Portfolio Annual Report 2008: Food Safety

United States Department of Agriculture
Cooperative State Research, Education, and Extension Service
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Portfolio Planning

Portfolio Mission

The Food Safety Program supports research, education and extension activities at public and private partner institutions to reduce/eliminate food borne pathogens in the food chain by providing leadership in determining the direction and administering grant funding for such activities.

Portfolio Vision

Pathogenic microorganisms and their toxic products, chemical residues, and natural toxins in foods consumed in the US are at lower than infectious doses that cause food borne illness.

Portfolio Introduction

While the food supply in the United States is one of the safest in the world, the Center for Disease Control (CDC) estimates that 76 million people get sick, more than 300,000 are hospitalized, and 5,000 Americans die each year from food borne illness. Preventing food borne illnesses and death remains a major public health challenge. The nation's food system(s) are large and highly complex, which increases the difficulty in addressing this societal issue. It also mandates government involvement.

In 1997 in response to increased concerns about food borne illnesses, President Clinton introduced the Food Safety Initiative (FSI). The initial focus and goal of FSI was to reduce the number of illnesses caused by microbial contamination of food and water. The responsibilities for different aspects of food safety are necessarily shared among various government agencies. Consequently, there is a need for close coordination of activities. The initiative stimulated the formation of numerous task forces, committees, initiatives, and funding incentives over the following years. Some of the actions included major reports and recommendations on food safety in the U.S. such as "Food Safety from Farm to Table: A National Food Safety Initiative - A Report to the President, a report of the National Academy's findings "Ensuring Safe Food from Production to Consumption", and the Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables. Other activities included the formation of many national and interagency task forces and working groups such as the Joint Institute for Food Safety Research, the Risk Assessment Consortium, and the National Food Safety System. Major initiatives included the implementation of the 1996 Pathogen Reduction and Hazard Analysis and Critical Control Point (HACCP) rule, which was passed to help reduce microbial pathogens in processing plants and to clarify federal and industry roles. The culmination of these efforts was the signing of the National Strategic Food Safety Plan in January 2000. The broad goal of the strategic plan was "the protection of public health by significantly reducing the prevalence of food borne hazards through science-based and coordinated regulations, surveillance, inspection, enforcement, research, and education programs."

The plan also established an outcome measurement. The goal by 2004 was a 25% decline in the incidence of the most common food borne illnesses and a 50% reduction in residues of carcinogenic and neurotoxic pesticides on foods. In 2002, The Food Safety Council became the Presidential Food Safety and Security Council, which was redefined to include the threat of bioterrorism. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 has changed the focus of some activities and initiatives. See (http://www.fda.gov/oc/bioterrorism/bioact.html). During the time period of the current peer review, several research, outreach, and educational initiatives within CSREES continued to address the need for new information to be able to make decisions based on sound science. These new programs included the National Integrated Food Safety Initiative (NIFSI) and the Epidemiologic Approaches in Food Safety Initiative. Centers for Disease Control and Prevention provided preliminary data on the estimated prevalence of food borne illness caused by major pathogens, up to 2007. Compared with 2004-2006 data, the estimated incidence of infections caused by *Campylobacter, Listeria*, Shiga toxin-producing *Escherichia coli* O157 (STEC O157)*, Salmonella, Shigella, Vibrio,* and *Yersinia* did not change significantly, and *Cryptosporidium* infections increased. CDC further noted that the progress toward the targets for Healthy People 2010 national health objectives and targets regarding the incidence of foodborne infections occurred before 2004; however, none of the targets were reached in 2007. *Salmonella* incidence was the farthest from its national health target, suggesting that reaching this target will require new approaches (CDC 2008, MMWR, 57(14): 366-370).

In the past decade food borne illness, resulting from the consumption of fresh and fresh-cut produce steadily increased and has been the second most prevalent food borne illness. In 2006, Utah and New Mexico health departments investigated a multistate cluster of Escherichia coli O157:H7. A case–control study of 22 case-patients found that consuming bagged spinach was significantly associated with illness ($p<0.01$). The outbreak strain was isolated from 3 bags of 1 brand of spinach. Nationally, 205 persons were ill with the outbreak strain (Grant et. al. Emerg Infect Dis. Oct; 2008), This incidence and recent salmonellosis outbreak resulting form the consumption of Serrano peppers www.fda.gov) , attracted the attention of consumers, producers of fresh produce, and regulators alike. Clearly, there is a trend towards increasing outbreaks of food borne illnesses caused by the consumption of contaminated fruit and vegetables. CSREES noted the trend in 2005 and started funding this area as emerging priority.

Food Safety Program at CSREES presently undertakes following seven interrelated approaches in implementing its mission:

1. Generation of basic knowledge: The Food Safety Program seeks to enhance the knowledge of mechanisms of pathogenesis in food borne illness eventually aimed at risk mitigation measures. Examples of research include, but are not limited to: investigations of vector-based transmission of pathogens, toxins and contaminants; development of novel vaccines; molecular and biochemical approaches to understanding the genetic and physiological mechanisms influencing pathogen virulence; model development to predict aspects of food production and processing wherein mitigation will be most effective;

socioeconomic factors affecting food safety; and genetic modification of crops to mitigate toxin producing microorganisms.

2. Epidemiological Approach: The Food Safety Program seeks to enhance epidemiological methods available for the study of food-borne diseases and other public health issues in order to understand the occurrence, transmission, distribution, persistence, and risk and levels of food-borne pathogens across the continuum of the food system, and providing recommendations for specific intervention strategies/prevention and control programs for food-borne disease and antimicrobial resistance. Examples of research include, but are not limited to: Novel epidemiologic that will provide the ability to evaluate the impact of intervention or management strategies on microbial contamination or food safety; innovative studies to quantify the effectiveness of new or existing interventions or management strategies in reducing pathogen loads across farm-to-fork; and innovative studies which seek to identify new risk factors or quantitative evaluation of existing risk factors that may affect prevalence, transmission, or persistence of food-borne organisms across the farm-to-fork continuum.

3. Integrated Approach: This approach is taken through the National Integrated Food Safety Initiative (NIFSI) which supports food safety grants that integrate research, education and extension to solve problems in applied food safety issues driven by stakeholders from farm to fork. Examples of activities supported include, but are not limited to: Providing food safety education and training for consumers of all ages, including those at increased risk for foodborne illnesses; providing food safety education, training, and certification for farmers, industry, and retail, including small farm direct-food-sales vendors and processors; improving the safety of fresh and fresh-cut fruits and vegetables; filling knowledge gaps about sources and persistence of microbial pathogens in meat, poultry, dairy, and fish, and applying control measures for reducing those pathogens; applying new or improved food processing technologies and monitoring their impact on food safety; strengthening the nation's food defense system through threat prevention, threat response, risk management, risk communication, and public education; improving national support and coordination of food safety programs by building an information infrastructure for integrated food safety.

4. Supporting Training of Future Work Force: National Needs Fellowships to train highly qualified and motivated graduate students in food safety are awarded to the universities with world renowned programs in food safety. At undergraduate level, challenge grants are provided to design innovative curricular approaches. This is a relatively a small program. Additionally, NRI and NIFSI grants frequently include funds for supporting training of graduate students and postdoctoral fellows. During 2002-06, the NRI Food Safety program provided support for 104 graduate students (average of 2.3 years of support for each) and 58 postdoctoral researchers (average of 2.3 years of support for each).

5. Support of Small Business: As part of the Government-wide Small Business Innovation Research (SBIR) program, CSREES administers the grants program for small businesses. The purpose of SBIR program includes stimulating technological innovation in the private sector, strengthening the role of small businesses in meeting Federal research and development needs, increasing private sector commercialization of innovations derived from USDA-supported research and development efforts and fostering and encouraging participation by women-owned and socially and economically disadvantaged small business firms in technological innovation. The Food Safety Program in SBIR funds 2 to 3 phase grants per year.

6. Nanoscale Science and Engineering: Nanotechnology is a new enabling technology, which has the potential to revolutionize the agriculture and food systems. The goal of this program is to provide knowledge, expertise, and highly qualified R&D human capital in nanotechnology for food and agricultural systems. This program has funded several grants in food safety related areas. Specifically, in the areas of nanoscale recognition, reception, and transmission mechanisms and novel materials for developing nano-based sensors specifically for targets important to food safety and agriculture biosecurity.

7. Water and Watersheds: The goals of the Water and Watersheds program are to protect and enhance the natural resource base and environment by improving and maintaining healthy watershed habitat and water supply protection; enhance economic opportunities by reducing economic liability from water contamination; improve the quality of life in rural America through adequate clean water supplies; and protect food safety through clean irrigation and livestock drinking water supplies. This program funds proposals in the area of water safety as it relates to irrigation of crops and Subsequent contamination of food crops, especially fresh produce.

Linkage to CSREES Strategic Plan

CSREES Supported Strategic Goal:
This portfolio supports strategic goal four, entitled "Enhance Protection and Safety of the Nation's Agricultural and Food Supply." Through cooperation with its partners, CSREES sponsors the development and distribution of scientific-based information, technology and practices to producers, manufacturers, the work force, and regulatory agencies to help ensure the safety of agriculture and the food supply to domestic and global consumers. Education programs strengthen the foundation for this goal by building capacity in the agricultural research and extension system and training the next generation of scientists and educators.

CSREES Supported Strategic Objective:
This portfolio supports strategic goal 4.1 entitled "Reduce the Incidence of Foodborne Illnesses and Contaminants through Research, Education, and Extension. CSREES sponsors education, research, extension, and technology development to identify and assess the impact of contributors to agricultural environmental related human diseases in foods, and in the processing and distribution system of food. CSREES supports the development and transfer of practices and intervention strategies that manage, reduce, or eliminate food safety risks throughout the food chain.

CSREES Strategic Plan Performance Measures Progress Table

Key Long-Term Outcome: Reduced incidence of prevalence of food borne illnesses and contaminants through increased knowledge and/or the development of mitigation, intervention, or prevention strategies via research or integrated research, education, and extension areas: pre-harvest food production and transportation, post-harvest processing and distribution, retail preparation and distribution, and consumer preparation, consumption, and behavior.
Performance Measures: 1. The number of methods that reduce food contamination and growth of foodborne organisms. 2. The number of food safety training, education, and certification courses that target multiple audiences, which includes all those who make food safety decisions in a variety of settings (i.e. foodservice workers, sanitarians, inspectors, retailers, growers, packers, shippers, processors, farmers, consumers, etc.)
Performance Criteria (objective 4.1)**:** • Ensure food products are free of harmful chemicals, including residues from agricultural and other sources • Protect food from contamination by pathogenic microorganisms, parasites and naturally occurring toxins

Actionable Strategies (objective 4.1)**:**

- Sponsor research to provide a science-based, cost effective approach to food safety that is valuable to industry, policy makers, academia, and the public;
- Sponsor education and extension to provide the public with information addressing food safety, recommended handling practices, microbiological testing, and innovative methods and technologies;
- Sponsor development of information on the epidemiology, ecology, and mechanisms of foodborne pathogens and diseases;
- Sponsor research for the development and implementation of new methods and approaches for foodborne pathogens and foodborne diseases;
- Work with federal food safety agency partners, industry, and academia, to evaluate foodborne illness data and the development of accurate measures on the effectiveness of prevention, control, or intervention strategies to reduce preventable food-borne illness;
- Support the recruitment, retention, training, graduation, and placement of the next generation of research scientists, educators, and practitioners in the food and agricultural sciences;
- Sponsor research that will fill existing data gaps and aid the development of risk assessments and models that will ensure implementation of science based policies;
- Provide educational and extension outreach to food animal and produce growers, to owners and operators of small and very small plants, and to food prepares and handlers, including minority populations such as Native Alaskans, Asian Pacific Islanders, and American Indians; and
- Provide educational and extension support for the implementation of HACCP

Performance Measure Progress Table

1.Performance Measure Description: Methods that reduce food contamination and growth of foodborne organisms		
Explanation of Measure: The number of contamination reducing methods (interventions, mitigations) for priority, high public health risk, and economically important microbial pathogens and contaminates that have been developed and used		
Baseline (FY 2002): 2	**Target**	**Actual**
Fiscal Year 2003	3	3
Fiscal Year 2004	6	6
Fiscal Year 2005	8	8
Fiscal Year 2006	10	10
Fiscal Year 2007	12	11
Fiscal Year 2008	14	
Fiscal Year 2009	16	
Fiscal Year 2010	18	
Fiscal Year 2011	19	
Fiscal Year 2012	20	

2. The number of food safety training, education, and certification courses.		
Explanation of Measure: The number of food safety training, education, and certification courses that target multiple audiences, which includes all those who make food safety decisions in a variety of settings (i.e. foodservice workers, sanitarians, inspectors, retailers, growers, packers, shippers, processors, farmers, consumers, etc.)		
Baseline (FY 2008): 2	**Target**	**Actual**
Fiscal Year 2008	3	
Fiscal Year 2009	6	
Fiscal Year 2010	8	
Fiscal Year 2011	10	
Fiscal Year 2012	12	
Fiscal Year 2013	14	
Fiscal Year 2014	16	
Fiscal Year 2010	18	
Fiscal Year 2011	19	
Fiscal Year 2012	20	

CSREES Food Safety Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: Food safety needs to be enhanced through research, education and extension programs. Contamination of food by chemicals, toxic compounds and allergens need to be detected and reduced. Actions are needed toward improving public health by improving the safety of food, e.g., development of sensitive and user-friendly detection methods, and interventions to reduce contamination of food should be developed and used.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	Related to Research, Extension, Education: - Detection of pathogens - HACCP implementation - Recognition of AR as a public health problem - Emerging diseases - Risk Assessment - Processing technologies - Regulatory impact - Pre-post harvest	- Research findings disseminated - Publications - Citations - Disclosures - Patents - Findings Vetted by Scientists - Activities related to extension programs are implemented by grantees/partners - Activities related to integrated programs are implemented by grantees/partners - Undergraduate and graduate education programs are implemented - Diplomas granted	**Changes in knowledge, attitudes, skills, motivations, decisions of users, demands on producers and processors regarding**: - New discoveries - New food safety approaches & methods; science-based practices	**Changes in behavioral practices, management uses or input that**: - Leads to reduction of food-borne contaminants in food. - Leads to reduced use of synthetic antimicrobials. - Development of novel environmentally compatible treatments of stored grains and other products.	National needs met: - Reduction in *Listeria* in processed foods, *Campylobacter* in poultry and other pathogens and foodborne diseases - Antimicrobials (fluoroquinolone) removed from market - Classification of risky food

Assumptions - CSRESS has the funds, personnel and facilities to accomplish this objective. There is a need to collaborate with lateral partner organizations and agencies

External factors - A number of factors could have a significant impact on programs. Some of those include change in funding; priorities, attitudes; food production, distribution and preparation habits; average lifespan & number of immune-compromised individuals; emergence & virulence of new pathogens; food safety issues requiring new management strategies & regulatory framework; trends in food contamination & hazard survivability and risk assessment; biosecurity issues; natural disasters; economic conditions; coordination & cooperation with other government entities.

