

S1077 – 2025 ANNUAL REPORT

Project/Activity Number: S1077

Project/Activity Title: Enhancing Microbial Food Safety by Risk Analysis

Period Covered: October 2024 to October 2025

Date of This Report: November 13, 2025

Annual Meeting Date(s): October 1-2, 2025

Annual Meeting Participants: Amanda Philyaw Perez (Arkansas), Abhinav Mishra (Georgia), Pratik Banerjee (Illinois), Byron Chaves (Nebraska), Christina Allingham (Massachusetts), Clint Stevenson (North Carolina State), Doris D'Souza (Tennessee), Francine Giotto (New Mexico State), Juan Moreira Calix (Colorado State), Maria Plaza (Puerto Rico), Matheus Cezarotto (New Mexico State), Matthew Taylor (Texas A&M), Azlin Mustapha (Missouri), Nicole Richard (Rhode Island), Pamela Martinez (New Mexico State), Stephan Schmitz-Esser (South Dakota State), Shihyu Chuang (Massachusetts), Steven Bowden (Minnesota), Valentina Trinetta (Kansas State), Yaohua Feng (Purdue), Kristen Gibson (Arkansas), and Ahmed Abdelhamid (Michigan State)

Annual Meeting Minutes Summary: A quorum was established, and the meeting was called to order at 11:00 a.m. The outgoing officer team was recognized, and leadership transitioned with Valentina Trinetta assuming the role of Chair and Nicole Richard becoming Vice Chair. A new Administrative Advisor was also welcomed. The group reviewed unfinished business related to creating a peer-reviewed repository for educational materials such as case studies and lab manuals. Potential hosting partners include IFPTI, NECAFS, and the Western Regional Center. Key considerations include peer review, accessibility requirements, and copyright. Nicole Richard and Clint Stevenson will follow up with NECAFS and IFPTI to evaluate platform options. In new business, members discussed upcoming reporting deadlines and clarified that only lead PIs should submit publications and grants to avoid duplication. Plans for future meetings included an offer to host the 2026 meeting at Texas A&M, featuring access to research and industry infrastructure. The group also emphasized integrating professional development sessions into future gatherings, with suggested topics including budgeting, mentorship frameworks, student recruitment, conflict management, and strengthening interdisciplinary collaboration. The meeting adjourned at 11:37 a.m., with the new Chair identifying expanded participation and resource-sharing as key objectives moving forward.

ANNUAL REPORT¹

1. PROJECT ACCOMPLISHMENTS

a. Short-Term Outcomes

Across the S1077 project, partners achieved strong and measurable short-term benefits through training, research, technology development, and stakeholder engagement. HACCP, FSMA, and sector-specific food safety trainings delivered across multiple states produced substantial gains in participant knowledge and confidence. One member documented increases in understanding of HACCP principles from 62% to 87%, familiarity with plan development from 53% to 85%, and confidence from 53% to 83% (all $p < 0.01$). Follow-up evaluations showed that 71% of participants improved sanitation, recordkeeping, and monitoring practices, while 80% passed regulatory audits and enhanced compliance and product quality. Approximately 29% of businesses accessed new markets, reporting economic gains of \$500–\$10,000, and many reduced consultant costs by roughly \$3,000 per HACCP plan. Additional national training efforts in Produce Safety, Preventive Controls, and HACCP expanded certification capacity and supported a trained instructional workforce.

¹ The report includes input from project members beyond those who attended the annual meeting.

Project research also generated actionable data that strengthened food safety practices in commercial, on-farm, and community settings. Needs assessments identified food safety capacity gaps among donation stakeholders, while studies of pasteurized milk (n=192) demonstrated effects of brand and temperature on spoilage microbiota dominated by *Pseudomonas*, *Paenibacillus*, *Streptococcus*, *Bacillus*, and *Yersinia*. An educational intervention with food bank clients increased shelf-life and refrigeration knowledge (median scores from 33% to 67%). On-farm assessments led to procedural changes among 30 growers, and additional research produced risk-relevant data on STEC and Salmonella in pork, backyard poultry, *Campylobacter* depuration in oysters, and pathogen ecology in specialty mushrooms.

S1077 researchers advanced multiple technologies that improved food safety intervention efficiency. UV-C LED and UV-sanitizer systems validated for postharvest processing were shared with more than 90 farmers, demonstrating potential to reduce sanitizer and water use. Additional technologies, including saturated steam treatments, UV-assisted produce washing, phage-based biosensors, antimicrobial packaging, PCR assays, and improved refrigerator water line cleaning, showed strong promise for practical adoption.

