**2016 Annual Meeting Multi-State Project S-1056**

**Enhancement of microbial Food Safety by Risk Analysis**

October 5 & 6, 2016

Hotel Encanto and New Mexico State University

Las Cruces, NM

|  |
| --- |
| **Tuesday, October 4th**  |
| 6:45 | Dinner at La Posta de Mesilla | Meet in Hotel Lobby to carpool to restaurant |
|  |  |  |
| **Wednesday, October 5th – Hotel Encanto** |
| 7:30 | Breakfast | Tularosa Room |
| 8:00 | WelcomeBarbara Chamberlin and Jeanne Gleason, NMSUFaith Critzer, UT |  |
| 8:30 | NMSU- Barbara Chamberlin and Jeanne Gleason |  |
| 8:50 | OSU- Qiuhong Wang and Sanja Illic |  |
| 9:10 | UMaine- Jennifer Perry |  |
| 9:25 | UPR- Lynette Orellana and Maria Plaza |  |
| 9:45 | Break |  |
| 10:00 | Auburn- Patricia Tyler, Luxin Wang, and Stuart Price |  |
| 10:25 | UMN- David Baumler |  |
| 10:40 | MSU- Elliot Ryser |  |
| 10:55 | OSU- Joy Waite-Cusic |  |
| 11:10 | Break  |  |
| 11:30 | Depart for lunch and food safety tour |  |
| 2:00 | VaTech- Rob Williams |  |
| 2:15 | UNebraska-Jeyam Subbiah |  |
| 2:30 | LSU-Achyut Adhikari and Marlene Janes |  |
| 2:50 | MsState-Chander Shekhar Sharma |  |
| 3:20 | UArkansas – Kristen Gibson |  |
| 3:35 | UI-Matthew Stasiewicz |  |
| 3:50 | Wrap-up |  |
| 4:15 | Depart for networking to White Sands National Monument | Meet in Hotel Lobby for buses |
| 7:45 | Dinner at De la Vega Pecan Grill |  |
|  |  |  |
| **Thursday, October 6th – New Mexico State University** |
| 7:30 | Depart for NMSU | Meet in Hotel Lobby for buses |
| 8:00 | Tour of Learning Games Lab, Breakfast in meeting room |  |
| 8:45 | Rutgers- Don Schaffner |  |
| 9:00 | UK-Melissa Newman |  |
| 9:15 | UT-Doris D’Souza, Tom Denes, and Faith Critzer |  |
| 9:40 | Break |  |
| 10:00 | Business Meeting |  |
| 12:00 | Adjourn and Lunch  | 100 Café West |

**New Mexico State**

*Jeanne Gleason and Barb Chamberlin*

Several digital resources were presented ranging from technical scientific communication on Norovirus to virtual labs and learning games. Group has a lot of expertise communicating food safety through digital media resources.

**The Ohio State University**

*Sanja Illic and Qiuhong Wang*

*Sanja Illic*

Human Pathogens in Fresh Produce and Food Contact Surfaces

Research in food safety of fresh vegetables including interventions and mixed methods research. Interventions to prevent and reduce risks of contamination (STEC, *Salmonella* spp., *Listeria monocytogenes*) of fresh produce and other foods in food systems (post-harvest, foodservice, consumer). Control interventions for microbial food safety of vegetables and surfaces.

•Ilic S., Mo K., Pool V. Effectiveness of Proton microfiber wipes in cleaning common domestic and foodservice surfaces

•Ilic S., Her, E.S., Pool V. Seo S. Risk Perceptions, observed food safety behaviors among consumers and microbial quality of surfaces in market-style restaurants

Pre-harvest Fresh Produce Food Safety Education

Control interventions for microbial food safety of fresh produce during pre-harvest, handling and processing. Workshops and training development for food safety education of fresh produce growers and packers in Ohio.

•Ilic S., Hoover L. Agricultural Water Quality and Testing Workshop

•Ilic. S., Doohan D., Lejeune J. Food Safety Training for Small and Medium Growers: specialized small grower workshop, PCQI, PSA

Food Safety Behaviors and Education for Targeted Populations

Promotion of food safety, reduction and prevention of food safety risks among consumers and populations at risk including blind, visually impaired and populations with chronic diseases such as cancer.

•Ilic, S., Msuya J. Kinabo J. Food safety of Homemade Baby Foods in Morogoro, Tanzania

•Ilic, S., Hatsu I., Seo S. 2016 Food safety knowledge and observed behaviors in blind and visually impaired students.

•Ilic, S., Hatsu I. Food safety and nutrition knowledge and self-efficacy of teachers of visually impaired students.

•Ilic, S., Paden H. Food safety behaviors, attitudes and coping mechanisms among food insecure cancer patients.

•Ilic S., Ingham B., Row K., Nichols J., Food Safety for gardens that donate to pantries

*Qiuhong Wang*

To study the mechanisms of Human norovirus (HuNoV) attachment on leafy greens.

Gao X, Esseili MA, Lu Z, Saif LJ, Wang Q. Recognition of Histo-Blood Group Antigen-Like Carbohydrates in Lettuce by Human GII.4 Norovirus. Appl Environ Microbiol. Vol. 82, no. 10: 2966-74. 2016.

To study the mechanisms of internalization of HuNoVs in leafy greens.

