THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Annual Research Forum Poster Competition 2024

Graduate and Professional Abstract Book

Tuesday, April 9, 1:00-3:00pm

In person poster session will take place at the Nationwide and Ohio Farm Bureau 4-H Center, Columbus, OH. This event is sponsored by the CFAES Office for Research and Graduate Education and Office of Academic Programs.

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Judges

A special thank you to all of the judges across competition levels!

Nezahat Pinar Barkan, Post Doc, Entomology
Patricia Boley, Staff, Animal Sciences
Pierluigi Bonello, Faculty, Plant Pathology
Emily Buck, Faculty, Agricultural Communication, Education, and Leadership
Katrina Cornish, Faculty, Horticulture and Crop Science
Rafael Domingues, Faculty, Animal Sciences
Thaddeus Chukwuemeka Ezeji, Faculty, Food, Agricultural and Biological Engineering
Anna Favalon, Staff, Plant Pathology
Carla Gavilan, Staff, School of Environment and Natural Resources
Soumya Ghosh, Post Doc, Plant Pathology
Daniela Gutierrez Yanez, Staff, Plant Pathology
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Dee Jepsen, Faculty, OSU Agricultural Safety and Health Program
Jim Kinder, Faculty, Animal Sciences
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Yu Ma, Faculty, Horticulture and Crop Science
Ashish Manandhar, Staff, Food, Agricultural and Biological Engineering
Luis Martinez Villegas, Post Doc, Entomology
Lorrayne Miralha, Faculty, Food, Agricultural and Biological Engineering
Ali Nazmi, Faculty, Animal Sciences
Benjamin Philip, Faculty, Entomology
Krystal Pocock, Staff, School of Environment and Natural Resources
Beenish Saba, Post Doc, Food, Agricultural and Biological Engineering
Florence Sessoms, Faculty, Horticulture and Crop Science
Mike Wiseman, Staff, ERIK, Corporate partnerships
Hui Yu, Faculty, Animal Sciences
Lingying Zhao, Faculty, Food, Agricultural and Biological Engineering
Rui Zheng, Post Doc, Animal Sciences

Poster Authors

Master's

No. 1, Toni Chinchar, MS, Food, Agricultural and Biological Engineering; Advised by Vinayak Shedekar

No. 2, Eric Devney, MS, Food, Agricultural and Biological Engineering; Advised by Judit E. Puskas

No. 3, Sandeep Dhakal, MS, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

No. 4, Sara Dolatyabi, MS, Animal Sciences; Advised by Renukaradhya Gourapura

No. 5, Malek El Mir, MS, Food Science and Technology; Advised by Monica Giusti

No. 6, Richard Gonzalez Aquino, MS, Plant Pathology; Advised by Horacio Lopez-Nicora

No. 7, Garrett Harsh, MS, Plant Pathology; Advised by Ye Xia

No. 8, Daniel Hemphill, MS, Horticulture and Crop Science; Advised by Jonathan Fresnedo-Ramirez

No. 9, Lillian Johnson, MS, Entomology; Advised by Reed Johnson

No. 10, Saroj Khatiwada, MS, Animal Sciences; Advised by Scott P Kenney

No. 11, Yeaeun Park, MS, Entomology, Interdisciplinary Environmental Sciences Graduate Program; Advised by Peter Piermarini

No. 12, Carlos Porras Guardado, MS, Food Science and Technology; Advised by M. Monica Giusti

No. 13, Caleb Rykaczewski, MS, Animal Sciences; Advised by Alvaro Garcia Guerra

No. 14, Lydia Salsbury, MS, Animal Sciences; Advised by Marilia Chiavegato

No. 15, Esha Shrestha, MS, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

No. 16, Shonna Smith, MS, Animal Sciences; Advised by Gireesh Rajashekara

No. 17, Raksha Suresh, MS, Animal Sciences, Center for Food Animal Health; Advised by Renukaradhaya Gourapura

No. 18, Aaron Tayal, MS, Entomology; Advised by Kayla Perry

No. 19, Anusree Thenissery, MS, Animal Sciences, Center for Food Animal Health; Advised by Gireesh Rajashekara

No. 20, Andres Velasco Delgado, MS, Horticulture and Crop Science; Advised by Osler Ortez

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Doctoral

No. 22, Md Washim Akram, PhD, Food, Agricultural and Biological Engineering; Advised by Qian (Victoria) Chen

No. 23, Courtney Anderson, PhD, School of Environment and Natural Resources; Advised by Stanley Gehrt

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No. 26, Menuka Bhandari, PhD, Animal Sciences; Advised by Gireesh Rajashekara

No. 27, James Cross, PhD, Food, Agricultural and Biological Engineering; Advised by Darren Drewry

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No. 29, Bishal Dhakal, PhD, Horticulture and Crop Science; Advised by Osler Ortez

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No. 34, Lucy Guarnieri, PhD, Entomology; Advised by Mary Gardiner

No. 35, Matthiew Haines, PhD, Food Science and Technology; Advised by Chris Simons

No. 36, Matthew Herkins, PhD, Food, Agricultural and Biological Engineering; Advised by Lingying Zhao

No. 37, Ashley Herkins, PhD, Food, Agricultural and Biological Engineering; Advised by Katrina Cornish

No. 38, Hetian Hu, PhD, Food, Agricultural and Biological Engineering; Advised by V.M. Balasubramaniam

No. 39, Cameron Jordan, PhD, Food Science and Technology; Advised by Luis Rodriguez-Saona

No. 40, Rae Ju, PhD, Agricultural, Environmental and Development Economics; Advised by Ani Katchova

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No. 42, Veeramani Karuppuchamy, PhD, Food Science and Technology; Advised by

Osvaldo Campanella

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No. 44, Manpreet Kaur, PhD, Food Science and Technology; Advised by Sheryl Barringer

No. 45, Nathaniel King-Smith, PhD, Food, Agricultural and Biological Engineering; Advised by Katrina Cornish

No. 46, Anna Kolganova, PhD, School of Environment and Natural Resources; Advised by Rattan Lal

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No. 51, Carolyn Lee, PhD, Animal Sciences; Advised by Scott Kenney

No. 52, Jonathan Lee-Rodriguez, PhD, Entomology; Advised by Luis Canas

No. 53, Shuja Majeed, PhD, Animal Sciences; Advised by Ali Nazmi

No. 54, Kate Marris, PhD, Interdisciplinary OSUN, Food Science and Technology; Advised by Martha Belury

No. 55, Jenna Moore, PhD, Plant Pathology; Advised by Horacio Lopez-Nicora

No. 56, Aayasee Nanda, PhD, Food Science and Technology; Advised by Monica Giusti

No. 57, Yunyang Qi, PhD, Food Science and Technology; Advised by Monica Giusti

No. 58, Juan Quijada Pillajo, PhD, Food, Agricultural and Biological Engineering; Advised by Michelle Jones

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No. 60, Shruthy Seshadrinathan, PhD, Food Science and Technology; Advised by V.M Balasubramaniam

No. 61, Bikas Shah, PhD, Animal Sciences; Advised by Ali Nazmi

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No. 71, Dong Hwan Kim, Post-doc, Animal Sciences; Advised by Kichoon Lee

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No. 73, Sandip Mondal, Post-doc, Plant Pathology; Advised by Horacio Lopez-Nicora

No. 74, Sachin Naik, Post-doc, Horticulture and Crop Science; Advised by Michelle.L.Jones

Research Staff

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No. 80, Asmita Khanal, Staff, Food, Agricultural and Biological Engineering; Advised by Ajay Shah

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No. 83, Zak Ralston, Staff, Plant Pathology; Advised by Horacio Lopez-Nicora

No. 84, Jose Theodoro, Staff, Food, Agricultural and Biological Engineering; Advised by Erdal Ozkan

Master's

Toni Chinchar*, Elizabeth Schwab, Ahmed Awad, Vinayak Shedekar

Performance of Ohio drainage systems under a hypothetical future climate scenario.

Future climate projections for the Midwest indicate that winter and spring seasons will be characterized by warmer temperatures and wetter weather, while summers will be characterized by hotter temperatures and more frequent and/or longer dry spells compared to present conditions. A prior study assessing climate change in the Midwest suggested that Ohio's future summer climate may resemble that of current-day Arkansas, while its winters may be like those presently experienced in North Carolina. These references to specific states are easy for general audiences to visualize, promoting the communication of climate science. Therefore, to assess the performance of subsurface drainage systems in Ohio under future climate scenarios, we conducted a modeling study replacing long-term (1992–2021) Ohio summer weather data with data from Arkansas and long-term Ohio winter weather data with data from North Carolina. These results were compared to simulation results using long-term Ohio weather records. The DRAINMOD model was used to simulate the daily water budget under subsurface drainage systems installed at two drain spacings (20 ft (6.1 m) and 40 ft (12.2. m)) in a silt loam soil. Results show that shifting the summer and winter weather patterns currently experienced in Arkansas and North Carolina to Ohio affected soil water availability. Compared to present-day Ohio simulation results, the simulated average annual future number of days with tile drain flow decreased by about 26% and 25.5% and average annual groundwater table levels receded by about 7% and 9% under 20 ft and 40 ft drain depths, respectively. Annual and seasonal trends demonstrate that current drainage system designs will still be essential for controlling excess water stress and maintaining trafficable conditions under the future climate scenarios. However, practices such as drainage water management and drainage water recycling may become a necessity to maximize water use efficiency and sustain future crop production.

Eric Devney*, Peter Polyak, Judit E. Puskas, Chinmoy Baroi, Sanandam Bordoloi, Gabor Kaszas, Katrina Cornish

Physical Characterization of Surface Modified (SuMo) Fly Ash Filled Rubber Composites

Fly ash is a residue created by the incomplete combustion of coal, which is still commonly used for heat and energy worldwide. Although fly ash is used in some concrete applications, at least 40% is wasted globally. In 2022, 11.4 million tons of FA were not

utilized for industrial purposes. FA has been tested as a rubber filler, but it is too hydrophilic to blend well with hydrophobic rubber. A novel method was developed to increase the hydrophobicity of fly ash (SuMo fly ash) to enhance its polymer-filler interaction with natural rubber. A partial replacement scheme was used to discover the amount of petroleum-based carbon black that could reasonably be replaced in rubber composites before significant loss of performance occurred. The results of the study showed that the SuMo fly ash incorporated much more effectively into the rubber mix than unmodified ash. Tensile plots showed that there was not a significant drop in performance up to a 20 wt% replacement of carbon black with SuMo fly ash, while unmodified ash could be used effectively up to 10 wt%. There was also a noticeable softening effect observed when additional fly ash was added, which could be useful in increasing the wet grip of tires. The crosslink density, a measure of how many crosslinks were formed during the curing process, was largely unaffected by the increasing addition of fly ash. The glass transition temperature was also unaffected by the addition of fly ash, which suggests the composites are performing similarly across different ash loadings. The environmental and financial incentives to use fly ash may lead to its adoption by the rubber industry, which uses many petroleum-based or otherwise unsustainable materials out of necessity. Around 16 million tons of carbon black were created globally in 2022, so even a 10 wt% replacement in all rubber products would prevent 1.6 million tons of fly ash from being sent to landfills. If adopted, this waste-derived filler could have an immediate, noticeable impact on the cost, quality, and environmental footprint of a multitude of rubber products.

Sandeep Dhakal*, Sami Khanal, Ashish Manandhar, Ajay Shah

Mapping Waste Coal Piles using Remote Sensing – A Regional Scale Study

Before the enactment of the Surface Mining Control and Reclamation Act in 1977, many coal mining operations were abandoned without proper reclamation, resulting in what is now referred to as Abandoned Mine Lands (AMLs). The coal refuse or waste coal, a low-value byproduct of coal mining, was often haphazardly disposed of in piles in these AMLs. The waste coal piles near communities, rivers, and streams pose significant environmental concerns, such as acid mine drainage, soil and water contamination, coal fires, and methane emissions. Therefore, proper management of these waste coal piles is crucial. Recently, different approaches have been proposed to reclaim these piles which include its utilization for the recovery of rare earth elements, soil amendment, as a construction aggregate, and fuel in power plants. However, the feasibility of using these approaches in Ohio remains uncertain due to the lack of accurate information on waste coal piles.

Traditional approaches to gathering the resource availability data rely on field visits and Global Navigation Satellite System surveying, which are costly and labor-intensive. Advances in satellite technologies provide an opportunity to address this limitation by mapping waste coal piles on a regional scale in a timely and cost-effective manner. This study aims to develop a data analysis framework to identify waste coal piles on a regional scale using publicly available multispectral satellite imagery and machine learning algorithms.

The workflow involved using 2019 Sentinel-2 imagery and spatial texture metrics to train a Support Vector Machine algorithm for waste coal pile identification in the Muskingum River watershed in Ohio. Preprocessing steps involved feature scaling, principal component analysis, texture metrics generation, and masking of irrelevant features. Results indicate that the integration of texture metrics along with spectral bands greatly improved the model performance (Precision=71.8%). The proposed framework identified ~32 km^2 (7900 ac) of land with waste coal piles in the watershed. The developed framework is a crucial step toward understanding the distribution and availability of waste coal across the United States. It provides valuable insights that can guide the selection of appropriate reclamation approaches to address environmental concerns associated with waste coal piles.

Sara Dolatyabi*, Sankar Renu, Jennifer Schrock, and Renukaradhya Gourapura.

Chitosan nanoparticle-based Salmonella Enteritidis subunit oral vaccine provides cross protective immunity in Broilers.

Non-typhoidal *Salmonella* infections are a significant public health concern worldwide. *Salmonella* encompasses an extensive range of pathogens that are important sources of foodborne diseases on a global scale. Developing an oral vaccine to induce cross protective mucosal immunity in the intestines against *Salmonella* in poultry is challenging. Our objective was to develop and evaluate an oral vaccine that can mitigate the load of multiple serotypes of *Salmonella* in broilers. We developed *Salmonella Enteritidis* (SE) immunogenic outer membrane proteins (OMPs) and flagellin (FLA) containing mannose chitosan nanoparticle (OMPs-FLA-mCS-NP) vaccine, and evaluated its efficiency to induce cross-protection against *Salmonella Typhimurium* (ST) serotype infection. Broilers were vaccinated with two doses of OMPs-FLAmCS-NP vaccine orally at age day 3 and a booster after three-weeks. As a control, a commercial live vaccine was

inoculated to a group of birds at age 3 days by the spray method and boosted through drinking water at 3 weeks of age as per the manufacturer's instructions. At 5-weeks of age, birds were challenged with ST and after 10-day post-challenge, samples were collected and examined. Previously, oral SE subunit OMPs-FLA-mCS-NP vaccinated broilers observed robust mucosal immunity and protection against SE infection. In this study, the orally delivered OMPs-FLA-mCS-NP SE vaccine induced a higher cross-protective immune response against ST compared to the commercial Poulvac® ST vaccine composed of a modified-live ST. The OMPs-FLA-mCS-NP vaccinated birds had increased production of IgA and IgY antibodies specific to OMPs and FLA antigens in samples collected at both post-vaccination and post-challenge compared to mock and commercial vaccine groups. Notably, the detected cross-protective immunity induced by OMPs-FLA-mCS-NP vaccine was associated with a reduced ST bacterial load of around 1 log10 CFU in the cecal content, which was comparable to the commercial vaccine group. The findings of our study suggest that the orally administered OMPs-FLA-mCS-NP SE vaccine elicited cross-reactive mucosal immune responses against ST infection in broiler chickens. This, OMPs-FLA-mCS-NP vaccine could be a viable option for commercial live vaccines.

Malek El Mir*, Lauren Ma, Vidarshani Ellepola, M. Monica Giusti.

Color comparison and tentative characterization of anthocyanins profile and content in peels of three commercially available table grapes

This work aimed to evaluate and compare the color, content and potentially characterize the anthocyanin profile of three varieties of table grapes peel: *Sweet Sapphire* (Moondrop: MD), *Jam grapes* (black: B) and *Red superior* (red: R). We aimed to identify the best source of Mavidin-3-O-glucoside and Cyanidin-3-O-glucoside. Pigments were initially extracted using 70% acidified acetone and then partitioned using chloroform to separate the polar fraction containing the anthocyanins. The fraction was subsequently evaporated to remove the organic solvent. Solid-Phase extraction (SPE) was utilized to semi purify the extract employing a C18 cartridge as a stationary phase. The color of the aqueous peel extracts was compared using recorded CIELAB values, measured with Hunter Labs ColorQuestXE. The total monomeric anthocyanin content was quantified using the pH differential method. Finally, the anthocyanin profile of the extracts was tentatively characterized using uHPLC-PDA and uHPLC-MS. The color comparison revealed that the Moondrop and Black grapes peel extracts exhibited higher a* values, respectively 66.38 and 65.15, indicating a higher intensity of the color red, while Red grape peel extract showed less intense red color expression (60.24) but higher lightness value L* equal to 62.71, compared to Moondrop and Black grapes peel extracts which recorded respectively

L* values of 36.5 and 44.25 . The total monomeric anthocyanin content of Moondrop, Black and Red grapes was found to be 513.2 mg Mv-3-O-glc/100g, 377 mg Mv-3-O-glc/100g and 55.7 mg Mv-3-O-glc/100g of grape peel, respectively. uHPLC-PDA and ESI-MS/MS data revealed that Maldivin-3-glucoside was the most abundant anthocyanin in both Moondrop and Black grapes peel, whereas Peonidin-3-O-glucoside was the most abundant anthocyanin in the Red grape peel sample. Acylated anthocyanin were tentatively identified in Black and Moondrop grapes peel (Malvidin-3-O-glucoside acylated with coumaroyl acid). In conclusion, Moondrop would be a good source of Malvidin-3-O-glucoside. None of the grape peels are a predominant source of Cyanidin-3-O-glucoside.

Richard S. González Aquino* and Horacio D. Lopez-Nicora

Innovative Soil Sampling Technology for Swift and Accurate Detection of Soybean Cyst Nematode (SCN)

Soybean cyst nematode (SCN), Heterodera glycines, remains the most economically damaging soybean pathogen in North America. Active management of SCN begins with an accurate soil sampling to assess current population densities. While manual sampling is commonly employed, it has limitations such as time consumption, difficulty in covering large fields, and the possibility of overlooking spatial aggregations of SCN. This project aimed to compare the accuracy and efficiency of an automated soil sampler with manual sampling in collecting and quantifying SCN in 100 cm^3 of soil. Three SCN-infested fields in Ohio were selected for this study: one in Clark County (WARS) and two in Fulton County (Fulton-1 and -2). We used an automated precision soil sampler (APSS) for automated sampling and a cylindrical stainless-steel soil probe for manual sampling. In a grid pattern, we collected a total of 750 samples across various locations. These samples were processed to determine the number of SCN eggs per 100 cm^3 of soil. Agreement between the two methods was measured using concordance correlation coefficient (CCC) analysis. Furthermore, a visual comparison of the spatial distribution of SCN obtained with the automated and manual sampling was conducted using QGIS software with the inverse distance weighting (IDW) interpolation analysis. The CCC analysis showed a significant positive relationship between APSS and manual sampling for WARS (ρ_c = 0.71) and Fulton-1 (ρ_c = 0.77). However, a lower correlation was observed for Fulton-2 (ρ_c = 0.47). While perfect agreements between methods were not observed, the SCN spatial aggregations were similar when using IDW interpolation for both automated and manual sampling methods. These findings suggest the potential use of technologies like APSS in large soybean fields to estimate SCN population densities and their spatial distribution. The use of APSS will streamline soil sampling, allowing for efficient

evaluation of SCN abundance, identification of at-risk areas, and proactive management of SCN-infested fields.

