



# 31st Annual CTAHRStudent Research Symposium

## PROGRAM SCHEDULE

Monday, April 15, 2019

Campus Center Rooms 307, 308, 309, and 310

**8:00—9:00 am Breakfast & Opening Remarks**Campus Center Ballroom

**8:15—8:30 am Judges’ Orientation**
Room 307

**9:00—10:30 am Session I *Product Design & Business***
Room 307 Presentation 1–8

 **Session II *Sustainability & Conservation***
Room 308 Presentation 17–24

 **Session III *Food Systems, Security, & Safety***
Room 309 Presentation 33–40

 **Session IV *Biotechnology***
Room 310 Presentation 49–56

**10:30—11:00 am Break**
Campus Center Ballroom

**11:00 am—12:30 pm Session V *Healthy Families & Resilient Communities***
Room 307 Presentation 9–16

 **Session VI *Sustainability & Conservation***
Room 308 Presentation 25–32

 **Session VII Food Systems, Security, & Safety**
Room 309 Presentation 41–48

 **Session VIII Biotechnology**
Room 310 Presentation 57–64

**12:30—1:30 pm Lunch & Closing Remarks**
Campus Center Ballroom

### Session I—*Product Design & Business*

9:00–10:30 a.m., Campus Center Room 307

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### **1 Making healthier whole wheat cinnamon rolls using banana blossom powder, a by-product in the banana crop industry.** Alan Martin\*, Beverly Yuen, Xiaohan Liu, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Banana blossom, an edible flower of the banana tree, is considered to be a by-product that accumulates as waste in the banana crop industry. In the culinary world, the search for alternative ways to create new food items utilizing by-products is on the rise. Current food trends have made a shift towards creating functional products such as antioxidants or dietary fiber-rich foods. Incorporation of banana blossom into baked goods will introduce a new sustainability factor to the culinary industry and benefit health-conscious diets.

##### 2 Sugar-free, Vegan Gummies to Aid in the Prevention of Tooth Decay. Bridgette Young\*, Yen Nguyen, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Dental caries, commonly known as cavities, are a preventable disease that affects most people in the US. They form over time through complex interactions between acid-producing bacteria, fermentable carbohydrates, and other factors such as diet, teeth, and saliva composition. Cavities may cause pain and infections, leading to a decreased quality of life. Preventative measures must be implemented to reduce the burdens of tooth decay on the individual and the community. Since diet is a direct factor that contributes to the formation of cavities, it is beneficial to develop a food product containing a probiotic that can enhance the oral microbiome**.**

##### 3 Hemp for Health. Savana Lendrum\*. Department of Family and Consumer Sciences.

Over the years, there has been increasing tension regarding whether or not the United States should actively cultivate and manufacture hemp in the fashion industry and beyond. Although it is one of the most historically used materials, the hemp plant carries around with it an immense amount of controversy. Just this past December, the Farm Bill was set in place to allow industrial growing of hemp within this nation. This is a wonderful step in the right direction; however, there is much more to do in order to push the future of this industry into a sustainable and beneficial movement.

##### 4 An Exhibition Case Study: Romeo and Juliet. Nara Nellis\*. Department of Family and Consumer Sciences.

Romeo and Juliet was written by the renowned author Shakespeare and was our inspiration in curating the most recent exhibition on view by the Costume Museum Management class. The main characters in the play (Romeo and Juliet themselves) are iconic in romance and we wanted to explore interpreting these characters into more contemporary eras. The exhibition was comprised of thirteen artifacts sourced from the archive of the UHM Costume Collections. We searched for both women’s and men’s pieces that reflected the original romance but continued the story into different settings. The clothing chosen reflected different aspects of daily life, from day to evening wear and casual to special occasion such as the wedding gown.

##### 5 Sekoya: Ethically made clothing for women on the go. Kaycee Yoshioka\*, Department of Family and Consumer Sciences.

The fashion industry is mostly to blame for the abundance of sweatshops and growing pollution. Yet despite these negative practices and side effects, not much has changed in terms of how fashion conglomerates operate. However, due to the Internet, many consumers are becoming more aware of such unethical and unsustainable issues. With the shift in consumer buying behavior, businesses will be forced to change for the better. To encourage such a movement, Sekoya an online retailer, was created to provide sustainable and ethically made apparel to consumers looking for an alternative to fast fashion.

##### 6° Give natives a chance: Morphological Characterization of Six Accessions of Pa'uohi'iaka (*Jacquemontia sandwicensis*) to Identify Selections for Hanging Basket Use. Darel Kenth Antesco\*, Orville C. Baldos. Department of Tropical Plant and Soil Sciences.

Invasive plants are a constant threat to Hawaii’s agriculture and natural ecosystems. They outcompete with native plants and greatly modify the environment. To curb the influx and spread of invasive plants, state laws requiring the use of native plants in public landscapes were enacted. Despite the active promotion of native Hawaiian plants as ornamentals in landscaping, only a few species are often used and no horticultural selections have been developed for specific purposes (i.e. landscape or container plants). To increase variety and availability of native plants, collection, morphological characterization, and evaluation for ornamental use are essential.

##### 7° Plant Solubilization of Metals: Production and Purification of Nicotianamine. James Carrillo\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

The bioavailability of metallic ions has a significant impact on plant growth and nutritional content. Nicotianamine is a metal-chelating compound produced by plants for the purpose of transporting metallic ions throughout plant tissue. Free metallic ions are highly reactive, causing oxidative damage, stress, and toxicity. Only when paired with nicotianamine can metals be easily and safely shuttled to newly developing plant tissue. Cloning the gene for nicotianamine synthase from *Leucaena leucocephala* has allowed for a recombinant enzyme to be made using E. coli. Quantification and purification of nicotianamine has been achieved using high pressure liquid chromatography.

##### 8° Enhanced Ecosystem Screenhouses: A Comprehensive Approach to Cucumber Crop Protection in Hawaii. Flora Samis\*, Koon-Hui Wang, Brent Sipes, Catherin Chan. Department of Plant and Environmental Protection Sciences, Department of Natural Resources and Environmental Management.

Cucumber is one of the most valuable vegetable crops in Hawaii but pesticide resistant pest populations challenge its production. Consumer demand for organic produce is pressuring producers to seek organic pest management approaches. One viable organic approach is using insect exclusion screenhouses. This project explores additional cultivation practices to improve natural ecosystem functioning inside screenhouses through companion planting of mint as additional cash crop, nitrogen fixing “chop-and-drop” border crops such as sunn hemp, as well as insectary flowering plants inside the screenhouse. We strive to develop a whole-farm management system for profitable organic cucumber production in Hawaii.

### Session II— *Sustainability & Conservation*

9:00–10:30 a.m., Campus Center Room 308

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 17 Sustainability Starts with Educating Children: A Socially Responsible Retail Business in Hawaii. Anne Mo\*, Makena Miles. Department of Family and Consumer Sciences.

Hawaii offers various opportunities for sustainability in order to maintain its rich environment and natural beauty. Hawaii has already taken initiative in preserving the environment. Nonetheless, it is a challenge to be able to create a retail business that integrates the aspects of sustainability while managing costs and meeting customer expectations. Through the children’s swimwear market, Hatchling implements sustainable ideas to the apparel industry in Hawaii by supporting children’s health through interactive events to educate consumers about responsible consumption in order to preserve a clean and brighter environment for children and their future.

##### 18 Steps Toward Microfiber Pollution Reduction. Savannah Adler\*. Department of Family and Consumer Sciences.

Synthetic and natural microfibers are shedding from our clothing with every wash; these fibers are so small that water treatment facilities are failing to filter them all out (Hartline, N., Bruce, N., Karba, S., Rugg, E., Sonar, S., Holden, P., 2016). Synthetic microfibers and plastics attract, and are comprised of, toxic chemicals that are linked to cancer, hormonal imbalances, behavioral and heart problems (Schug, T., Janesick, A., Blumber, B., Heindel, J, 2015), as well as adverse effects on the environment and its inhabitants. In order to reduce the negative impacts of synthetic microfiber pollution we must push the right legislation. We must also urge critical regulation of commercial and residential washing machine industries, as well as the fashion industry as a whole.

##### 19 Saving ‘Pisang Awak’ banana from Panama Wilt using Anaerobic Soil Disinfestation. Natasha Kerr\*, Gerardo Spinelli, Koon-Hui Wang. Department of Plant and Environmental Protection Sciences.

Anaerobic soil disinfestation (ASD) is an eco-friendly soil disinfestation technique achieved by amending a carbon source (rice straw or meal run) into water saturated soil covered by plastic mulch so as to increase anaerobic microbial colonization. Plant pathologists in different parts of the world are documenting ASD as a viable organic approach to combat various soil-borne pathogens. This project investigated the use of ASD using a locally available waste, wheat mill run, against a problematic soil-borne fungus of banana in Hawaii, *Fusarium oxysporum f. sp. cubense* (Foc), that causes Panama wilt disease.

##### 20 Intermicrobial interaction among marine bacteria with Hawaiian bobtail Squid: a model to study complex microbe. Katherine Murphy\*, Koon-Hui Wang. Department of Tropical Plant and Soil Sciences, Department of Plant and Environmental Protection Sciences.

Interactions between microbes play an important role in ocean complex ecosystems. Different relationships between bacteria include mutualistic, parasitic, and commensalism are depending on the host. Symbiotic relationships can be either harmful, helpful, or neutral to the host organisms. The relationship between bacteria and their eukaryotic hosts are complicated, and can be too complex to study when factoring in multipartite interactions among the colonizing microbes. This Department of Plant and Environmental Protection Sciences capstone project explores the complex relationship between marine bacteria and the symbiotic bacteria of Hawaiian bobtail squid to understand how this can interfere with symbiotic relationships in the ocean.

##### 21 Fruit waste don’t waste: using fruits to their full potential. Joanne H. Tong\*, Biyu Wu, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

An increase in consumption of fruits and vegetables may reduce the risk of noncommunicable diseases and certain types of cancer. Therefore, change in human diets has increased the demand for fruits and vegetables production. Unfortunately, this trend has also led to an increase in solid waste. These solid waste, especially fruit waste, are still rich in biodegradable organic ingredients and high in moisture content, which can support microbial growth and fermentation, causing odors and other environmental problems. Exploring the potential application of these biodegradable organic ingredients is critical in sustaining the environment and using fruits to their full potential.

##### 22° Blinded by the light: Impacts of light pollution and other fallout factors on Wedge-tailed Shearwaters along Southern Oahu. Brooke Friswold\*, Keith Swindle, David Hyrenbach, Tiana Bolosan, Melissa Price. Department of Natural Resources and Environmental Management, U.S. Fish and Wildlife Service, Hawaii Pacific University: Department of Oceanography, Division of Forestry and Wildlife.

Seabirds are the most endangered taxonomic group on Earth with 29% of seabird species at some risk of extinction. Seabirds are also top-order predators and imperative to the health of marine ecosystems, making understanding management practices that maximize their conservation extremely important. In the era of the Anthropocene some innate behaviors such as an attraction to light, were once favored by natural selection but now hinder survival under human-modified conditions.

##### 23° Nest Initiation Time and Distance to Water Predict Nesting Success of the Hawaiian Stilt in Wetlands on O‘ahu. Kristen C. Harmon\*, Nathaniel H. Wehr, Melissa R. Price. Department of Natural Resources and Environmental Management.

In temperate waterbirds, early nesters often have higher nesting success than late nesters, but because nesting seasons are typically longer in tropical regions and many birds are year-round residents, tropical waterbirds may lack an early-bird advantage. The Hawaiian stilt, or Ae‘o, is an endangered Hawaiian waterbird that nests in wetlands across O‘ahu. In order to effectively manage nesting habitat for the Hawaiian stilt, it is necessary to examine the relationships between nest-site characteristics, nest initiation time, and nesting success of the Hawaiian stilt.

##### 24° Novel approaches for eradicating the coconut rhinoceros beetle on Oahu, Hawaii. Mason Russo\*, Zhiqiang Cheng, Matthew Kellar, Kelsey Mitsuda, Jing Li. Department of Plant and Environmental Protection Sciences.

The introduction of invasive species has had detrimental effects on island ecosystems due to the susceptibility of the native species to these new threats. Many islands in the Pacific face these problems due to geographic isolation and their climatic suitability for invasive species to establish and thrive. The coconut rhinoceros beetle was detected on Guam and devastated the palm trees on the island. It was accidentally introduced to Hawaii, and an intensive eradication program was set up on Oahu in 2013, after adults and larvae were detected. New research methods have been developed to eradicate this insect.

### Session III—*Food Systems, Security, & Safety*

9:00–10:30 a.m., Campus Center Room 309

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 33 Diagnosing Nutrient Deficiencies in Hawaiian Breadfruit (*Artocarpus altilis*). Kahealani Acosta\*, Noa Lincoln. Department of Tropical Plant and Soil Sciences.

Nutrients consumed from food are dependent on the way these plants are grown. Like humans, plants require nutrients in certain quantities to maintain their health and vigor. Giving plants the necessary ingredients to grow provides abundant, nutritious fruits in local markets and can improve efficiency for farmers. In this experiment, I research the nutrients required by breadfruit for optimal growth and a long, fruitful life.

##### 34 Avian Botulism: Be on the lookout for dead birds! Cody Ching\*, Jenee Odani. Department of Human Nutrition, Food and Animal Sciences.

Botulism is caused by botulinum toxins that are produced by the organism *Clostridium botulinum*. These toxins bind to nerve endings causing paralysis and death. Bacterial spores are common in environments worldwide but only germinate in anaerobic areas. The disease is mainly spread through ingestion of the spores and outbreaks are due to the “carcass-maggot” cycle. In Hawaii, avian botulism has been reported in shovelers, native coots, gallinules, stilts and migratory birds. Unlike the mainland, avian botulism appears to occur year round in Hawaii and has been found on Kauai, Oahu, Molokai, Maui and Hawaii Island.

##### 35 The effects of environmental heat stress on the spleens of broiler chickens. Sabrina Nicole Haverly\*, Sanjeev Wasti, Donna Lee Kuehu, Rajesh Jha, and Birendra Mishra. HFNAS.

The poultry industry is one of the largest sectors of U.S. agriculture and one of the biggest losses of this industry is due to environmental heat stress. To understand the impacts of the heat stress on the broiler chicken’s growth and health, environmental heat stress was mimicked by raising the chickens at 33-35°C (during the day) and 21-22 °C (during the night) for 3 weeks. The results from the stressed and control group (raised at 21-22 °C) were analyzed and it was found that body weight and spleen size were significantly smaller in the chickens that underwent the heat stress.

##### 36 The GLY Clean. Skyland Koizumi\*, Xiaohan Liu, Yong Li, CN Lee. Department of Human Nutrition, Food and Animal Sciences.

Strawberries are one of the most popular berries consumed worldwide. They contain various nutrients and possess potential to lower risks of cardiovascular disease and regulate blood sugar. However, strawberries have also been the culprit of foodborne illness outbreaks. Various decontamination procedures used in the produce industry have either limited antimicrobial effect, high capital cost, or lack of resources. Previous research has shown that the amino acid glycine has antimicrobial effect on bacteria. This study investigated the usage of glycine as a potential sanitizing agent on fresh strawberries inoculated with pathogenic bacteria.

##### 37 Super Small and Super Important: Researching the Interactions between local Copepods and their Phytoplankton Food source. Clarine Phipps\*, Sabrina Haverly. Department of Human Nutrition, Food and Animal Sciences.

Aquaculture is a growing world industry, and making sure that we maximize local production as well as reduce environmental impacts is a notable concern in Hawaii. As Hawaii has a multitude of endangered indigenous species, making sure that we are not introducing possibly dangerous species to the ecosystem is of extreme importance. To ensure that we are as safe as possible, we not only need to think about what we’re feeding to our livestock, but, in the case of live feeds (i.e. copepods for shrimp), what we’re feeding to our feedstuff.

##### 38° Evaluation of superhydrophobic food contact surface to prevent adhesion of *Listeria monocytogenes* for improved food safety. Bog Eum Lee\*, Soojin Jun. Department of Human Nutrition, Food and Animal Sciences.

*Listeria monocytogenes* (*L. monocytogenes*) is a major foodborne pathogen, which causes listeriosis. Prevention of this bacterial adherence and biofilm formation to equipment surfaces is critical to control the foodborne illness outbreak. The study of superhydrophobic (SH) surface has increased exponentially as this material can provide features such as anti-fouling and self-cleanability. The repellency and the applicability of SH surface fabricated by coating nanoporous surface with polytetrafluoroethylene (PTFE) against *L. monocytogenes* should be investigated. The results demonstrated that the SH specimen contributed in lowering the adhesion of *L. monocytogenes* in both static and dynamic flow conditions

##### 39° Where’s the fresh eggs and meat? Improving the Hawai‘i poultry industry through communication and outreach. Kathryn Paradis\*, Jenee Odani. Department of Human Nutrition, Food and Animal Sciences.

Do you enjoy fresh foods? How about fresh eggs and chicken meat? Eggs from the mainland can be anywhere up to eight months old by the time they end up in consumers’ hands, affecting the nutritional value and taste. Unfortunately, the Hawai‘i poultry industry is producing less meat and eggs each year, causing a decline in the fresh, local meat and egg supply. My project aims to reach out to farmers to determine the current state of the poultry industry, identify areas where farmers can make changes to decrease production burdens, and communicate to farmers the findings of my project.

##### 40° Dietary supplementation of dried plum: A novel strategy to mitigate heat stress in poultry. Sanjeev Wasti\*, Donna L. Kuehu, Nirvay Sah, Amit Singh, Rajesh Jha, Birendra Mishra. Department of Human Nutrition, Food and Animal Sciences, Department of Molecular Biosciences and Bioengineering.

With global warming, environmental heat stress has been a significant problem in the poultry industry. Heat stress in poultry leads to increased mortality, reduced body weight, reduced feed intake, poor feed conversion, and increased susceptibility to diseases. Heat stress exerts negative impact on meat and egg production, and quality. Dried plum contains antioxidants along with several vitamins, minerals, and phenolic compounds; thus, can potentially minimize the heat stress when fed to birds. This study evaluated the effectiveness of dried plum as a noble remedy for heat stress in poultry by considering growth performance and gut health parameters.

### Session IV—*Biotechnology*

9:00–10:30 a.m., Campus Center Room 310

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 49 Identifying Genes for Stress Tolerance and Disease Resistance from the Koa Tree. Aaron Kam\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

Koa is an endemic and culturally important timber-wood tree that grows on all major Hawaiian Islands. The main objectives of most Koa improvement programs are to select trees for high quality wood, stress tolerance, and disease resistance. To find those genes responsible for these traits, individual gene sequences (transcriptome) of Koa were compared with those of Giant Leucaena, which is a highly stress tolerant and disease resistant woody Legume tree. Determining these beneficial genes in Koa, that also exist in Giant Leucaena, may lead to the discovery of more desirable genes for use in future koa breeding programs.

##### 50 Design of a Rapid Screening Multi-Diagnostic Device. Jaclyn Lee\*, Brianna Fujita, Kyle Marcelino, Jonathan Suda, Daniel Jenkins. Department of Molecular Biosciences and Bioengineering.

Plant pathogens and food borne illnesses can easily spread across nations due to globalization of food trade. Current testing methods include shipping samples to a laboratory for culturing and phenotypic studies. However, the logistics of sending off samples and waiting for lab results can be costly in terms of time and money and can be especially impactful for small scale farmers or farmers in developing countries. A low-cost and low-power handheld device that can screen for multiple pathogens simultaneously and return results in minutes rather than days or weeks could improve accessibility to safe food and reduce economic loss.

##### 51 WITHDRAWN

##### 52 Homegrown energy: Fuel properties of *Pongamia pinnata*. Sabrina Summers\*, Jinxia Fu, Scott Turn. Hawaii Natural Energy Institute.

Continuing population growth, increasing energy demand, rising fossil fuel prices, and the push for improved environmental policies are thrusting renewable energy into the spotlight. This research investigates the fuel properties of *Pongamia pinnata*, a leguminous, oil seed-bearing tree. Native to humid and tropical environments, Hawaii is an ideal location for production. After oil extraction, pods and seed cake residues remain. Torrefaction, a moderate-temperature, thermochemical treatment process, can modify their physicochemical properties, resulting in improved solid-fuel qualities. Characterizing Pongamia oil and its torrefied coproducts will provide fundamental information needed to develop *Pongamia pinnata* as a renewable energy source in Hawai’i.

##### 53° Protein disulfide isomerase 9 (PDI9) interacts with a critical stress response regulator to protect plants from environmental stress. Rina Carrillo\*. Department of Molecular Biosciences and Bioengineering.

Protein disulfide isomerase-9 (PDI9) catalyzes the formation of disulfide bonds in the endoplasmic reticulum (ER) to functionally stabilize proteins. Environmental stresses such as heat cause cellular proteins to unfold and misfold, which adversely impacts plants if uncontrolled. Levels of PDI9 increase in response to environmental stress through the unfolded protein response (UPR) pathway. We found that Arabidopsis PDI9 binds to a master regulator of the UPR pathway, IRE1. Deciphering the role of PDI9 in modulating UPR stress will promote novel strategies that improve plant tolerance to environmental stress as global temperatures rise.

##### 54° What are we doing to stop the declining population of ‘opihi in O’ahu, Hawai‘i? Bridget Murphy\*. Department of Molecular Biosciences and Bioengineering.

Opihi, (Cellana sps.) native Hawaiian invertebrates, are a highly sought-after food that’s fallen victim to overharvesting. To combat dwindling populations while maintaining ‘opihi as a food source, it is vital to understand the hormones involved in reproduction to successfully develop a spawning model for the purpose of aquaculture application. Gonadotropin-releasing hormone (GnRH) is characterized as a vital hormone inducing vertebrate reproduction and has also been identified in various invertebrate groups, suggesting a common functional role. Isolating GnRH from ‘opihi allows for characterization of the reproductive role GnRH plays in a species dealing with extensive population decline.

##### 55° Examining Biochemical Alterations in LRRK2 as a Key Factor in Parkinson’s Disease Pathogenesis. Thien Phuc Ngoc Nguyen\*, Kiana Lee, Nicholas G. James. Department of Molecular Biosciences and Bioengineering, Department of Cell and Molecular Biology.

Parkinson’s Disease (PD) is a common age-related movement disorder, which affects ~ 2% of the population over 65, with symptoms including resting tremor and rigidity. PD is characterized by degradation of motor neurons within the mid-brain. This process is believed to occur many years prior to the onset of clinical symptoms. Over the past 15 years, numerous genetic links have been associated with PD pathogenesis. Several laboratories have been characterizing these genetic deficits with the hopes of understanding the overall pathway leading to neuronal death. Thereby, determining the molecular marker is critical to understanding its involvement in neurodegeneration in PD.

##### 56° Regulation of Intestinal Nutrient Transporters by the Pituitary Gland in Mozambique Tilapia (*Oreochromis mossambicus*). Cody Petro-Sakuma\*, Fritzie T. Celino-Brady, Andre P. Seale. Department of Human Nutrition, Food and Animal Sciences.

Aquaculture production has taken center stage to supply the rising demands for food. Tilapia, one of the main finfish cultured worldwide, exhibit excellent growth in captivity. Growth is largely regulated by Growth hormone (GH), which is secreted by the pituitary gland. GH promotes growth by stimulating cell proliferation and differentiation as well as nutrient uptake in target tissues. Little is known, however, on how GH affects intestinal nutrient uptake. Using the Mozambique tilapia as a model species, we investigated the effects of surgical pituitary removal and replacement with GH on the intestinal gene expression of amino acid and ion transporters.

### Session V—*Healthy Families & Resilient Communities*

11:00 a.m. –12:30 p.m., Campus Center Room 307

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 9° Nānā i ke Kumu Lāʻau: Native Hawaiian Flora as Medicinal Sources. Rebecca P. Barone\*, Daniel K. Owens. Department of Molecular Biosciences and Bioengineering.

Chronic diseases (e.g., cardiovascular disease, cancer, and stroke) greatly impact communities in Hawaiʻi and worldwide, leading to millions of deaths each year. Though both prevalent and costly to treat, long-term illnesses are also among the most preventable of health concerns. Antioxidants are natural compounds that have been shown to decrease the incidence of chronic disease. Antioxidant-rich plants were utilized by traditional Hawaiian communities as primary sources of medicine. Identifying the bioactive compounds produced by medicinal native plants is crucial to understanding their roles in traditional medicine and for further application in the health and resilience of our communities today.

##### 10° Manganese, a metal that is critical for life but toxic in high concentration, is abundant in the plant-based Ornish diet. Teresa LeMoon\*, Monica Esquivel. Department of Human Nutrition, Food and Animal Sciences.

Manganese (Mn) is a mineral in our diet that is critical for many chemical reactions in the body, including building bone, processing food and immunity to prevent infection. Toxic levels of Mn can cause nerve damage, body tremors, and learning disabilities. This study examined Mn content in plant-based diets and found levels near the upper safe limits for intake. Future research should focus on the consequence of these diets on vulnerable populations, people with heart and liver disease, as well as all long-term plant-based dieters.

##### 11° Effects of Hawaiian-Grown Coffee on Adipocytokines among Healthy Individuals. Nyan Stillwell\*, Pratibha V. Nerurkar, Harry C. Bittenbender. Department of Molecular Biosciences and Bioengineering, Department of Tropical Plant and Soil Sciences.

Epidemiological studies indicate that moderate coffee consumption lowers risk of T2D. Biological effects of coffee are associated with not only caffeine but several other bioactive components that are dependent upon not only the variety but also the origin or location of coffee. Adipocytokines such as adiponectin and leptin are known to regulate glucose and lipid metabolism. An imbalance in circulating levels of adiponectin and leptin can stimulate pro-inflammatory cytokines linked to insulin resistance and type 2 diabetes (T2D). The purpose of this study is to provide insights into the benefits of Hawaii grown coffee on human health.

