California Department of Food and Agriculture
2012 Specialty Crop Block Grant Program

Research - Food Safety

Regents of University of California, Davis Center for Produce Safety ***$231,485***

Title: Novel coating systems with sustained release of food antimicrobials to improve safety of cantaloupe

Abstract: The Center for Produce Safety (CPS) will partner with the University of Tennessee to explore novel antimicrobial coating systems. The netted surface of cantaloupes provide harborage sites for pathogens that are protected from washing and sanitizing and can continue to proliferate during storage. Antimicrobial coatings can potentially improve microbial safety and quality of cantaloupes but have not been studied extensively. Application of antimicrobials is complicated because they can be absorbed by components of cantaloupes which could reduce their activity. Sustained release of antimicrobial compounds from coatings is needed to maintain sufficient quantities to inhibit microorganisms on rinds. Researchers propose to study novel antimicrobial coating systems to improve the safety and quality of cantaloupes. The team will use plant-based food antimicrobials, essential oils, to develop systems that can overcome barriers to diffuse into cavities on cantaloupe surfaces and continuously release antimicrobials. The technology will maintain the visual appearance of cantaloupes and reduce moisture loss during storage. Specific research objectives are proposed to develop such technology and characterize physical and antimicrobial properties of coatings, as well as impacts on the quality of cantaloupes. This novel technology can be applied to other melons and fresh produce products for enhanced microbial safety and quality.

Regents of University of California, Davis Center for Produce Safety ***$99,323***

Title: Science-based evaluation of risks associated with wildlife exposure for contamination of irrigation water by *Salmonella*

Abstract: The Center for Produce Safety (CPS) will partner with the University of Florida to explore risks to human health from *Salmonella enterica* from various wildlife reservoirs. Different *Salmonella* strains appear to be associated with different animal host species and represent a range of disease potential in humans. This project will define genetic diversity among strains recovered from wildlife sources and determine their relationship to strains recovered from water and sediment sources in irrigation ponds in a produce production region of the southeastern United States. The disease potential of these strains will be evaluated by integrating various strain collections using polymerase chain reaction-based (PCR) rapid diagnostics, Centers for Disease Control PulseNet fingerprinting analysis, and deoxyribonucleic acid (DNA) sequencing of selected virulence-associated genes. This project will link eventually with a Food and Drug Administration effort to establish genetic markers that define the regional distribution of *Salmonella* for the purpose of source tracking. The results will shed light on wildlife-associated risks, providing science-based data for implementation of agricultural management practices designed to reduce exposure of irrigation water to wildlife. Outcomes may provide more rapid and accurate assessment of food products implicated in outbreaks and prevent broad-based recalls that impact the specialty crop industry.

Regents of University of California, Davis Center for Produce Safety ***217,273***

Title: Avirulent *Salmonella* strains and their use to model behavior of the pathogen in water

Abstract: The Center for Produce Safety (CPS) will partner with the University of Florida to generate suitable surrogates that could be used to safely model persistence of *Salmonella* in the pre- and post-harvest environment. Such surrogates can then be used for field experiments on the effectiveness of different production practices and post-harvest treatments in reducing *Salmonella.* Coliforms and other indicator organisms are poor predictors of behavior of human pathogens (like *Salmonella*, pathogenic

Escherichia coli (*E. coli)* and *Listeria*) in the crop production environment. The research team will develop safe strains of *Salmonella* (derived from isolates recovered from produce-linked outbreaks) suitable for environmental release. These strains will lack virulence genes and plasmids, they will not be able to acquire virulence plasmids, nor carry antibiotic resistance genes. The safety of these strains will be validated in mouse and chick models. To establish whether these safe surrogate strains behave similarly to their virulent parents in the environment, their fitness will be tested under conditions that mimic pre- and post-harvest treatment of produce. Once the biological safety and environmental fitness of these strains is established, detection protocols will be designed to ensure that the surrogate strains do not trigger false-positive responses, yet are easy to identify.