Portfolio Inputs

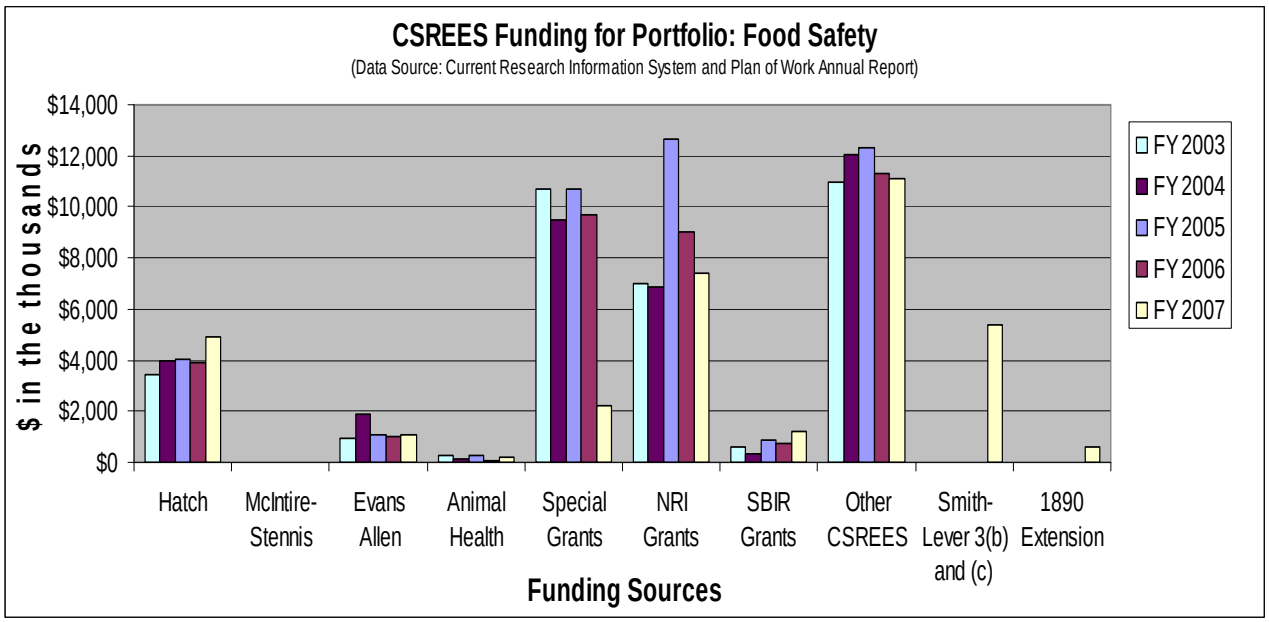
Agency funding data for fiscal year 2007 was collected from the Current Research Information System (CRIS) and the Plan of Work (POW) annual report. Fiscal year 2007 funding data includes Smith-Lever 3(b) and (c) and 1890 extension funding, which were not otherwise accounted for in FY 2003 – 2006. Agency funding data for fiscal years 2003 through 2006 were collected from CRIS only.

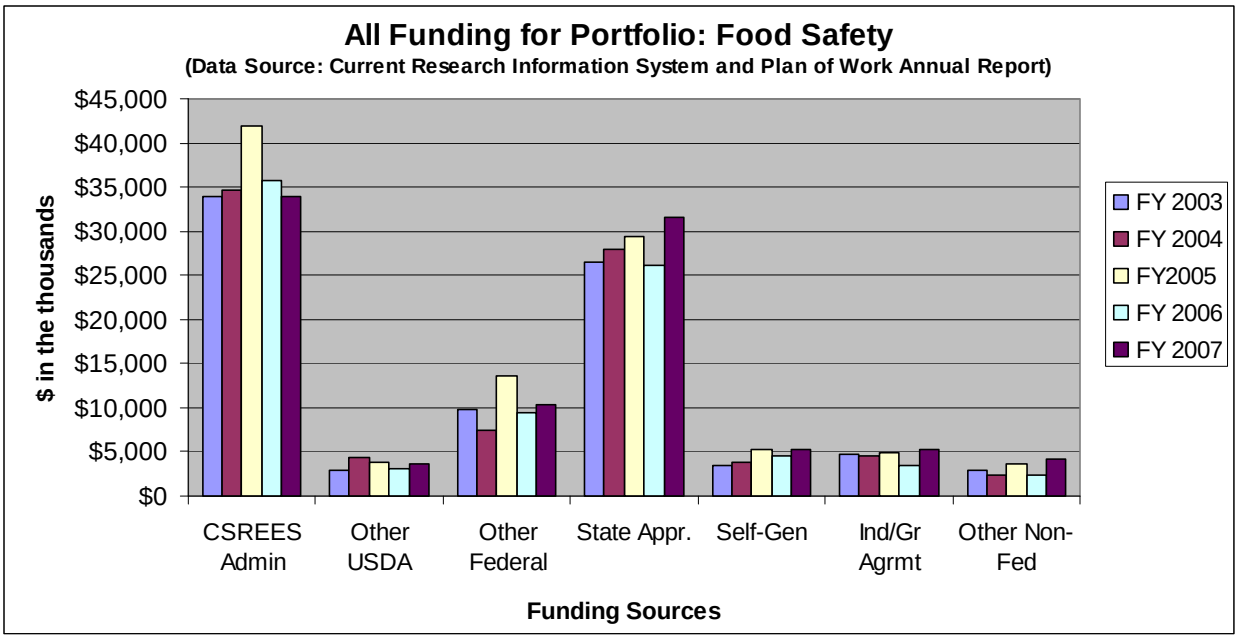
Portfolio Level Funding Table and Bar Charts

Table 1: Food Safety Portfolio Summary Funding Table
Combined Research and Extension Funding

	($ in the Thousands)					
Funding Sources	**FY 2003**	**FY 2004**	**FY 2005**	**FY 2006**	**FY 2007**	**Grand Total**
All CRIS Reported CSREES Funding	$33,924.00	$34,665.00	$41,882.00	$35,825.00	$28,060.00	**$174,356.00**
All Extension Funding Reported in POW	n/a	n/a	n/a	n/a	$5,961.25	$5,961.25
All non-CSREES Funding	$48,282.00	$51,248.00	$55,535.00	$52,382.00	$50,840.75	$258,287.75
Total Funding	$82,206.00	$85,913.00	$97,417.00	$88,207.00	$84,862.00	$438,605.00
Percentage of CSREES Funding	41%	40%	43%	41%	40%	41%

*n/a = Funding data are not available for that fiscal year





Discussion of changes in funding

A significant change in the budget reporting in fiscal year 2007 is the capturing of contribution of Smith-Lever (Extension) funds. The total amount of the funds expended for food safety activities in extension area was about $ 6 million. For research and integrated activities, as percentage of total funding reported, the CSREES contribution (about 40%) remained unchanged in the fiscal 2007 compared to the previous year. However, there was a funding decrease of about $ 7.8 million in fiscal year 2007 compared to fiscal year 2006. This decrease can be attributed to the removal of Congressional line-item funds from the fiscal year 2007 and a small decrease (about $ 1 million) in the NRI funding. Small fluctuations like this are usually due to the fact that funds are awarded from the fiscal year in which the proposal was submitted but reported by the FY in which the award was made. Although, the Congress rolled over the line-item funds into Hatch formula funds in fiscal year 2007, there was an insignificant increase in the Hatch funds expended on the food safety activities.

Portfolio Results

1. Recent years have seen a dramatic world wide increase in all allergies, including food allergies. NRI grantees form Florida State University have developed monoclonal antibodies specific to the tree nut allergens for the detection of minute qualities of the presence of these allergens in the food. They have developed a prototype method to for detection of tree nut allergens. It is anticipated that the methodology will be used for the development of commercial kits for routine use.

2. Virginia Polytechnic Institute and State University (an 1862 land grant university) along with the Virginia State University (an 1890 land grant university) using Hatch and Evans-Allen funds, respectively, and in cooperation with the Southern

Region Integrated Pest Management Center supported by AREERA 406 grant, constructed an advisory website for responsible pesticide use. Many extension specialists were able to use this advisory to help to help in using integrated pest management and10 applicators were recertified as pesticide applicators. Such activity continues to reduce the pesticide contamination levels through the integrated pest management practices.

3. CSREES funded the development of a rapid, sensitive and specific and field-usable method (Lateral-flow nucleic-acid based) assay for Cryptosporidium parvum (a water pathogen), developed under the aegis of Hatch funds. It is currently undergoing field testing. Once the field trials are successful, several collaborating companies will be adding new fabrication facilities and personnel for production, commercialization and marketing. Subsequently, several of the other assays are expected to be commercialized using similar technology. These simple, inexpensive, single-use tests will be further developed by the use of microfluidics and should improve food safety, homeland security and environmental quality.

4. Rapid and sensitive detection of animal feed containing banned ruminant tissues is first line defense against the spread of, Bovine Spongiform Encephalopathy (Mad Cow disease). Under the aegis of a special research grant, Auburn University have developed test kits for detection which are currently sold by Neogen so the farmers can test the livestock feed before feeding. They have also developed a very high-powered optical microscope that can provide resolution down to 100 nanometers for live organisms. With this scope scientists can watch food pathogens such as salmonella in action. This work has resulted in the establishment of a new company (Cyto Viva) which now routinely sells the microscope currently used by many scientists in microbiological and other laboratories. In addition, there were spin-off technologies that resulted in commercialization of detection devices (Test Kits for detecting the adulteration of meat of one animal with meats from other animals and a device tracking time-temperatures during shipments).

5. CSREES awarded a series of grants in the area of food irradiation Hatch, NRI, and NIFSI. Notable areas emphasized were consumer food safety and education, irradiation of complex and irregularly shaped foods such as fruits and vegetables, and irradiation of green leafy vegetables. United Fresh, Food Products Association and other parties used the outputs of this activity, along with those resulting from ARS research, in support of their petition to FDA for approval of irradiation of fruits and vegetables. FDA analyzed existing and new data on the safety and on August 21, 2008 approved the irradiation of fresh iceberg lettuce and fresh spinach at a dose level of up to 4.0 KiloGrays. The anticipated outcome is use of this technology for reducing pathogens (such as E. coli and Salmonella) and increase the shelf life of iceberg lettuce and spinach.

6. A grant awarded to Sterilex under NRI program, a private entity, resulted in the optimum formulation of sanitizers to completely kill Listeria in biofilms on processing surfaces. Total destruction of Listeria is needed before dumping the sanitizers and process water into sewage. Additional laboratory and field studies of the optimized formulations will be used to petition EPA for registration of the products for the control of *L. monocytogenes* biofilms in food plants, food service, and animal health facilities.

A highly specific and ultra sensitive nanobiosensor was developed for the direct detection of prions in the blood of cows with mad cow disease prior to slaughter. Researchers supported by NRI developed modified Resonating Mechanical nano-Biosensors (RMBs), which increased the sensitivity of detection by five orders of magnitude (X100, 000) to a point where 200 picograms of prions /ml of serum can be detected. Currently efforts are underway to achieve sensitivity by another two orders of magnitude, which is needed for direct detection of prions in cow blood.

