

American Meat Institute FOUNDATION

Ten Year Report



The American Meat Institute Foundation (AMIF) is a non-profit research, education, and information foundation established and funded by the American Meat Institute (AMI) to study ways the meat and poultry industry can produce better, safer products and operate more efficiently. Originally, created in 1944, the Foundation provides research funding to universities, private institutions, non-profit organizations and other foundations to conduct research on behalf of the industry. AMIF publicly disseminates research findings, best practices and other educational materials on a broad range of food safety, worker safety, nutrition and consumer information projects.

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A Letter from the Chairman and President

Dear AMI Member and Others Concerned About Food Safety:

This year marks the tenth anniversary of the AMI Foundation's Food Safety Initiative, an effort designed to research ways to target and destroy key pathogens and to educate consumers about the role they play in ensuring safe food.

This juncture is a time for reflection and resolve. We have demonstrated that research is a wise investment. We have had the opportunity to see hypotheses proven, new practices and technologies developed and implemented. We have created a culture of collaboration among industry members where good ideas become great when they are shared. And we have seen our industry embrace continuing education as a means of improving our companies, our practices and our products.

So what has this meant in real terms? Government data clearly point to improved food safety and enhanced public health. Our Foundation has developed a reputation for proactive leadership in food safety and in other areas as well, like animal welfare, worker safety and nutrition.

We have developed a formula to create real change and real progress. We will apply that formula to meet the challenges that lay ahead in the future.

Thank you for your support and your interest in the AMI Foundation and our efforts during the past decade. We look forward to working with you to improve continually the safety of the nation's meat and poultry products.

Best Wishes,



A handwritten signature in black ink that reads "J. Patrick Boyle".

J. Patrick Boyle
Chairman



A handwritten signature in black ink that reads "James H. Hodges".

James H. Hodges
President



The AMI Foundation has a historic connection to the University of Chicago. The building shown here originally housed the Foundation's laboratories.

History

The AMI Foundation (AMIF) has a rich history that began decades ago in 1944 when the Foundation led ground-breaking meat science research from its headquarters in Chicago. At that time, AMIF had a formal relationship with the University of Chicago. The Foundation originally was equipped with laboratories where more than 50 scientists conducted research.

When meat companies began building their own laboratories or using contract labs, AMIF discontinued that function and later moved with AMI to Washington, DC.

In the 1990s, when new food safety challenges emerged in the form of virulent pathogens, the AMI Foundation began a new course: to solicit research grant proposals focused on food safety and to conduct industry education to improve knowledge about key practices to enhance operations in food safety, animal welfare, worker safety and the food processing environment.

In 1999, the Foundation launched its Food Safety Initiative with a clear goal: to reduce and ultimately eliminate *E. coli* O157:H7 in fresh beef and *Listeria monocytogenes* (*Lm*) in ready-to-eat meat and poultry products. The AMI Board of Directors voiced its support for the new Foundation agenda by voting for a special voluntary dues assessment on AMI members in 1999 and 2000. These voluntary contributions from more than 125 member companies, non-member companies and other industry groups, have totaled more than \$3.5 million dollars, representing half of research funding to date.

The AMI Board of Directors reaffirmed its support of the Foundation in 2003 by voting to fund the Foundation annually through AMI's dues, ensuring that the Foundation's efforts will continue. After 10 years, the Food Safety Initiative is still going strong and has kept current and relevant by adapting as the needs of the meat and poultry industry continue to change.

In 2004, the goal of the Food Safety Initiative was expanded to include research about ways to reduce the prevalence of *Salmonella* in meat and poultry products. Additional priority research areas are highlighted annually to address unique technical challenges within the meat and poultry industry or knowledge gaps. These "Targeted Research" priorities may overlap with the general research priorities, but are highly detailed to address specific needs that need quick resolution.

The Foundation employs a team of professionals from the American Meat Institute staff in Washington, D.C., who have expertise in food, meat and animal science, communications and public policy.

Since the Foundation launched its Food Safety Initiative 10 years ago, it has funded nearly \$7 million in research.

Progress

The Foundation's contribution to progress in preventing pathogens on meat products and in reducing associated foodborne illnesses is unmistakable. Since 2000, *E. coli* O157:H7 prevalence on fresh ground beef products has declined 45 percent. Similarly, *Lm* prevalence on ready-to-eat meat and poultry products has declined 69 percent.

According to the Centers for Disease Control and Prevention (CDC), human *E. coli* O157:H7 infections have declined 44 percent since 2000 and human listeriosis infections have stayed at a very low level after declining 40 percent before 2000. (It is important to note that human infections are linked to a variety of foods – not just meat products – but CDC does not currently provide information about the source of illnesses and outbreaks.)

Less easy to measure, but important nevertheless, has been the AMIF's work in defending sodium nitrite and educating policymakers, scientists and the public about its necessity and safety.

Similarly, the Foundation's experts have been tireless in communicating the nutritional value of meat and poultry in the diet in the face of allegations that meat is associated with cancer. Aggressive and rapid media response has been essential in helping to balance reporting on this important issue. The Foundation has also devoted considerable resources to analyzing and understanding ongoing research in the area of diet and health. Nutrition epidemiology is often complicated by problematic study design and over-interpretation of results. AMIF's experts with backgrounds in meat and food science, chemistry and toxicology have provided critical review and feedback of ongoing research in an effort to ensure accuracy.

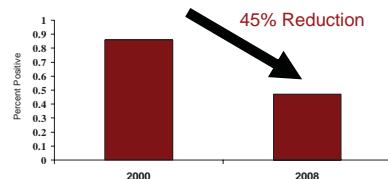
In addition to helping to fund practical research with real impact, the Foundation has developed a reputation as one of the leading sources of training in the meat and poultry industry.

Non-Competitive Issue

One of the hallmarks of AMIF's efforts has been its non-competitive approach to food safety – an approach that grew out of a board vote in 2001. This vote ushered in a new era in which members began sharing ideas, practices and technologies with one another. Food safety practices are not isolated to one plant or one company, but impact every aspect of the industry. This new ideology, as AMI's board concluded, would only strengthen the meat and poultry industry's dedication to producing safe and wholesome meat products for their customers. They concluded that sharing good ideas makes them great ideas.