##### 12° Mauli Ola: Determining Health Impacts of ʻĀina-Based Programs. Riley Wells\*, Anthony K. Sigmund, James Doherty, Christian Dye, Razvan Sultana, Rafael Peres-David, Ruben Juarez, Alika K. Maunakea. John A. Burns School of Medicine: Department of Native Hawaiian Health.

Members of a shared community may influence each other’s actions. In this sense, social networks may influence the development of behaviors that can promote or discourage a healthy lifestyle. There is a disproportionate prevalence of overweight and obesity in the Native Hawaiian community when compared to other racial groups throughout the Hawaiian islands. This prevalence among Native Hawaiian people mirrors that of obesity-related health conditions, including type 2 diabetes mellitus (DM). Understanding the extent to which social influence can affect an individual’s health may facilitate the development of new strategies to mitigate diseases that affect a community as a whole.

#####  13° Optimizing probiotic yeast with prebiotics to enhance their survival in the gastrointestinal tract. Beverly Yuen\*, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Yeast survives better in the gastrointestinal tract than bacteria. Probiotic yeast costs up to 15 times more than probiotic bacteria because fewer species of probiotic yeast have been discovered. Twenty-five tablets of probiotic yeast, *Saccharomyces boulardii* CNCM I-745, is $25 while 120 tablets of probiotic bacteria, Acidophilus, is $7. Studies found yeast survives better in the gastrointestinal tract (GI) than bacteria because of yeast’s adaptive response and tolerance to acidity. Probiotic yeast will be a better and more affordable alternative to probiotic bacteria if they are optimized with prebiotics, and if more probiotic species are discovered.

##### 14° Taro, Probiotics and the Gut Microbiome. Solange Saxby\*, Lee, CN, Kim, YS, Li, Y. Department of Human Nutrition, Food and Animal Sciences.

For thousands of years, cultivation of taro was traditionally used for medicinal practice to treat human ailments. Taro’s high dietary fiber makes it a perfect candidate as a prebiotic. Prebiotics are carbohydrates that are indigestible by the human digestive tract. Dietary prebiotics have been shown to improve gut health by providing nutrients to probiotics, which are microorganisms that promote a healthy gut microbiome. Our daily diet has a huge influence on the health of our gut microbiome. Understanding how taro, in the diet, and the gut microbiome interact expands knowledge of preventative and health properties to improve our overall health.

##### 15° Identifying motivators for program participation and factors contributing to produce choices in a pilot produce prescription (Rx) program. Cherese Shelton\*, Monica Esquivel. Department of Human Nutrition, Food and Animal Sciences.

Fruit and vegetable (FV) consumption is disproportionately lower among individuals in low socio-economic households, increasing their risk for diet-related diseases. In Hawaiʻi, this is evident in a community densely populated by Native Hawaiian and Other Pacific Islanders. Obesity and diet-related diseases in childhood and adulthood are prevalent in this population. A pilot produce prescription (Rx) program was implemented in this community. We evaluated factors affecting (1) participation in the program and (2) FV preferences. Results from this study will be used in the next phase of this program, as we work towards building healthier families and resilient communities in Hawaiʻi.

##### 16° Enhancing Agricultural Productivity, Poverty Reduction and Improving Food Security: A Case of Potato Cultivation in Western Guatemala. Rupananda Widanage\*, Catherine Chan. Department of Natural Resources and Environmental Management.

Poverty, food insecurity, child malnutrition, and unequal income distribution are some of the major socio-economic problems in rural Guatemala. Though Guatemalan economy records a moderate economic growth, poverty, income inequality, and food insecurity remain at a very high level. Existing data reveal that there is a high correlation between low potato productivity and poverty in Guatemala. The findings of this paper provide policy insights for formulating a rural development strategy which, enhances productivity through improving technical efficiency in potato farming. It is our opinion that such a development strategy will assist poverty reduction and improving food security among potato farmers.

### Session VI—*Sustainability & Conservation*

11:00 a.m. –12:30 p.m., Campus Center Room 308

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 25° Towards a Hawaiʻi Soil Health Index: Identifying Sensitive and Practical Indicators of Change Across Land Use and Soil Diversity. Hannah Hubanks\*, Susan Crow, Jonathan Deenik. Department of Natural Resources and Environmental Management, Department of Tropical Plant and Soil Sciences.

More than a century of intensive agriculture left much of the formerly productive Hawaiian soil in a degraded state, which currently exists as a diverse landscape of various land use and management. Soil is an important natural resource and in order to preserve it and prevent further degradation, a method for quantitatively assessing and tracking change in Hawaiʻi soil health must be developed. We identified the most sensitive indicators of change in soil health, to be developed into a soil health assessment system optimized for integration among land managers, farmers, policy, and landscape resilience plans in Hawaiʻi.

##### 26° Interactive feedbacks of climate, mineralogy and microbiological communities on soil carbon: A deep soil warming experiment. Casey McGrath\*, Nhu Nguyen, Brian Glazer, Stanley Lio, Caitlin Pries, Mathilde Duvallet, Susan Crow. Department of Natural Resources and Environmental Management, Dartmouth College, AgroParisTech.

Soils with high potential to drawdown carbon from the atmosphere could aid in the preservation of global ecosystems while longterm solutions to climate change are enacted, particularly in volcanically-derived soils, called Andisols, found across the Hawaiian Islands. Utilizing a novel temperature sensor system, this study focuses on how the rapid increase in global temperature from climate change may affect carbon protection mechanisms within the depth profile of a Hawaiian Andisol, through a soil warming experiment. After several months of warming, the amount of carbon released from the soil did not increase after intensified warming at depth.

##### 27° Turning waste into resources: Anaerobic digestate’s potential as a biofertilizer in Hawaii. Jacqueline Pitts\*, Jonathan Deenik, Nhu Nguyen, Samir Khanal. Department of Tropical Plant and Soil Sciences, Department of Molecular Biosciences and Bioengineering.

The demand for locally produced food continues to rise both nationally and in the state of Hawaii. However, the Hawaiian Islands face unique challenges in increasing production to meet this demand largely due to the cost and difficulty of importing fertilizers, fuel and seeds for agriculture. Increasing availability of locally made fertilizers and products that improve plant growth can help offset some of the higher costs of agriculture in Hawaii in order to meet increasing demands. This research investigates the use of digestate, a byproduct from energy production, as a potential biofertilizer. Preliminary results showed that digestate may reduce fertilizer use by half, thus increasing its value as a soil amendment in Hawaiian agriculture.

##### 28° Effects of Whole Soil Inoculation on the Translocation of the Endangered Plant, *Cyrtandra kaulantha*. Pia Ruisi-Besares\*, Carl I. Evensen, Rakan Zahawi, Tamara Ticktin. Department of Natural Resources and Environmental Management, Department of Botany.

The majority of Hawaiian flora require systematic restoration to survive in the wild, however, optimal growth conditions for many of these species are relatively unknown. Because reference sites are frequently degraded, ex situ studies need to be conducted to identify specific habitat preferences for threatened species prior to outplanting. We chose the critically endangered species, *Cyrtandra kaulantha*, to test the effect of local soil inoculation in the greenhouse on outplanting and restoration success. Differences in soil microbial communities by region may impact the success of outplantings based on the formation of beneficial relationships. Understanding these interactions can help inform cultivation and restoration practices.

##### 29° Environmental Conditions For Obtaining The Most Nutritious Fodder From Giant Leucaena. Ahmed Bageel\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

Giant leucaena (*Leucaena leucocephala subsp. glabrata*) is an important forage legume because of its high nutritive value, easy cultivation and resistance to biotic and abiotic stresses. However, the limiting factor for the use of leucaena as a fodder is the presence of two secondary metabolites, mimosine and tannin. The concentration of these two metabolites may vary under different environmental conditions. The objective of this research is to identify the optimum environmental conditions where leucaena’s digestible energy is increased, nutritive values are maintained and the contents of mimosine and tannin are reduced below toxic levels.

##### 30° You are what you eat: Modulation of the intestinal histology and microbiome using microalgae as a fishmeal/fish oil replacement in the diets of tilapia. Alyssa MacDonald\*, Rajesh Jha, Armando Garcia-Ortega. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences, University of Hawai'i at Hilo.

The aquaculture industry has been exploring alternative protein and lipid sources for aquaculture feed to reduce costs and promote sustainability. Microalgae is a desirable feed ingredient because it is grown in high volume and can be selected for high levels of protein and lipids. Additionally, microalgae have been recently explored as a prebiotic to promote the health of fish species through the modulation of the intestinal microbiota. This study investigated the use of microalgae as fishmeal and fish oil replacements and its effect on the intestinal histology and microbiota of hybrid tilapia (*O. niloticus × O. mossambicus*).

##### 31° Strawberry Guava as a Source of Natural Herbicides: Utilizing the Chemical Warfare Capacity of an Invasive Species for Human Benefit. Joey Ooka\*, Daniel K Owens. Department of Molecular Biosciences and Bioengineering.

While hiking on trails across Hawai’i, it is very common to encounter thickets of strawberry guava trees. They are attractive plants characterized by multicolored bark, tasty red or yellow fruit, and shade producing characteristics. However, they are also invasive species originating from Brazil that threaten native Hawaiian plant species. We have shown that strawberry guava is in ongoing chemical warfare. It produces chemicals that inhibit the growth of plants around it preventing competition for resources. Although these chemicals are detrimental to native plants, we plan to identify and use them to human advantage as natural herbicides for agricultural use.

##### 32° Below ground battle: Does biofumigation have non-target impacts on soil health promoting free-living nematodes? Philip Waisen\*, Koon-Hui Wang, Zhiqiang Cheng, Brent Sipes. Department of Plant and Environmental Protection Sciences.

Biofumigation is an environmentally friendly method to manage soil-borne agricultural pests using brassica plant-derived toxin, isothiocyanates (ITCs). ITCs are produced when brassica plant tissues are damaged giving the pungent smell. Tissue damage activates myrosinase (Myr) enzyme to degrade natural plant compound called glucosinolate to release ITCs. However, ITCs are similar to methyl ITC, the active ingredient in metam sodium (Vapam®), a biocidal soil fumigant. Thus, effects of biofumigation on non-target free-living nematodes that play important role in soil nutrient cycling is a concern. This project evaluates the impact of biofumigation on targeted and non-target nematodes in a zucchini cropping system.

### Session VII—*Food Systems, Security, & Safety*

11:00 a.m. –12:30 p.m., Campus Center Room 309

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 41° Potential in Organic Sweet Potato (U’ala) derived from Hawaiian Germplasm. Todd Anderson\*, Michael Kantar, Theodore Radovich, John Paul Bingham. Department of Tropical Plant and Soil Sciences.

Sweet Potato has been a crop in Hawaii since Polynesian settlers first came to the Islands. However, traditional Hawaiian germplasm has rarely been used for breeding. The focus of this project is explore the genetic potential of crosses within the traditional Hawaiian germplasm. Twelve experimental lines descended from the maternal parent Mohihi, and two check lines (Mohihi and Okinawa) for a total of fourteen entries will be grown in a randomized complete block in Waimanalo (Waialua series) and Pomoho (Wahiawa series) in two different seasons for a total of four environments. In order to identify superior lines phenotypic data on yield, sugar content, carbohydrate content, taste, and utility as a feedstock for fermentation will be measured. The ultimate goal is to produce a new commercial varieties that will provide local growers with a price premium for fresh market potatoes due to the known Hawaiian lineage.

##### 42° Hawaiian Sheep and Goats at Risk: Identification of Small Ruminant Parasites and Diseases in Conjunction with Farm Management Practices throughout Hawai’i. Nathan Heinzman\*. Department of Human Nutrition, Food and Animal Sciences.

Sheep and goats are commonly raised for meat, dairy, and land management throughout the state of Hawai’i. Small ruminants play a growing role in the Hawaiian agriculture system. However, there is currently a major gap in knowledge regarding what sorts of practices producers in Hawai’i are using to raise their animals. Additionally, little is known about the current level of infection of pathogens such as Johnes Disease, Caprine Arthritis Encephalitis/Ovine Progressive Pneumonia, and Caseous Lymphadenitis, as well as internal strongylid and coccidia parasite loads. Filling this major gap in knowledge is crucial to successful management of small ruminants in Hawai’i.

##### 43° Characterizing soil-water relations to improve irrigation practices in Hawaiʻi’s agricultural systems. Kristy Lam\*, Jonathan Deenik, Sayed Bateni, Yin-Phan Tsang. Department of Natural Resources and Environmental Management, Department of Tropical Plant and Soil Sciences, Department of Civil and Environmental Engineering.

The global population is increasing and so is food demand. Agricultural systems in the United States currently use about 90% of the nation’s fresh water to keep up with this increasing food demand (USDA, 2018). However, over- and under-irrigation of crops cause inefficiencies in irrigation practices. In order to increase water use efficiency and ensure food security for future generations, Hawaiʻi’s agricultural systems must adapt irrigation management tools which recommend irrigation schedules based on soil characteristics. Therefore, it is imperative to understand the specific soil properties that govern soil water dynamics in Hawaiʻi’s tropical soils.

##### 44° Comparison of the Antimicrobial Activities of Ohelo Berry and Cranberry. Xiaohan Liu\*, Stuart Nakamoto, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Ohelo berry is a Hawaiian wild relative of cranberry. This study aimed to determine and compare the polyphenolic contents and antimicrobial activities of ohelo berry and cranberry. The results indicated that ohelo berry has higher total phenolic contents than cranberry. The antimicrobial activities of ohelo berry extract were comparable or even stronger on some pathogens than cranberry extract. Additionally, the pathogenic bacteria were still inhibited by neutralized ohelo berry extract. But the extract did not affect tested probiotic bacteria. This study demonstrated the potential of ohelo berry as a healthy food and as a natural preservative.

##### 45° Eat to Live: a look into breadfruit nutritional qualities impacted by unique environment. Amber Needham\*, Noa Lincoln. Department of Tropical Plant and Soil Sciences.

Breadfruit (*Artocarpus altilis*) is a highly productive food crop that has become a trending topic in the conversations of hunger mitigation and human nutrition. Several Pacific nations have relied on this fruit for over a millenium, and others are now incorporating it into their cultivation practices and diets throughout the global tropics. As the crop continues to gain momentum as a tool to aid in food security, health, and well-being, it is important to better understand its growing habits in different conditions as well as how unique micro-climates will affect its nutritional content.

##### 46° Save the Vegetable, Implementation of Sanitizing Washes to Reduce Microbes on Watercress. Yen Nguyen\*, Jensen Y. Uyeda, Yong Li. Department of Human Nutrition, Food and Animal Sciences, Department of Tropical Plant and Soil Sciences.

Food contaminated by pathogenic microorganisms is a major concern with consumers and in the food industry. The CDC reports 48 million people are sick with foodborne illnesses in the US every year. *Escherichia coli*, *Listeria monocytogenes*, and *Salmonella spp*. are common foodborne pathogens known to cause vomiting, diarrhea, and at times even death. Leafy greens such as salads are highly risky because they are commonly eaten raw. In order to minimize the risk of foodborne diseases, sanitizing washes are implemented to effectively reduce microbial growth on fresh produce and extend their shelf life.

##### 47° Aqueous chlorine dioxide (ClO2) as a health friendly sanitizer to decontaminate foodborne pathogens on fresh papaya. Lianger Dong\*, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Each year, over 20 million pounds of papayas are produced, which make the third most produced agricultural commodity in Hawaii. However, concerns have been rising regarding the microbiological safety of fresh papayas. CDC reported four outbreaks of Salmonella on papayas in 2017, which caused at least 79 hospitalizations and 2 deaths. Chlorine dioxide (ClO2) is an FDA-approved fresh produce washing agent. Compare to conventional bleach, ClO2 has more oxidizing power and produces less cancerogenic compounds when reacted with organic matter. Washing papaya with ClO2 may reduce the risk of microbial contamination.

##### 48° Mimosine produced by *Leucaena leucocephala* may help plants grow in alkaline soils by facilitating mineral uptake. Michael Honda\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

Roughly 30% of the world’s available croplands contain soils that are too alkaline for efficient crop production. Alkaline soils cause important soil minerals, like iron and zinc to become insoluble and inaccessible to plants. *Leucaena leucocephala (*leucaena*)* is a tree-legume that has the unique ability to thrive in alkaline soils. Determining the mechanism that allows leucaena to grow in alkaline soils may provide information that can be used to help grow other important food-crops in alkaline soils. Utilizing the alkaline croplands of the world can enhance global food production and help to feed the rapidly increasing human population.

### Session VIII—*Biotechnology*

11:00 a.m. –12:30 p.m., Campus Center Room 310

(\* designates primary presenter, ° designates graduate student)

##### No. Title, Authors, Summary

##### 57° Fresh turmeric, but how much curcumin? Justin Calpito\*, Theodore Radovich, Jon-Paul Bingham. Department of Human Nutrition, Food and Animal Sciences, Department of Tropical Plant and Soil Sciences, Department of Molecular Biosciences and Bioengineering.

Turmeric has a long history in the Hawaiian Islands, having originally been brought over and cultivated for medicinal and ceremonial use by the Hawaiian people. Today, the global demand for “functional foods”, or foods fortified with health-promoting ingredients, has sparked a resurgence of turmeric cultivation and use in Hawaii. Our climate and soils are suitable for farming turmeric, as demonstrated centuries ago, but the content of the major health component in turmeric, curcumin, remains unknown. A high-accuracy chemical analysis has been designed to evaluate Hawaii’s turmeric and a color chart has been derived for rapid curcumin estimation.

##### 58° The Flavonoid Metabolon: Organization of a Metabolic Factory in Orange (*Citrus sinensis*). David Knittel\*, Lexus Porter, Daniel K Owens. Department of Molecular Biosciences and Bioengineering.

Metabolons are molecular factories within a cell that provide protection from damaging chemicals, increase biosynthetic rates, and impact end-product accumulation. Flavonoids are a large class of plant natural products known to be synthesized by a metabolon in the model plant Arabidopsis. They exhibit a wide variety of uses such as increasing agricultural yield, protecting plants against pests, and having medicinal benefits. Flavonoids also have a direct influence on taste characteristics in citrus. I am establishing the nature of the flavonoid metabolon in an agriculturally significant species, orange (*Citrus sinensis*), to examine its impacts on flavonoid accumulation and resulting plant attributes.

##### 59° Enhancing food safety using a highly specific and ultra-sensitive detection method. Biyu Wu\*, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Foodborne illness is an infection or intoxication that results from eating food contaminated by viruses, microorganisms, parasites, and toxic chemicals. The Center for Disease Control and Prevention estimates that 1 in 6 Americans gets illness from contaminated foods or beverages each year, and 3,000 die. *Campylobacter jejuni* and *Salmonella* are the leading causes of foodborne illnesses in Hawaii, where the reported number are 750 and 300 cases each year, respectively. Food contamination by pathogens has become such a serious public health problem that a rapid and sensitive detection method is of significance for enhancing food safety.

##### 60° Role of Long non-coding RNAs in Ovarian Cancer. Yuanyuan Fu\*, Herbert Yu, Wei Jia, Zhanwei Wang, Yi Shen, Harvey A. Risch, Lingeng Lu, Nicoletta Biglia, Emilie Marion Canuto, Dionyssios Katsaros. Department of Molecular Biosciences and Bioengineering, University of Hawaii Cancer Center, Yale School of Public Health, University of Turin.

Ovarian cancer is the most lethal gynecological malignancy in United State. Currently no reliable markers are available to predict ovarian cancer outcome and treatment response. Emerging evidences have suggested that long noncoding RNAs (lncRNAs) are involved in this disease development and progression, which may provide new prognostic and therapeutic opportunities. Our study showed that tumor expression of three lncRNAs differed significantly by tumor grade and disease stage. High expression of these lncRNAs were associated with more favorable overall survival of ovarian cancer. Our findings indicated these lncRNAs can serve as potential molecular biomarkers for prognosis and treatment in ovarian cancer.

##### 61° Inhibition of ice nucleation in beef steaks by an oscillating magnetic field for supercooling preservation. Taiyoung Kang\*, Sean Francis, Youngsang You, Soojin Jun. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences.

Application of an oscillating magnetic field (OMF) has attracted considerable interests in the food preservation industry because the OMF seems capable of preventing ice formation at subzero temperatures; however, the precise mechanism is not well understood. The experimental results showed that the OMF induced mechanical rotations of ferromagnetic materials in water, which might lead to inhibition of ice nucleation. This concept was applied for the subzero nonfreezing storage of beef steaks. The beef steaks stored at -4°C without ice crystal formation maintained their quality for a prolonged period with no significant changes in drip loss and color.

##### 62° Heat Stress Impacts the Health of the Laying Hen Through Altering the Regulation of Heat Shock and Reactive Oxidative Stress Genes in the Liver. Donna Lee Kuehu\*, Nirvay Sah, Chin N. Lee, Rajesh Jha, Birendra Mishra. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences.

Heat stress is one of the most challenging environmental stressors to the livestock industry known to have a negative impact on the laying hen’s reproductive health, egg production and qualities. To understand the mechanism by which heat stress exerts its biological effects on the liver, this study aimed to determine 1) the effect of heat stress on the liver health, and 2) expression of the heat stress and oxidative stress related genes (thermal neutral vs heat stressed).

##### 63° Distributional patterns and variation in the microbiome of *Aedes albopictus* (Diptera Culicidae) on Maui, Hawai‘i. Priscilla Seabourn\*, Helen Spafford, Matthew Medeiros. Department of Plant and Environmental Protection Sciences, Pacific Biosciences Research Center.

Mosquito-borne diseases present a global threat to public health and wildlife conservation. The mosquito microbiome has dramatic effects on the ability of mosquito populations to transmit disease but is understudied in *Aedes albopictus*, a dominant mosquito present in Hawai’i. Our study of *A. albopictus* microbiome on the island of Maui indicates variation in distribution of the mosquito and the microbiome over time and across the island. There is an urgent need to develop new and innovative strategies to suppress mosquito-borne disease transmission, and understanding the microbiome in local populations will aid in developing tools to manage these invasive insects.

##### 64° A Novel Luminescent Reporter Enables Characterization of *Flavivirus* Non-structural Protein Interactions in Live Cells. Alanna Tseng\*, Vivek Nerurkar, Pakieli Kaufusi. Department of Molecular Biosciences and Bioengineering, Department of Tropical Medicine, Medical Microbiology and Pharmacology.

*Flaviviruses*, such as West Nile virus (WNV) and Zika virus (ZIKV), pose an enormous threat to global public health. These mosquito-borne viruses can cause debilitating brain diseases and in the case of ZIKV, infections during pregnancy can cause microcephaly, a potentially fatal congenital brain condition. The increasing prevalence of these infections combined with the absence of clinically-approved therapeutics necessitates the development of novel antivirals. Utilizing new strategies to examine how these *flaviviruses* replicate in infected cells and which viral protein interactions contribute to virus replication will contribute to our understanding on *flavivirus* neuropathogenesis and provide new avenues for effective treatment.

## Articles

(\*designates primary presenter)

**(1) Making healthier whole wheat cinnamon rolls using banana blossom powder, a by-product in the banana crop industry**. Alan Martin\*, Beverly Yuen, Xiaohan Liu, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Cinnamon rolls lack health benefits such as antioxidants and dietary fiber, yet they are a tasty morning pastry. Current trends show that there has been an increase in consumer dietary needs for healthier alternatives. Banana blossom is an edible flower. It is considered to be a by-product of the banana tree, and studies claim that it contains significant amount of antioxidants, antimicrobial properties, and dietary fiber. However, there are very few studies with the incorporation of banana blossom as a food ingredient and its possible health benefits. Creating a new formula for cinnamon rolls to increase their health benefits using locally grown banana blossom is a novel approach for product development and sustainability.

The goal of this study was to assess the potential of utilizing a by-product, banana blossom, to increase health benefits in baked goods. This study incorporated banana blossom powder (BBP) in cinnamon rolls at concentrations of 0%, 10%, and 20% of total flour weight in the dough formula, and testing was done over the course of 21 days. To better understand the functionality of banana blossom as a food ingredient, shelf life, phenolic content, and antioxidant tests were conducted. A sensory evaluation study was also organized to test consumer acceptability of the product based on flavor, taste, and overall appearance.

Results have shown that the samples were ideal for some spoilage bacterial growth with increased moisture retention. Yet cinnamon rolls incorporated with BBP exhibited some antimicrobial properties compared to the plain cinnamon rolls. The samples displayed a decrease in organism growth with increasing BBP concentrations. The amount of phenolics in BBP displayed increased values in the samples and had antioxidant potential in contrast to plain cinnamon rolls. BBP extracts also exhibited inhibition against *Escherichia coli* and *Staphylococcus aureus*. But it was not effective against *Lactobacillus rhamnosus* GG (LGG), a probiotic bacteria. Overall, this study shows that there is potential of increased health benefits with the incorporation of BBP in cinnamon rolls or baked goods in general.

The strive to increase health benefits in food items while taking a sustainable approach in the culinary world is an ongoing effort. As current trends lean towards a more functional food diet, the utilization of by-products in agriculture is a novel approach to achieve these goals. Continued studies of using banana blossom in food can potentially increase health benefits and enhance sustainability in the banana crop industry in Hawaii.

(2) Sugar-free, Vegan Gummies to Aid in the Prevention of Tooth Decay. Bridgette Young\*, Yen Nguyen, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

One of the largest barriers to obtaining adequate dental healthcare in Hawai‛i is the lack of oral health awareness combined with a diet high in sugar and acid. Researchers have been looking for risk factors that can help predict the development of tooth decay and then implement appropriate preventive measures. This study addresses diet as a risk factor and proposes an oral probiotic gummy candy as a preventive measure.

