

## National Integrated Food Safety Initiative Post Award Management Meeting

### ABSTRACTS

#### **Consumer Risk Perception and Food Thermometer Use Among Food Assistance Recipients.**

**Kofi Adu-Nyako**

**North Carolina A&T State University**

Despite the extolled benefits of using thermometers during food preparation and food handling, there seems to be a rather low usage of thermometers among food preparers and handlers. Public health food safety interventions, including educational campaigns, will be more effective if we knew the factors that influence the use of thermometers in food preparation.

We used survey data to analyze attitudinal, risk perception, and sociodemographic factors associated with consumer use of food thermometers. A bivariate probit model of thermometer use for three different food sizes, large roast, chicken, and thermometer ownership was estimated. We used model thermometer as function of risk perception, attitudes, illness experience, and individual social and demographic variables. Results indicating differences in the attitudes towards food safety risk and use of thermometers in food preparation may imply the need to tailor and target educational messages to the specific demographic groups more likely to be at risk. Food assistance in the WIC and Food Stamps programs tended to influence positively the likelihood of an individual using food thermometers, which seems to imply some beneficial aspects, perhaps food safety education provided to participants impacting the decision to use food thermometer.

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#### **National Center for Home Food Processing and Preservation**

**Elizabeth L. Andress**

**University of Georgia**

Home food preservation remains a popular cultural activity but one with important public health implications. It is critical to provide those involved in the practice with the most reliable information available concerning food safety and food quality. The National Center (NCHFP) was a multi-institutional effort with the University of Georgia and Alabama A&M University as the primary institutions. The NCHFP conducted survey research for needs assessment: laboratory research for 26 new product recommendations, low-fat formulations of sausages, microwave blanching of vegetables, survival of *L. monocytogenes* in refrigerator dill pickles, impact of certain consumer practices on heat penetration, acidification levels needed for home canned salsas, and sensory parameters of peaches canned with sucralose; updated USDA recommendations in the Complete Guide to Home Canning and Complete Guide to Home Freezing bulletins and on the Internet; developed educational materials including a dedicated Web site, an online self-study course on home canning, a video series, slide shows, and other educator resources; is completing a Master Food Preserver curriculum; and provided education through in-service training of extension educators as well as graduate students. Gaps that still exist in research data which could provide additional recommendations requested from the public and educators have been identified.

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#### **Reducing Microbial Hazards in Raw Produce through Farm Worker Education**

**Betsy Bihn**

**Cornell University**

As part of the National Good Agricultural Practices (GAPs) Program at Cornell University, this project focused specifically on farm worker education to reduce microbial risks in fresh produce. Educational topics include the practice of proper hygiene in fields and packinghouses, as well as ways to protect and insure the health of workers on the job and at home with their families. Completed materials include a poster series, training video, two photo novels, a field hygiene training booklet, coloring book, and magnets. All materials were printed in English and Spanish. In addition to the creation of new materials, some existing documents were translated into Spanish for this project. Originally funded in 2000, this project was completed in 2005. This summary presentation focused on the educational materials that were created, their design, and focus group testing. There was significant focus on the challenges that were encountered as well as how they were overcome to meet the needs of several different cultural groups with diverse language issues.

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**Food Safety and Food Irradiation Education**  
**Christine Bruhn**  
**University of California, Davis**

Foodborne illness is likely to decrease if consumers select meat and poultry processed by irradiation. The project goal is to increase consumer knowledge of irradiation by informing health professionals and the public as to the role of irradiation in enhancing food safety. Further educational resources were developed to extend the potential to deliver accurate information about this technology. Collaborators in each state delivered educational information to the public, cooperative extension educators, other health educators, supermarket personnel, and others. Additionally, a symposium was delivered at the International Association for Food Protection. Irradiation was presented as an additional barrier to transmission of foodborne disease. Consumer surveys and simulated market experiments are conducted. Where irradiated meat was available, educational programs were presented in the supermarket. Some states developed their own educational displays and brochures with general information about irradiation. Minnesota focused its program to consumer and school board questions surrounding the opportunity to order irradiated ground beef in school lunch. The curriculum, "Serve it Up Safety TM," and the "Food Safety First," developed for the School Food Safety and Irradiation Education Project in Minnesota, are available. The videotape "Food Irradiation: Behind the Headlines" and the curriculum packet, which includes references, brochures, sample teaching outlines, marketing information, and an evaluation instrument, are available from Purdue University. A brochure in English and Spanish responding to consumer questions is available for free download at the University of California. After receiving information on irradiation, the majority of consumers responded that they will purchase irradiated food. Supermarket sales of irradiated beef and offerings in restaurants increased until the major provider went out of business. Educational materials are in place should market availability of safety-enhanced irradiated meat increase.

