Project Number: **S294**

Project Title: **QUALITY AND SAFETY OF FRESH-CUT VEGETABLES AND FRUITS**

Period Covered: **10/01/2022 to 9/30/2023**

Date of report: **02/01/2024**

Annual Meeting Date: **10/19/2023**;

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Emily Moyer, IFPA
Max Teplistki, IFPA
Drew McDonald, Taylor Farm
Mehea Park, Visiting Scientist at USDA Beltsville, MD poemmich@korea.kr

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Alessandro Banterle, Univ. of Milan, Italy

Non-attending participants also submitted a report:
Nannapaneni, Rama (nannapaneni@fsnhp.msstate.edu) - MS

Meeting minutes:

1. **Introduction**:

Brief introduction by Jorge Fonseca. Approval of the 2022 minutes.

2. **Welcome from Administrative Advisor, Scott Senseman**:

Scott Senseman congratulated the group for getting the new project accepted. This group is very productive in terms of accomplishments and publications. The current project is in its second year and will terminate in September 2027 (5-year projects). He encourages everyone to keep moving on research in Food Safety, Nutrition and Food Waste.

We have 60 days from the meeting date to submit the annual report for the group. Participants in this project S294 are encouraged to go to the NIMSS web site (www.nimss.org) to register. Make sure to fill the Appendix E so the participant list can be updated. Do not hesitate to contact the administrator, Scott Senseman, if you have problems getting registered.

Note: *An e-mail was sent by Jorge Fonseca on September 12th about the S294 project, with an attachment describing step-by-steps how to register*.

3. **Support to research, NIFA funding opportunities, Jodi Williams**

Presentation by Jodi Williams, NIFA, National Program Leader of the Food Safety Division.

Williams went through the various programs funded by NIFA under the Agriculture and Food Research Initiative (AFRI). She pointed out those that haven't had many proposals recently, such as "Education and Workforce Development". She recommended that under the AFRI programs, the "Sustainable Agricultural System (SAS") program needs to be prepared well in advance to put together a team.

Programs under AFRI:

- Food Safety and Defense funds: basic and applied research to reduce contaminants in food. Contaminants include heavy metals. Contact Jodi Williams for this program.
- Novel Foods and Innovative Manufacturing Technologies to develop "risk-based approaches to ensure the quality and safety of novel foods" (contact Hongda Chen)
- Mitigating Antimicrobial Resistance Across the Food Chain (contact Jodi Williams)
- Nanotechnology for Agricultural Food Systems (contact Hongda Chen)

Other non AFRI programs:

- Food Safety Outreach
- Small Business Innovative Research (SBIR): 10 topic areas, including food science, process and engineering
- Equipment Grant Program: this program is limited to Universities and does not need to be tied to any research proposal.

The Specialty Crop Research Initiative (SCRI) is also a non-AFRI program ($80M). There are two phases in the application process, pre-application reviewed by industry members for relevance, and full application. “SCRI requires transdisciplinary, systems approach that integrates research and extension.”

Dr. Williams’ power point will be distributed to all S294 members.

4. **Consumer Behavior Towards Fresh-cut Produce in Europe, Alessandro Banterle**

Dr. Banterle joined by zoom from the University of Milano, Italy, to present the state of fresh-cut consumption in Europe. The key points to take away were: convenience for meal preparation is still the main driver for purchasing fresh-cut produce, as well as the perception of health and consumption of fruits and vegetables in the Mediterranean diet.

The main challenge to industry is to maintain trust from the consumers, to provide a consistent product and a consistent message.

5. **International Fresh Produce Association (IFPA) ongoing work / technology research needs, Max Teplitski**

Max Teplitski, CSO IFPA, talked about industry challenges.

70% of food in the USA is lost or wasted. Please see his latest article in Current Opinion in Biotechnology https://doi.org/10.1016/j.copbio.2023.102971

There is an anticipated ban on all plastic packaging in Europe, already started in the UK. IFPA is trying to work with regulators; however, there is no data to show the regulators the obvious fact that packaging prevents contaminations. Most published data show that packaging increases shelf life (quality aspects), but nothing about keeping the food safe. Dr. Teplitski is appealing to S294 members to find such data if they exist. Some companies already are developing packaging from other-than plastics.

Another question some industry members are considering: is it possible to reduce the carbon footprint using the reverse supply chain? If yes, at what stage in the supply chain should a package be returned?

IFPA is a 501.C3 Trade Association, they have lobbyists on staff.

Max Teplitski suggested that S294 members look at non-traditional opportunities for funding. The USDA Trade and Foreign Agricultural Affairs (TASC) provides assistance for specialty crops; it is not funded by the Farm Bill, but funded by ICCC, to address technical barriers to trade. He encourages S294 members to contact IFPA when they have an idea for a proposal.

IFPA also has a robust educational and outreach program. They organize weekly virtual townhalls attended by 200 people, podcasts, short courses, etc. They collaborate with universities to organize and finance short courses. Contact Doug Bohr or Megan Nash, Chief Education Officers.

6. **Public-Private collaboration, Drew McDonald, Taylor Farms**

Drew McDonald listed 3 types of relationships between industry and academia:

1. Endorsement: When the scientist asks for a letter of support from industry when writing a proposal. This is minimum collaboration.
2. Active engagement: when the scientist makes an effort to understand the seasonality of the crop and time their research and communications accordingly.
3. Active participation: when the farm or packing operation is part of the project, when they provide data. They can also provide a risk analysis with the new project.

McDonald emphasized that it is important to build long term relationships for future applications. Need to identify hazards so that research should focus more on prevention. He focused his talk on the fact that PIs need to understand the production operation in order to provide meaningful data.

7. **Food safety research needs and opportunities for engagement with global IFPA members, Emily Moyer, IFPA**

Emily Moyer has been with IFPA for about 5 years. She is the VP of Regulatory Compliance and Global Food Safety Standards. She was here today because Gretchen Wall, Director of Food Safety and Quality, was unable to attend. Also, Deon Mahoney is the Head of Food Safety for Australia and New Zealand.

The Food Safety Team's goals are to advocate for science-based standards and policies.

There are 150 members on the Food Safety & Technology Council, and 4,400 members in the Food Safety group.

How do they engage in and support produce research: they can be reviewers, be on advisory committees, or collaborators in research projects.

The Food Safety Team facilitates connections between IFPA and academic researchers. They participate in the Center for Produce Safety Board of Directors and on technical committees.

<u>Research needed</u>:

Evolution of risks

Climate/weather events – what are the risks on produce commodities
Plant pathogens/pest damage; produce susceptibility to pathogen contamination
Chemical hazards: heavy metals, PFAS
New and emerging pathogens, REP strains (reoccurring, emerging and persistent enteric bacterial strains)

Intersection of safety and quality

Quality and safety indicators embedded in packaging
Iced produce
Hydrocoolers
How to optimize defect tolerance to reduce economic loss and food waste

New technologies and growing methods

Impact of new sustainable packaging and modified atmosphere packaging
Controlled environment agriculture

IFPA engages with consumer associations such as Consumer Reports by making sure that what they publish is correct.

IFPA is not so much engaged in nutrition science as in nutrition policy.

