Enhancing Microbial Food Safety by Risk Analysis

About 48 million cases of foodborne illness occur each year in the U.S. In addition to sickness and death, foodborne illnesses are costly for individuals and food companies. Preventing foodborne illnesses is possible, but difficult. A wide variety of constantly evolving viruses, bacteria, fungi, and parasites can cause harm, and contamination can occur at any point in the food system.

Since 2000, a team of multidisciplinary researchers and Extension professionals from 39 land-grant institutions has conducted risk-based research, education, and outreach to improve food safety from farm to table.

By collaborating across state lines and disciplines and working closely with growers, the food industry, consumers, government agencies, and others, project members are able to tackle a wide range of pathogens, food types, and points in the food supply chain. Establishing formal collaborations under the umbrella of a single goal helps project members share resources and access funding. With members across the U.S., the project is also able to widely share findings and recommendations.

Collaboration has led to a better understanding of food safety risks and inventive strategies that can help prevent or manage threats before they become dangerous and costly. This work will contribute to the long-term profitability and sustainability of the food industry and the health and safety of consumers.

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Learn more: mrfimpacts.org

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Research Highlights (2019-2023)

Project members studied pathogen behavior, characterized risks to human health, and developed ways to predict, detect, track, and manage pathogens at various points of food production. For example, project members:

- Worked together to standardize protocols among laboratories so that research results can be more easily and directly compared.
- Led a team evaluating the power of sampling and testing plans throughout various produce supply chains (University of Illinois).
- Evaluated the potential for common produce processing methods to result in cross-contamination (University of Massachusetts).
- Collaborated with the Tennessee Department of Health on whole genome sequences to aid with detection and tracking (University of Tennessee).
- Identified routes of preharvest pathogen contamination in wild blueberries, edible seaweed, and other fresh produce commodities in the Northeast (University of Maine, University of Delaware, University of Vermont, FDA).
- Evaluated *Salmonella* survival in flour and home-made play-dough (Rutgers University).
- Quantified the presence and spread of *Salmonella* via winged insects in poultry production systems (Texas A&M University).
- Developed detection tools for pathogens in raw poultry products (University of Wyoming).
- Demonstrated that prior exposure to a commercially produced culture reduced *Salmonella* virulence and protected against infection (University of Connecticut).
- Found that women of reproductive age with high consumption of maize-based foods are at risk of having a child with Neural Tube Defects due to fumonisin exposure (The Ohio State University).
- Identified possible risks associated with veterinary drug residues in cattle and recommended sampling plans to reduce contamination of meat and milk (Virginia Tech).
- Worked on ways to manage risks of *Salmonella* in the beef and pork production chain (Kansas State University).
- Developed technology and best practices to minimize food safety risks associated with hydroponics (Louisiana State University).
- Assessed the impact of vacuum steam pasteurization on pathogens in wheat grain (Michigan State University).
- Investigated the efficacy of commonly used sanitizers and disinfectants as well as novel formulations and techniques for reducing pathogens on food surfaces, equipment, and other facility surfaces, including: a titanium dioxide coating to reduce *E. coli* and *Staphylococcus aureus* on stainless steel surfaces (University of Missouri); superhydrophobic coatings that can be applied to hardwoods to reduce pathogen retention by 65-75% compared to untreated wood (Texas A&M University); a plant-derived encapsulated antimicrobial coating that reduces the number of pathogens on tomato surfaces; packaging films that are effective against Shiga toxin-producing *E. coli* (University of Missouri); UV-C and LED light to inactive pathogens on surfaces in food processing facilities (Kansas State University, University of Tennessee); food-grade sanitizers for refrigerator waterlines and microbrewery sanitation (Clemson University); grape seed extract and sodium bisulfate for pathogen control on food products (University of Wyoming); microbubble treatments that can detach *Listeria* from the surface of raw cucumbers and avocados (Virginia Tech).

Antimicrobial resistance is a major challenge for the food industry. Researchers studied the potential for various foodborne pathogens to develop resistance to common sanitation regimens used in food production (University of Massachusetts) and assessed the role of environmental factors on antimicrobial resistance and associated genes in bacteria (University of Wyoming).

To improve food safety knowledge and practices, project members provided learning materials and experiences for scientists and educators, the food industry, and consumers. For example, members:

- Conducted interviews with small food processors and food safety inspectors, providing insight on knowledge gaps, which helps develop appropriate communication strategies (Purdue University).
- Trained educators, Extension personnel, and others on food safety topics and teaching approaches to ensure they are using effective strategies to share accurate information.
- Helped farmers conduct risk assessments and create food safety plans that comply with FDA and USDA regulations (UConn Extension, University of Maine, University of New Hampshire, Southern Center, Texas A&M University, Louisiana State University, University of Rhode Island).
- Delivered a workshop in Ethiopia in which representatives from government, academia, and industry identified foodborne hazards and categorized them as high, medium, or low risk (The Ohio State University).
- Designed a fun, interactive game to convey food safety concepts (New Mexico State University, University of Massachusetts, Iowa State University).
- Provided food safety trainings and events focused on: composting and farmers markets (Louisiana State University); early stage food entrepreneurs, growers processing food in on-farm kitchens, and home food preservation (University of Rhode Island); backyard chicken farmers (University of Vermont); sanitation and sanitary equipment design for growers using specialized harvesting equipment (University of Maine Cooperative Extension in collaboration with The Northeast Center to Advance Food Safety).

Research is guiding food safety policy. For example, project members helped:

- Develop FDA guidance for applying raw and composted manure and requirements that protect produce from contaminated irrigation water (Louisiana State University).
- A team of scientists (led by the Food and Agriculture Organization and the World Health Organization) produce a comprehensive guidance document on Food Microbiological Risk Assessment (Rutgers University).

Many project members focused on Covid-19 in food production systems (University of Nebraska-Lincoln, University of Florida, Rutgers University, Texas A&M University, Kansas State University, North Carolina State University, University of Arkansas). Researchers also analyzed SARS-CoV-2 risk in food service facilities and evaluated use of steam treatments to eliminate the virus (Clemson University). Other work enhanced detection technology and assessed the risk of spillover from wastewater treatment plants to wildlife systems to food systems (University of Wyoming). Project members worked together to produce educational materials and guidelines to minimize the risk of SARS-CoV-2 in the food system.