Daniel Hemphill*, Jonathan Fresnedo-Ramirez, Diane Miller, Elizabeth Anderson

Establishing Accelerated Apple Breeding Pipeline in Greenhouse Setting

Apples hold immense economic significance in the US as the most consumed fruit, yet their breeding is hindered by a prolonged juvenility period of up to 10 years during which seedlings cannot produce flowers or fruit. Overcoming this obstacle is crucial for breeders seeking to augment desirable traits such as disease resistances, fruit quality, novel traits and those related to nutritional quality. Since the inception of short-juvenile-period apple genotypes carrying the *BpMADS4* gene from silver birch, it is possible to accelerate apple breeding toward developing new cultivars. However, there exists the need for investigation into the implementation of such an accelerated breeding program, which accommodates the phenotypic peculiarities of the short-juvenile-period apple genotypes. In this research, a systematic and comprehensive pipeline is developed on the implementation of such an accelerated program under greenhouse conditions. Through careful environmental controls, acquisition of genotypic data, selection of diverse parents, over 10,000 seedlings were raised, and two apple harvests were obtained within two years. This work then shows a pipeline which is a proven method for initiating and sustaining an accelerated apple breeding program all within a greenhouse environment. The combination of genetic advancements, meticulous breeding techniques, controlled environments, and containment show promise for application toward the efficient development of new apple cultivars, marking a significant stride in overcoming the challenges posed by the juvenility period in both apple production and research.

Lillian Johnson*, Luke Hearon, Chia-Hua Lin, Laura Lindsey, Reed Johnson

Effect of an insecticide-fungicide tank mix on honey bee visitation in blooming soybean fields

Soybeans and honey bees have a mutually beneficial relationship where nectar is provided in exchange for pollination that can improve yield. However, pesticide use on soybeans during bloom could disrupt this relationship by harming bees and reducing yield increases from pollination. The aim of this project was to document the impact on bee foraging and soybean yield resulting from a highly toxic pesticide application made at different times of day, mid-day and in the late afternoon, at different times of year, during peak bloom and

after bloom has ended. To do this, we sprayed soybean plots individually with a mixture of Fastac insecticide and Fitness fungicide using a backpack sprayer. The active ingredients in these two pesticides have been shown previously to have synergistic effects on bee mortality. Honey bee activity data within each plot was documented through use of an audio recording device sensitive enough to pick up honey bee buzzing. Audio files were then dissected for instances of bee buzzing by a specially trained machine learning tool. Yield data was obtained through harvesting soybean plants and measuring the plot weight, plot moisture, and test weight. The honey bee visitation was analyzed through an analysis of variance. Yield data was analyzed using a t-test. The timing of the pesticide application did not have a significant effect on honey bee visitation or on soybean yield. This is the first year of data from a two-year experiment.

Saroj Khatiwada*, John Ngunjiri, Patricia A. Boley, Kush K. Yadav, Amir Ghorbani, Carolyn M. Lee, Chang-Won Lee, Saad Gharaibeh, Gireesh Rajashekara, Scott P Kenney

Evaluation of reoviral arthritis in commercial turkeys derived from vaccinated breeder hens

Turkey arthritis reovirus (TARV) causes arthritic lameness in turkeys. The affected turkeys exhibit lameness, swelling of hock joints, aberrant gait, and reduced weight gain. In 2019, highly pathogenic strains of TARV caused an estimated loss of $33.7 million to the turkey industry. Age-related susceptibility to TARV is not fully understood, resulting in ineffective control strategies. Autogenous vaccines, derived from field isolates of TARV O'Neil strains, have been used by turkey breeders as a prevention strategy with limited effect. We assessed age-based host responses to TARV infection in poults from vaccinated commercial turkeys. Poults, with known maternally derived antibody titers, were orally challenged with 4×10^6 median tissue culture infectious dose ($TCID_{50}$) of TARV O'Neil at 1, 3, and 7 weeks of age (woa) and euthanized at 3, 7, and 28 days post infection (dpi). Intestinal contents, hock joints, tendons, and cloacal swabs were collected and compared by one-way analysis of variance (ANOVA) and post-hoc Tukey's test. TARV induced weight gain suppression was observed when poults were infected at 1 weeks of age but not 3 and 7 weeks of age. Cloacal viral shedding was significantly higher at 3 and 7 days post infection in poults infected at 1 and 3 weeks of age compared to poults infected at 7 weeks of age, and correlated with age dependent severity of inflammation in tendons. Maternally derived antibodies from breeder hens vaccinated with autogenous vaccines are likely insufficient to prevent viral shedding and associated pathology due to challenge virus at 4 weeks post infection. Future studies will examine how viral, host and intrinsic microbial factors contribute towards the onset, development, and severity of reoviral

arthritis in turkeys.

Yeaeun Park* and Peter Piermarini

The Effects of Ambient Temperature on the Efficacy of Mosquito Repellents

Mosquitoes are known to display preference for target host temperature while avoiding harmful ambient temperature to find suitable host for blood feeding. This behavior known as thermotaxis is partially regulated by a nociceptor called transient receptor potential ankyrin 1 (TRPA1), which is expressed in sensilla or brains of insects. TRPA1 of female mosquitoes is known to detect noxious chemicals and thermal stimuli and elicit avoidance. Therefore, TRPA1 is considered a potential target for mosquito repellents and antifeedants. One aspect of TRPA1 channels from mosquitoes and other insects that has not been fully studied is the potential interactions between temperature and chemical agonists. In mammals, it is found that thermal activation from warmth suppresses chemical activation of heterologously expressed TRPA1. In this study, I examined whether the high ambient temperature impacts the activity of Aedes aegypti TRPA1 (AeTRPA1) induced by the chemical agonists. The whole-cell voltage clamp recordings revealed that the activity of agonist-induced AeTRPA1 was significantly reduced at 39°C. The followed behavioral bioassay also confirmed that heat-evoked mosquitoes are less repelled by the chemical agonist (catnip oil) but not by non-chemical agonist (DEET). These results suggest that the heat above mosquito TRPA1 activation threshold suppresses its reaction to chemical agonists. Elucidating the interactions between ambient temperature and TRPA1-agonism will allow us to predict whether certain repellents will remain effective if global ambient temperature continues to increase.

Carlos Porras-Guardado*, Xinyue Fan, M. Monica Giusti

Decarboxylation of Hydroxycinnamic Acids by Lactic Acid Bacteria Strains under Acidic Conditions

Hydroxycinnamic acids (HCAs), commonly found in fruits and vegetables, are phenolics sharing a simple C6-C3 chemical structure with a carboxylic group in the lateral chain. The most abundant HCAs in nature include p-coumaric, caffeic, and ferulic acids. During red wine fermentation, p-coumaric (p-CA) and ferulic acid (FA) undergo decarboxylation by the enzymatic activity of yeast. The decarboxylated compounds (4-vinyl phenols, 4VP) react with colored compounds present in red wine (anthocyanins) to form more stable pigments called pyranoanthocyanins. Some lactic acid bacteria (LAB) strains can

decarboxylate these compounds during plant fermentation as a detoxification mechanism, yielding volatile 4VP. Studying the decarboxylation efficiency of LAB towards HCAs and subsequent reactions with anthocyanins will provide insight into bacterial selection for the efficient development of novel and stable natural food colorants.

The objective of this study was to evaluate 3 LAB strains (*L. plantarum, E. mundtii, P. pentosaceus*) preference and efficiency on decarboxylating HCAs under incubation conditions that favor pyranoanthocyanin production and study their reaction with anthocyanins.

HCAs were decarboxylated by LAB in a controlled environment (pH ~4 and 6), then assessed after 24 hr at 32˚C. PACN formation aided by LAB was evaluated in a mixture of pCA and blueberry ACNs (1:3 molar ratio) at pH 4. Samples were incubated for 24 hr at 32˚C followed by 48 hr at 45˚C. Aliquots were taken over time to monitor pH, pigment profiles (HPLC), absorbance (spectrophotometer) and color.

All strains tested exhibited high efficiency on decarboxylating p-CA and CA (~100% conversion) within the first 6 hours while FA was decarboxylated in smaller proportions, regardless of the pH of incubation. During the decarboxylation of the compounds, the medium was acidified by LAB production of lactic acid, providing a favorable environment for pyranoanthocyanin production. The formation of 4-VP by LAB strains in the presence of blueberry ACNs facilitated efficient pyranoanthocyanin production in 72 hr, leading to a hypsochromic spectral change and turning the color from red to orange typical of the new bacterially produced pigments.

LAB decarboxylation of HCAs can enhance pyranoanthocyanin production, suggesting an approach for producing stable food colorants.

Caleb Rykaczewski*, N. Bello, J. Kieffer, A. Z. Chang, M. Trotter, A. Garcia-Guerra

Assessment of On-Animal Sensors For Monitoring Activity of Beef Bulls During Breeding

Applications of on-animal sensors (OAS) remain underdeveloped for extensively managed beef bulls. Thus, this study aimed to compare two OAS types for monitoring bull activity during breeding. Angus and Angus crossbred beef bulls (n=52), aged 1-8 years, from six cow-calf operations in Ohio were placed into breeding groups (n=19) with a bull-to-female ratio of 1:25 (range 1:16-1:31). Reproductively sound bulls were placed with a female group from day 10 (range day 5-12) until day 60 after fixed-time artificial insemination. Before turnout, each bull was fitted with a collar-mounted GPS and an ear

tag-mounted accelerometer (AX3). Raw measurements, namely speed (m/s) and motion intensity (g), were converted to standardized Z-scores and summarized to an hourly resolution by computing the median hourly activity over a 24-hour cycle at early (day 13-28) and late (day 34-49) stages of breeding. Linear mixed models were fitted to standardized activity measurements to assess the dynamic effect of OAS type throughout the day at each stage. Size of the breeding group, bull age, scrotal circumference, and body condition were evaluated as potential covariates using stepwise selection. Diurnal activity followed a pattern of relative inactivity overnight from hours 21 to 5 and relative activity during daylight from hours 6 to 20. For both OAS, mean activity early in the breeding season was ~47% greater ($P < 0.01$) than late. At both breeding season stages, activity differed between OAS types ($P < 0.01$) at hours 2, 3, 4, 5, and 6 by at least 38%, with greater activity from GPS than AX3 ($P < 0.05$ all cases). Conversely, at hours 13, 14, and 16, activity derived from AX3 was greater than from GPS by at least 2.5-fold (14: $P < 0.01$; 13 and 16: $P < 0.1$), with no evidence ($P > 0.1$) for differences during the remaining hours. In conclusion, this study provides evidence that bull activity measured using independent OAS systems differ at specific time points. These differences may relate to the nature of bull behavior during breeding. Further exploration of benchmarks for bull activity may yield valuable tools for the identification of health and reproductive-related behaviors.

Lydia Salsbury*, Ricardo H. Ribeiro, Marília B. Chiavegato

Effects of Soil-Conscious Practices on Soil Health, C-Footprint, and Beef Cattle Productivity

Agricultural practices play a pivotal role in global climate change, with soil carbon (C) sequestration emerging as a crucial aspect of mitigating carbon emissions. The objective of this study is to evaluate soil-conscious grazing management, as opposed to conventional grazing management, in terms of soil health, C-footprint, and economic productivity. We hypothesize that soil-conscious grazing management improves soil health and reduces greenhouse gas emissions to decrease the C footprint as compared to conventional grazing management practices and increase profitability. Soil-conscious grazing strategies were characterized by planned rotational grazing, increased grazing seasons, and high forage species diversification. The study's methodology involves a paired comparison approach across two types of farms: those practicing soil-conscious grazing management and those adhering to conventional methods. Two farms of each type were selected based on history and descriptions of management practices, animal breed, soil type, and location. Data collection includes soil C stock at different soil depths,

soil texture, bulk density, particulate organic matter, aggregate stability, forage quality and yield, greenhouse gas emissions from pasture soils, enteric methane emissions from in-vitro simulation of forage fermentation, carcass evaluation, and economic survey data. Soil data will be analyzed utilizing SAS mixed model with Tukey test for comparison between means. C-footprint data will be evaluated through a GLM process with ANOVA. Productivity information from the survey will be included and analyzed PROCSURVEY. Meat data will be compiled and analyzed through SAS for ANOVA. The project findings will help understand and explain the importance of improved management practices such as rotational grazing and species diversification in enhancing soil carbon stocks. Moreover, the study emphasizes the potential for soil-conscious grazing to not only bolster soil health but also improve economic outcomes for ranches. By elucidating these connections, this research endeavors to foster greater awareness and adoption of sustainable agricultural practices, ultimately contributing to mitigating climate change impacts while sustaining ranch outputs. My abstract was reviewed by Dr. Marília Chiavegato (chiavegato.1@osu.edu).

Esha Shrestha*, Ashish Manandhar and Ajay Shah

Adsorption of phosphorus from agricultural runoff using hydrochar produced from agricultural wastes

Excess nutrient, mainly phosphorus (P), from agricultural runoff can cause harmful algal blooms in nearby water bodies leading to major environmental and health problems. The objective of this study was to evaluate the effectiveness of hydrochar produced by hydrothermally carbonizing agricultural wastes—dairy manure, corn stover and eggshell—as adsorbent to capture P from agricultural runoffs. The feedstocks were mixed in different ratios (1:0:0 to 2:1:1) and hydrothermally carbonized at 220℃ for 1 hour. The hydrochar was then activated at 800℃ for 2 hours in an inert environment to produce activated hydrochar. The P adsorption capacity of hydrochar before and after activation was investigated in batch setting. The results from batch adsorption showed improved P adsorption for adsorbents after activation. The feedstock mixes of dairy manure, corn stover and eggshell at the mix ratios of 1:0:1 and 1:1:1 showed maximum P adsorption capacity of 208 and 216 mg/g, respectively. Agricultural waste has great potential for producing sustainable adsorbent for P adsorption. If only 50% of eggshell waste produced in Ohio is utilized together with dairy manure and eggshell in the ratio (1:1:1), approximately 1,700 ton P can be removed from the runoff every year.

Shonna Smith*, M. Bhandari, M. Kauffman, J. Polestra, G. Habing, G. Rajashekara

Comparative genomics of *Listeria monocytogenes* isolated from small specialty crop farms (SSCF) in Northeast Ohio

Listeria monocytogenes is an invasive, zoonotic, foodborne pathogen that causes human listeriosis. *L. monocytogenes* is a resilient pathogen capable of surviving and even proliferating under various environmental conditions. Its capacity to persist in soil, manure, water, and various farm environments necessitates an investigation to safeguard consumers and maintain the reputation of small specialty crop farms. Small specialty crop farms (SSCFs) are an important and growing sector for crop production in the USA. Currently, there is little information on the prevalence and genetic landscape of the *L. monocytogenes* from SSCFs. Bridging this knowledge gap would help understand potential public health risks associated with the *L. monocytogenes* coming from these farms. The goal of our study is to understand the prevalence and genomic diversity among the isolates in the SSCF niche by characterizing pangenome, serogroups, antimicrobial resistance genes, and virulence genes. We collected, tested, and processed dairy and poultry manure, soil, water, and produce samples (n=1842) for *L. monocytogenes* from 15 SSCF between 2016 to 2020. Isolates were analyzed through Whole Genome Sequencing (WGS). The overall prevalence of *L. monocytogenes* on SSCF was 7.17% (132/1842 samples). Based on positive samples, the prevalence of *L. monocytogenes* was 23.2% (n=53/228) in dairy manure, 11.0% (n=14/127) in water, 6.2% (n=31/500) in produce, 3.6% (n=28/777) in soil, 2.9% (n=14/127) in poultry manure. From these 132 positive samples, 347 isolates were obtained and were subjected to whole genome sequencing (WGS). Pangenome analysis detected the presence of 2,036 core genes. In silico serotyping of *L. monocytogenes* detected the presence of four serotypes 1/2a, 1/2b, 1/2c, and 4b, implicated in human infections. Analysis of antimicrobial resistance (AMR) genes identified the presence of 10 genes: *abc-f, fos(x), mecA, vanZ, mprF, mprB, vga(G), ampC, group_1242,* and *tetR*. In addition, an arsenic-resistant cassette was detected in one of the isolates from a produce sample. Analysis of virulence genes revealed 68 virulence genes with six common virulence genes present: *prfA, plcA, hly, mpil, plcB,* and *actA*. These genes were present in all 347 (100%) of the genomes except for the *actA* gene in 243 (70.3 %) of our genomes. Overall, our results showed that SSCF harbored *L. monocytogenes* serotypes of public health significance and carried critical AMR and virulence genes. Therefore, regular monitoring is required to prevent the transmission of *L. monocytogenes* from SSCF to humans. Thus, our research may facilitate the implementation of effective management practices, enhance food safety, protect public health, sustain the economic viability of SSCFs, and contribute to environmental quality by

promoting prudent farming practices.

Raksha Suresh*, Olaitan Shekoni Comfort, Sara Dolatyabi , Jennifer Schrock , Mithilesh Singh, Renukaradhya J Gourapura

Evaluating the protective efficacy of chitosan-nanoparticle based adjuvanted oral Salmonella subunit vaccine against bacterial colonization in broilers

Salmonellosis continues to be one of the major public health concerns around the world causing a gastrointestinal disease. Poultry meat and eggs are recognized as one of the major sources of transmission of Salmonella to humans

In our previous research, we demonstrated that a chitosan-based nanoparticle vaccine incorporating outer membrane proteins and Flagella of Salmonella Enteritidis, administered orally, induced superior mucosal antibody and cell-mediated immune responses and reduced the challenge bacteria load by 1 log10 better than a commercial live Salmonella vaccine.

To further enhance its efficacy, we explored the inclusion of two adjuvants to the same chitosan-based nanoparticle vaccine, Whole cell Lysate of Mycobacterium smegmatis (WCL) and cyclic-di-GMP, in this study. Three concentrations (2.5µg, 10µg and 50µg) of WCL and cyclic-di-GMP were evaluated.

Specifically, cyclic-di-GMP at a concentration of 50µg reduced the caecal bacterial load by 1.2 log10 compared to mock challenge on day four of the challenge infection. WCL at a concentration of 10µg reduced the bacterial load by 0.69 log compared to mock challenge. Moreover, this same group exhibited increased trend in the frequency of adaptive immune cells like B cells, T-helper cells, and cytotoxic T cells at DPC 4 compared to the other groups.

Aaron Tayal*, Andrea Kautz, Kayla Perry

Responses of ground beetles nine years after tornado and salvage-logging

Disturbances caused by strong windstorms such as tornados alter forest habitat by creating canopy gaps and increasing downed woody debris. After a tornado, land managers commonly harvest the fallen trees for their economic value, in a process called salvage-logging. It is unknown whether salvage-logging of forests following a windstorm has long-term impacts on the habitat quality of forest ecosystems for wildlife. My research focuses on ground beetles (Coleoptera: Carabidae), a family of insects that serve as

indicators of changes in forest health. To assess long-term impacts, my research investigates ground beetle communities nine years after a tornado impacted two large sections of forest at Powdermill Nature Reserve in Pennsylvania, USA. After the tornado, half of each impacted area was salvaged-logged. My objective was to measure the taxonomic diversity and community composition of ground beetles found in wind-disturbed, salvage-logged, and undisturbed forest plots. I hypothesized that in the long-term (after 9 years), the number of species in salvage-logged sites would become lower than unsalvaged sites due to reduction of woody debris. To accomplish my objective, I identified ground beetles to species level using taxonomic keys. Progress is underway, with 596 ground beetles pinned, and 31 species identified. The most common species to date are *Pterostichus adoxus* and *Sphaeroderus stenostomus*. The results of this study will inform the management of forests for biodiversity conservation. My abstract was reviewed by: Dr. Kayla Perry (perry.1864@osu.edu).

