2019 CPS Research Symposium
Research Session #4- Packing and Processing
Project Summaries

Project Title
Preservation of stone fruits by spray application of edible coatings with antimicrobial properties

Principal Investigator
Kay Cooksey, Clemson University

Project Term: January 1, 2018 – December 31, 2018

Non-Technical Summary
Listeria monocytogenes is an important foodborne pathogen commonly found in the environment. Recent *Listeria* foodborne outbreaks have been linked to fresh produce including stone fruits. Contamination of stone fruits is problematic since these products are usually consumed without heating. In addition, some surfaces associated with packing operations (brushes, peach rollers) are inherently difficult to sanitize. In the packing house, these fruits are covered (brushed) with a wax--based coating, containing antifungal agents to prevent moisture loss and fungal infection. We propose to develop and compare alternative coatings based on edible components that have antilisterial properties in addition to their physical barrier and antifungal role. The coatings will be formulated to contain safe antimicrobial agents such as nisin, Listex P100, organic acids and or their combinations and could be applied as a spray reducing the risk of cross--contamination in the packing house. Experiments will be performed in laboratory settings and validated in challenge studies with inoculated stone fruits. The coating will prevent *Listeria* contamination on fruits and bacterial persistence on packing equipment. Results from this study will provide improved pathogen control in addition to the basic good agricultural practices, thereby helping fruit industry to produce safer produce for human consumption.

Project Title
Mathematical modeling tools for practical chlorine control in produce wash process

Principal Investigator
Daniel Munther, Ph.D., Cleveland State University

Project Term: January 1, 2018 – December 31, 2018

Non-Technical Summary
Food borne diseases associated to fresh produce continue to cause serious difficulties for public health in the United States. To offset this burden, the produce wash stage has received much attention as a critical control point. However, recent studies indicate a limited understanding of the dynamics of sanitizer control during washing. One problem is that the relationships between water quality constituents and sanitizer levels have only been described via experimental/correlative approaches or by risk models that are difficult to parameterize accurately. Accordingly, there is an urgent need to mathematically describe the fundamental dynamics that generate the observed relationships between sanitizer levels and water quality parameters.

Based on such formulations, our long-term goal is to develop optimal sanitizer strategies that are easily automatable and adjustable to specific commodities and washing practices. The primary objective of this proposal is to develop data-informed modeling tools which quantitatively link easily measurable water quality parameters (e.g. turbidity/total dissolved solids) to commodity specific organic load and free chlorine consumption during recirculated wash conditions. Based on USDA experimental data and our recent modeling results, we hypothesize that by using our modeling tools, the industry can obtain reliable predictive capabilities that are not possible with correlations alone.

Project Title
Characterization and mitigation of bacteriological risks associated with packing fresh-market citrus

Principal Investigator
Linda J. Harris, Ph.D., University of California, Davis

Project Term: January 1, 2017 – December 31, 2018

Non-Technical Summary
After harvest, fresh oranges and lemons are sorted, washed and packed for further distribution and sale in packinghouses. Because green and blue molds result in significant losses of citrus fruit during storage and shipping, fungicides are often applied to during packing. Recirculating drench applications are common because they significantly increase fungicide efficacy but they also provide an opportunity for cross contamination or movement of microorganisms throughout the facility which can be a food safety issue if not appropriately managed. The overall goal of this project is to provide data that the California fresh citrus packinghouse industry can use to support the controls that reduce or eliminate foodborne pathogen cross contamination where citrus fruits are comingled or where recirculating materials come into contact with the fruit. A laboratory component is included to determine for the most common fungicides, minimum compatible sanitizer concentrations that are effective in eliminating *Salmonella* and *Listeria monocytogenes*. The laboratory data will be verified in a pilot scale citrus packing facility and the results of these studies will be used to prepare documents the industry can use to support the efficacy of their food safety practices.

Project Title
Resolving postharvest harborage sites of Listeria protects Zone 1 surfaces

Principal Investigator
Trevor Suslow, Ph.D., University of California, Davis

Project Term: January 1, 2017 – June 30, 2019

Non-Technical Summary
Fresh citrus is an important global commodity and a major specialty crop in California. The 2014-15 CA Agricultural Statistics Review places the combined value of oranges, lemons, and tangerines at over $ 2 billion dollars and all three are in the Top 15 Specialty Crops by value. Fresh whole citrus has not experienced an incident of recall, illness, or outbreak and CA citrus production practices and regions appear to significantly limit the environmental risk of preharvest contamination. However, recent serious incidents involving the bacterial pathogen *Listeria monocytogenes*, associated with CA apple,

have prompted proactive measures to more carefully assess postharvest risks and develop validated interventions for citrus system-wide. Confidentially enrolled handlers will participate in a detailed survey for indicator Listeria and *L. monocytogenes*. The outcome will be the development of model Environmental Monitoring Program (EMP) and guidance in establishing an environmental-zone Master Sanitation Schedule linked to EMP-outcomes for California fresh citrus packinghouses. The anticipated outcomes are expected to include a general overview and report-card of the CA citrus packing environment and identification of potential sources of Listeria related to industry growing regions and harvest/postharvest practices. From this knowledge-gap closing effort, measureable improvements in reduced *L. monocytogenes* prevalence will result.

Project Title
Control of *Listeria monocytogenes* on apple through spray manifold-applied antimicrobial intervention

Principal Investigator
Meijun Zhu, Washington State University

Project Term: January 1, 2017 – December 31, 2018

Non-Technical Summary
Listeria monocytogenes is listed by the Food and Drug Administration as a 'pathogen of concern' and has been singled out on both ready-to-wash and ready-to-eat produce due to its nature as a true environmental species. The pacific apple industry, led by Washington, suffered a significant loss of income following the *L. monocytogenes* outbreak traced back to a California packer. The final FDA Produce Rule and Preventive Controls Rule are challenging apple packers and handlers to develop specific efficacy data for their process controls. The apple industry has an immediate need to begin the process of science-based improvements in *Listeria* control during packing and subsequent storage. The overall goal of the proposed studies is to comparatively assess and validate critical operating parameters for registered, commercially practical, and legally allowed sanitizer(s) against *L. monocytogenes,* and to further seek to verify their efficacy on multiple apple packing lines. The proposed project will develop information for apple producers about the practical efficacy of antimicrobial interventions under commercial packing conditions, resulting in tested and proven methods for spray bar intervention in fresh apples, which will fill critical gaps in the knowledge. It will be crucial for addressing *L. monocytogenes* safety in fresh apples.
