peanut (*Arachis hypogaea*) and its wild relatives *Arachis ipaensis* and *Arachis duranensis*. Lingling Fang[1], Tianhong Yang[1] and Fabricio Medina-Bolivar[1,2]. [1]Arkansas Biosciences Institute and [2]Dept. of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: lfang@astate.edu; fmedinabolivar@astate.edu

Peanut (*Arachis hypogaea*), an important food and oilseed crop, can produce prenylated stilbenoids as phytoalexins to counteract biotic and abiotic stresses. Two major prenylated stilbenoids, arachidin-1 and arachidin-3, identified from peanuts exhibit diverse biological activities with potential application in human health. However, the availability of these prenylated stilbenoids is limited. Our previous studies have established hairy root cultures of peanut cultivar Hull line 3 as an elicitor-controlled bioproduction platform for prenylated stilbenoids. Here, we further optimized elicitation conditions for maximum yield of prenylated stilbenoids via multiple steps, including an orthogonal array design method. The optimized elicitation procedure consisted of co-treatment of the hairy root cultures with 18 g/L cyclodextrin, 125 μM methyl jasmonate, 3 mM hydrogen peroxide, and medium supplementation with additional 1 mM magnesium chloride. After 168 hours of elicitation, the combined yield of prenylated stilbenoids arachidin-1, arachidin-2, arachidin-3, and arachidin-5 reached approximately 750 mg/L (equivalent to 107 mg/g DW). We also established two hairy root lines from the peanut wild ancestors, *A. duranensis* and *A. ipaensis*, and described for the first time the production of prenylated stilbenoids in these wild *Arachis* species. These wild *Arachis* hairy root lines may provide a platform to elucidate the biosynthetic origin of prenylated stilbenoids in peanuts.

19. Employing an in vitro digestion model to determine the absorption of medicinal chile compounds. Khadijeh Mozaffari[1] and Ivette Guzman[1]. [1]Department of Plant and Environmental Sciences, New Mexico State University, Las Cruces, NM 88003, USA. Email: mozafari@nmsu.edu; ivguzman@nmsu.edu

Capsicum species, chile peppers, is an important worldwide horticultural crop. It is a rich source of bioactive compounds, such as carotenoids and capsaicinoids. Carotenoids in chile peppers are a large group of plant natural pigments that are used as a food seasoning, protect plants from photooxidation damage, help in photosynthesis and reduction of human chronic diseases and have antifungal properties. Carotenoid bioavailability studies are important because of their health-promoting effects. Human gut bioavailability is influenced by many factors such as food matrix interactions, ingredients, ingested dose, and processing of foods. Human and animal studies that have been done so far are limited because they are expensive, and time-consuming, and may have ethical issues. Therefore, the objective of the present study was to use an in vitro simulated gut digestion model, with the

advantage of being fast, short, and highly reproducible, to measure chile carotenoid bioavailability. Moreover, different varieties of chile peppers with unique carotenoid profiles were digested using the in vitro method to determine the micellarization of carotenoids (β-cryptoxanthin, β-carotene, violaxanthin, capsanthin) and chlorophyll with and without olive oil. Our results showed that in general, the carotenoid bioavailability increased in all chile pepper varieties when olive oil was added. Specifically, the addition of olive oil to Chimayo peppers significantly increased the β-carotene micellerization. Moreover, the violaxanthin and β-cryptoxanthin micellarizations were significantly enhanced in NM Orange Spice jalapeños by adding olive oil. Our results indicate that the olive oil used had a high percentage of monounsaturated fatty acids that could have aided in the increased micellarization of carotenoids. The outcome from the current study indicates that changes to the food ingredients such as addition of olive oil can enhance results on carotenoids bioavailability.

20. *Eruca sativa* seed extracts: a powerful supplementation for lactic acid bacteria activity in intestinal barrier and inflammation, in a co-culture system of an enterohemorrhagic *Escherichia coli* and human intestinal cells. Angela Punzo[1], Alessia Silla[2], Francesca Bovincini[3], Patrizia Simoni[4], Mara Mirasoli[1], Eleonora Pagnotta[5], Aldo Roda[1], and Cristiana Caliceti[2]. [1]Dept. of Chemistry "Giacomo Ciamician", [2]Dept. of Biomedical and Neuromotor Sciences-DIBINEM, [3]Dept. of Pharmacy and Biotechnology-FABIT, [4]Dept. of Medical and Surgical Sciences-DIMEC, University of Bologna, 40126 Bologna, Italy; [5]CREA-Council for Agricultural Research and Economics, Research Centre for Cereal and Industrial Crops, 40128 Bologna, Italy. E-mail:angela.punzo2@unibo.it; cristiana.caliceti@unibo.it

Lactic acid bacteria (LAB) "fermentates" derived by a combination of the live microorganisms that the fermented foods contain, as well as the bioactive components released into the foods as by-products of the fermentation process, exert positive effects on gut health. Glucosinolates (GSLs) derived from *Brassicaceae* vegetables are hydrolyzed by bacterial enzymes leading to the formation of the bioactive molecules isothiocyanates (ITCs), with well-documented antioxidant and antimicrobial activities. However, the beneficial combination of *Brassicaceae* extracts in the LAB fermentation in increasing the fermentates' performance in intestinal function has not yet been elucidated. The study aimed to determine if broths derived by the LAB fermentation in the presence of the *Brassicaceae* seed extracts of *Eruca sativa* and *Barbarea verna* prevent gut barrier dysfunction and interleukin-8 (CXCL8) release *in vitro* in human intestinal cells infected with the enterohemorrhagic *Escherichia coli* (EHEC) O157:H7. The GSLs profile in the extracts was characterized by HPLC–UV analysis, obtaining 131 ± 3 μmoL g^{-1} of glucoerucin, and 5.6 ±0.8 μmoL g^{-1} of glucoraphanin in *Eruca sativa*, while in *Barbarea verna* was identified only gluconasturtiin, 123 ± 3 μmoL g^{-1}. Next, LAB broths were assayed for their biological effects in a co-culture consisting of EHEC and Caco-2 cells. In Caco-2 cells infected with EHEC, IL-8 release significantly increased, while Trans-Epithelial Electrical Resistance (TEER), a barrier-integrity marker, decreased. Notably, when Caco-2 cells were pre-treated with LAB broth enriched with *Eruca sativa* seed extract and thereafter infected, IL-8 expression and epithelial dysfunction were reduced compared to untreated cells. These results underline broths' beneficial effect from LAB fermented with *Eruca sativa* seed extracts in the gut barrier and inflammation after EHEC infection. This study revealed that these LAB broths could be used as functional bioactive compounds to regulate intestinal function.

21. *Euclea natalensis* A. DC. as a hepatoprotective adjuvant for tuberculosis. Reid, Anna-Mari[1]., Carel Basson Oosthuizen[2] and Namrita Lall[1, 3,4]. [1]Department of Plant and Soil Sciences, University of Pretoria, Pretoria, South Africa. [2]Institute of Infectious Disease and Molecular Medicine, University of Cape Town, South Africa. [3]School of Natural Resources, University of Missouri, United States/ [4]College of Pharmacy, JSS Academy

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Euclea natalensis A. DC. has been traditionally used by the Tsonga, Venda and Zulu people in southern and tropical Africa for the treatment of various ailments, chest related complaints, including tuberculosis. Pharmacodynamic properties of the ethanolic shoot extract included antibacterial, antimycobacterial, and hepatoprotectant properties. The extract showed a marked increase in the Th1 immune response through elevation of IL-12. Preclinical studies concluded that the extract was able to reduce alanine aminotransferase (ALT) in mice associated with drug-induced liver injury. Further development of the extract included additional toxicity tests, antifibrotic potential, as well as cytochrome (CYP) P450 inhibition studies. The extract showed effective antifibrotic activity by decreasing 50% of the levels of transforming growth factor-beta (TGF-β) at a concentration of 48.46±1.21 µg/mL (IC_{50}) in rat hepatic stellate cells (HSC-T6). A lesser effect was observed on alpha-smooth muscle actin (α-SMA), where the extract showed an IC_{50} value of 2249±3.09 µg/mL). The effect of the extract on CYP P450 enzyme metabolism, revealed the inhibition (IC_{50}) of CYP2A6, CYP2D6 and CYP3A4 and an induction of CYP1A1/2. The results of this study contributed towards further development of this plant-sample into an effective hepatoprotectant adjuvant for tuberculosis.