Anusree Thenissery*, Oluwatosin R. Ayinde, Katie Galgozy, James R Fuchs, Gireesh Rajashekara

Enhancing potency against avian pathogenic *Escherichia coli*: In vitro & In vivo characterization of synthetic analogues of a lead quorum sensing inhibitor

Avian colibacillosis, primarily caused by avian pathogenic *Escherichia coli* (APEC), represents a significant economic challenge in the poultry industry due to its profound impact on mortality, morbidity, and overall production efficiency. As a subset of extra-intestinal pathogenic *E. coli* (ExPEC), APEC shares genetic overlap with human ExPEC strains which brings forth potential zoonotic risks. Traditional antibiotic treatments face escalating resistance, necessitating exploration of alternative therapies. Our research focuses on quorum sensing inhibitors (QSIs) which interfere with bacterial communication mediated via autoinducers that controls gene expression related to virulence and pathogenesis. Inhibiting this pathway is hypothesized to provide an effective control method with a lower risk of resistance development. Building on our previous laboratory research that identified a potent QSI, designated QSI-5, this study aims to enhance the efficacy of this molecule through structural modifications. We developed six synthetic analogues of QSI-5 (OA4-107B, OA4-108B, OA4-109B, OA4-111A, OA4-112C, OA4-115A), each consisting of distinct molecular substitutions, to evaluate their impact on APEC's quorum sensing mechanism and pathogenicity. Initial screening involved a bioluminescence assay to determine the effectiveness of these analogues in disrupting APEC O78 (the model strain used for assays) quorum sensing. Two molecules, OA4-108 and OA4-109, displayed enhanced AI-2 inhibition compared to the parent molecule

exhibiting significant inhibitory effects at concentrations as low as 50 µM (100% inhibition for both OA4-108 and OA4-109), compared to 100 µM for QSI-5 (83% inhibition). Further both OA4-108 and OA4-109 significantly reduced the motility of APEC O78. Additionally, OA4-108 and OA4-109 showed minimal toxicity in sheep and chicken red blood cells (< 10% hemolysis). In vivo wax moth larvae assays further confirmed the non-toxic nature of these compounds, showcasing improved larval survival rates (100% larval survival for both OA4-108 & OA4-109 treated compared to the control). Further, both compounds resulted in significant reduction in APEC O78 load (3-6 log reductions to complete bacterial clearance) in wax moth larvae infection models. Continuing work focuses on assessing toxicity effects in cell lines, effect on virulence gene expression, and identifying potential targets to enhance our understanding on the safety and efficacy of the compounds.

Andres Velasco*, Alexander Lindsey, Manbir Rakkar, Osler Ortez

Agronomic Management and Input Combination Effects on Corn Physiology, Yield, and System Profitability. Andres Velasco

As corn (*Zea mays* L.) grain prices, climate variability, and industry marketing continue to rise and become more volatile, farmers are more driven to adopt integrated management approaches and preventive treatments to enhance corn production. As a strategy to maximize corn productivity in the state of Ohio, a study conducted in 2023 evaluated corn physiological, yield, and economic responses to a single/combination of management and input applications routinely marketed and used by farmers. Eight input applications were applied to 109 days relative maturity corn (7209TR RIB): Control Treatment (C) + Sub-surface banded fungicide, C + Increased corn seeding rate, C + Sulfur fertilizer, C + Foliar micronutrients, C + Delayed N Fertilizer Application, C + Foliar Fungicide, and Maximum Input Treatment. The study was established at three locations in Ohio: Wood County (Northwest, planted on 5/12/2023), Clark County (Western, planted on 5/18/2023), and Wayne County (Northeast, planted on 5/30/2023). Harvest dates were November 8 (Wood County), November 6 (Clark County), and December 7 (Wayne County). Depending on location and input combination, corn yield ranged from 177.28 bu ac^{-1} to 359.93 bu ac^{-1}. Preliminary results observed a significant difference ($P<0.05$) in one of three locations (Northwest) for Foliar Fungicide Treatments, resulting in a 34 bu ac^{-1} yield increment (compared to the control). The second year of this study is being established in 2024.

Nicole Volk*, Joy N. Rumble, & Sherifat T. Alabi

Electronic field trips and inquiry-based learning: A combination for food and agricultural literacy

As the food system, from production to consumption, has increasingly become complex, the need for food literacy among American school-aged children has also increased. Teaching and learning interventions using inquiry-based learning (IBL) can be used to improve food literacy. The purpose of this study was to determine how an IBL approach toward electronic field trips (EFTs) impacted students' ability to understand a systems-based process. The influence of the intervention was examined in a three-part EFT series with a focus on the tomato food system (growing, processing, and consumption) through teacher-reported feedback and student-generated drawings. Teacher observations indicated more than 80% of students demonstrated measured IBL markers. The comparative assessment of students' pre- and post-series drawings shows an increase in students' knowledge of the tomato food system. Students retained and built on their pre-existing knowledge of the tomato system, integrating more complex concepts into their post-series drawings. Results substantiate the educational value of EFTs in developing students' understanding of food systems. We, therefore, recommend the combined use of EFTs and IBL in classrooms to inform complex system topics aimed at improving food and agricultural literacy among elementary school students.

Doctoral

Md Washim Akram*, Qian Chen, Patrick Nortz, Gregory Nortz

Numerical Simulation and Experimental Investigation of Seasonal Impact on Heating and Cooling Performance of Horizontal Coaxial Ground Coupled Heat Exchanger

The building sector consumes more than 40% of the energy of a country and is responsible for 25% of greenhouse gas emissions worldwide, which can be reduced by using renewable energy sources. Geothermal energy could be an ideal renewable energy source to reduce the energy use of residential, commercial, and agricultural buildings through a ground source heat pump system. The aim of this study is to develop a transient numerical model in ANSYS Fluent for analyzing the seasonal impact on the performance of horizontal coaxial ground coupled heat exchanger (HCGCHE) and to validate the model with field measured data. The length and diameters of the inner and outer tubes of the studied HCGCHE are 91.44 m, 2.18 cm and 3.45 cm, respectively. The heat transfer rate per unit borehole length and overall heat transfer coefficient were found to vary from 0.21 to 40.37 W/m and 0.22 to 43.97 W/m^2.K for winter, and from 15.62 to 39.22 W/m and 14.61 to 53.06 W/m^2.K for summer, respectively. The root mean square error and temperature average error between experimental and simulated outlet temperatures for winter and summer were calculated as 0.8605 K and 0.2805%, and 0.8629 K and 0.2891%, respectively. The temperature distribution in surrounding soil both in the radial and longitudinal directions of the HCGCHE follows the second-order polynomial equation with R^2 ranging from 0.993 to 0.999. The results of this study show a very promising numerical model for studying thermal performance of the HCGCHE.

Courtney Anderson*, Abigail Thiemkey, Charlotte Milling, Stanley Gehrt

Coyote Complexity: Individual variation in the diet of Ohio's new "generalist" carnivore

Coyotes (*Canis latrans*) began to expand their range into the Midwest and eastern US in the late 1900s, becoming established across Ohio by 1980. As the new apex predator, it is important for us to understand what coyotes are eating so that we can predict what their long-term impact will be on other species. Adding complexity, a growing body of research shows that populations are not homogenous and that individuals can have varying dietary strategies. Coyotes are widely considered to be opportunistic generalists, consuming a

variety of food items. We sought to 1) classify individual dietary strategies on a scale from generalist to specialist, and 2) assess whether dietary strategy was demographically-driven or due to inter-individual variation. We collected whisker and tooth samples from road-killed and legally harvested contributions from around the state. Teeth were used to age the coyote while the whisker was used for dietary analysis with stable isotopes of carbon and nitrogen. By sub-sampling individual whiskers into segments, allowing us to estimate the dietary breadth of that individual. Dividing this individual breadth by the population's dietary breadth (using all segments of all individuals together) yielded an index of specialization. If an individual represents a low proportion of the population diet (index of specialization closer to 0), then it was a specialist, while a high proportion (closer to 1) was a generalist. We also ran ANOVA on the mean and standard deviation of each isotope to determine if there was a relationship to body size, age, sex, or region. None of these variables were significant predictors of isotopic signature. Our population appears to be composed of specialists (mean index of specialization 0.303 for carbon and 0.192 for nitrogen), and this strategy is not influenced by demographics. This means that, while some individuals may be in competition with native species, the effects of the population as a whole are more muted.

Liz Astorga-Oquendo*, H. Hu, A. Yousef, V.M. Balasubramaniam

Inactivation of *Clostridium sporogenes* PA 3679 spores by a synergistic pressure, temperature, and antimicrobial compound combinations

Conventional thermal processing methods employs prolonged thermal processing to guarantee the microbiological safety of food. Even though the food is ensured, excessive thermal exposure severely deteriorates the food heat-sensitive nutrients and quality. Pressure-assisted thermal processing (PATP) technology is an emerging sterilization method for food processing with minimal heat damage while ensuring microbiological safety, which employs a simultaneous combination of mild heat and high-pressure treatment. During food manufacturing, microbial safety is the most crucial prerequisite, where *C. botulinum* spores are the critical targets for elimination. *Clostridium sporogenes* PA 3679, a spore-forming bacteria, Gram-positive, nontoxic, and nonpathogenic putrefactive anaerobe, is a suitable surrogate for proteolytic *C. botulinum* that is commonly employed for shelf-stable foods thermal process validation. We investigated the efficacy of different 23 antimicrobial compounds (from a group of enzymes, polysaccharides, cyclodextrins, surfactants, polymers, and plant & fruit extracts) in combination with PATP to enhance the inactivation of *C. sporogenes* spores. Among all the antimicrobial compounds tested, this study demonstrated that combining chitosan

with PATP treatment can be used as an effective synergistic strategy to inactivate the spores of *C. sporogenes* PA 3679. Also, the results from this study can help food processors in developing methods to process foods using less severe pressure and thermal conditions than those used currently.

Avonti Basak Tukun*, Dakota Dustin, Kate Marris, Ali Kalhori, Rachel M Cole, Martha A. Belury

Assessment of the role of tBID in skeletal muscle atrophy during cancer cachexia

Background and objective: Cancer cachexia (CC), characterized by depleted adipose tissue and muscle wasting, affects 30-80% of cancer patients. One of the mechanisms of CC involves pro-apoptotic protein-induced mitochondrial dysfunction in skeletal muscle. Bcl2 family of proteins (BAX, BAK, BID, Bcl2) become activated through caspases-regulated apoptosis. Caspase-8 cleaves BID and cleaved BID (tBID) facilitates homo-oligomerization of both BAX/BAK and subsequent activation of mitochondrial pore and leakage of cytochrome C. The functionality of tBID depends on cardiolipin (CL) to activate BAX and BAK-dependent mitochondrial pore formation in yeast. However, the mechanism of tBID-induced BAX/BAK activation has not been studied in skeletal muscle in a mouse model of CC. This study aims to investigate the involvement of tBID in skeletal muscle atrophy using a mouse model of CC.

Method: The CD2F1 male mice will be randomized and inoculated with 0.5x10^6 C26 adenocarcinoma cells (Tumor group) or phosphate-buffered saline (Placebo group). Pre- and post-inoculation body composition and *in vivo* muscle strength will be measured during the progression of the disease. Once the Tumor group exhibits 10% weight loss compared to the maximum body weight will be euthanized and skeletal muscle tissue will be collected for measuring mRNA and protein expressions, subcellular localization of Bcl2 proteins, CL species, CL bound tBID, and mitochondrial function. An independent-sample t-test will be conducted to determine tumor effects.

Expected results: The Tumor group will exhibit lower lean mass and muscle strength along with higher expression of pro-apoptotic Bcl2 proteins and caspases, higher tBID levels, more tBID bound to CL, and lower mitochondrial function compared to the Placebo group. Pro-apoptotic Bcl2 proteins will be more localized to the mitochondrial fraction (activated) than the cytosolic fraction (inactive) in the tumor group.

Significance: This study will provide valuable insights into the mechanism of skeletal muscle atrophy in CC, specifically the involvement of pro-apoptotic Bcl2 proteins and mitochondria.

Acknowledgments: This project will be supported by the Ohio Agriculture Research and Development Center.

Menuka Bhandari* and Gireesh Rajashekara

Salmonella is the leading cause of death associated with foodborne illnesses in the USA. Non-typhoidal salmonellosis, disease caused by *Salmonella*, possess a significant challenge due to the evolution of multidrug-resistant (MDR) strains that are difficult to treat with existing drugs. To ameliorate this problem, we identified different sets of novel small antimicrobial peptides from the culture supernatant of *Lacticaseibacillus rhamnosus* GG and *Bifidobacterium lactis* Bb12 using LC-MS/MS. Among them, we characterized the effect of peptides (PN3 and PN5) against *Salmonella* both *in vitro and in vivo.*

To evaluate the efficacy of PN3 and PN5*,* the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) assays were performed by growing *Salmonella* Typhimurium (ST) in different peptides concentrations. MIC of peptides were tested against nine different serovars of *Salmonella* frequently reported in human illnesses. The Minimum Biofilm Eradication Concentration (MBEC) assay and gentamicin protection assay were performed to assess the ability of peptides to remove biofilm-embedded ST and intracellular ST. In addition, to check whether the *Salmonella* would gain resistance to the peptides, lethal and sub-lethal resistance assays were conducted. The thermal stability and proteolytic stability of the peptides were assessed by treating peptides at high temperatures and incubating peptides with proteinase K, respectively. The toxicity and *in vivo* efficacy of peptides were evaluated in *Galleria mellonella* (wax moth) larvae, using the MIC of peptides.

PN3 and PN5 were effective against ST. MIC and MBC of the PN3 were 18 and 24mM, whereas of PN5 were 21 and 30mM, respectively. MIC of these peptides inhibited growth of nine different serovars of *Salmonella* and completely eradicated ST inside the biofilm. Peptides at various concentrations completely removed the intracellular ST. The resistance assay demonstrated no resistance developed by ST. Thermal and proteolytic stability assay demonstrated stability of PN3 and PN5. Treating wax moths with PN3 and PN5 peptides significantly increased the survival rate of larvae but reduced the load of *Salmonella* in wax moths.

Overall, both PN3 and PN5 exhibited a promising effect against *Salmonella* and its serovars. Therefore, they could become novel antibiotic alternative to combat spread and evolution of MDR *Salmonella*.

James Cross*, Kanishka Mallick, Guler Aslan-Sungur, Andrew Vanloocke, Darren Drewry

Hybrid Biophysical – Machine Learning for Diurnal Estimation of Agricultural Surface Energy Fluxes

Accurate estimation of field-scale evapotranspiration is crucial for effective environmental monitoring and irrigation management, particularly in diverse agricultural systems. This study focuses on the Surface Temperature Initiated Closure (STIC) model, an innovative physics-based approach leveraging thermal radiometric observations to enhance the estimation of evapotranspiration fluxes through the Penman-Monteith (PM) equation. STIC has been widely validated using satellite remote sensing observations and shown to accurately estimate evapotranspiration fluxes and reduce associated uncertainties across a wide range of plant functional types and spatial scales. Our research evaluates STIC's performance in estimating evapotranspiration across multiple agricultural systems, emphasizing sub-hourly temporal resolution throughout the growing season. Utilizing data from the Sustainable Advanced Bioeconomy Research (SABR) farm at Iowa State University, we analyzed biophysical responses among four bioenergy crops—corn, miscanthus, sorghum, and soybean—under uniform climate and soil conditions. These crops include both modern commodity crops that span most of the Midwest US, and candidate bioenergy crops that may see broader application in the coming years. In addition to standard weather and turbulent flux observations, our study employed on-site remote sensing tools for canopy temperature and reflectance-based measurements (NDVI and PRI). We evaluate the degree and variance of modelled biophysical control, as well as the ability of STIC to capture the sub-diurnal variability in energy fluxes for these crops that differ in structural and physiological characteristics. A key aspect of our study is the integration of machine learning techniques, specifically the SHapley Additive exPlanations (SHAP) method, to dissect and understand the residuals of the STIC model. This approach not only highlights the effectiveness of machine learning in augmenting process-based models but also illuminates the pathways of flux estimation errors and their dependencies on crop variety. Our findings underscore the utility of machine learning in enhancing the precision of models like STIC, offering insights into their performance fluctuations and guiding future improvements in field-scale evapotranspiration estimation.

Madison Dahn*, Ben Eggers, Eric Stockinger

Genome-Wide Association Study Assessing Malt Quality Characteristics in a Panel of Winter Barley Varieties

In 2022, US growers produced 174 million bushels of barley, which contributed to a revenue of $115 billion for the beer market. A contributing factor to the beer market is the quality of the variety of barley used for beer. Different styles of brews require specific, but different, quality characteristics from the barley. Therefore, certain varieties work well for some styles, but not others. For breeding purposes, some quality characteristics are difficult to predict without first malting the barley. While informative, this requires highly specialized equipment and is expensive as well as labor and time intensive. To navigate this barrier, this study aims to understand how genetics plays a role in controlling the variation in these quality characteristics. We will pay specific attention to free amino nitrogen, as this malt quality characteristic can vary greatly and can be particularly difficult to predict. Free amino nitrogen, also known as FAN, is one component of malted barley that is measured to determine the suitability of a specific variety for brewing. Free amino nitrogen is a measure of amino acids, di-peptides, tri-peptides, and ammonium ions that are present after the breakdown of proteins. These components are then utilized by yeast in the fermentation process and is critical for successful fermentation. Thus far, no specific region of the barley genome has been linked to the control of variation in FAN levels. To identify regions of the genome affecting FAN and other characteristics, 350 diverse winter barley varieties were grown in Wooster, Ohio in 2020. They were later malted by the USDA Cereal Crops Research Unit. Utilizing the 'GAPIT' package in R, we tested for association between several malt quality characteristics, including FAN, and the genome to identify regions that may contribute to these traits.

Bishal Dhakal*, Greg LaBarge, Horacio Lopez-Nicora, Stephanie Karhoff,
Laura Lindsey, Amanda Douridas, and Osler Ortez

Cover Crops and Biological Applications in Corn-Soybean Systems

Poor cover crop establishment in the Fall has been a significant challenge in driving the holistic benefit of cover crop integration into the cropping system. It has further reduced the widespread adoption of cover crops. Various approaches for cover crop establishment exist, including interseeding during vegetative or reproductive stages into a standing crop or establishing a cover crop after corn or soybean harvest. However, these approaches place cover crops at competitive disadvantages. To address this limitation, utilizing biological products, such as *Beauveria bassiana* (Bb), shows promise in mitigating establishment challenges. Several studies have highlighted Bb's positive effects on the biological control of various insect species. However, researchers in the last decade have also documented the positive effect of Bb on plant growth enhancement across multiple crop species and have explored the new paradigm of these biologicals. To explore these

dynamics, an on-farm research project was started in 2023 to investigate the different cover crop establishment approaches and the potential of Bb as seed treatment for enhancing cover crop establishment in corn-soybean systems in Ohio. This study examines the efficacy of Bb seed treatment on: 1) interseeded cover crops during early vegetative stages in corn, 2) interseeded cover crops during reproductive stages in corn and soybean, and 3) drilled cover crops after corn and soybean harvest. Additionally, to understand Bb prevalence in the soil, Bb was applied to corn and soybean seeds before planting, with untreated cover crops sown in the fall post-harvest of cash crops. The study includes twelve on-farm sites in Central and Western Ohio, each with four replications in RCBD featuring four large strips with Bb seed treatment and four without treatment. The data will be collected and analyzed over two growing seasons, totaling 24 site-year combinations. The findings of this study will provide valuable insights to researchers, extension personnel, crop consultants, and farmers regarding approaches for improving cover crop establishment and the potential benefits of biological products in Ohio's corn-soybean systems.