**University of Maine**

*Jen Perry*

Research

* High Pressure Processing of Sous Vide Seafood Products, Skonberg, D, Bolton, J.
* Post Process Pasteurization of Lobster Meat and Products using Boiling and Steam. Bolton, J, Skonberg, D.
* A novel concentration and viability detection method for Brettanomyces using the Cellometer image cytometry, J. Bolton, B, Martyniak and L, Chan
* Mycotoxins in Beer and hard cider production brewed with various yeast species. Bolton, J, Perkins, L.
* Application of bacteriophage for control of pathogenic and spoilage microorganisms in minimally processed foods. Perry, J.
* Safety of naturally fermented vegetables with reduced sodium brine. Perkins, L, Calder, B, and Perry, J.
* Fungal contaminants of maple syrup, isolation and identification. Calder, B.
* Implications of merchandising practices at farmer’s markets on safety of cheese. Calder, B.

Cooperative Extension Outreach

 Educational Programing

* Meat and Poultry, Seafood and General Industry HACCP
* General and Dairy Sanitation
* Better Process Control School
* Recipe to Market
* Good Agricultural Practices
* FSMA
	+ Preventive Controls for Human Foods
	+ Produce Safety

 Other

* Process Authority Work
* Seafood Process Authority
	+ Lobster, Salmon, Crab, Shrimp, Smoked, Soups, Fresh, Frozen, and RTE
* Acidified Food Process Authority
	+ Over 600 products per year from Maine, New England and U.S.
	+ New online system for product submission, New prices Sept. 2016
* Meat and Poultry Process Authority
	+ Jerky, Cured, Smoked and some fermented products
* Approve Variances for Maine Health Inspection Program
* Food Code ROP Factsheet ([https://umaine.edu/cumberland/blog/2015/03/11/new-publication-3107-reduced-oxygen-packaging/)](https://umaine.edu/cumberland/blog/2015/03/11/new-publication-3107-reduced-oxygen-packaging/%29)

**University of Puerto Rico**

*Lynette Orellana and Maria Plaza*

Project 1. Risk assessment of agricultural water used in hydroponics production of lettuce.

The objective of this study was to monitor the water quality of the agricultural water used in leafy green vegetables and to assess the application of

Good Agricultural Practices at the farm level. Three water samples were collected from three farmers that use well and one municipal water sample. No contamination of municipal or well water neither the storage tank was found. The distribution tank and the three points of sampling in the hydroponics systems revealed fecal coliform contamination. As the number of days from seeding to harvesting increases, the number of colonies forming unit increases. Problem: System design, solution: use filters after the distribution tank.

Project 2. Use of Aloe Vera as antimicrobial agent on minimal processed cantaloupe

The main objective was to evaluate the antimicrobial properties of an aqueous solution of Aloe barbardenis (Aloe vera) in the following microorganisms:

*E. coli*, *Salmonella* typhi and Aspergillus niger. Suitable concentration that inhibits the growth of these microorganisms was determined by in-vitro studied and cyclic voltammetry. The most effective treatment was chosen (30% of Aloe vera) and applied to sliced cantaloupes. Evaluation of shelf life, physicochemical properties and overall acceptability of the product was conducted. . In addition, in vivo studies were conducted to evaluate also the behavior of microorganisms against Aloe vera.

The use of Aloe vera as a postharvest treatment works as a protective barrier, reducing weight loss and retarding ripening process without altering the taste and maintaining quality. For purposes of getting to know the effectiveness of this product and its antimicrobial activity, it is recommended future applications in different fruits and studies in different organisms for commercial use.

Project 3. Risk assessment of Ochratoxin A in Puertorican Coffee

The objective of this study is to analyze samples of mature and roasted coffee from Puerto Rico to determine the incidence of Ochratoxin A. The student started with the mold isolation form manure and roasted beans. Ochratoxin A detection will start on January 2017.

Project 4. Use of bacteriophages to control *Listeria monocytogenes* in soft cheeses

The objective of this study is to evaluate the use and application of bacteriophages in the production of soft chesses as bio-control measure against *Listeria monocytogenes*. The study is expected to start by January 2016. Work in progress: characterization of fresh cheese produced in Puerto Rico to determine which type of cheese we will be using.

Other ongoing projects {food safety and product development related it}:

1. Use of edible films (chitosan and hydroximethyl cellulose) to extend shelf life of fresh peeled oranges during storage at 55F.

2. Chemical characterization of honey produced in PR.

3. Value added to acid whey: Use of a by- product of white cheese making for the production of different milk products and desserts.

4. Sandia juice product development and shelf life studies as a value added alternative for sandia growers

5. Fermented Cabernet Sauvignon Seed Flour as Ingredient in Lentil: Corn-based formulations: Extrusion Cooking Effect on Physico-Chemical and Nutri-Functional Attributes of the Extrudates

**Auburn University**

*Stuart Price and Luxin Wang*

Proximal Movement of *Salmonella* in Food Animal Facilities

*Major Efforts*

 The *Salmonella* working group is investigating the dynamics of *Salmonella* movement between different animal species raised in close proximity to one another. An environmental sampling study was initiated at the Auburn University vet school, where multiple animal species are housed. Seasonal samplings began in winter, 2014, and revealed the presence of *S.* Muenster, a bovine-associated serotype. Subsequent environmental cultures documented the emergence of a second bovine serotype, *S.* Cerro, and in the summer of 2016, *S.* Heidelberg. Significant contamination of our dairy parlor, dairy barn, and dairy herd pasture with these three strains suggested that our dairy herd might be the source, and culture of feces from 10 dairy cows confirmed this suspicion. These same serotypes also were found in adjacent equine and beef facilities, and at our Animal Health Research unit located some distance from the hospital portion of the vet school, suggesting horizontal movement across the vet school campus.