22. Evaluating the cholesterol lowering mechanism of bergamot (*Citrus bergamia*). Yunying Huang[1], Mirielle Nauman[1,2], and Jeremy Johnson[1,2]. [1]Department of Pharmacy Practice, University of Illinois at Chicago College of Pharmacy, Chicago, IL, USA; [2]Department of Pharmaceutical Sciences, University of Illinois at Chicago College of Pharmacy, Chicago, IL, USA. E-mail: jjjohn@uic.edu

Bergamot, a Mediterranean citrus fruit native to southern Italy, has been reported to have cholesterol-lowering properties; however, the mechanism of action is not well understood. Due to proposed structural similarities with 3-hydroxy-3-methylglutaryl-coenzyme A reductase (HMGCR) inhibitors, it has been proposed that the phenolic compounds in bergamot may also inhibit HMGCR. Statins are widely used; however, they are not universally well tolerated, suggesting a need to identify novel cholesterol-lowering strategies. In the present study, we investigated bergamot polyphenolic fraction extract (BFE) and its principal components (neoeriocitrin, neohesperidin, naringin, melitidin, and brutieridin) and their ability to regulate cholesterol levels in HepG2 and Caco-2 cells. BFE at increasing concentrations in HepG2 cells decreased the levels of total and free cholesterol. BFE and its constituents did not directly inhibit HMGCR. However, BFE and neohesperidin decreased HMGCR levels in HepG2 cells, suggesting that neohesperidin and BFE may downregulate HMGCR expression. Consistent with this hypothesis, an increase in AMP-kinase phosphorylation was observed in BFE and neohesperidin-treated cells. In Caco-2 cells, brutieridin exhibited a significant reduction in cholesterol uptake and decreased the level of NPC1L1, an important cholesterol transporter. Taken together, our evidence suggests that the cholesterol-lowering activity of bergamot is distinct from statins. We hypothesize that BFE and its principal constituents lower cholesterol by inhibiting cholesterol synthesis and absorption.

23. Evaluation of a temporary immersion system for the in vitro production of *Curcuma longa* from Rapa Nui island. María Marchant[1,2], Paula Molina[2], Miriam Montecinos[2], Leda Guzmán[1], Cristobal Balada[1], Claudia Fassio[2], and Mónica Castro[2]. [1]Laboratory of Biomedicine and Biocatalysis, Institute of Chemistry, Faculty of Sciences and [2]Propagation Laboratory, School of Agronomy, Faculty of Agronomic Sciences and Food. Pontificia

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Rhizomes of *Curcuma longa* (fresh or processed) are widely used for their medicinal properties. Due to these properties, it has been used without regulations, which has led to a vulnerable state of conservation in Rapa Nui. The micropropagation by a temporary immersion system (TIS) facilitates the development of large-scale processes, reduces production costs, and increases propagated material productivity. We aimed to investigate the TIS's experimental conditions to improve the *in vitro* production of *C. longa* from Rapa Nui island. Therefore, we determine three parameters: the number of explants per flask, flask capacity, and the ratio of red:blue LED light. The culture conditions in all assays were: proliferation medium MS + BAP for 30 days and rooting medium MS + ANA for 10 days, immersion of 4 minutes each in cycles of 4 hours, a temperature of 23 °C, and the cycle of light/dark of 16/8 hours. Finally, average plant mass per plant, number of living plants (explants that sprouted), number of dead plants (explants without sprouting), and proliferation rate. The results showed that with 30 explants per flask, a greater number of plants and higher fresh biomass are produced compared to those with 20 and 40 explants per flask. The use of the 2-liter flask produced a greater number of plants with a higher average plant mass than with a 1-liter flask. The ratio of 4:1 of red:blue LED light generated a positive effect during the proliferation and rooting of *Curcuma longa in vitro*. Our results suggest that 30 explants in 2-liter flasks and illumination with ratio a 4:1 of red:blue LED light allow obtaining the largest amount of *Curcuma longa* plants *in vitro*.

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24. Exploring complexity in botanicals: a case study on the antimicrobial effects of *Verbascum thapsus.*

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Verbascum thapsus L. (*V. thapsus*) has a strong ethnomedical tradition. Unfortunately, the results of published *in vitro* studies on antimicrobial activity were not consistent, and it was not clear to what extent different assays or processing methods were responsible. A factorial design including two temperature levels (Room Temperature (RT) and 50oC) and 5 X % EtOH (100%, 80%, 50%, 25%, and 0% EtOH) was employed to screen extracts harvested in Serbia, GB, and Ireland using a well diffusion assay against *Staphylococcus aureus* control strain ATCC 29213. Selected extracts (100% EtOH-RT (Serbian), 100% H2O Decoction (Turkish). 80% EtOH-RT-Filtered (0.45µl) (Serbian) were tested on different brands (Fluka, Acumedia, and Oxoid) of Mueller-Hinton agar and different control strains (S. aureus ATCC 29213 and 25923). TLC with standards Catalpol, Ajugal, and Verbascoside were also completed for all the extracts. The results found significant variability in all three samples' activity, with significant interaction between the extracts at RT and 50oC. A similar activity profile found for the GB and West Cork harvested samples (50% or more EtOH) is reflected in the similar TLC profile. The Serbian harvested sample is active across all EtOH and water % and has a different TLC profile, including the absence of Catalpol equivalent band. Additionally, the brand of Mueller-Hinton agar had significant effects on the resulting activity, from no activity (Fluka brand) to significant activity, $p < 0.001$ (Oxoid and Acumedia) with ATCC 29213. With ATCC 25923, only 100% EtOH extract-RT is statistically significant ($P = 0.032$),

(Decoction (p = 0.093), 80% EtOH-RT-Filtered (p = 0.95). In conclusion, this study has shown that all samples are effective against *S. aureus* ATCC 29213, although with different EtOH or water solvent specifications. The agar brand is a confounding variable in this study and needs to be controlled in future studies.

25. From superfood to superb shelf life: Growing organic kale in the southeastern United States. Tony Reda[1] and Dil Thavarajah[1]. [1]Dept. of Plant and Environmental Sciences, Clemson University, Clemson, SC 29634, USA. E-mail: creda@g.clemson.edu

Since its inception in the early 20th century, organic agriculture has grown increasingly popular due to its focus on a holistic, environmentally friendly approach to crop production. However, it is comparatively limited in biomass production, nutritional quality, and postharvest treatment compared to conventional agriculture. These challenges carry over into kale production, the majority of which is certified organic. This study aims to determine which kale genotypes of 36 selected kale accessions and close kale relatives are most suitable for organic production in the Southeastern United States. The kale accessions were grown in a completely randomized block design at the Clemson Student Organic Farm. Following harvest, biomass, mineral content, prebiotic carbohydrates, and shelf life were measured. The cultivated kale varieties are expected to have shorter shelf life than some close kale relatives like heading cabbages. Cultivated kale varieties and USDA PI-accessions are expected to have variable concentrations of mineral nutrients and prebiotic carbohydrates. We expect several varieties to outperform others across all categories when adapting to organic production. These varieties will be subject to a more in-depth follow-up study to select parents for a breeding program focused on nutritional quality and increased shelf life.

