United States Department of Agriculture
Project Initiation

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Project Title

Advancing Produce Safety through Capacity Building in Metagenomics Research and Training

Project Details

Sponsoring Institution National Institute of Food and Agriculture	**Project Status** ACTIVE
Funding Source NIFA Non Formula	**Grant Year** 2026
Grant No. 2026-70001-46300	**Cumulative Award Amt.** $150,000.00
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Program Code [NLGCA] Capacity Building Grants for Non Land Grant Colleges of Agriculture	

Project Director

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Recipient Organization

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Performing Department

(N/A)

Non Technical Summary

Foodborne illness linked to fresh produce is a persistent public health challenge in the United States. Salmonella enterica alone causes over 1.35 million infections annually, with a substantial share attributed to contaminated fruits and vegetables. Conventional pathogen detection methods are effective for known strains but frequently fail to identify stressed or emerging threats within the complex microbial communities found on fresh produce. Regional weather patterns and agricultural practices add further variability, limiting the reliability of standard food safety protocols across production environments. This project addresses these gaps by applying metagenomics a DNA-based technology that analyzes all microbial life in a sample simultaneously to fresh spinach at multiple points along the production chain. The research will characterize how native microbial communities interact with Salmonella, assess how temperature and humidity fluctuations during storage and transport affect pathogen survival, and use these findings to develop practical guidance for growers, packers, and food safety professionals. Beyond the laboratory, the project will train the

next generation of food safety scientists through hands-on research experience, equipping students with high-demand technical skills in metagenomics and microbial analysis. Outcomes will strengthen produce safety systems, improve cold chain management practices, and expand the nation's technically skilled food safety workforce.

Animal Health Component

Animal Health Component: 0%

Research Effort Categories

Basic	40%
Applied	60%
Developmental	0%

Classification

Knowledge Area (KA)	Subject of Investigation (SOI)	Field of Science (FOS)	Percent
712	1430	1070	60%
503	1499	1040	40%

Knowledge Area

[712] Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

[503] Quality Maintenance in Storing and Marketing Food Products

Subject Of Investigation

[1430] Greens and leafy vegetables (includes endive, lettuce, spinach, turnip-greens, celery,rhubarb, parsley, asparagus)

[1499] Vegetables, general/other

Field Of Science

[1070] Ecology

[1040] Molecular biology

Keywords

Characterization, Food Safety, Foodborne Pathogens, Metagenomics, Produce, Salmonella

Goals / Objectives

Characterize the interactions between native microbial communities and Salmonella on spinach during different production and processing stages: This objective aims to identify and characterize the native microbial species on fresh produce at different stages of crop development that either promote or inhibit Salmonella persistence. By understanding these microbial interactions, we can determine potential microbiome-based strategies for reducing Salmonella contaminationEvaluate the impact of temperature and humidity fluctuations on Salmonella viability and microbial community dynamics on spinach: This objective will investigate how variations in storage and transport

conditions, specifically temperature and relative humidity, affect Salmonella survival, virulence, and the composition of microbial communities on produce. Findings will offer insights into optimal conditions for minimizing pathogen risk in the fresh produce supply chain.Provide comprehensive student training through hands-on experiential learning, guest lectures on cutting-edge advancements in food safety, and targeted professional development opportunities: This objective will equip students with skills in metagenomics, bioinformatics, and food safety research, preparing them for careers in food safety and quality.

Project Methods

Fresh spinach samples will be collected at pre-harvest, harvest, and post-processing stages from a collaborating farm and analyzed using 16S rRNA gene sequencing on the Oxford Nanopore MinION or other suitable platform to characterize bacterial community composition. Salmonella levels will be quantified in parallel using selective culture methods and confirmed by qPCR targeting the invA gene. Environmental stress experiments will expose inoculated spinach to controlled temperature and humidity combinations simulating real storage and shipping conditions. Community composition data will be analyzed using QIIME2, Phyloseq, and DESeq2; Salmonella survival data will be analyzed using ANOVA and first-order kinetic models. Findings will be shared with growers, packers, and food safety professionals through publications and conference presentations, and integrated into graduate and undergraduate coursework at UTRGV. Project success will be evaluated against four measurable indicators: (1) successful sequencing and analysis of spinach microbiome samples across all three production stages by end of Year 1; (2) submission of at least two peer-reviewed manuscripts by end of Year 2; (3) graduation of one MS student and completion of training for two undergraduate students, assessed through thesis defense, protocol competency evaluations, and symposium presentations; and (4) delivery of at least one workshop or conference presentation reaching food safety professionals or producers.