Gummy candies are an ideal food product for experimentation because they are simple enough to avoid some of the complexity inherent in biological systems, but are still real food products. Agar was chosen, as opposed to gelatin, for the base of the gummy to be inclusive of those who may have animal-based dietary restrictions (e.g., veganism). Xylitol is a naturally occurring sweetener that has been proven effective against dental caries. Sugar, in the form of sucrose, was used as a control. The functionality of these ingredients was addressed to ensure that the gummy would have a breadth of potential consumers.

A well-researched strain of lactic acid bacteria, *Lactobacillus lactis* (LL), has been shown to inhibit the growth of oral pathogens through the production of antimicrobial substances, called bacteriocins, which can reduce the risk of the development of dental caries. Another well-characterized probiotic strain is *Lactobacillus rhamnosus* GG (LGG). There is evidence to support the *lactobacilli* species as having a synergistic effect that enables them to prevent the colonization of pathogenic bacteria.

A successful probiotic must be able to survive and retain an appropriate concentration in the food product over time. The suggested optimal concentration is between 10^6 and 10^8 cells. However, the most suitable dosage for oral health purposes has not been well defined. In this study, a gummy candy was created using six different combinations of agar, a sweetener, and a probiotic. A quantitative comparison was conducted through plate count method on days 0, 2, 4, 6, and 12. Results showed that a combination of LGG with xylitol had the most probiotic survival over time, while a combination of LL and sucrose had the least survival. A gummy containing LGG and xylitol has the best potential to be used as a preventative dietary method.

In addition, four different combinations of LGG, LL, and xylitol were tested against saliva samples from five individuals with a history of caries. Results showed that all four combinations were successful in reducing the number of bacteria when quantitatively compared to a control of non-treated saliva samples. The combination of LGG with LL had the most reduced bacteria counts, indicating a synergistic effect could occur between these two probiotic strains that helps to reduce oral bacteria. These results reinforce the ability of LGG, LL, and xylitol to survive in and enhance the oral microbiome. They can be considered effective ingredients in an oral probiotic gummy.

(3) Hemp for Health. Savana Lendrum\*. Department of Family and Consumer Sciences.

Hemp is a plant that has strong historical significance here in the United States, and it is believed to be one of the first cultivated crops around the world. It has been proven that the founding fathers of this nation relied heavily on the use and cultivation of hemp due to the fact that the earliest versions of the Declaration of Independence were crafted on paper made of this very fiber. It would have been assumed that the U.S. is a country that is beyond supportive of this plant; however, only recently did the laws portray so. Up until this past December, hemp was considered a schedule one drug, making any and all cultivation, transportation, and possession of the material to be a crime. At the time this personal research began, growth and possession of this plant was still highly illegal; however, the 2018 Farm Bill changed the game for everyone.

Hemp fibers are considered to be one of the most sustainable fibers for the fashion industry for many reasons. This plant requires about half the amount of space and water to yield relatively the same amount of the fiber as cotton. Because of the nature of the plant, hemp does not require the use of pesticides or GMOs, thus allowing it to be hypoallergenic. It is believed that, if hemp is allowed to grow in abundance, the greenhouse effect on our environment can begin to be reversed by filtering out the greenhouse gases and toxins in the air. Unlike most cash crops, hemp works to replenish the nutrients back into the soil and this in turn helps to sustain the future of the land. When turning hemp into a useable fiber for textile production, there is little to no toxic byproduct, whereas some synthetic fibers produce sulfuric acid and other gases that contribute to lung cancers and other respiratory related illnesses, as well as severely harm the environment. Because the skin is the body’s largest organ, all substances placed on the skin are absorbed. When fabrics are worn, the harmful chemicals that are residing on the garment ultimately seep into the skin of that person; however, this does not happen with a natural hemp garment.

Since the passing of the Farm Bill, there has been a dramatic increase in the nation wide consumption and demand for this material. Hemp is most commonly used today in the form of CBD extracts within the health and wellness industry; however, once this constituent is extracted from the plant, the remaining fibers can provide a wide range of textile-based products. It is important that the fashion industry strives to change the way the public views hemp clothing and bring a contemporary spin on the potential of this textile. This industry must encourage companies to use this textile in manufacturing as well as using consumers to purchase garments made this way. If this is successful, the fashion industry could make a huge difference to help ensure the longevity of our mother earth."

(4) An Exhibition Case Study: Romeo and Juliet. Nara Nellis\*. Department of Family and Consumer Sciences.

The tragic romance of Romeo and Juliet sparks the imagination with its dramatic scenes and descriptive poetry. Written around 1595 by the author Shakespeare, the play and its characters have been long standing icons in the western world’s perception of love. In seeking to do an exhibition for the Costume Collection Museum Management class, Romeo and Juliet became the inspiration for the exhibition just as it has been an inspiration for many others who have come before. UH Manoa’s Costume Collection has an archive of over 13,000 articles and has been in existence since the 1960’s. The artifacts in this collection span from the 1800’s to present day. The Costume Collection’s purpose is to archive clothing articles and preserve them for study and for use as educational sources. This supplied extensive resources to allow for the re-interpretation of Romeo and Juliet as an inspirational source.

Interpreting these characters involved searching through the archive to find artifacts which for one reason or another spoke in the voice of either Romeo or Juliet. This means that the items chosen were not necessarily Shakespearean era appropriate, but were able to tell the story of the star-crossed lovers in their own way. Some items used that were era appropriate in looks were replicas or pieces inspired by the era. Other pieces used were reflective of more contemporary times. Artifacts from the 50’s, 60’s, 70’s, and 90’s were used as well as pieces from a multicultural background.

The exhibition itself was composed of thirteen artifacts sourced from the archive of the UHM Costume Collections. The archive was combed for pieces that best represented an image of Romeo and Juliet, and all selected articles were installed in dress forms in the Miller Hall Room 112 as a temporary exhibit for 2 weeks. This entailed configuring the room into a pop-up museum, including installing appropriate display fixtures. Each piece had descriptive plaques about why said piece was chosen and what was special about the artifact. These artifacts were not limited to one gender of garments. Both women’s and men’s pieces were chosen to fit theme of “Romeo and Juliet” to reflect the original romance, but to allow continuation of the story into different settings. Fabric structures, silhouette and colors are major characteristics looked at to form the outfits represented in the exhibit. Embellishments of prints, laces, embroidery, crochet, and fancy buttons (notions) were all used to reinforce the concept of romantic pieces.

The clothing chosen reflected different aspects of daily life. The styled artifacts range from day to evening wear and casual to special occasion. Examples of special occasion pieces are the white shift dress with angel wings and the cream silk wedding dress that had sheer and opaque contrasting design.

(5) Sekoya: Ethically made clothing for women on the go. Kaycee Yoshioka\*. Department of Family and Consumer Sciences.

The fashion industry is notorious for their unethical business practices. Sweatshops, pollution, animal cruelty, and design plagiarism are all negative impacts that society notes them for. Yet the way that these big fashion conglomerates mass produce has not changed much over the years. Not enough of these companies are considering the price that people and the environment pay. However this may all change, as more and more consumers are demanding products that are ethically and sustainably made. With the shift in consumer buying habits, businesses will be forced to adopt better practices or risk losing sales to competitors who can fulfill their needs.

Consumers are developing increasing awareness of such poor activities and are slowly changing their buying habits to reflect a more ethical and sustainable lifestyle. According to a study done by Nielson (2015), 66% of global consumers are willing to pay more for sustainable products. In another study done by Kimeldorf, Meyer, Prasad, and Robinson (2013), 30% of customers were willing to pay more for a sweatshop-free product. This change in consumer buying habits is reflected in the fashion and beauty industry, where businesses that provide cruelty-free, sweatshop-free, and sustainable products are growing. Customers want a guiltless product and the intangible benefit of supporting a worthy cause.

To support such a movement, Sekoya, an online clothing store, was conceptualized to provide an ethically-made and eco-friendly clothing option for women on the go. Our goal is to provide an alternative to fast-fashion by creating well-made garments that are made of eco-friendly, cruelty-free fabrics. For years, big brands have been pushing out new products at an unsustainable pace to keep up with changing fashion trends. For this reason, garments are made cheaply (making them prone to tears, holes, and other damages) with the expectation that they will be thrown out in a year or even less. However, this leads to landfills of wasted clothing, some of which are not biodegradable since they are made of synthetic fibers, another form of plastic. In response, our clothes will be well made with the intention to provide a durable product that will withstand many years. Manufacturing will be done in the USA for better control and monitoring and because of the better workplace safety and labor laws. Additionally, we will be using only natural fibers, so all clothes will be biodegradable once its life cycle has come to an end. Lastly, our garments will be made in a classic style with a twist. By providing timeless pieces, customers can continue to use our goods even when trends come and go and by adding our own unique spin, we can attract customers who still want to be fashion forward. We believe that consumers hold the power to change and by educating our customers and providing accessible alternatives to fast fashion we can make a positive impact on our environment and community.

(6) Give natives a chance: Morphological Characterization of Six Accessions of Pa'uohi'iaka (Jacquemontia sandwicensis) to Identify Selections for Hanging Basket Use. Darel Kenth Antesco\*, Orville C. Baldos. Department of Tropical Plant and Soil Sciences.

The proliferation of invasive plants in agricultural land and in natural areas is a major concern in Hawaii. These non-native plants can outcompete with native species in their natural habitat, alter ecosystem services such as water quality and availability, and become pests in agriculture. The horticulture industry is a known pathway for the introduction and spread of invasive species. A number of plants that have become invasive in Hawaii were introduced as ornamentals. To minimize the use of invasive and potentially invasive ornamental plants, the state legislated laws requiring the use of native plants in publicly funded landscaping projects (Acts 73 and 236). In 2015, this law was revised to increase the footprint of native plants in landscaping projects from 10% in 2019 to 35% by 2030. While these efforts promote the use of native Hawaiian plants in urban landscaping, lack of availability and variety, and limited knowledge on plant use continue to be major constraints. Identifying new selections of and developing new uses for native Hawaiian plants can help alleviate this problem.

Pa’uohi’iaka (Jacquemontia sandwicensis) is a common, coastal, native plant belonging to the morning glory family. It has been used as a ground cover in landscaping and has potential use as a hanging basket/container plant. Morphological variations exist in the wild, but these have not been collected and evaluated for ornamental use. The goal of this study is to document morphological characters of six accessions of Pa'uohi'iaka and use this information to evaluate their potential as a hanging basket/container plant.

Stem cuttings of Pa’uohi’iaka collected from Maui (Puhala Bay, McGregor, and Ahihi-Kinau via Maui Nui Botanical Garden), Hawaii (South Point) and Oahu (Shidler College [acultivated accession] and Lyon Arboretum [a seed bank accession from Leeward Community College]) were used to grow mother plants at the Magoon Research Station. Cuttings from mother plants of each accession were collected, rooted and potted up. Plants were grown for two months and then pruned to 10.16 cm (4.0 in) from the base to encourage lateral branching. One month after pruning, quantitative and qualitative characters were recorded. Results indicate that each accession can be easily distinguished based on a distinct set of morphological characters. McGregor, Puhala Bay and South Point plants exhibited leaf pubescence whereas Ahihi-Kinau, Lyon Arboretum (LCC) and Shidler College were glabrous or non-pubescent. In terms of flower color, Lyon Arboretum (LCC), McGregor and South Point possess white flowers (RHS White Group N155A). Puhala and Shidler College have a violet-blue flowers (RHS Violet-Blue Group 91B) while Ahihi-Kinau has a slightly pale violet-blue flower (RHS Violet-Blue Group 91C). Based on quantitative and qualitative characters, Lyon Arboretum (LCC), Puhala Bay and South Point were selected as promising accessions for hanging basket/container plant use. Further studies on cutting propagation and response to pinching is recommended to develop protocols for nursery production.

(7) Plant Solubilization of Metals: Production and Purification of Nicotianamine. James Carrillo\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

As sessile organisms, plants have adapted a variety of methods to be flexible in times of scarcity. Maintaining a balanced metal micronutrient content can be a challenge because plant health can suffer from deficiency as well as excess. Acquiring metals, especially iron, from soil is challenging as they are mostly insoluble and not bioavailable. Once supplied to developing tissue, excess metals must be safely stored in a nonreactive environment. The matter of transport, from the root system to a seed, is made possible by nicotianamine. Iron, nickel and zinc strongly rely on the metal chelating properties of nicotianamine to chaperone them cell-to-cell and maintain solubility.

There is still much work in understanding metal homeostasis in plants, especially in work to increase micromineral content of food crops. Iron deficiency anemia remains a worldwide issue affecting 15-20% of the world population. The practical applications in understanding and improving plant metal acquisition is not limited to human nutrition. In contaminated soils or urban settings, metal tolerant plant varieties may be a requirement for growth. Such traits may allow for resistant food crops to be grown in a toxic environment or for a nonfood crop to abstract contaminating metals from soil. Nicotianamine synthesis is strongly affected by the metal requirements of plants. Whether there is a scarcity or an abundance of metallic ions, generally nicotianamine synthesis is increased to facilitate the mobilization and distribution throughout the plant.

Nicotianamine is synthesized from three molecules of S-adenosylmethionine by the enzyme nicotianamine synthase. The gene for nicotianamine synthase from *Leucaena leucocephala* has been cloned into the expression vector pET39b so to produce the enzyme using Escherichia coli. Recombinant production using E. coli allows for quick production, high production, and easily purifiable enzyme. Once pure, enzyme characteristics and activity can be studied and nicotianamine production can be optimized.

High pressure liquid chromatography allows for the detection, quantification and purification of nicotianamine. Amino-acid derivatization using o-phthalaldehyde and nicotianamine is performed to produce a fluorescent compound enabling detection. An appropriate solvent mixture has been determined that allows for the detection of derivatized nicotianamine and for purification of the underivatized compound.

Developing efficient methods for nicotianamine production and purification is the first step in developing methods for its application. There are a variety of uses and new areas of research involving nicotianamine. Further understanding nicotianamine synthesis in plants can lead to crops with improved micronutrient content or improved metal tolerance. Due to its metal chelating properties, nicotianamine may be overlooked as an enzyme inhibitor. Recent studies have shown nicotianamine to relieve high blood pressure in mice by selectively inhibiting angiotensin-I-converting-enzyme. As a plant-derived non-toxic compound it has potential as a preservative or antioxidant agent. Production by recombinant enzyme would greatly improve current methods of production, making nicotianamine more affordable for research or commercial use.

(8) Enhanced Ecosystem Screenhouses: A Comprehensive Approach to Cucumber Crop Protection in Hawaii. Flora Samis\*, Koon-Hui Wang, Brent Sipes, Catherin Chan. Department of Plant and Environmental Protection Sciences, Department of Natural Resources and Environmental Management.

Pesticide treadmill has resulted in fruit fly and pickleworm resistance to multiple insecticides including two viable organic insecticides, spinosad and Bacillus thuringiensis (Bt), leading to a recent 20% reduction in farm-gate value in Hawaii. Consumer demand for organically produced vegetables in Hawaii is on the rise. However without the use of chemical pesticides, organic farmers face great challenges. Affordable Do-It-Yourself screenhouses schematic plans published by CTAHR’s Sustainable Pest Management Lab are designed to exclude difficult to control insect pests. Increased accessibility to such infrastructure can greatly increase cucumber yields while decreasing chemical inputs.

Four field trials conducted at both Waimanalo and Poamoho Research Stations compared three treatments of parthenocarpic cucumber grown inside screenhouses: 1) sunn hemp “green-mulch,” 2) mint living mulch, and 3) bare ground, against open field cultivation outside of the screenhouse in bare ground. Results from all four trials demonstrated effective exclusion of major cucumber pests such as fruit flies and pickleworms resulting in 100% more undamaged fruits than the open field control which yielded no marketable fruits. No additional chemical insecticides were applied, strongly supporting screenhouse cultivation as an effective non-chemical control for major cucumber insect pests.

The screen used to construct these houses, size 17 mesh, is effective at excluding larger insect pests. However, small insect pests such as thrips, aphids and white flies can still enter the screenhouse; while important beneficial organisms such as predatory insects and pollinators can be excluded. To improve natural ecosystem functioning within the screenhouse, insectary cover crop, buckwheat, was inter-planted inside to host beneficial insects, and a row of sunn hemp was planted outside the screenhouse to capture parasitoid wasps. After cucumber planting fresh-cut sunn hemp was added to plots of cucumbers inside the screenhouse as “green-mulch” to suppress weeds, introduce parasitoid wasps, creating niche for predatory arthropods such as spiders, and conserve soil moisture. Sunn hemp has the added benefit of fixing nitrogen and can be utilized as effective supplemental plant-available nitrogen. These “green-mulched” plots yielded greater fruit number and weight than the other inside treatments, which can be attributed to the additional nitrogen provided by the green mulch.

Use of mint as living mulch and companion planting with cash value is a new concept perceived to benefit to small-scale growers with additional marketable product. Mint is a vigorous perennial culinary herb that can outcompete weeds, is widely used in local cuisine and has high market value. Results show that well-established mint providing sufficient ground cover would outcompete weeds. However mint is a good host for plant-parasitic nematodes and can rob nutrients from the cucumber crop, resulting in reduced yield compared to the other treatments. New field trials will adjust fertilizer input to accommodate the needs of both cucumber and mint.

This HDOA funded project aims to provide small-scale organic farmers with affordable and profitable cucumber production to meet local market demand. Economic analysis and farmer surveys are underway to provide more incentives for farmers to increase local cucumber production.

(9) "Nānā i ke Kumu Lāʻau: Native Hawaiian Flora as Medicinal Sources". Rebecca P. Barone\*, Daniel K. Owens. Department of Molecular Biosciences and Bioengineering.

Globally, greater than 60% of deaths each year can be attributed to chronic diseases. By definition, chronic diseases, such as heart disease, cancer, diabetes, respiratory diseases, stroke, Alzheimer’s, and dementia, are long-lasting and debilitating. In Hawaiʻi, chronic diseases greatly impact all of our families, particularly within native communities, as thousands of lives are claimed by heart disease and cancer every year. In addition to being prevalent, chronic diseases are extremely expensive to treat, accounting for 90% of the United States’ multitrillion dollar health care costs. However, chronic diseases are also among the most preventable of health concerns, as specific life-style changes have been shown to reduce the probability of developing chronic diseases by as much as 80%.

In pre-contact Hawaiʻi, as in many other indigenous societies, plants were relied upon as primary sources of medicines. Though the use of plants is well-known, there has been little focus on the specific phytochemicals (plant-derived bioactive compounds) produced by native Hawaiian plants. Polyphenols are a class of phytochemicals that are abundant in all plants and have the capability to act as antioxidants. Antioxidants reduce the cellular damage caused by oxidation and greatly decrease the incidence of chronic disease. Quantifying and identifying these phytochemicals is crucial to thoroughly understanding the roles of plants in traditional medicine and for application in the health and resilience of our communities today.

To gain insight into the ways native plants affect human health, a study was conducted on the phytochemicals produced by two species commonly utilized in traditional medicine. The genus *Sida* (Malvaceae, the mallow family) includes a non-native species (Sida acuta) and a culturally- significant native species (Sida fallax, ʻilima). Here in Hawaiʻi, S. fallax was used primarily in family medicine and administered to pregnant mothers and babies. Though both of these species were used in traditional medicines by indigenous communities around the world, the phytochemical-richness of the native S. fallax has not been studied.

The aims of this study were to compare the amount of polyphenolic compounds produced by these two species and to investigate their corresponding abilities to act as antioxidants. Plants were collected from two coastal sites on Oʻahu. Each plant tissue-type (flowers, roots, stems, and leaves) was tested separately. Polyphenolic content was assessed using the well-established gallic acid equivalence method. Antioxidant capacity was assessed using the Trolox equivalent antioxidant capacity method. An additional goal of this study was to investigate the polyphenolic content of these species in relation to their use in traditional medicine and, to that end, specific plant tissues (flowers and roots) were tested using different solvents, as described in traditional medicinal treatments.

Plants were once vital to family health and community well-being in Hawaiʻi. Restoration efforts in recent years have increased the availability of native plants to our communities, but they remain greatly under-utilized today. Studies such as this one seek to better understand the medicinal value of native plants in the treatment of chronic diseases, so that they can contribute to family health and the overall resilience of our communities.

(10) Manganese, a metal that is critical for life but toxic in high concentration, is abundant in the plant-based Ornish diet. Teresa LeMoon\*, Monica Esquivel. Department of Human Nutrition, Food and Animal Sciences.

Manganese (Mn) is a mineral critical for growth, building bone, processing carbohydrates and proteins, and neutralizing DNA-damaging chemicals produced by our bodies. High levels of Mn can lead to tremors, nerve damage, and cognitive deficiencies in vulnerable populations. Mn is present in the soil, so the Mn content in food varies considerably. It is most concentrated in plant-based foods, whole grains, legumes (beans), nuts, seeds, vegetables, and fruits, while the Mn content of meats, dairy, animal fats, and oils is considerably lower. The recommended level of intake for nutrients in the United States known as the Dietary Reference Intakes (DRI) consists of an Adequate Intake (AI) representing the daily requirement of a nutrient to prevent deficiencies. The AI for Mn is 1.8 mg for women and 2.3 mg for men while the maximum daily intake or tolerable upper intake level (UL) for Mn is 11 mg/day for adults and 2-9 mg/day for children depending on age and gender. It is hypothesized that the average Mn content of the plant-based, Ornish diet will be significantly higher than that of the omnivore (plant and animal based) Dietary Approaches to Stop Hypertension (DASH) diet.

 A three-day sample DASH diet menu (www.mayoclinic.org) and three-day Ornish diet sample menu (www.ornish.com) were analyzed using the USDA National Nutrient Database to assess total Mn, iron (Fe), and energy (kcal) provided. A trained researcher used t-tests to compare Mn, Fe, and kcal daily values between the two diets and against the DRI values for Mn. The Ornish diet contained an average daily Mn, Fe, and energy content of 11.5 mg, 28.6 mg, and 1945 kcal respectively, exceeding the UL for Mn, while the average daily Mn, Fe, and kcal of the DASH diet were 7.5 mg, 14.8 mg, and 2117 kcal respectively. The average daily Mn level in the Ornish diet (11.5 mg) is statistically the same as the UL (11.0 mg), but the average daily Mn in the DASH diet (7.5 mg) is significantly lower than the UL. Both diets were significantly higher in Mn than the AI. This may indicate that people following a medically-prescribed, plant-based diet may have an Mn intake that is higher than the UL. However, Mn absorption and bioavailability are highly variable and dependent upon nutrient status and the interaction of other constituents in the diet. Increasing evidence of the heart health of a plant-based diet has led to a rise in medically prescribed modern diets such as the Ornish diet. By design, this and other plant-based diets have a higher propensity to include Mn-rich foods. Therefore future research is needed to determine if issues with the absorption and bioavailability of Mn makes this high dietary intake a potential problem for those following a plant-based diet.

(11) Effects of Hawaiian-Grown Coffee on Adipocytokines among Healthy Individuals. Nyan Stillwell\*, Pratibha V. Nerurkar, Harry C. Bittenbender. Department of Molecular Biosciences and Bioengineering, Department of Tropical Plant and Soil Sciences.

Adipocytokines such as adiponectin and leptin, secreted by adipose tissue, are known to regulate glucose and lipid metabolism. An imbalance of adiponectin and leptin plasma levels can stimulate pro-inflammatory cytokines linked to insulin resistance and type 2 diabetes (T2D). Epidemiological studies link moderate coffee consumption to lower risk of T2D. Mechanistic studies correlate increased plasma adiponectin and reduced inflammation to moderate coffee consumption reduced risk of T2D. However, the effects of coffee on plasma leptin levels remain controversial. Biological effects of coffee are dependent upon not only the variety but also the origin or location. We tested the hypothesis that short-term consumption of Hawaii-grown coffee will reduce plasma leptin levels among healthy individuals. Green coffee was obtained in bulk, roasted and freshly ground before distribution. Twelve participants consumed four cups (24 oz. total) of Hawaii-grown coffee daily, for four weeks. Blood was collected before and after coffee consumption, plasma was separated by centrifugation and stored at -80oC. Commercial kits were used to analyze plasma leptin levels. Preliminary results from five participants indicate that consumption of Hawaii-grown coffee for four weeks had some significant effect on plasma leptin. Additional samples are being analyzed. Proposed studies are expected to provide mechanistic insights into health benefits of Hawaii grown coffee. Supported in parts by NIFA, USDA (HAW05023-R, HAW00598-H, W3122, HAW00526-H, 2004-34135-15182), NIH (G12RR003061) grants and Undergraduate Research Opportunities Program (UROP).

(12) Mauli Ola: Determining Health Impacts of ʻĀina-Based Programs. Riley Wells\*, Anthony K. Sigmund, James Doherty, Christian Dye, Razvan Sultana, Rafael Peres-David, Ruben Juarez, Alika K. Maunakea. John A. Burns School of Medicine: Department of Native Hawaiian Health.

Type 2 diabetes mellitus (DM) is an obesity-related condition. It is a metabolic disorder that is characterized by high blood sugar and insufficient insulin production. As friends and family members can influence an individual’s actions, the extent to which social influence can affect behaviors contributing to the development of obesity-related conditions such as type 2 DM is not fully understood. Compared to other racial groups, the Native Hawaiian community is disproportionately afflicted by overweight/obesity and type 2 DM. Investigating the impact of social networks on health outcomes may allow for the development of community-based strategies to combat the high prevalence of type 2 DM and other obesity-related diseases in Native Hawaiians.