26. *Garcinia mangostana* xanthones target drug-resistant androgen receptor mutants for degradation in prostate cancer. Mirielle Nauman[1,2], Jonghoon Won[2], Bhaskar Vemu[2], and Jeremy Johnson[1,2]. [1]Department of Pharmaceutical Sciences, the University of Illinois at Chicago College of Pharmacy, Chicago, IL 60612; [2]Department of Pharmacy Practice, University of Illinois at Chicago College of Pharmacy, Chicago, IL 60612, USA. E-mail: jjjohn@uic.edu

Xanthones from the purple mangosteen fruit (*Garcinia mangostana*) have been identified as selective androgen receptor (AR) degraders in prostate cancer cells. α-Mangostin, the most common and abundant xanthone, was chosen for further mechanistic studies. Preliminary data in our lab has shown that α-mangostin induces apoptosis in prostate cancer cells. Mechanistic data highlights a simultaneous decrease in AR protein expression and increased BiP protein expression in prostate cancer cells treated with α-mangostin. Through immunoprecipitation and in-cell western assays, we validated that AR and BiP interact in LNCaP cells treated with α-mangostin. AR is ubiquitinated and degraded by the proteasome. Interestingly, α-mangostin also promotes the degradation of AR protein with clinically relevant mutations and AR splice variants, both of which are currently not targetable by any FDA-approved drugs. We hypothesized that α-mangostin promotes the degradation of wild-type and mutant AR through the protein interaction between AR and BiP. This study represents a novel strategy to targeting AR and can provide a new therapeutic approach to drug-resistant prostate cancer cases.

27. Genetic variation in the prebiotic carbohydrate and mineral composition of kale (*Brassica oleracea* L. var. acephala) adapted to an organic cropping system. Dilrukshi Thavarajah[1], Tristan Lawrence[1], Sarah Powers[1], Boone Jones[1], Nathan Johnson[1], Joshua Kay[1], Anuruddha Bandaranayake[1], Emerson Shipe[1],

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Kale is a highly nutritious leafy green that is commonly grown in conventional cropping systems. The goal of this study was to determine the genetic variation in biomass and concentrations of prebiotic carbohydrates and mineral nutrients among different kale cultivars. Eighteen commercial cultivars and thirty-five PI accessions of kale were analyzed and genetically evaluated to determine the genetic variability between kale cultivars for these traits. It was found that a 100 gram serving of kale supplied the mineral micronutrients potassium (20–314 mg), calcium (95−539 mg), magnesium (20−67 mg), phosphorus (13−87 mg), iron (0.4−3.1 mg), zinc (0.3−0.9 mg), manganese (0.4−1.9 mg), copper (20−1030 μg), and selenium (0–940 μg). A 100 gram serving similarly yielded prebiotic carbohydrates, including sugar alcohols (1.7-26.9 mg), simple sugars (0.03-334 mg), raffinose, and fructooligosaccharides (0-11.2 mg). Leaf biomass was found to range from 41.4-271.2 g/plant. Kale accessions were found to have higher amounts of minerals (except in magnesium and manganese) and prebiotic carbohydrates (except in sucrose and verbascose + kestose). Commercial cultivars displayed relatively low heritability estimates for prebiotic carbohydrates and minerals, with the exception of having high heritability estimates for zinc, magnesium, and sugar alcohols. In kale accessions, heritability estimates were high for potassium, selenium, glucose, and fructose. These findings indicate that significant genetic variation exists within the kale germplasm and commercial cultivars for mineral and prebiotic carbohydrate content, demonstrating the potential for improving the nutritional quality of organically produced kale through germplasm selection.

28. Impact of root biomass to increase stilbenoid yield in hairy root cultures of peanut cultivars Hull and Georgia Green. Izzeldin Ahmed[1], Krystian Roedel[1], Gaurav Gajurel[1,2], and Fabricio Medina-Bolivar[1,2,3]. [1]Arkansas Biosciences Institute, [2]Molecular Biosciences Graduate Program and [3]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: izzeldin.ahmed@smail.astate.edu; fmedinabolivar@astate.edu

Stilbenoids are polyphenolic compounds that possess antioxidant and anticancer activities. Previously, a bioproduction platform for stilbenoids, including resveratrol and its prenylated derivatives, was established by culturing peanut hairy roots of cultivar Hull in 250 mL flasks with 50 mL of medium. In order to perform *in vivo* studies, an increase in stilbenoid yield is demanded. To this end, the objective of this study was to increase stilbenoid yield by modifying culture conditions to increase root biomass. The hairy roots were cultured under various growth conditions, including flask size and volume of culture medium. Culturing in 500 mL flasks with 100 mL of the medium led to an 11an 4% increase in root biomass compared to culturing 250 mL flasks with 50 mL of medium. Consequently, we used 500 mL flasks with 100 mL of medium to investigate the impact of root biomass and stilbenoid yield. To this end, the hairy root cultures were co-treated for 168 hours with methyl jasmonate, hydrogen peroxide, cyclodextrin, and magnesium chloride, and the stilbenoids were analyzed in extracts of the culture medium by high-performance liquid chromatography. We found that the increase in root biomass corresponded to a 97% increase in stilbenoid yield. In addition, these optimized culture conditions were also tested with a different hairy root line from the cultivar Georgia Green, an agriculturally important cultivar. The results from the Georgia Green line showed the same trend. These findings showed that by increasing the root biomass, the stilbenoid yield could be increased in hairy root cultures of different peanut cultivars. Ongoing studies are focused on optimizing purification conditions for these stilbenoids and assessing their biological activity.

29. In silico studies of compounds present in the plant *Ocimum sp*. Zhongrui Zhang[1], Jinay Patel[1], and Sonia Arora[1]. [1]Department of Plant Biology, School of Environmental & Biological Sciences, Rutgers University, New Brunswick, NJ 08901. E-mail: zhongrui.zhang@rutgers.edu; sonia.arora@rutgers.edu

Ocimum sanctum is a prominent medicinal plant in traditional Indian medicine, Ayurveda. It has a very complex chemical composition, and it is known for its wide range of therapeutic potentials and healing properties, including inflammation. Eugenol, a major component in *O. sanctum*, was previously found to be an anti-inflammatory component for COX-2/5-LOX pathways. However, no known study has proposed a mechanism of action for the remaining compounds present in *O. sanctum* against inflammation. This study aimed to construct an *in silico* database of compounds present in *O. sanctum* and propose a computational analysis of these compounds against COX-1 and COX-2 inflammatory pathways. We took a comprehensive *in silico* approach to understanding binding pockets of COX-1 and COX-2 proteins, followed by molecular docking of *O. sanctum* compounds using Autodock Vina. A deductive analysis of docking energies of *O. sanctum* compounds with each protein revealed seven and forty-five potential binders for COX-1 and COX-2, respectively. The COX-2 binders were further clustered to identify ten top-tier, nine second-tier, and twenty-seven third-tier binders. In addition, ligand interaction maps were generated for the potential binders using Ligplot and compared to known therapeutic ligands for two proteins. We found that several *O. sanctum* compounds gained new hydrogen bonds and hydrophobic interactions compared to the known ligands. In conclusion, we propose an underlying binding potential of a number of *O. sanctum* compounds with COX-1 and COX-2 enzymes, hence a potential mechanism for the anti-inflammatory activity for *O. sanctum.*

30. In vitro conservation, antioxidant capacity, and preliminary anti-cancer studies on *Scutellaria havanensis* Jacq. (*Havana skullcap*). Lani Irvin[1,3*], Yarelia Zavala Ortiz[2*], Brajesh Nanda Vaidya[1*], Alok Arun[2], Juan A. Negrón Berríos[2**], and Nirmal Joshee[1]. [1]Agricultural Research Station, Fort Valley State University, Fort Valley, GA, USA; [2]Institute of Sustainable Biotechnology, Inter American University of Puerto Rico, Barranquitas, PR, USA; and [3]College of Natural and Health Sciences, University of Northern Colorado, Greeley, CO, USA. E-mail: josheen@fvsu.edu