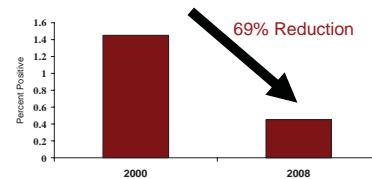
The vote spurred collaboration and ushered in important new initiatives, like the development of Sanitary Design Principles for

Prevalence of *E. coli* O157:H7 in Ground Beef*



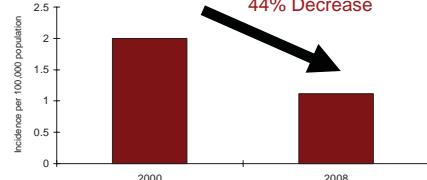
*Results of raw ground beef products analyzed for *E. coli* O157:H7 in federal plants.

Prevalence of *Listeria* in RTE Meat and Poultry Products*



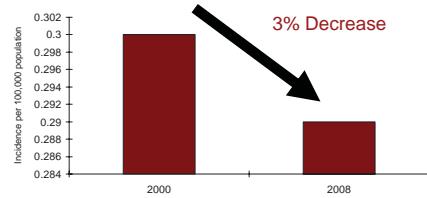
*FSIS results of all ready-to-eat products analyzed for *Listeria monocytogenes*

Incidence of Foodborne Illness 2000-2008: *E. coli**



*Preliminary FoodNet Data on the Incidence of Infection with Pathogens Transmitted Commonly Through Food -- 10 states, 2008

Incidence of Foodborne Illness 2000-2008: *Listeria**



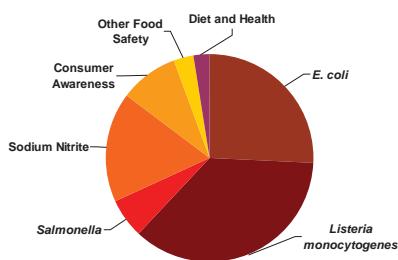
*Preliminary FoodNet Data on the Incidence of Infection with Pathogens Transmitted Commonly Through Food -- 10 states, 2008

Equipment Design, the sequel Sanitary Design Principles for Facility Design and the establishment of curricula written and taught by industry leaders and AMIF professionals to their colleagues in areas like *Listeria* control and *E. coli* prevention. The effort also spilled into other areas, like animal welfare and environmental issues, which now are treated as non-competitive issues.

Today, a collegial spirit exists not only within the AMI membership, but among non-members as well. It is clearly believed that the meat and poultry industry benefits by helping to make each other as good as we possibly can be.

Research Priorities

**Food Safety Research Funding
1999-2009: \$6,997,766**



The Foundation's research priorities are set by the AMI Foundation Board, which is comprised of the AMI Executive Committee and the Foundation president. These decisions are made based upon recommendations from the Foundation's Research Advisory Committee.

In the late 1990s, the Foundation's research priorities focused on reducing and ultimately eliminating *E. coli* O157:H7 on fresh beef and *Lm* on ready-to-eat meat and poultry products. More recently, the Foundation's work has expanded to include research to reduce and eliminate *Salmonella* on fresh meat.

Additional priority research areas are highlighted annually to address unique technical challenges within the meat and poultry industry or knowledge gaps. These "Targeted Research" priorities may overlap with the general research priorities, but are highly detailed to address specific issues that need quick resolution.

The Foundation has also devoted considerable resources to analyzing and understanding ongoing research in the area of diet and health. AMIF's experts with backgrounds in meat and food science, chemistry and toxicology have provided critical review and feedback of ongoing research in an effort to improve accuracy.

The Foundation also recognizes that the meat and poultry industry constantly faces new and emerging food safety concerns that are not included in the Food Safety Initiative's scope. AMIF has funded many projects that address those food safety needs. AMIF also supports other research needs in the meat and poultry industry to address issues that need further understanding. This research has ranged from economic analysis to baseline studies.

AMIF is widely recognized for its merit-based approach and competitive grant process. Research objectives are based upon their potential to deliver meaningful and applicable information to expand the knowledge base in the meat and poultry industry. The research objectives are developed through a collaborative process conducted within the AMIF Research Advisory Committee, which is made up of AMI members, non-members, academia and government officials.

Over the course of AMIF's Food Safety Initiative, 5 percent of *E. coli* O157:H7, 10 percent of *Lm* proposals, 2 percent of *Salmonella* proposals and 22 percent of Targeted Research proposals submitted have received funding.

Grant Process

AMI Foundation experts participate on a number of research committees, a role that helps ensure that federal and other monies are directed toward projects that can yield real and practical results for the meat and poultry industry.

Over the years, AMIF has served on USDA's National Institute of Food and Agriculture, formerly CSREES, National Research Initiative (NRI) Competitive Grants Program and Agricultural Research Service's Office of Scientific Quality Review – Retrospective Assessment of the National Program in Food Safety of the Agricultural Research Service among others. The former program is a major granting entity for agricultural research in a variety of topic areas, including food safety. NRI has been a multi-million dollar source of funding of various programs that deal directly with interests of meat and poultry food safety. The latter program is a review team that assessed the effectiveness and deliverables of the Agricultural Research Service research programs.

AMIF staff have participated extensively with state and university research programs nationwide. The Foundation has also sponsored and served on the advisory boards of the Cattlemen's Beef Board, Cornell University's Institute of Food Science, Food Safety Research and Response Network Advisory Board, Kansas State University's Animal Industries Advisory Council, National Cattlemen's Beef Association, National Pork Board, Texas Tech University's International Center for Food Industry Excellence, University of Georgia's Center for Food Safety and University of Wisconsin's Food Research Institute. Through its participation, AMIF has been able to provide guidance to faculty on research and education programs in the meat quality and safety areas.

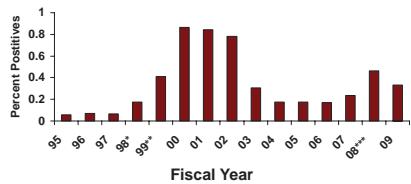
The Foundation frequently collaborates with other industry organizations that also fund meat and poultry research. Through these collaborations, AMIF has strategically increased its research

Collaborative Efforts



dollar by an almost 10 to 1 ratio. Past collaborators include the National Cattlemen's Beef Association, the Cattlemen's Beef Board, National Pork Board and government research agencies through congressional appropriations.