 A second environmental study was initiated at the AU Poultry Farm, a nalidixic acid resistant *Salmonella* strains were used to infect chickens (one time on August 28 and one time on September 28). Samples were collected within the facility and around the farm. The nalidixic acid was isolated from locations that are outside of the farm, an approximately 1,500 ft from the house 3 months after the first inoculation and 2 months after the second inoculation event.

*Impact*

 *Salmonella* appears to be able to establish itself and move in the multi-host species environment. In the vet school study, factors that correlated with finding a positive *Salmonella* sample included bovine species as a source, bovine facilities, and pastures. Long-term presence of one or a few predominant serotypes over time suggests that natural controls that target these particular strains, such as bacteriophages, could be harnessed to control movement of this pathogen in the production environment.

 With the help of the nalidixic acid resistant strain, the group was able to confirm the transferring of *Salmonella* from the poultry houses to the environment. It is worth to point out that this poultry farm is well managed, isolation of tested *Salmonella* strains from sites that are outside of the farm indicates that birds, winds, and run-off water can all be possible reasons that contribute to the spreading of *Salmonella* from animal agriculture to environment.

*Grants*

Cattle as an Emerging Source of *Salmonella*. L. Wang (PI), K. Macklin, S. Price, J. Wright, S. Duran, C. Bratcher. Auburn University Institutional Grants Program. 5/1/15 – 4/30/17.

Characterization and Control of *Salmonella* Environmental Contamination in a Food Animal Facility. S. Price (PI), J. Wright, P. Walz. Alabama Agricultural Experiment Station. 10/1/15 – 9/30/17.

**University of Minnesota**

*David Baumler*

*Models and risk management:* Using Genome-Scale Metabolic Models of Foodborne Pathogens to Address Human Disease and Food Safety (oral presentations at IAFP and IFT Annual meetings)

Using a combination of computational techniques and laboratory methods, genome-scale metabolic models (GEMs) can be created, validated, and used to identify differentiating metabolic capabilities of microbes of interest within the same genus*.* With projects sequencing the genomes of  >100,000 important foodborne pathogens currently underway, the objective of this study was to generate GEMs for numerous foodborne outbreak strains of *Salmonella* spp. and *Listeria monocytogenes*, and to compare nutrient utilization predictions of these models to *in vitro* results. Genomes of six *L. monocytogenes* and five *Salmonella* spp.strains were taken from the NCBI database and uploaded to KBase—a semi-automated computational resource used to generate the GEMs. These models were then used to generate strain-specific nutrient utilization predictions for 95 sources of carbon under aerobic and anaerobic conditions using General Algebraic Modeling System (GAMS) software.  *In silico* predictions were then compared to *in vitro* experiments performed using BiologTM phenotypic microarray plates.  Following this comparison, GEMs were manually curated to increase agreement between *in silico* predictions and *in vitro* results. Carbon source utilization agreement between *in silico* predictions and *in vitro* results was strong and significant (Pearson correlation test statistic yields p<0.001) and ranged from 80% to 90% for *L. monocytogenes* and from 90% to 98% for *Salmonella* strains. Once validated, *L. monocytogenes* and *Salmonella* GEMs were used to simulate environments of numerous food matrices and host-niches to identify differentiating metabolic pathway capabilities and 100’s of essential metabolic reactions required for growth and viability for the strains from each genus. Since many of these pathogenic bacteria continue to emerge in foods and have large global impacts to human health and the economy, this research has demonstrated new post-genomic era approaches to identify new targets to treat human disease and make foods safer from *Salmonella* spp. and *Listeria monocytogenes*.

*Assessment of food safety risks in agricultural systems:* Microbial risk analysis of produce grown on a sustainable chicken production farming system (poster presentation at IFT Annual meeting)

Sustainable agriculture encourages the use of organic fertilizers instead of synthesized ones, and poultry manure can be recycled as an economical organic fertilizer and added to soil to supply necessary plant nutrients. However, fruits and vegetables in direct contact with manure-contained soil can easily be contaminated by coliforms and food-borne pathogens such as *Salmonella* spp., *E. coli,* and *Listeria* spp. These human pathogens may lead to serious foodborne outbreaks and infections in individuals with weakened immune systems (e.g. children and pregnant women), thus remaining a concern for sustainable farming using poultry manure. In this study, chicken manure was added to soil in 2014, and then we identified the presence or absence of coliforms and the above three pathogens in the soil samples collected from a sustainable farming system over five months during 2015 in Minnesota and analyzed the risk of microbial contamination through the use of Petrifilms. In addition spinach and cantaloupes grown in the study field were examined for the presence of these microorganisms and the risk of foodborne disease. This study detected acceptable coliform levels in soil, spinach, and cantaloupes, but that *Salmonella* spp. and *Listeria* spp. were present in soil throughout the study and in harvested cantaloupes. Overall this study identified that additional control parameters such as heat or chemical treatment of chicken manure should be implemented into this practice of sustainable farming to improve the safety of produce items.