The rare medicinal *Scutellaria havanensis* Jacq. (Havana skullcap) is restricted with limited presence in Florida, Puerto Rico, and the West Indies. Reports document the presence of bioactive compounds in *Scutellaria havanensis* that can potentially treat microbial infections, inflammation, and skin diseases. We report an efficient *in vitro* propagation protocol through an adventitious shoot induction pathway using nodal explants to assist the conservation efforts, develop disease-free planting stock for biomass production, and facilitate genetic transformation. Murashige and Skoog media supplemented with 10µM 6- benzylaminopurine, a cytokinin, induced the highest number of adventitious shoots in a time-dependent manner. A 10-day exposure produced an optimal shoot bud induction, while longer incubation times resulted in hyperhydricity. *Agrobacterium tumefaciens* EHA105- mediated gene transfer was achieved based on transient expression of a green fluorescent protein. Transformation studies exhibited responsiveness of internodes over other explants. Comparative total polyphenol and flavonoid content measurement of fresh and air-dried leaf extract revealed that the fresh leaf extracts contained a higher total polyphenol and flavonoid content. Scanning Electron Microscopy of the leaf surface revealed a high density of glandular and non-glandular trichomes, probably contributing to high anti-oxidant capacity. Methanolic leaf extracts were used to study the viability of human colorectal cancer cell line HCT116. The HCT 116 cell viability assessed by colorimetric assay using a 3-(4, 5-dimethyl-thiazol-2-yl)-2, and

5-diphenyltetrazolium bromide reflected a steady growth inhibition after 24 hours of incubation. This foundational research provides a basis for future phytochemical screening and clinical research on *S. havanensis*.

31. In vitro micropropagation, antioxidant, and preliminary anti-cancer studies on a rare medicinal *Scutellaria* species from Puerto Rico. Rosalinda Aybar Batista[1*], Yarelia Zavala Ortiz[1*], Nirmal Joshee[2], Alok Arun[1], Juan A. Negrón Berríos[1] *Authors contributed equally. [1]Institute of Sustainable Biotechnology, Inter American University of Puerto Rico, Barranquitas, Puerto Rico; [2]Agricultural Research Station, Fort Valley State University, Fort Valley, GA, USA. Email: raybar@br.inter.edu; janegron@br.inter.edu

Secondary metabolites have been developed as therapeutic agents from botanical sources and are being tested against many human diseases. *Scutellaria* is a genus of about 400 species, of which several have been used in traditional medicine. Recent studies have demonstrated that flavonoids produced by *Scutellaria* species show anti-cancer properties. However, only a handful of *Scutellaria* spp. has been studied for their potential role in medicine. Our research focused on establishing the identity of a putative *Scutellaria* species from Puerto Rico using morphological, and DNA barcoding approaches. We aimed to characterize the pharmacological properties of *Scutellaria havanensis,* a species native to the Greater Antilles, Bahamas, and Florida (Acevedo-Rodríguez and Strong, 2012), and compare the properties to the putative *Scutellaria sp.* from Puerto Rico. Currently, only one phytochemical study on *S. havanensis* has been carried out, identifying the presence of several groups of compounds of potential pharmacological interest, such as flavonoids and alkaloids, among others. We employed *in vitro* seed germination. The antioxidant capacity was evaluated by TROLOX Equivalent Antioxidant Capacity (TEAC) assay, and the antitumor properties were assessed by a colorimetric assay using MTT in which both plant extracts were assayed against the colorectal cancer cell line HCT 116. DNA barcoding was performed using three molecular markers. Our preliminary findings show that the species of Puerto Rico has tremendous medicinal properties. Our work is a maiden report of characterizing Puertorican *Scutellaria* pharmacological profile focusing on its potential anti-oxidant and antitumor capacity, which could provide the basis for future phytochemical screening and clinical research.

32. MTA1-targeted chemopreventive potential of dietary pterostilbene against prostate cancer. Rutu Hemani[1], Ishani Patel[1], Avinash Kumar[1], and Anait S. Levenson[2]. [1]Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, Brooklyn, NY 11201, USA; [2]College of Veterinary Medicine, Long Island University, Brookville, NY 11548, USA. E-mail: rutu.hemani@my.liu.edu; anait.levenson@liu.edu

Nutritional chemoprevention can be of particular importance and a promising approach for managing prostate cancer (PCa) due to its slow-growing nature, usually in men aged 60 or older. Particularly, data indicate a reduced PCa risk associated with red wine consumption attributed to high resveratrol (Res) content. Pterostilbene (PTER), a natural dimethoxy analog of Res, has improved bioavailability and biological activity compared to Res. While metastasis-associated protein 1 (MTA 1) overexpression is strongly associated with advanced PCa, its role in premalignant condition [prostatic intraepithelial neoplasia (PIN)] and promotion of PCa early stages is unclear. In order to study the biological role of MTA1 in the initiation of oncogenic processes with subsequent activation of cell survival pathways and address dietary chemoprevention of PCa, we generated prostate-specific $R26^{Mta1/Mta1}$; $Pten^{+/f}$ mice and treated them with PTER supplemented diet (PTER-Diet, 100 mg/kg diet) for 5 months. Data showed that dietary supplementation with PTER restored favorable histopathology of high-grade PIN accompanied with reduced cell proliferation, angiogenesis, and MTA1, CyclinD1, and Notch2

downregulation. Moreover, mice fed with PTER-Diet had reduced levels of pro-inflammatory IL-6 and IL-1β and circulating oncogenic miRNA expression detected in the serum. The results of this study provide strong support for future clinical trials on prostate cancer chemoprevention with dietary stilbenes in the subpopulation of "active surveillance" patients at high risk for developing PCa.

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33. New antimalarial lanostanes triterpenes from a new isolate of Egyptian *Ganoderma* species. Amir E. Wahba,[1,2*] Ahmed K.A. El-Sayed,[3] Amira A. El-Falal,[3] and Eman M. Soliman[3]. [1]Department of Neurosurgery, Robert Wood Johnson Medical School, Rutgers University. [2]Chemistry Department, Faculty of Science, Damietta University. [3]Botany & Microbiology Department, Faculty of Science, Damietta, Egypt. E-mail: amir.wahba@rutgers.edu

Two new lanostane triterpenes named ganoderic acid AW1 and ganoderic acid AW2 were isolated from the fungal fruiting bodies of the cultivated new isolate of the Egyptian *Ganoderma sp* in addition to the known compounds ganomycine A, pinellic acid, and ergosterol peroxide. Their structures were elucidated by detailed analysis of their 1D and 2D-NMR data, as well as high-resolution mass spectroscopy. Ganoderic acid AW1 showed good antimalarial activity against the chloroquine-sensitive strain of *Plasmodium falciparum* with an IC_{50} value of 257.8 nM with no cytotoxicity up to the concentration of 9 μM.