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**Characterization of the Cadmium Health Risk, Concentrations and Ways to Minimize Cadmium Residues in Shellfish**  
**Daniel Cheney, Michael Morrissey, Pacific Shellfish Institute, Oregon State University**

International public health organizations recently proposed lowering the maximum level for cadmium in molluscan shellfish tissue to as low as 1 µg/g in an effort to protect consumers from long-term exposure to low levels of the metal. Limited testing of farmed shellfish worldwide indicates that it is not uncommon for certain species and growing areas to exceed both the proposed action level and the U.S. Food and Drug Administration's 3.7-µg/g level of concern. Shellfish imported from certain waters in Washington, Alaska, and British Columbia increasingly are being rejected by public health officials in Europe and Hong Kong. In response, the Oregon

State University Seafood Laboratory, in collaboration with research and extension organizations, engaged in a 2-year study to:

- determine the spatial distribution of cadmium concentration in Pacific oyster tissue harvested from west coast commercial, recreational, and tribal shellfish growing areas,
- evaluate sources and factors that may influence oyster cadmium concentrations and uptake rates,
- study cadmium assimilation efficiencies, efflux rates, and filtration rates in a controlled laboratory environment,
- determine ways to minimize cadmium residues in shellfish products, and
- assess impacts to the shellfish industry.

Included in the presentation are results from Year 1 and an overview of Year 2's ongoing experiments and activities.

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**Food Safety FIRST: Online Education for Science Teachers**  
**Nancy Cohen, and Lynne McLandsborough**  
**University of Massachusetts, Amherst**

Dissemination of food safety principles through science classrooms is one route to providing consumers with food handling information and skills. In conjunction with the National Science Teachers Association, the food safety attitudes, knowledge, and behaviors of 221 science teachers were surveyed. Baseline data showed only 37 percent were comfortable with teaching food safety; less than 1/3<sup>rd</sup> provided food safety classroom education. In response, "Food Safety FIRST" was developed to focus on inquiry-based learning and incorporate food safety principles into secondary science education standards. Food Safety FIRST consisted of 3 15-hour online modules with readings, activities, and discussions, a CD-ROM with videos of lab techniques, interactive activities, lab reports, PowerPoint presentations, and a laboratory supply kit. Over 150 teachers participated, significantly increasing food handling practices and gaining comfort in teaching food safety. Follow-up surveys indicated teachers taught food safety for an average of 12.4 hours, with an average of 67 students. Preliminary youth surveys indicated that most were knowledgeable about food safety, but did not always practice safe handling. Participating youth reported discussing food safety with family. Thus, online education of science teachers is an effective way to increase food safety education in the classroom, and disseminate information to youth and families.

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**Germ City: Clean Hands, Healthy People,**  
**Susie B. Craig**  
**Washington State University**

Handwashing is the single-most important barrier to the spread of foodborne disease according to the Centers for Disease Control. "Germ City: Clean Hands, Healthy People Program" is a unique, highly successful interactive exhibit, education, and research program that has reached 400,000 participants. Washington State University, West Virginia University, Alabama A & M University, University of Hawaii, and the University of Idaho are program collaborators for this project, funded as part of the National Integrated Food Safety Initiative of the Integrated Research, Education, and Extension Competitive Grants Program.

Program goals:

- enhance awareness of the importance of handwashing using science-based education;
- improve effectiveness and frequency of handwashing among audiences in rural and urban settings and in at-risk population groups;
- modify attitudes, enhance personal motivation, and facilitate behavior change; and

- generate a data/research base to support future study and evaluate effectiveness of handwashing education programs.

The primary function of Germ City: Clean Hands, Healthy People Program is to facilitate cognitive-behavioral change in handwashing behaviors to foster a more healthful quality of life. Research showing intent to change and observational studies conducted at Germ City events at fairs and festivals and in schools was highlighted.