8. **History of S294, Jeffrey Brecht, University of Florida**

"S" was because the group originated from University of Georgia, in the Southern region. Funding is mostly provided to bring researchers together, not to fund research. The motivation for produce research came from a letter from Albertsons to its suppliers in 1998 saying "you will only sell produce to us if you have a food safety plan and submit to third-party audits of your plan". S294 was established in 1999 and scientists met for the first time in 2000. The main goal was that it involved "cooperative, joined planned research" that has "national or regional priorities". S294 scientists, which includes universities (Land Grant), USDA-ARS, other public and private sector and international scientists have historically met jointly with International Fresh-cut Processing Association (IFPA), United Fresh Produce Association (UFPA, a merger of IFPA and United Fresh Fruits & Vegetables Association) and now the new IFPA (a merger of United Fresh and the Produce Marketing Association).

Brecht went through the 5 objectives and the list of participating universities, available on the NIMSS web site. Members are organized into two fields of expertise: microbiology/food safety, and postharvest physiology/biochemistry/quality. Examples of accomplishments include a project to enhance the microbial safety of fresh and fresh-cut melon, a joint project between UC, UF, UGA, and ARS-PA.

9. **Station reports:**

<u>Online attendees</u>:

USDA Florida

Marlee Trandel (new member) - effect of LED lights on volatiles and nutritional components of selected microgreens

Gabriela Olmedo – Thymol essential oil vapors to control *Penicillum digitatum* and *Lasiodiplodia theobromae* (stem-end-rot) on grapefruit

Jinhe Bai - Active packaging to improve blueberry shelf life: clamshells with lower vent to reduce fruit dehydration and weight loss, and slow-release thymol vapors to reduce decay.

USDA Maryland

Yaguang Luo (*Sunny*) – use of LED to enhance salad nutrition with edible flowers. Light could stimulate flower production (e.g., snapdragon, marigold, mustard). Nutritional content of such salad mixes could be as high as in microgreens. Combined UV light with PAA treatment of water to reduce microbial contaminations of leafy greens.

Tianbao Yang – delaying browning of fresh cut lettuce

Bin Zhou – tested ultrasonic cutting system to efficiently harvest microgreens. Identify and optimize paper sensors responsive to VOCs to measure produce quality. Develop novel fresh-cut produce washing and disinfection technology.

Regina O'Brien – Using advanced imaging system, eye tracking and other consumer biometrics in sensory studies.

Clemson University: Karin Albornoz (new member) – Current research studying the relationship between internal ethylene levels at harvest and the postharvest performance of fresh-cut *Brassica* leafy greens

Purdue University: Amanda Deering (new member), extension & research appointment – studying microbial contamination, internalization and transport of human pathogens in the plant.

Virginia State University: Toktam Taghavi. Emphasis on reducing food waste. Project to optimize anthocyanin extraction from strawberries. Explore bacterial communities on strawberry fruit that could inhibit *Botrytis cinerea* growth. Quality of ginger and turmeric as affected by temperature and packaging.

Texas A&M University: Vijay Joshi (new member). Strategies to mitigate Salmonella in onion bulbs.

Iowa State University: Byron Brehm-Stecher presented for the Iowa State University group. Research areas include sample preparation methods to capture foodborne pathogens, rapid detection and identification techniques, natural antimicrobial systems, novel processing methods, sensory and quality analysis of fruits and vegetables. Example: Magnetic Ionic Liquids for sample preparation to aggregate and capture microbial pathogens.

<u>In person attendees</u>:

Michigan State School of Packaging

Eva Almenar: fresh produce packaging and food waste. Development of new packaging materials made from agricultural waste for produce packaging. Training of first generation Latino growers to improve product quality and safety using packaging among others.

Amin Joodaky: effect of transportation shock and vibration on apple shelf life (e.g. bruising)

University of Georgia

Angelos Deltsidis: use of gaseous ozone. Tried on many fruit types. In general, lower O_3 resulted in better fruit quality, except for onion. There is a killing zone for O_3 that is detrimental to fruit quality.

Studied pitting incidence on cucumber; degreening of Satsuma mandarins; and cooling efficiency trials.

University of Florida

Jeff Brecht presented the UF team: Tie Liu and Steve Sargent (Horticulture) and Keith Schneider and Charlie Sims (Food Science). Demonstrating the role of stress ethylene in banana chilling injury (CI) symptom development (JKB); Using hyperspectral imaging to detect internal CI in avocado (TL); Postharvest application of melatonin to lettuce retards pink rib (SAS); Lead Regional Coordination Center and the Southern Region Center for produce (KS).

Introducing new member: Qingyang Wang (Oregon State University)

10. Planning on addressing the needs

Drew McDonald repeated the need to address Hazard Risks. We should conduct hypothesis risk-driven science.

Need to provide a collective summary of critical elements.

11. Unfinished business

Planning the 2024 meeting in Atlanta – contact IFPA early, in February, to be more active participants.

Elect new secretary who will start in October 2024. Anne Plotto contacted Toktam Taghavi, who accepted. Will need to be voted at the next annual meeting.

Elect a vice chair to replace Anne Plotto: Jeff Brecht contacted Angelos Deltsidis, who accepted. Will need to be voted at the next annual meeting.

Other members may be nominated by the next annual meeting.

Eva Almenar and Byron Brehm-Stecher will organize several meting focused on produce safety and quality before our next meeting in Atlanta.

Accomplishments

Objective 1. Evaluate methods of sampling and measuring flavor and nutrition of fresh-cut products to facilitate comparison to traditional shelf life factors:

Optimization of Extraction Solvents to Measure Strawberries Anthocyanin Yield, Color, and Profile. A total of nine organic and water-based solvents (methanol and chloroform: methanol, acetone, ethanol, water) and their combinations were compared to extract anthocyanins from freshly-pureed strawberries. Solvents changed anthocyanin yield, color parameters, and profile. The color parameters of a* values lower than 30, L* values higher than 85, hue angle more than 40, and chroma less than 30 indicated some color degradation in strawberry anthocyanins. Therefore, the best solvents for anthocyanin assessment were methanol and methanol: water. The second-best solvent was the pH differential buffers. Other solvents such as ethanol, chloroform: methanol, water, and water-based solvents extracted considerable amounts of anthocyanins; however, they showed some degree of color degradation, evidenced by the color parameters. Acetone did not yield a stable extract which degraded over 48 h of storage at 4 °C. The extraction solvent determined the main anthocyanin of the anthocyanins profile. Pelargonidin was the major anthocyanin in chloroform: methanol solvent, while delphinidin was dominant in all other solvents. (VSU)

Objective 2. Develop new strategies to improve and better maintain inherent fresh-cut product quality and nutrition:

Using modified atmosphere packaging (MAP) +/- ethylene scrubbing to maintain the quality of advanced ripeness fruits. To address the issue of transport and temporary storage of ripe fruit, we have been investigating the application of appropriately designed MAP +/- ethylene scrubbing, either at higher than normal temperatures (tomato) or lower, normally chilling, temperatures (mango). (UF)

Efficacy of essential oils for maintaining postharvest quality and reducing decay of blueberry and peach fruits. Thyme oil and oregano oil are being evaluated for postharvest control of gray mold on blueberry and brown rot on peaches. Both effective and phytotoxic concentrations have been determined. The essential oils are more effective if applied at higher temperature, prior to cold storage, and do not have persistent aromas that could affect consumer satisfaction. (UF)