34. Novel antibacterial and antifungal effects of a purified triterpene from *Quillaja saponaria* Molina on biofilm-producing cariogenic microorganisms. María Fernanda Argaluza-Sabioncello[1], María José Marchant-Lillo[1], Cristóbal Balada-Carrasco[1], and Leda Guzmán-Maluenda[1]. [1]Laboratorio de Biomedicina y Biocatálisis, Instituto de Química, Facultad de Ciencias, Pontificia Universidad Católica de Valparaíso, Valparaíso, Chile. E-mail: leda.guzman@pucv.cl

Dental cavities are an important health problem. The World Health Organization estimated that between 60% and 90% of the world's population suffers from the disease. In Chile, they are the most prevalent chronic non-communicable disease, affecting children and the adult population. Cariogenic bacteria found on teeth form an adherent film called dental plaque or biofilm that can present higher antimicrobial resistance than planktonic cells. Due to this health problem, it is imperative to find new molecules capable of inhibiting bacterial biofilm. New alternatives, using plant extracts, have been developed for the prevention and treatment of dental cavities. Among these, terpenoids are currently being used for their antimicrobial activity. A novel triterpene, obtained from a saponin extract from *Quillaja*, is synthesized by a biotransformation process and shows antibacterial and antifungal properties on biofilm-producing cariogenic microorganisms. This work aimed to evaluate these triterpene effects in an *in vitro* biofilm assay. This assay was performed using 3 microorganisms founded in a buccal cavity: *Staphylococcus aureus*, *Staphylococcus epidermidis,* and *Candida albicans*. Biofilms were formed using 96-well microtiter plates. 1.0 × 106 cells/mL of *S. aureus*, *S. epidermidis,* or *C. albicans* were inoculated in 96 well plates with Müller Hilton or Sabouraud Dextrose medium at 37°C for 24 hours. Subsequently, a range of triterpene (0 to 3.2 mg/mL) was added. The microplate was incubated at 37° C for 24 hours. The biofilm inhibition or disaggregation assays were analyzed using standardized protocols from our laboratory. Our results showed a significant effect of the novel triterpene molecule on biofilm inhibition formed by *S. aureus, S. epidermidis,* or *C. albicans* at concentrations higher than 0.6 mg/mL, compared with the control group. In the

future, we will analyze this triterpene effect on a human teeth model to keep studying its anti-cariogenic effect. Acknowledgment: ANID scholarship 2018. DIE-PUCV 2019.

35. Optimization of in vitro biomass production of the anxiolytic herb *Scutellaria lateriflora* L. Samantha H. Sherman[1] and Nirmal Joshee[1]. [1]Agricultural Research Station, Fort Valley State University, Fort Valley, GA, USA. E-mail: josheen@fvsu.edu; ssherma3@wildcat.fvsu.edu

Scutellaria lateriflora (American skullcap) is known for its anxiolytic properties and is used in traditional medical systems and commercially as an herbal supplement. As the demand for its products increasing, acquiring clean and unadulterated biomass becomes imperative. As very little research on *in vitro* micropropagation is available, a series of experiments were conducted to optimize an efficient protocol for *S. lateriflora* micropropagation. Stem explants with two nodes were inoculated on MS medium supplemented with four cytokinins, kinetin, benzyl amino purine, metaTopolin, and thidiazuron) at three concentrations (0.1, 1.0, and 10.0 µM). After six weeks, fresh and dry weights were recorded, suggesting the superiority of 10µM BAP and 10µM metaTopolin over other treatments. For adventitious shoot initiation, 10µM metaTopolin was the best treatment. To further optimize biomass production, three culture systems viz. semi-solid, liquid stationary with white paper towel support and liquid agitated (4.0 RPM) with white paper towel support were also tested, supplementing MS basal medium with non-reducing (sucrose) and reducing sugar (maltose) at 0%, 3%, 5%, 7%, and 10% (w/v) for six weeks. This experiment was done in the absence of plant growth regulators. Cultures grown in 3% sucrose were not hyperhydric and produced the highest quality plants. Two sugar treatments (7% and 10%) were inhibitory to the growth and induced hyperhydricity early on, rendering cultures useless for biomass production. Regenerated plants rooted in the basal MS medium were then acclimatized for two to three weeks and transferred to the greenhouse for further growth and flowering. Post-acclimatization, 87% of plants survived in the greenhouse condition and flowered setting seeds. This study suggests liquid agitated culture system with fiber support was the best for shoot induction in the presence of mT and BAP for biomass generation when supplemented with 3% sucrose.

36. Pharmacological and insilico studies of *Caesalpinia bonducella* as potential therapeutic agent. Shreya Rajasekar[1], Allan D'Silva[1], Aishwarya D.A.[1], Priya Narayan[1], Jagadeesh Kumar D[1], Nagendra H.G.[1], Sir M Visvesvaraya Institute of Technology, India. E-mail: shreya99rajasekar@gmail.com; allandsilva99@gmail.com

Caesalpinia bonducella is a tropical plant well known for its medicinal value in Indian Ayurveda. It is a prickly shrub that produces a nut and grows in regions like Kerala, Andaman Islands, and the Western Ghats. It is claimed to have antipyretic, anti-inflammatory, anti-diabetic, anti-mitotic, anti-microbial, anti-oxidant properties. However, experimental data has to be collected to substantiate these claims. In view of the above claims, our work focused on the evaluation of the above-mentioned therapeutic properties. Soxhlet extraction of the nut was prepared using water, methanol, and petroleum ether as solvents. Phytochemical analysis was carried out to check the presence of metabolites like alkaloids, flavonoids, saponins, tannins, phenols, and amino acids. Pharmacological assays were conducted for anti-microbial, anti-mitotic, anti-oxidant, and anti-inflammatory effects. Our results revealed the presence of phytochemicals like alkaloids, flavonoids, saponins, tannins, and steroids. Our work also indicated that the nut has potential anti-diabetic, anti-inflammatory, and anti-oxidant properties. Further studies like LCMS and insilico related experiments are underway. Taken together, we propose the possible use of Caesalpinia bonducella as potential drug molecules.

37. Phytochemical Gnetin C acts through AR signaling against castration-resistant prostate cancer. Rabab Al Deabel[1], Joyce Zhang[2], and Anait S Levenson[3]. [1]School of Health Sciences and Nursing, Long Island University, Brookville, NY 11548, USA; [2]College of Arts and Sciences, Boston University, Boston, MA 02215, USA; [3]College of Veterinary Medicine, Long Island University, Brookville, NY 11548, USA. E-mail: rabab.aldeabel@my.liu.edu

Prostate cancer (PCa) is a major public health issue in the United States. The activation of the androgen receptor (AR) and its signaling is a key process in the development and progression of PCa. In castration-resistant PCa, an aberrant AR reactivation includes various mechanisms such as AR mutations, AR overexpression, production of ligand-independent splice variants, and other changes in cell signaling pathways that modulate AR function. There is an urgent need to develop therapeutic strategies that effectively suppress the constitutive tumor-promoting signals associated with AR action in castration-resistant PCa. Our previous studies showed that stilbenes [resveratrol (Res), pterostilbene, and piceatannol] could decrease AR expression in PCa cells, presenting an attractive potential for stilbenes as promising pharmacologically safe agents. Gnetin C, a Res-dimer found abundantly in melinjo plant (*Gnetum gnemon*), possesses potent biological properties compared to resveratrol and analogs due to its improved pharmacokinetics. Here, for the first time, we examined the efficacy of Gnetin C in targeting both full-length and ligand-independent AR splice variants (AR-V7) expressed in the castration-resistant 22Rv1 cells. We found that Gnetin C used in twice lesser doses showed substantially more inhibitory effect on AR/AR-V7 than Res, analogs, and enzalutamide (ENZ), a known AR antagonist used in the clinic. Ongoing *in vivo* studies using unique transgenic mice with activated AR signaling under Gnetin C treatment are in progress. We will evaluate prostate tissues from these mice for the effects of Gnetin C therapy by analyzing molecular markers associated with castrate resistance (AR, PSA) as well as functional mechanisms linked to cell proliferation (Ki67), apoptosis (cc3), and angiogenesis (CD31).