To better understand the influence of social networks on community health outcomes, a survey was prepared to gather information about community members’ health and lifestyle choices. This survey was administered to participants of the MAʻO Youth Leadership Training (YLT) internship program and members of their social networks at the time of their entrance to the program, and again after a 12-month period.

Situated in Wai’anae, a region of Oʻahu with a dense Native Hawaiian population and a particularly high type 2 DM incidence rate, MAʻO YLT is a community-based program that may facilitate healthy lifestyle adjustments. It aims to connect ʻōpio (youths) to the ʻāina (land; that which feeds) by engaging young members of the Hawaiian community to create a local, sustainable system of organic food cultivation. YLT interns are actively involved in a positive environment that promotes education, healthy dietary habits, and the daily exercise that comes with hands-on immersion in organic farming.

To determine the health impacts of this ʻāina-based program, diabetes risk was assessed through measures such as body mass index (BMI), blood pressure, and A1c level. The A1c test is designed to measure average blood sugar levels over the past 3 months. A1c levels were categorized into healthy (below 6%), pre-diabetic (6-6.4%), and diabetic (over 6.5%) ranges. This data was collected upon each administration of the health assessment survey.

In addition to potential change in diabetes risk, change in gut microbiome composition was studied to investigate physiological factors that may be affected by a 12-month lifestyle adjustment. Study participants provided stool samples around the time of each survey administration. From these samples, bacterial DNA was extracted and sequenced to characterize the presence or prevalence of different bacterial species. This bacterial composition data was associated with diabetes risk data to evaluate health implications regarding trends in the abundance of specific gut bacteria.

Understanding the relationships between diabetes risk, lifestyle choices, and social influence may provide an avenue for the development or improvement of successful ʻāina-based programs. Changes in gut microbiome composition during participation in these programs may provide insight into biological mechanisms underlying health outcomes. The implementation of these programs may help to mitigate preventable diseases within the Native Hawaiian community, and potentially, in other communities afflicted with diseases of health disparity.

(13) Optimizing probiotic yeast with prebiotics to enhance their survival in the gastrointestinal tract. Beverly Yuen\*, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Probiotics are “live microorganisms, which when administered in adequate amounts, confer health benefits on the host”. Lactobacillus and Bifidobacterium are the most common probiotics. Probiotics replace essential bacteria loss in the colon to maintain a healthy gut microflora; some probiotic effects are treating diarrhea and gastrointestinal infections by producing antimicrobials against pathogens. Saccharomyces boulardii CNCM I-745 is an established probiotic yeast that treats GI disorders. S. boulardii is expensive because it is the only probiotic yeast sold in the market.

The biggest hindrances of the survival of probiotics in the GI tract is the high acidity of the stomach and their passage through the intestines. Prebiotics are non-digestible foods that selectively stimulate the growth and survival of probiotics in the colon. Many potential prebiotics are foods high in dietary fiber, such as breadfruit and inulin. Prebiotics are fermented by probiotics but are poorly fermented by pathogens. However, there are limited studies on the effect of prebiotics on probiotic yeast.

The first objective of this study was to discover potential probiotic yeast strains from produce such as grapes, pineapples, broccoli, and kimchee, to expand the variety of probiotic yeast that can be marketable. Yeast are selectively isolated by examining antimicrobial effects against pathogens: Escherichia coli, *Staphylococcus aureus*, and *Salmonella enterica*. The second objective of this study was to use 2% (w/v) inulin and breadfruit powder to optimize the growth of probiotic S. boulardii CNCM I-745 and reference yeast strain, *Saccharomyces cerevisiae* during incubation at 30°C for 24 h. Moreover, the growth of E. coli in inulin and breadfruit was analyzed at 37°C for 24 h.

The results indicated there are potential probiotic yeast naturally present in certain produce, and the addition of prebiotics enhanced the growth and survival of these yeasts. *Debaryomyces hansenii*, found in white grapes, inhibited the growth of *S. aureus*. Moreover, with the addition of inulin, *S. boulardii* and *S. cerevisiae* exhibited a 22% and 14% increase in growth, respectively. Adding breadfruit with *S. boulardii* and *S. cerevisiae* demonstrated a 22% and 0% increase in growth, respectively. The negative controls (yeasts with no carbon source) exhibited no growth. In contrast, E. coli showed insignificant growth with the addition of inulin and breadfruit. These results suggest prebiotics have the potential to selectively stimulate the growth and survival of probiotic yeast in the GI tract. Further investigation involves optimizing the growth of *D. hansenii* with inulin and breadfruit, along with examining the survival of *S. boulardii* and *D. hansenii* supplemented with prebiotics during simulated digestion.

This study identifies a potential probiotic yeast strain to increase the variety of the limited species of probiotic yeasts with antimicrobial properties. It is fundamental to consider methods, such as adding prebiotics to enhance probiotic survival and growth during digestion, because health benefits of probiotic supplements are enriched. Probiotic yeast will be more affordable if more strains are marketable.

(14) Taro, Probiotics and the Gut Microbiome. Solange Saxby\*, Lee, CN, Kim, YS, Li, Y. Department of Human Nutrition, Food and Animal Sciences.

Taro is a staple Pacific Island food that is associated with Indigenous origins beliefs, culturally important dishes, and is traditionally used in medicinal practices. As a nutrient dense food, taro’s high fiber content allows probiotic bacteria to thrive. Probiotic bacteria are beneficial microorganisms that keep our gut microbiome healthy. The gut microbiome is an ecosystem of microorganisms in our colon that helps maintain a health metabolism, immune system, and supply of nutrients.

Nutrients from our diet have a great influence on our gut microbiome. Dietary fiber, also known a prebiotics, is the portion of food that is indigestible by the human gastrointestinal tract and promotes growth of probiotic bacteria. In contrast, probiotics are alive “good” microorganisms that promote overall health by helping to digest food, producing vitamins, and outcompeting “bad” microorganisms. When dietary prebiotics and probiotics are combined they produce symbiotes. These symbiotes provide increased health benefits compared to probiotic or prebiotic used alone .

Therefore, promoting taro as a prebiotic source for probiotic growth can help maintain a healthy gut microbiome. Taro may also be used as a dietary aid to prevent certain disease. To better understand how taro affects the gut microbiome health, a study was conducted on five different varieties of taro: bun long, lehua, mana ulu, moi, and Tahitian. The study simulated the flow of the taro varieties through human digestive tract; starting from the mouth, stomach, small intestine and ending at large intestine. Afterwards, the taro varieties were places in human fecal samples to simulate the gut microbiome and study the beneficial byproducts produced.

With these results, the promotion taro as a functional prebiotic food, a healthy food for our gut microbiome, can occur to be added into dietary food patterns. Food is medicine and the advancement of out nutritional knowledge is key to improving public health and important in incorporating indigenous foods into diets for improving gut health--- harking back to its traditional roots.

(15) Identifying motivators for program participation and factors contributing to produce choices in a pilot produce prescription (Rx) program. Cherese Shelton\*, Monica Esquivel. Department of Human Nutrition, Food and Animal Sciences.

Fruit and vegetable (FV) consumption among all Americans is well below national recommendations and the shortfall is even greater among individuals in low socio-economic households. Low FV consumption is associated with increased risk for chronic disease and obesity in both childhood and adulthood. The formative years of childhood are when lifelong healthy habits, such as eating fresh FV are developed and children living in homes reliant on federal food assistance programs often lack access to fresh FV. In Hawaiʻi, Native Hawaiian and Other Pacific Islanders (NHPI) are disproportionately affected by food insecurity. Improving access to fresh food for these children and their families contribute to building healthy families and resilient communities in Hawaiʻi.

A pilot produce prescription (Rx) program was implemented in a community densely populated with NHPI where the prevalence of food insecurity, adult obesity, and diabetes is among the highest in the state. Program evaluations were conducted to identify strategies for program optimization and expansion for the future. Children and their families were referred to the produce Rx program by their pediatrician, based on diet and growth assessment. Produce prescriptions were provided at the local farmers market and were redeemable for up to $24/month for three months. After redeeming all prescriptions, parents participated in an exit survey and received an additional $25 farmers market voucher upon completion of the survey. Sixteen parents completed the survey.

Two survey questions were analyzed for the current presentation, “Why did you choose to participate in the program?” and “Why did you choose to purchase certain FV over others?” Survey responses were coded by a graduate student and categorized to identify themes. The themes that emerged related to motivation to participate were 1) family’s desire to increase affordability and accessibility of FV in their homes, 2) pediatrician’s recommendation of the program, and 3) desire to improve child health. Themes related to participants’ decisions on purchases were 1) knowledge of the FV (i.e. recipes it can be used in, child familiarity/preference) and 2) versatility and stability in storage (i.e. can be used in many recipes, won’t perish quickly). Based on the themes emerged, families are interested in participating because they are motivated to use resources that can get more FV into their homes and diets of their children. The support of the pediatrician also aids in motivation to participate and complete the program. Lastly, purchases are decided based on the family’s knowledge of the FV. The themes identified can be used to expand participation by incorporating motivating factors into recruitment and enrollment materials and influence diversified FV purchasing choices by educating parents and children about unfamiliar FVs. Future studies should assess other factors affecting participation and the effect of this program on FV intake and food insecurity. Filling the gap in knowledge on how produce Rx programs can be utilized in pediatric populations to overcome food insecurity and poor FV intake can reduce future risk for health disparities in this undeserved population.

(16) Enhancing Agricultural Productivity, Poverty Reduction and Improving Food Security: A Case of Potato Cultivation in Western Guatemala. Rupananda Widanage\*, Catherine Chan. Department of Natural Resources and Environmental Management.

Role of agriculture in poverty reduction and improving food security have become a key aspect of agricultural and rural development planning in developing countries. Despite the moderate economic growth (3.2%) in 2017, Guatemalan economy faces high level of poverty and income inequality (National poverty 59% & Rural poverty 76% in 2014). Similarly, agricultural sector plays a significant role in producing food, generating foreign exchange, and providing employment opportunities for rural households. However, currently, agricultural sector contributes only 13% to the country’s real GDP and reflects the symptoms of stagnation. Potato is one of the major export crops as well as a food crop in Northern Guatemala. Although 88% of rural households engage in potato farming, potato cultivation records low productivity compared with the world average as well as North American and European Averages. Hence, the existing data reveal that there is a high correlation among potato productivity, rural poverty, income inequality and food insecurity in rural Guatemala. Agricultural and development economic literature indicates that high growth in agricultural sector makes a significant contribution to poverty reduction and improving the food security status of farming households. However, little is known about the causes of low productivity in potato farming and its’ impact on poverty reduction and improving food security. This paper aims to fill such a knowledge in the current literature of agricultural and development economics and provides policy implications for formulating a rural development strategy which integrates productivity enhancing factors in potato farming.

In doing so, this paper estimates a stochastic frontier production function for four rural municipalities in Guatemala and attempts to identify the factors that lead to inefficiency in potato farming system. Our preliminary estimates show that technical inefficiency contributes to the 58% of production variability among potato farmers. The average technical efficiency is at 42%. Hence, there is a considerable room for the implementation of best agricultural practices for potato farming system in rural Guatemala. The estimated stochastic frontier indicates that the use of pesticide is the significant factor, which contributes to increase yield. This finding has vital policy implications for formulating an innovative rural development strategy which integrates crop disease management because Guatemalan potato sector has been suffering from crop disease since 2017’s. Inefficiency model indicates that gender makes a positive contribution to the inefficiency. Since the majority of household decision makers are males, this finding has important policy implications to design various programs in agricultural and rural development planning. Likewise, this paper suggests that an increase in technical efficiency leads to improve productivity in potato cultivation and thereby increases farm household income. An analysis of the determinants of efficiency shows that the relative importance of farm physical and human resources targeted by the public investment in agricultural sector to improve farm efficiency. Hence, the findings of this study can be used to formulate a rural development strategy that aims at poverty reduction among potato farmers through improving efficiency in potato cultivation.

(17) Sustainability Starts with Educating Children: A Socially Responsible Retail Business in HawaiI. Anne Mo\*, Makena Miles. Department of Family and Consumer Sciences.

How can we maintain the natural beauty of the Hawaiian islands? Sustainability brings various opportunities in Hawaii. Hawaii was the first state that banned the use of plastic bags at grocery stores to decrease plastic waste (Herreria, 2017), while the government issued its first hemp grower licenses for hemp production for conserving water consumption (Peterkin, 2018). In this business plan, two sustainability goals, which are good health and responsible consumption, are selected from seventeen global goals for sustainable development (United Nations, 2015) to implement sustainable future ideas for the apparel industry in Hawaii. The objective of the business plan is to offer a sustainable apparel brand to support children’s health by educating consumers and focus on their responsible consumptions.

Swimwear is a year-round wardrobe in Honolulu. The global children’s swimwear market grew by 24% from 2012 to 2013 (Technavio, 2016). Local competitors in the children’s swimwear market do not offer sustainable swimsuits for kids, which is a major opportunity for a new retailer to take advantage of. Meanwhile, it is a challenge to be able to create a retail business that integrates the aspects of sustainability while managing costs and meeting customer expectations. As an emerging sustainable retail business, Hatchling promotes children’s health by educating consumers using interactive events, which support the local economy for the future generations.

Hatchling creates a competitive branding concept, which offers androgynous and gender neutral options and highlights the use of sustainable materials for leading their responsible consumptions. Hatchling’s marketing strategy is to educate children and their parents by monthly weekend activities at the store site. A retail space in Ward area can attract both tourists and local customers. The educational activity shows the importance of recyclable materials, such as recycled nylon called Econyl. Using a question/answer activity on the production process of nylon and polyester fibers will stimulate children's interests and familiarizes them with swimwear materials. Additionally, the activity will show a bag-free approach to help Hawaii’s environment and people’s health.

While consumers are becoming more educated about their children’s swimwear, the challenge for Hatchling is to use sustainable production. The recyclable nylon and polyester textiles will be used from an online manufacturer, Vivify, that offers the fabric at approximately $10 per yard. Knit fabrics have relatively wide width for producing children’s swimwear, which approximately takes 15 inches per suit depending on the design and size. The material cost can be maintained as low as $1.50 per recycled material. A limitation of opening a retail business in Hawaii is having higher operating expenses including in-house production. To solve this issue, Hatchling swimsuits will be produced by contractor-based productions to maintain Hawaii's human capital. In order to make the swimwear have a long life span, textile testing, such as abrasion resistance and colorfastness to perspiration and sunlight, will be conducted to assure the product quality. The next steps will be educating employees including contractors. This health and education emphasis on Hatchling swimwear will create a cleaner, brighter Hawaii and world for their future.

(18) Steps Toward Microfiber Pollution Reduction. Savannah Adler\*. Department of Family and Consumer Sciences.

The fashion industry is becoming commonly known as an industry that contributes largely to world pollution. Up to 40% of microfibers from each wash manage to make it past water treatment centers, and into our rivers, lakes, and oceans (Hartline, N.L., Bruce, N.J., Karba S.N., Ruff, E.O., Sonar, S.U., and Holden, P.A., 2016). According to the University of Rhode Island Graduate School of Oceanography, synthetic microfibers are being discovered around the world in samples of, but not limited to, ocean water, glacier ice, beer, table salt, and fish (2018). It has been discovered that one garment can release more than 1,900 fibers per laundering cycle (Greenberg, 2018). It is estimated that 0.6-1.7 million tons of microfibers being released into the oceans annually (The Story of Stuff, 2017). Research has also shown that microorganisms, fish, birds, and mammals are consuming microfibers, and ultimately so are humans (Mishra, S., Rath, C., Das, A., 2019).

Synthetic microfibers and plastics attract, and are comprised of, toxic chemicals, including polyhydromatic hydrocarbons, phthalates, polychlorinated biphenyls (PCBs), and Bisphenol A (BPA), which are linked to cancer, hormonal imbalances, behavioral and heart problems, as well as adverse effects on the environment and its inhabitants (WebMD, 2017). Microfiber pollution is a physical barrier to food intake for coral, affecting their ability to acquire food (Chapron, et al., 2018). Without the protection and rehabilitation of coral reefs, billions of aquatic and non-aquatic species will suffer. According to the International Coral Reef Initiative, coral reefs provide protection by acting as a natural barrier to cyclones, typhoons, hurricanes, and tsunamis, due to wave energy reduction (Carey, B., 2014)

The domestic taxing of manufactured synthetic fibers, yarns, and fabric can shift domestic consumption to outsourcing international materials, as it did with the 2017 Goods and Services Tax (GST) in India. Without a ban on imports in conjunction with an output tax, society and the environment could actually become worse off, as this increases production and demand in potentially unregulated markets; otherwise known as leakage.

One of the ways to incentivize the reduction of microfiber pollution domestically, in the United States, could be the introduction of a federal income tax credit for parties who use washing machines with filtration systems. One such example of success with the implementation of a tax credit is Hawaii’s Department of Taxation with Hawaii Renewable Energy Technologies income tax credit. In order for this to be effective, a domestic incentive would have to be coupled with strict oversight, in addition to a ban on the importation of washing machines that do not have filters. This incentivization strategy could take less time and money than overhauling wastewater treatment centers and sewage system infrastructure, creating more immediate environmental impact. Furthermore, there could be an income tax credit and subsidy for households and businesses who agree to install filters on their existing washing machines. Additionally, there could be another subsidy on the domestic production of natural fibers and fabric in the USA.

(19) Saving ‘Pisang Awak’ banana from Panama Wilt using Anaerobic Soil Disinfestation. Natasha Kerr\*, Gerardo Spinelli, Koon-Hui Wang. Department of Plant and Environmental Protection Sciences.

When banana farmers in Hawaii became challenged by the Banana bunchy top virus epidemic, they shifted to plant ‘Pisang Awak’ banana due to its resistance against the virus. Later, farmers realized that ‘Pisang Awak’ is extremely susceptible to *Fusarium oxysporum f. sp. cubense* (Foc). CTAHR Sustainable Pest Management Lab in collaboration with Cooperative Extension agents are investigating the effectiveness of locally available carbon sources for ASD against Foc. This PEPS capstone project investigated two distinct organic matter sources to support the concept of ASD for soil-borne disease suppression.

A pot experiment was conducted at the Magoon Research Facility using Foc infested soil collected from a banana farm in Kahuku. This soil was either amended with 2% of 1) mill run, 2) humic acid, or 3) not amended. Each soil treatment was saturated with water to reach field capacity in a Ziploc bag for 2 weeks. In addition, a non-saturated and non-amended soil was included as a control. To examine if oxygen in the soil had undergone anaerobic fermentation, an oxidative-reduction potential (ORP) meter was used to measure the redox potential of the aqueous solution from each bag at the termination of ASD. Disease-free ‘Pisang Awak’ banana suckers from a Foc-free field from Poamoho Experiment Station were planted into the prepared soils. Pots were randomized, each treatment was repeated 3 times, and experiment repeated once. Plant growth was recorded biweekly over 4 months and examined for shoot and root disease on a scale of 1-5 (1=healthy, 5=severely wilted/damaged with lesions) at termination. Roots from each pot were then washed, surface sterilized with clorox, and plated on corn meal agar to examine for *Fusarium conidia*.

Most plants in the untreated control died, confirming high infestation rate of Foc in this soil. The ORP readings revealed that only ASD by mill run achieved negative redox potential (-55.67 mV). Humic acid, a stable organic matter source, did not undergo anaerobic fermentation under the water saturated sealed environment. Mill run resulted in the lowest shoot disease rating (1.83) compared to the untreated control (3.67). Similarly, root ratings were also lowest for mill run ASD (2), lower than the untreated control (4.5). Root ratings for banana planted in humic acid treatments were not different from the untreated control. Reduction in disease incidence of mill run ASD corresponded with taller plants, thicker stem diameter (P ≤ 0.05) when compared to the untreated control.

These results suggested easily decomposable carbon inputs when combined with anaerobic conditions is effective at lowering Panama wilt disease severity, while increasing survival rate and growth of banana keikis. On the other hand, amending soil with stable, labile carbon sources such as humic acid failed to achieve ASD conditions and hence did not suppress the disease. This study also showed anaerobic conditions alone were incapable of combating Foc. Suggesting fermentation of organic matter generates the extremely stressful conditions for soil pathogens, potentially producing volatiles or promoting shifts in soil microbial communities that can out-compete plant pathogens.

(20) Intermicrobial interaction among marine bacteria with Hawaiian bobtail Squid: a model to study complex microbe. Katherine Murphy\*, Koon-Hui Wang. Department of Tropical Plant and Soil Sciences, Department of Plant and Environmental Protection Sciences.

The symbiosis between *Euprymna scolopes*, the Hawaiian bobtail squid, and the bacterium, Vibrio fischeri, offer microscopic-scale organisms to study multipartite symbiosis in the ocean. Despite microscopic, the interactions between Hawaiian bobtail squid and microbes associated with it are considered one of the most complex relationships between eukaryote and microbes. The Hawaiian bobtail squid provides a nutritious protected environment for the bacteria, and *V. fischeri* in turn provides the nocturnal squid with counter-illuminating bioluminescence. The two have a simpler relationship that can be studied on a small scale.

To better understand the relationship between these two complex organisms, this project has been conducted over several laboratory trials to look at interaction between bacterium *V. fischeri*, and the Hawaiian bobtail squid along with other strains of bacteria that inhibit the growth of *V. fischeri*. This study aims to determine if other bacteria can prevent the normal development of this symbiosis.

In the initial trial, several marine bacterial were isolates by in vitro plate streaking. A total of 18 isolates were screened for antagonistic against *V. fischeri* in solid media using test tubes with a series of incubation periods, and growing on solid media streaked with *V. fischeri*. Results showed that only a few strains have been identified that can prevent *V. fischeri* growth in solid media. Four strains of bacteria were selected as ideal candidates. After determining strains of bacteria with antagonistic effects that can prevent growth of *V. fischeri* on the solid media, combinations of these isolates were further tested against this beneficial symbiotic bacteria in the solid plates. A series of spot drop test were conducted.

Virulent strains were further tested in an ocean-like environment simulated in test tubes and small aquariums that held young Hawaiian bobtail squid in marine biology laboratory at Kewalo Marine Lab. It is anticipated that a significant difference in capability for the bacteria to grow in solid media versus in a free moving environment like water. If some of these antagonistic bacteria alter *V. fisheri* ability to colonize the bobtail squid only in an ocean-like environment, mechanism on how this antagonistic activity may suppress the squid growth will be further explored in the salt-water marine tank by co-inoculating young squid with *V. fischeri* and the antagonistic marine bacteria.

This is a novel model marine system that can help marine biologists to understand the relationship between bacteria and multicellular organisms in a simple, natural system, and may provide information on how interbacterial interactions interfere or benefit symbiotic relationships.

(21) Fruit waste don’t waste: using fruits to their full potential. Joanne H. Tong\*, Biyu Wu, Chin Nyean Lee, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Fruit and vegetable waste, for example, banana peels, sugar beet pulp, grape pomace, potato peel waste, etc., have previously been studied for their nutrient profiles as well as their antioxidant properties. In general, fruit and vegetable waste contain significant quantities of complex polysaccharides. These complex polysaccharides often are the challenge of re-utilizing the fruit waste because the structure of polysaccharides varies depending on the type of food and the processing method. Several studies utilized enzymes to chemically degrade the complex polysaccharide structure in the effort of optimizing the available biodegradable ingredients. Yet, little is known whether other commercial fruit waste have similar functional potentiality after enzymatic treatment.

The goal of this study was to explore and highlight the potential application of fruit waste with a focus on the recovery of reducing sugars after enzymatic treatment and their prebiotic potentials. Mango peels, pineapple peels, pineapple cores, and mandarin peels were analyzed in this study. To generate reducing sugars, Viscozyme, food-grade enzymes, were used to convert the cell walls of freeze-dried fruit waste samples to reducing sugars. The optimal time (2 h, 3 h, 4 h) of enzyme treatment for each waste was investigated. A selected concentration of reducing sugars (100 mg/mL) from different fruit waste was added into basal medium to grow probiotic bacteria *(Lactobacillus acidophilus)* and its enteric competitor *(Escherichia coli)* to study their prebiotic potentials. The waste with the highest yield of reducing sugars was used to further explore the correlation between the concentration of reducing sugars and the growth of bacteria.

The results of this study indicated all four fruit waste treated with Viscozyme showed an increase in reducing sugars. The optimal time for enzymatic treatment was 3 h. Among all samples, mango peels yielded the highest reducing sugar concentration (13.23 g/mL) followed by mandarin peels, pineapple core and pineapple peels. After 24 h of incubation, all samples showed that the reducing sugars supported and favored Lactobacillus acidophilus. Incubation of various reducing sugar concentrations of mango peels also showed higher optical density of *Lactobacillus acidophilus* than *Escherichia coli*. Ongoing efforts include using different time treatments and concentrations of the reducing sugars to optimize their prebiotic potentials as well as analyzing prebiotic oligosaccharides in the reducing sugars. In summary, all fruit waste tested in this study showed a prebiotic potential after enzyme treatment and might be used as functional ingredients for improving gut health.

(22) Blinded by the light: Impacts of light pollution and other fallout factors on Wedge-tailed Shearwaters along Southern Oahu. Brooke Friswold\*, Keith Swindle, David Hyrenbach, Tiana Bolosan, Melissa Price. Department of Natural Resources and Environmental Management, U.S. Fish and Wildlife Service, Hawaii Pacific University: Department of Oceanography, Division of Forestry and Wildlife.