One education grant has connected a 2 year Hispanic Serving community college with University of California, Riverside to work on water and food safety. Two minority community college students were selected each year for 3 years for a total of 6 students. They served an 8 week summer internship working on water and food safety issues at UC Riverside and continued as student interns throughout the school year. They had an intensive mentoring and evaluation program to continue with advanced education in food safety and water issues. Two students have already enrolled in 4 year engineering programs. An open house for the project drew 200 students and faculty interested in future participation. A graduation ceremony drew 500 students, parents and faculty interested in these opportunities. Students were also involved in grade 6-12 science fair project judging to encourage younger students to also consider careers in food safety and water careers. An additional grant from NSF will continue to expand higher education opportunities for minority students to other projects. A video, website and news story on this project was featured in the UC Riverside magazine and local cable TV channel. The website is www.bridges.engr.ucr.edu. The students presented their own research at the California Undergraduate Research conference on "Establishing the phenotypic nature of Salmonella spp. and Escherichia coli isolates as a function of environmental stress". Students are pursuing advanced college degrees in the food safety and water issues and additional students are becoming interested in joining the program.

Portfolio Leadership and Management:

For 2007, the portfolio management core leadership consisted of largely two National Program Leaders (NPLs) and one Program Specialist for the entire year, with two other NPLs, who left the agency around the middle of the year. During the preparation of the report, four other NPLs provided input. Candidates for the two vacant NPL positions have been interviewed with the decision pending. Processing Engineering and Technology section of the Plant and Animal Systems division, provided the leadership in the collation and synthesis of information and preparation of the report.

All of the food safety programs in the CSREES have been developed and modified using extensive stakeholder input. The discussion of stakeholder input is presented as an aggregate discussion in the 2007 portfolio review document. In 2007, stakeholder input for CSREES food safety programs was solicited through a variety of ongoing mechanisms. Those mechanisms have included:

A CSREES-sponsored food safety stakeholder session held in July 2007: Participants included university partners, representatives from industry, and federal partners from FSIS, FDA, and ARS. Participants presented food safety priorities from their representative organizations. In small group break-out sessions, participants identified overall food safety priorities. Their recommendations provided guidance for food safety program priorities identified in FY 2008.

A CSREES-sponsored grant writing workshop in Scottsdale, Arizona, held in July 2007: Participants included university and industry partners interested in learning how to compete successfully for CSREES food safety grant funds. Breakout sessions were held for the various competitive food safety programs offered within the agency. During those sessions, participants were encouraged to provide input on program priorities and competitive review processes.

A Briefing for the Coalition on Funding Agricultural Research Missions (Co-Farm) held in June 2007: Drs. Singleton and Rao, of CSREES, met with the Executive Board of Co-Farm to provide a briefing on CSREES food safety programs and priorities, and to seek input from the Board on future needs and priorities of the programs. Discussion focused on developing a continuing dialog between CSREES and Co-Farm members.

An IFT-sponsored annual business meeting and Council of Food Science Administrators' Luncheon held in Chicago, IL, in August 2007: Dr. Rao attended both the annual meeting and the luncheon during the annual meeting of the Institute for Food Technologists. Dr. Rao gave food safety program updates during the meeting and luncheon, and received input from participants on CSREES food safety program priorities.

A Food Safety Information-Sharing Meeting held in Philadelphia, PA, in September 2007: University, industry, and federal, and international stakeholders met with Dr. Singleton during an international food safety conference (the Annual Meeting of the American Dietetic Association) to share highlights of their food safety research, and to make recommendations to CSREES for FY 2008 program priorities. Federal partners provided agency updates, and discussed areas where each agency could work together to strengthen overall food safety programs throughout the government.

An NRI-sponsored Project Directors' Meeting held in November of 2007: Participants included university, industry, public, and private Project Directors awarded competitive grants through the National Research Initiative. Project Directors gave updates on their

research, networked with those conducting similar research, and met jointly with food safety National Program Leaders to provide input about program priorities and competitive review processes and procedures.

Stakeholder input was solicited in the annual Request for Applications. Each year stakeholders are encouraged to provide written comments about food safety program priorities in annual Requests for Applications. The RFAs include instructions for submitting comments, which are forwarded to CSREES Program Leaders. Comments provide guidance for priority-setting each successive funding year.

Stakeholder input was solicited from members of peer review panels, and from the Panel Managers. Annual competitive review panels include university, industry, and Federal (FSIS, FDA, ARS, and NAL) partners with expertise in food science, food safety, food microbiology, and food technology. Panelists conclude their deliberations by providing recommendations for program priorities and suggesting improvements for the competitive review process.

Prioritization of stakeholder inputs and resource allocation was based primarily on the following factors.

- Emerging issues of national or global concern
- National food safety initiatives and Congressional directives
- Critical need to achieve reduction in microbial pathogens and toxic substances in the food chain
- Effective integration of research, education and extension to solve complex food safety problems
- Science and research needs of sister Federal food safety agencies
- Implementation of new food safety guidelines and regulations
- Health and economic impacts of foodborne illness outbreaks in the U.S.
- Results of research conducted by other food safety agencies and private entities

Integrated and Interdisciplinary Approaches to Focus on Issues:

Despite many research and outreach efforts, by the partners USDA and FDA, foodborne illness associated with fresh produce continued to increase in the past 10 years. The Centers for Disease Control and Prevention estimated that, in the 1990's, at least 12 percent of foodborne illnesses were linked to fresh produce items. Between 1996 and 2006, there were at least 65 foodborne illness outbreaks, resulting in over 8,040 reported illnesses and several deaths due to contaminated fresh and fresh-cut produce. Stakeholder

input in this area was overwhelming. As a result, in 2007 and 2008 Request for Applications, this topic was identified for special emphasis grants of up to $ 2 to 2.5 million each in the NIFSI program. As per the program goals the investigators were asked to integrate research, education and extension with a multidisciplinary, multistate and multiinstitutional approach. In 2007 two projects of 2.5 million dollars each were awarded. One of the projects is briefly described below.

A grant entitled "A systems approach to minimize Escherichia coli 0157:H7 food safety hazards associated with fresh and fresh cut leafy greens was awarded to a consortium of universities led by the University of Georgia. Briefly the objectives of this grant are to: Ensure inactivation of E. coli O157:H7 on the surface of composting heaps; 2. Determine if and how the organism is internalized into the leaves; 3. Assess the transfer of E. coli O157:H7 among leafy greens during processing; 4. Investigate the potential for using processing water as a contamination marker for leafy greens; 5. Assess the efficacy of intervention strategies; 6. Characterize survival and growth of E. coli O157:H7 in contaminated leafy greens during post-harvest storage and distribution conditions; 7. Develop a mathematical risk model for E. coli O157:H7 contamination; and 8. Disseminate outcomes and management strategies through annual steering committee meetings and regional stakeholder meetings, followed by evaluation of the practices. The results so far are encouraging. The project has potential to provide many solutions.

Note: More integrated activities, outputs and outcomes are reported in Appendix G.

Process for Providing Guidance to Partners/Grantees:

In general, guidance was provided to the potential grantees and partners through the standard agency approaches. These included NRI grants workshops, NRI Integrated workshop, contact information at the agency including grants.gov application process, information posted on CSREES website, and finally instructions in the RFA.

Post Award Review Process:

1. Each of the program areas undertakes post award management activity which is usually the meeting of all the project directors every 1-2 years. For example, NRI has conducted its workshop in connection with the Annual Meeting of the International Association of Food Protection in 2007. The objectives of the workshop are to monitor the progress of the project, make any midcourse corrections based on results, networking among the PDs, and sensing the general direction of the food safety research, education and extension activities.

2. In some instances, particularly when large multi-institutional and multidisciplinary projects are involved, the NPL managing the project serves on the technical/advisory committee to monitor the progress from a quarterly to a yearly interval. For example, on one the NIFSI projects addressing a systems approach to the safety of green leafy vegetables involving four universities, an

FDA laboratory, and a strong technical committee, the NPL participates in the quarterly meetings and attends the annual meeting of the technical committee to monitor the progress.

3. One of the best methods is the meeting of the NPLs with individual PDs at professional society meetings and chatting informally about the progress of the project. In addition, the PDs are sometimes involved in organizing workshops and symposia at meetings around their project theme. Attendance and interaction at these meetings provides information on the progress of the project.

Portfolio Considerations

Programmatic or Management Shortcomings

The most critical programmatic shortcoming is the emergence of new food safety issues and new priority areas for which additional funding is not available. Current strategies to address this shortcoming have involved reducing funds previously allocated to existing priority areas. An alternative strategy would be to link new and emerging issues with new funding. Another strategy would be to develop mechanisms for rapid response to emerging issues with a portion of funds set aside for emerging issues. In any case, these strategies are an agency wide issue and should be addressed as such.

Key Future Activities and Changes in Direction

In the next 5 to 8 years, CSREES food safety programs will focus on the following:

Improving the Safety of fresh and fresh-cut fruits and vegetables: Recent foodborne illness outbreaks in fresh tomatoes, spinach, lettuce, and peppers have focused the attention of the Food and Drug Administration on microbial contamination of produce. Preliminary results of research funded by the National Integrated Food Safety Initiative have indicated that food safety alerts issued by the Federal government are not always clear, concise, and easily understood. Many consumers (up to 30%) ignore the alerts, while others eliminate broad classes of foods from their diets, even though the alerts are often very narrowly focused. Additional research is needed on how to improve media messages and consumer awareness and behaviors following a food safety alert or food recall.

Improving the safety of beef and beef products: In 2007, more than 11 million pounds of tainted beef and beef products were recalled in the U.S. Many of the recalls involved ground beef. The most common pathogens of concern were salmonella and E. coli 0157:H7. A less common, but equally grave concern, involved Listeria monocytogenes in ready-to-eat deli meats. Consumer attitudes about the safety of ground beef and other beef products have steadily eroded over the past few years, and sales of ground beef have dropped precipitously. To address these issues, additional research is needed to detect

microbial contamination and to trace contamination back to its source. Additional research is needed on how to improve media messages and consumer awareness and behaviors following a food safety alert or a food recall.

Improving food safety through novel and alternative processing technologies: The Food and Drug Administration has recently approved, for the first time, the irradiation of fresh lettuce and spinach for improved consumer safety. It was recognized that leafy green vegetables were a particular food safety concern, and that advice typically given to consumers to address these concerns were not always effective. It is likely that additional food products will be added to the list of irradiated foods in the future. Additional research is needed to identify safer and more effective alternative food processing technologies, including irradiation, for produce as well as other food products. In addition, risk-based communication and education and outreach to consumers is needed to accurately inform the public about new processing technologies and their potential effects on quality and nutritive value of foods.

Strengthening the Nation's Food Defense System: Research is needed in this area to support the development of food safety systems that prevent and/or reduce intentional or unintentional threats to the safety of the U.S. food supply. Particular focus should be given to the following: 1) threat prevention (e.g. probabilistic assessment of vulnerabilities in postharvest area); 2) threat response (e.g. high throughput, fieldable and robust analytical methods for threat agents in food matrices); 3) risk management and communication; and 4) public awareness and education.

Molecular Mechanisms of persistence of pathogenic microbes in the food and its environment: For an effective intervention to reduce/eliminate microorganisms from the food and its environment, an understanding of hoe the microbes interact with the food and its environment and persist for extended periods. This basic knowledge can be used to devise intervention technologies.

Risk-based Approach to Management of Food Safety: Total elimination of microorganisms is not possible unless sterilization techniques are which may compromise the quality of the food. Thus, a risk based approach is essential in the management of food safety across the food chain. Novel epidemiological approaches and innovative risk based approaches are needed.

Traceability and imported food: Rapid methods of traceability are essential to track the source of the organism in case of intentional or unintentional contamination.

<u>What are Others Doing</u>

- **Agricultural Research Service-USDA:** This is an intramural research program of the USDA and provides means to ensure that the food supply is safe and secure for consumers and that food and feed meet foreign and domestic regulatory requirements. Food safety research seeks ways to assess, control, or eliminate

potentially harmful food contaminants, including both introduced and naturally occurring pathogenic bacteria, viruses and parasites, toxins and non-biological-based chemical contaminants, mycotoxins, and plant toxins. The research program also involves international collaborations through formal and informal partnerships. ARS also works with CDC to collect information about food consumption at the individual/household level. This agency, however, is not involved in extension and education activities. We collaborate with the national program staff in ARS to avoid any duplicate research.

- **Agricultural Marketing Service (AMS)-**USDA: Microbiological Data Program and Pesticide Data Program manage the collection, analysis, data entry, and reporting of food-borne pathogens and pesticides on agricultural commodities in the U.S. food supply. The National Science Laboratory provides chemical, microbiological, and molecular biology testing and assistance.
- **Economic Research Service (ERS)-USDA:** Provides analysis of economic impacts of food safety problems. Collects and publishes data on food consumption at the commodity level.