**Michigan State University**

*Elliot Ryser*

Overall Goal

The overall goal of this multi-disciplinary, multi-institutional, multi-functional special emphasis project is to enhance the microbial safety and quality of ready-to-eat, fresh-cut produce via integrated research and outreach/training targeted at the processing, packaging, and retail distribution segments of the produce chain. The multi-disciplinary project team integrates expertise from Michigan State University, California Polytechnic State University, Rutgers University, Ohio State University, and the International Food Protection Training Institute (Battle Creek, MI). Five project modules target: 1) processing - quantify and develop predictive models for pathogen transfer during slicing/dicing of fresh-cut produce, 2) packaging - develop and validate optimal packaging systems for safety of fresh-cut produce, 3) retail distribution - evaluate and model potential pathogen survival/growth in packages at retail, 4) risk modeling and economics - develop and validate a risk model for pathogen transfer and survival/growth in packaged fresh-cut produce through retail, and conduct a benefit-cost analysis for processing and packaging interventions, and 5) outreach/training - develop, implement and assess outreach/training programs on the safety of fresh-cut fruits and vegetables for processors, distributors, retailers, and regulators. Critical data gaps to be filled from this work, as identified in the RFA, include: 1) identification of commercial slicing/dicing practices that increase risk for cross-contamination of fresh-cut produce, along with various mitigation strategies, 2) development of novel packaging strategies for minimizing pathogen growth/survival in the cold-chain, and 3) reduction of risk of foodborne illnesses from fresh-cut produce through a series of training activities aimed at processors, retailers, foodservice workers, and regulators. Overall, this integrated project will serve to enhance the safety and quality of fresh-cut fruits and vegetables and reduce the number of produce-related outbreaks.

Target Audience

Leafy green growers and processors (e.g., Earthbound Farms, Dole, Fresh Express) and retailers; suppliers of equipment (e.g., Heinzen Manufacturing, Urschel Laboratories) and sanitizers (e.g., Ecolab) used in the processing (e.g., conveying shredding, fluming, dewatering) of leafy greens; government regulators; industry associations (e.g., United Fresh, California Leafy Green Handler Marketing Board)

Accomplishments

The primary focus of the current research in my laboratory is assess the extent of cross-contamination that can occur during slicing and dicing of fresh fruits and vegetables with this information needed for improved risk assessments that will impact both government policies and future federal funding in the area of produce safety. During the time period for this report, three major studies were conducted as summarized below.

Study 1. Impact of Cutting Speed on *Listeria monocytogenes* transfer during slicing of zucchini squash and cucumbers to better ensure the safety of fresh-cut fruits and vegetables from the point of commercial processing through retail sale.

Increased consumption fresh-cut produce has led to heighted food safety concerns as evidenced by on-going recalls and outbreaks. Using cucumbers and zucchini squash as model products based on their inherent compositional differences, this study aimed to evaluate the impact of mechanical slicing speed on *Listeria* transfer. In this work zucchini squash and cucumbers were contaminated with *Listeria* and then sliced with a commonly used supermarket/kitchen slicer at different speeds followed by uninoculated zucchini and cucumbers to determine the extent of cross-contamination. The extent of fresh produce cross-contamination was affected by slicing speed with less cross-contamination seen for cucumbers regardless of slicing speed compared to zucchini due to the different physical characteristics of the two products. These findings should prove useful in developing improved predictive models for bacterial transfer based on product composition and expanding current risk assessments across a wider range of products.

Study 2. Spread of *Escherichia* coli O157:H7 during Flume Washing and Drying of Fresh-Cut Romaine Lettuce

In this study, low levels of *E. coli* O157:H7 contamination (0.1 to 1000 cells per leaf) and different amounts of contaminated and uncontaminated Romaine lettuce (10:100, 5:100, 1:100 and 0.5:100) were used in combination to assess the spread of *E. coli* O157:H7 during simulated commercial washing and drying. In this study, lower inoculation levels led to decreased *E. coli* O157:H7 transfer to romaine lettuce during processing. Within the same inoculation level, the amount of contaminated product processed did not have a significantly impact the extent of cross-contamination. Washing of fresh-cut produce in water containing a sanitizer also did not eliminate *E. coli* O157:H7. These findings are critical for predicting the extent of cross-contamination under more realistic conditions and will help to improve the exposure assessment in risk assessments for leafy greens.

Study 3. Quantifying the redistribution of *Salmonella* Typhimurium LT2 during simulated commercial production of fresh-cut baby spinach and cilantro

Using the same design in Study 2 above, *Salmonella* was substituted for *E. coli* O157:H7 and baby spinach and cilantro for Romaine lettuce. These results again showed that *Salmonella* transfer between the inoculated and uninoculated products decreased as the initial inoculation level decreased. In addition, the amount of contaminated product processed had less of an impact on cross-contamination than the level of pathogen contamination. Adding 60 ppm free chlorine to the flume tank generally failed to decrease the extent of cross-contamination during washing and drying. These data will again be used to refine current risk assessments designed to predict the likelihood of illness from consumption of fresh-cut leafy greens.

**Oregon State University**

*Joy Waite-Cusic*

* Projects focusing on foodborne pathogen survival during onion growth and curing
* Many projects focusing on agricultural water quality
* Data collection for risk assessment in hazelnut production and processing
* Food processing projects related to nut butter and *Salmonella* and jerky process validation, many more projects related to process validation coming from industry given FSMA implementation