The attraction to light was a previously beneficial behavior for seabirds. The invention of artificial light is now negatively impacting their survival due to distraction and disorientation, leading to fallout and often death. Hundreds of Wedge-tailed Shearwaters (WTSH, Ardenna pacifica, ʻuaʻu kani) experience fallout each fledging season across O‘ahu, possibly due to artificial light pollution. We hypothesized the presence of artificial light was a significant factor contributing to fallout, and that fallout increased over time. From 2002 to 2010 standardized surveys were conducted on the southeastern shore of O‘ahu during the Wedge-tailed Shearwater fledging season (November-December). The location of downed birds as well as the presence or absence of an artificial light source or fallout factor within 25 feet was analyzed along transects. We employed spatial and temporal analyses to determine if a correlation existed between likelihood of fallout with presence of artificial light and other fallout factors. The effects of wind, lunar cycles, colony proximity and power lines were also analyzed. We found that artificial light was present in 94% of recovered Wedge-tailed Shearwaters, power lines in 83% and that fallout has been steadily increasing over time despite some years of decline. In November 2019 1,141 WTSH were banded across various colonies on Oahu with varying degrees of exposure to light. The following fledging season allowed for analysis of where fallout is occurring through recovery of the bands resulting in seven bands recovered from four colonies. Biometric data was also taken from seabirds at the site to determine if WTSH health varied across colonies of varying degrees of light exposure with no significant difference discovered. Rehabilitation center data provided a holistic view of the cycle and outcomes of WTSH fallout throughout Oahu. This research suggests artificial lights are negatively impacting fledging seabirds; the most endangered taxonomic group. The results may be used to improve management of seabird colonies near urban areas and to alleviate or influence human-induced effects. The information will assist with proactively resolving human-wildlife management across the state of Hawai‘i concerning a federally protected species.

(23) Nest Initiation Time and Distance to Water Predict Nesting Success of the Hawaiian Stilt in Wetlands on O‘ahu. Kristen C. Harmon\*, Nathaniel H. Wehr, Melissa R. Price. Department of Natural Resources and Environmental Management.

Nest initiation time is an important factor in reproductive success of avian species. Studies of waterbirds in temperate regions show that early nests typically have higher nesting success than late nests, which is likely because early nests are often located in the most suitable habitat close to adequate food resources and sufficient protection from predators. Because nesting seasons are typically longer in tropical regions and many birds are year-round residents, nesting success of tropical waterbirds may not be dependent on nest initiation time. The Hawaiian stilt, a federally endangered subspecies of the Black-necked stilt, nests from February to August across the Hawaiian Islands. A recovery plan for the Hawaiian stilt was developed by the State Department of Land and Natural Resources and U.S. Fish and Wildlife Service that includes restoration of primary foraging and nesting habitat as a means for recovery; however, it in unclear if nest initiation time impact nesting success of the Hawaiian stilt. Our study will compare nest-site characteristic and nesting success between early and late periods of the Hawaiian stilt nesting season.

We conducted nesting surveys of the Hawaiian stilt in wetlands on the windward, leeward, and north shore regions of O‘ahu. Weekly field surveys and game cameras were used to monitor nests. Nest status, approximate nest initiation time, and nest-site characteristics, such as distance to water, vegetation type, vegetation height, and vegetation cover, were recorded for each nest. We determine nest fate by examining game camera photos and evaluating nest-site conditions. The nesting season was separated into early and late periods by dividing in half the total number of days in the nesting period constrained by the first and last days nests were initiated. We then calculated and compared nesting success using the Mayfield method.

Hawaiian stilt nests were observed from March 14th to June 26th of 2018. A total of 49 nests were found in the early period of the nesting season, which was from March 14th to May 3rd, and 36 nests were found during the late period of the nesting season, which was from May 4th to June 26th. We found that early nests were more successful than late nests, and that early nests were located closer to water and in taller vegetation than late nests. As distance to water increased, the probability of a nest surviving increased. We did not find any relationships between vegetation characteristics and nesting success. Further investigation is needed to examine other factors that may differ between early and late periods of the nesting season and therefore, impact nesting success of the Hawaiian stilt.

Differences in nest-site characteristics and nesting success may suggest that different habitat management strategies are needed throughout the Hawaiian stilt nesting season. Further, examining the relationship between nest-site characteristics and nesting success is necessary to better understand the potential threats that climate change my pose to Hawaiian stilt productivity.

(24) Novel approaches for eradicating the coconut rhinoceros beetle on Oahu, Hawaii. Mason Russo\*, Zhiqiang Cheng, Matthew Kellar, Kelsey Mitsuda, Jing Li. Department of Plant and Environmental Protection Sciences.

The coconut rhinoceros beetle has devastated palm trees throughout the Pacific islands, and the Hawaiian Islands are its current target. Coconut palm is the main host plant for the coconut rhinoceros beetle, but date palm, pineapple, sugarcane, and other valuable plants can be fed on as well. The beetles use organic matter or dead palms to deposit their eggs, but only feed on emerging palm fronds. The beetles bore into the crown of the palm, leaving characteristic V-cuts. This can be used to identify an infestation.

The pest is currently under an active eradication program on Oahu using trapping, sterilization of organic debris, and other approaches. Surveillance using adult trapping with pheromone baited vane traps helps determine the geographical extent of the invasion and to reduce adult populations. Implementing biological control and chemical control options into this strategy could be the last steps needed to achieve eradication before the pests expands outside its current urban containment.

This research focuses on the use of local entomopathogenic nematodes and fungi as biological control agents on 1st instar coconut rhinoceros beelte larvae. Entomopathogenic organisms are non-toxic to humans and can persist in the soil long after application. Fungus strains were tested from around Oahu, and strains from Lyon Arboretum yielded 80% mortality in laboratory testing. This has received Hawaii Department of Agriculture approval for field testing, along with permission to make fungus based biopesticides for early field dispersal. This fungus would be grown on rice that could be applied to mulch piles where the larvae of the beetle are likely to develop.

A separate study has been running to assess the impact of systemic insecticides. There is no risk of the chemical having unintended environmental impacts because they are injected directly into the trunk of palm trees with signs of coconut rhinoceros beetle damage. The chemicals being used have caused significant mortality on adults in laboratory testing, and are expected to have similar results in the field with trials currently occurring at Ewa beach. This could be implemented to all coconut palm trees with signs of an infestation to eliminate adult feeding on a large scale.

Entomopathogens are effective biocontrol agents in agricultural fields but there is a lack of recent research on urban landscape pests such as coconut rhinoceros beetle. Identifying virulent strains that can be produced for large-scale application is necessary to treat this infestation. Systemic insecticides are relatively new and have decreased environmental impacts compared to traditional insecticidal application methods. These projects will fill gaps in the current integrated pest management strategy for coconut rhinoceros beetle eradication, which could be implemented into current infestations across the Pacific Islands. The introduction of new species through globalization is inevitable, but projects like this will shift the focus towards using local biotic agents to mitigate invasive species threats.

(25) Towards a Hawaiʻi soil health index: Identifying sensitive and practical indicators of change across land use and soil diversity. Hannah Hubanks\*, Susan Crow, Jonathan Deenik. Department of Natural Resources and Environmental Management, Department of Tropical Plant and Soil Sciences.

Soil is an important natural resource and has the potential to provide food security, mitigate climate change, and protect coastal and inland ecosystems from degradation if it is in, or is restored to, a healthy and resilient state. Measuring soil health allows land managers to track improvements or degradation over time and optimize their management strategies for long-term benefits of the land by use of a soil health index. Yet similar to human health, there is no one-size-fits-all measurement that encompasses what it means to be healthy and is dependent instead upon considering many various meaningful tests. Such soil health testing methods and analysis necessary to monitor changes are not currently established for the unique soils of Hawaiʻi with diversity spanning soil taxonomy, land use and history, and climates. We sought to identify the most sensitive indicators of change in soil health, to be available for the development of a Hawaiʻi soil health index. Ten soil series samples within six soil orders were collected from 22 field sites on Oahu, Molokai, and Maui, spanning a range of soil conditions and land cover including cropland, forest, and grassland. Values from 30 soil health parameters measured physical, chemical, and biological soil properties. Multivariate analysis identified those parameters which could be used as indicators of soil health, based on their sensitivity to changes in the soil characteristics as well as their practicality for routine soil testing. Current and previous management based on land use history showed the greatest association to the variance in soil data and created an associated potential gradient of soil health. Nine indicators from a reduction process using quantitative and qualitative criteria comprise the recommended soil health indicators for detecting differences in management practices across a spectrum of soil health and include: water holding capacity, water-stable mega-aggregates, percent total organic carbon, C:N ratio, 24 hour CO2 burst, B-glucosidase, B-glucosiminidase, hot water extractable organic carbon, and potentially mineralizable nitrogen. The proposed indicators showed effective in detecting differences in management across the full landscape as well as qualitative differences in soil management within soil order, highlighting soil taxonomy as an important inherent contributor to data variance. Going forward, no one soil health test will universally function to predict soil health due to high variability among inherent soil properties across Hawaiian soil and goals of index use. These most practical and sensitive indicators of soil health will be used in further field trials which will be necessary to determine the effectiveness of implementing new soil health management strategies as well as to identify the quantitative thresholds used in developing scores in a Hawaiʻi soil health index. The preservation of Hawaiian landscapes depends on the collaboration of all types of land managers to improve soil health, as a common goal, for the short term benefits of their livelihoods as well as the long term benefits of generations to come.

(26) Interactive feedbacks of climate, mineralogy and microbiological communities on soil carbon: A deep soil warming experiment. Casey McGrath\*, Nhu Nguyen, Brian Glazer, Stanley Lio, Caitlin Pries, Mathilde Duvallet, Susan Crow. Department of Natural Resources and Environmental Management, Dartmouth College, AgroParisTech.

Climate change conversely is the largest issue facing humanity today. Natural systems exist that could potentially drawdown large amounts of carbon from the atmosphere and aid in the preservation of global ecosystems while long term solutions to destructive human behavior are enacted into policy. Soils are one such system with high potential to drawdown carbon and reduce atmospheric greenhouse gas concentration. But, this benefit may only occur if the mechanisms for stabilizing and storing carbon are not overwhelmed by the interactive effects of rapid warming on multiple soil processes.

Empirical evidence for how deep soil processes (>30cm) will react to the rising global temperature is lacking. The International Soil Experiment Network (iSEN) documents the effects of deep soil warming on the global carbon cycle, but tropical soils are underrepresented, and young volcanic soils, called Andisols, are absent. Andic soils are a critical end member for iSEN given their intrinsic ability to stabilize carbon through their unique mineralogy, which could have immense carbon drawdown potential. This project is working to fill this gap under partial implementation of the iSEN methodology due to limited resources, with a low cost system design.

Through piloting a methodology to be adopted by the database, the projects design could aid in including under-represented soil and climate types to the iSEN network that lack the funding for traditional soil warming experiments. The reaction of deep soils to the rise in global temperatures is one of the most complicated issues global climate change modelers face due to lack of data. By improving the forecast for global climate models, this study has potential to showcase Hawaii's unique soils as a possible tool to drawdown carbon. If the proposed hypothesis that Andic soil respiration (release of carbon dioxide by microbes) does not increase with an increase in soil temperature proves true, then efforts could be focused on increasing the carbon drawdown potential on Andisols, which are the most extensive soil type in Hawaiʻi. This would include the work of land managers and farmers increasing the vegetative cover of the soil and improving soil tillage practices, in turn improving the health of the communities.

The project began soil profile heating in November 2018 with data collection each week on soil respiration, moisture and temperature to determine the relationships between these feedbacks and soil mineralogy and microbial communities with intensified warming. After several months of warming, there has been no response from the microbes within the profile (1m) of the soil. This indicates that there has yet to be a significant release of carbon from the soil via microbial respiration, even with intensified warming. This is contrary to other soil warming experiments, which saw an immediate microbial respiration response after heating, but consistent with other research showing Hawaiʻian Andisols may not feedback to warmer temperatures. This means that Andic soils have potential to reduce the overall carbon in the atmosphere, even with intensified warming. If the lack of response continues then Andisols could possibly be used as a carbon management tool.

(27) Turning waste into resources: Anaerobic digestate’s potential as a biofertilizer in Hawaii. Jacqueline Pitts\*, Jonathan Deenik, Nhu Nguyen, Samir Khanal. Department of Tropical Plant and Soil Sciences, Department of Molecular Biosciences and Bioengineering.

Currently, Hawaiian farmers import the majority of fertilizers, fuel and seeds for local food production, leaving the island state particularly vulnerable to price fluctuations, scarcity and natural disasters. Hawaii’s fertilizer prices are higher than the U.S. largely because of shipping costs. Increasing availability and accessibility of local fertilizers and other products that improve plant growth will offset some of the higher costs of agriculture in Hawaii. This in turn will contribute to making agriculture in the state both less vulnerable to external pressures and more competitive with U.S. mainland agriculture. Ultimately, this improves livelihoods for local farmers while helping to satisfy the increasing demand for locally produced food in Hawaii.

Anaerobic digestion is a process used to both manage waste and produce renewable fuel from organic materials. The primary product is biogas, largely composed of methane, which can be used to generate electricity or refined into natural gas and fuels. The effluent that remains, referred to as biogas slurry, biogas residue, and hereafter termed “digestate” can be utilized as a nutrient-rich fertilizer and soil amendment. Various feedstocks are used in AD, ranging from waste products (i.e. manures, agricultural wastes, food waste) to dedicated energy crops. The use of waste products in AD provides additional benefits including net energy production rather than consumption and mitigation of the need for costly waste disposal, while also producing a potentially high-value soil amendment.

In order to assess the value of digestate as a biofertilizer, a study was conducted investigating its impacts on the growth of kai choy, a commonly grown leafy green in Hawaii. The goal of the study was to assess the effects of two different digestates at varying concentrations in comparison with a retail organic fertilizer on kai choy growth and yield. In addition, various parameters were measured (root structure and growth, nutrient use efficiency, and total biomass) in order to better understand the mechanisms behind digestate’s effects on plant growth.

The results from preliminary studies indicate that digestate may have a greater impact on plant growth than its nutrient value alone. Digestate addition increased plant dry biomass significantly more than an equivalent synthetic nutrient solution. This suggests that there may be additional mechanisms by which digestate improves plant growth. In addition, digestate addition showed similar growth to a conventional fertilizer at only half the rate of application, suggesting that the use of digestate may help decrease the need for costly inputs of fertilizer. An additional study is currently being conducted to assess the effects of the digestates on root growth and morphology as a possible mechanism for improved plant growth with digestates.

Utilizing digestate in agriculture has the potential to improve local agriculture while also reducing waste. Further research on the mechanisms that lead to improved plant growth from digestate is needed to better utilize this valuable resource. Studies of this nature provide valuable information to help increase local food production here in Hawaii by using locally available resources.

(28) Effects of Whole Soil Inoculation on the Translocation of the Endangered Plant, Cyrtandra kaulantha. Pia Ruisi-Besares\*, Carl I. Evensen, Rakan Zahawi, Tamara Ticktin. Department of Natural Resources and Environmental Management, Department of Botany.

Over 85% of Hawaiʻi’s flora is found nowhere else in the world, yet, human related disturbance has caused widespread extinction of native species. In attempts to combat this loss, land managers rely heavily on habitat restoration and reestablishment of species. However, because native plant populations are often small and isolated, most rare species have not been empirically studied leading unpredictable restoration success. In order to make assessments and create best practices, different variables need to be tested to determine optimal planting conditions prior to outplanting. One potential variable is the ability for plants to form beneficial relationships with belowground microbiota. Recent research suggests that effective plant restoration is directly correlated with the health and availability of soil microbial communities in the area. Certain soil microbiota can form mutualisms with plants that enhance their resilience in degraded systems. Thus, it is necessary to understand the relationship between local soil microbial communities and their host species.

My research uses the critically endangered endemic plant species, *Cyrtandra kaulantha*, as a model to explore the impacts of mutualistic relationships formed in the greenhouse on the success of restoration of the species in the wild. To test this, we grew *Cyrtandra kaulantha* individuals in 5 different treatments in the greenhouse: 1.) control media, 2.) media with phosphate amendmen, 3.) media with whole soil collected from the native reference site, 4.) media with whole soil collected from the ʻAihualama site where the plants were outplanted, and 5.) media with both ʻAihualama soil and phosphate amendment. In the greenhouse we measured the growth and survivorship of each plant over 10 weeks before translocating them to the restoration site. Once outplanted, we measured the same characteristics every 4 weeks. Data collected from the field study is ongoing and will culminate with 12 months of data this November.

Native plants that thrive in the greenhouse don’t always survive after outplanting. Under greenhouse conditions, young propagated plants create fewer relationships with beneficial soil microbiota because resources are abundant. However, field conditions are often harsher and nutrients are locked in inaccessible forms that are difficult to uptake without these enhancing relationships. Plants that don’t form these relationships during cultivation are less likely to develop them when they are mature and thus, struggle in the wild. As anticipated, *Cyrtandra kaulantha* in our greenhouse experiment showed no difference in growth by treatment, but presence of mycorrhizae was confirmed. The effect of these treatments will become more important as the plants are forced to acclimate to conditions in the field.

Positive correlations between whole soil inoculation in the greenhouse and plant growth and survivorship in the field could have significant implications for plant cultivation practices. Getting plants to survive once translocated to the field, is one of the biggest hurdles to native restoration. Whole soil amendments collected from the reference or translocation sites are relatively easy and inexpensive to obtain and the technique does not require sterile conditions or expensive laboratory equipment. Land managers in Hawaiʻi need efficient and applicable methodologies in order to fight rampant biodiversity loss across the islands and need to better understand the interactions between regional community structure and beneficial soil microbial relationships.

(29) Environmental Conditions For Obtaining The Most Nutritious Fodder From Giant Leucaena. Ahmed Bageel\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

In tropical and sub-tropical regions during dry seasons, ruminants are usually fed on annual grasses. These grasses are not ideal as fodder because of their low concentrations of crude protein and low digestibility. Such a diet leads to a daily weight gain of less than 300 g of young animals, and low milk production in lactating cows. Therefore, the need for a high-protein fodder became essential, and the candidate forage for these regions is giant leucaena.

Leucaena is a legume tree suitable for sustainable agroforestry systems. It can withstand biotic and abiotic stresses in general; therefore, it grows successfully in a wide range of tropical and subtropical areas. Leucaena can be divided into two groups, common leucaena and giant leucaena. Common leucaena is considered as short, shrubby and invasive weed; whereas, giant leucaena is considered as a medium/large size tree but it can be grown as bushy small trees by repeated pruning. Leucaena, especially giant leucaena, is one of the best fodder legume due to its high protein content and palatability of the foliage. In fact, leucaena is referred to as the ‘alfalfa of the tropics’ because of its high nutritional value. However, the presence of mimosine and condensed tannin in high concentrations prevents the use of leucaena as a main fodder source, and make it as a complementary protein source with other fodders.

Mimosine and tannin are secondary metabolites, and leucaena uses them to withstand biotic and abiotic stresses. Therefore, their concentrations vary depending on the stresses, which the plant is exposed to. Mimosine is a non-protein amino acid and toxic to animals; and thus, it reduces the nutritive value of the plant. On the other hand, tannin is a phenolic compound that reduces the nutritive value of the fodder since it binds and forms a complex with crude proteins and makes them indigestible by ruminants.

According to previous studies, there are safe daily intake for both mimosine and tannin so that they will not be harmful to animals. In terms of mimosine, safe daily intake varies depending on the ruminant body weight (BW), 0.18 g/kg BW for cattle, 0.14 g/kg BW for sheep, and 0.18 g/kg BW for goats. In contrast, safe daily intake of tannin is the same for all ruminants, less than 50 g/kg dry mater.

The concentrations of these two chemicals with other nutritional factors such as crude protein and digestibility were investigated in both giant and common leucaena under different environmental conditions. Although, we are interested primarily in giant leucaena, it is available in limited locations. On the other hand, common leucaena is found almost everywhere. So, samples from different regions on Oahu Island were collected depending on the rain fall of each region. Then, samples were analyzed by biochemical aspects. Mimosine and protein contents were found to be negatively affected by drought. In contrast, tannin content increased under drought conditions, and it did not corelate with the production of either protein or mimosine. Our goal is to find the optimum environmental conditions to give the best combination of the nutritional components in giant and common.

(30) You are what you eat: Modulation of the intestinal histology and microbiome using microalgae as a fishmeal/fish oil replacement in the diets of tilapia. Alyssa MacDonald\*, Rajesh Jha, Armando Garcia-Ortega. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences, University of Hawai'i at Hilo.

The largest costs in aquaculture production include the fish feed and maintenance of fish health through disease prevention and treatment. Many fish feeds include fishmeal as protein source from wild caught fish, which has been shown to be unsustainable. Therefore, the aquaculture industry has been exploring alternative protein and lipid sources for aquaculture feed. Since the ban or regulation on the use of antibiotics as a growth promoter in aquaculture, research has been directed into the use of alternatives to modulate the intestinal microbiota of aquaculture species. Prebiotics are fibrous compounds in food that induce the growth or activity of beneficial microorganisms such as bacteria and fungi in the intestinal tract of hosts. To date, the majority of prebiotic research has involved the use of non-digestible oligosaccharides and inulin.

Modulation of the intestinal microbiota of aquaculture species through the use of prebiotics not only benefits the health of the host, but also reduces costs to aquaculture production. Like prebiotics, feed ingredients with high fiber and resistant starch also modulate the intestinal microbiota of the host while providing nutritional value for growth performance. Microalgae have been considered as alternative feed ingredients to reduce the reliance on wild-caught fishmeal and fish oil in the diets of aquaculture species. They are ideal alternative feed ingredients because they can be easily cultivated and can be selected for high production of lipids and protein and may also modulate the intestinal microbiota of species of interest.

Tilapia *(Oreochromis sp.)* are the most widespread aquaculture species in the world due to their relative fecundity, omnivorous feeding habits, and tolerance of marginal growing conditions, making them ideal study species for alternative feed ingredients. This study investigated the use of microalgae as fishmeal and fish oil replacements to reduce feed cost while promoting the intestinal health of hybrid tilapia *(O. niloticus x O. mossambicus)* through the promotion of beneficial microbes. Growth parameters were recorded weekly and intestinal samples were collected monthly and processed for microbiota analysis using metagenomics and histological analysis of the intestinal lumen. Tilapia growth performance was significantly higher in the 100% algae-based diet compared to the fishmeal and fish oil control (P>0.05), suggesting that microalgae can completely replace fishmeal and fish oil in the tilapia diets without negative impact. Microalgae inclusion into the tilapia diets did not significantly alter the overall intestinal microbiota. However, several species were significantly different between treatments, most notably an increase in *Parabacteroides goldsteinii* in the 100% algal inclusion. P. goldsteinii is a known beneficial microbe in the human GI tract, thus the inclusion of algae in the diets may be used as a strategy to modulate the gut health of Tilapia. Additionally, several novel species were reported in tilapia including the two most common species across all treatments, *Mycobacterium pinnipedii*, a closely related species to the tuberculosis-causing *Mycobacterium tuberculosis*, and the non-tuberculosis causing, *Mycobacterium brasiliensis*. Histological results did not show a significant difference between treatments, suggesting that algae inclusion in the diet does not negatively affect the health of tilapia.

(31) Strawberry Guava as a Source of Natural Herbicides: Utilizing the Chemical Warfare Capacity of an Invasive Species for Human Benefit. Joey Ooka\*, Daniel K Owens. Department of Molecular Biosciences and Bioengineering.

There is growing interest in alternatives to commercial herbicides and increased enthusiasm for organic farming practices. This is particularly true in geographically-isolated Hawaiʻi where the protection of land, water and residents is of the highest concern. Strawberry guava *(Psidium cattlianum)* is one of the most widespread invasive species in Hawai’i, due in part to its lack of native predators and allelopathic properties. Allelopathic plants are defined as those which can produce their own natural herbicides to compete with other plants for desired resources such as nutrients or sunlight.

While there has been little work with allelopathy in strawberry guava, it has been shown that the common or American guava *(Psidium guajava)*, a close strawberry guava relative, is allelopathic. Studies have shown that a 20% leaf extract solution of regular guava is enough to cause an almost 40% reduction in growth of lettuce plants. Even more interesting, common guava leaf extract has shown to be selective, inhibiting the growth of weeds and nematodes, but leaving crop plants such as sunflower undisturbed. Our primary aim is to establish the allelopathic profile of strawberry guava and to investigate the weed-killing activity of identified compounds. We have shown for the first time experimentally, to our knowledge, that strawberry guava has allelopathic activity. Leaf extracts inhibit lettuce growth from up to 10mm away from whole strawberry guava leaves. In addition, both lettuce (representative dicot) and green onion (representative dicot) show inhibited growth comparable to regular guava when exposed to strawberry guava leaf extracts. By comparing leaf extracts from water and acetone, we have determined that the allelopathic chemicals have an affinity for water, and are currently in the process of determining the identity of the allopathic chemical in question. Therefore, strawberry guava may represent an, as of yet, uninvestigated source of new herbicidal compounds.

Herbicides are a critical component of most pest management strategies, but past overuse of available chemistries has reduced their effectiveness. This work is an initial step toward the discovery of new herbicidal modes of action to combat weeds. In addition, establishing the nature of allelopathy in strawberry guava has implications for reestablishing native environments. For example, native plants resistant to strawberry guava’s allelopathic complement can be planted around the perimeter of reclaimed areas to provide a defense against intrusion by the species. Our work provides a sustainable strategy to utilize strawberry guava to advantage for its inherent abilities while having implications on limiting its negative effects on native species.

(32) Below ground battle: Does biofumigation have non-target impacts on soil health promoting free-living nematodes? Philip Waisen\*, Koon-Hui Wang, Zhiqiang Cheng, Brent Sipes. Department of Plant and Environmental Protection Sciences.