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### **Food Safety Training for the Foodservice Industry**

**Angela Fraser**

**North Carolina State University**

Nearly 50 percent of reported cases of foodborne illness are attributed to foodservice operations. Many states train retail food workers as a way to reduce foodborne illness. These training programs are limited because often they do not address many of the barriers that foodservice operators face. Foodborne illness is nearly 100 percent preventable if one knows and then applies safe food handling practices. Lack of effective training is one reason foodborne illness may still be a problem.

Educational tools were developed in all three projects to help food safety educators deliver more effective training. Because food safety is so complex, an educator needs to first meet a level of competency in the area of food safety before delivering a training program. A list of 103 competencies that educators should master was prepared in 2004. Backgrounders for each competency were developed and posted on the Web site [www.foodsafetysite.com](http://www.foodsafetysite.com). Evaluation tools, activities, and other supplemental information are also posted on this Web site.

A research study was conducted to identify beliefs that impede adoption of safe food handling practices. Six focus groups and 99 face-to-face interviews were used to collect data. Two important themes emerged from the focus groups: pressures of working in foodservice, such as the demands of preparing food, supervision, customer demands, financial pressures, and regulatory requirements, and; the implications of these pressures. Preliminary results from the interview data showed that when asked about the relationship between specific food safety practices and foodborne illness, most repeated food safety information learned in a training program. Many also reported that you get food poisoning from eating at fast food restaurants or places staffed by teens or by eating mishandled chicken. Respondents reported the frequency of foodborne illness as a rate, percentage of population, or a specific number. Furthermore, 57.7 percent said that they were very or somewhat likely to get foodborne illness; 42.3 percent said they were somewhat or very unlikely to get foodborne illness.

After English and Spanish, Chinese is the most commonly spoken language in foodservice. Preparing culturally-appropriate materials in Chinese is essential to helping this important population group have access to food safety information. A Web site, 243 training slides based on the 2005 Food Code, 14 summaries that correspond with the training slide set, 6 interactive online activities, music with food safety themes, and a videotape have been developed or in various stages of development. These materials were designed to be used by both Chinese- and English-speaking food safety educators.

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### **Control Strategies for *Listeria monocytogenes* in Food Processing Environments**

**Ken Gall and Martin Wiedmann**

**Cornell University**

The goal of this project was to integrate research and outreach efforts to develop, evaluate, and deliver science-based control programs for *Listeria monocytogenes*, with a particular focus on the Ready-To-Eat (RTE) seafood industry. Ten RTE seafood processing plants (4 smoked fish plants, 4 crab plants, and 2 crawfish plants) located in the United States were selected to initially characterize *L. monocytogenes* transmission patterns for 1 year through sampled collection and *Listeria* testing, including DNA fingerprinting of isolates, in each plant. Year 1 data were used to define plant-specific *Listeria* transmission patterns and to implement and evaluate plant-specific *Listeria* control strategies and employee training programs in each plant. Smoked seafood processing plants showed a significant decrease in environmental *Listeria* prevalence after implementation of control strategies, including one processing plant which decreased finished product *L. monocytogenes* prevalence from 4.6 percent prevalence before full implementation of control strategies to 0.33 percent prevalence after implementation. Data and experiences from these field studies were used to (i) develop and conduct a United States-wide series of 5 workshops on *Listeria* control in RTE seafood processing plants, which was attended by 170 individuals, and to (ii) develop a comprehensive Smoked Seafood Working Group *Listeria monocytogenes* Control Manual, which was published in a series of four peer-reviewed manuscripts and was incorporated into a the Association of Food and Drug Officials model, "Cured, Salted, and Smoked Fish Establishments Good Manufacturing Practices." In conclusion, this project has considerably improved the ability of the U.S. RTE seafood processing industry to control *Listeria monocytogenes*.

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### **Food Safety Education for the Prevention of Foodborne Illness Among U.S. Residents 65 and Older**

**Joye Gordon**

**Kansas State University**

Growing numbers of older adults, a heightened threat from foodborne pathogens, and known maladaptive food-handling practices drives the need for food-safety education to benefit the high-risk audience of U.S. residents 65 and older.

The objectives include:

- understand why mature adults choose to adopt or reject safe food-handling practices;
- develop, execute, and evaluate an extension education effort that provides effective food safety education for this high-risk audience; and
- develop, implement, and distribute a formal education component aimed at those who deliver health education, food-safety education, and related services to mature adults.