Brooke Donzelli* and James Strange

Mycelium as a potential beneficial additive for bumble bee development and reproductive success

Bumble bees (*Bombus spp*.) are quintessential pollinators of many crops and wild flowering plants. Managed bumble bee colonies are commercially reared and sold for crop pollination. Though needed for pollination, these reared colonies often harbor pathogens that spread to native bee communities. Because of this, it is important to supplement the health of these managed colonies, while reducing the threat of pathogen spillover to native bees. In this study, we evaluated the influences of mycelium-augmented pollen on bumble bee development and reproductive success. We hypothesized that 1) mycelium-augmented pollen provides a nutritional benefit to developing bumble bee larvae by increasing their weight, size, and fat content, and 2) microcolonies provided with mycelium-augmented pollen produce more offspring. To test our hypotheses, we created microcolonies of *Bombus impatiens* workers and provided them with pollen provisions containing a 1% concentration of dried mycelium (either *Pleurotus columbinus* or *Pleurotus djamor*) or a mycelium-free control. We found that microcolonies provided with *P. columbinus*-augmented pollen had more offspring with faster development times that were higher in weight and total fat content than *P. djamor* or mycelium-free colonies. These results suggest that *P. columbinus* mycelium has the potential to be used as a beneficial dietary additive to managed *B. impatiens* diets to

increase reproductive success and offspring development. (This abstract was reviewed by my advisor James Strange (strange.54@osu.edu))

Dakota Dustin*, Lauren Otto, Avonti Basak Tukun, Kate Marris, Ali Kalhori, Leah Pyter, Yael Vodovotz, Noah Wiesleder, Miguel A. Lopez Perez, Alexis Tucker, and Martha A. Belury

Naringenin Prevents Immobility and Loss of Muscle Function Caused by Cancer Cachexia in Mice

Background: Cancer cachexia, a progressive wasting of adipose and skeletal muscle, frequently occurs in cancer patients and is responsible for up to 20% of cancer related deaths. Many cancer therapies neglect treating reductions in physical activity and muscle function, which are associated with increased risk of death. Naringenin is a phytochemical in citrus fruits that has anti-inflammatory and anticancer activities and may promote physical activity and preserve muscle function.

Objective: This study investigated whether naringenin could significantly improve locomotor activity and muscle function in mice with cancer cachexia.

Methods: Mice (16 male, CD2F1) were implanted with electronic telemetry transmitters to monitor locomotor activity. When mice were seven-to-eight weeks old, they were fed a semi-purified AIN 93-G diet supplemented with 2wt% naringenin (NAR+) or without (CON+) starting two weeks before being inoculated with colon-26 adenocarcinoma cells. Prior to inoculation and prior to sacrifice, muscle function was assessed using grip strength, and the Aurora 1300A *in vivo* system to determine maximal torque during dorsiflexion.

Results: Tumor bearing (NAR+) mice had 14.6% higher cumulative locomotor activity counts, and significantly higher activity counts during the last three light phases before sacrifice (7740 vs 4940 P=0.047, 7230 vs 3538 P=0.006, 4217 vs 3244 P=0.015) compared to CON+ mice. NAR+ mice, versus CON+ mice, had significantly higher gastrocnemius weight (0.976 vs 0.831%TFM, P=0.039), and higher forelimb (4.28 vs 3.55gf, P=0.042) and all-limb (10.25 vs 8.76gf, P=0.018) grip strength. Maximal torque was not significantly different between NAR+ and CON+ diet groups.

Conclusions: Tumor bearing (NAR+) mice had significantly higher locomotor activity, grip strength, and gastrocnemius weight compared to tumor bearing (CON+) mice. Further research will explore the role of naringenin in attenuating systemic- and neuro-inflammatory signaling pathways which may regulate locomotor activity and sickness

behavior.

Acknowledgments: Supported by the Center for Advanced Functional Foods Research and Enterprise.

Alexandre F. Mammana*, Marília B. Chiavegato

Fostering Resilience: Integrating Planned Plant Diversity and Grazing Management in Ohio’s pastures

Ohio's extreme seasonality challenges the growth of perennial forages due to droughts and flooding. Grazing management and planned plant diversity are promising alternatives to increase pasture resilience. The research´s objective was to implement optimally managed forage plants with complementary traits as an alternative to conventionally used fescue-clover pastures. Pilot greenhouse research evaluated two contrasting defoliation frequencies for six common forage species in Ohio - tall fescue, orchard grass, Kentucky bluegrass, Indiangrass, and big bluestem. The contrasting defoliations were: 1. frequent when the plant canopy intercepted 95% of the incident light, and 2. infrequent when the plant canopy reached maximum light interception. The experiment was located in Columbus, OH, from December 2022 to August 2023 with a factorial CRD design and 36 experimental units (3 replicates per combination of 6 species and 2 defoliation frequencies). Overall, frequent defoliation had shorter swards with greater leaf accumulation rates, while infrequent defoliation had taller plants with lower leaf accumulation rates. Target heights for both infrequent and frequent defoliations were identified for all species and will be used to guide a subsequent field study. The upcoming field experiment will evaluate three different plant mixtures grazed under the two contrasting defoliation protocols found in the greenhouse study (frequent and infrequent) and two inundation conditions (soil prone to inundation and not prone to inundation). Mixtures will be a conventional tall fescue-clover mixture, a cool-season mix (fescue + white clover + orchard + bluegrass), and a warm-season mix (big bluestem and Indiangrass). The field experiment will be a split-plot RCBD conducted in 2024-2025. Plant measurements will include forage growth rate, nutritional content, and botanical composition. Animal measurements will be plant selectivity, grazing efficiency, and in-vitro methane emission of available forage. Optimizing plant growth with higher quality forage can lead to better nutrition of livestock. This can ultimately result in improved animal health and productivity. Improved pasture systems contribute to ecosystem services and also reduce the effects of environmental disturbances.

Rinky Ghosh*, Xiaoying Zhao, Yael Vodovotz

Development of Sustainable Packaging with Enhanced Properties: Utilizing Waste-Derived Plasticizer, Eggshells, and Natural Rubber in PHBV Bioplastic Blends

Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV) is a biodegradable polymer with promising properties for use in various applications, including packaging. The limitations of PHBV's processability and brittleness were addressed by incorporating waste derived plasticizer, coffee oil epoxide (COE), and eggshells as a reinforcing agent in PHBV blend with highly viscous high-molecular-weight natural rubber (NR). The blends were produced via a twin-screw extruder. The primary objective of this study was to enhanced blends processability, mechanical properties, and thermal stability while maintaining their biodegradability. The addition of COE improved the flexibility and processability of the blends, while eggshells enhanced their mechanical strength. The melting point of the blends increased slightly upon the addition of eggshells. The thermal degradation temperature of PHBV/NR/COE (~82.16%) and PHBV/NR/COE/CaCO3 (~78.8%) blends was lower than that of neat PHBV (~97.21%) at 265-325°C, but the COE and CaCO3 components had good thermal stability compared to pristine PHBV. The crystallization behavior of the blends was studied using polarized light microscopy. PHBV/NR/COE blend revealed well-dispersed morphology with no observed phase separation, as confirmed by Scanning electron microscopy (SEM) analysis. Furthermore, a comprehensive analysis of the barrier properties was conducted. Thus, preliminary findings suggest that the PHBV blends hold promising prospects for future applications in environmentally friendly packaging films due to their good flexibility, effective water vapor and oxygen barrier characteristics, enhanced processability, and scalability in manufacturing.

Lucy Guarnieri* and Mary Gardiner

Moth conservation depends on the preservation of large habitats, but small habitats might help, too

Urbanization is driving moth declines worldwide; two-thirds of common species have declined significantly since the mid 1900s. Moths are pollinators, and are an important food resource for birds, bats and other wildlife. Urban greening investments such as wildflower habitats improve bee diversity, but their value for moths had not been thoroughly assessed. The goal of this project was to measure the value of large greening investments and small greening investments for moth conservation. Our objective was to measure the abundance of moths in metro park grasslands (large greening investments), urban pollinator habitats (small greening investments), and turf fields (negative control)

along an urbanization gradient. We hypothesized that metro park grasslands would support more moths than urban pollinator habitats, but that both greening investments would support more moths than turf-based landscaping. We used blacklight traps to collect moths from metro park grasslands, urban pollinator habitats, and turf fields in Columbus, Ohio, in the summer of 2023. We found that metro park grasslands had significantly more moths than turf fields. We also found a positive association between impervious surface area within a 1000m radius and moth abundance in metro park grasslands and urban pollinator habitats, suggesting that both types of greenspace can provide a refuge for moths in highly urbanized areas. The results of this study will inform greenspace management practices to improve pollinator conservation outcomes in cities.

Matthiew Haines* and Christopher Simons

To Milk or not to Milk? The Impact of Dairy Aroma on Cold Brew Coffee

Many people add dairy to coffee to reduce the bitterness[1]. Previous research has focused on aromatic changes, but not sensorial changes, of whitened coffee beverages[2]. Cross-modal interactions (CMI), or the integration of taste and smell sensory systems[3], may play a role in the perception of bitterness in whitened coffee beverages. The objective of the present study was to assess CMI of dairy aromas on the perceived bitterness of cold brew coffee when milk is added. Two experiments were conducted. In the first experiment (N = 32), subjects wore nose clips to prevent olfaction and CMI. In the second experiment (N = 34), nose-clips were not used, allowing retro-nasal olfaction to occur. Skim milk (SM), whole milk (WM), or water was added to cold brew coffee (CB) concentrate at 17% and 8% levels. Participants performed 2-alternate forced choice (2-AFC) comparisons on bitterness (SM v. water; WM v. water), indicated the certainty of their choice, and provided bitterness intensity ratings (from 0 to 10) for each sample. Choice data were analyzed by R-index analysis, whereas ratings were analyzed by paired t-tests, with ÃŽÂ± set at 0.05. Results indicate when olfaction is eliminated, there is no significant difference ($p > 0.05$) in the bitterness of the samples, as corroborated by the bitterness intensity ratings and R-index. When removing the nose-clips to allow retro-nasal olfaction to occur, samples containing 17% WM and CB were rated less bitter than 17% water added to CB. However, this was not seen at the 8% WM level. When CB containing water was compared to CB and SM, no significant differences in bitterness ratings or the R index were found at the 17% or 8% levels. The addition of milk reduced the perceived bitterness of CB through CMI between the coffee and the dairy aromas. This study saw significant decreases in bitterness only when WM, but not SM, was added to CB. This suggests that the aromatics from dairy fat may be modulating the bitterness when mixed with coffee.

Future research should continue to investigate the nature of CMI on bitterness between coffee and milk.

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Ashley Herkins* and Katrina Cornish

A Circumallergenic Guayule Latex Endotracheal Tube Balloon Cuff

Endotracheal tube (ETT) balloons are important for maintaining the health and safety of intubated patients. The balloon, which surrounds part of the tracheal tube, is intended to hold the tracheal tube in place in the trachea. Ideally, the inflated balloon also creates a seal between the ETT and the tracheal wall, preventing bacteria-laden saliva drainage into the lungs which can cause pneumonia. ETT balloons are commonly made of hard plastics such as polyvinyl chloride (PVC). If a PVC balloon is overinflated it can damage the cells of the tracheal lining. Unless the balloon forms a perfect fit with the trachea when fully inflated, pleats remain, which is usually the case, through which saliva can drain into the lungs of the patient. As a solution, ETT cuffs made from soft, hypoallergenic guayule latex, placed outside the PVC balloon and sealed to the tracheal tube, were previously developed but have not been commercialized. Although these outer cuffs do not cross-react with Type I latex allergy, they were made using conventional vulcanization chemicals which can cause adverse contact reactions. New outer cuffs have been made with guayule latex using a xanthate-based accelerant system designed to avoid contact reactions. A combination of 2 parts per hundred rubber (phr) diisopropyl xanthogen polysulphide (DIXP) and 0.6 phr zinc diisononyl dithiocarbamate (ZDNC) resulted in the highest tensile strengths in both thin and thick ETT cuffs (39.50 MPa and 42.35 MPa, respectively). A leak test was conducted for the guayule ETT cuffs, and the resulting two-way ANOVA revealed no significant effect of accelerant concentration on leak rate ($P = 0.5783$). Thus, all cuffs performed consistently. Finally, varying the size of the simulated trachea for the PVC cuffs revealed that larger tracheas had lower average leak rates due to the increased room for the cuff to expand, reducing the number of longitudinal folds.

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Modeling and Validation of Ammonia Emissions from a Commercial Poultry Facility Using AERMOD

Ammonia (NH_3) emissions from large-scale commercial poultry production facilities have become a significant public health concern in recent years. Emissions of NH_3 lead to ecosystem acidification and the formation of fine particles ($PM_{2.5}$). It is difficult for producers and regulators to estimate these emissions' impact on the surrounding environment. AERMOD is a US EPA regulatory model that is used to estimate the dispersion of air pollutant emissions in the atmosphere and their potential environmental impact. However, AERMOD's application for NH_3 emission from poultry facilities has yet validated. This study measured NH_3 emissions from various sources and NH_3 concentrations at downwind locations at a commercial poultry facility and modeled NH_3 dispersion using AERMOD. NH_3 emission rates were calculated using concentration data measured by an INNOVA multi-gas analyzer, building ventilation rate, and the indoor air temperature and relative humidity. NH_3 concentration measurements were obtained downwind using an INNOVA multi-gas analyzer and ammonia diffusion tubes for validation. The validation data was then compared with the average NH_3 concentrations and the maximum 1-h average NH_3 concentrations each day. Model performance was then assessed using statistic criteria including the absolute value of fractional bias (| FB |), the normalized mean square error (NMSE), the fraction of predictions within a factor of 2 of the observed value (FAC2), the geometric mean bias (MG), and the normalized absolute difference (NAD). Four of the model simulations were valid when comparing the maximum 1-h average NH_3 concentrations measured by the INNOVA ammonia analyzer and the predicted values by AERMOD. In addition, three AERMOD model simulations were validated with the diffusion tube-measurement of 6-h average NH_3 concentrations. Therefore, the study concluded that it is valid to use the US EPA regulatory model tool, AERMOD, to estimate NH_3 dispersion at a commercial poultry facility.

Hetian Hu*, Jerish Joyner Janahar, Susana C. M. Teixeira, Yimin Mao, V.M. Balasubramaniam

Structural analysis of ultra shear technology processed β-lactoglobulin, lectin proteins and their mixtures using small angle x-ray scattering

The goal of this study is to evaluate the effects of high pressure, shear, and holding time under pressure during high-pressure-based food processing (high-pressure processing (HPP) and ultra-shear technology (UST)) on the structures and conformations of an animal protein (β-lactoglobulin, BLG), a plant protein (pea lectin, PL), and their mixture. The

effects of high pressure on the protein samples (suspended in buffer solutions) were evaluated by treating the samples using HPP at 25 °C with a target pressure of 400 MPa. To evaluate the contribution of holding time under pressure, two holding times (0 and 5 min) were used after pressure come-up. The effects of high-pressure + shear on the protein samples were evaluated using 400 MPa – 40 °C UST treatments. Additionally, unprocessed protein samples were also incubated at elevated temperatures (40 and 65 °C) prior to analysis to evaluate the thermal effect on the proteins. The conformations of the processed and unprocessed proteins were characterized using small-angle X-ray scattering (SAXS), a non-destructive structural characterization technology that provides nanometer-scale resolution without extensive sample preparation.

The SAXS results indicated that all the proteins remain folded after 0 min HPP treatment. However, 5 min HPP treatment or incubation at 65 °C resulted in partial unfolding of BLG. PL is more resistant against HPP, UST, and thermal incubation, although some aggregations were observed after UST treatment. For the protein mixture, 5 min HPP treatment also caused partial unfolding, and UST treatment resulted in aggregation of the proteins. Interestingly, incubation at elevated temperatures did not result in unfolding of the protein mixture, revealing some protective effect of the proteins to each other against elevated temperature. Overall, this study contributes to improving the understanding of how high pressure, holding time, shear, and temperature can affect proteins. The results indicated that high-pressure-based processing technologies (UST and HPP) could potentially alter the functionality of protein dispersions (e.g., minimizing allergenicity). The current findings are useful to design liquid protein foods based on animal, plant proteins and their mixtures for greater control of the functional properties, thus extending their utilization in food, nutraceutical, and bio-medical applications.

Cameron Jordan* and Luis Rodriguez-Saona

The current reference method for cannabinoid quantification is gas or liquid chromatography, which is costly, time-consuming, and has a large environmental impact. Fourier Transform Near Infrared (FT-NIR) is a rapid and nondestructive spectroscopic analytical technique. NIR instrumentation costs considerably less than chromatography instrumentation, making it an attractive option for hemp producers to implement and is substantially easier for untrained operators. A critical source of variation in product from the initial analysis could be the degradation of cannabinoids during distribution and storage. The objective of this study was to design a method of analysis that can be implemented in real time, leading to a more accurate cannabis analysis.

Dry baths with lids were set to different temperatures (25°C, 35°C, 45°C, 55°C). Around 0.4 grams of homogenized inflorescence were weighed into tubes and placed in the appropriate temperature condition. Three samples were removed from each of the temperature conditions at one-week intervals and stored at -40°C until analysis so that no further degradation would occur. Inflorescence samples were analyzed by reference ultrahigh performance liquid chromatography-mass spectrometry (UPLC-MS/MS) to obtain cannabinoid concentrations (CBD, CBG, Δ9-THC, CBN, and acidic forms). Hemp samples were scanned with a handheld FT-NIR Scanner with a 10-second exposure time. Multivariate regression (PLSR) allowed for the correlation of spectral data with reference UPLC data. For kinetics modeling, data were fit to the Arrhenius equation to determine the kinetic parameters.

PLSR models show the quantification of major cannabinoids from the inflorescence with low detection limits (0.0012% w/w CBN) and high quantification limits (20.7% CBD acid). PLSR models show reproducible and sensitive results (Rcv>0.95). The kinetics equations show the degradation of cannabinoids follows first-order kinetics.

Cannabinoid degradation and quantification are important traits for maintaining the quality control of hemp products. This study provides a rapid and nondestructive alternative testing method to UPLC. NIR with chemometrics provides a simple solution for chemically complex matrices and determines the optimal storage conditions of hemp inflorescence. Producers and growers of hemp would benefit greatly from an easy-to-use analytical tool like NIR.

Rae Ju* and Ani Katchova

The Effect of Bank Consolidation on Agricultural Lending

Over the past decades, the banking sector in the U.S. has witnessed a wave of consolidation, leading to the emergence of fewer but larger banks. The primary aim of this study is to examine the impact of the consolidation trend on farmers' access to credit and explore potential differentiated effects between the county and state levels. Bank consolidation results in decreased agricultural loan volume, with a less significant impact observed at the state level. This trend may be attributed to the reduction of branches and the prioritization of other lending services by consolidated banks, which potentially hinder farmers’ access to credit.

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Zarich, Ai Ni, Martha A Belury

The Association of the Hepatic Steatosis Index with Pro/anti-inflammatory mediators in adult patients with NAFLD: A Cross-sectional Study

Objectives: In this study, we examined the association between the hepatic steatosis index (HSI) and visceral fat while controlling for various potential covariates. Next, we plan to explore the correlation between serum Maresin-1 (MaR1) levels and a range of clinical parameters, such as inflammatory cytokines, adipokines, and BMI.

Methods: In this study data from 74 individuals diagnosed with NAFLD was used. After screening, patients aged between 22 and 80 years with a BMI of 20-55 kg/m² participated in the study. The HSI score was calculated in all patients using the following formula: 8× (ALT / AST) + BMI + 2 (if type 2 diabetes) + 2 (if female). Partial correlation coefficients were employed for age- and sex-adjusted data. Linear regression analyses were conducted to explore the association between HSI and visceral fat. In the next step correlations between serum HSI and other clinical parameters were determined using either Pearson correlation or Spearman correlation test based on the distribution of the parameters. STATA software and GraphPad Prism were used for conducting all statistical analyses and generating graphical representations. Statistical significance was defined as a P value < 0.05.