Prevalence of *E. coli* O157:H7 in Ground Beef¹



¹ Results of raw ground products analyzed for *E. coli* O157:H7 in federal plants.

* In 1998 FSIS increased sample size from 25g to 375g.

** In July 1999 FSIS changed to a more sensitive analytical method.

*** In 2008, FSIS changed to a more sensitive enrichment broth. 2009 data as of September 27.

E. coli O157:H7 Research & Results

E. coli O157:H7 is a virulent strain of the family of generic bacteria that is found in cattle, deer and other warm-blooded animals. The pathogen gained notoriety in the early 1990s, when a highly publicized outbreak occurred in the Pacific Northwest.

Since that outbreak, the AMI Foundation has been committed to reducing and ultimately eliminating *E. coli* O157:H7 on beef products. The AMI Foundation has developed a comprehensive research agenda to achieve this goal. In addition to researching hurdles to prevent the pathogens from entering the food supply, AMIF has also focused on pre-harvest research to control pathogens at the farm level.

Due in large part to intensive research, applied technology and consumer education, the incidence of *E. coli* O157:H7 in beef is down by 45 percent since 2000, to less than one-half percent. Likewise, *E. coli* O157:H7 infections are down sharply – 44 percent since 2000 – according to the CDC.

In one of its most recognized initiatives, AMIF provided funding to Mindy Brashears, Ph.D., Michael Galyean and Ph.D., Guy Loneragan, Ph.D., of Texas Tech University and West Texas A&M University to study the effects of direct-fed microbials, including strains of *Lactobacillus acidophilus* in reducing *E. coli* O157:H7 in live cattle. The results were compelling. Cattle fed a high level dose of *Lactobacillus acidophilus* were 77 percent less likely to shed *E. coli* O157:H7.

Initial encouraging results led to a follow-up trial in which AMIF teamed with the National Cattlemen's Beef Association to further document the potential effectiveness of this on-farm intervention. The studies have potential practical application because these direct-fed microbials were already approved as a healthy, growth-promoting feed additive.

Researchers from Colorado State University have been studying the effect of individual ingredients or combinations of ingredients used for brining on the destruction of *E. coli* O157:H7. This research examined storage and cooking conditions impact on moisture-enhanced beef steaks and roasts.

The findings of these studies should be useful for development and/or improvement of brines for improving the safety of moisture-enhanced meat products.

AMIF with other funding partners have invested in research from Texas Tech University that was developed to gather additional information on the benefits of modified atmosphere packaging to improve storage of fresh ground beef. The researchers studied the impact of packaging methods and temperature abuse on the pathogen loads in ground beef inoculated with *E. coli* O157:H7 and *Salmonella* and on the spoilage characteristics and shelf-life of ground beef. Texas Tech found higher levels of *E. coli* O157:H7 in ground beef packaged in overwrap and high oxygen packaging treatments than carbon monoxide, no oxygen and vacuum packages during temperature abuse. Ground beef packaged in carbon monoxide exhibited an extended shelf, less odor development, greater color stability and less oxidative rancidity development compared to the other packaging treatments. Under temperature abuse scenarios, packaging type had a role in the prevalence of *E. coli* O157:H7.

In its ongoing effort to continue to improve the food safety profile of meat supply, AMIF asked U.S. Department of Agriculture's Food Safety and Inspection Service (USDA FSIS) to support the Foundation's petition to allow low-penetrating, low dose electron-beam irradiation to be used as a surface-only treatment for beef carcasses.

The petition, which was submitted in 2005, was the result of an AMIF-led research project jointly funded with the Cattlemen's Beef Board. The Foundation pointed out that the data clearly showed that irradiation could be remarkably effective in destroying bacteria on the carcass surface and added that in no case has FSIS ever required the labeling of the ingredient merely because of its antimicrobial properties at time of treatment. AMI Foundation stressed that the petition demonstrates the process has no significant effect on the smell, taste, appearance, shelf life or nutritional properties of the carcass or derived products.

The key difference in AMIF's proposed application, compared with other approved methods of finished product irradiation, is that it uses a low dose and penetrates only a minuscule, exterior portion of the carcass. When this technology is used, the vast majority of the edible portion of the carcass receives no irradiation exposure at all. Still, by destroying exterior bacteria, the technology has the potential to enhance the safety of the finished, cut or ground products.

In an effort to expand its understanding of human illnesses caused by *E. coli* O157:H7 from food and non-food sources, the AMI Foundation funded an important white paper to take a comprehensive look at this pathogen.



AMI Foundation experts have documented the safety of ground beef packaged in modified atmosphere packing.

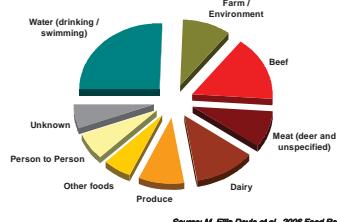




AMI Foundation Ten Year Report

E. coli O157:H7 Outbreaks Worldwide 1982 - 2006

207 total outbreaks reported in published scientific and government literature

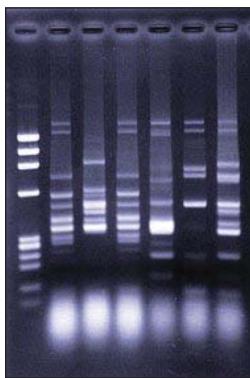


Source: M. Ellen Doyle et al., 2008 Food Research Institute, University of Wisconsin

Led by researchers at the Food Research Institute at the University of Wisconsin-Madison, the scientific literature, industry publications and government publications and regulations from the United States, Canada, Europe and Japan from the date that *E. coli* O157:H7 was first recognized as a possible human pathogen in 1975 up until July 2006 were analyzed. The researchers examined information on the emergence of the organism as a human pathogen, surveillance and outbreak reports, epidemiological studies, important government regulations and industry initiatives to control *E. coli* O157:H7.

From this, the authors of the paper generated a historical timeline summarizing major events occurring from the first recognized cases of illness cause by *E. coli* O157:H7.

The research identified the need for more structure and resources on the state level and called for greater uniformity in statewide investigations and reporting of foodborne illnesses and federal grants targeted at improving laboratory facilities and training for state epidemiologists, as well as urging greater participation by all states to aid in rapid and effective identification of multi-state outbreaks.