- **Food Safety Inspection Service (FSIS)-USDA**: Related work at FSIS is mainly in outreach/education. There are a variety of information resources for consumers. Notable among these are: Be Food Safe, Food Safety Mobile, Thermy, Is it Done Yet?, Fight Bac, and Food Safety Education Conference. In addition, there are several guidance documents for the meat and poultry and egg processing industry to facilitate compliance. FSIS also has information on HACCP and Pathogen Reduction, Laboratories and Procedures, Data and Reports, and Risk Assessment. There is limited targeted research sponsored by FSIS.
- **Food and Nutrition Service (FNS)**: The Food and Nutrition Service (FNS) administers the food and nutrition assistance programs in the U.S. Department of Agriculture. FNS provides children and needy families with better access to food and a more healthful diet through its programs and nutrition education efforts. There is emphasis on foods especially in school lunch programs. In administering the school lunch programs, FNS provides educational material to the workers for safe handling of food.
- **Food and Drug Administration**: Food and Drug Administration enforces the safety and prevention of adulteration of food other than Meat, poultry and egg products. Through Center for Food Safety and Applied Nutrition, FDA provides guidance documents for producers, processors, packers, and consumers on food safety. FDA sponsors targeted research on a targeted basis.
- **Centers for Disease Control and Prevention**: The mission of this agency is is "to promote health and quality of life by preventing and controlling disease, injury, and disability." Food borne illness is a significant portion of the mission. CDC, FDA, and USDA trace the source of the pathogen in food borne illness out breaks. There is in house research on the detection of food pathogens.

- **Department of Defense and Department of Homeland Security** support contract and in house research for the development of detection of pathogenic microorganisms and toxic substances.
- **Private Organizations**: In 2007, Fresh Express supported research worth about $2.0 million in the area of safety of green leafy vegetables. American Meat Foundation funds proposals every year over a million dollars for research on meat safety.

Section II: Primary Knowledge Areas

Knowledge Areas 711 Ensure Food Products Free of Chemicals, Including Residues from Agricultural and Other Sources

KA 711: Introduction:
This knowledge area addresses the occurrence, detection, toxicity, metabolism, risk, and measures to decontamination of toxic compounds from the food chain. Toxic compounds include: harmful chemicals such as contaminants from industry, food allergens, and agricultural residues and food processing contact chemicals such as pesticide residues and packaging additives. Research, education and extension activities are funded to prevent and remove contaminants form the food chain.

Areas of work include but are not limited to:

- Safe or acceptable levels of residues and environmental contaminants on or in farm products for human consumption.
- Behavior and fate of pesticides, antibiotics, hormones, and other applied chemicals and environmental contaminants, on or in food plants and animals and their products.
- Methods to remove or mitigate the effects of chemicals harmful to human health.
- Rapid, accurate methods for monitoring pesticide residue, antibiotic, environmental, or other contaminants on or in food plants and animals and their products.
- Assessing risk to human health from harmful chemicals in food plants and animals and their products.
- Determining consumer attitudes and developing techniques to communicate relative risks of harmful chemicals in food plants and animals and their products
- Hazard analysis and critical control points (HACCP).

CSREES KA 711 Food Safety Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: Food safety needs to be enhanced through research, education and extension programs. Contamination of food by chemicals, toxic compounds and allergens need to be detected and reduced. Actions are needed toward improving public health by improving the safety of food, e.g., development of sensitive and user-friendly detection methods, and interventions to reduce contamination of food should be developed and used.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	Related to Research, Extension, Education: - Development of new knowledge and methods to test the presence of allergy causing compounds in tree nuts	Publications and patents generated, prototypes developed	**Changes in knowledge, attitudes, skills, motivations, decisions of users, demands on producers and processors regarding**: Understanding of basic biochemistry of allergens in Cashew nuts, pistachios walnuts, and pecans. Understanding of basic principles of liposome immuno-analysis and Lateral flow nucleic acid assay for chemical residues, microbial toxins, Crypto-sporidium parvum (a water pathogen) and listeria developed	**Changes in behavioral practices, management uses or input that**: New test kits Market tested. The methods are being tested in field conditions New monoclonal antibodies developed.	National needs met: - Once prototype is market tested, companies will have an opportunity to develop test kits for use. - Several companies are showing interest in fabricating the field testing devices once the field testing is successful.

Assumptions - CSRESS has the funds, personnel and facilities to accomplish this objective. There is a need to collaborate with lateral partner organizations and agencies

External factors - A number of factors could have a significant impact on programs. Some of those include change in funding; priorities, attitudes; food production, distribution and preparation habits; average lifespan & number of immune-compromised individuals; emergence & virulence of new pathogens; food safety issues requiring new management strategies & regulatory framework; trends in food contamination & hazard survivability and risk assessment; biosecurity issues; natural disasters; economic conditions; coordination & cooperation with other government entities.

.KA 711 Key Activities, Outputs and Outcomes:

Selected examples of Activities, Outputs and Outcome under KA 711

- **Activity:** Recent years have seen a dramatic world wide increase in all allergies, including food allergies. To address this issue two NRI grants (one in 2003 and the other in 2006) were made to the biochemists at the Florida State University with a physician collaborator from California. The objectives of these projects were: To identify and characterize (basic biochemistry) those tree nut proteins in almonds, cashew nuts, pistachios, walnuts and pecans that are responsible for causing allergic reactions in patients, and to develop monoclonal antibodies for detection of allergens, followed by development of kits for detection of the allergenic proteins in the food chain. These projects addressed the current issue of deadly allergies and detection of these allergens in foods.

  Outputs: The investigators established the nature of the allergenic proteins in the tree nuts, developed cDNA libraries, and published over a dozen peer-reviewed journal articles. Close to half-a-dozen graduate degrees were offered in this emerging area.

  Outcomes: Using the basic knowledge developed the investigators developed monoclonal antibodies (antibodies specific to the allergens) for the detection of minute quantities of the presence of allergens in the food. It is anticipated that the methodology will be used for the development of commercial kits for routine use.

- **Activity:** Agricultural crops are grown on more than 40,000 farms and 400 million acres of land in Virginia, and make a major contribution to Virginia's economic vitality. Timely and effective pest management of insects, diseases, and weeds is critical to the successful production of most of the important crops such as corn, soybeans, cotton, small grains, peanuts, potatoes, and vegetables. Rapid and direct delivery of real time pest information is a key but challenging element of IPM.

  Outputs: Under 2007 Hatch formula, Evans-Allen, and cooperative Extension funds, Virginia Polytechnic Institute and State University (an 1862 land grant university) along with the Virginia State University (an 1890 land grant university) and in cooperation with the Southern Region IPM Center, developed the Virginia Ag Pest Advisory (http://www.sripmc.org/virginia/). This is a database driven website that compiles pest updates from Virginia Commonwealth Extension Specialists. Weekly e-mails go to agents, growers, and crop consultants across the state. In 2007, the Advisory was discovered by AgFax Media, Brandon, MS, which routes information throughout the eastern U.S. through three electronic newsletters PeanutFax, Ag Southern Grain, and Southeast Cotton Report. IPM information was also included in the pesticide safety education curriculum statewide. The pesticide regulatory program works closely with the Southern IPM Center to communicate critical issues to the public and to decision-makers.

Outcome: In 2007, the number of local e-mail recipients, by request, grew to over 400, the number of pest alerts posted increased from 119 in 2006 to 134, and the number of web hits increased from 8,562 to 12,761. AgFax Media quoted or referenced Virginia cotton IPM information 7,600 times, peanut IPM information 4,000 times, and grains IPM information 1,200 times. A recent survey of the advisory recipients indicated that 87% of respondents accessed the Virginia Ag Pest Advisory. Virtually all of them found it useful and educational, and most stated that it favorably impacted their agricultural production. Extension agents reported that 6,814 individuals gained knowledge on IPM through pesticide safety education programs. Ten applicators were recertified as pesticide applicators.

- **Activity:** Rapid and sensitive detection of chemical residues, microbial toxins, and allergens in the food chain is essential for setting safe levels (in case of chemical residues) and fast response to contamination. Research funded at Cornell University by Hatch Formula funds focused on the development of sensitive and specific bioanalytical assays based on liposomal amplification strategies. The assay platforms fall primarily under two formats: (1) automated, computer-controlled Flow-Injection Liposome ImmunoAnalysis (FILIA) or Nucleic-acid Analysis (FILNA) systems and (2) rapid, simple lateral flow assays (LFA). Assays have been completed for the determination of the herbicides imazethapyr and alachlor, the pathogens Escherichia coli and Listeria monocytogenes, and the mycotoxin fumonisin B1. With the LFA approach, assays have been completed for the detection of the pathogens Escherichia coli, Cryptosporidium parvum, Salmonella spp. and Listeria monocytogenes, for the pesticide alachlor, for the natural glycoalkaloidal toxins solanine and chaconine, for Shiga toxins I and II, and for the peanut allergen Ara h1. Also, extremely sensitive and specific assays have been developed for cholera and botulinum toxins using a hybrid recognition LFA approach. Finally, several projects have been completed: the detection of the principal peanut allergen, Ara h1 in chocolate; E. coli using 'universal' immunoliposomes prepared with protein G conjugated to the liposome surface; a nucleic-acid LFA for Streptococcus pyogenes; a LFA based on nucleic-acid detection of C. parvum and an antibody immunoassay for Erwinia amylovora, the organism causing fire blight in fruit.

  Outputs: The investigators published 3 peer reviewed journal articles and developed prototypes for both the methods for testing a variety of toxins, allergens and microbes. Some companies have collaborated in developing these procedures.

  Outcomes: The lateral-flow nucleic-acid based assay for Cryptosporidium parvum is currently undergoing field testing. If these tests are successful, several collaborating companies will be adding new fabrication facilities and personnel for production, commercialization and marketing. Subsequently, several of the other assays are expected to be commercialized using similar technology. These simple, inexpensive, single-use tests will be further developed by the use of

microfluidics and should improve food safety, homeland security and environmental quality.

Knowledge Area 712: Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

KA 712 Introduction:

This knowledge area addresses the prevalence, occurrence, ecology, physiology, pathogenicity, and mechanism of pathogenicity of microorganisms causing food borne illness. Intervention strategies to prevent and reduce contamination of food chain by these microbes are the central theme of this knowledge area. Approaches taken include funding research, education and extension and integrated activities covering epidemiology of food borne pathogens and antimicrobial resistance, development of novel risk models to reduce microbial loads in food chain, integration of research and outreach, and education of the stakeholders (consumers and food producers). In addition to microbes, microbial toxins, parasites and naturally occurring toxins are also covered.

Areas of work include but are not limited to:

- Production of food animals and crops free of microorganisms, parasites, natural toxins, or other biological agents harmful to humans.
- Prevention of transmission of pathogenic microorganisms and parasites from human carriers to livestock and food systems.
- Maintenance of food security in handling, processing, packaging, and distributing food
- Products.
- Improved methods of food handling, processing, storage, and preparation for greater food security.
- Methods for preventing or eliminating mycotoxins in peanuts and other field crops
- Methods for preventing, removing, or controlling naturally occurring and induced toxins. and allergens in agricultural products.
- Assessing risk to human health from pathogenic microorganisms and natural toxins in food animals and crops and their products.
- Determining consumer attitudes and developing techniques to communicate relative risks of pathogenic microorganisms and natural toxins.
- Basic work on growth and mechanisms of pathogenesis of foodborne microbial pathogens
- Education on safe food handling.

CSREES KA 712 Food Safety Logic Model

Situation	Inputs	Activities	Outputs	Outcomes		
				Knowledge	Actions	Conditions
Situation: Food safety needs to be enhanced through research, education and extension programs. Contamination of food products by microorganisms, parasites, and their toxins. Actions are needed toward improving public health by improving the safety of food, e.g., safe food handling practices, antimicrobial resistance, epidemiology, use of kill steps, etc.	**Funding Sources:** - Federal - CSREES (NRI, NIFSI, SBIR, Special Grants) - other (ARS and ERS through collaboration) - State-matching from Hatch Formula **Human Capital:** - CSREES NPLs - Administrative Support - Grantees (Researchers, educators, and extension specialists) - Para-professionals - Stakeholders (Industry, etc.) - Volunteers - End Users - Consumers	Related to Research, Extension, Education: - Development of new knowledge and methods to test the presence of ruminant tissue in livestock feed. Development of a high resolution microscope - Testing the efficiency of irradiation on E. coli in spinach and lettuce	Publications and patents generated, prototypes developed - Publications, extension brochures	**Changes in knowledge, attitudes, skills, motivations, decisions of users, demands on producers and processors regarding**: - Basic principles for the testing of ruminant tissue and a new powerful optical microscope developed. - Irradiation at low doses kills E. coli in spinach and lettuce with out compromising the quality and safety of the produce.	**Changes in behavioral practices, management uses or input that**: - New test kits Market tested. - Several produce organizations petitioned FDA for approval of irradiation of spinach and lettuce. FDA approved the petition to allow up to 4 kilo grays of irradiation in August 2008	National needs met: - Test kits for the detection of ruminant tissue in livestock feed are currently sold in the market. Since ruminant tissue is the only source of prions (causing BSE-Mad Cow disease), the spread of the disease can be prevented by routine testing of livestock feed. - If adopted by the industry, irradiation will eliminate/reduce the presence of E. coli in spinach and lettuce and make this produce safe for consumption.

Assumptions - CSRESS has the funds, personnel and facilities to accomplish this objective. There is a need to collaborate with lateral partner organizations and agencies

External factors - A number of these factors could have a significant impact on programs. A non exhaustive list of changes that might occur is provided below: funding; priorities, attitudes; food production, distribution and preparation habits; average lifespan & number of immune-compromised individuals; emergence & virulence of new pathogens; food safety issues requiring new management strategies & regulatory framework; trends in food contamination & hazard survivability and risk assessment; biosecurity issues; natural disasters; economic conditions; coordination & cooperation with other government entities.