Evaluation of elite lettuce breeding lines in St. Johns County: Year 2 – Field performance, postharvest quality and shelf life. Using the Accelerated Shelf Life Test protocol, differences in postharvest quality and shelf life were determined for 10 lettuce cultivars and advanced breeding lines grown in open field or protected culture. (UF)

Efficacy of HarvestHold^{TM} technology for extending postharvest quality and shelf life of selected fresh vegetables. Plastic sheets were placed in shipping cartons to release 1-MCP during shipping and handling. Shelf life was extended up to 2 days, depending on the crop. (UF)

Developing Effective Pre- and Postharvest Methods to Control Diplodia Stem-end Rot (*Lasiodiplodia theobromae*) and Reduce Mandatory Segregation of Fresh Florida Grapefruit Exports Arriving in Japan. Several fungicidal materials were tested pre-harvest on mature grapefruit trees to prevent post-harvest

decay due to Diplodia stem-end rot (SER) caused by *Lasiodiplodia spp*. Two fungicides significantly reduced fruit decay, while an essential oil (thyme oil) had no effect. Post-harvest applications of gaseous chlorine dioxide (ClO_2) effectively reduced Diplodia SER on inoculated fruit; however, phytotoxicity was observed as peel injury when ClO_2 doses exceeded 1 g per kilo of fruit. In the end, treatments of gaseous fast release CO_2 in an enclosed chamber at a rate of 1 g per kilo of fruit and duration of 8 hours effectively controlled Diplodia SER in grapefruit. (UF & ARS FL)

Develop low calorie juice using winter melon and jicama roots. Winter melon and jicama roots are productive and have the advantage of storing up to 4 months without deterioration of the fruit/root. Processing methods to optimize flavor and nutritional content were established. (ARS FL)

Improving microgreen and tomato yield and quality by regulating LED light combinations. Blue and red lights are extensively used in controlled environment agriculture as light sources or supplementary lights. We have been focusing on additional lights to improve vegetable quality and enhance the tolerance of tomatoes to postharvest chilling injury. Our results indicate that green light can increase the yield of microgreens and enhance the volatile intensity in addition to blue and red light treatments. We will confirm if adding far-red light in the blue/red lighting growth chamber can enhance tolerance of tomatoes to postharvest chilling injury. (ARS FL)

Quality and shelf life of ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) as affected by temperature and packaging. Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) are grown as specialty crops and spices. Experiments were conducted to evaluate storage temperatures on chilling injury. In the first year, tubers stored at 4 °C had less water loss and fungal growth compared to room temperature. Differences in total soluble solids and titratable acidity were not significant between the two temperatures. In the second year, discoloration occurred due to the chilling injury to tubers. Cold storage reduced water loss significantly and paper bags and clamshells reduced fungal decay compared to the plastic ziploc bags. (VSU)

Packaging and household food waste intersections: facts and consumer awareness. Fresh whole fruits and vegetables are the top food category wasted in American households. Produce without packaging that spoiled before it was eaten was the largest fresh whole produce waste state. There is a need for packaging that extends produce shelf life to reduce American household food waste. Other conclusions can be found in upcoming publications. (MSU)

Turning agricultural waste into packages for food. Publication of literature review to identify gaps of knowledge. Use of different agricultural wastes that result in packaging materials with improved performance for food packaging applications. Obtention of a novel coupling agent from waste to improve properties of these novel materials. (MSU)

La Cosecha (The Harvest) 2020: Expanding the Success and Sustainability of Farming for Beginning Latino Farmers. Education and training for first- and next-generation Latino/a farmers in Michigan. Development and delivery of a workshop consisting of 4 sessions for blueberry growers. The workshop was developed using the 2022 pre-assessment and post-assessment survey questionnaires. The 2023 pre-and post-assessment survey questionnaires were used to assess growers' knowledge acquisition and changes in behavior. (MSU)

An optimization tool for the ventilation design of cold-chain food packages. The designs for ventilation cutouts in food and produce packaging were examined using mechanics-based models, the finite element method, experimental procedures, and machine learning techniques. Through the algorithms and tools developed, the enhanced ventilated package design meets the necessary ventilation requirements while maintaining superior compression strength. Consequently, this leads to a reduction in both packaging materials and produce waste. (MSU)

Apple damage in distribution cycle. Throughout the supply chain, apples experience various forms of damage. This research project is centered on examining the factors involved, with particular attention to the impacts of vibration levels and cushioning properties on apple damage. Currently, the project is in an early phase, and its findings have yet to be shared or published. (MSU)

Release Kinetics of 1-MCP from HarvestHold Fresh (HHF). 1-MCP accumulated to effective treatment levels in boxes of broccoli at all temperatures. The 1-MCP released from HHF readily escapes from treated boxes. More exposed boxes lose 1-MCP most rapidly. (MSU)

Evaluation of Alternative Atmosphere Treatments to Extend Shelf-life of Georgia-grown Blackberries. CA and gaseous ozone application have potential in retaining the shelf-life of Georgia grown blackberries. Further investigation is needed to evaluate the technologies and adapt them for farmer adoption. (UGA)

Evaluating the Suitability of Controlled Atmosphere Storage for New Pecan Varieties. Ongoing trial to study the effects of CA and hermetic sealed packages on the quality attributes of Georgia-grown shelled pecans. The study is currently underway with samples being evaluated every 3 months. (UGA)

Online Training Series of Harvest Quality and Postharvest Handling of Small Fruits. Production of a series of short video trainings for agents, growers and other interested parties to improve the understanding of the appropriate handling methods for small fruits grown in the Southeast. (UGA)

Objective 3. Improve understanding of physiological mechanisms that affect fresh-cut product quality:

Flavor and taste on demand via dynamic application of LED light. Using basil as a model produce, we demonstrated the capability of modulating flavor of herbs via dynamic application of LED light. (USDA MD).

Application of eye tracking to understand attention to labeling in eCommerce: an observational study using apples. Using apples as a model, we demonstrated that consumer attention to quality information on a product webpage follows a general pattern; more attention is given to sensory descriptions when a product is unfamiliar. (USDA MD)

Visual quality evaluation of fresh-cut Romaine lettuce during post-processing storage as affected by “Forward Processing” and “Source Processing”. Fresh-cut Romaine lettuce processed via Forward Processing, processed closer to selling location, retained similar browning and decay visual quality scores over storage when images were compared to lettuce processed via Source Processing at the harvesting location. (USDA MD)

Further studies to reduce development of pink rib, a stress-related disorder in lettuce. Following the completion of CE Belisle's dissertation in 2022, a series of tests were conducted that validate the efficacy

of postharvest application of melatonin to reduce development of lettuce pink rib disorder, which is related to stress, wounding, and over-maturity. (UF)

Identifying senescence-associated genes (SAGs) in broccoli and lettuce that have potential to be used as markers of freshness or physiological age. A number of genes have been identified that are expressed at different times during development of senescence. We are working to identify the most reliably expressed genes that are strictly identifying senescence stages as opposed to, for example, stress, ethylene, or CA/MA conditions. (UF)

Ethylene involvement in early chilling injury (CI) development of mature-green (MG) banana. We showed that ethylene is involved in early development of banana CI symptoms, including vascular browning and reduced quantum yield of chloroplast photosystem II [Y(II)] in the peel and lower peel and pulp aroma volatiles. 1-MCP-treated chilled fruit develop less vascular discoloration and higher Y(II) in the peel, less peel and pulp electrolyte leakage, and close to normal levels of volatiles in the peel and pulp. (UF)