AMIF research has helped to decipher the genetic code of pathogenic bacteria.

Validated testing for pathogens plays a vital role in industry control programs. In an effort to validate various *E. coli* O157:H7 testing methods, AMIF teamed with the Cattlemen's Beef Board to jointly fund a comprehensive study of four, commercially available testing kits. The study provided valuable insight on *E. coli* O157:H7 testing programs for beef processors, including recommendations on sampling composite sizes and incubation times.

Just as researchers worked to decipher the genetic codes of humans and animals, AMIF funded research focused on cracking the *E. coli* O157:H7 genetic code. A University of Nebraska study by Andy Benson, Ph.D., identified a genetic-based analytical method used to study which lineages of *E. coli* O157:H7 are more likely to cause human disease. The research has enhanced understanding and hopefully will lead to more targeted design of intervention methods aimed at the most virulent *E. coli* O157:H7 strains.

***Listeria monocytogenes* Research and Results**

Most people are routinely exposed to *Listeria* with no health consequences. But one species of *Listeria*, *Listeria monocytogenes* (*Lm*) – is a virulent member of the genus and can lead to a very serious disease, listeriosis, particularly among at-risk populations.

As part of its Food Safety Initiative, AMIF developed an aggressive agenda to reduce and ultimately eliminate *Lm* on ready-to-eat (RTE) meat and poultry products. AMIF's research has focused on two areas: eliminating the pathogen in the plant processing environment and eliminating the pathogen or preventing its growth on products.

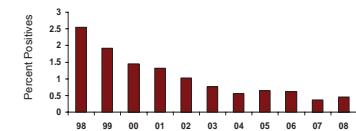
Thus far, these research efforts have proven successful, with the prevalence of *Lm* in RTE products dropping by 69 percent since 2000, to less than 0.5 percent and no products recalled due to illness outbreak have occurred since 2003.

Phil Crandall, Ph.D., and his colleagues at the University of Arkansas conducted AMIF-funded research that examined cost-effective treatments to minimize *Lm* cross contamination at the retail deli. Crandall and his colleagues found that two approved red food dyes, FD&C No. 3 and No. 40 vividly stain the protein and fat in bologna and turkey luncheon meats.

Researchers also determined that the use of a 1:1,000 dilution of these inexpensive dyes should improve the ability of deli managers and deli personnel to determine quickly if areas exist on the deli slicer or in the environment where cross contamination occurs and further determine if additional cleaning is required before sanitizing the slicer or beginning operations. Researchers also analyzed the effectiveness of sanitizers and “hot boxes” and developed a draft “accepted manufacturer practices” for cleaning retail deli slicers. This is the first phase of a multi-phase project funded by AMIF.

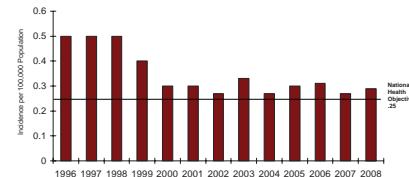
In an AMIF-funded project, Peter Muriana, Ph.D., of Oklahoma State University studied the effectiveness of antimicrobial and organic acid sprays with pre- and/or post-package pasteurization technologies in RTE meat products to reduce the prevalence of *Lm*. While the application of antimicrobials, organic acids and pre- and/or post-package pasteurization were effective in reducing microbial loads and increasing shelf-life, the combination of treatments produced a synergistic reduction that was the most effective.

Prevalence of *Listeria monocytogenes* in RTE Meat and Poultry Products*



*FSIS results of all ready-to-eat products analyzed for *Listeria monocytogenes*

Incidence of Foodborne Illness 1996-2008: *Listeria**



*Preliminary FoodNet Data on the Incidence of Infection with Pathogens Transmitted Commonly Through Food -- 10 states, 2008

Controlling the Environment



Foundation experts actively review dietary research and work to highlight the role processed meats can play in a balanced diet. AMIF has critiqued claims by some groups that processed meats are linked to cancer.

The use of multiple hurdle interventions like heat, antimicrobials and organic acids were found to successfully reduce the prevalence of *Lm* on RTE products.

The development and validation of thermal surrogate microorganisms of *Enterococcus faecium* to those of *Lm* and *Salmonella* in ground beef was performed in AMIF-funded studies conducted by Michael P. Doyle, Ph.D., of the University of Georgia.

The results of Doyle's work were compelling as processors could use *E. faecium* 2354 as a surrogate for validation studies of thermal processes for lean and 12 percent fat ground beef at 58°C and 68°C.

Research, also performed by Dr. Doyle, focused on using *Jonesia denitrificans* as a surrogate for aerosol studies of *Lm* and to study the role of aerosol in transmission of microorganisms to RTE meat and poultry products. The settling rates of aerosol-borne *Lm* and *J. denitrificans* were similar and both dependant on particle size and relative humidity of the environment. Ultimately, through Doyle's research *Jonesia denitrificans* were shown to be a poor surrogate for aerosol studies of *Lm* and concluded other surrogates need to be identified.

Looking for New Ingredients

AMIF has committed significant research monies to identify ingredients that could be added to RTE meat and poultry products to inhibit bacterial growth.

Kathy Glass, Ph.D., and other researchers at the University of Wisconsin have been looking to identify combinations of food-approved antimicrobials that are inhibitory to *Lm* in processed poultry and meat products and minimum nitrite levels required to control *Lm* on RTE poultry products containing sodium lactate and sodium diacetate. Data from the University of Wisconsin studies provided manufacturers with viable formulation options to inhibit the growth of *Lm* during refrigerated shelf-life. Glass and her colleagues suggest that a minimum of 30 ppm nitrite will enhance the anti-listerial activity of sodium lactate-diacetate in RTE poultry, but as with other traditional antimicrobials, the effect is concentration dependent with adequate activity estimated at greater than 70 ppm.

Additional research is needed to verify the minimum antimicrobial levels required to prevent growth. Data from such studies will provide manufacturers with viable formulation options to inhibit growth of *Lm* during refrigerated shelf life. Data collected for

additional research can be used to petition USDA for approval for use of sorbate, benzoate and propionate as antilisterial agents in RTE meats.