**Virginia Tech**

*Rob Williams*

* Survival and transmission of airborne *Listeria* species
* Cavitation for the removal and inactivation of *Listeria* and *Salmonella* on produce surfaces
* Evaluation of how different signs affect meat and poultry processing employees’ hand washing practices
* Use of a quantitative microbial risk assessment model to estimate exposure to *Campylobacter* from consumption of chicken in the United States
* Determining the microbiological quality of fresh produce sold at farmers markets
* Assessing consumer knowledge, attitudes and handling practices for mechanically-tenderized beef products
* Developing a Farmer’s market food safety plan for farmer’s market managers to their own plans
* Editing the current "Enhancing the safety of locally grown produce" curriculum to incorporate recommendations under the Produce Safety Rule.
* Working with other colleagues in the Southern Regional Center to develop a Farmer’s Market Food Safety Tool Kit
* Evaluate the microbial quality of surface agricultural water used in pre-harvest production on the Eastern Shore of Virginia
* Identify environmental and meteorological factors that are associated with microbial populations in agricultural surface water
* Examining transfer and regrowth of antimicrobial resistant bacteria from manure and compost applied to fresh produce.
* Validated use of *Enterococcus faecium* NRRL B-2385 as a surrogate for Inactivation of *Salmonella enterica* on dried spices treated with a vacuum assisted steam process.
* Developing benchmarks for postharvest application of sanitizers and irradiation to reduce regrowth of antibacterial resistant bacteria on fresh produce.
* Developing model for inactivation of *Salmonella enterica* on spices processed using a vacuum assisted steam process.
* Evaluating recovery of *Salmonella enterica* from steam and ethylene oxide-treated spices using overlay with supplements

**University of Nebraska**

*JeyamSubbiah*

*Jeyam Subbiah*

Research interests: food safety engineering, multiphysics modeling and simulation of food processes and product, microwave and radiofrequency processing of low-moisture food products, extrusion process validation of low-moisture food products.

*Andreia Bianchini*

Research Interests: Areas of interest include applied research on the evaluation of ingredients, assessment of processes, and development of strategies to reduce/prevent contamination of final products with mycotoxins and bacterial pathogens; and HACCP assistance focusing on food, dairy and feed products. Extension activities include technical advice and training, as well as preparation of guidelines, protocols, standard operating procedures and related technical documents for improvement of safety and quality of food and pet food processes.

*Jayne Stratton*

Research Interests: Food safety microbiology, rapid detection methods for pathogens (Listeria, *E. coli* O157:H7, *Salmonella*), evaluation of interventions for the reduction of pathogens in various food and pet food matrices

*Bing Wang*

Research Interests: Dr. Wang is a human health risk analyst, particularly applying risk assessment approach in addressing food safety issues. Her primary research interests center around human health risk assessment, epidemiology and research synthesis methodologies.

*Angela Anandappa*

Research Interests: Her work involves developing cross disciplinary research to address complex sanitary design and sanitation challenges including validation, methods and addressing manufacturing challenges in the food industry. The work of the alliance includes identifying and evaluating new and improved materials fit for food manufacturing environments to better control pathogens and biofilms, identify improved products and methods of cleaning and improve the effectiveness and ecological friendliness of cleaning agents for all types of manufacturing processes.

**Louisiana State University**

*Marlene Janes and Achyut Adhikari*

Summary of Accomplishments by objective area (No more than 4-5 sentences on each area)

1) Risk Assessment: Assess food safety risks in agricultural systems

Limited data is available regarding the presence of *C. difficile* in food and water. The main purpose of this study was to characterize *C. difficile* isolates from retail lettuce, test the antibiotic-resistance property using five common clinical-selected antibiotics (metronidazole, vancomycin, clindamycin, erythromycin, and cefotaxime). Lettuces (grown in California, Arkansas, and Louisiana) were purchased from retail stores. Toxigenic *C. difficile* was isolated from 13.8% (41/297) of the lettuce samples. Among the toxigenic isolates, 82.9% (34/41) only produce toxin B, and 17.1% (7/41) produced both toxin A and toxin B. The *C. difficile* isolates were identified as having antibiotic resistance to metronidazole, vancomycin, and erythromycin. This present research contributes in revealing a possible source of community-associated *C. difficile* infection.

2) Risk Management: Develop science-based interventions to prevent and mitigate food safety threats

Contaminated surface water used for irrigation is a potential source of microbial contamination in fruit and vegetable crops. This study evaluated the efficacy of ultraviolet (UV)-C light on pathogen risk reduction in surface water used for irrigation of cantaloupe in an agricultural setting. Significant reduction (*P< 0.05*) of generic *E. coli* (>3 log MPN 100 mL–1) was achieved with lower doses of UV-C light (10-20 mJ cm–2) and below the detectable limit of the test for UV-C doses above 50-60 mJ cm–2. The generic *E. coli* counts on cantaloupe irrigated with UV-C light-treated or non-treated water were not significantly different.

3) Risk Communication: communicate food safety messages to stakeholders

LSU AgCenter team has developed and delivered multi-disciplinary, team-based extension programs to address food safety issues spanning the farm-to-table continuum. Twelve GAPs/GHPs workshops and several produce food safety workshops were hosted in Louisiana between 2014-2016. Evaluation of emphasized programs yielded significant, documented impacts among clientele in Louisiana which should reduce foodborne illness and enhance the safety of foods produced in Louisiana.

Impacts:

List grants received with a start date of January 1, 2016 – December 31, 2016

1. M. Janes, J. Finley. 01/2016 to 12/2016. Cocoa Study. Hershey’s Co. $89,892.
2. A. Adhikari, C. Graham. Pecan Food Safety Study. LDAF-Specialty Crop Block Grant. $96,000
3. D. Michelle, A. Adhikari et al. Southern Center for Produce Safety. LSU portion $33,802
4. B. Fletcher, A. Adhikari et al. Designing state program to implement FDA FSMA Produce Safety Rule in Louisiana. LSU AgCenter’s portion: $614,665 for five years.

Poster Presentations:

1. Parraga E. K., T. C. Vieira, M. Janes, K. Fontenot, R. C. Williams, V. S. Chhetri, and A. Adhikari. Effectiveness of Ultraviolet (UV-C) light treatment on reducing microbial levels from surface water used for irrigation of cantaloupes. IAFP 2016 annual meeting, Missouri, USA.