Results: The initial findings of the study revealed a significant association between visceral fat and HSI (p=0.002). However, when examining the interaction between sex and visceral fat to HSI no significant association was observed (p=0.180). Additionally, we observed a correlation between HSI and gamma-glutamyl transferase (GGT) (P=0.043).

Conclusions: In an adult population with NAFLD, HSI was significantly associated with visceral fat and GGT in a crude model. Moving forward, we plan to use liver fat data from MRI scans to construct various models to explore any potential links between MAR1 and inflammatory cytokines, which may serve as predictors of NAFLD severity.

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Veeramani Karuppuchamy*; Shreya Nuguri; Luis Rodriguez-Saona; Osvaldo Campanella

Sensors help uncover value-added ingredients in waste streams from breweries

Background: Brewers' spent grains (BSG), accounting for 85% of breweries waste, is an excellent source of dietary fibers and proteins. There is a growing interest in exploring BSG as a food ingredient. It is essential to determine the composition of BSG to get

desired nutritional profile. Conventional wet chemistry methods are time consuming, labor intensive, and costly. We investigated the application of a new generation of handheld near-infrared (NIR) devices for quantifying macronutrients in BSG.

Hypothesis: The unique NIR vibrational overtones and combination bands of molecules that makeup foods combined with pattern recognition algorithms can provide rapid quantitative information of macronutrients in BSG, representing an alternative to conventional wet chemistry methods.

Methods: BSG samples were obtained from 11 local breweries. The proteins, carbohydrates, and lipids in the samples were determined using reference methods. Samples were scanned by a handheld Near Infrared (NIR) device operating in the 1350 to 2500 nm region. Absorbance spectra were analyzed by supervised classification (soft independent modeling of class analogy, SIMCA) and regression (Partial least squares, PLS) algorithms for developing predictive models.

Results: BSG components obtained from reference methods agreed with previously reported results. Calibration models were developed for proteins, lipids, and carbohydrates. In 10s scans, models predicted the BSG components with standard error of cross-validation (SECV) <0.5 and correlation coefficient of validation (r_{val}) >0.95. These results indicate that NIR spectroscopy can provide fast and reliable results for estimating BSG composition within a few seconds.

Conclusions: An accurate measurement of composition is essential for nutrition labels. The NIR spectroscopic method was easy to use for rapid quantification of nutrients without any need of sample preparation or operator training. The NIR spectroscopy can be easily implemented in plants for real-time analysis of by-products of the food industry providing sustainable added value and low-cost alternative to ingredients that otherwise would become waste.

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Sushma Katari* and Sami Khanal

Determining Corn Crop Growth Stages by Extracting Plant Morphological Features Using Unmanned Aerial System based Images

Understanding plant morphological parameters is instrumental in identifying various growth stages of crops. Characteristics such as leaf size, shape, color, flower development, and fruit formation serve as indicators of specific crop growth stages. Precise identification of these crop growth stages through plant morphology can enable farmers to undertake

informed and timely management decisions. These decisions encompass various aspects including irrigation scheduling, nutrient management, pest and disease control measures, and optimal harvesting timing. Our objective in this study was to extract plant morphological parameters such as canopy length, width, area, and distribution of plant colors, from a time series of high-resolution field images and train a Random Forest model with these features for determining corn growth stages. For capturing the high-resolution images, vertical takeoff and landing unmanned aerial system (UAS), Wingtra, with RX1RII 42MP RGB camera was flown over the corn field in Northwest, Ohio. Then, image processing techniques were employed using the Python platform for extracting the corn plant morphological features. The model was able to well differentiate the corn growth stages from V1-V9 and R1-R5 with RMSE<3, using morphological features such as horizontal canopy width, vertical canopy length, and color distribution. This utilization of plant features for crop growth identification can demonstrate significant value in enhancing sustainability and improving resource management within farming practices.

Manpreet Kaur* and Sheryl Barringer

The Effect of Yogurt and its Components on the Deodorization of Garlic Sulfur Volatiles

Introduction: Garlic is a popular condiment known for its flavor-enhancing properties. Consumption of garlic leads to the persistence of "garlic-breath" due to the presence of malodorous sulfur volatiles that may persist for as long as 24-hours. The sulfur volatiles allyl mercaptan, allyl methyl sulfide, allyl methyl disulfide, diallyl disulfide, and methyl mercaptan, formed when garlic is crushed, are the cause of the bad odor.

Objectives: To study (1) the effect of yogurt and its components in the deodorization of sulfur garlic volatiles in breath and (2) the role of yogurt components (fat, protein, water, microbes, pH) in deodorization.

Methods: Garlic was cut into 1mm slices. 100g of treatments like yogurt, water, 5%butter fat, 9% different dairy-proteins, emulsions, yogurt microbial culture at pH 4.4 & 7 were used. For In-vitro, samples were mixed and held for 30 minutes at 25°C. For in-vivo, garlic was ingested with each treatment. For effect of time of consumption, yogurt was consumed 5 minutes after, before or with garlic. Measurements of volatiles were taken after ingestion using selected-ion-flow-tube mass spectrometer.

Results: Fat, proteins, microbes and water were effective in deodorization of sulfur-garlic volatiles. Decreasing pH of water and fat had no effect on the deodorization whereas decreasing pH of protein solutions resulted in increased deodorization. In acidic-

conditions, the structural changes in proteins improved interaction between sulfur-volatiles and proteins, facilitating more effective binding. Whey-protein was most effective and milk-protein was least effective in deodorization of sulfur-volatiles whereas milk protein-fat emulsion was more effective than whey protein-fat emulsion. Yogurt was effective in deodorization of garlic-volatiles in breath. Fat-protein emulsion was not as effective as yogurt implying not only fat, protein, and water but also microbes in yogurt have synergistic effect on the deodorization of garlic-volatiles. Consuming yogurt at the same time as garlic was most effective in deodorizing garlic breath. Novel food-products with fat, proteins or active-microbial cultures can be developed targeting sulfur-volatiles for mitigating garlic breath.

Nathaniel King-Smith* and Katrina Cornish

From Roots to Rubber: A Comparative Study of Rubber Dandelion Cultivation Methods

Natural rubber (NR) is a critical raw material which is relied upon globally for transportation (mostly tires[1]), industrial components, and medical devices. We rely on a single plant, the tropical rubber tree (*Hevea brasiliensis*), for all the world's rubber. *Hevea* is restricted to a narrow geographic region, threatened by climate change, with over 90% growing in southeast Asia. Rubber trees are grown in plantations and being clonal, are at risk of rapid disease spread. The demand for rubber is increasing[2] but room for expansion of plantations requires clear cutting of rainforests[3,4], which is no longer legal practice. Given there are thousands of plant species that make rubber, it is logical to consider alternative rubber producing plants which could provide security in the event of a *Hevea* population collapse or other supply chain shortage. One such alternative plant is the rubber dandelion (*Taraxacum kok-saghyz*) (TK) which produces high quality rubber in its roots[5,6].

TK grows in temperate regions which means that areas such as the United States and Europe could use it to produce rubber instead of relying on imports. Additionally, TK can grow in hydroponics which allows for constant year-round production rather than the annual harvest used in the field. Hydroponic TK roots can be repeatedly harvested from the same plants[7] and are ready to harvest much faster than field-grown TK, resulting in several root harvests per year. Despite its potential, little research has been done comparing the actual performance of hydroponic TK to conventional production strategies.

In this study, two styles of hydroponic production (aeroponics and ebb-and-flood) were compared alongside two conventional TK production methods (field soil, and soilless mix

in a greenhouse). Roots from the hydroponic systems were harvested three times and the second harvest data was used for comparative purposes because it was close in age to the greenhouse-grown plants when ready for harvest. Root dry weights, rubber concentrations, and rubber per root are reported.

Anna Kolganova*, Jeffrey L. Firkins, Rattan Lal, Kelly Elizabeth Mitchell, Murray Minnema, Yairy Roman-Garcia

Combining Nitrate with Biochar to Inhibit Methanogenesis In Vitro

Ruminants emit CH_4, contributing to climate change. Biochar (BC) can inhibit ruminal CH_4 production based on redox-active chemical elements but lacks research information. We studied the impact of BC (a product of hardwood gasification) on ruminal methanogenesis while assessing the potential for added NO_3^- to be embedded in the BC matrix and non-additively interact to suppress CH_4 production in vitro. Feeding NO_3^- inhibits methanogenesis, but the absorption of NO_2^- into the blood system can limit its adoption. BC retains NO_3^- in soils, thus, we hypothesized that BC could retain NO_3^- in the rumen as well. We used a randomized complete block design with 200-mL flasks of buffered, anaerobic rumen fluid taken from Jersey cows analyzed using a mixed model with 3 random incubation blocks with 8 duplicated treatments that were assessed by orthogonal comparisons. Mylar balloons maintained anaerobiosis and gas production during the 24-h incubation. Diets were low (LF) or high (HF) forage without or with BC (6% of diet) and without or with NO_3^- (4% of diet). Data were analyzed with R Studio. Main effects of BC and NO_3^- in the HF diet reduced ($P \leq 0.04$) CH_4 production by 84 and 70%, respectively. However, only main effect of BC significantly reduced (P= 0.03) CH_4 production per unit of fiber degraded (NDFD). Interaction of BC and NO_3^- did not surpass the individual treatments in CH_4 production inhibition. In the HF diet NO_3^- decreased ($P = 0.04$) NDFD by 8.9%, whereas BC did not cause any changes. Interactions ($P \leq 0.02$) of BC and NO_3^- for NH_4-N concentration in both diets support the hypothesis of a BC matrix affecting NO_3^- reduction. However, minimal analyzed NO_3^- and NO_2^- concentrations showed complete reduction by the end of incubation. $(^{15}NH_4)_2SO_4$ and $^{15}NaNO_3$ were used to estimate microbial N production, which did not differ among treatments. BC is hypothesized to limit H_2 production or sink H_2 to compete with methanogenesis. Interactions of BC and NO_3^- were minimal but could be detectable with lower doses and increased microbial adaptation.

Audrey Kuei* and Christopher Simons

Applying Gamification to Improve Performance and Engagement in Descriptive Analysis

Panel performance is a measure of panel reliability and data actionability in sensory testing. However, panelists are commonly found to be disengaged from the repetitive tasks associated with descriptive testing, leading to poor panel performance, and resulting in data that lack actionable insights. Motivation is included in the definition of engagement and is recognized as one of the key factors contributing to data quality from sensory panels. One potential solution to this issue is gamification, an effective design strategy to stimulate engagement and performance by applying game elements to targeted non-game environments. Previous research demonstrated that embedding gaming elements improved panelist engagement, but the impact on performance was equivocal in a series of triangle tests performed in a single sitting. Alternative gamification models suggest that the application of random game elements is not an effective strategy and, instead, they should be optimized for an individual to maximize each subject's motivation. We hypothesized that optimizing the gamification design increases panelist engagement leading to improved performance under the following conditions: (1) increasing the duration of exposure to the gamification elements and (2) applying the User Types Hexad to characterize panelists into one of six user categories that provide corresponding game elements as motivation drivers with specialized mechanics. This study used four descriptive analysis panels treated with gamification elements during the training phase and/or evaluation stage (control/control, control/gamified, gamified/control, gamified/gamified). In all gamified sessions, panelists were repeatedly exposed to game elements identified from the User Types Hexad model. Following training, panelist performance (product discriminability, repeatability, panel consistency), engagement, and their response to implemented gaming elements were measured in the evaluation session. Results from the qualitative analysis indicated that panels with longer gamification exposure showed better panel performance with no significant impact on engagement. In addition, results also suggested that panelists showed weak to moderate responses to being motivated by individual game elements. Overall, as the first study to inspect the impact of gamification in descriptive analysis, these findings suggested that longer gamification exposure and a combination of game elements are necessary to maximize the effect of gamification in sensory panel performance.

Kaustubh Kumar* and Douglas Jackson-Smith

Credibility, Saliency, and Legitimacy of Outcomes in Participatory Modeling

Traditional approaches to systems modeling tend to be expert-led, top-down and take place in closed spaces. However, they have been found to fall short in addressing peoples' needs and complex sustainability challenges. They often fail to generate societal trust in the models and actual use of the models can be surprisingly low. While the importance of science in guiding environmental management cannot be overstated, the difficulty lies in generating scientific knowledge and products (including models) that are both credible and salient to decision-makers, while also being perceived as legitimate by other stakeholders. Societal acceptance and use of the models is more likely to be achieved when people/stakeholders are engaged in the design and evaluation of those models. This has led to a growing field called 'participatory modeling' (PM) where researchers collaborate with diverse stakeholders in the modeling process and identify plausible solutions for complex sustainability challenges, especially at the nexus of food-energy-water systems. Stakeholder engagement is also believed to strengthen the credibility, saliency, and legitimacy (CSL) of the PM process and the models and outputs that are created. Evaluation studies assessing the CSL of a PM process and models are sparse. I address these gaps based on an endline evaluation of a PM project called the Dynamic Regional Food, Energy, and Water Systems (DRFEWS). The DRFEWS project was designed to engage stakeholders and university scientists to develop an integrated FEWS model for the Great Lakes region to simulate sustainability outcomes under alternative future scenarios. The key research questions examined in the evaluation are: (1) Were the DRFEWS project outcomes perceived as credible, salient, and legitimate? and (2) Do CSL perceptions of stakeholders and scientists differ? Results suggest that broadly all participants felt that the DRFEWS project outcomes exhibit strong CSL, though they were not convinced that most regional decision-makers would use the outputs unless they were better packaged and disseminated. Interestingly, stakeholders rated the DRFEWS project outcomes on CSL more highly than members of the science team. This shows positive impact of stakeholder participation on CSL of PM outcomes.

Chih-Chun Kuo*, Osvaldo H. Campanella, Rafael Jimenez-Flores,

Valorization of byproducts from meat and dairy industries through fermentation to obtain protein hydrolysates

The escalating global issue of waste streams, particularly within the food industry, necessitates a sustainable approach to valorizing food wastes and incorporating these valorized compounds into new products. This study addresses the existing limitations of protein extraction methods by proposing innovative bioprocessing technologies able to effectively recover them from waste streams. The primary objective is to regulate protein

hydrolysis through a fermentation procedure applied to waste streams from the meat and dairy industries. Sodium-citrated whole blood from cattle and pre-sterilized acid whey from cottage cheese production were blended followed by the addition of *Lactobacillus rhamnosus* (OSU-PECh-69), which is a highly proteolytic lactic acid bacterium. The fermentation process, conducted at 37°C for 5 days, revealed that *L. rhamnosus* maintained viability at ~9 log CFU/g, while coliforms remained below the detection limit of 250 CFU/g. The acid whey natural acidity favored the growth of lactic acid bacteria over other pathogens, resulting in a decline in pH, which restrained coliform growth. The fermentation mixture with the addition of *L. rhamnosus* achieved a degree of hydrolysis of 6%. SDS-PAGE analysis confirmed the modification of proteins into smaller fragments during fermentation, which are different than those obtained by the byproduct putrefaction. This biotechnological process demonstrates the potential to valorize nutrient-dense byproducts through fermentative hydrolysis, offering promising and practically feasible alternatives for creating economically viable and sustainable processing solutions to make better use of the food industry byproducts. Furthermore, this approach stands out for its potential to transform nutrient-dense byproducts into high-value ingredients, aligning seamlessly with the UN's Sustainable Development Goals.

Thamonpan Laocharoensuk*, Linda J. Saif, Qiuhong Wang, Finn Grey and Scott P Kenney

Swine cell line susceptibility to porcine epidemic diarrhea virus (PEDV) for genomic CRISPR knockout screens

Porcine epidemic diarrhea virus (PEDV) is a swine enteric coronavirus, causing significant economic losses in swine industry due to high mortality in newborn and suckling piglets. Entry receptors and other host factors facilitating PEDV infection remain poorly understood. Characterizing the interaction between the virus and these host factors provides a foundation for uncovering potential therapeutic targets and breeding animals that are less susceptible to specific pathogens. Genomic CRISPR knockout (GeCKO), a newly developed high throughput genetic assay, has provided an invaluable tool for a rapid identification of host genetic factors critical for viral infection. In this project, we propose to utilize GeCKO to identify critical host factors contributing to PEDV infection. Ideally, a cell line that is highly permissive to PEDV and matches the primary host species and primary site of infection must be used for both positive and negative GeCKO screening. Therefore, porcine cell lines were screened for permissiveness to PEDV. IPEC-J2 cells from porcine small intestine, LLC-PK1 cells derived from porcine kidney, swine testicular (ST) cells, and neonatal porcine tracheal (NPTr) cells were tested for permissiveness to PEDV using dORF3-EGFP reporter virus. We found that NPTr cells, ST

cells, LLC-PK1 cells, and IPEC-J2 cells were only partially susceptible to infection with PEDV and produced infections that were multiple folds less in magnitude than Vero cells, which are the cell line primarily used for PEDV propagation due to its ability to produce high titers of virus. To enable appropriate screening via GeCKO, modification of existing cell lines to increase potential virus receptors, or to reduce the interferon response may be necessary to achieve appropriately high permissiveness to enable host factor screening.

Keywords: PEDV, permissiveness, genomic CRISPR knockout, high throughput genetic assay

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Carolyn Lee*, P. Boley, R. Suresh, O. Shekoni, J. Schrock, S. Dolatyabi, M. Singh, S. Khatiwada, K. Yadav, D. Bugybayeva, J. Hanson, R. Gourapura[2], S.P. Kenney

Evaluation of Multiple Immune Parameters Following Vaccination with an African Swine Fever Virus Multiepitope Protein Nanoparticle-Based Subunit Vaccine

African swine fever virus (ASFV), the virus that causes African swine fever (ASF), is a highly contagious virus affecting domestic and feral pig populations with mortality rates approaching 100% within seven days of infection. To date, there is no treatment or vaccine available for this disease. Although endemic in sub-Saharan Africa, ASF has also spread to many areas around the world and recently to the Dominican Republic and Haiti, bringing the virus closer to the United States (US) border. An ASF jump to the US will result in dire consequences to livestock producers and the pork economy. Therefore, there is an increasing need for the development of vaccine interventions to treat ongoing outbreaks abroad before, and if, the disease makes its way to the US. Recently, immunogenic epitopes of ASFV have been identified but have provided only limited protective immune responses without reported cross-protection. Here, we use in-silico modeling to engineer a synthetic multiepitope ASFV protein containing key immunogenic ASFV sites. The aim being to induce cross-protective immune responses utilizing a single protein vaccine antigen coupled with novel vaccine platforms. The multiepitope protein was expressed and entrapped into mannose-chitosan nanoparticles for vaccine formulation. The candidate vaccine was delivered intramuscularly to pigs, and T- and B-cell responses were evaluated following initial and booster doses. Nanoparticle entrapped vaccinates showed a positive multiepitope-specific IgG antibody response earlier than unentrapped protein vaccinates. The candidate vaccine also induced a greater number of cytotoxic and T-helper cells compared to unentrapped and mock (PBS) vaccinated pigs. Overall, our nanoparticle entrapped multiepitope protein vaccine induced antigen specific T- and B-cell responses, both of which have been identified as important correlates of

protection against ASFV. This promising preliminary immunological data suggests that our candidate vaccine could provide protection against ASFV, which will be evaluated in future studies.