Utah State University's Drs. Carpenter and Broadbent were funded by AMIF to study the use of levulinate as an anti-listerial additive compared to the meat and poultry industry standards of sodium lactate and sodium lactate/diacetate mixture for RTE products. Specifically, the study evaluated the extent to which sodium levulinate inhibits growth of *Lm* and established the impact of sodium levulinate on the sensory acceptability in meat products. The additions of sodium lactate, sodium lactate/diacetate, or sodium levulinate were not detrimental to the sensory acceptability of turkey roll or bologna. This study demonstrated that levulinate can be used in meat products as an antilisterial additive without any negative sensory attributes to consumers.

In an AMIF-funded study, the researchers of Colorado State University examined the behavior of *Lm* in RTE meat products containing lactoferrin, surface treated with the activated form of this protein lactoferrin or both, in comparison to or in combination with the effective combination of sodium/potassium lactate and sodium diacetate. Overall, the results showed that, under the conditions of this study, lactoferrin added as a formulation ingredient was not as effective as the combination of potassium lactate and sodium diacetate; also lactoferrin used in combination with potassium lactate and/or sodium diacetate did not enhance, or in some instances reduced, their antimicrobial activity. However, lactoferrin combined with potassium lactate in the formulation was as effective as the potassium lactate-sodium diacetate combination. Lactoferrin can be used in RTE meat products to control *Lm*, particularly in combination with already existing antimicrobial interventions.

Work done by the University of Connecticut looked at the efficacy of monocaprylin and its combination with acetic acid as an antimicrobial dip for killing *Lm* in pork-beef frankfurters and the effect of monocaprylin as an ingredient in turkey breast slices in reducing *Lm*. The inhibitory effect of combining monocaprylin and acetic acid resulted in significant inhibition of *Lm* growth without affecting frankfurter odor and color. Monocaprylin as an ingredient in turkey breast slices primarily inhibited the growth of *Lm* on the turkey breast slices. The combination of monocaprylin and acetic acid represents a potential post-processing anti-listerial treatment that could be used by meat processors.

An important study by the University of Georgia Center for Food Safety, under the direction of Director Michael Doyle, Ph.D., found that lactic acid bacteria were extremely effective in inhibiting *Lm* growth in the lab environment.



AMIF research and education efforts into Listeria control have enhanced the safety of ready-to-eat meat and poultry products.

Salmonella Research and Results



An AMIF-funded study at Kansas State University examined cooking instructions for heat-treated not fully-cooked poultry products like frozen chicken kiev to determine how to communicate safe cooking instructions most effectively.

While not originally a key priority for the AMI Foundation Food Safety Initiative, *Salmonella* has emerged as a pathogen in need of the same focus that has been applied to *E. coli* and *Listeria*. New Foundation research projects are helping to increase understanding about this pathogen, its etiology and ways to target and prevent it.

An AMIF sponsored project recently completed by Kansas State University and University of Nebraska researchers aimed to create a representative inventory of consumer handling and cooking recommendations on packages of heat-treated, not fully-cooked, not shelf-stable poultry products available at retail and for food service in the U.S. Specifically, uncooked, breaded, boneless poultry products that also may be stuffed or filled, char-marked, or artificially colored were studied. These types of products have been implicated in a number of foodborne illness outbreaks.

A research team from Michigan State University led by Bradley P. Marks, Ph.D., worked to determine the likelihood that *Salmonella* will develop heat resistance in the relatively short times used to cook RTE foods, especially whole-muscle cuts.

This AMIF study has reached several key findings. *Salmonella* can develop significantly increased thermal resistance due to sub-lethal injury that can occur during slow cooking of whole-muscle meat and poultry products. In addition, traditional inactivation models based on isothermal inactivation studies can significantly over-predict the actual lethality of *Salmonella* in slow-cooked meat and poultry products, with the degree of over-prediction increasing with the extent of sub-lethal heating.

The study also found that the uncertainty underlying thermal process validations increases significantly when scaling predictions from laboratory-to pilot-scale (and presumably commercial-scale) applications; whole-muscle turkey and beef products cooked in a moist-air convection oven to a core temperature of 160°F all exceeded the lethality performance standards; but there was a significant risk of not achieving the lethality performance standards for whole-muscle turkey and beef products cooked just to the target lethality (i.e., 7.0 or 6.5 \log_{10} reductions, respectively), via traditional methods.

The aim of this large project was to translate results from this AMIF study and the USDA project into a Web-based process lethality tool that will account for the effects of product species, structure, composition and heating profile (including sub-lethal injury) in computing process lethality and reliable estimates of uncertainty.

Texas A&M University researchers validated the safety of slower cooking and cooling procedures for large whole-muscle meat products which meet FSIS lethality and stabilization microbiological performance standards.

Identifying slower cooking and cooling times that meet the FSIS lethality and stabilization microbiological performance standards will give the processing industry greater flexibility. This will allow extended processing times to be utilized without the concern of producing an unsafe product.

Iowa State University conducted a systematic review of literature on pork chain epidemiology. A great deal of the scientific knowledge describing the epidemiology of *Salmonella* in the pork chain is available as primary research. The goal of this project was to report on the scientific literature that describes the epidemiology of *Salmonella* in the pork chain using a systematic review. Current and future *Salmonella* public health risk assessments will benefit from the systematic review. Furthermore, this systematic review identified areas where research is repetitive or lacking and can be used as a tool to initiate research to “fill in the gaps” in risk assessment models.

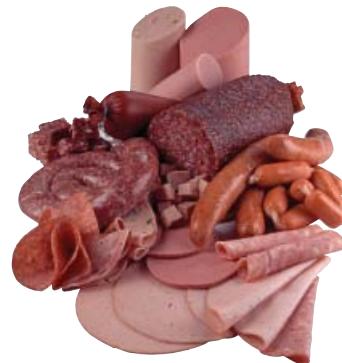
Diet and Health Initiatives

The evidence in support of sodium nitrite safety and benefits has increased dramatically thanks in part to efforts by the AMI Foundation.

In the 1970s, sodium nitrite found itself under assault when a single and ultimately discredited study alleged that nitrite was a carcinogen. This study put in motion events that would cast doubt on sodium nitrite’s safety. In particular, sodium nitrite was recommended for review by the National Toxicology Program (NTP). After waiting years in a research queue, in the 1990s, a multi-year bioassay on sodium nitrite was begun. A panel assembled in May 2000 to review the results and determined whether nitrite belonged on a list of carcinogens published annually by NTP.