Regulatory agencies are stringent on the use of toxic pesticides such as methyl bromide and 1,3-dichloropropene to control soil-borne agricultural pests. Biofumigation is considered a viable alternative. However, limited information is available on non-target impacts of biofumigation on soil health. Free-living nematodes are a diverse group of beneficial nematodes living in the soil with different feeding behaviors, and responding differently to subtle environmental changes in the soil. A structured soil food web has higher abundance of omnivorous and predatory nematodes, whereas nutrient enriched soil has high bacterivorous but low fungivorous nematode abundance. The objective of this experiment was to use nematodes as soil health bioindicators to evaluate the impact of biofumigation on soil food web.

Three field trials were conducted at Poamoho Experiment Station to compare the use of brassica crops having low or high glucosinolate content such as oil radish *(OR; Raphanus sativus)* and brown mustard *(MS; Brassica juncea)*, respectively. These crops were grown as biofumigant crops and terminated by different methods expected to generate different levels of ITCs. Treatments include tilling or not tilling in the soil, macerating or not macerating the tissues, followed by covering or not covering with black plastic. Zucchini *(Cucurbita pepo)* was transplanted 1 week later. Soils were sampled at 1 week after biofumigant crop termination and at monthly intervals during the subsequent zucchini crop. Nematodes were extracted from the soil, counted and calculated into nematode community indices. Glucose and sulfate in the soil were analyzed as indicators of biofumigation efficiency. Canonical Correspondence Analysis (CCA) was conducted to detect relationships between the soil health bioindicators and biofumigation indicators.

Results showed that combining all three termination methods together maximized biofumigation effect on root-knot and reniform nematodes, two of the key plant-parasitic nematodes in this field. Suppression of root-knot nematode was stronger when using MS than OR. Interestingly, all biofumigation method did not compromise soil health. Instead, biofumigation with OR enhanced nutrient enrichment as indicated by higher abundance of bacterivorous nematodes and Enrichment Index (EI) calculated from these group of nematodes throughout the zucchini crop compared to the untreated control. Whereas biofumigation with MS regardless of termination methods enhanced bacterial decomposition and EI for up to 1 month after biofumigation in one of the three trials. Though no significant effect was detected in the second trial, terminating MS by tissue maceration and tillage also increased abundance of bacterivores throughout the zucchini crop on another trial. Biofumigation efficiency measured by glucose analysis (with toluene added immediately after soil sampling to arrest soil microbial degradation of glucose) had a strong positive relationship with abundance of all free-living nematodes including bacteriovorous, fungivorous, omnivorous and predatory nematodes. When using sulfate as indicator of biofumigation efficiency, it was again positively related with abundance of bacterivorous and predatory nematodes, as well as EI. CCA clearly depicted that increasing soil temperature by covering soil with black plastic, and generating more biomass of brown mustard enhanced biofumigation efficiency. In conclusion, biofumigation was very suppressive against plant-parasitic nematodes but did not compromise soil health.

(33) Diagnosing Nutrient Deficiencies in Hawaiian Breadfruit *(Artocarpus altilis).* Kahealani Acosta\*, Noa Lincoln. Department of Tropical Plant and Soil Sciences.

Breadfruit *(Artocarpus altilis)* is an abundant staple crop in Hawai'i, possessing historical and cultural value in its versatility. As a low maintenance crop, breadfruit has considerable potential to provide economic and ecological benefits in agricultural systems throughout the tropics and subtropics. Encouraging the productivity of breadfruit can increase food security and environmental sustainability; however, little research has been conducted regarding optimal breadfruit growth. In this classic agronomic "minus-1" experiment, physical and physiological symptoms of depriving a single essential nutrient will be examined to understand optimal breadfruit growth and development. Ten treatments, each consisting of three replicates, are maintained in 45-gallon pots of inert media at the Magoon Research Station. Treatments include one control with all necessary nutrients, eight treatments lacking in one essential macro or micronutrient (N, P, K, Ca, Mg, B, Fe, S), and one treatment that contains all essential nutrients with the addition of a toxic level of NaCl. Monthly applications of fertilizer solutions are applied to the trees until deficiency symptoms are exhibited. Growth is measured by above-ground biomass; a function of trunk height (cm) and diameter (at every 20 cm trunk height increments), leaf color, chlorophyll, photosynthesis, water exchange, and foliar nutrient concentration. Preliminary results from January to December 2018 display limitations of growth in (-)N, (-)P and (-)S treatments. Subsequently, (-)N has shown the lowest productivity in all parameters measured, delineating the furthest from the control. Further results from this experiment will provide essential information to growers seeking to maximize breadfruit productivity.

(34) Avian Botulism: Be on the lookout for dead birds! Cody Ching\*, Jenee Odani. Department of Human Nutrition, Food and Animal Sciences.

*Clostridium botulinum* is an anaerobic, gram-positive, and spore-forming rod organism. These spores are light, heat and radiation resistant, and can be found in soil. After ingesting and absorbing the spore, the toxin will bind to presynaptic membranes of cholinergic nerve terminals. The toxin will then enter the cells and block the release of acetylcholine across neuromuscular joints, ultimately causing flaccid paralysis.

The goal of this paper was to compile known information about this disease to eventually publish and hand out to the general public. Hopefully these efforts create a more informed community that will know how to handle avian botulism in case an outbreak appears and native species are in danger of being intoxicated. The etiology, geographical distribution, transmission, zoonotic potential, treatment, prevention, and public safety was investigated for a full disclosure of this organism.

After compiling the above information, it was discovered that the best way to prevent a *C. botulinum* outbreak is to discard the intoxicated carcasses to prevent organisms from eating any contaminated tissues. The proper way to dispose of them is through burial or burning because both are highly effective in removing toxin and maggot sources from the surroundings to prevent other animals from getting infected. Luckily, the zoonotic potential of avian botulism is minimal because it is a Type-C toxin and humans are mainly affected by types-A, B, and E. In humans, botulism mainly happens after people eat home-canned, preserved, or fermented foods that contained the toxin.

Efforts to preserve the native species can start with recording dead bird findings and performing necropsies on any suspicious carcasses. If any dead birds (domestic and wild) are seen and the cause of death is undetermined, it is important to notify the District Division of Forestry and Wildlife (DOFAW) Office on your corresponding island. For private islands, individuals are asked to take wetland management actions to prevent more birds from being affected by this disease.

(35) The effects of environmental heat stress on the spleens of broiler chickens. Sabrina Nicole Haverly\*, Sanjeev Wasti, Donna Lee Kuehu, Rajesh Jha, and Birendra Mishra. HFNAS.

With the ever-rising global population, there is continuous increase in the demand for more food more food, however, with the rising population comes the rise of the global temperature due to emissions and human’s impact on the earth. Based on trends that have been studied for decades, there is no sign that the global temperature will start to drop, or at least plateau anytime soon. The big question then becomes: how will our agricultural systems handle the rising temperatures while still being able to produce enough food to feed the growing population?

To better understand the impact of heat stress on the poultry growth and health, broiler chickens (n=48) were raised as per standard protocol of Small Animal Facility of College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa. After twenty-one days in the standard commercial condition, the chickens were randomly separated into two groups (n=24/group): 1) No heat stress with a normal diet (control), and 2) Heat stress with a normal diet for 3 weeks. At the end of the experiment, total body weight was recorded and the chickens were euthanized with CO2. All the vital organs, including the spleen were collected. The fresh spleen weights were measured. Pieces of the spleen were snap frozen and stored at -80°C until total RNA isolation. Relative spleen weight was calculated. Total RNA was isolated from the spleen samples using TRIzol. Then 1000ng of total RNA was reverse transcribed into cDNA. The expression of the genes (immune-related, oxidative stress, antioxidants, cell proliferation, and apoptosis) are being analyzed using real time-PCR (qPCR).

The results showed that the total body weight was significantly reduced in the chickens exposed to heat stress compare to the control group. The heat stress significantly decreased the weight of the spleen. This is crucial because, in chickens, the spleen plays an integral part in the immune system of the chickens as it produces antibodies and inflammatory responses to aid the body with coping with stress. The fact that the spleens in these chickens were so small show that the chickens will be more susceptible to bacteria, stress-related illnesses, and death. Future work will look into the main genes, related to immunity, that are downregulated in the spleen so that future counter measures, such as supplements, can be put into place to improve the immune system of the heat stressed chickens.

(36) The GLY Clean. Skyland Koizumi\*, Xiaohan Liu, Yong Li, CN Lee. Department of Human Nutrition, Food and Animal Sciences.

Fresh produce are often eaten raw or after minimal processing. Between 1998 and 2013, fruits accounted for 35% of 972 raw produce outbreaks that resulted in 34,674 illnesses. Good agricultural practices (GAP) contribute to lowering the risk for pathogens to enter the food chain. However, due to the open nature of farming, there are many points along the production process where produce can become contaminated. Contamination routes for produce include, but are not limited to, contaminated irrigation water, growth adjacency to the ground, and poor worker hygiene.

The produce industry uses high pressure and pulsed light treatments to reduce or kill bacteria on the products. While these two methods are effective, they are costly and may create undesirable characteristics of the final product resulting in poor consumer acceptance. Other decontamination procedures utilized by the produce industry include edible coating, irradiation, sulfur dioxide, and sodium hypochlorite. These also have their own respective disadvantages, such as high capital cost, potential health risk, and limited antimicrobial effect. Therefore, cost-efficient and effective alternative methods of fresh produce decontamination require investigation.

Amino acids play a vital role in the human body, such as building proteins and synthesizing neurotransmitters and hormones. Glycine exists as the simplest amino acid. It possesses a sweet taste which allows it to be used as a suitable additive to food products. Previous research has shown that glycine has antimicrobial effect on some bacteria in food matrices such as milk, pasta, chicken, and pork. This study aimed to determine the antimicrobial effect of glycine on pathogenic bacteria in microbiological media and on strawberries.

20% glycine (w/v) was tested on *Escherichia coli* and *Salmonella Typhimurium* via the agar well diffusion assay. Glycine did generate zones of inhibition against the two bacteria in Mueller-Hinton agar. Broth growth test further proved the antimicrobial properties of glycine at 10%, 5%, and 2.5% in Mueller-Hinton broth. E. coli inoculated onto strawberries was able to grow during refrigeration, and the number increased seven fold from day 0 to day 1. However, following the application of glycine at concentrations of 20%, 10% and 5% to fresh strawberries inoculated with E. coli, the bacteria displayed a substantial decrease in number during refrigeration, indicating glycine is an effective antimicrobial. Current efforts look to investigate if glycine will be able to inhibit other pathogenic bacteria inoculated on strawberries. The results of this study suggest that glycine has potential to be used as an alternative method for effective decontamination of fresh strawberries.

(37) Super Small and Super Important: Researching the Interactions between local Copepods and their Phytoplankton Foodsource. Clarine Phipps\*, Sabrina Haverly. Department of Human Nutrition, Food and Animal Sciences.

Copepods are abundant in all freshwater and marine systems with over 11,000 species currently identified. They are the natural prey for most larval fishes, crustaceans and molluscs. Previous study has shown that copepods as a live feed can increase survivability and growth rates in larval stages of many species, and that copepods are an important live feed in hatcheries as copepods stimulate strong feeding responses in larvae. The copepod *Euterpina acutifrons* is ideal for use on Oahu, as they are readily found on the coastline, are small in size which is optimal for beginning larval stages of aquaculture species such as shrimp, and have high nutritional value. However, their use is only as good as their survivability, which is directly tied to the nutrition provided. Copepods are notoriously difficult to keep, but we have found that with the correct feed and habitat maintenance it is a passive culture.

Phytoplankton species are the basis of all marine and freshwater food webs, and are the main source of nutrients to copepod populations. The balance of phytoplankton species in a natural environment is extremely important to the ecological services they provide. Marine diatoms, for example, provide approximately half of the world’s oxygen. If one species of phytoplankton displaces another it could impact these types of ecological services. Aquaculture producers on the Hawaiian islands mainly rely on powdered or pelleted phytoplankton to feed, which is often imported from China and is not highly regulated. Because of the ecological concerns, it is important that we focus on local species when choosing phytoplankton feeds for aquaculture.

Keeping these locally sourced standards in mind, a live culture of copepods was collected from the Waikiki Aquarium, and research began into which feeds stimulated the most successful feeding response. Four feed types were utilized, either those currently used in production, or identified as suitable by previous study; algae wafers, Shellfish 1800, diatoms, and Haptophyta species. Based on preliminary studies, it was hypothesized that the algal wafers and live feeds would be the least and most successful respectively. Feeding trials were conducted in 7 and 3 day intervals, with phytoplankton cell counts calculated for each trials. Results showed that copepod populations increased with the Shellfish 1800, algal wafer, and Haptophyta species whereas the population remained stable with no increase when fed the diatoms. No evidence of spontaneous reanimation in the inert feeds were seen which substantiates the ecological safety of these feeds in production. Greater ingestion rate of live feeds were attributed to its ability to remain in the water column. In addition, the live feeds have an advantage in an ability to be seeded in the water column and sustain a population rather than needing to be fed daily. Overall, the research showed no evidence of ecological concern in using inert feeds and a greater ingestion rate of live feeds leading to further population densities of the copepods.

(38) Evaluation of superhydrophobic food contact surface to prevent adhesion of Listeria monocytogenes for improved food safety. Bog Eum Lee\*, Soojin Jun. Department of Human Nutrition, Food and Animal Sciences.

A biofilm is a population of microbial cells growing on a surface and enclosed in an extracellular matrix. Biofilm formation on the surfaces of food processing equipment has been widely recognized as a problem as it can act as a source of microbial contamination. Extensive research has been progressed towards the reduction of bacterial adhesion and subsequent biofilm formation using superhydrophobic (contact angle > 150 o) surface finishes. A superhydrophobic (SH) surface can be fabricated by using low surface energy on micro/nanoscale rough substrate. It is well-known that this surface repels water droplets and has self-cleanability attribute. *L. monocytogenes* is one of a major hazardous biofilm-forming pathogenic bacteria which can cause foodborne illness, *listeriosis*. To control this outbreak, it is important to control the adherence of the microorganism to food contact surfaces.

SH surface fabricated by electrochemically etching of stainless surface with PTFE coating was utilized to test the repellency against *L. monocytogenes*. The superhydrophobicity (contact angle > 150 o) of the stainless steel coupons were confirmed by a contact angle goniometer. The goal of this study was to evaluate the anti-adhesive properties of SS under static and dynamic flow conditions. The coupons were incubated for 6 days at 25 oC to test the biofilm formation under static condition. Under a dynamic flow condition, a higher supply rate of bacteria could result in strong attachment to the surface. To better study the biofilm growth behavior of bacteria under a flow condition, a study was conducted by using Centers for Disease Control and Prevention (CDC) reactor for 24 h. A nutrient medium was applied at a flow rate of 11.67 ml/min to control fluid shear stresses on *L. monocytogenes*.

The contact angle of SH surface was greater than 150° and indicated that the contact area of water droplet on the SH surface was low. The number of bacterial cells adhered to SH surface under a static condition was significantly lower than the bare specimen (contact angle=82°) by 2.1 CFU/cm2. This result indicated that the superhydrophobicity could effectively inhibit microbial adhesion. Under a dynamic flow condition, bacterial repellency was further increased by 2.9 CFU/ cm2 compared to the smooth specimen. This demonstrated the important self-cleaning properties of SH surface. The fluid shear stress contributed in detaching water droplet efficiently and removed bacteria on the SH surface. These results highlight the importance of SH surface in reducing bacterial adhesion for preventing biocontamination.

This study has suggested that SH surface fabricated by PTFE coating on the nanoporous surface can hinder the bacterial attachment and biofilm development of *L. monocytogenes.* Further investigation of the universally applicable SH surface against a variety of microorganisms should be investigated.

(39) Where’s the fresh eggs and meat? Improving the Hawai‘i poultry industry through communication and outreach. Kathryn Paradis\*, Jenee Odani. Department of Human Nutrition, Food and Animal Sciences.

Poultry are a major part of the animal agricultural industry, especially in the U.S. where approximately 92 pounds per capita of broiler meat were consumed in 2018 (compared to 59 pounds per capita of beef and 52 pounds per capita of pork). Poultry production across the U.S. is steadily increasing; however, in the state of Hawai‘i, production is declining. There are a number of factors that could be contributing to this decrease in Hawai‘i, including competition with mainland imports, limited slaughter options, and higher business costs associated with feed, labor, predators, and health challenges. In order to find areas where improvements can be made to reduce production burdens and provide room for the Hawai’i poultry industry to grow, a good understanding of the Hawai‘i poultry industry is necessary. My project aims to determine the current state of the poultry industry in Hawai‘i by 1) determining current management practices of chicken farmers in Hawai‘i, 2) determining the general health status of domestic chickens in Hawai‘i, and 3) characterizing external and internal parasites of domestic chickens in Hawai‘i. To do so, I will create a survey and communicate with farmers to collect information about management practices currently in use on farms. I plan to reach out to 75 farmers with my survey. I will also perform physical examinations on birds and fecal flotation tests on fecal samples collected from 25 farms to characterize external and internal parasites. The data collected from my project will be used to determine beneficial management practices and identify parasites present on Hawai‘i poultry farms. This information will then be reported back to farmers, and used to create general recommendations for Hawai‘i poultry farmers, which will in turn help reduce production burdens aiding in the future increase of poultry production in Hawai‘i.

(40) Dietary supplementation of dried plum: A novel strategy to mitigate heat stress in poultry. Sanjeev Wasti\*, Donna L. Kuehu, Nirvay Sah, Amit Singh, Rajesh Jha, Birendra Mishra. Department of Human Nutrition, Food and Animal Sciences, Department of Molecular Biosciences and Bioengineering.

The Earth is warming at an alarming rate, and it is likely that the global average temperature will increase by 4°C by 2100 A.D. Heat stress, one of the consequences of global warming, is a significant problem in the poultry industry and results in an annual economic loss of $128 million to the U.S. poultry industry. Heat stress causes several physiological changes such as, oxidative damage, acid-base imbalance, and suppressed immunocompetence. These all lead to reduced feed intake and body weight, poor feed conversion, decreased meat and egg quality, increased susceptibility to diseases, and increased mortality. With the growing human population and rising environmental temperature; heat stress in poultry, therefore, impends food security for the protein if we do not adopt proper remedies.

Various strategies such as supplementation of vitamins, antioxidants, electrolytes, and phytochemicals have been used to reduce heat stress in broilers. However, only a few of them have been partly effective to mitigate the deleterious effects of heat stress at a nominal cost. Dried plum (DP) is a good source of minerals, vitamins, antioxidants, and phenolic compounds, and is found to play a role in calcium homeostasis, and cardiovascular dysfunctions in humans. Based on the health benefit and commercial availability of DP, we hypothesized that the dietary supplementation of DP would ameliorate the detrimental effects of heat stress in broilers. The objective of this study was to determine the effects of dried plum on the growth performance, and gut health parameters of broilers.

To test the hypothesis, day-old chicks (n=72) were randomly allocated to three treatment groups (n=24/group): no heat stress (NHS), heat stress (HS), and heat stress with dried plum (HS+DP) and reared under standard husbandry practices. After 21 days, birds in the HS and HS+DP were exposed to heat stress condition (33°C for 8 hours during the day) for 3 weeks. HS+DP birds were provided with 2.5% of DP in the feed during the treatment period, while birds in other treatment were provided with a standard broiler diet. Weekly body weight and feed intake were recorded to calculate the average daily growth rate (ADG), average daily feed intake (ADFI), and feed conversion ratio (FCR). After 3 weeks of treatment, chickens were euthanized, a portion of ileum tissue was collected for gene expression analysis. Approximately 1 cm of ileum segment was preserved in 10% NBF for ileum histomorphometric analysis. Similarly, cecal digesta was collected to analyze the microbial population by using 16s DNA sequencing.

Supplementation of DP in the heat stressed birds significantly increased the final body weight, ADG, ADFI, and FCR. Furthermore, supplementation of DP significantly increased the expression of antioxidant-related genes (SOD1, SOD2, GPX1, GPX3, PRDX, ROS, TXN), tight junction-related genes (CLDN1, OCLN), and immune-related genes (IL-4, MUC2) in the ileum. Additionally, DP also improved the gut microbial profile in the heat stress birds. In conclusion, dietary supplementation of DP reduced the negative effect of heat stress on broilers. Thus, this novel finding can potentially be used in dietary programming for industrial purposes.

(41) Potential in Organic Sweet Potato (U’ala) derived from Hawaiian Germplasm. Todd Anderson\*, Michael Kantar, Theodore Radovich, John Paul Bingham. Department of Tropical Plant and Soil Sciences.

Sweet Potatoes have been an important staple in the Hawaiian islands and throughout the Pacific for centuries. The plants ability to be stored, high nutritional value, reliability to yield in drought or poor soil and versatility is the reason for this. The importance of sweet potato eclipsed taro in some dry leeward areas of Hawaii. Like all of the canoe crops, a plethora of varieties of U’ala were developed and maintained by the Hawaiians. These cultivars are genetically distinct from the newer varieties now commercially grown in the state, which are descended primarily from Japanese germplasm. The traditional varieties have been displaced throughout the state because of their growth habits, maturation time, pest resistance and yield are not easily adapted to commercial production.

Sweet Potato growers, like all farmers in the state are facing increasing pressure from high production costs. These include land prices, labor and import competition from the mainland. Sweet Potatoes are functionally a commodity crop, if cured they can be shipped long distances, meaning the fresh market of sweet potatoes in Hawaii is open to competition to mainland growers. Imports of Asian type and orange flesh type sweet potatoes have forced local growers to leave the industry, switch to higher value shorter rotation crops or to concentrate on the value products from sweet potatoes, especially chips. Processing the crop requires a commercial kitchen, which is simply not possible for most growers, preventing them from being able to produce sweet potatoes economically. Varieties developed from Hawaiian traditional cultivars could be marketed as “Hawaiian Heritage” or similar designation so growers could earn a higher price point without processing. Value added products such as alcohol and desserts

The main purpose of this project is to identify useful traits in open pollinated crosses of Mohihi that was planted with eleven other varieties of traditional Hawaiian u’ala. This is called a polycross block, common with establishing breeding populations of sweet potatoes. Sexual reproduction in plants allows traits in the progeny to be expressed that are not visible in the parent plants. This is how we will use the crosses to identify traits such as yield, sugar content and basic traits and appearance of tubers. These traits will be used, along with a collaboration in trialing for potential alcohol production to establish the potential for further breeding work. It is hoped cultivar development utilizing traditional Hawaiian crops will help farmers, create new marketing opportunities and allow the general population to access traditional Hawaiian foods currently unavailable.

(42) Hawaiian Sheep and Goats at Risk: Identification of Small Ruminant Parasites and Diseases in Conjunction with Farm Management Practices throughout Hawai’i. Nathan Heinzman\*. Department of Human Nutrition, Food and Animal Sciences.

Small ruminant production has played a significant role in Hawaiian agriculture since sheep and goats were introduced to the islands in the late 1700s. Since that point local producers have raised sheep and goats for a meat, dairy, and land management. Currently there are over 35,000 sheep and goats across approximately 800 farms in the state. Despite the growing number of small ruminant producers in Hawai’i, there is little to no testing being done for disease surveillance and management practice identification.

Proper farm management and biosecurity practices are key to keeping animals healthy and productive. Prior to this study, the current practices being used by small ruminant producers around the states were unknown. A survey administered to producers throughout the state collected data on sources of new animal introductions, herd numbers, vaccination protocols, deworming protocols, pasture type/management, supplementation practices, husbandry practices, number of breeding animals, disease conditions observed, and the biosecurity protocols used on each farm. Information on what current practices are being used is central to linking particular practices to high disease prevalence, as well as making recommendations to producers to improve the overall health of their herds.

Disease surveillance programs sponsored by the USDA and Hawai’i Department of Agriculture are limited in the diseases that they screen for, as they currently only test for Scrapie. There is no record for the prevalence of other common and potentially costly diseases such as Johnes Disease, Caprine Arthritis Encephalitis/Ovine Progressive Pneumonia, and Caseous Lymphadenitis. Left unchecked, these diseases result in production loss for producers and often death of the animals. To understand the prevalence of these diseases throughout the state blood samples were collected from herds on the islands of Hawai’i, Maui, Oahu, and Kauai and tested for the presence of absence of these diseases.

Additionally, the control of internal parasites on small ruminant farms is necessary in maintaining healthy sheep and goat populations. Strongylid stomach worms and coccidian parasites are two of the most common internal parasites afflicting small ruminants. In high numbers, both of these parasites can result in retarded growth, production loss, and death. Similar to the method for disease testing, fecal samples were collected from herds on the islands of Hawai’i, Maui, Oahu, and Kauai and used to calculate egg counts for individual animals. These egg counts allow for the identification of farms which are hotspots for high internal parasites, and what sorts of management practices may be linked to these particular farms.

The goal of this project is to provide data that farmers and veterinarians can use to understand the distribution of disease throughout the islands, make scientifically sound decisions regarding animal movement and biosecurity, and provide the baseline data to begin disease eradication efforts at the herd level. Using baseline data from this study, general and owner-specific herd health programs can be developed. This will improve animal welfare, animal production, and food safety in Hawai’i.

(43) Characterizing soil-water relations to improve irrigation practices in Hawaiʻi’s agricultural systems. Kristy Lam\*, Jonathan Deenik, Sayed Bateni, Yin-Phan Tsang. Department of Natural Resources and Environmental Management, Department of Tropical Plant and Soil Sciences, Department of Civil and Environmental Engineering.