Lipid Oxidation and Volatile Compounds of Almonds as Affected by Gaseous Chlorine Dioxide Treatment to Reduce *Salmonella* Populations. Gaseous chlorine dioxide at conditions that reduced a 4-log population of *Salmonella* increased lipid oxidation and the formation of many volatile flavor compounds that originate from lipids. In addition, several chlorine-containing compounds were formed in treated almonds, though most of them decreased to non-detectable levels during storage. The results may help the almond industry in deciding whether to apply the technology or not, in order to improve the safety of almonds. (ARS PA)

Objective 4. Determine critical factors in controlled inoculation studies with human pathogens and surrogates that influence the outcome of quantitative microbial risk assessments:

Efficacy of Inline Application of Postharvest Sanitizers to Reduce Foodborne Pathogens from Cantaloupe Rinds and Extend Shelf-Life. A total of three different sanitizers were used in tandem, chlorine, chlorine dioxide, and peroxyacetic acid, to determine if that had a better efficacy at killing human pathogenic bacteria, *Listeria monocytogenes*, *Salmonella Typhimurium*, and *E. coli* O157:H7, compared to just using one type of sanitizer as is often done in the fresh produce industry. It was found that the combination of sanitizers had ~1 log better reduction of human pathogenic bacteria compared to using just one type of sanitizer. We also are doing some shelf-life studies to see if using the combination of sanitizers helps to increase the shelf-life of eastern cantaloupes stored at both refrigeration and room temperatures. (Purdue)

Impact of the Growing Location on the Microbial Load of Different Varieties of Cantaloupes. Cantaloupes are perishable and susceptible to microbiological contamination during production, harvest, and distribution. Since cantaloupes are grown on the ground, preharvest safety concerns come from the bacterial load that they can harbor from the soil and the contamination with foodborne pathogens carried by irrigation water, manure-based fertilizers and wild animals. The study examined the microbial concentration of 8 different varieties of cantaloupes that were grown under greenhouse conditions in two different locations in Indiana. *Escherichia coli* was absent on all the cantaloupes rinds evaluated. Aerobic bacteria and coliforms concentration were found to be between 107 and 108 CFU/ml. For some varieties, location of production influenced the aerobic bacteria, yeast and mold concentration. In

contrast, coliform concentration was found to not have a significant difference between varieties regardless of the growing location. Finally, it was found that there is a strong interrelationship among microorganisms (p-value <0.05). (Purdue)

Effect of heat-treated poultry pellets and poultry litter compost on the survival of *E. coli* in Florida and Georgia soils. The presence of organic amendments, i.e., BSAAOs, was shown to enhance the survival of pathogen surrogates in inoculated field trials. This study also demonstrated that these surrogates could transfer to root crops, potentially affecting consumer products. (UF)

Effects of water activity, ammonia, and *Corynebacterium urealyticum* on the survival of *Salmonella Typhimurium* in poultry litter microcosms. This project demonstrated that the breakdown of compounds such as urea and ammonia had a significant negative impact on pathogen survival; more so than indigenous microflora. (UF)

Biocide tolerant *Listeria monocytogenes* surviving in first and second generation QAC. Small colony variants of *L. monocytogenes* serotypes 1/2a and 4b were isolated after frequent exposure to first generation QAC, benzalkonium chloride (BAC), that exhibited a low-level tolerance to BAC versus parent strain. (Mississippi State U)

Biocide tolerant *Salmonella Typhimurium* surviving in first and second generation QAC. Rugose morphotypes of *Salmonella* strains were isolated after frequent exposure to first generation QAC, benzalkonium chloride (BAC), that tolerated higher BAC versus parent strain. (Mississippi State U)

Strategic approaches to mitigate *Salmonella* contamination of bulb onions. Transcriptomic (RNA-Seq) analysis of onion bulbs inoculated with *Salmonella enterica* subsp. *enterica* serotype *Typhimurium* showed significant upregulation of onion FFLS2 : Leucine-rich repeat serine/threonine protein kinase involved in MAP kinase signaling relay involved in innate immunity. The gene is essential in the perception of flagellin22, a potent elicitor of the defense response. (Log2 5.7- fold upregulation), Upregulation of Rhoh: Respiratory burst oxidase- needed for accumulation of ROS intermediates (Log2 20-fold upregulation), upregulation of potential chitinase, - (Log2 3.7 fold upregulation) and upregulation pathogenesis-related protein 4 - (Log2 3.3 fold upregulation). Metabolite analysis using LC-MS of onion bulbs of three varieties (Carta Blanca- white; Red Label- Red, Dulciana- White) inoculated with *Salmonella enterica* showed significant variations across colors and upregulation of flavonols, specifically the quercetin derivatives. (Texas A&M)

<u>Objective 5. Development and validation of novel diagnostic methods to determine presence of human pathogens and chemical hazards associated with fresh and fresh-cut products</u>:

Biocide tolerant *Listeria monocytogenes* and *Salmonella* strains surviving in first and second generation QAC. This work will lead to methods for isolation and confirmation of persister cells and subpopulations of *L. monocytogenes* and *Salmonella* strains that tolerate commonly used disinfectants which may survive longer in some food processing environments. (Mississippi State U)

Detection of Culturable Bacteria in Greenhouse Grown Romaine Lettuce Using the Light Scattering Technology (BEAM). Technologies for rapid detection and identification of bacterial communities, especially for pathogens, are crucial for securing a safe food supply. The light-scattering technology

(BEAM) incorporates the traditional culture-based approach as a part of the detection procedure and is an easier and faster method for detection and identification of bacteria based on the morphological characteristics of the colonies. A light scatter pattern library was created based on the most common bacterial genera associated with different varieties of romaine lettuce with each scatter patterns being unique to each bacteria genera. However, scatter patterns obtained from the same bacterial colony was found to change depending on the incubation time due to changes in colony size and morphological characteristics. Therefore, the scatter patterns for the different bacterial genera were evaluated at 12, 21, 32 and 72 hours of incubation for fast, intermediate, medium and slow growth rates to create a library to be able to detect various bacteria using the BEAM technology. (Purdue)

Strategic approaches to mitigate *Salmonella* contamination of bulb onions. Survival of *Salmonella* in raw onion extracts differs across onion varieties with different colors, although *Salmonella* could not survive adequately in crude onion juices regardless of variety. The magnitude of the decline in *Salmonella* populations differs (Log reduction CFU/ml); over six hour storage was Red > Yellow > White. To understand the entry routes and internalization of *Salmonella* in onion, we used fluorescent strains of *Salmonella enterica* subsp. *enterica* serotype *Typhimurium* (ATCC 14028GFP). The *Salmonella* was internalized and translocated from damaged roots, injured bulbs and leaves and remained active until 3 weeks of inoculations. (Texas A&M)

Impacts

Developed the smart use of far-red light to produce nutritious edible mustard flowers (USDA-MD)

Performed pioneering research on nutrition and microbial profiles of CEA leafy greens (USDA-MD)

Developed hydrogels for microgreen growth on Earth and in simulated microgravity in space (USDA-MD)

Pioneering evaluation of food quality using Deep Learning Optimization (USDA-MD)