Simultaneously, sodium nitrite was nominated for review in California to determine whether it was a developmental toxicant and qualified for listing (and product labeling) under the state’s Proposition 65 law.

AMIF assembled a team of industry experts and retained some of the best experts in the fields of toxicology, epidemiology and pathology to argue a basic but compelling point: that less than 5 percent of human nitrite intake comes from cured meats. Ninety-three percent comes from vegetables and human saliva. Yet vegetables are the very foods that people are urged to consume to maintain good health.



Following a multi-year bioassay in which rats and mice were fed high levels of sodium nitrite, a scientific panel at the National Toxicology Program in May 2000 determined that nitrite at the levels used in cured meats is not a carcinogen in laboratory animals.

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Janet Riley, AMIF's senior vice president of public affairs, appears on Fox News to affirm processed meat safety after a cancer group claimed that the products posed a risk.

"Nitrite can prevent injury from a heart attack, control blood pressure, promote wound healing, help treat sickle cell anemia and many other health conditions and may even prevent disease progression. Old myths about an alleged link to cancer are very weak at best."

—Nathan Bryan, Ph.D., University of Texas Health Science Center in Houston.

The National Toxicology Program's scientific panel gave nitrite a clean bill of health. Similarly, just weeks after the NTP panel vote, California's Development and Reproductive Toxicant committee voted that sodium nitrite is not a development toxicant.

More recently, AMIF has actively promoted new research at the National Institutes of Health and the University of Texas Health Sciences Center that has shown that nitrite offers a wide array of health benefits, including promoting wound healing, blood pressure regulation, organ transplantation and preventing preeclampsia during pregnancy.

Jimmy Keeton, Ph.D., and other Texas A&M University researchers have just finished a multi-city national survey of the nitrite/nitrate concentrations looking at organic and conventionally produced cured meat products and non-meat foods available at retail. This project established a comprehensive database for comparison to other historic surveys and in turn, validated the limited contribution of cured meat products to the total dietary nitrite/nitrate load. Overall, nitrite/nitrate contents of U.S. cured meat products have remained low since the last national survey in 1997. It appears that the current USDA regulations and manufacturer's processing procedures are consistently controlling the levels of nitrite/nitrate in cured meat products and continue to be effective for minimizing their contribution to the dietary nitrite/nitrate load.

Despite all the good news about nitrite and affirmation from key scientific panels, processed meats continue to be targeted by many who have not fully comprehended or accepted research documenting nitrite's safety and its benefits.

In particular, the World Cancer Research Fund (WCRF) report, released in 2007, recommends that red and processed meat consumption should be limited significantly, saying there is a convincing link between meat consumption and colon cancer. AMI Foundation experts tracked the report's development closely and quickly provided critical analysis to media and policymakers, identifying errors and omissions in the report. The Foundation was able to show that the report did not consider the largest epidemiological study ever done. This study involved 725,000 people from research centers around the world and determined that there was no relationship between red and processed meat and colon cancer.

In response to the report's release, AMIF experts made numerous media appearances to reassure the public that meat and poultry continues to be a safe and nutritious part of a healthy, balanced diet. AMI collaborated closely with the National Cattlemen's Beef Association, the National Pork Board, Canada Pork and Canada's Beef Information Centre to ensure consistency of message in North America. Polling done after the report showed that it had little impact on public confidence in the safety and nutrition of meat.

To keep abreast of the many diet and health issues according around the world, AMIF experts actively participate in the International Meat Secretariat Nutrition Committee to share global research findings and information about public policy initiatives occurring worldwide.

The AMIF with the National Pork Board have funded a series of research projects that examine the formation of heterocyclic amines in meat products. Experts working for E^xponent® were funded to review and perform a risk assessment of the major categories of fresh and processed meat products that are candidates for heterocyclic amine formation during handling, preparation and cooking and determine the impact of processing procedures, added ingredients, packaging and cooking methods and other factors known to affect heterocyclic amine formation. This work will be essential in showing the low public health risk associated with the formation of heterocyclic amines in meat products.

Also co-funded by the National Pork Board, researchers from Kansas State University are examining the occurrence and levels of heterocyclic amines in various meat products, including meat products containing antioxidant-containing marinades and enhancement with various ingredients. An extensive literature review and evaluation of potential exposure and risk will be undertaken during the course of this research. The Kansas State work will likely support the findings of the heterocyclic amines risk assessment.



AMIF conducts research related to grilled meat and poultry safety to stay engaged in the policy and scientific debate.

Other Food Safety Research

The Foundation also recognizes that the meat and poultry industry constantly faces new and emerging food safety concerns that are not included in the Food Safety Initiative's scope. AMIF has funded many projects that address food safety concerns that fall outside of the initiative's scope.

AMIF funded a white paper through the University of Wisconsin that reviewed information on avian flu viruses, the extent of the ongoing worldwide outbreak and then focused on available information on destruction of the virus in meat and meat products. The researchers found that avian influenza viruses should not be a threat to food safety if meat and eggs are properly cooked and persons involved in food preparation do not cross-contaminate vegetables, fruit, or other ready-to-eat foods with infected meat. This information will enable AMIF to provide timely information to its members and the public and to determine future research needs.

The University of Nebraska through AMIF-funded research is studying and developing a practical method for measuring ammonia contamination levels in meat products. The method will then be used to study

the uptake of ammonia by meat, and the effectiveness of methods designed to decrease contamination levels.

Also funded by AMIF was an economic analysis of measures proposed by FSIS to reduce human exposure to the BSE agent in human food. This report analyzed each of the potential regulatory options outlined by FSIS in their “BSE Current Thinking Paper.” The analysis described and quantified potential food industry costs expected by the industry such as unintended consequences from widespread abandonment of certain practices, including the use of advanced meat recovery systems, which could significantly increase production costs and jeopardize worker safety.

AMIF and the National Meat Association co-funded a Colorado State University Study project to perform an Advanced Meat Recovery (AMR) Baseline Study. This study compared the fluorescent glial fibrillary acidic protein (GFAP) enzyme linked immunosorbent assay to ELISA test kits for GFAP manufactured by R-biopharm. The study documents that the R-biopharm test kits provided a reliable field method of estimating the presence of GFAP in meat produced from AMR equipment and may have utility as a process control tool for ensuring that GMPs for spinal cord removal are effective.