2. Chhetri, V. S., K. Fontenot, R. Strahan, R. C Williams, K. J Parraga Estrada and A. Adhikari. Effect of weed levels on microbial die-off rate on watermelon surface in an agricultural setting. IAFP 2016 annual meeting, Missouri, USA.

**Mississippi State University**

*Chander Shekhar Sharma*

* Intervention Approaches for Improving Microbial Safety of Poultry Products:
	+ Mechanically separated poultry and poultry parts
* Survival, persistence, and stress adaptation of foodborne bacterial pathogens in food processing environment
	+ Emergence of Antibiotic Resistance in foodborne Bacterial Pathogens after Prolonged Exposure to Sublethal Stress Environments
	+ Development of rugose morphotype of *Salmonella* Typhimurium and Heidelberg following exposure to sub-inhibitory chlorine concentrations that exhibit chlorine resistance and strong biofilm forming ability
	+ Thermal resistance of rugose phenotype of *Salmonella* Typhimurium with normal smooth morphology at different growth phases

**University of Arkansas**

*Kristen Gibson*

1. Enteric virus (human norovirus) interactions with environmental microbiota.
	1. hNoV receptor-like expression on:
		1. ATCC bacteria – associated with human gut and leafy green phyllosphere
		2. Isolates from retail leafy greens - !6S rRNA sequencing
			1. *Pseudomonas*, *Exiguobacterium sibiricum, Pantoea*, *Bacillus*
	2. hNoV and surrogate virus association with bacteria in suspension
		1. Surrogates – murine norovirus, Tulane virus, Aichi virus A
			1. All associate with ATCC bacteria after 1 h incubation at RT with very few unbound
				1. Is the association non-specific or specific?
2. Enhance food safety at farmers’ markets through market manager, vendor, and consumer engagement
	1. Wholesome and Healthy at the Farmers’ Market – “Wash Me” cards, produce type specific materials (recipes, fact sheets), reusable bags, aprons, meat thermometers
		1. Beta Test at 5 markets in Northwest Arkansas
			1. Market managers liked the materials
			2. Vendors loved the “Wash Me” cards
			3. 69% of surveyed consumers *noticed* the materials
			4. 72% who noticed felt they learned something about food safety
		2. Part of new Food Safety Outreach Program project to develop total Farmers’ Market Manager Food Safety Kit from “farm-to-consumer”
3. Handwashing (HW) tools = gel-based vs. foaming soap types and impact on HW efficacy
	1. Review of methods used to determine HW efficacy
		1. Lack of uniformity in methods used for recovery of microbes from hands
	2. Soap type and HW time
		1. Participants wash hands 4.3 s longer, on average, with gel-based hand soap when compared to foaming
		2. Need larger study population to determine if difference truly exists
	3. Soap type and removal of microbes
		1. Foaming soap removed significantly less MS2 (p = 0.0008) when compared to *E. coli*
		2. No difference in removal of microorganism type by gel-based soap
4. Cleaning in Place (CIP) Food Service Dipper Well
	1. Evaluation of recirculating dipper well combined with ozone sanitizer
		1. *E. coli*, *Listeria innocua*, PRD1 bacteriophage, *S. aureus*
	2. CIP dipper well out performed traditional dipper well with respect to inactivation of microorganisms

**University of Illinois**

*Matt Stasiewicz*

## *Matthew J. Stasiewicz*, Assistant Professor. Food Science and Human Nutrition

Email: mstasie@illinois.edu; Phone: (217) 265-0963

Projects:

* Genomic and statistical approaches to identify and characterize *L. monocytogenes* and *Salmonella* persistent in food associated environments.
* Single-kernel optical sorting to remove aflatoxin and fumonisins from corn.
* Data analytics in food safety

Recent Publications:

* Stasiewicz, M. J., T. Falade, M. Mutuma, S.K. Mutiga, J. Harvey, G. Fox, T. Pearson, J.W. Muthomi, R.J. Nelson. Multi-spectral kernel sorting to reduce mycotoxins in Kenyan maize. Submitted to *Food control* (6/29/2016)
* Gorton, A and M.J. Stasiewicz. 22-Years of U.S. Meat and Poultry Product Recalls: Implications for Food Safety and Food Waste. Submitted to *J. Food Prot.* (9/19/16)

## *Michael Miller*, Associate Professor. Food Science and Human Nutrition

Email: mille216@illinois.edu ; Phone: (217) 244-1973

Projects:

* Development of novel anti-listerials for Hispanic-style fresh cheeses
* Metabolism of dietary bioactives by the gut microbiome
* Hygiene solutions for industrial fermentations

Recent Publications:

* Angelino D, Dosz EB, Sun J, Hoeflinger JL, Van Tassell ML, Chen P, Harnly JM, Miller MJ, Jeffery EH. Myrosinase-dependent and –independent formation and control of ‘toxic’ isothiocyanate products of glucosinolate hydrolysis. *Frontiers Plant Sci.,* 2015 (in press)
* Van Tassell ML, Daum MA, Kim JS, Miller MJ. Creative lysins: *Listeria* and engineering of antimicrobial enzymes. *Current Opinion of Biotechnology* 2016, 37:88-96.