In the first year of this 3-year project, investigators conducted a national telephone survey and focus group research to identify determinants of safe food-handling behaviors. In the second year, a research-based extension education program was delivered and experimentally tested for effectiveness. Finally, a formal teaching component in the form of a professionally designed educational CD was developed and is being distributed through educators and members of the American Dietetic Association.

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### **Prioritizing Opportunities to Reduce the Risk of Foodborne Illness: A Conceptual Framework**

**Helen H. Jensen**

**Iowa State University**

Determining the best use of food safety resources is a difficult task faced by public policymakers and regulatory agencies, state/local health agencies, and private firms. The Food Safety Research Consortium (FSRC) developed a conceptual framework for priority setting and resource allocation for food safety that takes full account of the food system's complexity and available data, but is simple enough to be workable and of practical value to decision makers. The framework addresses how societal resources can be used most effectively to reduce the public health burden of foodborne illness. It quantitatively ranks risks and considers the availability, effectiveness, and cost of interventions to address the risks. We identify two types of priority-setting decisions: Purpose 1, to guide risk-based allocation of food safety resources, primarily by government food safety agencies, across a wide range of opportunities to reduce the public health impact of food borne illness; and Purpose 2, to guide the choice of risk management actions and strategies with respect to particular hazards and commodities. The framework incorporates the need to be grounded in a systems approach, multi-disciplinary in approach, and integration of data, practical, flexible, and dynamic by including ongoing evaluation and continuous updating. The conceptual framework synthesizes ideas and information generated in connection with three workshops. See the project Web site: [http://www.card.iastate.edu/food\\_safety/](http://www.card.iastate.edu/food_safety/).

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**Assessment of the Pathogenicity of *Campylobacter jejuni* from Broiler Chickens**  
**Lynn Joens**  
**University of Arizona**

Sixty-three of 435 (14.5 percent) samples collected from broiler chickens were positive for *C. jejuni*. Twenty-two of 55 samples were from organic chickens (40 percent) and 41 of 380 samples were from conventional chickens (10.8 percent). Genotyping of isolates indicated one to three profiles per flock. Of the organic isolates, only 3 (13.6 percent) were able to survive within macrophages, but for the conventional isolates, 21 of 41 (51.2 percent) were able to survive. For invasion, only 9.5 percent from both organic and conventional isolates were capable of invading epithelial cells. However, in piglet studies, regardless of the combination of *in vitro* results or type of flock, most piglets (16/25) in all groups exhibited hyperemia, edema, and hemorrhage in the small intestine or colon upon gross examination. Microscopic examination revealed congested mucosa and erosion of the epithelium in 10 of the 25 piglets. In conclusion, this study suggests that *C. jejuni* isolated from broiler chickens are virulent in piglets and are probably capable of causing disease in humans. Furthermore, the results of the *in vitro* assays did not correlate with the results of the piglet studies and cannot be relied upon to predict degree of virulence. Therefore, another virulence factor is responsible for the pathogenesis, such as a toxin(s). As this is the first study to confirm putative *in vitro* virulence traits with an animal model, further research is recommended with the piglet model to assess pathogenicity.

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**Food Safety for the Immune Suppressed/Compromised: A Multi-Media Approach**  
**Pat Kendall, Val Hillers, and Lydia Medeiros**  
**Colorado State University, Washington State University and Ohio State University**

The objectives include:

- understand the beliefs, motivators, and barriers that affect adoption of safe food handling practices among high-risk populations,
- assess food safety attitudes/beliefs of health care professionals working with high-risk populations, and
- develop and evaluate educational materials for high-risk populations.

We targeted pregnant women, cancer patients, HIV patients, and health professionals who work with these groups. Focus groups were used to determine food safety knowledge, practices, and preferences for education among the high-risk groups. Health professionals were interviewed.

Patient materials were developed from information learned in focus groups, interviews, and literature, and were based on the Health Belief Model. Acceptability of materials was assessed in a second round of focus groups with the same high-risk groups. An academic class was developed and taught to graduate students at the three participating universities. E-mail, video links and WebCT were used to facilitate interaction. Curriculum materials developed for the academic class and the outcomes of the focus groups and health professionals' interviews were the basis for an online continuing education course (Food Safety for High-Risk Populations) approved for 6 CEU hours for dietitians and nurses. Numerous peer-reviewed publications, research presentations, and outreach materials have resulted from these studies.