KA 712 Key Activities, Outputs and Outcomes

Selected examples of key activities, outputs and outcomes are provided below.

Activity: Starting in year 2000, CSREES awarded a series of grants in the area of food irradiation. Notable areas emphasized were consumer food safety and education, irradiation of complex and irregularly shaped foods such as fruits and vegetables, and irradiation of green leafy vegetables. The awards were made to Iowa State University, Texas A&M University, Chapman University, Colorado State University and University of California, Davis. The source of funds included the National Integrated Food Safety Initiative, National Research Initiative, Special Research Grant, and Hatch Formula funding (including the participation of the multistate group S 1033), not withstanding many extension activities by the partners. The funding for this activity was around $ 1.5 million.

Outputs: Enhanced education of the consumer about the safety of irradiated fresh fruits and vegetable including green leafy vegetables; models for irradiating irregularly shaped foods, establishment of effective irradiation dose for reduction of pathogenic microorganisms, especially in green leafy vegetables without compromising the quality; and several journal article publications, and extension bulletins.

Outcome: United Fresh, Food Products Association and other parties used the outputs of this activity, along with those resulting from ARS research, in support of their petition to FDA for approval of irradiation of fruits and vegetables. FDA analyzed existing and new data on the safety and on August 21, 2008 approved the irradiation of fresh iceberg lettuce and fresh spinach at a dose level of up to 4.0 KiloGrays. The anticipated outcome is use of this technology for reducing pathogens (such as E. coli and Salmonella) and increase the shelf life of iceberg lettuce and spinach

- **Activity**: In food processing plants formation of Listeria biofilms has been a problem leading to long term persistence and a mechanism for the organism to protect itself form sanitizers. An NRI grant made to Sterilex Corporation addresses this issue both from the stand point of food safety and environmental safety by killing all the organisms before the wash water and sanitizers are dumped. For any new sanitizer developed, protocol development and validation is critical to the establishment of standards for registration of EPA biofilm claims for use in food processing.

  Outputs: The researchers developed an optimized formulation of a disinfectant to treat meat and poultry food processing equipment that is used to produce ready to eat meats. The formulation kills all the Listeria in biofilms. Four journal articles were published and several abstracts were presented at scientific meetings. Funds were leveraged by the investment of $ 75,000 from the Sterilex Company in professional time after one of the key PIs from another laboratory resigned from the project.

Outcome (Expected): Sterilex will be conducting additional laboratory and field studies on the optimized formulations, and will then proceed to EPA registration of the products for the control of *L. monocytogenes* biofilms in food plants, food service, and animal health facilities. In addition, Sterilex has demonstrated the efficacy of the AP-PT platform as a basis for the development of a family of formulations for future development.

- **Activity**: A special research grant entitled "Detection and Food Safety" funded at Auburn University, Auburn, AL (PI Bryan Chin), addressed the development of several food safety related technologies.

  Outputs: During the past 6 years of this project, the investigators have leveraged funds from other funding sources and published 239 refereed journal articles and filed for 235 patents of which 23 were granted. They were able to license the technologies for commercialization as described above. Additional information is provided in the logic model.

  Outcome: The investigators not only have advanced the science of rapid detection of tissues of ruminant origin (Only source of prions of bovine spongiform encephalopathy) in live stock feed, but have also took it to the level of commercialization; the test kits are now being sold by Neogen and the farmers can test the livestock feed before feeding. They have also developed a very high-powered optical microscope that can provide resolution down to 100 nanometers for live organisms. With this scope scientists can watch food pathogens such as salmonella in action. This work has resulted in the establishment of a new company (Cyto Viva) which now routinely sells the microscope which used currently by many scientists in microbiological and other laboratories. In addition, there were spin-off technologies that resulted in commercialization of detection devices (Test Kits for detecting the adulteration of meat one animal with meats from other animals and a device tracking time-temperatures during shipments).

Section III: Secondary Knowledge Areas

KA 501 - New and Improved Food Processing Technologies

KA 501 Introduction:
Work in this area focuses on development or improvement of methods, techniques, or processes to maintain or improve quality or functionality, stabilize or preserve foods, or prepare foods for further processing.

Areas of work include but are not limited to:

- Food physical processes (i.e., thermal and non-thermal pasteurization/ preservation, size reduction, separation, concentration)
- Food bioprocesses (i.e., enzyme and microbial applications, fermentation, genetic engineering of foods and food ingredients)
- Food chemical processes (i.e., salt, sugar, acid, preservatives, colorants, antioxidants, chemical modification)
- Food processing efficiencies (i.e., management of energy, water, wastes)
- Improved or new food packaging technologies
- Food process modeling, automation, and sensors
- Processing technologies for new food uses of agricultural products
- Food bioengineering and food process engineering
- Maintaining or enhancing bioactive components in food and food ingredients.

An NRI grant jointly awarded in 2007 to Innovative Biotechnologies International Inc., NY (Richard Montagna) and Cornell University (Herald Craighead), is developing a highly specific and ultra sensitive nanobiosensor for the direct detection of prions in the blood of cows with mad cow disease prior to slaughter. Current evaluation of cows for Bovine Spongiform Encephalopathy (BSE) relies upon post mortem testing of suspicious animals. The ability to directly detect infectious prions in the blood of all cows prior to slaughter will dramatically improve the safety of the human food supply. Construction modified Resonating Mechanical nano-Biosensors (RMBs), the investigators increased the sensitivity of detection by five orders of magnitude (X100, 000), to a point where 200 picograms of prions /ml of serum can be detected. Currently efforts are underway to achieve sensitivity by another two orders of magnitude. One paper has been published in Analytical Chemistry and another manuscript is in preparation at this writing. This proposal is an excellent example of integration of the disciplines of biology and physics to solve a real world problem.

KA 903 - Communication, Education, and Information Delivery

KA 903 Introduction:
This area of work focuses on educational processes, needs, and methods to achieve educational goals. Work includes development, use, and assessment of communication, information delivery, and technology transfer methods and systems. List topic or discipline-specific education under the appropriate KA.

Areas of work include but are not limited to:

- Techniques, procedures, and processes of education
- The science of teaching, learning, and cognition
- Curriculum design and educational instrumentation (applications of technology and media in teaching and learning)
- Teacher preparation and improvement
- Communication and information systems and delivery, including electronic networks and distance education
- Technology transfer
- Educational psychology and human motivation.

This grant is educating the future workforce, especially among minority students, to be trained in food safety and water issues (PI: Heather Smith, S.L. Walker).

Short and long term goals: This project has connected a 2 year community college that meets Hispanic Serving Institution (HSI) criteria with University of California, Riverside to work on the above funded water and food safety project. Two minority community college students were selected each year for 3 years for a total of 6 students. They served an 8 week summer internship working on water and food safety issues at UC Riverside and continued as student interns throughout the school year. They had an intensive mentoring and evaluation program to continue with advanced education in food safety and water issues. Two students have already enrolled in 4 year engineering programs. An open house for the project drew 200 students and faculty interested in future participation. A graduation ceremony drew 500 students, parents and faculty interested in these opportunities. Students were also involved in grade 6-12 science fair project judging to encourage younger students to also consider careers in food safety and water careers. An additional grant from NSF will continue to expand higher education opportunities for minority students to other projects. A video, website and news story on this project was featured in the UC Riverside magazine and local cable TV channel. The website is www.bridges.engr.ucr.edu. The students presented their own research at the California Undergraduate Research conference on "Establishing the phenotypic nature of Salmonella spp. And Escherichia coli isolates as a function of environmental stress" Students are pursuing advanced college degrees in the food safety and water issues and additional students are becoming interested in joining the program.

Section IV: External Panel Recommendations to the Portfolio

Relevance

Scope:
There was a need to have more quantitative data on the outputs of the funded research projects. The criteria for assessment should be developed within the CSREES leadership and used to objectively evaluate the research outputs from the portfolio; foods other than animal-based food products and infectious agents should be fully demonstrated in the portfolio, specifically produce and non-meat foods need to be better represented in the portfolio; NPLs and scientific staff in the food safety program in CSREES could increase and improve communication between the competitive grants programs and the state agriculture experiment stations and extension. Communication about CSREES programs and about what states are doing are areas of concentration; program staff should consider current geographic needs in food safety, specifically considering the needs of rural communities in the US and developing nations; CSREES food safety staff should be involved at some level at other Agency programs, and obtain additional funding for research, education and extension activities concerning food security.

- Portfolio Response for 2008:
  The agency continues to make earnest efforts to improve its data collection and reporting, e.g. the One Solution project improving the CRIS system; redesigned Plan of Work with new designs to make it possible for projects to report on progress, outcomes, etc., with the deadline of April 2008 for annual reports. NPLs were provided with the Administrative Dashboard to enable their quantitative data collection for project outputs and outcomes, and many NPLs are using the Dashboard to track their progress. NPLs are now assigned the responsibility as state liaisons to, among other things, improve communications with partners. This effort has served to provide greater detailed information to the Land Grant Universities, Tribal Colleges and State Experiment Station Directors relative to competitive grant programs and other Agency activities and initiatives. Additionally, information from these institutions has aided NPLs and the Agency in communicating advances to the public. The NRI Food Safety program included priorities for safety of fresh produce and seafood beginning in FY 2007. The NRI Project Directors' Workshops held in 2007 in conjunction with the IAFP Annual Meeting is an example of communication of project results with members of professional societies

Focus:
Additional funding is needed for work on viruses based on the proportion of food borne illnesses caused by viral agents. Data from 1997 to 2006 on reported causes of food borne illness from the Centers for Disease Control and Prevention show that Norovirus-borne outbreaks increased by more than 600%. This increase may be, in part, due to improved methodologies in the detection of viruses It should be noted that norovirus outbreaks are more related to worker hygiene rather than the entire food system as is the case with many food borne illnesses.

- Portfolio Response in 2008
  The portfolio continues to communicate and consult other USDA agencies, particularly ARS, and external agencies, such as FDA, CDCP, etc. involved in food safety activities. Agency NPLs now meet annually with sister Federal food safety agencies during the ARS/FSIS Annual Research Planning Conference to help define interagency program priorities. The portfolio continues to focus on all important issues of food borne illnesses within the allocated funding. The focusing of program priorities within the NRI-based Food Safety programs was necessitated by several cycles of flat funding accompanied by increases in research costs. Because researchers and reviewers invest large amounts of time in preparing and reviewing proposals, it is not efficient to run granting programs that can only fund 10-15% of proposals submitted. Therefore, the agency has chosen to focus resources on a few critical areas, based on advice from stakeholders. This change in funding philosophy has led to emphasis and enhancement in the most critical areas; however, other areas of importance within the food safety realm do not receive needed research funding as a result. Research funding for work on enteric viruses, including caliciviruses, has increased substantially since the external review analysis. These include efforts in both pre- and post- harvest research to track source and point of contamination during production and processing of fresh produce.

Emerging Issues:
CSREES staff should be more involved with National Advisory Committees for Microbiological Criteria in Foods (NACMCF); even if CSREES staffers are not members of boards, they should attend meetings and seek interactions with other advisory committees, and CSREES needs to define and clarify what emerging issues represent in order for the category to be evaluated properly.

- Portfolio Response in 2008:
  Members on the National Advisory Committee are appointed and, currently, no NPLS in CSREES have been appointed directly to the Committee. However, agency NPLs have attended open Committee meetings and have shared proceedings with other agency contacts.

The 2008 team states that the portfolio continues to improve upon its ability to put emphasis on national emerging issues. Competitive grants programs in food safety continue to reflect the evolution of food-borne illness issues and priority setting is based upon statistical analysis of ongoing and emerging issues.

NACMCF respects NPL's knowledge, expertise, and vision of merging issues. The committee solicits the inputs from the NPLs at regular basis. For example, the NPL of nanotechnology was asked to give a brief on nanotechnology applications in food safety at one of the quarterly meeting.

Integration:
CSREES should further develop partnerships with ARS and State Agricultural Experiment
Stations and host discussions between these various entities through regular workshops.

- Portfolio Response in 2008:
  The portfolio continues to improve in this area. National Program Staff from ARS have been involved in stakeholder listening sessions hosted by CSREES Food Safety NPLs and ongoing informal discussions have increased to maintain a knowledge sharing pathway. ARS NPLs have also attended competitive grants program proposal reviews to gain greater understanding of the process of awarding research funding. In a similar vein, ARS NPLs have shared their annual reports detailing ARS activities in food safety research. ARS scientists are eligible for funding from the NRI and do submit proposals and receive NRI grants. They also participate on NRI and NIFSI peer review panels.

  Regularly scheduled conference calls with Land Grant University personnel, including Deans, Experiment Station Directors, Research Directors and NASULGC representatives, have fostered greater interaction and information exchange between all parties. More integrated proposals have been received in integrated programs, including NIFSI.

Even though the NRI water program is offered as a research program, recent research such as Rob Atwill at UC Davis on water borne pathogens was immediately moved into extension outreach during the spinach E. coli outbreak in California to share latest research on setbacks of livestock from irrigation streams and fields with fresh produce at numerous public meetings and fact sheets.

Multidisciplinary:
Increase the number of coordinated agricultural projects (CAPs) in food safety; gather more quantitative data to evaluate the effectiveness of the interdisciplinary programs; encourage other disciplines, including the psycho-social sciences, to be a part of interdisciplinary work.