## *Hao Feng*, Professor. Food Science and Human Nutrition

Email: haofeng@illinois.edu; Phone: (217) 244-2517

Projects:

* Molecular mechanisms underlying *Salmonella* attachment to fruits and nuts, USDA NIFA Foundational, Food Safety Program, Co-PI
* Mechanisms of viral contamination in fresh leafy vegetables and tomatoes, USDA NIFA Foundational, Food Safety Program, Co-PI
* An Integrated Approach for Enhancing Food Safety in Qatar, Qatar National Research Fund (QNRF), Co-PI

Recent Publications:

* Fuzawa M, Ku K-M, Palma-Salgado S, Nagasaka K, Feng H, Juvik J, Sano D, Shisler J, Nguyen T. 2016. Effect of leaf surface chemical properties on the efficacy of sanitizer for rotavirus inactivation, *Appl Environ Microbiol*, doi:10.1128/AEM.01778-16. (Cover story)
* Lu L, Ku K-M, Palma-Salgado S, Storm A, Feng H, Juvik JA, Nguyen TH. 2015. Influence of epicuticular physicochemical properties on porcine rotavirus adsorption to 24 leafy green vegetables and tomatoes, *PLOS ONE*, DOI: 10.1371/journal.pone.0132841.

**Rutgers University**

*Don Schaffner*

Research

Schaffner lab

1. Fresh Citrus QMRA (collaboration with Danyluk)

2. *Salmonella* growth modeling in cut tomatoes

3. *Salmonella* in tomatoes QMRA (Buchanan grant)

4. Cross-contamination modeling in fresh cut (Ryser grant)

5. *Salmonella* cucumber cross-contamination (possible Strawn collaboration)

6. Dynamic temperature modeling, *Salmonella* in ground beef

7. Surface to food cross-contamination, 5 sec rule (Published!)

8. Norovirus QMRA (Jaykus NoreCORE grant)

9. Petri plate for sociology graduate student

10. *Salmonella* in leafy greens QMRA (Brazilian student)

11. Surface geometry and cold plasma (co-advised with Karwe)

Collaborations outside Rutgers University

1. Laura Green-Brown (CDC, Cooling EHS-Net)

2. Michele Jay-Russell, Dennis D'Amico (Raw Milk Review)

3. Bulk soap contamination (GOJO, Gerba)

Other Rutgers University faculty

1. Mukund Karwe (Food Engineer)

2. Karl Matthews (Food Micro, fresh produce)

3. Mike Chikindas (Food Micro, bacteriocins)

4. Tom Montville (Retired)

5. Carol BB (Youth food safety)

6. Deb Palmer (SNAP-Ed, EFNEP)

Extension

1. Food Safety Talk, 108 episodes and counting (Chapman)

2. Workshops and Short Courses (OCPE, IAFP)

Donna Schaffner (FIC-S)

3. Entrepreneurs

Bill Franke, et al. (FIC-N), Steve Komar (Ag agent)

4. Fresh Produce

Wes Kline, Meredith Melendez (Ag agents)

University of Kentucky

*Melissa Newman*

1) Risk Assessment: Assess food safety risks in agricultural systems

a) We have developed a qualtrics survey for KY growers to determine needs for small produce producers to determine the FSMA coverage and exemptions. In addition, to determining readiness of producers to meet GAPs.

b) Working with the Kentucky dairy industry. Specifically farms utilizing the compost bedded pack barns. We are assessing the relationships among temperature, moisture, carbon-to-nitrogen (C:N) ratio, space per cow, and bacterial counts from bedding material collected from compost bedded pack (CBP) barns.

c) Investigating the ability of *Salmonella* and *E. coli* STXs to survive fermentation and storage in traditional dry sausages. Products were inoculated, processed and stored for up to six moths

2) Risk Management: Develop science-based interventions to prevent and mitigate food safety threats

 a) The Food Industry is changing with many new or expanding entrepreneurs participating in the production and marketing of food products. With the expansion of this food business clientele there is a need for education programs that address the issues involve with producing food items that are safe, of high quality and meet the demands of the consumer.

The Food Systems Innovation Center at the University of Kentucky uses a multi-disciplinary approach to provide problem solving and education to Kentucky’s food businesses.  Between July 2015 and June 2016 FSIC has assisted 102 clients with nutritional labeling, process reviews, taste panels, shelf life’s and microbial challenge studies.  In addition, FSIC personnel were involved in 100 consultations via phone or facility visits that address site specific issues for food business clientele. .

FSIC has conducted trainings and workshops that have transitioned into annually anticipated events to fill gaps in Kentucky Food Safety programs.  These trainings include: The Better Process Control School (BPCS) (22 attendees Dec 2015) and Hazard Analysis and Critical Control Points (HACCP) (25 attendees May 2016), FDA’s FSMA training (13 attendees April 2016) and Good Agricultural Practices (GAP) training recommended for Kentucky producers.

In October 2015, we co hosted an Entrepreneurship Hour with the Von Allmen Center for Entrepreneurship and Bluegrass Small Business Development Center.  This event brought local food businesses together to answer questions for aspiring food entrepreneurs in an open Q/A session.  Over 80 attendees from the community and UK engaged in the discussion of financial, marketing, and regulatory issues facing new businesses.

Our collaboration with Kentucky State University on the Fruit and Vegetable Mobile Processing Unit was successfully concluded this year, in which FSIC played a major role in the development of processing protocols and food safety plans.  FSIC worked closely with both KSU and the Food Safety Branch of KY to compose recipes, facility layout, and procedures for the mobile commercial kitchen.  This endeavor will provide new opportunities for local producers to expand their operations for value-added processing, and FSIC is dedicated to continuing food safety support for the fledgling project.

The education programs and outreach activities of the FSIC have addressed the growing needs of the diverse Kentucky Food Industry.