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38. Prenylated stilbenoids from peanut augment anticancer effects of paclitaxel in triple-negative breast cancer cell lines. Sepideh Mohammadhosseinpour[1,2], Linh-Chi Ho[1], and Fabricio Medina-Bolivar[1,3]. [1]Arkansas Biosciences Institute, [2]Molecular Biosciences Graduate Program, and [3]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: sepideh.mohammad@smail.astate.edu; fmedinabolivar@astate.edu

Triple-negative breast cancer (TNBC) is one of the most difficult to treat types of breast cancer. Therefore, there is ongoing research for new treatments to increase survival rates for this disease. This study aims to examine the role of prenylated stilbenoids as an adjuvant for paclitaxel, a chemotherapeutic drug with severe side effects. Prenylated stilbenoids were purified from elicitor-treated hairy root cultures of peanut by semi-preparative high-performance liquid chromatography. The cytotoxicity of the prenylated stilbenoids arachidin-1 and arachidin-3 and the non-prenylated stilbenoid resveratrol combined with paclitaxel was studied in different TNBC cell lines (MDA-MB-231 and MDA-MB-436) by checkerboard assays. The immortalized human breast epithelial cell line MCF10A was used as a control. FITC Annexin V Apoptosis and Apo-ONE Homogeneous Caspase-3/7 assays were used to detect early apoptosis and caspase-3 and caspase-7 in the treated cells. The results showed that arachidin-1 induces higher cytotoxicity in the TNBC cell line MDA MB 231 when compared to arachidin-3 and resveratrol. Prenylated stilbenoids, at the same concentrations, did not induce cytotoxicity in the immortalized human breast epithelial cells (MCF10A). Cytotoxicity and apoptosis were higher when paclitaxel and prenylated

stilbenoids were applied as a combined therapy. This highlights the significance of continued research with prenylated stilbenoids as an adjuvant in TNBC and their potential use to reduce paclitaxel's undesirable side effects. Current studies focus on elucidating the signaling pathways affected by prenylated stilbenoids in TNBC cells to increase our understanding of these natural products' anticancer mechanisms.

39. Purification of arachidin-1 and arachidin-3 from elicited peanut hairy root cultures. Amit Raj Sharma[1] and Fabricio Medina-Bolivar[1,2]. [1]Arkansas Biosciences Institute and [2]Department of Biological Sciences, Arkansas State University, Jonesboro, AR 72401, USA. E-mail: asharma@astate.edu; fmedinabolivar@astate.edu

Stilbenoids are phenolic compounds that exhibit diverse biological activities with potential benefits to human health. Peanut hairy root culture provides an excellent platform for the production of stilbenoids. The major stilbenoids reported in these cultures are resveratrol and the prenylated stilbenoids arachidin-1, arachidin-2, arachidin-3 arachidin-5. Resveratrol is commercially available and has been extensively studied *in vitro* and *in vivo*. Arachidin-1 and arachidin-3 have demonstrated antioxidant, antiviral, and anti-inflammatory activities. However, because these stilbenoids are not commercially available, their studies *in vivo* have been limited. To address this issue, the aim of this project was to develop a high-level bioproduction and purification platform for arachidin-1 and arachidin-3. To this end, peanut hairy root cultures were co-elicited with 18 g/L cyclodextrin and 125 µM methyl jasmonate to enhance the production of arachin-3. Whereas the hairy root cultures were co-elicited with 18 g/L cyclodextrin and 3 mM hydrogen peroxide to enhance the production of arachidin-1. These selective elicitation conditions enhanced the production of the targeted stilbenoids facilitating their purification. To purify the stilbenoids, fractions from the culture medium were subjected to solvent extraction and column chromatography, followed by semi-preparative high-performance liquid chromatography. The procedure yielded sufficient quantities of stilbenoids to carry out *in vivo* experiments.

40. Resveratrol or curcumin do not do it all. What is the cocktail effect of multiple bioactive components? Stefan Profft, Vineet Chanduri, Elisabeth Sophie Bech, Natacha Marie Skotte Hansen and Ole Vang. Department of Science and Environment, Roskilde University, Roskilde, Denmark. Email: ov@ruc.dk

The biological and health-promoting activity of well-known bioactive compounds like resveratrol and curcumin is well described. Clinical trials including either resveratrol or curcumin only show significant activities when given at high doses that do not correspond to the level normally achievable in the human diet. The conclusion could be that these compounds are not relevant, but we want to show that the same or even stronger responses are found when combining 2, 3, or 4 bioactive compounds in a mixture. This may indicate that the health-promoting effect of a healthy diet is caused by the combinatory effect of many bioactive compounds. We have analyzed the effect on cell proliferation during 72 hours in human colon cells exposed to either resveratrol and three additional resveratrol derivatives or to four different bioactive compounds: Resveratrol, curcumin, 3,3'-diindolylmethane, and artemisinin. The Chou-Talalay model analyzed the interaction of the four compounds. The interaction depends on the concentration of the compounds (and therefore the total effect) and the composition of the mixture. In both cases, stronger responses showed additivity of the four compounds, whereas antagonism was seen at low concentrations (and small effects) when combining the four resveratrol derivates. On the other hand, combining the four structurally different compounds, a strong synergism was observed at low concentrations, showing mild inhibition of cell proliferation. This is the first study measuring the combinatory response of four bioactive

compounds in a mixture. This is the first step for investigating the combinatory effect of many compounds in the same mixture. Further, the study pointed out that it is hard to forecast the combinatory effect of many bioactive compounds, why we have to develop better methods to analyze the cocktail effect of these compounds.

41. Rice bran microbiota changes and associated metabolite profile driving anti-colorectal cancer effects. Annika Weber[1], Bridget Baxter[2], Kristopher Parker[2], Komal Raina[3,4], Hend Ibrahim[5], and Elizabeth P. Ryan[2]. [1]Department of Food Science and Human Nutrition, Colorado State University, Fort Collins, CO, USA; [2]Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO, USA; [3]Department of Pharmaceutical Sciences, University of Colorado Denver-Anschutz Medical Campus, Aurora, CO, USA; [4]South Dakota State University, Brookings, SD, USA; [5]Department of Medical Biochemistry, Faculty of Medicine, Zagazig University, Zagazig, Egypt. Email: annika.weber@colostate.edu; e.p.ryan@colostate.edu

Dietary rice bran-mediated colon carcinogenesis inhibition has been described via multiple mechanisms, including altered cell cycle progression in malignant cells, reduced cell proliferation, and induction of apoptosis. Human clinical research further supports rice bran modulation of gut microbiome metabolism for enhancing colonic health and preventing chronic inflammatory responses. However, little is known on the fecal metabolite changes involved in the progression of colon cancer in Azoxymethane (AOM)/Dextran Sodium Sulfate (DSS) treated mice and modulation of metabolic pathways by dietary rice bran supplementation. This study investigated rice bran's mechanistic effect in protecting against cancer development in a mouse model of colitis-associated cancer by evaluating the microbiome and associated metabolic profiles of feces collected over 14 weeks. Conventional adult male BALB/c mice were fed a control diet (AIN93) or 10% w/w rice bran diet during AOM-DSS treatment. Gut microbiome and non-targeted metabolomics were applied to murine fecal samples following rice bran consumption at baseline, and at 2, 6, 10, and 14-weeks compared to mice fed the control diet. Gut microbiome analysis elucidated significant differences in both species richness and diversity between rice bran and control groups. Key changes included enrichment of sequences related to *Xylanophilum* and *Lachnospiraceae NK4B4 group* (both members of the *Lachnospiraceae* family) in the rice bran consuming mice, which are related to the fermentation of fiber and possible cancer protection. Metabolite analysis revealed dietary distinctions in metabolites at 10wk and 14wk, including vitamins such as thiamine (vitamin B1), retinol (vitamin A), pyridoxine (vitamin B6), and trigonelline, with therapeutic, antioxidant, and anti-inflammatory properties. There were also fold-increases in rice bran-derived phenolics, namely 2-hydroxyhippuarte and 3-phenylpropionate, at 10 and 14-weeks when compared to control. This study supports a time series of fecal metabolic profiles associated with dietary rice bran alongside identifying novel mechanism(s) by which rice bran protects against colon cancer progression.