Many water pathogens relating to irrigation for food production and processing studies use multiple expertise of microbiologists, veterinarians, engineers, modelers, animal scientists and horticulture specialists.

- Portfolio Response in 2008:

The portfolio continues to improve in multidisciplinary balance. Flat funding for 2007 did not support the creation of new CAPs grants, but the existing CAPs grant continued to demonstrate success. One hundred percent of the 31 NIFSI grants funded in 2007 were multi-state, multi-institutional, multidisciplinary grant projects. These awards represent the application of non-traditional disciplines to food safety and the interaction of scientists from more than one discipline in each project working to solve complex problems. Nevertheless, the increase in multidisciplinary grants was not for the entire portfolio. Food safety priority area of NRI 75.0 Nanotechnology program has typically

supported multidisciplinary research projects involving physical, chemical, biological, materials, and food scientists.

Quality

Significance:
Increase linkages of specific programs to improvements in public health. RFAs should request the development of novel and innovative approaches to increase these linkages.

- Portfolio Response in 2008
  This remains a problem across the entire food safety community. Over the past decade the overall incidence of foodborne illness has decreased, but no single food safety agency, or single food safety effort is able to demonstrate that the decrease is directly attributable to specific variables. Attribution of research, education, and extension efforts to reflect a decline in the number of food-borne illnesses or the number or magnitude of product recalls requires the interplay of multiple variables in production, processing, quality assurance and even consumer behavior to be accurate. The Agency continues to interact with others in the food safety community to investigate methods that will promote reliable attribution studies. Additionally, grant recipients are reminded at least twice per year to acknowledge CSREES funding in presentations and publications and compliance with this requirement has improved since these reminders began being sent by email. In times of scarce resources, it is more appropriate to focus funding on continuing efforts to improve the safety of food while avoiding overlap with other agencies, rather than on overt concern over who takes credit for improvements.

  Critical food safety biosecurity measures have been developed since September 11 to prevent food terrorism, including surveillance, testing, training of producers and processors. Documented cases of attempted intentional food contamination and intervention have been documented, and training to avoid future events has been implemented.

Stakeholder:
Clarify who the key stakeholders are, specifically those who should have input in the portfolio;
NPLs should attend committee meetings such as the NACMCF and offer advice to these groups; NPLs should seek opportunities to enhance the involvement of end-users (stakeholders, NGOs, industry, Congress, Project Directors, etc.) in all aspects of the portfolio.

- Portfolio Response in 2008
  The 2008 team felt that the portfolio has made an effort to solicit information from the end-users, and has processed unsolicited information, as well. This information has helped reduced duplication of work in Food Safety. Further, all Request for Applications posted by the Agency ask all interested parties to provide input into the

competitive grants process, including providing contact information to facilitate this input. A stakeholder listening session was held by Food Safety NPLs in 2007 seeking input into the RFA and related processes. The session involved a cross-cut of University, Experiment Station, industry, trade organization and Federal Agency staff. CSREES anticipates offering joint funding priorities with FDA in the AFRI RFA in FY 2009. This came about as a direct result of a meeting between CSREES and FDA staff in 2008.

Alignment:
If necessary, allow NRI programs to take a more integrative approach; develop a mechanism to gather data on Extension programs in food safety and a system for gathering these data on a continuing basis; NPLs should sit on food security committees if CSREES elects or is directed to fund research and education in this direction; if funding for food defense issues becomes available then the Agency should seek to develop joint programs with other federal agencies using the successful NSF-NRI genome program as a model.

- Portfolio Response in 2008:
  The 2008 team felt that the portfolio continues to do an excellent job in aligning its work with current state of science. To avoid program duplication, NIFSI has funded the lion's share of integrated food safety research and NRI has funded basic research. The agency One Solution effort continues to focus specifically on collecting data on extension program impacts. Data from state Annual Reports can also provide additional information about the impacts of extension programming in food safety. Additional funding for food defense has not been forthcoming and CSREES does not need to duplicate the efforts of other agencies (e.g. DOD, HS

Methodology:
Provide a consistent set of instructions and guidelines on how to evaluate and rank proposals for grants review panel members; the portfolio and/or Agency should consider a grant proposal triage procedure similar to the one used by NIH.

- Portfolio Response in 2008:
  External reviewers have assessed the portfolio as having routinely utilized appropriate review methodologies. Panelists have consistently praised agency NPLs for clarity and direction during panel orientations preceding competitive review panel deliberations. Proposal triage procedures were adopted and revised by NIFSI in 2007 and NRI in 2004. The NRI (soon to be AFRI) has drafted a procedures manual for NPLs to follow, which is expected to be released in early FY 09. Competitive review processes assure the project with best science being supported. Nanoscale science, engineering and technology is the new frontier of scientific research and discovery. Nanotechnology is a cutting edge research area in food safety area.

Performance

Productivity:
Consider measures of productivity and establish linkages to milestones; increase the amount of quantitative data to provide evidence of productivity particularly for formula funds and extension.

- Portfolio Response in 2008:
  The agency One Solution effort continues to focus specifically on collecting data an extension program impacts. Data from state Annual Reports can also provide additional information about the impacts of extension programming and formula grants research in food safety. The USDA/HHS Healthy People 2010 milestones for incidence of food-borne illness continue to serve as the gold standard for agency food safety programs; preparation of milestones for Healthy People 2020 is underway. New programs or emphases were added during this period (2003-2008) include nanotechnology and water programs.

  For the amount of federal funds received by CSREES, very high quality projects are being funded. Some are cutting edge such as new models and measurements to understand how pathogens survive and move in soil and water and onto food to develop intervention methods.

Comprehensiveness:
Possibly generate funds that will allow programs to be comprehensive, focused and responsive.

- Portfolio Response in 2008:
  Additional funding to bolster the portfolio was not forthcoming in 2007. In an effort to focus on high priority and emerging areas of food safety, focus has been placed on what the agency has determined through stakeholder input to be the most critical aspects of the food safety spectrum.

  For the amount of federal funds received, CSREES covers a broad spectrum of professional course development, training and research in epidemiology, pesticide residue reduction, food bioterror, meat, dairy, eggs, vegetables, water irrigation, restaurant training, home consumer training, and volunteer training in soup kitchens and charity suppers. It covers prevention, intervention, and final consumer endpoints

Timeliness:
The panel was pleased that most projects are completed. The panel did, however, believe that there should be a change in expectations around no cost extensions and that more realistic timeframes be requested by investigators in their proposals.

- Portfolio Response in 2008:
  Legislative requirements for project closure in 5 years remained in place in 2007. The 2008 team felt that the portfolio continued to have most projects achieve closure

on time. Under the Federal Demonstration Partnership, the first no-cost extension can be granted by the Project Director's institution and this is therefore not under CSREES control. Requests for a second no-cost extension must be approved both by the NPL and the Office of Extramural Programs, and justification for the extension must be provided (e.g. loss of staff, relocation of the PD to a new institution).

Agency Guidance:
The panel felt that the food safety staff was (are) working hard and demonstrate significant leadership. The panel was impressed with the qualifications of the NPLs. As a group, the NPLs have improved considerably in the last ten years. NPLs appear to be up to date and authoritative scientists in their respective fields (for example, they write books, articles, serve on professional society committees, etc.); they are on the cutting edge. The NPLs are led by an administration that is open to new directions and that allows the NPLs to do their jobs in a mostly unencumbered way. The panel observed that the food safety program NPLs are among the best in CSREES.

- Portfolio Response in 2008
  NPLs continue to strive toward improved management, leadership, and program planning.

Accountability:
CSREES is urged to identify ways to improve this system to allow for better and more comprehensive data. The panel recognizes that the quality of the data in CRIS is dependent on what is entered into the system by the scientists. CSREES staff should work with experiment station directors to improve this process.

- Portfolio Response in 2008
  As stated elsewhere in this report, the agency continues to make earnest efforts to improve its data collection and reporting, e.g. the One Solution project improving the CRIS system; redesigned Plan of Work with new designs to make it possible for projects to report on progress, outcomes, etc., with the deadline of April 2008 for annual reports. NPLs were provided with the Administrative Dashboard to enable their quantitative data collection for project outputs and outcomes, and many NPLs are using the Dashboard to track their progress. NPLs are now assigned the responsibility as state liaisons to, among other things, improve communications with partners. This effort has served to provide greater detailed information to the Land Grant Universities, Tribal Colleges and State Experiment Station Directors relative to competitive grant programs and other Agency activities and initiatives. Additionally, information from these institutions has aided NPLs and the Agency in communicating advances to the public. Modifications to the CRIS system are expected to further enhance the quality of information provided. Grantees' meetings enhanced the sense of accountability among grant recipients.

  Projects are completing thorough reports on a timely basis and making wise use of scarce funding. They are linking USDA projects to other funding to expand the impacts.

Section V: Self-Assessment

Portfolio Scoring:

Criteria	Panel Score	2006 Score	2007 Score	2008 Score
Relevance				
1. Scope	3	3	3	3
2. Focus	3	3	3	3
3. Contemporary and/or Emerging Issues	2	3	3	3
4. Integration	2	2	2.5	3
5. Multi-disciplinary Balance	2	2.5	2.5	3
Quality				
1. Significance of Findings	2	2	2	2.5
2. Stakeholder/Constituent Inputs	2	2	3	3
3. Alignment with Current State of Science	3	3	3	3
4. Appropriate and/or Cutting Edge Methodology	3	3	3	3
Performance				
1. Portfolio Productivity	2	2	2.5	3
2. Portfolio Comprehensiveness	2	2	2	2.5
3. Portfolio Timeliness	3	3	3	3
4. Agency guidance	3	3	3	3
5. Portfolio Accountability	2	2	2	2.5
*Overall score**	*83*	*86*	*91*	*97*

* The overall score is based on weighted calculations

2008 Portfolio Score Change Discussion:

In the area of Integration (1.4), the portfolio self assessment team decided to raise the score from 2.5 to 3.0. The rationale for the increase is from several angles. First, both the quality and the quantity of the integrated proposals funded increased from fiscal year 2006 to 2007. For example in 2007, the National Integrated Food Safety program awarded two large special emphasis grants in the amounts of $ 2.5 million each for addressing the spinach and lettuce E. coli contamination issue in a highly integrated manner involving stakeholders who participated in the beginning of the proposal writing and are currently serving on the advisory committees for the projects. These projects are integrated for both outreach and research to draw up on the success of each other. In a short period of time, these projects are already yielding encouraging outputs which are very likely to lead a solution to the issue. Second, in the same vein, epidemiological

approach to food safety program, which typically made research grants previously, has awarded grants with research and out reach components addressing the safety of fresh fruits and vegetables. Third, even though the NRI water program is offered as a research program, recent research funded at UC Davis on water borne pathogens was immediately moved into extension outreach during the spinach E. coli outbreak in California to share latest research on setbacks of livestock from irrigation streams and fields with fresh produce at numerous public meetings and fact sheets.

The team also increased the score for Multidisciplinary Balance (1.5) from 2.5 to 3.0. A large majority of the grants made in 2007 were not only multidisciplinary but also multi-institutional, multistate and multifunctional. This is especially apparent in the epidemiology and NIFSI grants. Selected examples are: 1) an integrated NIFSI grant made to the University of Georgia as the lead institute, included Illinois Institute of Technology, Clemson University, Michigan State University and National Center for Food Safety and Technology (FDA). The disciplines represented in this project are: microbiology, biochemistry, statistics, food technology, animal waste utilization, plant science, and extension. 2) Food safety priority area of NRI 75.0 Nanotechnology program has typically supported multidisciplinary research projects involving physical, chemical, biological, materials, and food scientists to develop nano-based sensors for monitoring safety and quality of foods, especially in real time. 3). Many water pathogens relating to irrigation for food production and processing studies use multiple expertise of microbiologists, veterinarians, engineers, modelers, animal scientists and horticulture specialists.

During the discussion, the team members brought up compelling reasons for increasing the score of Significance of Findings (2.1) from 2.0 to 2.5. Primary reason was the outputs that came from grantees in food security area. Critical food safety biosecurity measures have been developed since September 11 to prevent food terrorism, including surveillance, testing, training of producers and processors. Documented cases of attempted intentional food contamination and intervention have been addressed, and training to avoid future events has been implemented. A classical example is the results obtained by the University of Minnesota investigators in successfully developing the contents of the FoodShield, a web-based interactive networking fro food professionals and regulators. We are confidant that we would be using the outcomes of the project in the near future.

Likewise, the team increased the Portfolio Productivity score from 2.5 to 3.0. A significant addition this year is the capturing of extension funds expended on the food safety activities. In 2007, approximately $6.0 million were spent in food safety outreach activities. Significant activities are reflected in the document under portfolio activities, outputs and outcomes. Also in 2008, NRI nanotechnology program funded in excess of $1.0 million for development of nanotechnology based sensors for detecting intentional and unintentional contamination of foods. Development of a nano method to detect prions in the blood of cattle with mad cow disease is cited in the document.