Risk assessment activities delivered high-value datasets for regulatory and industry use, including work on SARS-CoV-2 spillover risk, microbial ecology in meat and poultry facilities, and effective chlorine concentrations for norovirus control in agricultural water. Modeling studies revealed that commercial salami fermentation cultures did not reduce *Salmonella* or STEC, identifying critical gaps in existing process assumptions.

Risk management support directly benefited industry stakeholders. Predictive microbiology tools guided decisions for approximately 35 companies facing HACCP deviations, preventing unnecessary rework or product destruction. Additional support aided beef producers in managing AMR *Salmonella* risks from fly transmission and helped growers adopt rainwater harvesting and other on-farm mitigation practices. Technology transfer and instructional activities strengthened research capacity through graduate student training and dissemination of emerging topics via VR tours, social media analyses, consumer surveys, eye-tracking research, and digital platforms such as ProduceTRAINer and iTips. These resources reached thousands of users across formal and informal learning environments.

Overall, the project's short-term outcomes demonstrate substantial advances in food safety knowledge, regulatory compliance, technology adoption, and risk-based decision-making, delivering validated tools and evidence-driven education that improved public health protection and reduced economic losses.

b. Outputs

The project generated a diverse portfolio of research, educational, and extension products. Training-related outputs included multiple HACCP and seafood safety workshops delivered in online, hybrid, and in-person formats to more than 40 participants. These programs produced slide decks, case studies, hands-on exercises, participant manuals, updated templates, sanitation tools, verification forms, and microcredential modules aligned with FDA FSMA and Seafood HACCP Alliance guidance. Training datasets documented knowledge and confidence gains and were summarized in evaluation reports.

Research outputs included peer-reviewed publications, theses, dissertations, abstracts, posters, and oral presentations covering topics such as *Listeria* stress responses, *Salmonella* ecology,

biofilms, enteric virus inactivation, antimicrobial packaging, and environmental transmission of antimicrobial-resistant *Salmonella*. Several laboratories produced MS and PhD theses, honors projects, and conference contributions, as well as patent applications for Listeria control through photocatalytic and single-atom catalyst packaging films.

The project produced multiple publicly accessible datasets, models, and analytical tools, including AI/ML code and labeled TikTok datasets for infant-feeding analysis; microbial kinetics and risk models for salami fermentation and preharvest water disinfection; microbial source-tracking datasets; and Zenodo-hosted chlorine inactivation and oyster cooking datasets. Additional datasets addressed powdered infant formula handling, consumer responses to food safety documentaries, chatbot performance, and 3D-printed food safety risks.

Extension and digital communication products were extensive. Project teams developed websites such as LSU AgCenter's "Freeze-Drying at Home," iTips Food Safety, ProduceTRAINer, and the Market Set Go! farmers' market game, many available in English and Spanish. These sites supplied decision tools, videos, FAQs, interactive modules, and educator resources. Additional outputs included fact sheets, seaweed safety guidance, VR modules, 2-D learning tools, eye-tracking datasets, Extension YouTube content, and the *_food_guardian* social media campaign. Members also produced USDA and NSF reports, regional guidance documents, commodity-specific safety manuals, and contributed leadership within produce safety coordination centers.

c. Activities

S1077 participants led a broad range of research, training, and extension activities across the food system. Teams delivered HACCP, Preventive Controls, produce safety, seafood safety, GMP, sanitation, environmental monitoring, retail validation, and entrepreneur-focused trainings in multiple states in partnership with AFDO, PSA, FSMA regional centers, and universities. These courses incorporated assessments, hands-on exercises, case studies, and updated tools that provided thousands of stakeholders with practical skills for regulatory compliance and risk-based process control.

Laboratory and pilot-scale research activities applied microbiological, molecular, and materials science methods to advance knowledge of pathogen survival and control. Studies examined antimicrobial packaging, photocatalytic films, nanocellulose and phytocatalysts, nano-curcumin safety, UV-C/UV-LED virus inactivation, antimicrobial films for low-moisture foods, steam/UV sanitizer treatments, disinfectant wipes, phage-based interventions, and plant-derived antimicrobials. Additional experiments evaluated protective cultures, bacteriophages, and novel antimicrobials against multiple pathogens, as well as microbial outcomes for mushrooms, freeze-dried fruits, and poultry under varied stress conditions.