Jonathan Lee-Rodriguez*, Christopher Ranger, Andrew Michel, Ashley Leach, Luis Canas

Utilizing Environmental DNA for the Detection and Identification of Two Common Greenhouse Pests (Sweet Potato Whiteflies and Twospotted Spider Mite) Infesting Tomato Plants

Environmental DNA (eDNA) is defined as the genetic material shed by living organisms which is then deposited in the environment. This offers a unique and novel opportunity to detect and identify terrestrial insect pests without the need for visual identification. The sweetpotato whitefly, *Bemisia argentifolii*, and the twospotted spider mite, *Tetranychus urticae*, are associated with crop losses due to the transmission of viruses and direct feeding. Our objectives were to: (1) assess the effectiveness of *B. argentifolii* literature-based PCR primers for eDNA amplification against our devolved primers, (2) compare sensitivity of polymerase chain reaction (cPCR) and real-time quantitative PCR (qPCR) to detect eDNA samples of *B. argentifolii* and *T. urticae*, (3) and determine a quicker eDNA processing methodology. Tomato plants (*Solanum lycopersicum*) were infested using clip cages to confine the pest population in each plant, the pest species were exposed to the plant for a period of 24 hours before being removed. eDNA was collected from the leaves surface using a water spray method, which would dislodge the genetic material and have it suspended in water. The water containing the eDNA was then collected before being filtered and subsequently processed for DNA amplification. We successfully amplified collected eDNA after only 24-hour pest exposure to the plants using both cPCR and qPCR. While the literature-based primers exhibited appropriate sensitivity, their specificity fell short for eDNA utilization. Which led to novel PCR primers being designed for both pest species. Positive eDNA detection was achieved using both DNA amplification methods, still, qPCR prove to be more reliable in detecting eDNA as we found that cPCR would fail to successfully amply all our positive samples. Additionally, we determined a quicker approach to obtaining eDNA results through the utilization of a LGC Biosearch Technologies QuickExtract DNA extraction kit, which yielded better detection results when compared to the more commonly used Qiagen DNeasy Blood and Tissue kit. We expect that our results will be the first step towards the practical use of eDNA in greenhouses as a highly sensitive, early detection tool.

Shuja Majeed*, Bikas Raj Shah, Shaimaa Kamal Hamad, Nimra Khalid, and Ali Nazmi

Natural intraepithelial lymphocytes respond to necrotic enteritis in chickens.

Intraepithelial lymphocytes (IEL) are located strategically in the intestinal epithelium, which enables them to play an essential role in immunological and physiological events, such as pathogen control and maintaining homeostasis. Compared to mice and humans, research on chicken IEL is lacking. In the former, diverse populations of IEL have been characterized and numerous studies have also examined their immunological functions, indicating their critical role in the enteric immune system. Contrarily, the subsets of IEL and their role in intestinal illness remain uncertain in chickens. Therefore, we carried out this research to study the response of IEL subpopulations following necrotic enteritis (NE) in chickens to glean further knowledge and move closer to achieving our goal of developing immune therapy against prominent enteric diseases of poultry. Sixty-three specific pathogen-free layer birds were placed in environment-controlled housing and randomly allocated to three treatments: *Eimeria maxima* with *Clostridium perfringens* co-infection (EM/CP*), Eimeria maxima* infection (EM), and Control (no infection), on 14 days of age (d). The EM/CP and EM birds were orally gavaged with *Eimeria maxima* on 14d, and EM/CP birds were subsequently inoculated with *Clostridium. perfringens* consecutively for two days (18 and 19d). Body weight was recorded on 18, 20, and 26d to calculate weight gain (BWG). At 1 day-post *Clostridium. perfringens* infection (DPI [20d]), and 7 DPI (26d), seven birds in each group were euthanized, and jejunum was checked for gross lesion scores and sampled for gene expression and IEL isolation. The EM/CP birds developed subclinical NE disease, as indicated by lesser BWG and greater lesion score. On 1 DPI, The EM/CP group exhibited at least two-fold elevation in the cell number of natural IEL subsets, comprising CD8a (iCD8a), TCR +, TCR-, TCRαβ+CD8αα+, and TCRαβ+CD4-CD8- cells. However, only the cell counts of TCRaβ +CD8aa + and TCRαβ+CD4-CD8- IEL persisted in greater amounts for the EM/CP group by 7 DPI. Gene expression was also greater for Osteopontin (OPN) and proinflammatory cytokines (IFN-g and IL-1b) in the EM/CP group on 1 DPI. These findings indicate that the natural IEL subpopulations respond during subclinical NE, potentially assisting in defense against NE.

Kate Marris*, Rachel M Cole, Genevieve Sparagna, Ai Ni, Martha A Belury

The Effect of Linoleic Acid on Heart Structure and Function in Mice Administered Anthracycline Chemotherapy

Anthracycline chemotherapy (AC) has toxic effects in non-tumor, mitochondrial rich tissues including cardiac muscle by inhibiting topoisomerase IIb and impairing the cell

cycle. In addition, AC binds to cardiolipin (CL), the signature phospholipid of the inner mitochondrial membrane. Linoleic acid (LA), the preferred fatty acyl side chain in CL, maximizes ATP synthesis. In heart failure, oleic acid (OA) replaces LA on CL. Therefore, we will test our hypotheses that increasing LA in the diet in mice undergoing chemotherapy will preserve cardiac structure and function through CL remodeling.

Ovariectomized, female (n=36, C57Bl/6J) mice will be inoculated with mammary E0771 cells. After 3 weeks of growth, tumors will be resected and mice will be divided into four groups: saline vehicle (veh) + lard (LD) diet, veh + high-linoleic safflower oil (SO) diet, chemo + LD, chemo + SO. Chemotherapy regimen will include 2 tail vein injections of 9 mg/kg anthracycline, 90 mg/kg cyclophosphamide 2 weeks apart. Before necropsy, echocardiograms will be performed on mice to measure left ventricular function. At necropsy, hearts will be evaluated for differences in histology, myosin heavy chain (MHC) isoform separation using SDS-PAGE, and mitochondrial lipidome and oxidative phosphorylation.

We anticipate that AC will reduce fractional shortening and LA will attenuate this. Cardiac tissue of mice on the LA-rich diet will have a higher proportion of LA-rich tetralinoleoyl cardiolipin and higher oxidative phosphorylation. Histological analysis will reveal fibrosis and ultrastructural alterations caused by AC and will be reduced in the LA group. AC will cause an isoform shift, decreasing MHCα and increasing MHCβ, which will be attenuated by the LA-rich diet. We expect to find that LA-rich diet (vs. control diet) will attenuate damage to cardiac muscle caused by AC treatment.

Jenna Moore*, Taylor Dill, Mesfin Bogale, Laura Lindsey, Horacio Lopez-Nicora

How does planting date impact fungal & oomycete communities associated with seedlings & rhizospheres of corn & soybean?

Plant health is affected by the microbial communities occupying the space on and around the plant system. In the Midwest US, microorganisms that threaten crop health continue to evolve due to changes in climatic patterns which include the progression towards warmer temperatures, increased precipitation in the early growing season, and decreased precipitation in the late growing season. The change in climatic conditions has led to an earlier optimal planting date for corn and soybean; however, increased precipitation in the early spring frequently disrupts the ideal planting period. Environmental variation can impact microbial communities and may result in undesirable shifts in pathogen populations. However, the influence of varying planting dates on fungal communities associated with corn and soybean rhizospheres, the region of soil in the vicinity of plant

roots, and seedlings are not well established. In this study, environmental and temporal features will be analyzed in conjunction with community structure and diversity using both metagenomics and traditional plant pathology approaches. The objectives of this study are to 1) assess fungal abundance and diversity in corn and soybean rhizosphere soils collected around seedlings sowed at five different planting dates, 2) assess fungal abundance and diversity in corn and soybean seedlings from plants sowed at five different planting dates, and 3) determine how environmental conditions (temperature, precipitation) and growing season (planting date, growing degree days) may impact fungal communities associated with the rhizosphere and seedlings. Currently, a total of 150 fungi and 120 oomycetes were isolated from seedlings and rhizosphere soil respectively. Molecular identification of isolates using the internal transcribed spacer (ITS) region with ITS1 and ITS4 primer pairs is completed for seedling-associated fungi and ongoing for rhizosphere-associated oomycetes. To compliment data from the traditional isolation approach, a metagenomic evaluation of the rhizosphere soil will be conducted. Outcomes from this study will identify the impact of planting date on pathogen risk, as well as indicate changes in seedling microbiome that may interfere with plant productivity, yield, and quality

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Aayasee Nanda*, M. Mónica Giusti

From Berry to Bottle: Crafting Lotion Consistency and Color

Skin care products containing active ingredients play an important role in maintaining healthy skin. Lotions are particularly valued for their ease of application. Lotion formulation allows for some control over the interaction among the ingredients and the incorporated active compounds. The desired consistency of oil-in-water emulsions, like lotions, can be tailored by adjusting the ratios of water and emulsifiers, meeting specific consumer needs. In this study, we evaluate addition of anthocyanins, water-soluble flavonoids known for their ability to prevent oxidative skin damage from UV exposure. Elderberries, recognized for their high anthocyanin content, were chosen as the natural antioxidant source. Our objective was to create a lotion with smooth consistency similar to commercial lotions and to effectively incorporate elderberry anthocyanins. Additionally, we tested solvents to extracts anthocyanins from the lotion to allow us to monitor anthocyanin stability in the lotion. We adjusted the formulation's ingredients for optimal consistency and stability. Three lotion formulations were compared over 60 days, and the most stable was chosen for anthocyanin addition. Elderberry powder rich in cyanidins, was integrated into this base after dissolving the powder in water. The efficacy of anthocyanin extraction with three different solvents, acetone, ethanol and water, was evaluated using the pH

differential method. Results were quantified as cyanidin-3-glucoside equivalents per grams of lotion. Our findings indicate that the formulated lotion maintained its stability and desired consistency over a two-month period at room temperature, closely resembling a commercial lotion base. Homogeneous color was obtained with incorporation of anthocyanins from elderberry into the lotion. Spectrophotometric and colorimetric analyses showed that ethanol was the most effective solvent to recover anthocyanins from the lotion. The successful extraction and quantification of anthocyanins from elderberries within the lotion underscore its potential for use in skin-protective benefits. We were able to tailoring lotion viscosity through formula adjustments. Future studies will investigate anthocyanin extraction optimization, and its long-term stability in the lotion, as well as bioavailability, and skin efficacy.

Yunyang Qi*, Carlos Porras-Guardado, Aayasee Nanda, Danielle M. Voss, M. Monica Giusti

Anthocyanin Content and Color Characteristics in Different Food By-Product Extracts

This study particularly focuses on the potential of agricultural by-products as sources of valuable compounds. Anthocyanins stand out for their vibrant colors and health benefits. The research aimed to determine the monomeric anthocyanin content, compare the color, and identify specific anthocyanins in three types of by-products: red onion peel, pomegranate peel, and red leaf lettuce tip. The study utilized the pH differential method through spectrophotometry for quantifying anthocyanins and UHPLC-PDA-ESI-MS/MS for their identification. The color characteristics were measured by spectrophotometer.

The results highlighted that red onion peels contained the highest amount of monomeric anthocyanins, 17 times higher than pomegranate peel and 62 times higher than red leaf lettuce tip extract, making them a potential source for natural colorant production. The study found acylated anthocyanins in red onion peel and red leaf lettuce, which are known for their enhanced color stability, a desirable attribute in colorant applications. The color of the red onion peel extract is more vivid and redder than the pomegranate peel and red leaf lettuce tip extract. Also, the red onion peel extract presented a darker color than the other two.

The research concluded that red onion peels hold promise for colorant production due to their high anthocyanin content and present acylated anthocyanins. The study suggests further exploration into the color stability of these natural colorants under varying conditions and their potential application in food products. This work contributes to the broader goal of reducing food waste by valorizing agricultural by-products, aligning with the trend to achieve a sustainable agricultural system.

Juan Quijia Pillajo*, Nathan Nordstedt, and Michelle L. Jones

Integration of in-vitro and in-planta approaches for high-throughput identification of phosphate solubilizing bacteria from greenhouse ornamentals

Phosphorus (P) is an essential macronutrient absorbed by plants as orthophosphate. P availability depends on the pH of the substrate. At high pH, P forms insoluble compounds like $Ca_3(PO_4)_2$ which is unavailable for plant uptake. Phosphate solubilizing bacteria (PSB) are plant-associated microorganisms that can break down $Ca_3(PO_4)_2$ by secreting organic acids. PSB have been primarily evaluated as inoculum for crops grown in soil to improve P availability. However, less is known about the application of PSB in ornamentals grown in soilless substrates. Our goal was to identify PSB from a collection of bacteria isolated from greenhouse ornamentals. First, the collection was screened in-vitro for the bacterial capacity to reduce pH of the media using the bromophenol-blue color assay. Thirty-five isolates were identified to reduce media pH, and their P solubilization capacity was quantified using ion chromatography. Fourteen isolates with the highest P solubilization were selected for whole-genome sequencing, but only two bacterial isolates were advance to the in-planta evaluation using Marigold (*Tagetes patula*) 'Durango Yellow' grown in a peat-based substrate (pH = 7). Plants were irrigated with 100 $mg{\cdot}L^{-1}$ N from a 15-0-15 fertilizer, and P was supplemented weekly as $Ca_3(PO_4)_2$ via drench. Plant evaluation was conducted weekly using the TraitFinder system (Phenospex). Leaf purpling is a common symptom of P deficiency, *Pantoea* sp. strains C2B11 and C8D10 reduced leaf purpling. Only, C2B11 significantly increased plant digital biomass. We identified two PSB that solubilize P in-vitro and promoted growth and health in marigold plants fertilized with $Ca_3(PO_4)_2$.

Alexander Ryan*, Yongyang Cai, Ani Katchova

Bank Response to Climate-Induced Disasters

As society confronts compounding risks associated with climate change, an expanding literature on climate adaptation seeks to understand how to mitigate the effects of climate change. From an economic perspective, as more frequent and extreme weather events damage assets such as homes and factories, financial institutions are faced with rising delinquencies and defaults. For this reason, regulators warn that more severe and frequent occurrences of natural disasters could adversely affect the safety and soundness of financial institutions and the financial system as a whole. To assist regulators and policymakers in monitoring climate-related risks in the financial system, I study whether

banks are tailoring their overall business strategy to manage the risk of rising occurrences of flood natural disaster events ("disaster risks"). Using a novel quasi-experimental research design, this study seeks to determine whether financial institutions reduce financial exposure to communities with high disaster risk by either reducing residential mortgage originations or increasing mortgage sales. My empirical strategy deviates from the existing literature which does not explicitly incorporate information on ex-ante flood risk within a county into the bank decision-making process. Results suggest that banks reduce residential mortgage originations and increase loan sales in counties with 2 or more large flooding events since 1990, providing evidence that banks include climate-related financial risks in their risk management frameworks. These results will support ongoing efforts by financial regulators to monitor climate-related financial risks and become more poignant as the trend in climate-induced natural disasters increases over time.

Shruthy Seshadrinathan*, Abigail B. Snyder, and V.M Balasubramaniam

Inactivation of *Enterococcus faecium* NRRL B-2354 on different material types used in food industry using superheated steam

Traditional sanitation in dry food manufacturing plant is challenging as moisture residue can harbor microbial contamination. Superheated steam (SHS) is produced when water is heated to temperatures beyond boiling point (125-400°C) without leaving any moisture on surfaces and there are limited studies available on sanitation efficacy of superheated steam on different surfaces. This study was conducted to understand the efficacy of superheated steam as a novel dry sanitation tool to inactivate *Enterococcus faecium* NRRL B-2354 (surrogate for pathogens like *Salmonella enterica*) in a wide range of surface materials (stainless steel, concrete, plywood, leather, PFTE, silicon rubber, cotton, and cardboard) commonly used in food industries. The surfaces were either spot inoculated or coated with representative food matrix and treated with SHS at 150°C for the process time (come-up time + treatment time) of 3 minutes. Spot inoculated surfaces showed a higher microbial inactivation (>9.2 log reduction/coupon) whereas, surfaces with inoculum coated with baby formula had lower inactivation ranging from 8-9.3 $\log_{10}$CFU/coupon due to protective effects of food matrix. Surface properties like high thermal inertia, low hydrophobicity and roughness contributed to higher microbial inactivation rate. We also studied the implications on surface roughness due to long term use (superheated steam at 150°C, 5 mins over 8 weeks) of superheated steam on selected surfaces (stainless steel, plywood, and silicone rubber). We observed no change in roughness during the experimental conditions ($p<0.005$). Hence, superheated steam can be effectively used to

sanitize wide range of surfaces for long time.

Bikas Raj Shah*, Shuja Majeed, Nimra Khalid, Ali Nazmi

In-Ovo Administration of Osteopontin into Chicken Eggs: Hatchability, Chick Quality, Intestinal Development, and Growth

Osteopontin (OPN), a pleiotropic cytokine encoded by the Spp1 gene, is a glycoprotein with roles in various physiological processes, such as tissue development and remodeling. In human milk, OPN makes up approximately 2.1% of the total protein content, suggesting its significance in growth and development. In the intestines, OPN is predominantly expressed by innate CD8αα cells in both mice and humans, contributing to the maintenance of the intraepithelial lymphocyte balance by promoting their survival and proliferation, as well as fostering a healthy intestinal microbiome. However, the exact role of OPN in intestinal development hasn't been investigated in chickens to the same extent as in other animal species. Our overarching hypothesis posits that introducing bovine milk – derived OPN has no detrimental effects on newly hatched chicks, but rather enhances their intestinal and immune system development while preserving a beneficial gut microbiome composition.

To test this hypothesis, 197 fertilized specific-pathogen-free (SPF) eggs were randomly allocated into five groups on day 18 of embryonation. *In ovo* inoculation was performed with varying doses of bovine milk OPN (0, 1, 10, 25, or 50 mg in 200 µl of 1X PBS per egg). We recorded hatchability for each group, alongside individual chick quality assessments, including navel condition, chick length, and hock condition. Furthermore, body weights and residual yolk weights were measured weekly, with individual intestinal lengths assessed at one-week post-hatch. While our results have not yet been disclosed, they suggest that administering OPN in-ovo increases egg hatchability and does not negatively affect chick quality or growth. Intriguingly, eggs that received 25 mg of OPN demonstrated the highest hatchability at 97%, had the highest body weight at hatch, and lowest residual yolk wt. until two weeks post-hatch. Similarly, eggs that received 50 mg of OPN had low naval score and high intestinal length which was comparable to eggs administered with 0 mg of OPN. These preliminary findings indicate a potentially advantageous role of OPN in early chick development. Consequently, we plan to further investigate its impact on intestinal development, functionality, immunity, and the composition of the microbiome.

Keywords: Chick Quality, Eggs, Hatchability, Intestine, Osteopontin

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Shyam Singh*, Jin Hong Mok, Mohamed Ali, and Sudhir K Sastry

Effects of field strength and frequency on inactivation of Clostridium sporogenes PA3679 spores during ohmic heating

The study explored the effects of electric field strength, temperature, and frequency on the inactivation of *Clostridium sporogenes* PA3679 spores (a surrogate of *Clostridium botulinum*) within buffer and in green bean puree. The experiments were conducted at three different field strengths (30, 40, and 50 V/cm), temperatures (110, 120, and 130°C), and frequencies (60, 1000, and 5000 Hz). Ohmic heating resulted in significantly greater reduction of *C. sporogenes* compared to conventional heating. Electric field strength significantly influenced spore inactivation. It was found that lower frequencies led to quicker rates of inactivation. Given that high field strengths have dual benefits of increasing both heating and spore kill rate, the possibility exists to process foods to sterility without a hold. This is expected to result in improved product quality, reduced process times and increased efficiency.

Zhining Sun* and Ani Katchova

Similarities in WASDE Estimates among Crops

The United States Department of Agriculture's (USDA's) World Agricultural Supply and Demand Estimates (WASDE) forecasts, prepared and released monthly by the World Agricultural Outlook Board (WAOB), providing annual forecasts, are a key public information source in the agricultural sector, given their policy relevance and market influence. A large body of literature has examined the announcement effect, forecast performance, informativeness, and accuracy of the WASDE. At the same time, SOME literature argues that USDA projections and forecasts suffer from bias which limits their informativeness. However, little attention has been given to identifying sources of bias under the forecast preparation process, which is crucial for improving forecast accuracy.