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### **Food Safety Education for High Risk Families: Pregnant Women, Infants, and Children (WIC)**

**Junehee Kwon**

**Texas Women's University**

WIC clients were selected as participants in this research project that assessed the food safety education needs of low-income families of diverse ethnic backgrounds. Surveys of state and local WIC directors and focus groups of WIC clients were conducted to identify food safety knowledge, practices, education needs, and preferred education methods. Based on results of surveys and focus groups, scripts were written to include Clean, Separate, Cook, and Chill principles for food handling for families that included infants and children. Two separate videotapes entitled "Food Safety for Families" were produced in English and Spanish and field-tested with 71 participants. Pre- and post-test analyses showed a significant increase in knowledge for both English and Spanish groups. As a supplement to the videotapes, a CD-ROM was developed that included additional resources (lesson plans, games, and activities). Each state WIC director was sent a set of two videotapes (English and Spanish) and the CD-ROM with permission to duplicate materials as needed. The education materials were also marketed and sold at cost through state professional meetings, county extension offices, and a curriculum center at another university. Through these marketing efforts, 100 videotapes and 50 CDs were sold, mostly within the state of Texas.

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### **The Food Safety Professional Development for Early Childhood Educators**

**Huey-Ling Lin**

**Alabama State University**

The goal of the project is to reduce the risk of foodborne illness in Alabama by developing a research-based food-safety education curriculum, creating a training module for dissemination of the curriculum, training early childhood administrative personnel and teachers in the implementation of the curriculum and the training of other early childhood personnel in its implementation, and disseminating the curriculum state-wide using the first cohort of trained personnel as trainers of others. A joint effort by several agencies has combined a variety of unique strengths for planning a cooperative food safety education training program for teachers. A total of seven training workshops have been conducted. Four mini-grants have been awarded to hosting local food safety training workshops. Self-report assessment instruments were administered before and after the training workshop to participants, focused on participants' perceptions of their knowledge of food safety and their skills in teaching children about food safety. Analysis of gain scores in the areas of food safety knowledge and instructional strategies knowledge revealed significant increases in both areas. There is evidence that the workshops are having their intended impact on participants, in increasing their knowledge about food safety, food safety practices, and instructional strategies for food safety.

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**Reducing Risk with Food Thermometers: Strategies for Behavior Change**  
**Sandra McCurdy**  
**University of Idaho**

The purpose was to increase consumers' use of food thermometers to test the endpoint temperature of small cuts of meats. The project included:

- market survey of thermometers,
- laboratory study of consumer cooking methods and of thermometer cleaning,
- use of focus groups to determine attitudes toward food thermometer use,
- development of educational materials using Transtheoretical and Health Belief models,
- development and validation of an instrument to measure consumer stages of behavior change for thermometer use,
- use of the educational materials and evaluation instrument to conduct and assess educational interventions among adults and youth, and
- a partnership with Washington and Idaho grocery stores to promote thermometer use.

Instant-read food thermometers were available in more than 73 percent of grocery stores and most were accurate within 1.1<sup>0</sup>C. Lethality findings include that ground beef patties should either be cooked in a two-sided grill or turned frequently during cooking. Focus group participants said the primary motivator to food thermometer use was avoidance of foodborne illness. Educational materials, developed based on consumer attitudes and with inclusion of messages specific for each stage of the behavior change continuum, increased regular thermometer use among consumers, from 4 percent before to 16 percent after the intervention.

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**Attitudes, Moral Duty, Perceived Constraint, and Planned Behavior Concerning Antibiotic Use in Beef Cattle Feedlots**  
**H. Morgan Scott**  
**Texas A&M University**

An interdisciplinary team of epidemiologists, feedlot veterinarians, sociologists, and moral philosophers in Texas has been investigating opportunities for, and barriers against, implementing efforts to mitigate antibiotic-resistant bacteria in pre-harvest settings. Using the theory of planned behavior (TPB), we administered an extensive mail-out survey to feedlot veterinarians, feedlot operators, and pharmaceutical technical services veterinarians. Using a 7-point ordinal scale, we measured attitudes, sense of moral duty to act, perceived behavioral constraints, and current and intended behavior under several different scenarios and while considering four major applications of antimicrobials: therapeutic in acutely sick cattle, therapeutic in chronically sick cattle, subtherapeutic in 'at-risk' cattle, and mass treatment in high-risk cattle. We extended the existing TPB model by adding a dimension of trust or confidence in others' actions.