Identified and optimized paper sensors/E-nose responsive to VOCs characteristic of target fresh and fresh-cut produce quality, providing a tool for quality evaluation (USDA-MD)

Tested and optimized the design and development of harvesting device for microgreens (USDA-MD)

Evaluated and optimized In-flight washer (USDA-MD)

We have shown that stress ethylene plays a role in early chilling injury symptom development in banana fruit and that using 1-MCP to inhibit ethylene perception inhibits those symptoms. This could have important applications for fresh-cut tropical crops. (UF)

Using hyperspectral imaging (HSI) analysis, we identified the spectra that correlated with areas of internal chilling injury in avocado. This implies that HSI has the potential to be used to monitor internal disorders of avocado and possibly other fruits prior to fresh-cut processing. (UF)

Postharvest application of melatonin to lettuce retards development of pink rib disorder shows particular promise for fresh-cut lettuce processors. (UF)

Served as the Lead Regional Coordination Center and the Southern Region Center for produce safety in the US for the past 5 years and were renewed for another 3 years to remain in this role, establishing Florida as one the nation's leaders in produce safety. (UF)

Released a classification of *Citrus* and related hybrids (*Poncirus* introgressed *Citrus* hybrids tolerant to Hunaglongbing (HLB), the devastating citrus greening disease) into orange-like and mandarin-like using sensory and chemical evaluation. Esters are the necessary volatile compounds that contribute to range flavor (ARS FL)

Developed low calorie fruit juice from winter melon fruit by optimizing process technology (ARS FL)

Contributed to the release of a new line of white-fruited strawberries, the pineberry, as well as release of strawberry cultivars adapted to Florida conditions by providing quality evaluation (ARS FL and UF)

Developed active clamshell packaging for berries (ARS FL)

Demonstrated the impact of LED lights on flavor and nutritional quality of microgreens (ARS FL)

Understood the potential link between disinfectant usage and occurrence of biocide-tolerant strains of *Listeria monocytogenes* and *Salmonella* in food processing environments, which may lead to food safety risk. (Mississippi State U)

Understood the favorable conditions leading to the persistence of disinfectant tolerant strains of *L. monocytogenes* and *Salmonella* in some food processing environments. (Mississippi State U)

Demonstrated the potential for formation of low-level antibiotic tolerant strains of *L. monocytogenes* after exposure to first generation QAC, benzalkonium chloride, that may persist in some food production and food processing environments. (Mississippi State U)

Education and outreach activities to improve Good Agricultural Practices for fruit and vegetable growers in Indiana. (Purdue)

Developed postharvest sanitizers for the reduction of human pathogenic bacteria on fruits and vegetables. (Purdue)

Opened the Purdue Food Safety Training Hub to teach sanitation of postharvest washing equipment for fruit and vegetables. (Purdue)

Unraveled the effect of *Salmonella* on onion bulb chemical composition and metabolites using untargeted metabolomics and transcriptome. (Texas A&M)

Studied the internalization of *Salmonella* into onion bulbs. (Texas A&M)

We identified that methanol and methanol:water are the most efficient solvents to extract stable anthocyanins from for strawberries compared to methanol:chloroform, ethanol and acetone. (Virginia State SU)

Established optimum storage temperature (12 °C) and packaging (ventilated) for ginger and turmeric tubers. (VSU)

Completed a survey that shows intersections between packaging and American household food waste. (MSU)

Research turning agricultural waste into packages for food. (MSU)

Education and training of first- and next-generation Latino/a farmers in Michigan. (MSU)

Demonstrated optimization of ventilation cutout designs for food and produce packaging sustainable designs using mechanics based models and Machine Learning (MSU)

Showed at which levels apple damages occur in the distribution cycle (MSU)

Measured the release kinetics of 1-MCP from Harvest Hold Fresh (HHF). (MSU)

Establishing projects that respond to farmers' need. (UGA)

Extension events to responds to regional and national needs. (UGA)

Presentations

Brecht, J.K. (Presenter). 2022 Fresh–cut Quality Issues. Fresh–Cut Products: Maintaining Quality and Safety Workshop Univ. of Calif., Davis, CA
Brecht, J.K. (Presenter). 2022 Modified Atmospheres: Benefits and Risks to Fresh–cut Produce. Fresh–Cut Products: Maintaining Quality and Safety Workshop Univ. of Calif., Davis, CA
Brecht, J.K. (Presenter). 2022 Impact of Storage, Transportation, Distribution Temperature on Fresh-cut Quality & Nutrition. Fresh–Cut Products: Maintaining Quality and Safety Workshop Univ. of Calif., Davis, CA
Liu, T. (Presenter) 2022 Abiotic Stress Response and Postharvest Biology of Broccoli University of South Carolina, Department of Biology, fall semester seminar. Columbia, SC
Liu, T. (Presenter) 2022 Imaging-based Machine Learning for Evaluating Freshness of Fruit and Vegetables. The XXIX Plant & Animal Genome Meeting. San Diego, CA
Liu, T. (Presenter) 2022 Machine Learning for the Molecular Evaluation of Fresh Produce Quality XXXI International Horticultural Congress Angers, France
Sargent, S.A. (Presenter) 2022 Postharvest Physiology International Sweet Corn Development Association West Palm Beach FL
Schneider, K.R. (Presenter) 2022 A Produce Safety Webinar Series: Post-Harvest Water: Things to Consider CONTACT Grant Webinar Series Virtual
Schneider, K.R. (Presenter) 2022 Convener, Moderator National Program Directors Webinar Orlando FL
Schneider, K.R. (Presenter) 2022 Cleaning and Sanitizing Cleaning and Sanitizing Workshop Virtual
Schneider, K.R. (Presenter) 2022 Multiple Talks Advanced GAPs Workshop Geneva, NY
Schneider, K.R. (Presenter) 2022 Multiple Talks Bridging the GAPs Training Workshop Virtual
Schneider, K.R. (Presenter) 2022 Cyclospora: Introduction Produce Safety Webinar Series Virtual
Schneider, K.R. (Presenter) 2022 Multiple Talks Packinghouse HACCP Training Virtual
Schneider, K.R. (Presenter) 2022 Multiple Talks Juice HACCP Training Lake Alfred, FL
Schneider, K.R. (Presenter) 2022 Multiple Talks PSA Training Virtual; Like Oak, FL; Palmetto, FL;
Schneider, K.R. (Presenter) 2022 Multiple Talks PSA Train the Trainer Lake Alfred, FL
Schneider, K.R. (Presenter) 2022 Multiple Talks PCQI Training Lake Alfred, FL
Brecht, J.K. (Presenter), S.A. Sargent, F. Shahzad, M. Doron, and S. Tonetto de Freitas 2023 Feasibility of Modified Atmosphere Packaging (MAP) Plus Ethylene Scrubbing for Extended International Shipping of Mangos. Florida State Horticultural Society Daytona Beach, FL
Habibi, F. (Presenter), A. Sarkhosh, P.J. Conner, and J.K. Brecht. 2023 Total Phenolic Content of Peel and Flesh of Muscadine Grape Genotypes: A Comparative Study. Florida State Horticultural Society Daytona Beach, FL
Liu, T. (Presenter) 2023 Imaging-based Machine Learning for Evaluating Freshness of Fruit and Vegetables. The PAG30 Plant & Animal Genome Meeting. San Diego, CA