This paper aims to fulfill this gap by studying three research questions—do the forecast for multiple crops tend to be similar towards corn and soybean? Do the forecast errors for multiple crops tend to be similar for corn and soybean? Do these similarities contribute to bias in the forecast? To answer these questions, this study first applies the dynamic time warping (DTW) algorithm to evaluate the similarities between the crop forecast series and the forecast error series. Next, a regression controlling for weighted production will be run to map the relationship between similarities and bias. WASDE reports for the marketing year from 1999-2000 to 2022-2023 are extracted to do the analysis. Corn, soybean, wheat, sorghum, barley, oats, rice, and cotton are included. Variables including area

harvested, average farm price, yield per acre, exports, imports, total supply, total use, and ending stocks are analyzed.

Motivated by the work Chandio & Katchova (2022), this paper makes the initial attempt to investigate how the WASDE preparation process can influence its forecast errors. The paper finds evidence that crop forecast series are very different from corn and soybean forecast series for most of the variables. Additionally, this study finds that crop forecast errors are very similar to corn and soybean forecast errors. Also, differences in forecast series can reduce forecast errors. The findings from this study carry significant implications for the experts involved in preparing WASDE forecasts, which offer guidance on adjusting and enhancing the accuracy of forecasts.

Manita Thapa*, Annie Specht, Guilherme Signorin

Exploring ICT Usage Patterns and Challenges among Agricultural Extension Agents of Nepal

This study explores the usage patterns of Information and Communication Technology (ICTs) for disseminating agricultural information to farmers and identifies associated challenges for adoption of ICTs among agricultural extension agents in Nepal. With agriculture's significant role in Nepal's economy, understanding how extension agents utilize ICTs for information dissemination is crucial. Through a quantitative survey method, this study collected 128 responses from agricultural extension agents working in the Bagmati and Gandaki provinces of Nepal. We used Qualtrics Research Services for data collection and analyzed data using SPSS version 29. The findings indicate that phone calls are the dominant platform (91.20%) used by respondents, followed by email (84.90%), websites (76.10%), and Facebook (66.60%). This finding illustrates the significant reliance on phone calls for agricultural information dissemination, emphasizing the importance of direct contact in fostering interpersonal connections as a vital aspect of effective extension services. Conversely, voice messages (8.70%) and mobile apps (11.90%) exhibit lower adoption among extension agents. Further exploration into the reasons for the limited adoption of modern ICTs by extension agents reveals that this is mainly due to limited adoption among farmers (74.22%), followed by the perceived ineffectiveness of ICT tools in disseminating technical information in agriculture (48.44%). The other reasons include difficulties in navigating ICT tools (35.16%), perceived time constraints (28.91%) and organizational discouragement (20.31%). These results stress the need to address usability, user adoption, and organizational factors to bridge the gap between technology availability and end-user acceptance. We recommend targeted interventions to bridge the

digital literacy gap among extension agents and farmers to promote the benefits of underutilized modern ICT platforms. Policymakers and extension organizations can apply these findings to formulate strategies that enhance the overall efficiency of agricultural extension services in Nepal.

Keywords: Information and Communication Technology, Usage Patterns, Extension Agents.

Danielle M. Voss*, M. Monica Giusti

Glycosylation Impacts Color and Solubility of Wine-Inspired Pyranoanthocyanin Colorants

Red wine's vibrant, long-lasting color is contributed by pigments called pyranoanthocyanins. Formed from anthocyanins, red grape pigments, pyranoanthocyanins differentiate themselves from other nature derived colorants by their stability. With the potential to form pyranoanthocyanins from a variety of anthocyanin containing fruits and vegetables, they are being investigated as colorants for foods and consumer goods. Depending on the anthocyanin source, pyranoanthocyanins will have different sugar attachments. While sugars are colorless, when attached to the chromophore unit, they may affect the properties. Our objective was to assess how glycosylation number and type impacted the color expression across pH, stability, and solubility for 10-guaiacyl-pyranocyanidins.

Six 10-guaiacyl-pyranocyanidins with different glycosylations were formed by mixing anthocyanin extracts from *Aronia melanocarpa*, *Sambucus nigra*, and *Daucus carota* with 4-vinyguaiacol at pH 3.1, 1:5 M ratio, and 40 °C incubation. The formed pyranoanthocyanins were identified with uHPLC-PDA-ESI-MS/MS and isolated by semi-preparatory HPLC. Stock pyranoanthocyanin isolate solutions were added to buffers from pH 1 to 8 and 0.1% HCl MeOH at 40 μM. UV-Vis spectra was measured (260–700 nm), CIELAB color coordinates calculated with ColorBySpectra, and precipitation was observed visually over 17 days at room temperature.

The 10-guaiacyl-pyranocyanidins produced orange colors in acidic pH and acidified MeOH with 10-guaiacyl-pyranocyaindin-3-arabinoside being an exception as it was pink. Glycosylation number and type had a slight but significant impact on color. Disaccharides were significantly yellower (lower h_{ab}), lighter (lower L*), and less intense (lower C_{ab}* and extinction coefficient) than the mono- and trisaccharides. As pH increased above 5, the orange color became browner. However, at pH 8, pyranoanthocyanins were purple, most evident for the trisaccharide. The arabinoside and glucoside precipitated at all pH levels in

less than 4 days. However, di- and trisaccharides were more soluble with only ~9% absorbance loss over 17 days at pH 5.

The 10-guaiacyl-pyranocyanidins produced vibrant orange colors, retained color across pH, and had a diverse range of solubilities making them promising colorants for a variety of applications. Adjusting the glycosylation altered these characteristics to form pyranoanthocyanins with the desired properties.

Liam Whiteman*, Amber Tripodi, Pinar Barkan, James P. Strange

Endoparasites of Bumble Bees

Conopid flies (Diptera: Conopidae) and Mermithid nematodes (Mermithid: Mermithidae) (Figure 1) are obligate endoparasitoids of multiple insect taxa. Several conopid genera are associated with bumble bees; female conopids parasitize foraging bumble bees by ovipositing an egg into the bumble bee's abdomen. Mermithids parasitize a range of insects, however, they are not currently associated with bumble bees. There are only 17 records of mermithid parasitism in bumble bees so it is not clear if bees are an intentional host for mermithids. Parasitism has adverse effects on host bumble bee behavior and survival, but very little is known about conopid fly/mermithid worm host choice, distribution, or identification. Morphologically, both parasites are ambiguous, and keys do not exist for larval specimens. Here, we attempt to sequence both conopids and mermithids dissected from 2,094 bumble bees representing three bumble bee species from Madison, WI during the summers of 2019 and 2020 using universal primers.

Kush Kumar Yadav*, Patricia A Boley, Carolyn M Lee, Saroj Khatiwada, Kwonil Jung, Thamonpan Laocharoensuk, Jake Hofstetter, Ronna Wood, Juliette Hanson, Scott P. Kenney

Rat hepatitis E virus (HEV) cross-species infection and transmission in pigs

Strains of Rocahepevirus ratti, an emerging hepatitis E virus (HEV), have recently been found to be infectious to humans through unknown transmission sources. Rats are a primary reservoir of the virus; thus, it is referred to as "rat HEV". Rats are often found on swine farms in close contact with pigs. Our goal was to determine whether swine may serve as a transmission host for zoonotic rat HEV by characterizing an infectious cDNA clone of a zoonotic rat HEV, strain LCK-3110, in vitro and in vivo. RNA transcripts of LCK-3110 were constructed and assessed for their replicative capacity in cell culture and in germ free pigs. 4 days old, germ-free pigs were used to amplify the virus via injection in

liver. Fecal suspension from rat HEV-positive germ-free pigs was inoculated into 1 month old conventional pigs via ear vein inoculation. These inoculated pigs were cohoused with rat HEV negative naive pigs to determine if the natural fecal oral transmission is a major route of rat HEV transmission between animals. Rectal swabs and blood samples were collected from inoculated and cohoused pigs every 7 days. Student's t-test and two-way ANOVA were used to find the statistical differences between the groups. Our results demonstrated that capped RNA transcripts of LCK-3110 rat HEV replicated in vitro and successfully amplified in germ-free pigs, infected conventional pigs and transmit the virus to cohoused animals. Virus in rectal swabs demonstrate virus shedding in feces, virus in blood signifies viremia in conventional pigs. The virus in the feces and blood of cohoused animals demonstrates the ability of rat HEV transmission through fecal-oral route. Hence, the infectious clone of rat HEV is a valuable tool to study the genetic mechanisms of rat HEV cross-species infection and tissue tropism.

Alexis Zickafoose*, Theresa P. Murphrey, Rafael Landaverde, Manual Pina Jr., and Melinda Garcia

Evaluating a Virtual Interdisciplinary Team for Gender Capacity Building: Recommendations and Guidance for Agriculture and Development Professionals

Understanding interdisciplinary team functioning can provide a more in-depth understanding of the team's quality and collaboration rather than solely relying on project outcomes. This research aimed to assess the quality of collaboration within a gender-focused interdisciplinary team through examining the team members' process and structures of collective work. The objectives were to (1) identify the strengths and weaknesses of the interdisciplinary team across seven critical areas of interdisciplinary work, (2) assess how the interdisciplinary teamwork progressed as the project evolved, and (3) evaluate how the team has worked with each other during project development and implementation. This research used a descriptive retrospective survey design (n = 15) and interviews (n = 5) to assess participants' critical areas (promoting inclusion, considering time requests, facilitating participation, using inclusive tone and voice, reducing burden, providing recognition, and engaging in passionate leadership) and understand team collaboration. Wilcoxon tests revealed that there was no significant difference in the seven critical areas between the initial year and third year of the project. Participants expressed how the team continually promoted inclusion and demonstrated engaging and passionate leadership, recognizing these as the group's key strengths. Though, third year project data indicated that despite rare engagement, participants felt included and respected. Team dynamics were inductively sorted into five themes:

responsiveness, collaboration, representation, celebrations, and turnover. The interviewees pointed to the unavailability of many of the team members due to other obligations, the siloed nature of the modules, the need to have additional diverse perspectives and recognition for achievement, and the frequent changing of graduate students. When the team engages with each other, they are engaging positively. However, efforts to increase engagement may be vital to support project completion. Future research should investigate inter- and intra-team dynamics to illuminate team collaboration structures. Developing deep connections is essential to increasing collaboration and teamwork. Rich discourse and informal communication could create deeper connectivity amongst team members. As interdisciplinary teams become more common in research and development practices, teams could promote inclusion and facilitate engagement to increase collaboration.

Postdoctoral

Javier Campos*, Zhu H., Jeon H. and Ozkan E.

Evaluation of PWM valves at high frequencies for variable-rate applications of pesticides

Variable-rate orchard sprayers equipped with laser scanning sensors and pulse width modulation (PWM) solenoid valves can adjust the amount of pesticide applied in real-time based on canopy characteristics. Current PWM valves regulate nozzle flow rates at a 10 Hz speed to perform precision variable-rate spray applications. However, this regulation speed is much lower than the 40 Hz detection speed of the laser scanning sensors. Thus, the potential advantages of the high-speed laser sensor are not fully utilized because of the slow PWM valve speed. The capability of twelve PWM valves to modulate hollow-cone nozzles for variable-rate applications was investigated with PWM frequencies ranging from 5 to 50 Hz and duty cycles (DUCs) ranging from 10% to 100%. The PWM valves were assembled on a laboratory spray system with a hollow-cone disc-core nozzle operated at 1380 kPa pressure. The upstream and downstream pressures of the PWM valves were recorded and analyzed to determine the maximum functional DUC ranges and the maximum PWM frequency at which the PWM valves could functionally manipulate the nozzle. Test results showed that there were noticeable differences in the modulation capability among the 12 PWM valves due to their design differences. Two out of the 12 valves were able to manipulate the hollow-cone nozzles with DUCs ranging from 30% or 40% to 70% at the modulation frequency of 40 Hz. Thus, by integrating these PWM valves into the variable-rate sprayers could increase the nozzle flowrate modulation speed by four times so that the variable-rate accuracy would be potentially increased by four times. Therefore, these two valves would be selected for future investigation on their flow rate modulation accuracy and droplet size distributions before being recommended for adaptation in the variable-rate orchard sprayers to further reduce pesticide use.

Srishti Gaur* and Darren T. Drewry

Digital Twins to Model Leaf-scale Plant Water Use: A Combined Data- and Knowledge-driven Approach

Process-based models are the cornerstone of prediction and knowledge discovery across the environmental sciences. Despite their utility, process-based models are complex tools that require parameterization and re-parameterization as dynamic systems evolve and change over time. The next generation of hybrid models is now being developed to

integrate process-based and data-driven models in joint architectures, leveraging the knowledge built into process-based formulations with the flexibility and robustness of data-driven approaches.

The process of transpiration from plant leaves and evaporation from the soil surface, known as plant water use or evapotranspiration (ET), or latent heat flux (LE), is central to quantifying vegetation water use, carbon uptake and the energy balance of the terrestrial surface. The Penman-Monteith (PM) equation is a widely utilized process-based model for estimating ET rates by considering both meteorological drivers and physiological controls.

Here, we present a hybrid data-physics model to compute leaf-level latent heat flux which is constrained by the leaf-scale energy budget, and therefore energy conservation. Surface resistance (r_s) is the primary unknown element in the PM equation and is a complex function of factors spanning the meteorological environment of the leaf and the physiological controls the leaf exerts. In this work, we break away from typical empirical models by using a data-driven approach that leverages our knowledge of the soil-plant-atmosphere continuum to estimate this critical land surface variables controlling eco-hydrological processes.

This hybrid model incorporates a deep-learning neural network to estimate r_s as an intermediate variable in the PM equation to compute LE flux as the final outcome. The model was trained and validated using a leaf gas exchange dataset collected on eight soybean genotypes and three water application treatments under field conditions at Ames, Iowa.

Results obtained from the hybrid model suggest a high degree of success in predicting across a wide range of plant hydraulic stress. The developed hybrid model illustrated better generalization in LE predictions on unseen data while maintaining leaf-level energy conservation.

Keywords: machine learning; evapotranspiration; hybrid simulation; surface resistance

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Dong-Hwan Kim*, Joonbum, Lee, Kichoon Lee

Reversed Sexual Dimorphism in Muscle and Adipose Tissues in Quail

Sexual dimorphism refers to phenotypic differences between males and females within the same species. Generally, males are larger than females in most animal species; however, in quail, females exhibit a larger body size with greater muscle mass than males. This study aimed to understand the roles that growth characteristics in muscle and adipose tissues play in the reversed sexual dimorphism observed in quail. To this end, the pectoralis major

and gastrocnemius muscles (PM and GM, respectively), as well as leg and abdominal fat (LF and AF, respectively), were compared between male and female quail. The data revealed that adult female quail have significantly heavier bodies, and greater PM and GM weights than male quail; however, the weights of adipose tissues (both LF and AF) were significantly lower in females than in males. To compare muscle and adipose characteristics such as hypertrophy (increased size) and hyperplasia (increased cell number), the tissues were stained with hematoxylin and eosin. Subsequently, histological characteristics such as the total cross-sectional area (CSA), number and size of myofibers, and muscle bundles were measured and analyzed. In both PM and GM, no differences were observed in the total number of myofibers and muscle bundles, as well as the average number of myofibers per bundle, between sexes. However, the sizes of myofibers and bundles were significantly larger in females compared to males. Additionally, fat cell size was significantly smaller in female quail than in males for both LF and AF. These findings suggest that the hypertrophy of muscle and atrophy of adipose tissues in female quail contributes to the sexual dimorphism in body size observed in this species.

Peiyang Li*, Matthew Herkins, Reyna Knight, Lingying Zhao, Suraiya Akter, Lingjuan Wang-Li, Ji-Qin Ni, Albert Heber

Comparison of three on-field measurement methods for low-level ammonia concentrations at ambient locations of a poultry layer production facility

Ammonia emissions from large-scale commercial poultry facilities affect ambient air quality, surface water quality, ecosystem acidity, and human health in nearby areas. Estimating the fate and transport of NH_3 emissions after being discharged from animal buildings is crucial for producers and regulators in evaluating the impact of animal operations on the nearby ecosystems and neighbors' well-being. The US Environmental Protection Agency (EPA) uses the AERMOD model to estimate air pollutant dispersion. However, validation of ammonia dispersion estimation of AERMOD is needed before it can be used for agricultural animal production. For the model validation, accurate measurements of low-level ammonia concentrations, which have been a significant challenge, are needed. Three measurement technologies, including a non-dispersive infrared gas analyzer (INNOVA), diffusion tubes, and wet scrubber, were used to measure ambient low-level ammonia concentrations at a commercial poultry layer facility. The objectives of this study are to (1) assess the feasibility of these methods in measuring ambient air quality downwind poultry facility; (2) evaluate the effectiveness of the measurement data for validating the AERMOD dispersion model; (3) compare operation easiness, procedures, and costs of each measurement method. The findings of this study

will be beneficial for researchers, producers and regulators in selecting proper methods for ambient air quality assessment, ecosystem acidity estimation, and validation of ammonia dispersion models.

Sandip Mondal*, Conner Johnson, Zak Ralston, Laura Lindsey, and Horacio Lopez-Nicora

Beyond SCN Numbers for Maximizing Soybean Yield: Know Your SCN Type!

Heterodera glycines, the soybean cyst nematode (SCN), is a major contributor to soybean yield loss in Ohio and the country. Commercial varieties of soybean most often have PI88788 as a source of resistance to SCN. In this study, we assessed the host reaction of 128 soybean cultivars against two Ohio populations of SCN with differing virulence: HG Type 0 and HG Type 2-. Host reaction was determined using the female index (FI). It was calculated by dividing the average number of reproductive females on a test cultivar by that of a susceptible check (Lee 74). Each cultivar was inoculated with 3000 eggs of SCN. At 30 days after inoculation, mature females were dislodged and counted. The experiment was repeated once. The mean FI for HG Type 0 was 8.51 and for HG Type 2-, 57.53. When exposed to HG Type 0, 69% of soybean lines were resistant, and 31% moderately resistant. In contrast, with HG Type 2-, no lines were resistant, and only 7.81% were moderately resistant. Thus, identifying the SCN population's HG type in a field is crucial when selecting commercial soybean lines. Using the newly developed SCN Coalition tool called the SCN Profit Checker, we assessed the potential economic yield loss (EYL) and monetary yield loss (MYL) for both types of SCN. Our analysis revealed noteworthy positive correlations between EYL, MYL, SCN female counts, and FI. The outcomes also indicated a greater potential for yield loss in HG Type 2- compared to Type 0, emphasizing the significance of knowing the HG Type to maximize SCN management and soybean yield.