3) Risk Communication:  communicate food safety messages to stakeholders

a) The GAPs Audit workshops for Kentucky growers to prepare for a third party GAPs audit.

This one-day program conducted at the UK South Farm,

· Learn the scientific basics of food safety,

· Focuses on the development of a Food Safety Plan

· Provide practical tips on third-party audit preparation for growers interested in obtaining a third-party certification of GAPs

· Provide a tour of the GAP-certified facilities at the UK Horticulture Research Farm.

AUDIENCE

This training is intended for growers,

· Thinking about documenting their food safety practices in the form of a food safety plan

· Getting ready to get their farm Third-Party GAP certified, to enter into the wholesale market

· Growers who want to meet their buyer’s requirement for an on-farm food safety program.

Impacts:

We are is part of the Southern Regional Center team along with members from land-grant universities in Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, and Virginia. This collaborative effort will critically benefit fruit and vegetable growers in the Commonwealth by advancing the new food safety education and training required by the passing of the Food Safety Modernization Act in 2015.

Specific roles are:

1. Become Produce Safety Alliance (PSA) and Food Safety Preventive Controls Alliance (FSPCA) certified trainers focused on supporting the produce industry.

2. Deliver region specific education, training curricula, and technical assistance.

3. Report impacts of education, training, and technical assistance to the Regional Center.

Publications:

Poster Presentation:

Inactivation of B. cereus in reconstituted infant rice cereal by trans-cinnamaldehyde Hayriye Cetin-Karaca and Melissa Newman, University of Kentucky, IFT Annual Meeting 2015

Peer review Publications:

Paul Priyesh Vijayakumar, Melissa Newman and Gregg Renfrow. Foodborne Illness Risks and Prevention. 2016. University of Kentucky College of Agriculture Food and Environment, Cooperative Extension Service.  ASC – 227.

Paul Priyesh Vijayakumar and Melissa Newman. Understanding Produce Safety Programs and Making a Food Safety Plan. 2016. University of Kentucky College of Agriculture Food and Environment, Cooperative Extension Service.  IP-78.

The relationship between compost bedded pack performance, management, and bacterial counts. 2014. R.A. Black, J.L. Taraba, G.B. Day, F.A. Damasceno, M.C. Newman, K.A. Akers, C.L. Wood, K.J. McQuerry, J.M. Bewley. J.D.S. [May 2014](http://www.journalofdairyscience.org/issue/S0022-0302%2814%29X0005-6)Volume 97, Issue 5, Pages 2669–2679.

**University of Tennessee**

*Doris D’Souza, Tom Denes, Faith Critzer*

Doris D’Souza presented findings from her most recent research evaluating various detection methods (LAMP) for detection of foodborne pathogens in various food matrices. She also shared recent research evaluating inactivation of viral foodborne pathogens using heat and discussed resistance of HAV compared to bacterial foodborne pathogens. Currently evaluating various surrogates that mimic viral pathogen heat resistance.

Tom Denes introduced himself to the group. He recently joined the UT in August and will be evaluating phage as a control mechanism for foodborne pathogens. He has specific interest in the adaptation of foodborne pathogens when they become resistant to phage and determining the underlying mechanisms of adaptation.

Faith Critzer described current extension efforts related to FSMA readiness for food manufacturers and produce growers. Tennessee has and will continue to deliver standardized FSPCA curriculum to food manufacturers and is gearing up to begin delivering PSA trainings to fruit and vegetable growers. Additional efforts are being put forth to build additional education modules with the Southern Center, hosted by UFL and other colleagues to help fill the gaps in knowledge for our clients. Research interests have focused on gene expression of foodborne pathogens when exposed to commonly use sanitizers (chlorine and peroxyacetic acid) under various physiological conditions. Additional research evaluating the efficacy and applicability of emulsified essential oils as sanitizers during post-harvest washing of produce is concluding. Emulsified oils could perform as well as 200 ppm free chlorine at preventing cross-contamination, but were not found to be acceptable in sensory tests. Additionally, exposure to essential oils resulted in cellular damage of spinach and romaine lettuce making it unmarketable.

**S-1056 Business Meeting – October 5, 2016 in Las Cruces, NM**

Chair Faith Critzer begins meeting

* Goes through the specific goal for this upcoming year as well as certain deliverables for the “end” of the multistate project as well as how we will go about writing a new multistate project

Goal for S1056

* Invite folks from USDA-ARS units and other complementary research units at the state and federal level to join group for meeting next year
* Executive board will send out email to group and collect potential names of collaborators and courage members to contact them

2017 – Project and Annual meeting

* Final year of funding 2017-2018
* Current project ends 9/3/2018
* Must write a white paper (decide topic) and submit to Food Protection Trends
* Hammer out new objectives of new project renewal due in 2018
* Secretary will be elected
* What should the focus of the next meeting be? Should we continue to have progress reports from each state, focus on the white paper and new objectives, or try to work more on the formation of collaborations and potential funding opportunities?

2018 – Renewal of Multistate Project

* What do we want our focus to be? What are our new objectives?
* Stuart Price suggested that it will be better for states to align with what the group is doing

Potential hosts for 2017 annual meeting

* Don Schaffner – NJ, blueberry production, vineyards
* Jason Bolton/Jen Perry – Portland, ME, brewing industry focused, or maybe seafood
* VOTE: Maine

Announcements

* Qiuhong Wang announced OSU position announcement
* Faith talked about state reports for final report for the group. Only a few sentences needed for each objective and use JFP referencing style. Faith will send out info.
* Jeyam indicated that members need to indicate/highlight collaborations between states