42. Seismic stress enhanced in vitro regeneration efficiency and foliar microstructural analysis in *Gardenia jasminoides* J. Ellis. Manokari M.[1,2*], Priyadharshini S.[1], Jayaprakash K.[1], Cokulraj M.[1], Mahipal S. Shekhawat[1]. [1]Biotechnology Unit, Kanchi Mamunivar Government Institute for Postgraduate Studies and Research, Puducherry, India and [2]Siddha Clinical Research Unit, Central Council for Research in Siddha, Palayamkottai, Tirunelveli, TN, India. E-mail: smahipal3@gmail.com; manokari01@gmail.com

Gardenia jasminoides J. Ellis (Rubiaceae) is an important medicinal and ornamental plant with significant commercial values and less explored for *in vitro* regeneration studies. Cultures were initiated on Murashige and

Skoog's (MS) medium containing 1.5 mg L-1 6-benzylaminopurine (BAP), and the shoots were proliferated using MS medium supplemented with 0.5 mg L-1 BAP and 0.25 mg L-1 1-Naphthaleneacetic acid. The multiplied shoots were subjected to various levels of deliberate seismo-mechano agitation for 4 wk. The application of seismic stress treatment at 100 rpm for 10 min/day enhanced the rate of multiplication (38.4±0.27 shoots with 7.2±0.22 cm length), leaf area (1.8±0.10 cm × 1.0±0.25 cm), and leaf biomass (22.0±0.13 mg fresh weight/leaf) as compared with the control plantlets. The light microscopic analysis of leaves revealed that seismic-stress treated plantlets showed improved phenotypes and foliar micro-structures compared to untreated cultures. Additionally, the stress-treated plantlets responded better in root induction (28.6±0.36 roots with 3.8±0.17 cm length) and acclimatization experiments with increased growth, yield, and survival rate (100%). The study would enhance the concentrations of primary and secondary metabolites under *in vitro* conditions using seismo-mechanical stress, supporting the field adaptation of micropropagated plantlets with increased survival success.

43. Shade and fertilizer affects yield and quality in a clonal plantation of Yaupon Holly. Jeffrey Adelberg[1], Cory Tanner[1], Rabia El-hawaz[1], and Nishanth Tharayil[1]. [1]Dept. of Plant and Environmental Sciences, Clemson University, Clemson SC, USA. E-mail: jadlbrg@clemson.edu; shannt@clemson.edu

Yaupon holly (*Ilex vomitoria* Ait.) is the only native American source of caffeinated tea. The small amounts of tea product available are currently wild-collected from diverse populations. A clonal field plantation of yaupon was grown under shading and fertilizer treatments and harvested three times in one season to observe changes in yield and phytochemistry. The June and September harvest produced more mass than the July harvest for all treatments. Shading and fertility had interactive effects on increasing fresh mass of the pooled annual harvest, whereas providing 30% shade with 567 mg/N per plant raised yield 58% compared with plants grown in full sun. Fertility of 1134 mg/N per plant with 60% shade increased yield another 13% to approximately 1070 kg/ha. This experimental plantation contained 467 plants per ha and was at about half the density of commercial fields (882 plants per ha). Leaves were smaller in July and larger in June and September. Shade greatly increased the leaf size and water content. Caffeine content increased with leaf size over the duration of the experimental treatments, and 60% shade treatments in September produced the highest caffeine content (1.21 ± 0.17% of dry mass). In general, alkaloids were promoted by shading, and phenylpropanoids were promoted by bright light. This report from one season of observation showed that genetically uniform yaupon holly plantations were manipulated for yield and quality using shade and fertilizer.

44. Specific STS gene sequences in *Vitis rotundifolia* as possible modulators of resveratrol (rsv) synthesis. Jeffery A. Stewart[1], Srinivasa R. Mentreddy[1], V. Sripathi[1], Karolina Mukhtar[2], and Devaiah Kambiranda[3]. [1]Dept. of Biological and Environmental Sciences, Alabama A&M University, Huntsville, AL, USA; [2]Dept. of Biology, University of Alabama at Birmingham, Birmingham, AL, USA; and [3]Dept. of Agricultural Sciences, Southern University and A&M College, Baton Rouge, LA, USA. 70807. E-mail: jstewa27@bulldogs.aamu.edu

Vitis rotundifolia is a wild grape of the southeastern United States with an estimated 300 cultivars. This wild grape, also known as the Muscadine, has 40 chromosome pairs making it unable to hybridize with common wine grapes of *Vitis vinifera* naturally. Muscadines are highly pest resistant and drought tolerant and do not demonstrate visible or physiological effects to some diseases known to devastate other grapevines. These properties have been attributed to the robust production of the phytoalexin called resveratrol (RSV). RSV is a secondary metabolite

known for its cellular protective qualities, its function as a scavenger of free radicals, and a stimulator in the synthesis of antioxidants. RSV biosynthesis is known to be modulated by the actions of stilbene synthase (STS), with a host of *STS* genes identified as possible regulators to its production. This study will identify *STS* genes in *Vitis rotundifolia,* which could be used to genetically boost the performance of *STS* genes previously identified in *Vitis vinifera* (PN2004) and other crop plants, which lack *STS* genes and RSV biosynthesis. *STS* genes in the Muscadine "Noble" cultivar will be identified, and their functions characterized by genomic and qPCR. Stimulation of *STS* genes will occur by mechanical injury created by a 1cm slice with a sterilized scalpel to the leaves of the plant and analyzed by qPCR and LC/MS. This investigation is expected to shed light on the genomic sequences and regulatory mechanisms of *STS* genes in Muscadine and their roles in the synthesis of RSV in response to mechanical injury.

45. Structure-activity relationship of isoprenylated xanthones from alcoholic tinctures of *Garcinia mangostana* leaves and pericarp in targeting Nrf2 and iNOS. Restituto Tocmo and Jeremy James Johnson. Department of Pharmacy Practice, University of Illinois at Chicago College of Pharmacy, Chicago, IL, USA. E-mail: jjjohn@uic.edu

Medicinal plants have been explored for their anti-inflammatory and antioxidant properties. In this study, tinctures from pericarp and leaves of the tropical fruit mangosteen (*Garcinia mangostana*) were prepared as 40:60, 60:40, and 80:20 (%, *v/w*) ethanol:water extracts and evaluated for their xanthone contents and *in vitro* anti-inflammatory potential. Xanthones isolated through semi-preparative chromatography and identified by LC-MS and NMR analyses were used for quantification. HPLC analysis revealed eight major xanthones in pericarp and leaves tinctures whose concentrations varied significantly based on the ethanol:water ratios. A luciferase reporter assay using a recombinant HepG2 with stably integrated luciferase firefly gene under the control of antioxidant response element promoters (HepG2-ARE) revealed that Nrf2 is activated by both pericarp and leaves tinctures with the 80% and 60% pericarp tinctures showing 16- and 10-fold ARE activation, respectively relative to the control. All tinctures revealed a dose-dependent inhibition of nitric oxide (NO) production in lipopolysaccharide (LPS)-activated RAW264.7 macrophages. Structure-activity relationship study revealed a dose-dependent inhibition of LPS-induced NO by Garcinone D (GarD) and Garcinone C (GarC), with the rest of the compounds showing only minimal inhibitory activity. Western blot analysis revealed moderate inhibition of inducible nitric oxide synthase (iNOS) by pericarp and leaves tinctures and by GarD and GarC. A 12-week stability study at 4°C, 22°C (room temperature), and 40°C revealed that two major xanthones, α-mangostin and γ-mangostin, were stable throughout the study period, indicating long-term stability of the tinctures. Our study suggests that xanthones isolated in alcoholic tinctures display anti-inflammatory and antioxidant properties.