Liu, T. (Presenter) 2023 Development of Innovative Tools for Understanding Postharvest Senescence in Ornamental Vegetables. The XII International Symposium (ISHS) on Postharvest Quality and Ornamental Plants Amsterdam, Netherlands.
Liu, T. (Presenter) 2023 Study the Mechanisms of Ethylene Action during Postharvest Senescence
in Broccoli. XII International Symposium on the Plant Hormone Ethylene (Ethylene 2023) Toulouse, France.
Liu, T. (Presenter) 2023 Abiotic Stress Response University of North Carolina, Department of Biology, Spring semester seminar. Zoom seminar
Morgan, M., J.K. Brecht, S.A. Sargent, M. Doron (Presenter), and J.H. Crane. 2023 A Comparison of the Effects of 1-MCP Treatment on Climacteric and Nonclimacteric Guava Fruits. Florida State Horticultural Society Daytona Beach, FL
Sargent, S.A. (Presenter) 2023 Efficacy of HarvestHoldTM Technology for Extending Postharvest Quality and Shelf Life of Grape Tomato Amer. Soc. Hort. Sci. (poster) Orlando FL
Sargent, S.A. (Presenter) 2023 Maximizing Postharvest Quality and Shelf Life of Snap Beans Snap Bean Field Day, PSREU Citra FL
Sargent, S.A. (Presenter) 2023 Postharvest Evaluation of Elite Lettuce Germplasm, March - April 2023 Spring 2023 Field Day Hastings FL
Schneider, K.R. 2023 What is Cleaning and Sanitizing Cleaning and Sanitizing Workshop Lake Alfred, FL
Schneider, K.R. 2023 The Effects of BSAAOs on the Survival of Pathogens in Soil FAFP Annual Educational Conference Orlando FL
Schneider, K.R. 2023 Multiple Talks PCQI Training Lake Alfred, FL
Schneider, K.R. 2023 Multiple Talks Juice HACCP Training Lake Alfred, FL
Schneider, K.R. 2023 Convener, Moderator National Program Directors Meeting Tampa, FL
Schneider, K.R. 2023 Multiple Talks Packinghouse HACCP Training Virtual
Shahzad, F., J.K. Brecht (Presenter), S.A. Sargent, and M. Doron. 2023 Evaluation of Akorn Semipermeable Fruit Coatings to Extend Mango Shelf Life by Creating an Internal Modified Atmosphere. Florida State Horticultural Society Daytona Beach, FL

Schade, S., and Nannapaneni, R. Isolation of different colony morphotypes of *Listeria monocytogenes* after exposure to high and low concentrations of first generation QAC benzalkonium chloride (BAC) in water. Abstract No. P1-62. IAFP Annual Meeting July 16-19, 2023, Toronto, Ontario, Canada. Poster

Schade, S., and Nannapaneni, R. Survival, persistence, and regrowth of two strains of *Listeria monocytogenes* after exposure to high and low concentrations of first generation QAC benzalkonium chloride (BAC) in water. Abstract No. 239. Annual Meeting of the Institute of Food Technologists, IFT FIRST: Annual Event and Expo scientific program July 16-19, 2023, Chicago, IL. Poster

Kode, D., and Nannapaneni R Strain variation in formation of QAC-adapted subpopulations of *Listeria monocytogenes*. Abstract No. 783. Annual Meeting of the Institute of Food Technologists, IFT FIRST: Annual Event and Expo scientific program July 10-13, 2022, Chicago, IL Poster

Umutesi, G., and Nannapaneni, R. *Salmonella Typhimurium* ATCC 14028 survival and persistence after exposure to low to high concentrations of quaternary ammonium compound (QAC) in water. Abstract

No. 861. Annual Meeting of the Institute of Food Technologists, IFT FIRST: Annual Event and Expo scientific program July 10-13, 2022, Chicago, IL Poster

Deering, A.J. Regulatory and Labeling Requirements for Growers and Food Processors. Food Safety Trainings , La Molina University. May 2023. Tarapoto, Peru. Extension

Deering, A.J. Sanitation Best Practices for Growers and Food Processors . Food Safety Trainings , La Molina University. May 2023. Lima, Peru. Extension

Deering, A.J. GMPs, HACCP, and GAPs for Growers and Food Processors in the San Martin of Peru. Food Safety Trainings , La Molina University. Dec. 2022. Tarapoto, Peru. Extension

Deering, A.J. Food Safety in Hydroponic Environments . Purdue Hydroponic Workshop. Nov. 2022. West Lafayette, IN. Extension

Deering, A.J. Sanitizers for Postharvest Washing for Fruit and Vegetables. North Central FSMA Center Annual Training Conference. Oct. 2022. Vincennes, IN. Extension

Deering, A.J. Fresh Produce Food Safety. Indiana Horticultural Conference. Feb. 2022. West Lafayette, IN. Extension

Joshi, V. Strategic approaches to mitigate *Salmonella* contamination of bulb onions. Center for Produce Safety Annual Conference. 2023, Georgis, USA. Oral.

Taghavi T, Bell M, Opoku M, James C, Siddiqui R, Rafie R. Quality and shelf life of ginger (Zingiber officinale) and turmeric (Curcuma longa) as affected by temperature and packaging. V International Conference on Postharvest and Quality Management of Tropical Crops. 2021. Mexico. Oral.

Fan, X. Ryu, V., Ngo, H., Ashby, R.D. Bio-based antimicrobials derived from fatty acids. The Korean Society of Food Science and Nutrition International Symposium and Annual Meeting Oct. 19-21, 2022, Jeju Island, South Korea. Oral.

Wang, W., Ngo, H., Jin, T., Fan, X. Gaseous chlorine dioxide reduced *Salmonella* populations on almonds, while accelerating lipid oxidation during storage International Association for Food Protection Annual meeting July 16 –19, 2023 Toronto, Ontario, Canada. Poster

Lew, H., Fan, X. Ashby, R.D. Advanced bio-based polymers with antimicrobial properties AOCS Annual Meeting & Expo April 30-May 3, 2023, Denver, Colorado. Oral

Gurtler, J., Grass-Kelly, E., Fan, X., Jin, T., Garner, C. Inactivation of desiccation-resistant *Salmonella* on apple slices following treatment with epsilon-polylysine, sodium bisulfate or peracetic acid. International Association for Food Protection Annual Meeting July 16-19, 2023, Toronto, Ontario, Canada Poster

Fan, X. Chlorine dioxide fumigation of fresh produce and nuts: microbial reduction and quality change American Chemical Society Annual Meeting August 13 - 17, 2023 San Francisco, CA, Oral

Fan, X. Undesirable Chlorine Byproducts in Water, Fresh Produce and Nuts International Association for Food Protection Annual Meeting, July 16-19, 2023, Toronto, Ontario, Canada Oral

Ryu, V., Chuesiang, P., Corradini, M.G., McLandsborough, L., Jin, T., Ngo, L., Fan, X Use of lauric arginate ethyl ester micelles to enhance photosensitizers' antimicrobial activity and stability Institute of Food Technologists Annual meeting July 16 –19, 2023 Chicago, IL Poster

Almenar, E. Turning agricultural waste into packages for food. The 10th Shelf-life International Meeting (X SLIM 2022), November 29, 2022, Bogota, Colombia. Oral