There were marked differences between veterinarians and feedlot operators in their attitudes towards antibiotic resistance and current and planned behavior. Perceived behavioral constraints and the importance of salient others differed across subject type with operators indicating greater economic dependence on subtherapeutic use and a strong expectation of their clients and investors that they use these products. In contrast, veterinarians felt obliged to professional groups, their colleagues, and federal regulatory agencies. There were marked differences in the sense of moral duty to use antibiotics in different ways (mapping a varied reluctance to use less in the future) with therapeutic use in acutely sick cattle and mass treatment ranked strongest, and subtherapeutic ranked the lowest. Our findings suggest both important constraints and barriers to managing antibiotic resistant bacteria in the future.



**Produce Safety and Biosecurity – A Multi-State Research, Education, and Extension Initiative**  
**Karen Simmons**  
**University of Georgia**

The project is a collaborative effort within Georgia, South Carolina, and Florida involving extension, research, and teaching efforts directed at food defense risks faced by the fresh produce industries. Outreach efforts have included produce operation food defense surveys, the development of printed educational material, and the presentation of food defense trainings for consumers and industry and extension personnel. Research efforts have included bacterial surrogate assessments and produce attachment and internalization studies with *E. coli* O157:H7. Additional research has focused on methods to reduce endospore-forming bacteria on produce surfaces and on the assessment of *Clostridium botulinum* toxin stability on produce surfaces. The education component has involved the incorporation of food defense issues into existing undergraduate and graduate food safety and food laws classes. Research yet to be completed includes nonpathogenic *E. coli* surrogate studies on attachment and recoverability from chilled produce. Outreach efforts to be completed include development of additional educational material for consumers and employees in the produce industry. Future workshops and trainings are also planned for extension and industry personnel.

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**Intervention Strategies to Reduce Escherichia Coli O157:H7 in Beef Feedyards**  
**David R. Smith**  
**University of Nebraska-Lincoln**

We conducted a large-scale clinical trial to test a vaccine against type III secreted proteins of enterohemorrhagic *Escherichia coli* O157:H7. Within commercial feedlots, pens of vaccinated cattle were matched by reprocessing schedule to unvaccinated pens. Vaccine was administered at initial processing and re-implanting. Pens of cattle were sampled starting at least 1 week after the second dose of vaccine and every 3 weeks for four test periods. Pair-matched pens of cattle were sampled concurrently. Test samples were seven ropes per pen hung overnight from the feed-bunk neck-rail (ROPES). At harvest, terminal-rectum-mucosal cells (TRM) collected from a sample of vaccinated and unvaccinated cattle were cultured to assess colonization. *E. coli* O157:H7 isolates were identified by standard biochemical methods and multiplex PCR. We studied 140 pens of cattle (n=20,556 cattle) in 19 feedlots. TRM samples were collected from 720 cattle within 21 pens (11 vaccinated, 10 not vaccinated). Vaccinated pens of cattle were less likely to test ROPES-positive (OR=0.59, P=0.004); and at harvest, vaccinated cattle had 75 percent lower probability for *E. coli* O157:H7 colonization (OR=0.20; P=0.03). Vaccination of fed cattle appears promising for pre-harvest control of *E. coli* O157:H7. These results are being shared through research and extension communications.

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**Food Safety Practices and Hazard Analysis Critical Control Point (HACCP) Implementation in Assisted Living for the Elderly**  
**Jeannie Sneed**  
**Iowa State University**

This 3-year project included three phases. Phase 1 assessed registered dietitians' and dietary managers' perceptions of food handling practices and HACCP implementation. They were knowledgeable about risky food handling practices and identified inexperienced employees, employee turnover, and employee knowledge and training as barriers to food safety. Phase II assessed Iowa assisted living (AL) residents' food handling practices and found that 67 percent prepared some food in their apartments. Phase III assessed employee food handling practices and HACCP implementation in 40 Iowa AL facilities. In years 1 and 3, site visits were made to

observe food handling practices and swab food contact surfaces for aerobic plate count, *enterobacteriaceae*, and *Staphylococcus aureus*. Employee food safety knowledge was tested both times. Between site visits, there were ServSafe® and two HACCP training sessions. Educational materials were provided: written standard operating procedures; documentaton forms; employee orientation brochure; and monthly newsletters. Mean food safety practices score (FSPS), based on observations, was higher at the second visit (87.2+8.8) than the first (82.9+9.4; p=.000). More than half (n = 22) of the facilities had higher FSPS for the follow-up visit. Seventeen facilities met standards for all microbiological tests during the follow-up visit, compared with only two in the initial visit. Employee knowledge improved (pretest mean score 14.6 of 20, 15.9 post test, p=.000).