Regents of University of California, Davis Center for Produce Safety ***$280,071***

Title: Genomic elucidation of the physiological state of enteric pathogens on pre-harvest lettuce

Abstract: The Center for Produce Safety will partner with Cornell University to explore how agents of foodborne disease present in the pre-harvest environment can contaminate produce and enter into the food supply. The methods used by these pathogens to survive on pre-harvest produce have the potential to impact survival of the pathogen during post-harvest processing. The purpose of this work is to determine how the enteric pathogens enterohemorrhagic *Escherichia coli* (EHEC) and *Salmonella* respond to the pre-harvest environment by monitoring changes in gene expression under growth conditions representing those occurring during different harvest seasons. Changes in gene expression will be used as an indicator of the physiological state of the pathogen under different conditions. The physiological state of the pathogen plays a significant role in its ability to survive subsequent stresses, such as decontamination treatments and stresses encountered during distribution. Understanding how these pathogens survive on plants is the first step in mitigating the presence of these pathogens in the food supply. Data resulting from this research determining how pre-harvest conditions impact the ability of EHEC and *Salmonella* to survive in the food chain will provide insights for developing effective post-harvest treatments to reduce consumer exposure to these pathogens via produce.

Regents of University of California, Davis Center for Produce Safety ***$194,770***

Title: Practical validation of surface pasteurization of netted melons

Abstract: Since 1990 cantaloupes have been associated with thirty-six outbreaks and pathogenbased recalls recorded in the public health database. Preventive controls are viewed as the best strategy to combat this burden on consumers and public health, the general economy, and the sustainability of this important fruit category. This project will seek to translate wellestablished laboratory findings that support the effectiveness of hot water pasteurization of cantaloupe and other nettedrind melons into a validated and verified process. This research will be conducted in controlled experimental farm and model process studies and at newly constructed, essentially identical, rind pasteurization and disinfection lines in major commercial facilities in California and Arizona across two growing seasons. The outcome of these studies, using a combination of applied environmentally fit and adapted bacterial strains and native indicator bacteria common to all melon production fields, will assist in the design and implementation of preventive controls and postharvest interventions for netted melons. This research data is viewed by a diverse group of stakeholders as vital to establish meaningful and verifiable food safety control measures to regain and enhance consumer confidence so badly shaken by the listeriosis outbreak of 2011.

Regents of University of California, Davis Center for Produce Safety ***$85,758***

Title: Rapid assessment of oxidative stress induced in microbes to evaluate efficacy of sanitizers in wash water

Abstract: The overall goal of this research proposal is to develop a rapid assessment approach to measure antimicrobial efficacy of sanitizers in wash water. The proposed rapid assessment approach is based on a direct measurement of oxidative stress induced in microbes upon exposure to sanitizers and its correlation with reduction in microbial count. The central hypothesis of the proposed research is that the microbes labeled with cell permeable spin probes will provide a rapid assessment of oxidative stress induced by diverse sanitizing agents and the oxidative stress in the microbes is a sensitive indicator of microbial death induced by sanitizers. The results of this research will lead to (1) a novel approach to rapidly assess the antimicrobial efficacy of diverse sanitizers in the presence of organic load based on direct measurement of oxidative stress in microbes; (2) an evaluation of the differences in oxidative stress response of pathogenic and non-pathogenic organisms induced by sanitizers and their correlations with reduction in microbial count; (3) demonstrate that the proposed assessment approach to evaluate antimicrobial activity of wash water does not require measurement of organic load levels in wash water, thus can lead to a direct measurement of antimicrobial efficacy of sanitizers.

Regents of University of California, Davis Center for Produce Safety ***$252,777***

Title: Reducing the risk for transfer of zoonotic foodborne pathogens from domestic and wild animals to vegetable crops in the Southwest desert

Abstract: This study will help the leafy greens produce industry identify domestic and wildlife animal reservoirs of shiga toxin-producing *Escherichia coli* (STEC) and *Salmonella* in the desert southwest growing region (DSGR) of the United States and northern Mexico, a region second only to the central California coast in lettuce production. Additionally, the study will identify management and risk mitigation practices that reduce contamination of leafy greens by these species. Scientific collections and epidemiologic methods will be used to complete three main objectives: 1) Determine if terrestrial and avian wildlife species reported by the local growing community to most frequently intrude upon produce fields in the DSGR, are reservoirs of STEC and *Salmonella*; 2) Determine the extent to which wildlife and livestock share genetically related strains of STEC and *Salmonella* and measure the movement of strains from livestock operations to produce fields by wildlife populations; 3) Extend knowledge to growers of produce contamination prevention gained from the first two objectives. Data from this collaborative study between industry, game management, and academic organizations will fill gaps in knowledge pertaining to animal intrusions and establishing buffer zones between adjacent livestock and produce operations in the desert environment.