Scores for Portfolio Comprehensiveness (3.2) and accountability (3.5) were also increased from 2.0 to 2.5. The grantees continued to leverage other resources using CSREES as base. In spite of a decrease in the CSREES funding for the portfolio, the leveraged money form non-CSRRES sources remained about the same (Table 1). Thus, even though the amount of CSREES funds was relatively small, the grantees covered a broad spectrum of research, education and extension activities outlined in the document. They are linking USDA projects to other funding to expand the impacts. As for accountability, completed projects are now reviewed through CRIS reports on a timely basis. Further, modifications to the CRIS system are expected to further enhance the quality of information that can be retrieved. Additionally, project directors' meetings are being conducted for each competitive program to measure the progress. Grantees' meetings enhanced the sense of accountability among grant recipients.

Appendix A – External Panel Recommendations to the Agency:

In response to directives from the Office of Management and Budget (OMB) of the President, CSREES implemented the Portfolio Review Expert Panel (PREP) process to systematically review its progress in achieving its mission. Since this process began in 2003, fourteen expert review panels have been convened and each has published a report offering recommendations and guidance. These external reviews occur on a rolling five-year basis. In the four off years an internal panel is assembled to examine how well CSREES is addressing the expert panel's recommendations. These internal reports are crafted to specifically address the issues raised for a particular portfolio; however, despite the fact that the expert reports were all written independent of one another on portfolios comprised of very different subject matter, several themes common to the set of review reports have emerged. This set of issues has repeatedly been identified by expert panels and requires an agency-wide response. The agency has taken a series of steps to effectively respond to those overarching issues.

- **Issue 1: Getting Credit When Credit is Due**
  For the most part panelists were complimentary when examples showing partnerships and leveraging of funds were used. However, panelists saw a strong need for CSREES to better assert itself and its name into the reporting process. Panelists believed that principal investigators who conduct the research, education and extension activities funded by CSREES often do not highlight the contributions made by CSREES. Multiple panel reports suggested CSREES better monitor reports of its funding and ensure that the agency is properly credited. Many panelists were unaware of the breadth of CSREES activities and believe their lack of knowledge is partly a result of CSREES not receiving credit in publications and other material made possible by CSREES funding.

  Issue 1: Agency Response:
  To address the issue of lack of credit being given to CSREES for funded projects, the Agency implemented several efforts likely to improve this situation in 2005.

  First it developed a standard paragraph about CSREES's work and funding that project managers can easily insert into documents, papers and other material funded in part or entirely by CSREES.

  Second, the Agency is in the process of implementing the "One Solution" concept. One Solution will allow for the better integration, reporting and publication of CSREES material on the web. In addition, the new Plan of Work (POW), centered a logic model framework, became operational in June 2006. The logic model framework is discussed in more detail below. Because of the new POW requirements and the POW training conducted by the Office of Planning and Accountability (also described in more detail below), it will be simpler for state and local partners to line up the work they are doing with agency expenditures. This in turn will make it easier for project managers to cite CSREES contributions when appropriate.

- **Issue 2: Partnership with Universities**
  Panelists felt that the concept of partnership was not being adequately presented. Panelists saw a need for more detail to be made available. Questions revolving around long-term planning between the entities were common as were ones that asked how the CSREES mission and goals were being supported through its partnership with universities and vice versa.

  Issue 2: Agency Response:
  CSREES has taken several steps to strengthen its relationship with university partners. First, to the extent possible, implementing partners will be attending the CSREES strategic development exercise which is intended to help partners and CSREES fully align what is done at the local level. Second, CSREES has realigned the state assignments for its National Program Leaders (NPLs). Each state is now assigned to one specific NPL. By reducing the number of states on which any individual NPL is asked to concentrate and assigning and training NPLs for this duty, better communication between state and NPLs should occur. Finally, several trainings that focused on the POW were conducted by CSREES in geographic regions throughout the country. A major goal of this training was to better communicate CSREES goals to state leaders which will facilitate better planning between the universities and CSREES.

- **Issue 3: National Program Leaders**
  Without exception the portfolio review panels were complimentary of the work being done by NPLs. They believe NPLs have significant responsibility, are experts in the field and do a difficult job admirably. Understanding the specific job functions of NPLs was something that helped panelists in the review process. Panelists did however mention that often times there are gaps in the assignments given to NPLs. Those gaps leave holes in programmatic coverage.

  Issue 3: Agency Response:
  CSREES values the substantive expertise that NPLs bring to the Agency and therefore requires all NPLs to be experts in their respective fields. Given the budget constraints often times faced by the agency, the agency has not always been able to fund needed positions and had to prioritize its hiring for open positions. In addition, because of the level of expertise CSREES requires of its NPLs, quick hires are not always possible. Often, CSREES is unable to meet the salary demands of those it wishes to hire. It is essential that position gaps not only be filled but that they be filled with the most qualified candidate.

  Operating under these constraints and given inevitable staff turnover, gaps will always remain. However, establishing and drawing together multidisciplinary teams required to complete the portfolio reviews has allowed the Agency to identify gaps in program knowledge and ensure that these needs are addressed in a timely fashion. To the extent that specific gaps are mentioned by the expert panels, the urgency to fill them is heightened.

- **Issue 4: Integration**
  Lack of integration has been highlighted throughout the panel reviews. While review panelists certainly noted in their reports where they observed instances of integration, almost without fail panel reports sought more documentation in this regard.

  Issue 4: Agency Response:
  Complex problems require creative and integrated approaches that cut across disciplines and knowledge areas. CSREES has recognized the need for these approaches and has undertaken steps to remedy this situation. CSREES has recently mandated that up to twenty percent of all NRI funds be put aside specifically for integrated projects. These projects cut across functions as well as disciplines and ensure that future Agency work will be better integrated. Finally, integration is advanced through the portfolio process which requires cooperation across units and programmatic areas.

- **Issue 5: Extension**
  While most panels seemed satisfied at the level of discussion that focused on research, the same does not hold true for extension. There was a call for more detail and more outcome examples based upon extension activities. There was a consistent request for more detail regarding not just the activities undertaken by extension but documentation of specific results these activities achieved.

  Issue 5: Agency Response:
  Outcomes that come about as a result of extension are, by the very nature of the work, more difficult to document than the outcomes of a research project. CSREES has recently shuffled its strategy of assigning NPLs to serve as liaisons for states. In the past, one NPL might serve as a liaison to several states or a region comprised of states. Each state will be assigned a specific NPL and no NPL will serve as the lead representative to more than one state. This will ensure more attention is paid to extension activities.

  In addition CSREES also has been in discussion with partners and they have pledged to do their best to address this issue. The new POW will make extension-based results and reporting a priority. Placing heavy emphasis on logic models by CSREES will have the effect of necessitating the inclusion of extension activities into the state's POWs. This, in turn, will require more reporting on extension activities and allow for improved documentation of extension impact.

- **Issue 6: Program Evaluation**
  Panelists were complimentary in that they saw the creation of the Office of Planning and Accountability and portfolio reviews as being the first steps towards more encompassing program evaluation work; however, they emphasized the need to see outcomes and often stated that the scores they gave were partially the result of their own personal experiences rather than specific program outcomes documented in the portfolios. In other words, they know first hand that CSREES

is having an impact but would like to see more systematic and comprehensive documentation of this impact in the reports.

Issue 6: Agency Response:
The effective management of programs is at the heart of the work conducted at CSREES and program evaluation is an essential component of effective management. In 2003 the PREP process and subsequent internal reviews were implemented. Over the past three years fourteen portfolios have been reviewed by expert panel members and each year this process improves. NPLs are now familiar with the process and the staff of the Planning and Accountability unit has implemented a systematic process for pulling together the material required for these reports.

Simply managing the process more effectively is not sufficient for raising the level of program evaluations being done on CSREES funded projects to the highest standard. Good program evaluation is a process that requires constant attention by all stakeholders and the agency has focused on building the skill sets of stakeholders in the area of program evaluation. The Office of Planning and Accountability has conducted training in the area of evaluation for both NPLs and for staff working at Land-Grant universities. This training is available electronically and the Office of Planning and Accountability will be working with NPLs to deliver training to those in the field.

The Office of Planning and Accountability is working more closely with individual programs to ensure successful evaluations are developed, implemented and the data analyzed. Senior leadership at CSREES has begun to embrace program evaluation and over the coming years CSREES expects to see state leaders and project directors more effectively report on the outcomes of their programs as they begin to implement more rigorous program evaluation. The new POW system ensures data needed for good program evaluation will be available in the future.

- **Issue 7: Logic Models**
  Panelists were consistently impressed with the logic models and the range of their potential applications. They expressed the desire to see the logic model process used by all projects funded by CSREES and hoped not only would NPLs continue to use them in their work but, also, that those conducting the research and implementing extension activities would begin to incorporate them into their work plans.

  Issue 7: Agency Response:
  Logic models have become a staple of the work being done at CSREES and the Agency has been proactive in promoting the use of logic models to its state partners. Two recent initiatives highlight this. First, in 2005, the POW reporting system into which states submit descriptions of their accomplishments was completely revamped. The new reporting system now closely matches the logic

models being used in portfolio reports. Beginning in fiscal year 2007, states will be required to enter all of the following components of a standard logic model. These components include describing the following:

- Program Situation
- Program Assumption
- Program Long Term Goals
- Program Inputs which include both monetary and staffing
- Program Output which include such things as patents
- Short Term Outcome Goals
- Medium Term Outcome Goals
- Long Term Outcome Goals
- External Factors
- Target Audience

The system is now operational and states were required to begin using it in June of 2006. By requiring the inclusion of the data components listed above states are in essence, creating a logic model that CSREES believes will help improve both program management and outcome reporting.

The second recent initiative by CSREES regarding logic models concerns a set of training sessions conducted by Planning and Accountability staff. In October and November of 2005 four separate training sessions were held in Monterrey, California, Lincoln, Nebraska, Washington D.C. and Charleston, South Carolina. More than 200 people representing land-grant universities attended these sessions where they were given training in logic model creation, program planning, and evaluation. In addition, two training sessions were provided to NPLs in December 2005 and January 2006 to further familiarize them with the logic model process. Ultimately it is hoped these representatives will pass on to others in the Land-Grant system what they learned about logic models thus creating a network of individuals utilizing the same general approach to strategic planning. These materials also have been made available to the public on the CSREES website.

Appendix B - Detailed Funding Tables for Primary KAs – CSREES Funding:

KA 711: Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources CSREES Funding (as reported by the Current Research Information System and Plan of Work Annual Report						
Funding Source	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	**Total**
Hatch	$823.00	$890.00	$849.00	$774.00	$872.00	$4,208
McIntire-Stennis	$0.00	$0.00	$0.00	$0.00	$0.00	$0
Evans Allen	$0.00	$110.00	$106.00	$165.00	$175.00	$556
Animal Health	$180.00	$4.00	$15.00	$1.00	$25.00	$225
Special Grants	$3,165.00	$2,529.00	$3,240.00	$2,796.00	$2,198.00	$13,928
NRI Grants	$202.00	$667.00	$665.00	$404.00	$297.00	$2,235
SBIR Grants	$444.00	$0.00	$296.00	$184.00	$394.00	$1,318
Other CSREES	$1,178.00	$764.00	$1,113.00	$1,537.00	$1,573.00	$6,165
Total Reported in CRIS	$5,992.00	$4,964.00	$6,284.00	$5,859.00	$5,534.00	$28,633
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$1,149.40	$1,149.40
1890 Extension	n/a	n/a	n/a	n/a	$118.94	$118.94
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$1,268.34	$1,268.34
Combined CSREES Total	$5,992.00	$4,964.00	$6,284.00	$5,859.00	$6,802.34	$29,901.34

*n/a = Funding data are not available for that fiscal year

KA 712: Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins CSREES Funding (as reported by the Current Research Information System)						
Funding Source	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	**Total**
Hatch	$2,605	$3,076	$3,196	$3,124	$4,043.00	$16,044
McIntire-Stennis	$0	$0	$0	$0	$0.00	$0
Evans Allen	$961	$1,757	$947	$873	$886.00	$5,424
Animal Health	$86	$117	$239	$90	$147.00	$679
Special Grants	$7,510	$6,977	$7,483	$6,929	$0.00	$28,899
NRI Grants	$6,803	$6,195	$11,970	$8,604	$7,086.00	$40,658
SBIR Grants	$150	$305	$555	$579	$849.00	$2,438
Other CSREES	$9,817	$11,274	$11,208	$9,765	$9,515.00	$51,579
Total Reported in CSREES	$3,652	$4,950	$35,598	$29,964	$22,526.00	$96,690
Smith-Lever 3(b) and (c)	n/a	n/a	n/a	n/a	$4,213.42	$4,213.42
1890 Extension	n/a	n/a	n/a	n/a	$479.49	$479.49
Total Extension Reported in POW	n/a	n/a	n/a	n/a	$4,692.91	$4,692.91
Total CSREES	$27,932	$29,701	$35,598	$29,964	$27,219	$150,414

*n/a = Funding data are not available for that fiscal year

Appendix C - Detailed Funding Tables for Primary KAs – All Known Funding:

KA 711: Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources Overall Funding (as reported by the Current Research Information System)						
Funding Source	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	**Total**
CSREES Admin	$5,991	$4,965	$6,284	$5,859	$6,802.34	$29,901
Other USDA	$416	$403	$358	$604	$740	$2,521
Other Federal	$2,099	$1,692	$2,970	$1,441	$2,290	$10,492
State Appr.	$4,718	$5,411	$6,364	$5,601	$7,079	$29,173
Self-Gen	$1,272	$1,315	$2,482	$1,835	$2,207	$9,111
Ind/Gr Agrmt	$911	$846	$890	$744	$1,317	$4,708
Other Non-Fed	$577	$430	$935	$659	$1,063	$3,664
Total	$13,855	$15,985	$15,062	$20,283	$16,744	$81,929

KA 712: Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins Overall Funding (as reported by the Current Research Information System)						
Funding Source	FY 2003	FY 2004	FY 2005	FY 2006	FY2007	**Total**
CSREES Admin	$27,931	$29,701	$35,598	$29,964	$27,219	$150,413
Other USDA	$2,419	$3,937	$3,436	$2,486	$2,857	$15,135
Other Federal	$7,789	$5,745	$10,674	$7,942	$8,115	$40,265
State Appr.	$21,789	$22,470	$23,044	$20,538	$24,581	$112,422
Self-Gen	$2,200	$2,468	$2,802	$2,666	$2,977	$13,113
Ind/Gr Agrmt	$3,834	$3,716	$4,059	$2,712	$3,881	$18,202
Other Non-Fed	$2,386	$1,892	$2,742	$1,614	$3,180	$11,814
Total	$68,349	$69,929	$82,355	$67,922	$68,118	$356,673

Appendix D - List of Supporting Programs:

Since food safety is an issue cutting across the agriculture system (from soil/water to food ready for consumption) several programs cross cut with food safety. The following areas with respective knowledge area support food safety.