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### **Mentoring Model for Hazard Analysis Critical Control Point (HACCP) Implementation in School Foodservice Operations**

**Jeannie Sneed**

**Iowa State University**

A multi-method mentoring model assisted 40 Iowa school districts with developing and implementing a HACCP program. The 3-year project consisted of site visits (years 1 and 3) to observe food handling practices, sample food contact surfaces for basic microbiological tests, and assess employee knowledge. After the first site visit, schools were funded to send five employees from one school to ServSafe® training. At the end of year 1, five regional 1-day HACCP training sessions were conducted. At that time, a resource notebook and CD were provided: self-assessment tools, sample HACCP plan, written standard operating procedures (SOP) with documentation forms, flow charts, and implementation planning tools. Lesson plans focusing on key problem areas identified in observations were provided for managers' use in employee training, as was an eight-lesson HACCP training program. A second 1-day training session was conducted at the end of year 2. Training sessions were held regionally to involve extension specialists and develop rapport among directors to encourage sharing. Observed food safety practice scores improved (67.5+14.4; 87.0+9.7; p=0.0001), particularly for practices related to documentation. Over half (n=23) of summative evaluation respondents reported that written SOP had been developed and 33 reported to have begun documenting end-point cooking temperatures. Directors rated sample written SOPs and documentation forms as the most useful tools provided.

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### **Minimizing the Risk of *Listeria monocytogenes* and Other Pathogens in Dried Foods**

**John N. Sofos**

**Colorado State University**

The project goal was to develop and disseminate improved guidelines for home-food drying in order to control pathogenic bacteria and provide products of acceptable quality. Following a needs assessment of drying recommendations by Cooperative Extension, we evaluated the antimicrobial efficacy of drying treatments for jerky, fruits, and vegetables, and developed modified methods, involving pre-drying treatments and modified marinades that result in extensive pathogen inactivation and palatable products. Then, we developed educational and training materials to teach the modified methods to extension agents and master food preservers, and evaluated the efficacy and adoption of the new methods. We trained six graduate and two post-graduate students, and six postdoctoral fellows; developed, piloted, and now offer a train-the-trainer program on Safe Food Drying at Home; conducted 10 seminars; presented 43 posters/oral abstracts at professional meetings; published 26 papers in refereed scientific journals; developed several research reports, newsletter articles, columns, 1 bulletin and 1 correspondence course; published new guidelines/procedures for drying foods; our 3 fact sheets on home food drying are cited/linked to from the National Home Food Preservations website (University of Georgia); and, 2 of our refereed papers are cited in the USDA/FSIS "Compliance

Guideline for Meat and Poultry Jerky Produced by Small and Very Small Plants”  
[http://www.fsis.usda.gov/PDF/Compliance\\_Guideline\\_Jerky.pdf](http://www.fsis.usda.gov/PDF/Compliance_Guideline_Jerky.pdf)

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**Fluoroquinolone-resistant *Campylobacter* in Poultry**  
**Qijing Zhang**  
**Iowa State University**

Antibiotic resistant *Campylobacter* has become a major public concern. Our research team has been actively studying the risk factors associated with the emergence and persistence of antibiotic resistant *Campylobacter* in poultry. Our farm-based surveys showed that the antibiotic resistance rates in conventional operations are significantly higher than those in organic flocks, and turkey operations tend to have more antibiotic resistant *Campylobacter* than broiler farms. Especially, the resistance rates to fluoroquinolone antimicrobials were 46 percent and 67 percent for integrated broiler and turkey farms, respectively, while the fluoroquinolone resistance rates for organic broiler and turkey farms were 0 percent and 2 percent, respectively. Using laboratory experiments, we demonstrated that treatments of *Campylobacter*-infected chickens with a fluoroquinolone transiently reduced the shedding of *Campylobacter*, but didn't eradicate *Campylobacter* from the chickens. Drastic increases in the resistance to ciprofloxacin were detected in the isolates derived from the treated chickens. These findings clearly showed the differences in antibiotic resistance rates between different production systems and indicated that treatment of chickens with fluoroquinolones is a significant risk factor for the emergence of fluoroquinolone-resistant *Campylobacter*.

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