46. Targeting SREBP-dependent lipogenesis to combat metastatic prostate cancer. Gisella Campanelli[1], Nitesh K Nandwana1, Bhaskar C Das[1], and Avinash Kumar[1]. [1]Arnold and Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, Brooklyn, NY, USA. E-mail: gisella.campanelli@my.liu.edu; avinash.kumar@liu.edu

Prostate cancer (PCa) is one of the most commonly diagnosed cancers in men, and in cases of metastatic PCa, the five-year survival rate is about 30 percent. Despite varying success with drugs targeting androgen receptor signaling, PCa remains a lethal disease. Therefore, the development of alternative therapies that target other molecular players remains a top priority. Sterol regulatory element-binding proteins (SREBPs) are a family of

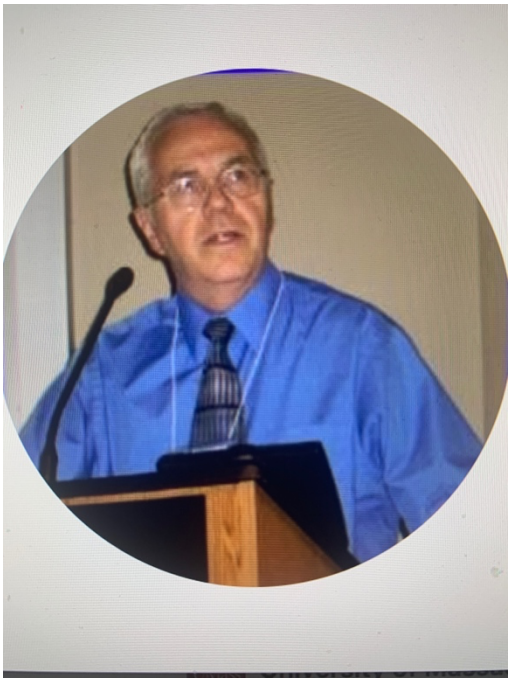
transcription factors that govern lipid homeostasis by regulating the expression of numerous enzymes involved in fatty acid and cholesterol synthesis. This study demonstrates that an increased SREBP gene expression exists in primary prostate tumors compared to normal prostate tissue that is even further increased in metastatic samples. It is anticipated, therefore, that inhibiting SREBP pharmacologically could be an effective therapeutic strategy against metastatic PCa. BF175 is a newly developed boron-containing stilbene derivative that inhibits SREBP expression and activity, but its role as an anticancer agent has not been investigated. Using PC3M and C4-2B aggressive PCa cells treated with BF175 in various phenotypic assays, we have examined the inhibition of viability, proliferation, survival, migration, and invasion of these cells after treatment with BF175. We have also evaluated the inhibition of SREBP expression and activity by BF175 in PCa cells by performing western blot and quantitative real-time PCR (qRT-PCR) analysis. Furthermore, by generating an experimental metastasis model in mice and treating them with BF175, we will examine the inhibition of PCa metastasis by BF175 in vivo. Findings from this study are anticipated to provide substantial preclinical evidence to develop BF175 as a novel therapeutic agent to abrogate metastatic PCa.

47. The flavonoid apigenin sensitizes triple-negative breast cancer spheroids to doxorubicin-induced apoptosis by targeting the oncogene hnRNPA2. Meenakshi Sudhakaran[1,2], Michael Ramirez Parra[2], Hayden Stoub[1,2], Kathleen A. Gallo[2], and Andrea I. Doseff[2,3]. [1]Molecular, Cellular and Integrative Physiology graduate program, [2]Department of Physiology, and [3]Department of Pharmacology and Toxicology, Michigan State University, MI, USA. Email: doseffan@msu.edu

Triple-negative breast cancer (TNBC) is a highly aggressive metastatic breast cancer (BC). Its high mortality rate often arises from acquired resistance to first-line chemotherapeutic drugs such as doxorubicin, underscoring the need to identify safe and effective sensitizing agents. Flavonoids, a group of natural polyphenols, are known for their health-beneficial roles. Among them, the flavone apigenin is emerging as a potential anti-cancer and chemo-sensitizer. To study the molecular mechanisms responsible for its beneficial health effects, we identified direct apigenin targets by screening a human BC-derived phage-display peptide library coupled with next-generation sequencing (PD-Seq). Among the high-affinity targets, we found hnRNPA2, an RNA binding protein and oncogenic driver that is highly upregulated in BC. This project aimed to elucidate molecular mechanisms by which hnRNPA2 affects the chemo-sensitizing activity of apigenin. Here, we compared the anti-cancer activity of structurally related flavonoids using TNBC three-dimensional cultures (spheroids), which mimic the complexity and heterogeneity of clinical tumors. Apigenin inhibited spheroids' growth more effectively than the other flavonoids studied, owing to their higher cellular uptake. Importantly, apigenin inhibited the growth of TNBC patient-derived organoids at an *in vivo* achievable concentration. Furthermore, apigenin sensitized spheroids to doxorubicin-induced apoptosis. Silencing of hnRNPA2 significantly decreased apigenin-induced sensitization to doxorubicin and diminished apigenin-mediated reduction of doxorubicin efflux transporters *ABCC4* and *ABCG2*, which are known to be highly upregulated in TNBC. Our results suggest that apigenin through hnRNPA2-mediated mechanisms increases cellular levels of doxorubicin, thereby increasing its efficacy. Together these findings provide novel insights into the role of natural products in mediating sensitization of TNBC to doxorubicin, highlighting the relevance of using dietary compounds as a chemotherapeutic adjuvant.

ACMAP Lifetime Achievement Award

2021 Award Recipient is Dr. Lyle E. Craker, Professor Emeritus, University of Massachusetts



On behalf of ACMAP, we are delighted to award Prof. Lyle E. Craker, our society's first Lifetime Achievement Award. Dr. Lyle E. Craker recently retired and was awarded Professor Emeritus status following a successful and faculty career at the University of Massachusetts. His areas of research earlier in his career included light physiology and environmental stress physiology with a focus on plants response to air pollutants. Dr. Craker continued his work in ethylene and ethane at UMass that also began when he was working at Ft. Detrick while in the USARMY with Dr. Frederick Abeles on ethylene. Relevant to ACMAP, it's important to point out that Lyle's work in Medicinal and Aromatic Plants began later in his career in 1979. In 1980, he co-founded the Herb, Spice and Medicinal Plants Newsletter at UMass; and later co-founded the Herb, Spice and Medicinal Plants Working Group in the American Society of Horticulture Science, 1981. One of his first research projects on MAPS culminated in 1983 in his first book on Herbs: An Indexed Bibliography, 1971-1980, included and categorized over 6,000 references and a 100-page monograph on the herbs of the temperate zone. This work published by Archon Books received the prestigious Oberly Award for Bibliographic Excellence in Agriculture & Related Sciences by the American Library Association, the Associates of the National Agric. Library & Council on Botanical & Horticultural Libraries for scientific reference.

Lyle began to teach one of the first undergraduate classes in herbs in the US from a department of plant science. This 3-credit class in Herb, Spice and Medicinal Plants for Dept. of Plant Science, at UMass remained a popular course from 1985 till his retired.

From a scholarly perspective, Dr. Craker also co-edited the original Haworth 4 volume series of Herbs, Spices and Medicinal Plants: Recent Advances in Botany, Horticulture and Pharmacology, published over 155 scientific papers including other technical reference books, and is credited with over 2,550 citations. Dr. Craker was very involved in the MAP working group in the ISHS (International Society of Horticulture Science) and served as a co-convenor and co-editor on multiple Acta Hort. Publications. His reach extended to working with the public to promote herbs and to industry where he worked closed with the American Herbal Products Society active in Quality Control and served as an advisor to HerbalGram. As Lyle saw the need to include and engage the public in MAPs so he introduced and coordinated the popular HerbFest at the UMass that ran for >20 years and published a book on herb gardens.

Dr. Craker was one of the original founding scientists of ACMAP, hosted the 2013 annual meeting of ACMAP at UMASS and took on the building and publishing of the Society's journal JMAP where he served as Editor-in-Chief till his retirement in 2021. As an internationally recognized scholar and champion of the study of MAPS and more recently cannabis, Dr. Craker has had a profound impact on his students, and to others, to international scholars on MAPs.

In recognition of a distinguished record of research and service that has reshaped and supported the science of natural products around the world and for this society including co-founding and serving as the Editor-in-Chief of Journal of Medicinally Active Plants, ACMAP awards its first Lifetime achievement Award to Professor Lyle E. Craker.

Prepared by

Jim Simon, 2021 ACMAP Host, Distinguished Professor of Plant Biology

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