White Papers and Literature Reviews

Comprehensive reviews of key issues in science can be invaluable in problem-solving. The AMI Foundation has funded a number of key white papers, including:

- Human Illness Caused by *E. coli* O157:H7 from Food and Non-food Sources (University of Wisconsin)
- Minimizing Microbiological Food Safety Risks: Potential for Pre-slaughter (Pre-harvest) Interventions (Colorado State University)
- Human Illness Caused by *Salmonella* from All Food Sources and Non-Food Vectors (University of Wisconsin)
- Destruction of H5N1 Avian Influenza Virus in Meat and Poultry Products (University of Wisconsin)

Likewise, literature reviews are a critical part of the research and investigation process. AMIF has funded key literature reviews, including:

- *Listeria* Literature Review-Survey of the Various Techniques Used in *Listeria* Interventions
- Survival and Growth of Bacterial Pathogens on Raw Meat During Chilling (University of Wisconsin)

Both the white papers and literature reviews may be found on the Foundation Web site at www.AMIF.org.



Education and Training

The AMI Foundation's Board has long placed a high value on education as a means of preventing food safety and other challenges and improving operations overall.

During the last decade, the AMI Foundation has offered an array of highly-rated educational programs and trained thousands of members of the meat and poultry industry. Since 2000, AMIF has conducted more than 18 workshops, educating more than 1,200 industry associates on how best to control *Listeria* in the plant environment.

These workshops provide intensive instruction on procedures that make an impact on *Listeria* control as well as scenario-based problem-solving. Additionally, AMIF has conducted short courses for both the Food and Drug Administration (FDA) and FSIS employees, including members of their risk assessment teams.

On three different occasions, AMIF also hosted a Beef Best Practices workshop and trained more than 200 people in strategies to prevent *E. coli* O157:H7 on fresh beef and enhance beef safety overall.

During 2008, AMIF produced a series of education webinars to address key issues and challenges facing small and medium businesses in the meat and poultry industry. Topics included Top Ten Steps to Reduce *E. coli* O157:H7, Top Ten Ways to Enhance Animal Handling in your Beef and Pork Plants, Top Ten Ways to Ensure You are I-9 Compliant, Top Ten OSHA Violations Found in Meat Plants and How to Prevent Them, Top Ten Ways to Reduce NRs, and Top Ten Steps to Managing a Product Recall. These webinars were recorded and are an available resource on www.meatami.com. More than 73 businesses participated in the summer series.



During the last decade, the AMI Foundation has offered an array of highly-rated educational programs and trained thousands of members of the meat and poultry industry.

For over 50 years the Meat Industry Research Conference (MIRC), cosponsored by the American Meat Science Association and the American Meat Institute Foundation, has served as a forum for presenting the latest meat production research in terms of direct application for the industry. MIRC includes conference programming focused on technical strategies for the future of the meat industry, new research on ingredients and emerging technologies and food safety developments, challenges and issues.

Meat Industry Research Conference

Animal Handling



Temple Grandin, Ph.D., associate professor of animal behavior at Colorado State University and one of the world's leading experts on livestock handling and welfare, has been a lead instructor at AMIF's Animal Care and Handling Conference since it was established in 1999.

The Animal Care and Handling Conference for the Food Industry is the leading animal welfare educational opportunity for meat companies offering practical and proven ideas for implementing and encouraging change and improvement for those involved in the production and management of livestock and meat products.

This important conference has trained more than 2,500 people since it was launched in 1999 – testament to the increasing significance of animal care and handling in the meat industry. This conference recently featured sessions including discussions on systematic approaches to humane handling based on HACCP principles, dairy issues and challenges and an update on new transportation audits.

Worker Safety, Human Resources and the Environment

The Conference on Worker Safety, Human Resources, and the Environment program touches on core worker and workplace issues facing the meat and poultry industry. Since 1999, more than 2,000 professionals have been trained in issues including worker safety challenges, employee retention, crisis/disaster management, health care costs, and environmental sustainability initiatives. Since 2000, AMIF has presented 1,191 worker safety awards to members of the industry. These awards recognize safety performance and improvement and are co-sponsored by the well-respected National Safety Council.

The AMI Foundation also offers two important awards programs to encourage continuous improvement in the areas of worker safety and the environment.

The Foundation sponsors the annual Environmental Achievement awards to recognize member companies that go beyond environmental compliance by designing and successfully implementing an innovative plant upgrade or environmental program. The awards focus on key areas like resource conservation, pollution prevention, upgrades to improve environmental sustainability (advanced technology, upgraded systems, software), environmental outreach to the public and environmental training programs. More than 32 facilities have been recognized since the program began in 2006.

Similarly, AMIF runs the Environmental MAPS 4-Tier Recognition Awards, which were developed to recognize a company's dedication to continuous environmental improvement, measured by the development and implementation of Environmental Management Systems (EMS). Since 2005, 698 awards companies have been recognized through the MAPS program.



Other Foundation educational events include:

- Sanitary Equipment Design Workshop, where members of the industry learned how to redesign equipment to prevent contamination.
- The Annual Meat Conference, where attendees learn about consumer food safety knowledge and how to educate consumers in safe handling.
- The education components of the AMI Annual Convention featuring the Innovation Showcase and the International Meat, Poultry and Seafood Industry Convention & Exposition, part of Worldwide Food Expo.

The Foundation also has offered timely Issue Briefings when key topics have emerged. These briefings have focused on:

- **Novel H1N1** – When outbreaks of influenza in swine have raised concern regarding their impact on public health, AMIF has partnered with other associations to keep members informed about the global and domestic spread of the viruses.
- **Avian Influenza** – The AMIF held a webinar in June 2006 to brief its members on highly pathogenic avian influenza and the risk it posed to employees and to poultry. AMIF detailed scientific and regulatory issues related to the disease, as well as resources that AMIF developed to help respond to customers, media, employees and consumers.
- **Bovine Spongiform Encephalopathy (BSE)** – In December 2003, when BSE was diagnosed for the first time in a cow within U.S. borders, within 30 days, the Foundation assembled leading experts in the field to brief the industry on what this development meant for the industry, for consumers and for international trade. Over 500 people attended these briefings.
- **Foot and Mouth Disease (FMD)** – When FMD began generating extensive news in the United Kingdom in 2001 and the U.S. began to contemplate the possibility of FMD penetrating U.S. borders, AMIF planned a comprehensive one day session to help the industry prepare.