Field and observational studies occurred across produce farms, packinghouses, meat and poultry facilities, seafood systems, and wildlife-associated environments. These included sampling in strawberry and blueberry production, soil and environmental microbiome characterization linked to Listeria persistence, supply-chain contamination studies, and evaluations of sanitation and peroxyacetic acid treatments in tree fruit and poultry.

Social science and analytics activities included human coding of >3,400 TikTok videos, machine learning and NLP tool development, sentiment and network analysis, caregiver and client surveys, focus groups, eye-tracking studies, VR evaluations, systematic literature reviews, farm tour modules,

and documentary impact assessments. Teams also tested AI chatbots for accuracy in consumer food safety communication.

Members supervised students, coordinated multistate efforts, engaged industry partners, performed comparative genomics, developed kinetic models, conducted qualitative interviews, evaluated digital tools under IRB protocols, and led professional committees, workshops, and webinars at multiple scales.

d. Milestones

Training milestones included delivery of multiple HACCP, seafood safety, produce safety, GMP, sanitation, and environmental monitoring courses supported by new curricula, SOPs, templates, and evaluation tools. Pre- and post-assessment systems were standardized across states, enabling consistent measurement of knowledge gains and behavioral intent.

Research milestones included completing laboratory experiments on antimicrobial packaging, UV-C/UV-LED inactivation, laminated films, phytocatalytic interventions, nanocellulose materials, disinfectant wipes, protective cultures, bacteriophages, and plant-derived antimicrobials. Method optimization, surrogate validation, pilot-scale transitions, model development, and initial data analyses were achieved. Field milestones included multi-site sampling across produce, meat, poultry, seafood, and wildlife systems, as well as environmental microbiome characterization.

Social science milestones included completion of surveys, focus groups, eye-tracking studies, VR pilot tests, documentary evaluations, and coding of over 3,400 TikTok videos. Machine learning and NLP pipelines reached operational status. VR and interactive 2-D tools completed pilot testing and IRB evaluations, showing strong engagement.

Collaborative milestones included multi-institutional systematic reviews, new industry partnerships, cross-state training networks, regulatory collaborations, USDA and NSF reporting, and contributions to regional and national guidance documents.

2. PROJECT IMPACTS

Project activities generated substantial economic, social, and public health benefits. HACCP and food safety trainings increased regulatory compliance across processors, farmers, and distributors; 80% of participating seafood businesses passed audits, 71% improved sanitation and monitoring, and 29% accessed new markets generating \$500–\$10,000 in additional revenue. Reduced reliance on consultants saved roughly \$3,000 per HACCP plan and decreased product loss by 20%. Research on microbial ecology, materials science, virus inactivation, packaging, and pathogen control improved risk management for milk, cheese, poultry, produce, nuts, mushrooms, seafood, and low-moisture foods. Social science work strengthened communication with caregivers, consumers, and food donation stakeholders. Digital and VR tools improved workforce training and supported modern risk communication strategies.

The project attracted substantial new funding through USDA Hatch, NIFA AFRI, Sea Grant, Board of Regents, federal cooperative agreements, and industry-supported research. Awards ranged from \$20,000 to more than \$800,000 and supported work on pathogen control, UV-photonic interventions, antimicrobial coatings, seafood safety, oyster depuration, sanitizer optimization, consumer training, cottage food safety, and environmental microbial risk reduction. Multiple laboratories received multistate Hatch support (2024–2028) for microbial risk reduction and emerging pathogen work. Additional federal and commodity funding from USDA FSIS, NSF, AMS, the National Pork Board, the

Hughes Center, and the Kansas Sorghum Commission advanced applied microbiology and materials science. These impacts demonstrate the project's ability to improve food safety systems and catalyze external investment in high-priority risk assessment, management, and communication.

In the next reporting period, the committee will continue coordinated research, training, and extension activities with a focus on completing ongoing laboratory studies, expanding predictive microbiology and risk modeling resources, and strengthening technology transfer through digital platforms, VR modules, and training tools. Additional plans include refining assessment systems across states, completing multi-site field sampling efforts, and generating new risk-relevant datasets to support regulatory and industry decision-making.

The committee also plans to expand cross-institutional collaborations, strengthen engagement with industry partners and regulatory agencies, and support graduate student development through coordinated mentorship, research exchanges, and involvement in multistate project activities.

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