Doubling local food production by 2030 is one of the six sustainability goals of the Aloha+ Challenge. However, one of the limiting factors to vegetable production is water. Thus, irrigation management tools are necessary to meet this ambitious goal. In Salinas, California, a web-based management tool called CropManage was developed to recommend irrigation schedules based on evapotranspiration, crop characteristics, and soil water data. A soil water characteristic curve (SWCC) graphically represents the relationship between soil volumetric water content and soil matric potential and is used to assess soil moisture threshold values to prevent water stress in field crops. A soil moisture threshold is a critical point in a SWCC because it represents where plant available water (PAW) is maximized and water stress minimized. Soil structural properties (i.e. particle size distribution, pore size distribution, etc.) determine the shape of a SWCC. Thus, understanding what drives soil water dynamics can help predict SWCC for other soils. However, most studies focus on vegetable production in temperate soils rather than tropical soils. Therefore, the same water retention models (i.e. pedotransfer functions) cannot be applied to tropical soils because soil water dynamics are driven by different soil properties, especially clay mineralogy and soil organic matter. Currently, Hawaiʻi lacks basic soil water data necessary to characterize and predict soil water behavior. The first research objective is to identify key soil properties that control water retention at the wet end of the soil moisture range important to vegetable production (i.e. 0 to -100 kPa) and develop a model that can predict SWCCs. To further explain soil water behavior, the second objective aims to determine the relationship between distribution of pore size and shape, and the SWCC. The study will compare soil types with varying clay mineralogy (high-activity, low-activity, and amorphous) and soil organic matter. Management and depth effects will also be investigated.

Preliminary data on two contrasting soils (i.e. Andisol and Vertisol) under cultivated management showed that over 80% of the total water content is retained between 0 and -30 kPa. Furthermore, a oneway ANOVA showed that from -10 to -30 kPa, the two soils were significantly different from each other (0.0006<α=0.05), with the Andisol (0.073±0.003) retaining more water than the Vertisol (0.027±0.003). The -10 and -30 kPa range is particularly important because plants extract water from the soil matrix with ease, therefore, this range is optimal for plant growth. Additionally, the soil porosity (i.e. volume of pore spaces) was significantly greater for the Andisol (0.72±0.009) compared to the Vertisol (0.53±0.009) indicating a higher capacity for water storage.

The future of Hawaiʻi’s agriculture needs irrigation management tools such as CropManage. Improving irrigation schedules increase food security and promote a more sustainable and robust agricultural system. Predictive models recommending more efficient irrigation schedules help conserve water resources, combat future climatic changes, and increase food security. Understanding soil water dynamics in Hawaiian soils will not only increase the knowledge base of tropical food systems, but it can also be applied to other soil processes (i.e nutrient transport, etc.).

(44) Comparison of the Antimicrobial Activities of Ohelo Berry and Cranberry. Xiaohan Liu\*, Stuart Nakamoto, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Ohelo berry *(Vaccinium reticulatum)* is a Hawaiian wild relative of cranberry *(Vaccinium macrocarpon)* and an endemic plant in Hawaii. Cranberry is well known for its antimicrobial activity and has been used to prevent urinary tract infections. Previous research indicates that both ohelo berry and cranberry are rich sources of phenolic compounds. However, there is no report on the antimicrobial activity of ohelo berry. The control of foodborne pathogens is imperative since the pathogens can threaten human health and cause enormous economic loss. Nowadays consumers tend to choose natural, safe, and healthy food. Thus, the addition of natural antimicrobials into food as preservatives is a desirable way to enhance food safety. Besides, some lactic acid bacteria are probiotics and can benefit human intestinal health. Therefore, it is important to conserve the beneficial microbial population when antimicrobials act on target pathogens.

In this study, polyphenolics were extracted from freeze-dried ohelo berry and cranberry using the organic solvents. The concentrations of phenolic compounds and anthocyanins in the extract were determined by the Folin Ciocalteu method and the pH differential method, respectively. The extracts were further evaluated against various bacteria via the agar well diffusion assay and the determination of minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Four pathogenic bacteria, *Staphylococcus aureus, Listeria monocytogenes, Salmonella Typhimurium*, and *Escherichia coli* O157:H7 and two probiotics, *Lactobacillus rhamnosus* and *Lactobacillus acidophilus* were used in this study. After that, the antimicrobial activity of neutralized ohelo berry extract against four pathogens were analyzed.

The results showed ohelo berry extract had significantly higher total phenolic content (21.15 vs. 6.81 gallic acid equivalent mg/ml) and lower anthocyanins (477.42 vs. 996.59 cyanidin-3-glucoside equivalent mg/L) than cranberry extract. For antimicrobial tests, all the pathogens were inhibited by cranberry and ohelo berry extracts. *E. coli* O157:H7 was more sensitive to cranberry extract than ohelo berry extract, as indicated by MBC at 6.25% vs. 12.5%. Lower MIC and MBC were shown with ohelo berry extract against *Staphylococcus aureus* and *L. monocytogenes* than cranberry extract. Moreover, probiotic *Lactobacillus rhamnosus* and *Lactobacillus acidophilus* were most resistant to the extracts. It was speculated that growth inhibition against microorganisms by berries relied on the low pH. However, the antimicrobial effects on pathogenic bacteria were also shown in neutralized ohelo berry extract, although the inhibition was not as strong as in the extract at native pH.

Polyphenolic compounds are well known for their antioxidant activity that is beneficial to human health. Ohelo berry has polyphenolic content and antimicrobial activity comparable to cranberry. This study lays the groundwork for exploring the potential of ohelo berry as a functional food and as a natural preservative to enhance food safety.

(45) Eat to Live: a look into breadfruit nutritional qualities impacted by unique environment. Amber Needham\*, Noa Lincoln. Department of Tropical Plant and Soil Sciences.

The global tropics is comprised of some of the world’s largest populations that face poverty and malnutrition, despite these areas being where majority of our food is grown. In the search for both highly nutritious and highly productive food crops to supplement those that are already being grown, breadfruit offers a sustainable source. Compared to other globally recognized staple crops, such as corn, wheat, or potato, breadfruit provides higher quality protein as well as essential vitamins and minerals, carbohydrates, and fiber. These nutritive qualities vary among cultivars however whether or not they vary across micro-climates is currently unknown.

In order to investigate the impact of environmental variables on breadfruit nutritional quality, a meta-analysis of 41 studies in breadfruit literature was conducted using online scholarly search engines and databases. Nutritional content provided by each study was recorded and climate and soil data were derived from the lattitude and longitude coordinates from each study site. Other relevant information such as fruit preparation method and cultivar type, if available, were also reported. The goal of this analysis was to observe any patterns between and among environmental variables and nutritive aspects of the fruit.

Our results indicated that few key environmental factors play a role in altering nutritional content, some nutritional measurements were impacted by nearly all external variables, and some were not significantly affected by environmental variables at all. Precipitation was the most influential for majority of the proximate components of analysis, which included protein, carbohydrates, fiber, and others. Macro- and micro-nutrients showed no significant impacts by any of the measured environmental data, while vitamins displayed significant impact by nearly all of the climate and soil measurements.

Although there are few confounding factors within this study, our findings suggest a select amount of highly correlated relationships between certain nutritional qualities and specific environmental factors. As breadfruit makes its way into more of the global tropics, these patterns become increasingly necessary to understand for reasons such as addressing nutrient deficiencies, providing transparency with breadfruit consumers, and promoting the crop to its specific growing area.

Based on these results, it is clear that further research needs to be done in the field of plant physiology for breadfruit, which is sorely lacking in the literature today. Once we are able to understand the physiological responses that breadfruit has to its surroundings, we may be able to narrow down our objectives by targeting more specific mechanisms and better understand the role that environment plays in breadfruit nutrition.

(46) Save the Vegetable, Implementation of Sanitizing Washes to Reduce Microbes on Watercres. Yen Nguyen\*, Jensen Y. Uyeda, Yong Li. Department of Human Nutrition, Food and Animal Sciences, Department of Tropical Plant and Soil Sciences.

Despite increased hygiene and advanced technology in food production, there is still a serious concern regarding foodborne illness. Pathogenic *E. coli* and Salmonella are some of serious foodborne pathogens. With increased demand for fresh food, there is a rising risk of foodborne illness. Leafy greens are more susceptible to contamination of microorganisms due to minimal cooking which can cause foodborne illness. For example, there was a recent recall of all romaine lettuce due to contamination by pathogenic *E. coli* O157:H7. Leafy greens can be an ideal place for bacteria to thrive making it a high-risk food because of this type of food does not require any thermal treatment.

Watercress a plant that is also commonly consumed raw. However, efforts to sanitize it are not commonly discussed. Watercress is usually grown in a partially submerged running water, the same water is also used in the sprinklers. Irrigation water is home to fishes, crawfishes and at times bird feces. If watercress is not properly treated, this vegetable is at high risk for contamination. Thus, it is important to control foodborne pathogens through proper sanitization methods.

Chemical washing systems are widely used by major fresh-produce industry to reduce microbial contamination with good results. The aim of this study was to use sanitizers, such as ozone and peroxyacetic acid (PAA), on watercress to reduce the threat of human pathogens. Recent studies regarding the antimicrobial activity of PAA and ozone showed that these sanitizers have strong oxidizing potential by disrupting cell walls of bacteria, which further leads to cell death.

The results of this study showed that PAA and ozone do effectively reduce microbes. Preliminary testing has been done to observe the antimicrobial activity of PAA (5, 10, 15, 24, 48, and 84 ppm) and ozone (1.5 ppm) against pure E. coli bacterial suspension. *E. coli* showed a two-log reduction by PAA treatments at 5 and 10 ppm. PAA of 15 ppm or greater concentrations showed no surviving *E. coli* or Salmonella. Ozone treatment of 1.5 ppm showed an average log reduction of 0.135 for the bacteria. Watercress was inoculated with E. coli and Salmonella. Treatment with PAA at 24, 48, and 84 ppm showed 1.01, 1.49, and 1.89 *(E. coli)* and 0.58, 1.06, and 1.21 (Salmonella) log reduction, respectively.

Both PAA and ozone showed effective sanitizing potential when used with watercress. The potential of watercress in the fresh-cut industry is vast because the plant is very versatile. This study will provide more insight into microbial growth and shelf life of watercress, which is important for food safety.

(47) Aqueous chlorine dioxide (ClO2) as a health friendly sanitizer to decontaminate foodborne pathogens on fresh papaya. Lianger Dong\*, Yong Li. Department of Human Nutrition, Food and Animal Sciences.

Salmonella is one of the three most dangerous foodborne pathogens along with *Escherichia coli* O157:H7 and *Listeria monocytogenes*. Salmonella infects intestines and causes diarrhea, fever, and abdominal cramps. Severe Salmonella infections may lead to death. Salmonella may be transmitted through raw foods such as fresh produce. While papaya is usually eaten raw, Salmonella may attach to the surface of papaya through soil, animal feces, and human contact. Therefore, post-harvest washing becomes an important strategy to decontaminate papayas before transferring them from farms to grocery stores.

Currently, bleach (NaClO) is the most widely used sanitizer in fresh produce industry. However, bleach has low effectiveness on killing pathogens and it forms carcinogenic or mutagenic byproducts, such as chloroform, when reacting with other organic matter. ClO2 is originally used as a water disinfectant and has attracted interests as an alternate sanitizer for fresh produce washing. The advantages of ClO2 over NaClO include higher oxidant capacity and higher effectiveness at low concentrations. In addition, the main byproduct (ClO2-) of ClO2 and organic matter reaction is noncarcinogenic. Therefore, the objective of this study was to reduce Salmonella population on papaya using on-site generated aqueous ClO2.

We first investigated the growth potential of Salmonella on green papayas by inoculating Salmonella cells on the fruit surfaces. After incubating for two weeks, Salmonella population increased by 2.13 log CFU at room temperature and remained at its initial inoculation level at refrigeration temperature. This result indicates that there is a great potential of Salmonella to grow or survive once they attach to the surface of papayas, and hence, the study of reducing Salmonella contamination is meaningful.

Next, we studied the release kinetics of ClO2 generated by sodium chlorite (NaClO2) and acids. Most studies reported producing ClO2 with NaClO2 and hydrochloric acid (HCl). Since HCl is a strong corrosive acid, we compared the effectiveness between using HCl and three food-grade acids including citric acid, lactic acid, and malic acid, as well as a food additive sodium bisulfite (NaHSO4). Results showed all of the test acids produced sufficient amount of ClO2 (261-780 ppm) for the sanitizing purpose.

To test the killing effects of ClO2, Salmonella cells was treated with 2.5, 5, and 10 ppm of bleach and ClO2 generated with different acids for 5, 10, and 20 min. While bleach only achieved 0.93-1.12 log CFU population reduction for all treatments, ClO2 reduced Salmonella to undetectable level with citric acid being the most effective acid (2.5 ppm for 5 min).

The present study showed that there was a great survival and growth risk if Salmonella attaches to papaya surface. Food grade acids were able to generate sufficient ClO2 for sanitizing purposes and reduce Salmonella to undetectable level in culture medium. Further tests will be done on papaya fruits to investigate the effectiveness of ClO2 on decontaminating Salmonella. Overall, aqueous ClO2 has shown potentials to improve microbiological safety of papaya.

(48) Mimosine produced by *Leucaena leucocephala* may help plants grow in alkaline soils by facilitating mineral uptake. Michael Honda\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

By the year 2050, the Earth’s population is expected to reach 9.7 billion. Experts predict the global food demand will increase by 58% to 98%. To meet these demands, it is important to efficiently utilize all of the world’s available croplands. However, it is estimated that 30% of these croplands contain soils that are too alkaline for efficient crop production. A vast majority of the world’s most important food crops require neutral to acidic soil conditions. Under acidic soil conditions, important mineral nutrients like iron and zinc, are highly soluble and easily accessible to plants. However, under alkaline conditions, these same minerals are insoluble and poorly accessible to plants. A deficiency in iron or zinc leads to wilting and yellowing of leaves, and eventually plant tissue death. Interestingly, the tree-legume *Leucaena leucocephala* (leucaena) thrives in alkaline soils. Although it is not known why leucaena can grow in alkaline soils, it is hypothesized that it is due to its unique ability to both produce and release into the soil mimosine, a strong metal-binding molecule. It is believed that mimosine can enter the soil either from leucaena roots or from fallen leaves. Once in the ground, it is thought that mimosine serves to solubilize minerals through acidification of the soil, or by directly binding to minerals.

To prove mimosine is released into the soil, leucaena root secretions, and growth media containing leucaena plants were tested for the presence of mimosine. The results of these experiments suggest that i) mimosine is secreted into the soil by leucaena roots; and ii) fallen leaves (dried and fresh) contain considerable amounts of mimosine, which can easily leach from leaves into the surrounding media.

To determine if mimosine facilitates plant uptake of soil minerals, the chemical-binding properties of mimosine and iron, an essential plant nutrient, were studied. These studies found that i) mimosine can bind strongly to iron at alkaline pHs; and ii) when iron binds to mimosine, it remains water soluble, even at alkaline pHs.

To see if mimosine leached from fallen leaves can acidify the soil, the pH of plant growth media was measured before and after addition of leucaena leaves. The results of this experiment indicate that within 24 h, mimosine could leach out of leaves and into the growth media, where it was able to lower the pH by 0.7 to 1.4 units. One pH unit is equivalent to a 1000 times change in acidity/basicity.

Based on these results, it may be possible to utilize leucaena foliage as a green mulch/manure, to help grow other important crop plants in alkaline soils. In addition to mimosine, leucaena foliage is rich in various macro and micronutrients. Taken together, leucaena foliage may help increase soil fertility, acidify the soil, and facilitate mineral uptake by plants. The findings of this study could help increase global food production by helping farmers to utilize croplands that were once too alkaline for efficient food production. Increasing the world’s food supply is essential for the rapidly increasing human population.

(49) Identifying Genes for Stress Tolerance and Disease Resistance from the Koa Tree. Aaron Kam\*, Dulal Borthakur. Department of Molecular Biosciences and Bioengineering.

Koa has many attributes that make it a useful timber-wood tree. Its ability to fix nitrogen, and its high demand as a valuable hardwood for luxury products make it an important component in both Hawaii’s economy and ecosystem. However in recent years, Koa forests have been heavily infected with *Fusarium oxysporum*, a fungal pathogen that causes Koa wilt. It is a devastating disease that has decimated a large number of koa trees in native forests. Therefore, selection of genes for the improvement and preservation of Koa is of utmost importance.

To help narrow down candidates for genes related to stress and disease resistance, a study was conducted to determine highly conserved genes between Koa and Giant Leucaena, another highly stress tolerant and disease resistant woody Legume. Because there are bound to be many genes that are relics of much more distant ancestors, only sequences that were highly similar between the two organisms were selected. Therefore the housekeeping genes that are highly conserved between all plants, like those responsible for photosynthesis and other miscellaneous functions were ignored. This was done by comparing the remaining Koa gene sequences to that of various model plants like Arabidopsis, Tobacco, and Soybean, and taking those that were very similar out of consideration. After that, the remaining sequences’ functions were characterized by comparing them with other known and annotated genes.

The results of this study show that there exist at least 315 environmental stress related genes and 417 related to disease response. Of those, 158 have to do with defense or a response against bacteria, and 109 are related to the response or defense against fungus. This means that there is a decently large number of genes to choose from when it comes to different kinds of defenses in various kinds of situations. In particular, those that are related to fungal resistance are worth further study.

In order to help protect and maintain the growth of one of Hawaii’s endemic plant species, further research into them is critical. By examining the strongest traits of the native organisms in Hawaii, we can help with the discovery of new and novel genes. This not only assists Koa, but also other trees that face similar problems. Studies like these can push forward conservation and proliferation of native life on the beautiful islands that they call home.

(50) Design of a Rapid Screening Multi-Diagnostic Device. Jaclyn Lee\*, Brianna Fujita, Kyle Marcelino, Jonathan Suda, Daniel Jenkins. Department of Molecular Biosciences and Bioengineering.

Globalization of the food trade has made seasonal produce available year round and region-specific produce available internationally. While this has greatly improved the number of options available to consumers, it has also exponentially increased the potential spread of disease. Waiting for lab results could delay controlling and containing potential pathogens and initiating recalls, and, should the results be negative, could lead to lost opportunity for sale.

As an improved design of Dr. Daniel Jenkin’s BioRanger, the Multi-Diagnostic Card utilizes Loop-Mediated Isothermal Amplification (LAMP) to rapidly screen for multiple pathogens in food crops. Samples are self-loaded into individual reaction wells to carry out simultaneous LAMP reactions. A temperature control system initiates thermal expansion and maintains the temperatures necessary to carry out the reactions while an image processing system monitors the reaction progress by reading fluorescence levels. The design is planned to be economically cheaper than Quantitative Polymerase Chain Reaction (qPCR) which costs about $2 a reaction with machines costing about $3000. Vacuum forming will be used as the primary fabrication method to yield mass-manufacturing of cheaply made cards.

Preliminary cards have been successfully vacuum formed. Cards vacuum formed from polypropylene showed a higher resolution compared to cards vacuum formed from polyethylene terephthalate glycol. Adding holes for card molds also helped increase resolution for the resulting vacuum formed cards. A low-powered temperature control system has been successfully designed from thermocouples, resistive heaters, and aluminum blocks.

The Multi-diagnostic card has the potential to help farmers around the world by enabling rapid detection of food-borne pathogens in the palm of a hand. The technology has the potential to reduce the number food-borne pathogen cases and biological vectors that arise in farming and food manufacturing. It is critical to advance food testing technology to ensure the safety and wellbeing of all people in a 21st century globalized environment.

(51) WITHDRAWN

(52) Homegrown energy: Fuel properties of Pongamia pinnata. Sabrina Summers\*, Jinxia Fu, Scott Turn. Hawaii Natural Energy Institute.

Global population has increased exponentially in the past 100 years. With a population of about 1.65 billion in 1900 growing to 7.6 billion in 2018, energy demand and consumption has skyrocketed. These needs are met primarily by three fossil fuels—petroleum, natural gas, and coal—together generating 80% of total energy in the United States. In 2018, U.S. crude oil production averaged 10.88 million barrels per day (bpd), exceeding the previous 1970 record of 9.6 million bpd. Meanwhile renewable energy accounted for 11.3% of energy consumption in the United States this past year; the highest it has been since the early 1900s. Based on current trends, renewable energy is expected to grow 400% by 2040.

Isolated in the Pacific Ocean, Hawaii’s dependence on fossil fuels is particularly jarring. In comparison to other states, Hawaii is heavily reliant on oil—from which nearly 90% of energy is generated. However, the Hawaii Clean Energy Initiative along with the Hawaii legislature have set a deadline to generate 100% of electricity from renewable resources by 2045.

*Pongamia*, or *Pongamia pinnata*, has been identified as a potential biofuel source due to its robust nature; growing easily with little care, the trees can grow on non-fertile and waste lands. The high oil content of the seeds also makes *Pongamia* an ideal candidate. Biodiesel can be easily derived from the extracted oil via a transesterification reaction.

Furthermore, pods and seed cakes have potential as biofuel. Untreated biomass faces several challenges as fuel, including high moisture content, low energy density, and biodegradability; all of which cause problems in transportation, storage, and utilization. However, torrefaction can simultaneously combat these drawbacks while improving the biomass to have properties more similar to coal.

The purpose of this research is to investigate the fuel properties of extracted oil, biomass, and torrefied biomass. Eight samples were taken from two locations on Oahu: Terviva plantings in Wahiawa and Hawai’i Agriculture Research Center in Waipahu. The oil, pod, and seed cake characteristics were measured (oil content, heat of combustion, flash point, density and viscosity, elemental analysis) to provide the data needed to assess the usefulness of *Pongamia* as a biofuel. Each solid sample will be analyzed before and after torrefaction.

The results of this study indicate *Pongamia* oil as a promising biodiesel source. The oil extraction shows *Pongamia* seeds to have high oil content, with an average 27.5% w/w yield. The heat of combustion of seed cake and pod before torrefaction was 18.0 MJ/kg and 16.6 MJ/kg, respectively. The heat of combustion for the extracted oil was 38.3 MJ/kg. Torrefaction of the solid pods and seed cake is expected to result in increased heat of combustion and energy density and decreased equilibrium moisture content.

As Hawaii works toward its clean energy goal and shifts toward renewable energy, the identification of viable new resources is crucial. Determining the fuel properties of Pongamia pinnata and the impacts of torrefaction can play a vital role in the future of Pongamia as a renewable energy source in the islands.

(53) Protein disulfide isomerase 9 (PDI9) interacts with a critical stress response regulator to protect plants from environmental stress. Rina Carrillo\*. Department of Molecular Biosciences and Bioengineering.

Abiotic stresses, such as drought or heat, are leading causes of crop loss worldwide. Temperature is considered a primary factor in regulating plant development, with pollination and photosynthesis being heat-sensitive events. Rising temperatures can drastically impact plant productivity, contributing to yield losses of up to 80-90% in maize. A main challenge in addressing abiotic stress is to understand the molecular mechanisms and signal transduction pathways by which plants perceive and respond to such stress.

Protein disulfide isomerases (PDIs) are an essential class of folding enzymes that catalyze the formation and rearrangement of disulfide bonds in nascent or misfolded proteins in the endoplasmic reticulum (ER). PDIs are imperative to maintain proper protein folding to prevent cellular ER stress and the accumulation of aberrant proteins. In mammals, perturbation of the protein folding-homeostasis is associated with various diseases, including hypoxia, neurodegeneration, and cancer. In plants, the disruption of this homeostasis is associated with poor seed development, light stress, and can lead to cell death if left uncontrolled.

PDI9 is a unique member of the Arabidopsis PDI family. PDI9 levels increase in response to ER stress through a critical pathway known as the unfolded protein response (UPR). When proteins fail to fold, their accumulation in the ER activates the UPR, which stimulates protein folding capacity. Crops are particularly subject to environmental conditions such as heat stress that disturb protein homeostasis and activate the UPR. This quality control mechanism reduces the level of unfolded proteins and alleviates the cellular stress so enzymes can function normally.

Inositol-requiring enzyme 1 (IRE1) is the primary sensor of the UPR pathway. As the first responder, it detects the cellular stress in the ER and stimulates protein folding by increasing the expression of protein folding enzymes. Until now, there have been no documented protein-protein interactions involving PDI9 in plants. We found that PDI9 binds to and interacts with IRE1 in the model plant, Arabidopsis thaliana. PDI9 co-immunoprecipitated with IRE1, suggesting that these two proteins functionally interact.

Determining how they interact together in the UPR pathway will be critical to unravel the mechanisms by which plants mitigate stress. This preliminary finding provides a framework of knowledge for future discoveries that reveal strategies for stress tolerance in plants. The UPR pathway has a critical role in the development of cereal crops such as wheat and maize. These grains require an abundance of storage proteins and are often subjected to conditions that induce ER stress. A greater understanding of how this pathway functions will allow optimization of crop improvement strategies such as those addressing heat stress.

(54) What are we doing to stop the declining population of ‘opihi in O’ahu, Hawai‘i? *Bridget Murphy\*. Department of Molecular Biosciences and Bioengineering.*

Gonadotropin-releasing hormone (GnRH) is a critical reproductive regulator in vertebrates. Homologous peptides have more recently been found in invertebrates and retain conserved terminal domains involved in receptor binding and activation. The conservation of GnRH between taxa indicates its importance as a physiological regulator. However, existing research on the functions of GnRH in molluscan reproduction is inadequate for a group that is so commercially important.

Mollusks are responsible for producing the highest volume of food in the global aquaculture market. By and large, mollusks are a globally important resource but ‘opihi in particular are cultural treasures whose populations are in vast decline due to pressures from overharvesting. Since the entirety of the life cycle is not known, there is no commercial aquaculture for ‘opihi species in Hawai‘i, leaving locals to collect on their own without regulations. Although ‘opihi are known as the “deadliest delicacy” due to the dangers of collecting on outcroppings where rogue waves are common, this hasn’t stopped people from trying. As populations continually decline, people are going to further extremes to get their fix.