Almenar, E. "Factores que afectan la vida util de los arandanos" (Factors that affect the shelf life of blueberries), Workshop: "La vida util de los arandanos y su envasado". October 4, 2023. South Heaven, MI, USA. Oral

Almenar, E. "Relacion entre la vida util de los arandanos, el envase y la atmosfera" (Relationship between blueberry shelf life, packaging and the environment), Workshop: "La vida util de los arandanos y su envasado". October 4, 2023. South Heaven, MI, USA. Oral

Almenar, E. "Relacion entre la vida util de loa arandanos, el material de envasado, y la tecnologia de envasado" (Relationship between blueberry shelf life, packaging materials, and packaging technologies), Workshop: "La vida util de los arandanos y su envasado". October 4, 2023. South Heaven, MI, USA. Oral

Almenar, E. “Frutas y hortalizas, el envase, y el consumidor” (Produce, packaging, and the consumer). Workshop: “La vida util de los arandanos y su envasado”. October 4, 2023. South Heaven, MI, USA. Oral

Fitzgerald, P.R.; Duguma, H.; Almenar, E. An analysis of corn cob based plastic filler for development of plastic biocomposites for food packaging. University Undergraduate Research and Arts Forum. April 14, 2023, East Lansing, MI, USA. Oral

Duguma, H.T.; Fehlberg, J.; Macke, P.; Cho, S.; Almenar, E. Orange peel powder as a filler for plastic films for food packaging applications: a case study in bread. Graduate Academic Conference April 29, 2023. East Lansing, MI, USA. Oral

Martin, N.; Duguma, H.T.; Almenar, E. Determining particle size for novel coupling agent-treated soybean hull filler. 2023 MSU SROP (Summer Research Opportunities Program) July 25, 2023. Virtual Oral

Mitchell, D.; Khule, P.; Yang, Q.; Almenar, E.; Beaudry, R. Coating Bagasse Paper for Enhanced Barrier Properties. 2023 MSU SROP (Summer Research Opportunities Program) July 25, 2023. Virtual Oral

Shirzad, K.; Joodaky, A. Buckling. Strength Prediction of Thin Plates With Cutouts Using Machine Learning SMAISIS ASME 2023, Austin Sep 11-13 Sep 11-13, 2023, In person, Austin, TX, USA Oral

da Silva, A.P.G, P. Engelgau, N. Sugimoto, and R. Beaudry. Factors affecting 1-MCP release from various formulations and release systems. Postharvest Unlimited Conference, 2023. Poster

Ramsey Corn, Orestis Giannopoulos, Camille Esmel McAvoy, Angelos Deltsidis Examining Novel Methods to Extend the Shelf Life of Georgia-grown Muscadine Grapes (Vitis rotundifolia). SR-ASHS 2/3-2/5/2023 Oklahoma City, OK Oral

Orestis Giannopoulos, Ramsey Corn, Camille Esmel McAvoy, Dario Chavez, Angelos Deltsidis Investigating the Effect of Gaseous Ozone Addition During Cold Storage on Fresh Peach Quality SR-ASHS 2/3-2/5/2023 Oklahoma City, OK Oral

Angelos Deltsidis, Camille Esmel McAvoy, Zilfina Rubio-Ames Studying the Possible Causes of Postharvest Quality Disorders of Georgia-Grown Blueberries (Vaccinium spp.). SR-ASHS 2/3-2/5/2023 Oklahoma City, OK Oral

Ramsey Corn, Orestis Giannopoulos, Camille Esmel McAvoy, and Angelos Deltsidis Use of Modified Carton Boxes Improves Airflow during Forced Air-Cooling Operations FSHS 6/11-6/13/2023 Daytona Beach, FL Oral

Amit Godara, Karoline Ponder, Ramsey Corn, Camille Esmel McAvoy, Zilfina Rubio Ames and Angelos Deltsidis Evaluating the Effect of Various Picking Intervals on the Storability and Postharvest Quality of Georgia-grown Blueberries FSHS 6/11-6/13/2023 Daytona Beach, FL Oral

Orestis Giannopoulos, Ramsey Corn, Camille Esmel McAvoy, Dario Chavez, Angelos Deltsidis Assessing the Effects of Gaseous Ozone Application During Cold Storage on Fresh Peach Quality FSHS 6/11-6/13/2023 Daytona Beach, FL Oral

Amit Godara, Zilfina Rubio Ames, Angelos Deltsidis, Karoline Ponder and Ramsey Corn Assessing the Impact of Different Picking Intervals on the Storability and Postharvest Quality of Blueberries ASHS 7/31-8/4/2023 Orlando, FL Poster

Orestis Giannopoulos, Ramsey Corn, Camille Esmel McAvoy, Dario J Chavez and Angelos Deltsidis Studying the Kinetics of Ozone Decomposition during Postharvest Treatments in Fresh-Market Peaches ASHS 7/31-8/4/2023 Orlando, FL Poster

Amit Godara, Zilfina Rubio Ames and Angelos Deltsidis Utilization of Photo-Selective Devices for Increasing Production and Reducing Replanting in Blueberries ASHS 7/31-8/4/2023 Orlando, FL Oral

Orestis Giannopoulos, Ramsey Corn, Camille Esmel McAvoy, Zilfina Rubio Ames, Dario J Chavez and Angelos Deltsidis Examining the Effects of Gaseous Ozone Application on the Postharvest Quality of Different Fruits and Vegetables ASHS 7/31-8/4/2023 Orlando, FL Oral

Tricia M. Jenkins, Cary L. Rivard, Londa Nwadike, Manreet Bhullar, Angelos Deltsidis, Jeffrey K Brecht, Elizabeth J Mitcham and Eleni D Pliakoni Identifying Challenges in Postharvest Handling on Organic Specialty Crop Farms ASHS 7/31-8/4/2023 Orlando, FL Oral

Publications

Teng, Z., Luo, Y., Pearlstein, D.J., Wheeler, R.M., Johnson, C.M., Wang, Q, and Fonseca. 2022. Microgreens for home, commercial, and space farming – a comprehensive update of the most recent developments. Annual Reviews of Food Science and Technology. 14:5.1-5.24. DOI: 10.1146/annurev-food-060721-024636

Wu, Y., Pham, Q., Wang, Y., Huang, H., Jiang, C., Li, R.W., Yu, L., Luo, Y., Wang, J., Wang, T.Y. 2023. Red cabbage microgreens modulation of gut microbiota is associated with attenuation of diet-induced obesity risk factors in a mouse model. Food & Function. 14: 6654–6664. DOI: 10.1039/d3fo01249b

Ahmed Elaraby, Hussein Ali, Bin Zhou, Jorge M. Fonseca. 2023. Digging for Gold: Evaluating the Authenticity of Saffron (Crocus sativus L.) via Deep Learning Optimization. Frontiers in Horticulture. 2: 1225683. https://doi.org/10.3389/fhort.2023.1225683

Zhu, X., Trouth, F., Yang, T. 2023. Preharvest UV-B treatment improves strawberry quality and shelf-life. Horticulture. 9: 211. https://doi.org/10.3390/horticulturae9020211.