Animal Health
Animal Biosecurity
Plant Biosecurity
Invasive Species
Animal Manure Management
Aquaculture
Biotechnology Risk Assessment
Higher Education
Improving Food Quality and Value
Integrated Pest Management
Education, International Science
Microbiology
Microbial Genomics
Nano Scale Science and Engineering
Water Quality
Water and Watersheds

Appendix E - Partnering Agencies and Other Organizations:
There were no partnering agencies providing direct support for the food safety portfolio during this reporting period.

Appendix F - Program Evaluations*:*

Portfolio Program Evaluations

1. For special Emphasis Research Grant made to a consortium of four Universities led by the University of Georgia, NPLs have participated in quarterly teleconferences and participated in the face-face meeting of the technical/advisory committee on August 7, 2008 held in conjunction with the Annual Meeting of the International Association of Food Protection (IAFP) in Columbus, OH, to assess the progress of the grant made in 2007 under the NIFSI program. In general, the progress was very good. The following recommendations were provided by the committee and the NPL.

- Drop the bacterial phage experiment to control the E. coli on the surface of manure composts, since the preliminary results were not encouraging. The project director and other PIs felt that this was a good recommendation and indicated that they would drop the experiment and redirect the resources to other experiments within the manure compost area.

- While the internalization of E. coli by lettuce leaves was demonstrated in the laboratory experiment, the committees raised a number of questions in order to steer the experiment reflect field conditions, while appreciating the difficulties involved.

- In addition to the meeting above, a Special Session of a Round Table on Leafy Greens: An Integrated Risk Management Approach was held by the grantees under the aegis of this grant.

2. At the same IAFP meetings (see above), The PI of a special research grant at Cornell was asked by the NPL to organize a stakeholder input meeting in order gain a better insight into the direction of the research and outreach. The PI contacted several potential stakeholders including, CDC, Industry, Universities, and FDA. Representatives from all the entities were represented at the IAFP Meeting.

- There were a variety of suggestions to improve the project but the one that stood out was an increased collaboration with CDC to enhance attribution in the area of food borne illness, especially in the area of molecular epidemiology.

3. An on-site review was conducted by the NPL for a grant provided to the University of Minnesota in Food Defense area in 2006 under the NIFSI program. The goal of this grant was to evaluate the usefulness of the Association of Food and Drug Officials (AFDO) web-based system to provide timely access to information and identify specific gaps in threat prevention activities, identify and meet educational needs of food regulatory personnel, and enhance the ability of the National Environmental Health Association (NEHA) and the Extension Service to provide food protection and defense outreach activities to their stakeholders.

- The investigators were making excellent progress and no suggestions were made to change the course. As per the 2007/08 progress report, they have built a "food shield" -a web-based platform that is creating community between the varied entities that make up our national food and agricultural sectors. Secure, integrated resources give state departments of agriculture and health and their affiliated laboratories the ability to communicate and coordinate with their peers in other states.

4. During routine review of the Food Science and Technology programs at Land Grant Universities, projects funded by the Food Safety Portfolio program were also part of the broader cursory review. These institutions included: North Carolina State University, University of Idaho, University of Nebraska, Purdue University, Rutgers University, University of Wisconsin, Iowa State University, and Oregon State University.

Appendix G- Integrated and Multidisciplinary Activities, Output, and Outcomes

Integrated Activities, Output, and Outcomes

Fresh Fruits and Vegetables

Researchers at Cornell University have developed an online bi-lingual (Spanish) Good Agricultural Practices (GAPs) education course and asses the courses impact on participants. Two pilot courses of the GAPsOPSC have been conducted with twenty-eight individuals having completed the course including all written requirements and online submissions. The biggest impact is that many participants responded that they were now ready to begin writing a farm food safety plan and had learned how to begin implementing GAPs. The initial post-course surveys also indicate improvements in knowledge regarding trace back, food safety hazard identification, and sanitation practices.

Researchers at the University of Georgia plan to develop a systems approach to minimize *Escherichia coli* O157:H7 food safety hazards associated with fresh- and fresh-cut leafy greens. Information generated from this project will assist in providing guidance to farmers as to the risk associated with harvesting of leafy greens when field contamination events have occurred.

Researchers at Purdue University and Michigan State University are working to improve the Safety of Fresh Fruits and Vegetables Using Chlorine Dioxide Gas in a miniaturized industrial-sized tunnel system. This research has shown that ClO_2 gas technology provides more than a 5 log reduction, as recommended by FDA for produce surfaces, for E. coli O157:H7, Salmonella, and Listeria making this technology 1000 times better than other existing antimicrobial treatments. Optimal gas treatments also enhance product quality without leaving dangerous levels of chemical residues. This technology has tremendous potential to be used as a powerful antimicrobial agent for fresh fruit and vegetables.

Education

Researchers at Delaware State University developed a food safety workshop for Teachers/Students and Caregivers to Meet the Changing Demographics of the State. They recruited 20 high school students during the summer and provided them with lectures and laboratory experiences on the causes of foodborne illness, common symptoms, risk factors, poor and good food handling practices, list of common food borne pathogens, and the proper methods of cooking and storing foods. Three courses, Introduction to HACCP, Introduction to Nutrition and Advanced Nutrition, were either developed or modified to increase food safety awareness for nutrition students. Eighty students have enrolled to date. The high school students who participated in the workshop are more than willing to change the way they handle foods and prepare foods and the undergraduate students were given an opportunity to gain knowledge in food safety where they traditionally would not have been exposed.

Listeria

This collaborative project includes research, outreach and education components aimed at reducing the risk of listeriosis by intervening at the processing, retail/foodservice, and consumer levels. Eight industry workshops, comprised of 12-34 attendees each, were conducted at meetings of various associations (e.g., American Meat Institute, American Association of Meat Processors, North American Meat Processors Association, and National Meat Association), and in conjunction with state meat processor association annual meetings, regional meetings of processor associations or product shows, in order to help small and very small RTE meat processors meet regulatory requirements for pathogen control. Topics of discussion at these workshops included regulatory requirements, *L. monocytogenes* control strategies, designing sanitary facility/equipment, developing valid sampling plans, data analysis, root cause identification and corrective actions, validation of intervention strategies and product tasting. Product tasting was an integral part of these workshops as the processors were able to evaluate product quality impacts from the interventions for *L. monocytogenes* control. In addition, two train-the-trainer workshops, consisting of 20 or more attendees each, were conducted at national meetings (American Meat Science Association's Reciprocal Meats Conference, International Association for Food Protection) with the goal to train food safety and meats extension specialists on the intricacies of the *L. monocytogenes* Control Final Rule, the USDA-FSIS Compliance Guidelines for control of *L. monocytogenes*, *L. monocytogenes* control strategies, preparing for a food safety audit and how small and very small RTE meat and poultry processors can adapt strategies to minimize *L. monocytogenes* risks in their operations. In addition, complete materials for small industry workshops including CDs with PowerPoint presentations as well as supporting materials were made available to facilitate presentation of additional workshops by extension agents. A *Listeria* Control Input and Planning Workshop was held in Colorado as a pre-conference workshop of the Food Safety Education Conference; more than 70 participants contributed input during breakout sessions dealing with each objective of the project at the processing, retail/food service and consumer education stages of the food

chain. Also, a two-part symposium on "*Listeria monocytogenes* Control in Ready-to-eat Meat and Poultry Products: Post-processing Issues" was held at an annual meeting of the Institute of Food Technologists, where findings from the project were disseminated to a scientific audience. For the education component of the project, three webinars on "Promoting Safe Food Practices during Pregnancy, with Emphasis on *Listeria*" for WIC (i.e., Women, Infants, and Children) nutritionists were conducted, and involved 325 health professionals from 45 states and one territory. Fifteen food safety workshops were held in Colorado with 219 seniors, and 11 focus groups were conducted with women of child-bearing age and senior women in Colorado and Ohio on the topic: Consumer Assessment of Safety and Date Labeling Statements on Ready-to-eat Meat and Poultry Products. The focus groups assessed consumer awareness of *L. monocytogenes* and use of risky food consumption and storage practices, opinions on common date labels used on perishable items as well as government recommended safety labels, and food safety education needs of consumers. The research component of the project has at this point produced 45 posters or oral presentations at professional meetings, and resulted in 16 publications in refereed scientific journals, which, within a year have led to almost 30 citations. To-date, four visiting scientists and three postdoctoral fellows have been involved in the project, while, the project has resulted in five Master of Science thesis projects and three PhD dissertations. Additional outputs include several research reports and magazine articles.

Researchers at Iowa State University are improving the control of bacterial pathogens on ready-to-eat processed meats that are manufactured to simulate traditionally cured meats but without direct addition of nitrite or nitrate. This research is expected to provide the information necessary to improve the safety assurance of ready to eat cured meat products and prevent food poisoning outbreaks that could occur with consumer mishandling of natural and organic cured meat products.

Researchers at Ohio State University are working on a project which focuses on a highly vulnerable group, pregnant women and their unborn children. An intervention is developed and implemented with two specific target audiences: low income English speaking pregnant women and low income Spanish speaking pregnant women. Knowledge of behaviors related to avoiding cross-contamination (cutting board and dish cloth sanitation) and do not show improvement in any group. These behaviors related to risk of *Salmonella* contamination. Participants either already know or are not learning the correct use of date labeling as a guide to safety of luncheon or deli meats. This behavior is related to risk of *Listeria monocytogenes* contamination. Hand washing before food preparation improved among all groups. This behavior related to both *Salmonella* and *Listeria monocytogenes* control. Checking the temperature of the refrigerator improved among all groups, and especially in the Experimental groups (based on magnitude of pre to post change). Participants in the experimental group were given a refrigerator thermometer as an incentive and instructed on its proper location and use. Fewer participants reported consumption of undercooked eggs (runny yolks and unbaked cookie dough) post than pre in some groups, especially overall, in the Experimental group and among English-speaking participants. These foods are associated with *Salmonella* contamination. Self-reported consumption of cold hot dogs or cheeses made

with unpasteurized milk, or queso fresco did not change for any group. These foods are associated with *Listeria monocytogenes* contamination. Fewer participants in some groups reported consumption of unpasteurized juices, deli meats and raw milk post vs. pre education. Notably, unpasteurized juices and raw milk are more traditional for Spanish-speaking groups and desired changes pre to post intervention were not seen. These foods can be associated with either pathogen.

Salmonella

Researchers at the University of Nebraska, Lincoln are working to improve the safety of Shell Eggs and Egg Products by Addressing Critical Research Needs for *Salmonella* Enteritidis and *Salmonella* spp. Two papers have been published resulting from the project so far. Heat transfer models for cooling of eggs have been developed, and dynamic growth model for *Salmonella* Enteritidis (SE) in egg yolk has been developed. The models were integrated to develop a tertiary model that could predict the potential growth of SE in egg yolks in case the eggs are contaminated. We have provided the research to the egg processing industry. While the industry currently has not used the models, these will be critical to evaluate the safety of the egg cooling practices followed in the egg processing industry. These models can be used by the industry, regulators as well as food safety policy personnel (USDA-FSIS) to evaluate the risk of salmonellosis from eggs and egg products and identify risk reduction and management strategies.

Pork Safety

Researchers at Iowa State University plan to improve the safety of moisture enhanced pork by evaluating the potential microbiological concerns, developing a quantitative risk assessment, identifying critical control points in the process, and developing educational materials to convey this information to industry. The major outcomes of this project will clearly identify the points, steps or procedures which are most important in controlling microbial contamination during the moisture enhancement of pork. This knowledge, when disseminated to the industry, will allow the processors to establish effective quality control and HACCP procedures to reduce the risk. This knowledge will also benefit regulatory personnel in the further understanding of the process, and allow them to provide guidance to inspection personnel. An interim report has been presented to the National Pork Board regarding microbiological concerns with the process.