These issues lie at the frontier of this research and further implicate the need to continue moving forward in developing the technology to successfully spawn and rear ‘opihi in an aquaculture setting. This study aims to isolate and characterize the native GnRH peptide of *Cellana sandwicensis,* the yellowfoot ‘opihi, using molecular biology methods such as genomics and proteomics to extract and synthesize the GnRH peptide structure which may be essential to closing the lifecycle of ‘opihi.

To determine functionality of a GnRH peptide it must be isolated from targeted tissues expected to contain GnRH from ‘opihi at their final maturation stage. By designing primers based upon shared homology, PCR can be used to isolate and amplify cDNA fragments from tissues of interest. To verify the expression of GnRH throughout tissues, we will develop an antiserum for the identified peptide for use in immuno-histo-chemistry on the dissected tissues expected to contain the hormone of interest. From here, the peptide will be synthesized, and captive ‘opihi will be exposed to the chemical stimulant via oral administration. Behavioral changes in both sexes linked to mating behavior, reproduction and gonadal maturation can be monitored over time to characterize GnRH functionality in ‘opihi reproduction.

In order to relieve pressures on wild populations and effectively undertake the aquaculture of this species in Hawai‘i, it is vital to determine the natural stimulants and hormonal contributors of the reproductive cycle and identify both endogenous and exogenous cues that control reproduction. Understanding these signals and pathways will aid in developing effective techniques to induce final maturation and spawning in a laboratory setting. Carrying out this research will help gain a fuller understanding of the biochemical and behavioral controls GnRH exhibits on ‘opihi. If successful, these findings will prove important for the future aquaculture of ‘opihi, and the maintenance of wild populations.

(55) Examining Biochemical Alterations in LRRK2 as a Key Factor in Parkinson’s Disease Pathogenesis. *Thien Phuc Ngoc Nguyen\*, Kiana Lee, Nicholas G. James. Department of Molecular Biosciences and Bioengineering, Department of Cell and Molecular Biology.*

Parkinson’s Disease (PD) is a common neuromuscular disorder that has grown to affect ~ 2% of the population over 65, with the most common risk factor being age. The major characteristics of PD are the formations of protein aggregates within neurons (called Lewy Bodies) and loss of motor neurons. Physiologically, PD presents with a number of symptoms including, but not limited to, resting tremor, slowed movement, and rigidity. PD, along with other age dependent diseases, is becoming a major health concern for our aging population with the prevalence being expected to double over the next 20 years. All of these events put a financial burden on our aging population that causes a reduction in the quality of life for affected individuals. The major road blocks that hinder our progression for treating neuron loss in PD is our limited understanding of the mechanism(s) which reduce the connections between nerve cells. However, significant strides have been made over the past ~ 15 years as researchers identified several genetic and risk markers for PD pathogenesis. Many of these identified markers have been characterized in both sporadic and familial PD, and present with identical symptoms as “normal” PD. To gain better insights into these mechanisms, researchers have been developing methods to characterize how these risk factors function in nerve cells and to identify pathways that are disrupted when these molecules are modified in a similar fashion as within PD patients. The hope is that by characterizing molecules within this group of proteins, researchers will be able to identify a common pathway associated with neuron loss. The most commonly affected molecule that is associated with PD progression is Leucine Rich Repeat Kinase 2 (LRRK2) and is the primary molecule being researched as a potential targeted therapeutic treatment for PD. Our study utilizes a number of experiments designed to establish the function of LRRK2 activity within cells wherein we will provide a detailed mechanism that can be targeted to prevent neuron loss. A common mutation associated with PD is Glycine 2019 to Serine (G2019S), enhances the properties of LRRK2 function. We predict that this increased in interaction will disrupt the natural pathway in which the protein would normally undergo. The results of this study indicate that LRRK2 may be involved in regulating how protein interacts in order for it to be recruited to cellular organelles. Further research on the protein interactions and its impact on disrupting this molecular pathway will allow us to gain critical insight into developing a more precise and quicker search for novel targets for advanced therapeutics for PD.

(56) Regulation of Intestinal Nutrient Transporters by the Pituitary Gland in Mozambique Tilapia *(Oreochromis mossambicus)*. *Cody Petro-Sakuma\*, Fritzie T. Celino-Brady, Andre P. Seale. Department of Human Nutrition, Food and Animal Sciences.*

With a rising world population and limited resources, the need for animal production systems to operate at the highest levels of efficiency increases accordingly. The production of fish and other aquatic organisms through aquaculture is the fastest growing sector of animal production. Tilapia are second only to the common carp in total finfish produced globally. Tilapia are used extensively in aquaculture because of their rapid growth, resistance to disease, ability to reproduce in captivity, and resilience to a range of environmental conditions. Understanding how these fish grow, therefore, is a critical step in increasing production efficiency and reducing time to market.

In vertebrates, including fish, the endocrine system orchestrates the production and release of chemical messengers, or hormones, from secretory glands by integrating sensory information with an array of physiological functions in nearly every organ. Hormones bind to specific receptors in target tissues, thereby ensuring specific physiological responses. Growth is regulated by the growth hormone/insulin-like growth factor (GH/IGF) system. In this system, internal and external stimuli elicit the release of growth hormone-releasing hormone (GHRH) from the hypothalamus, which in turn stimulates the production and release of GH from the anterior pituitary. Once in circulation, GH can bind to its receptor (GHR) in target tissues, such as muscle, liver and intestine, resulting in a physiological response that includes cell proliferation and differentiation, nutrient uptake and protein synthesis. Growth hormone can also act indirectly by binding to its receptor in the liver, resulting in the production of IGFs. These growth factors then travel to target tissues to stimulate cell growth and differentiation.

Our laboratory has developed a model for investigating whole-organism effects of GH by employing the Mozambique tilapia *(Oreochromis mossambicus)*. In this model, we surgically remove the pituitary gland (Hypophysectomy - Hx) and replace GH via intraperitoneal injections. With this approach, we have shown that the expression of GHR in muscle and liver of Hx fish is dramatically reduced; this effect is recovered by replacement with GH. In this study, we have employed the same experiment to identify the effects of GH on key intestinal nutrient transporters.

Proteins of the family of solute carriers, known as SLCs, are responsible for the transport of small peptides, amino acids, and ions across the intestinal epithelium for their utilization by the animal. The mRNA expression of these solute carriers has been shown to vary in different regions of the intestine. Our preliminary results indicate that intestinal expression of NKCC2, a protein involved in ion transport across intestinal epithelia, is suppressed in Hx fish, indicating that at least one hormone produced by this gland regulates ion transport in the gut.

Further analyses of the expression of GHR, and SLCs in the intestine shall provide insight into the underlying endocrine control of intestinal nutrient transport that is associated with growth.

(57) Fresh turmeric, but how much curcumin? Justin Calpito\*, Theodore Radovich, Jon-Paul Bingham. Department of Human Nutrition, Food and Animal Sciences, Department of Tropical Plant and Soil Sciences, Department of Molecular Biosciences and Bioengineering.

Turmeric *(Curcuma longa and Curcuma spp.)* is a rising specialty crop in Hawaii’s agriculture; it has been included for the first time in the USDA Hawaii Tropical Fruit and Crops Report in 2016 and ranked 2nd to ginger among tropical specialties in production (110,000 pounds) and 2nd to vanilla in value ($6.00 per pound). A major contributor to turmeric’s popularity and value is its principle medicinal component curcumin, a compound which, among other benefits, has demonstrated potential anti-inflammatory and anti-Alzheimer’s effects in preliminary studies. Curcumin is a secondary metabolite produced in the rhizomes of the turmeric plant and its content can vary due to genetics and to horticultural and environmental causes, such soil amendments, harvest time, rain, sun, etc. Although production in Hawaii is increasing steadily, determining curcumin content amongst cultivars has largely been speculative. A common yet unverified method is correlating how orange the rhizome looks to how much curcumin it has.

A high-performance liquid chromatography method has been designed for precise and accurate quantification of curcumin in turmeric. Samples from Oahu and Maui sites have been analyzed and the results have shown a large discrepancy in curcumin from as high as 6% down to 0% dry weight. Some of the cultivars studied include Curcuma longa cultivars “Hawaiian Red”, “Olena”, and “BKK”, and C. spp. cultivars “mango”, “green”, and “black”. Also, correlation between rhizome color and curcumin content has been explored as a method of rapid curcumin estimation. The color of rhizomes of known curcumin content were measured using a reputable color chart and the LAB color-space values were used to design a color chart for curcumin estimation. The methods designed here can assist farmers in optimizing cultivar selection and growth conditions, which all aid in producing high-quality turmeric in the Hawaiian Islands.

(58) The Flavonoid Metabolon: Organization of a Metabolic Factory in Orange *(Citrus sinensis)*. *David Knittel\*, Lexus Porter, Daniel K Owens. Department of Molecular Biosciences and Bioengineering.*

Flavonoids are ubiquitous throughout the plant kingdom with over 9,000 different individual compounds having been identified in plants. They are potent antioxidants having the ability to scavenge free radicals and quench free radical cascade reactions. The compounds can be used in a wide variety of uses for the benefit of humans. These include pharmaceutical applications such as anti-tumor, anti-allergic, anti-thrombic, anti-diabetic, and anti-atherosclerotic activities and agricultural benefits such as inhibiting certain plant pathogens, regulating auxin activity, regulating auxin activity, affect plant-plant interactions in either positive or negative ways.

To take advantage of these beneficial properties and induce or increase their production for pharmaceutical or agricultural benefit further research is needed on how metabolons are formed and how this affects the accumulation of particular end-products in the plant. I will focus on understanding the structure of the flavonoid metabolon and extend current models to reflect glycosyltransferase enzymes, the core structure derivatizing enzymes that produce the flavonoid compounds that actually accumulate in plants. I am using *Citrus sinensis* as species to investigate flavonoid metabolon formation. It was chosen because it is known to accumulate early classes of flavonoids (e.g. flavones) and I hypothesize will have key differences when compared to the current models derived from Arabidopsis, which accumulates predominantly late classes of flavonoids (e.g. anthocyanins). Furthermore, it is an agriculturally significant species in which flavonoid compounds have a direct impact on taste and therefore marketability of fruit and fruit products.

To accomplish these tasks I will be using the yeast two-hybrid method to identify protein interaction within the metabolon. The initial research will focus on interactions between glycosyltransferase 7 (GT7) and the proteins of the core biosynthetic pathway; being chalcone synthase (CHS), chalcone isomerase (CHI), flavanone 3β-hydroxylase (F3H), dihydroflavonol 4-reductase (DFR), and flavonol synthase (FLS), and flavone synthase (FNS). All of these genes were identified within the Citrus sinensis genome by homology to characterized genes. These sequences were then used to generate primers for the cDNA sequence of interest. The mapping of these interactions will allow for a potential metabolon structure to be created for the biosynthetic pathway. These primers have been confirmed to be working through PCR on both genomic and cDNA. However, some of the primers cross react with other sequences within the genome resulting in multiple products being formed. To combat this we are gel purifying the bands of the proper size and carrying these through into the final ligation. The vector that the genes are being placed into are part of the GATEWAY system which will allow for rapid and easy generation of further transformants for both the yeast two-hybrid system as well as future protein expression vectors for assays. Following the successful mapping of the interactions, I will expand the scope of the investigation to include the interactions within the core pathway as well as other predicted GT sequences. By increasing knowledge of the metabolon structure, it may be possible to modify, introduce or increase beneficial characteristics in other plants.

(59) Enhancing food safety using a highly specific and ultra-sensitive detection method. *Biyu Wu\*, Yong Li. Department of Human Nutrition, Food and Animal Sciences.*

Food contamination caused by pathogens has attracted increasing attention worldwide. According to the Centers for Disease Control and Prevention, each year approximately 48 million Americans become sick due to food contamination. About 128,000 persons are hospitalized and 3,000 die. Foodborne illness not only causes billions of dollars in losses but also poses serious threats to human health. Salmonella and *Campylobacter jejuni* are the most common cause of the foodborne disease. Conventional detection methods for these pathogens often require several days to obtain results and do not always supply information rapidly enough to allow appropriate actions needed to protect the public. Therefore, a rapid, specific, and sensitive detection method is of utmost significance.

This study aimed to design a single-tube nested multiplex polymerase chain reaction (STN-PCR) assay for simultaneous detection of Salmonella and *C. jejuni*, and further investigate the efficacy of the developed assay with ground chicken homogenate inoculated with *C. jejuni*. The parameters of the STN-PCR assay were optimized. The sensitivity of the STN-PCR assay was determined using different concentrations of Salmonella and *C. jejuni* DNA extracted from the pure cultures. The ground chicken homogenates were artificially inoculated with serial dilutions of *C. jejuni* culture and enriched for 2, 4, 6, 8, 10, 12, 24 and 48 h. The culture-based detection method following FDA manual, STN-PCR, and conventional PCR were compared in detecting *C. jejuni* at each time point. The enrichment time for each method to detect the lowest concentration of *C. jejuni* inoculated in ground chicken homogenate was investigated.

The results of this study demonstrated the developed STN-PCR assay was highly specific and 100 times more sensitive than conventional PCR for detecting Salmonella and *C. jejuni* simultaneously. This assay could detect as low as 3 *C. jejuni* cells per ml ground chicken homogenate without enrichment. The STN-PCR assay was able to detect 30 cells per 100 ml homogenate after 6 h of enrichment and detect 3 cells per 100 ml homogenate after 12 h of enrichment. In comparison, conventional PCR and culture-based methods required 48 h of enrichment to reach a detection limit of 3 cells per 100 ml homogenate. Further research is needed to investigate the applicability of this assay in different food matrices.

The developed STN-PCR assay provides an ultra-sensitive and specific approach for simultaneous detection of *C. jejuni* and Salmonella. It would help regulatory agencies and food manufacturers improve the safety of food supply.

(60) Role of Long non-coding RNAs in Ovarian Cancer. Yuanyuan Fu\*, Herbert Yu, Wei Jia, Zhanwei Wang, Yi Shen, Harvey A. Risch, Lingeng Lu, Nicoletta Biglia, Emilie Marion Canuto, Dionyssios Katsaros. Department of Molecular Biosciences and Bioengineering, University of Hawaii Cancer Center, Yale School of Public Health, University of Turin.

Long non-coding RNAs (lncRNAs) are a class of non-protein coding transcripts that has gained significant attention lately due to their important biological actions and potential involvement in cancer. Ovarian cancer is a devastating disease with poor prognosis, and our understanding of lncRNA's involvement in the malignancy is limited. To further our knowledge, we measured the expression of three lncRNAs, *ASAP1-IT1*, *FAM215A*, and *LINC00472*, in tumor samples, and analyzed their associations with disease characteristics and patient survival.

Two hundred sixty-six patients diagnosed with primary epithelial ovarian cancers were recruited for the study. Fresh-frozen tumor samples were obtained from the patients at tumor resection and analyzed by RT-qPCR for expression of *ASAP1*-*IT1*, *FAM215A*, and *LINC00472*. Associations of lncRNA expression with patient survival were determined using Cox proportional hazards regression models.

We observed high expression of *ASAP1-IT1*, *FAM215A* and *LINC00472* more frequently in low grade tumors and early stage disease compared to high grade tumors and late stage disease, respectively. High expression of *ASAP1-IT1* and *FAM215A* were associated with favorable overall survival, and the survival association with *ASAP1-IT1* was independent of tumor grade and disease stage. Analyses of online data also demonstrated similar survival associations with *ASAP1-IT1* and *FAM215A*, suggesting that these lncRNAs may be involved in ovarian cancer progression.

LncRNAs may play appreciable roles in ovarian cancer and more research is needed to elucidate their biological mechanisms and clinical implications in tumor characterization as well as disease prognosis and treatment.

(61) Inhibition of ice nucleation in beef steaks by an oscillating magnetic field for supercooling preservation. *Taiyoung Kang\*, Sean Francis, Youngsang You, Soojin Jun. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences.*

Supercooling is a metastable state in which the temperature of a liquid drops down below its freezing point without ice crystal formation. There has been continuous interest in applications of supercooling for food preservation since it promises an extended storage life of perishable foods while avoiding freezing damage by ice crystals. Ice nucleation is defined as the formation of a new ice crystal with a critical size in a liquid phase. In supercooled water, ice nucleation spontaneously occurs once a sufficient number of water molecules form an initial nucleus. In most cases, nucleation primarily takes place at the boundary interface between supercooled water and any foreign components such as impurities because the ice crystal/liquid interface reduces the energy barrier for nucleation. An external oscillating magnetic field (OMF) has been employed to modify the supercooling behavior in biological materials during the freezing process; however, the precise mechanism is not completely elucidated.

To better understand how the OMF influences the supercooling behavior, water-dispersed iron oxide nanoparticles (WIN) was used because ferromagnetic materials naturally present in biological materials and they are considered as nucleation sites. The objectives of this study were to shed light on the possibility that the OMF could have effects on the supercooling of water and to explore its potential application as a novel food preservation technology. Helmholtz coils were designed and fabricated based upon a computational simulation study to achieve a desired magnetic field intensity and distribution. The supercooling frequency (number of unfrozen samples/numbers of total samples) of the WIN preserved at -11°C under the OMF was represented to examine the stability of supercooling. Beef steaks (Sirloin) treated with the OMF were preserved in a supercooled stated for 7 days and quality evaluations were carried out with drip loss and color changes.

The results of this study show that the OMF promoted the supercooling stability and reproducibility. The supercooling probability of the WIN was significantly higher (82%) than that of distilled water samples (55%). Additionally, the supercooled state of the WIN supported with the OMF function was successfully extended for 7 days, whereas ice nucleation events were frequently detected in distilled water samples under the same conditions. These results indicate that the OMF induced rotational motions of iron nanoparticles and it led to inhibition of ice nucleation by disrupting the formation of water clusters in supercooled water. By extension, the similar protocol was applied to beef steaks. The beef steaks were able to be preserved in the supercooled state at -4°C with the presence of the OMF, whereas the untreated samples were completely frozen under the same conditions. The drip loss and color results showed that the supercooling preservation effectively extended the storage life of beef without ice crystal formation.

The experimental results in this study have suggested the possibility that the magneto-mechanical motion of ferromagnetic materials induced by the OMF effectively extends the supercooling of water. To better understand the effect of a magnetic field on ice nucleation, other mechanisms associated with water molecules should be investigated.

(62) Heat Stress Impacts the Health of the Laying Hen Through Altering the Regulation of Heat Shock and Reactive Oxidative Stress Genes in the Liver. *Donna Lee Kuehu\*, Nirvay Sah, Chin N. Lee, Rajesh Jha, Birendra Mishra. Department of Molecular Biosciences and Bioengineering, Department of Human Nutrition, Food and Animal Sciences.*

The liver is an organ responsible for many functions involved in producing biochemicals for nutrient digestion, proteins synthesis, and metabolites detoxification. Some of the liver functions in the chicken involve cholesterol and hormone synthesis which have direct effects on egg production, primarily the ooplasm (egg yolk). Our objectives were to determine 1) the effect of heat stress on the liver health, and 2) expression of the heat stress and oxidative stress related genes (thermal neutral vs heat stressed). We hypothesized that chronic exposure to heat stress would down-regulate the heat and oxidative stress genes. Hy-line hens (35 to 60 week old) were housed with 16h light/8h dark cycle, and ad libitum access to feed and water. Laying hens under heat stress (n=10) were exposed to 32-35 °C with 42-50% relative humidity (heat stress treatment), and thermal neutral (n=8) were housed at 21-22 °C and 50% relative humidity (control) for three weeks. Liver tissues were collected for RNA extraction. Total RNA was extracted using TRIzol reagent, and concentration was determined using Implens NanoPhotometer P-Class. Complementary DNA (cDNA) synthesis was completed using Bio-Rad C1000 Touch Thermal Cycler. Heat stress and oxidative stress related genes were amplified using quantitative polymerase chain reaction qPCR. Differential gene expression (DEGs) were measured using Applied Biosystems StepOnePlus Real-Time PCR. Statistical analysis was done using SAS ver. 9.1, RStudio ver. 3.4.3, and MS Excel. The results showed that the heat shock protein Transferrin was significantly up-regulated. Oxidative stress genes such as GTP binding protein, Superoxide dismutase, Glutathione peroxidase, Thioredoxin, Peroredoxin, Glutaredoxin, and Glutamate cysteine ligase modifier 1 were significantly down-regulated in heat stressed hens. These results suggest that while heat stress exposure was chronic, there was an indication that the natural defense against heat stress was still functional, but oxidative stress was shown to impair the liver in the laying hen. Further investigation in the correlation of heat stress on declining hen reproductive health and egg production, and developing mitigation efforts could beneficially impact the poultry industry.

(63) Distributional patterns and variation in the microbiome of *Aedes albopictus (Diptera: Culicidae)* on Maui, Hawai‘i. *Priscilla Seabourn\*, Helen Spafford, Matthew Medeiros. Department of Plant and Environmental Protection Sciences, Pacific Biosciences Research Center.*

The mosquito microbiome alters the physiological traits of medically important mosquitoes by interfering with reproduction, steering the course of development, and stimulating the immune system, and these effects influence the ability of mosquitoes to sustain disease transmission. The microbiome is defined as a community of microorganisms, including bacteria, archea, fungi, protozoa, and viruses, that live on or within a host organism. These microorganisms maintain diverse interactions with their host that vary from mutualisms (where both the microbe and host benefit) to parasitism’s (where the host face a negative cost for its association with the microbe). The composition of the mosquito microbiome varies significantly across mosquito populations. However, the factors that contribute to this variation are poorly understood. Investigating these factors will help to develop successful disease suppression strategies.

To further understand the factors that influence variation and diversity of the microbiome of mosquitoes, a survey of the mosquito microbiome was conducted in the medically important mosquito, *Aedes albopictus*. This widespread mosquito readily transmits both dengue and chikungunya viruses, two emerging pathogens that are spreading worldwide. Adult mosquitoes were sampled on the island of Maui across an entire sampling year at nine sites that differed in climate. Microbial diversity was assessed y next generation sequencing technologies that enabled us to identify bacterial taxa and measure their abundance and diversity in mosquitoes.

The results indicate that the microbiome *of Aedes albopictus* on Maui was dominated by Wolbachia and several genera within *Enterobacteriaceae. Wolbachia* live within host cells and are inherited from the mother very early in development, whereas the bacteria within *Enterobacteriaceae* are acquired from the environment during the course of development. The diversity of other bacteria varied between sampling sites. These results give a snapshot of the influence that the environment has on the microbial diversity and variation of mosquitoes. Future analyses will reveal how environmental parameters like rainfall and temperature influence microbiome variation of *Aedes albopictus.*

The continual increase of mosquito-borne disease world-wide requires the development of new and innovative prevention strategies. The mosquito microbiome is already being used to suppress mosquito populations, and create disease free mosquitoes by infecting them with certain microbes that suppress pathogen replication. Implementing these strategies in the field, however, is limited by a gap in knowledge in how microbes are shared between mosquitoes in different environments. Indeed, further advancement requires knowledge on regional microbiomes, and a deeper understanding of what drives diversity and variation. To our knowledge, this is the first study that has assessed the diversity and variation of the microbiome of a medically important mosquito in Hawai’i. The unique landscape, high biodiversity, and year-round suitable climate for mosquitoes in Hawaii make it an excellent model system in which to study microbiomes.

(64) A Novel Luminescent Reporter Enables Characterization of Flavivirus Non-structural Protein Interactions in Live Cells. *Alanna Tseng\*, Vivek Nerurkar, Pakieli Kaufusi. Department of Molecular Biosciences and Bioengineering, Department of Tropical Medicine, Medical Microbiology and Pharmacology.*

Flaviviridae is a family of mosquito-borne, enveloped, RNA viruses that contain important human pathogens such as West Nile Virus (WNV), and Dengue viruses (DENV) and Zika viruses (ZIKV). A universal feature of these RNA viruses is their ability to exploit host cell machinery and reorganize the membranes inside the cell to support its own virus replication. To achieve robust replication, these viruses build unique intracellular compartments known as replication organelles (RO). These RO are thought to enwrap the viral proteins and generate a microenvironment for viral RNA synthesis and provide structural protection, possibly from host-response proteins that can recognize and degrade the viral genome. These RO comprise all of the viral non-structural proteins (NS1, NS2A, NS2B, NS3, NS4A, NS4B, and NS5) which all play key roles in synthesizing more viral RNA and producing more viral particles.

Of all of the NS proteins, NS3 and NS5 are soluble viral proteins located in the cytoplasm and contain major enzymatic components essential for virus replication. NS3 contains protease and helicase activities that are needed for flaviviral RNA replication. NS5 harbors the RNA polymerase required for the synthesis of new viral RNA. Given that NS3 and NS5 must associate with the RO to promote efficient virus replication, how NS3 and NS5 are recruited to these unique compartments remains unclear. Studies have shown that other NS proteins may contribute to the functional activation of NS3 and NS5, but the mechanistic details of these interactions at the RO are unknown.

To identify the NS proteins that bind to *flavivirus* NS3 and NS5 proteins, we have utilized a new NanoBiT structural complementation reporter assay. The NanoBiT® system is composed of two subunits, Large BiT (LgBiT; 18kDa) and Small BiT (SmBiT; 11 amino acid peptide), that are expressed as fusions to target proteins of interest. ZIKV NS genes were cloned into plasmid vectors composed of LgBiT or SmBiT subunits and introduced in human epithelial cells, which mimic the initial target cells of ZIKV. The NS proteins that interact in vitro will allow the SmBiT and LgBiT subunits to form an active luciferase enzyme and generate a luminescent signal that will be monitored over time in live cells. Results from this study will identify which viral proteins bind to NS3 and NS5 to promote the association of these key viral proteins to the RO. Future studies will utilize this robust reporter assay to examine further interactions between viral and host proteins and perform high-throughput screening for inhibitors that disrupt the NS protein-protein interactions as novel antiviral treatment.

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