National Multistate Research Award
S1056: Enhancing Microbial Food Safety by Risk Analysis (2013-2018)
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Foodborne pathogens cause an estimated 48 million illnesses and 3,000 deaths in the U.S. each year, racking up over $55 billion in associated medical expenses annually. Food companies feel the pain, too. In addition to damaging brand reputation and sales, food recalls cost companies at least $10 million in direct expenses. Since 2013, a multidisciplinary team of researchers and Extension educators from 39 institutions across the U.S. (*Multistate Research Project S1056: Enhancing Microbial Food Safety by Risk Analysis*) has helped the nation's growers and processors address food safety concerns.

Over the years, *S1056* has illuminated how microbes react to their environment and designed cutting-edge models to better anticipate how foods might become contaminated. For example, scientists evaluated how pear firmness affects the transfer of *Salmonella* during mechanical slicing (Michigan State), how temperature affects pathogen growth in leafy greens (Rutgers), and how glove material affects bacterial transfer during jerky production (Virginia Tech). Other project members designed devices to help detect pathogens. Scientists at the University of Wyoming developed inexpensive, disposable paper-based devices that detect even low concentrations of *E. coli*, and University of Illinois researchers developed a custom spectroscopy system that identifies toxic mold in single corn kernels. Researchers also monitored pathogen presence on farms and in food processing environments, including tree fruit packing houses (PSU), small pork product manufacturers (Texas), catfish processing plants (LSU), and artisan cheese factories (UConn). Better prediction and detection of foodborne pathogens helps growers, processors, and others prevent threats or control them before they become dangerous and costly.

S1056 researchers have also suggested interventions to control risks along the food production chain. Some scientists focused on ways to prevent or eliminate bacteria, such as packaging fruit in natural edible films loaded with essential oils (K-State); dipping fresh-cut cantaloupe in aloe vera solution (University of Puerto Rico); feeding prebiotics to poultry (University of Arkansas); spraying antimicrobials on beef and poultry products with electrostatic sprayers (CSU); and using intense pulsed light technology to pasteurize powdered foods without heat (UMN). Other studies (Virginia Tech) have informed management practices that keep bacteria from developing resistance to antimicrobials.

Multistate research has guided food safety policy in major ways. In particular, exhaustive water sampling and data analysis by *S1056* scientists in New York, Florida, and other states showed that the irrigation water quality requirements stipulated by the FSMA did not adequately reflect the risks of using water from ponds, canals, and streams to irrigate fruit and vegetable crops. As a result, the U.S. Food and Drug Administration has delayed the requirements while they try to find a more effective, practical way to reduce the risk of introducing pathogens to produce via contaminated agricultural water. This research has also given growers the information they need to accurately assess the quality of their irrigation water and implement interventions that protect produce from pathogens. Produce causes about half of all foodborne illnesses in the U.S.

By providing learning materials and experiences for both the food industry and consumers, for varying age groups and platforms, and in multiple languages, including Spanish, Navajo, and Chinese, *S1056* has improved food safety knowledge and practices among a wide audience. Many researchers and Extension specialists have collaborated with New Mexico State University to create interactive learning curriculum. These materials have been widely used. For example, *Ninja Kitchen*, an online game that teaches middle

schoolers about safe food handling and storage, has been accessed 2.3 million times since 2013. In 2015, the University of Florida leveraged funding and manpower from prior *S1056* partnerships to help launch the Southern Center, which coordinates food safety training, outreach, and technical assistance for the region's produce industry. With participation from land-grant institutions in 13 states and Puerto Rico, the Southern Center has been able to reach more people in more locations and with distinct needs. In less than two years, Southern Center collaborators have developed a cadre of over 400 trainers who help the region's produce industry understand and comply with FSMA rules.

Solutions to the nation's food safety problems lie well beyond the capacity of any single researcher, discipline, producer, retailer, or regulator. *Multistate Research Project S1056* is the first comprehensive attempt to develop risk-based strategies for controlling foodborne pathogens at all points along the nation's food system spectrum and across all food commodities. The group was awarded the 2019 National Excellence in Multistate Research Award in recognition of their outstanding collaborative research, development, and education efforts, which will continue to improve food safety and reduce the risk of foodborne illness for years to come.

Project Funding and Participation:
S1056 Enhancing Microbial Food Safety by Risk Analysis (2013-2018) was funded in part by the Multistate Research Fund through USDA-NIFA and by grants to project members. Since 2015, the project has acquired robust external funding of at least $12 million due to leveraging across multiple institutions. Participating institutions include: Auburn University, University of Arkansas, University of Arkansas–Pine Bluff, California Cooperative Extension, University of California–Davis, Clemson University, Colorado State University, University of Connecticut-Storrs, Cornell University-Geneva, Cornell University, University of Delaware, University of Florida, University of Georgia, Idaho Cooperative Extension, University of Illinois, Purdue University, Iowa State University, Kansas State University, University of Kentucky, Louisiana State University, LSU Agricultural Center, University of Maine, Maine Cooperative Extension, University of Maryland, University of Massachusetts, Michigan State University, University of Minnesota, Mississippi State University, University of Missouri, University of Nebraska, Rutgers University, New Mexico State University, New Mexico Cooperative Extension, North Carolina State University, North Dakota State University, Ohio State University, Oregon State University, Pennsylvania State University, University of Puerto Rico, University of Rhode Island, University of Tennessee, Texas A&M University, Texas AgriLife Research, Virginia Polytechnic Institute and State University, Washington State University, Wayne State University, University of Wisconsin, and University of Wyoming. The project was renewed through 2023 under project number S1077. Learn more: ***https://www.nimss.org/projects/14836***

S1056 group members on a tour of an oyster farm (left) and produce farm (right) in Rhode Island.