Ji, W., Li, M., Yang, T., Li, H., Li, W., Wang, J. Ma, M. 2022. Effect of cold plasma on physical–biochemical properties and nutritional components of soybean sprouts. Food Research International. 161:111766. https://doi.org/10.1016/j.foodres.2022.111766

Gu, G., Zhou, B., Mendes-Oliveira, G., Redding, M., Luo, Y., Millner, P., and Nou, X. 2023. Impact of sanitizer application on *Salmonella* mitigation and microbiome shift on diced tomato during washing and storage. Postharvest Bio. Technol. 198: 112268. DOI: 10.1016/j.postharvbio.2023.112268

Boyd, A., Luo, Y., Kustas, B., Fukagawa, N., Mattoo, A., Crow, W., Pachepsky, Y., Kim, M., Lillehoj, H., Van Tassell, C., Zhang, H., Blomberg, L.A., Dubey, J. and Lunney, J. 2023. Cross-cutting concepts to transform

agricultural research. Frontiers in Sustainable Food Systems. 7:2023. https://doi.org/10.3389/fsufs.2023.1242665

Qu, B., Xiao, Z., Luo, Y., and Luo, Y. 2023. Carboxymethyl cellulose capped zinc oxide nanoparticles dispersed in ionic liquid and its antimicrobial effects against foodborne pathogens. Carbohydrate Polymer Technologies and Applications. 6: 100364. DOI: 10.1016/j.carpta.2023.100364

Peng, H., Luo, Y., Teng, Z., Zhou, B., Pearlstein, D., Wang, D., Turner, E., Nou, X., Wang, T., Tao, Y., Fonseca, J., and Simko, I. 2023. Genome-wide association mapping reveals loci for oxidative discoloration of cut lettuce. Postharv. Bio. Technol. 207: 112577. DOI: 10.1016/j.postharvbio.2023.112577

Li, Y., Zhou, B., Teng, Z., Zhang, M., Yu, L., Luo, Y., Chen, P. and Sun, J. 2023. Improved metabolomic approach for evaluation of phytochemicals in mustard, kale, and broccoli microgreens under different controlled environmental agriculture conditions. Journal of Agriculture and Food Research. 14: 100719. https://doi.org/10.1016/j.jafr.2023.100719

Habibi, F., Boakye, D., Chang, Yu., Casorzo, G., Hallman, L., Madison, M., Clavijo-Herrera, J., Sarkhosh, A., Liu, T. 2024. Molecular mechanisms underlying postharvest physiology and metabolism of fruit and vegetables through multi-omics technologies. Scientia Horticulturae. 324:112562 https://doi.org/10.1016/j.scienta.2023.112562

Baker, C.A.G, A. Gutierrez, R. Bell, and K.R. Schneider. 2023. Draft genome sequences of 110 Shiga toxin-producing *Escherichia coli* isolates collected from bovine manure samples in the southern United States Microbiol. Resour. Announc. Apr. 18 12(4) e0117722. https://doi.org./10.1128/mra.01177-22

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Chang, L. and J.K. Brecht. 2023. Responses of 1-methylcyclopropene (1-MCP)−treated banana fruit to pre− and post−treatment ethylene exposure. Sci. Hort. 309 111636 https://doi.org/10.1016/j.scienta.2022.111636

Ghimire, U., E. Pliakoni, F. Yu, J.K. Brecht, and T. Liu. 2023. Identifying genes regulated during natural, on-plant senescence in broccoli (Brassica oleracea) in contrast to postharvest senescence. Postharvest Biol. Technol. 206 112535. https://doi.org/10.1016/j.postharvbio.2023.112535

Guo, X., Tseung, C., Zare, A., Liu, T. 2023. Hyperspectral image analysis for the evaluation of chilling injury in avocado fruit during cold storage. Postharvest Biol Technol. 206 112548. https://doi.org/10.1016/j.postharvbio.2023.112548

Habibi F, Liu T, Muhammad S, Schaffer B, Sarkhosh A. 2023. Physiological, biochemical, and molecular responses of fruit trees to rootzone hypoxia. Environmental Experimental Botany. 206 105179. https://doi.org/10.1016/j.envexpbot.2022.105179

Khalil, U., I.A. Rajwana, K. Razzaq, U. Farooq, B.A. Saleem, and J.K. Brecht. 2023. Quality attributes and biochemical changes in white and colored table grapes as influenced by harvest maturity and ambient postharvest storage. S. African J. Bot. 154 273-281. https://doi.org/10.1016/j.sajb.2023.01.044

Pabst, C.R.G, J. De, C.A. Bardsley, B. Bertoldi, and K.R Schneider. 2023. Evaluating the efficacy of peroxyacetic acid in preventing *Salmonella* cross-contamination on tomatoes in a model flume system. Available at SSRN 4642383.

Yahia, E.M., J. de J. Ornelas-Paz, J.K. Brecht, P. Garcia-Solis, and M.E. Maldonado Celis. 2023. The contribution of mango fruit (Mangifera indica L.) to human nutrition and health. Arabian Journal of Chemistry. 16:104860. http://dx.doi.org/10.1016/j.arabjc.2023.104860

Bardsley, C.A.P, M.J. Young, M. Sharma, C. Kesslerg, C.B. Appolon, and K.R. Schneider. 2022. Growth media of E. coli does not affect its survival in soil under static conditions. J. Food Protect. 85(12):1842-1847. https://doi.org/10.4315/JFP-22-082

Batziakas, K.G., S. Singh, H. Stanley, J.K. Brecht, C.L. Rivard, and E.D. Pliakoni. 2022. An innovative approach for maintaining the quality of pink tomatoes stored at optimum and above-optimum temperatures using a microporous membrane patch. Food Packaging and Shelf Life. 34:100981 https://doi.org/10.1016/j.fpsl.2022.100981

Bender, R.J., J.K. Brecht, and E.A. Baldwin. 2022. Aroma of mature-green and tree-ripe mangoes after refrigerated air or controlled atmosphere storage. Ciencia Rural. 52(6) 8 p. http://doi.org/10.1590/0103-8478cr20210062

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Guo X., Ahlawat, Y., Liu, T., Zare, A. 2022. Evaluation of postharvest senescence in broccoli via hyperspectral imaging. Plant Phenomics. https://spj.sciencemag.org/journals/plantphenomics/2022/9761095/

Gutierrez, A.G and K.R. Schneider. 2022. Draft genomes sequences of 278 *Salmonella enterica* isolates from poultry litter in the Southeastern United States. Microbiol. Resour. Announc. 11(8): 7 p. https://doi.org/10.1128/mra.00387-22
Gutierrez, A.G and K.R. Schneider. 2022. Survival and inactivation kinetics of *Salmonella enterica* serovar Typhimurium in irradiated and natural poultry litter microcosms. PLoS ONE. 17(4):e0267178 https://doi.org/10.1371/journal.pone.0267178

Gutierrez, A.G, A.H. Havelaar and K.R. Schneider. 2022. Antimicrobial efficacy of un-ionized ammonia (NH3) against *Salmonella Typhimurium* in buffered solutions with variable pH, NH3 concentrations, and urease-producing bacteria. Microbiol. Spectr. 10(1):e01850-21 https://doi.org/10.1128/spectrum.01850-21

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Liu T., Albornoz K., Deltsidis A., Beckles, D. 2022. Editoral: Postharvest ripening, senescence, and technology. Frontier in Genetics. https://www.frontiersin.org/articles/10.3389/fgene.2022.920584/full

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