Sachin Naik*, Juan O. Quijia Pillajo, Laura J. Chapin, and Michelle L. Jones

Enhancing Phosphorus Bioavailability in Soilless Cultures: Identifying Phosphorus-Solubilizing Bacteria for Greenhouse Ornamentals and Vegetables

Phosphorus (P) is essential for plants but often becomes unavailable due to its reactivity with soil cations, forming insoluble complexes. Phosphorus-solubilizing bacteria (PSB) can enhance the bioavailability of P by dissolving these complexes. The goal of this research is to identify PSBs that can increase P bioavailability in soilless culture systems to produce greenhouse ornamental and vegetable bedding plants. From greenhouse rhizosphere

isolates, we screened 1,056 bacteria using a malachite green assay, identifying 24 PSBs that solubilized over 25% of P from $FePO_4 \cdot 2H_2O$. These were tested in greenhouse trials on *Tagetes patula* (marigolds) and *Solanum lycopersicum* (tomato) grown in peat-based substrate (pH 7.0), assessing growth and P deficiency. Digital phenotyping with TraitFinder (Phenospex) measured morphological (3D Leaf Area, Plant Height, Digital Biomass) and physiological traits [Normalized Pigment Chlorophyll Index (NPCI), Normalized Difference Vegetation Index (NDVI), Green Leaf Index (GLI), and Hue] associated with P deficiency. The top-performing bacteria were further validated in a greenhouse trial. Four PSBs (*Bacillus megaterium*C3F10, *Pseudomonas sp.* C6E7, *Pantoea rwandensis* C3A8, and C8D10) were found to efficiently solubilize P from $FePO_4 \cdot 2H_2O$, significantly enhancing plant growth and health compared to controls. Notably, improvements in plant health were evidenced by improvements in hue, NPCI, PSRI, and NDVI values. This research has identified novel PSBs that improve phosphorus uptake in marigolds and tomatoes, offering sustainable solutions for P nutrition management in floriculture.

Ricardo H. Ribeiro* and Marilia B. Chiavegato

Unraveling the relationship between management choices and soil carbon stocks in Ohio's forage production systems: an on-farm approach

Perennial forages have significant potential for storing carbon (C) in the soil due to their extensive root development, continuous C inputs, and absence of tillage. However, distinctions in management can impact the overall C inputs to the system and its subsequent accumulation. The objective was to evaluate on-farm soil carbon stocks from perennial forage systems with different management practices and compare them to annual cash crops in Ohio. Thirty different farms were selected, totaling 140 fields. Currently, 47 fields across 10 farms have been evaluated, in the Southeast, Northwest, West, and West Central regions. A survey with farmers was conducted to collect management information from the past 20 years. Soil cores were extracted at depths of 0-10 cm, 10-30 cm, and 30-60 cm and analyzed for total carbon concentration and bulk density. Fields vary in their use for annual crops, alfalfa, grass hay, or grazing, as well as in the age of the forage stand, and management strategies. Grazed pastures yielded the highest C stocks across the regions, particularly when managed with rotational grazing, diverse forage species mixtures and manure application. The type of management on pastures demonstrated a significant impact on C, even over a shorter period. Alfalfa systems exhibited a dependency on stand age, with newer establishments resulting in C stocks at the lower range, comparable to annual cash crops under conventional tillage,

while older stands were similar to grazed pastures. Carbon stocks under grass hay production were generally comparable to those of annual crops, but when managed with planned cutting and fertilization regimes, and composed of a mixture of forage species, including legumes, it resulted in C stocks similar to those of long-term improved pastures. Perennial production systems such as alfalfa and grass hay, or grazed forages, under more sustainable management practices such as planned fertilization and manure application, rotational grazing, and species mixtures are crucial for enhancing soil C sequestration.

Research Scientist

Nuris M. Acosta*, Luis A. Canas and Carlos E. Bogran

Direct and residual effect of three biopesticides on the predatory mites *Amblyseius swirskii* and *Amblyseius cucumeris* (Acari: Phytoseiidae)

The increasing use of natural enemies and biopesticides in agriculture production to control pests, makes it vital to study their compatibility. The objective of this study was to evaluate the effect of direct and residual biopesticides applications on two generalist predatory mites, *Amblyseius cucumeris* (Oudemans) and *Amblyseius swirskii* Athias-Henriot. Two biopesticides containing *Beauveria bassiana* (Mycotrol ESO and BioCeres-Strain ANT-03) as well as one biopesticide containing (CX-2140 *Isaria fumorosea* Apopka Strain 97), each one with two doses, was tested on adult's predatory mites compared to an untreated control. *Zinnia elegans* and Poinsettias (*Euphorbia pulcherrima*) grown under greenhouse conditions 25ºC/14:10 (L:D) were used for foliage. For residual exposure, zinnias (*A. swirskii*) and poinsettia's (*A. cucumeris*) plants were sprayed, and the biopesticide residuality was evaluated at five evaluation time, each for 48h. For direct effect, the adult's mites were topical applied 100 nL with a micro-applicator and evaluated 72h after. Our results indicate significant effect of biopesticides on, *A. swirskii* (F= 8.03; df 6,30; *P* = <.0001) and *A. cucumeris* (F= 11.0; df 6,30; *P* <.0001) when applied directly to adult predatory mites but no effect when they were exposed to residual biopesticides on leaves over the evaluation times. Bioceres dose 2 (*Beauveria bassiana* Strain ANT-03) as well as both doses of CX-2140 (*Isaria fumosorosea* Apopka Strain 97) were slightly harmless to *A. cucumeris* whereas only dose 2 of CX-2140 was slightly harmless to *A. swirskii*. Our finding suggests that it should be possible to combine the use of biopesticides with predatory mites. However, multiple factors should be taken into consideration when using predatory mites in an IPM program.

Wonjun Choi*, Joonbum Lee, Dong-Hwan Kim, Yeunsu Suh, Kichoon Lee

Heart-specific expression of the GFP gene in chicken embryos by administration of recombinant adenovirus type-5 vector into embryonic blood vessel

The adenovirus type-5 (Ad5) could be used for gene transfer to study the function of genes that have potential to improve productive performance, quality of products, and health in poultry. The Ad5 was micro-injected into embryonic blood vessel at Hamilton–Hamburger (HH) stage 14 to 17 to investigate permissive embryonic stages and transduced tissue/organs by Ad5-mediated gene delivery during chicken embryogenesis.

At 2 d of post-injection, strong GFP signal was exclusively identified in the heart of injected embryos. In addition, western blot analysis revealed that GFP protein was exclusively expressed in the heart. These results suggest that the GFP gene is specifically delivered to embryonic heart when Ad5 is injected through embryonic blood vessel at HH 14-17. This adenoviral transduction of genes of interest in the embryonic hearts can be used for understanding functions of genetic factors on embryonic heart development and unravel genetic etiology of congenital heart diseases.

Rachel Cole*, Eric Colombo, Austin Angelotti, Genevieve Sparagna, Andy Ni, Martha Belury

Delivering Soybean Oil through Foods to Alter Linoleic Acid Blood Biomarkers

Biomarkers of linoleic acid (LA), an essential omega-6 polyunsaturated fat, are inversely associated with risk of cardiovascular disease (CVD) and type 2 diabetes (T2DM) and liver and visceral fat. LA is the predominant fatty acid in cardiolipin (CL), a phospholipid important for mitochondria function. We have shown that consuming 10g of LA-rich oil each day, for 2 weeks increases plasma and erythrocyte LA and peripheral blood mononuclear cells (PBMC) tetralinoleoyl cardiolipin (LA_4 CL) in adults. To further understand how using food to deliver LA-rich oils will increase blood LA while maintaining body weight, we conducted a pilot study to determine changes in blood LA and body weight after 4 weeks of consuming foods made with 10g of SO or palm oil (PO). In this randomized placebo-controlled crossover study, 12 adults were randomly assigned to consume 3 study foods per day each made with 10g of SO or PO for 4 weeks (30g oil/day) with a 2-week washout period in between. Participants were instructed to replace foods in their habitual diets with the study foods to maintain body weight. Fasting blood samples were collected to analyze dried blood spot (DBS), plasma, PBMC and erythrocyte fatty acids and PBMC cardiolipin species. Body weight was measured every 2 weeks. Nine adults completed the entire study. Preliminary analysis shows that the percent of LA_4 CL and erythrocyte LA increased with the LA-rich SO foods while PBMC LA decreased with the PO foods. The change in plasma LA and DBS LA was significantly different when participants consumed the SO foods compared to the PO foods. There was no change in weight. Our findings suggest that delivering LA-rich oils through food should be explored in studies designed to assess if LA can impact CVD and T2DM risk, and visceral and liver fat. This work was supported by the United Soybean Board (funding reference number, 2411-108-0101).

Anmol Kaur Gill* and Darren Drewry

Hyperspectral Sensing of Winter Wheat Nutritional Traits

The increasing need to enhance crop productivity demands inventive approaches in contemporary plant breeding. Hyperspectral sensing is one such technique, which measures the amount of light reflected by plants across hundreds of wavebands and thereby offers a potential solution to tackle the issue. This method explores the structural and functional relationship between plants and electromagnetic energy across the visible, near-infrared, and shortwave infrared ranges. Therefore, in this comprehensive study, we attempt to model the macro and micronutrients of various winter wheat genotypes plotted across a diversity panel. This type of monitoring is essential for precision farming, aiding in the judicious application of fertilizers. To develop the models and identify effective spectral bands that could explain the variation in our target crop traits, 360 genotypes were sampled with a hand-held spectroradiometer. Prediction models were developed using partial least squares regression, a multivariate technique well-suited for managing high-dimensional spectroscopic data. Initially, quantitative models were developed at leaf scale and subsequently extended to canopy levels through appropriate upscaling methodologies. The study also evaluated an appropriate method to select the optimal number of components retained by the PLSR models to prevent overfitting and establish a fair trade-off between model complexity and performance. The most accurate models were obtained with leaf-level reflectance for nutrients like nitrogen, calcium, magnesium, sulfur, iron, zinc, and moisture content on a wet basis, yielding R^2 (% RMSE) values of 0.87 (6.22), 0.84 (14.85), 0.84 (13.90), 0.72 (15.38), 0.72 (13.33), 0.71 (11.32), and 0.85 (2.08), respectively. The canopy models performed on average lower that the leaf level results; moderate predictions for nutrients like nitrogen (R^2 = 0.52, RMSE = 23.19%), potassium (R^2 = 0.59, RMSE = 21.30%), sulfur (R^2 = 0.51, RMSE = 26.91%), and zinc (R^2 = 0.54, RMSE = 25.30%). Coefficients derived from PLSR models highlight important wavelengths influencing trait prediction, especially within the visible and near-infrared bands. Hence, this study provides swift and non-destructive methods for nutrient measurement to plant breeders and farmers to make well-informed decisions.

Sai Sasidhar Guduru*, Silvia de Lamo Castellvi, Aurélie Ballon, Madushika Keshani Ranasinghe, Maria Carme Güell, Montserrat Ferrando, Luis Rodriguez-Saona, V.M. Balasubramaniam

High-pressure processing, a promising technology to enhance insect protein extraction

The global population is expected to reach 9.8 billion by 2050. There has been increased demand for protein foods. Thus, food engineers and scientists are evaluating insects as an alternative protein source. Insects are a good source of nutrients, with protein content ranging from 41 to 66%, fat between 15-50%, fiber between 2-19%. Insect protein extraction is mainly performed using chemical extraction followed by iso-electric point precipitation. So far, very limited studies evaluated the potential of high-pressure processing as a tool for protein extraction. Due to the sensitivity of proteins to heat or solvents, high hydrostatic pressure (HHP)--assisted extraction can be more efficient in terms of yield and extraction time. The main objective of this work was to study the potential of using HHP to enhance insect protein extraction. Edible *Tenebrio molitor* and *Alphitobius diaperinus* powders were fully defatted with hexane. Fractions of 0.8 g were mixed with 4.2 mL of 0.15 mM NaCl solution (pH 8.3), placed in plastic bags, and treated at pressures ranging from 100 MPa to 300 MPa for 5 min at 25ºC. Treated samples were centrifuged and the supernatants were analyzed to determine protein content, molecular weight distribution (MWD) of the protein fractions, emulsifying activity, and changes in secondary structure of proteins by FT-MIR. All the pressures tested enhanced protein extraction up to 14% for both insect species tested and nonsignificant differences were detected among the treatments applied. Nonetheless, MWD results showed an increase of protein bands intensity in the range of 11-14 kDa as the pressure applied increased for both insect species. Moreover, for *A. diaperinus*, the protein bands intensity in the 26-27 and 37 kDa also increased with the pressure, and for *T. molitor* was around 18 kDa. Emulsifying activity only increased for *A. diaperinus* samples treated at 250 and 300MPa and that could be linked to the higher presence of 26-27 and 37 kDa proteins. Some conformational changes in the secondary structure of proteins were also detected with an increase of β-sheet and random coil and a decrease in the α-sheet content mostly for *T. molitor* extracts. The research shows the potential of using high pressure to increase up to 14% protein extraction and to modify functional properties.

Asmita Khanal*, Birendra Bahadur Rana, Sandeep Dhakal, John Wanjura, Edward Barnes, Ajay Shah

Evaluating feasibility of cotton stalks as solid fuels

Cotton harvest in the U.S. is currently done using stripper and picker harvesters, which pick cotton bolls and form cotton modules in a single pass. These harvesters pick/strip the cotton bolls off the stalk leaving the cotton stalks in the fields. However, cotton stalks have multiple value-added applications including feedstock for solid fuel (e.g., fuel pellets) and bioproducts (e.g., particle board). Thus, the objectives of this study were to evaluate the

feasibility of converting cotton stalks into fuel pellets by optimizing the pelletization conditions and to evaluate the techno-economic feasibility of the harvest, post-harvest logistics and pelletization of cotton stalks through process modeling. Pelletization of cotton stalks was conducted using two pellet dies of 6 and 8 mm sizes with biomass of 3 mm particle size at 30% moisture content without additional binding agent. According to the grading criteria of the Pellet Fuel Institute, the cotton stalk pellets could be classified as utility pellets while their calorific value was comparable to wood pellets. The techno-economic analysis was conducted considering all operations required for harvest and post-harvest logistics of cotton stalks and upgrading to fuel pellets and pellet plant capacity of 33,000 t pellets per year. The total cost of producing cotton stalk pellets was estimated to be $81-85/t with 70% of the cost contributed by the harvest operations. Considering the cotton stalk pellet price to be 70% of the wood pellet price, $33-41/t net income could be generated. Cotton stalk pellets produced from the capacity considered in this study could eliminate use of 26,000 t of coal per year, which would be equivalent to eliminating 54,000 t CO_2 from being released into the atmosphere.

Sarah McNulty*, Beenish Saba, Thaddeus C. Ezeji, and Katrina Cornish

Food Waste Fermentation to Produce Solvents

Valorization and utilization of industrial food processing waste as value added products, platform chemicals and biofuels, are needed to improve sustainability and reduce waste management costs. Plant-based industrial food waste stream samples were characterized with respect to their physico-chemical characteristics and elemental composition. A subset of starchy food wastes and milk dust powder were evaluated in batch fermentation to acetone, a useful platform chemical. Production levels were similar to acetone produced from glucose but were achieved more quickly. Low calorific content (10-15 MJ/Kg) vegetable wastes are not ideal for energy production. A model mapping food waste characteristics to the best valorization pathway was developed to guide waste management and future cost and environmental impact analyses. These findings will help advance food industry knowledge and improve sustainable food production through valorized processing waste management.

Emanoella Otaviano*, Ricardo Ribeiro, Steve Lyon, Ryan Haden, Douglas Jackson-Smith, Marilia Chiavegato

Greenhouse gas emissions under different crop-livestock integration methods

Diversification provides opportunities to achieve high productivity and bring environmental benefits to the system. Manure is an important source of nutrients to plants and reduce the need for commercial fertilizer. However, the effects of manure application associated with different modes of crop-livestock integration on GHG emissions remain unknown. The objective of this study was to evaluate GHG emissions in different methods of crop-livestock integrated farms. Four fields on four different farm systems were evaluated: grain crops without manure (Crop only); grain crops with manure application (crop-manure); crop and forage rotation with manure application (crop-forage-manure); and perennial crops for grazing (pasture only). Three replicates were assessed with the static chamber methodology in each field, with five chamber per replicate. Nitrous oxide (N_2O), methane (CH_4), and carbon dioxide (CO_2) emissions from soil were evaluated during Spring, early and late Summer of 2022. Soil samples were analyzed for organic matter (OM), carbon (POX-C), and nitrogen (ACE-protein) contents. N_2O emissions were higher on crop-manure farm (120 g N_2O ha^{-1} day^{-1}), in early summer, but similar among other treatments and seasons (below 30 g N_2O ha^{-1} day^{-1}). CH_4 emissions varied from source in pasture soil (2 to 7 g CH_4 ha^{-1} day^{-1}) to sink in other treatments (average of -10 g CH_4 ha^{-1} day^{-1}). CH_4 sink was higher during early summer when soil moisture was at its lowest. Soil respiration was higher in the crop-forage-manure field (262 kg CO_2 ha^{-1} day^{-1}) and in the pasture (183 kg CO_2 ha^{-1} day^{-1}), compared to crop-only and crop-manure (average of 100 kg CO_2 ha^{-1} day^{-1}). OM and POX-C were higher (3.5% and 457 mg kg^{-1}, respectively) for crop-forage-manure field. Preliminary results suggest that use of diversified crop-livestock systems does not increase GHG emissions to atmosphere and results to higher soil respiration, indicating that these are a sustainable and productive option for agriculture.

Zak Ralston*, Sandip Mondal, Horacio Lopez-Nicora

Update of distribution and abundance of soybean cyst nematode (SCN) in Ohio

The soybean cyst nematode (SCN), *Heterodera glycines*, is the most economically damaging pathogen of soybean in North America and is widely distributed in Ohio. From 2018 through 2023 SCN populations were quantified for over 1620 soil samples collected from Ohio soybean fields, representing 71 counties. Samples were submitted by growers and county Extension educators to the OSU Soybean Pathology and Nematology Lab. Such an endeavor was supported by the Ohio Soybean Council. From each sample, 100 cm^3 of homogeneous field soil was elutriated to extract SCN cysts. Cysts were subsequently crushed to release eggs and eggs were collected to determine a viable population and enumerated via microscopy. SCN was identified in over 62 percent of

submitted samples. Most SCN populations were at trace or low levels (<2000 eggs/100cm^3 soil.) Less than 10% of fields had population levels greater the 5000 eggs/ 100cm^3 soil, considered high- and at-risk level. Of the 71 counties represented, 63 had detectable populations of soybean cyst nematode. For the first time in 2023, SCN populations were detected in Athens and Gallia Counties.

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Wind tunnel evaluation of variables affecting spray deposition and penetration in soybeans

Adequate spray deposition of pesticides inside soybean plants plays a significant role in effective pest control. Weather conditions (especially the wind), choice of nozzle, and canopy density can influence spray depositions inside soybean canopy. To avoid the uncontrollable weather conditions and non-uniformity of soybean canopy in the field, the effects of wind speed, spray droplet sizes, and canopy density on spray deposition inside the soybean canopy were studied using uniform size container-grown soybeans placed in a wind tunnel. Tests were conducted at wind speeds of 0, 1.0, 2.0 and 4.0 m/s using four spray nozzles (XR 11004, TTJ60 11004, AITTJ60 11004, and AI 11004). The nozzles were operated for 3 seconds at 276 kPa pressure. A stationary boom with three nozzles 0.5-m apart was installed inside the wind tunnel at 0.5 m above the canopy. Soybeans in pots were placed on the floor of the wind tunnel in 2 (row spacing of 0.76 m) or 3 (row spacing of 0.38 m) rows, and each row had 11 soybean pots in series. To determine the spray deposition, water sensitive papers (WSPs) were placed at three different heights (top, middle and bottom) inside 5 soybean plants located 0.15, 0.70, 1.25, 1.80 and 2.40 m downwind from the nozzles. The WSPs were collected 5 minutes after each spray, scanned and analyzed to determine the spray coverage. The air speeds were measured by an anemometer with a 3D hot-wire probe. Air speed measurements were taken at four vertical positions: above the canopy, and top, middle and bottom of the canopy. The results showed that XR and AITTJ60 nozzles were the most effective at delivering spray to the bottom of the canopy. The results also showed that the structure of the soybean canopy significantly influences the air movement inside the soybean canopy. Once completed, the results obtained from this research will help Ohio soybean growers spray pesticides more effectively and economically. This can potentially reduce the amount of pesticide used while maintaining high yield.