Additional Education Opportunities



AMI Foundation Ten Year Report

Communicating the Message



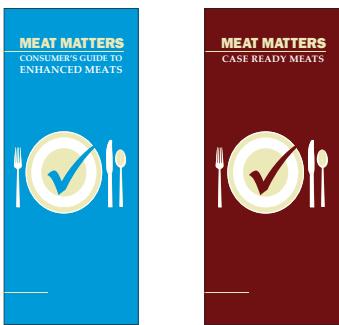
In 1999, the Foundation launched its inaugural quarterly newsletter, which reports ongoing research and offers important findings from the millions of dollars in projects it has funded. AMIF's quarterly newsletter, which is now distributed almost entirely electronically, is sent to thousands of scientists, university professors, lawmakers, regulators, members of the media and AMI member companies to keep them informed of important developments related to meat and poultry safety, quality and nutrition. The newsletter highlights the Foundation's work with a host of outstanding scientists and academic institutions on a variety of projects that have made meaningful and practical contributions to meat and poultry science and to the practices used in our plants.



www.meatmattersinfo.org

Beyond the industry and academic audiences, AMI Foundation has made important contributions toward educating consumers about how to ensure meat and poultry safety – from farm to fork. As one of the founding partners of the Partnership for Food Safety Education, AMIF financial and in-kind support have helped the Partnership both launch and grow into the vital organization it remains today.

AMI Foundation has expanded upon the Fight BAC! messages of Cook, Clean, Chill and Separate with its own food safety education efforts. As part of its dedication to providing retailers and consumers with accurate, consumer-friendly information, and building on the success of its 2005 "Safe Handling of Meat and Poultry" brochure, AMI Foundation in 2007 launched a consumer outreach initiative called "Meat Matters," a series of brochures that can be downloaded and printed from a centralized Web site: www.MeatMattersInfo.org.



The "Meat Matters" series of brochures were developed in consultation with government, industry and academia. The 12 brochures in the "Meat Matters" series include: Case Ready Meats; Understanding Product Dating; Safe Handling of Meat and Poultry Products; Meat and Poultry Nutrition; Livestock Cloning; Animal Welfare in the Meat Industry; Consumer's Guide to Enhanced Meats; Stretching Your Meat Dollar; Country of Origin Labeling; Common Ingredients in Processed Meats; A Consumer's Guide to the Meat Case; and Meat and Poultry Safety. The brochures are available and can be downloaded at www.MeatMattersInfo.org.

AMI Foundation Ten Year Report



AMI Foundation's Web site, www.AMIF.org, serves as a hub of information, including research priorities, final reports and updates of ongoing research. Fact Sheets are also listed on the Web site to provide facts and figures for a variety of industry and food safety topics.

The site is also home to the Foundation Library, an online information database where users can search for reference and literature resources. The Library also features sources for statistical and government information and houses industry news on a variety of topics.

AMIF.org also links to the Foundation's calendar of annual education conferences, topical workshops, award programs, committee meetings and biennial tradeshow.

In addition to the home page, two of AMIF's Web sites mark their five-year anniversary in 2009: www.MeatSafety.org and www.MeatPoultryNutrition.org.

MeatSafety.org offers consumers and the media comprehensive information about meat and poultry safety. The site also offers detailed information about cooking, safe handling, thermometer use and storage of specific meat and poultry products.

Reviewed by staff at USDA's Meat and Poultry Hotline, MeatSafety.org also includes links to nutrition guidelines, kid-friendly information, food safety publications and articles and a "Hot Topics" section for the most up-to-date news on food safety.

MeatSafety.org also offers extensive resources to media, with a wide array of fact sheets, charts, links and articles on important topics. The Foundation has thus utilized the Web site as a spring-board for media interviews with staff experts about a host of food safety issues – all aimed to empower the consumer with valuable and easy-to-understand information.

The second Web site celebrating its fifth-year anniversary, www.MeatPoultryNutrition.org, offers consumers and the news media quick and easy meat and poultry nutritional information.

The site, a joint project of the AMI Foundation, National Chicken Council and National Turkey Federation, includes scientifically referenced sections on dietary fat, protein, weight loss and portion size; a recipe section; frequently asked questions; and a list of third-party experts who can provide background and comment.

On the Web



www.AMIF.org



www.meatsafety.org



www.meatpoultrynutrition.org



AMI Foundation Ten Year Report

Social Media



AMIF has used new media strategies to reach consumers in meaningful ways, like a series of online videos called Ask the Meat Science Guy, which featured former AMI Foundation President Randy Huffman, Ph.D.

In recent years, AMI Foundation has supplemented its traditional public affairs and communications strategies, like press releases, media advisories and conference calls, with ever-evolving new social media tools available on the Internet today. AMIF has been utilizing Twitter, LinkedIn, and YouTube technologies to spread the Foundation's message.

One of the most successful uses of social media for AMIF was launched in 2007. The AMI Foundation created a YouTube channel, called the Meat News Network, to post educational videos, b-roll and video statements to counter myths and misinterpretations.

The channel has gained popularity since and has proven an extremely efficient tool for communicating directly to consumers. Introduced in 2008, the "Ask the Meat Science Guy" video series is among the most popular on the Meat News Network as it provides answers to many of the questions consumers pose about meat and meat safety.

Media Education and Outreach

AMI Foundation has taken both a proactive and reactive approach to media education and outreach.

Proactively, the Foundation designed new media booking sheets and has mailed educational packages to reporters and producers to market its experts as resources to ensure that the Foundation is the "go-to" group for comment on stories related to meat and poultry safety.

Knowing the importance of "face time" with the media, as well, Foundation experts have participated in several editorial board meetings to express its views to top tier publications such as the *Wall Street Journal*, *USA Today* and the *Denver Post*.

In addition to its proactive media outreach, the Foundation and its communications professionals keep their finger on the pulse of daily media activity and breaking news. When CNN ran a segment on a World Cancer Research Fund report linking processed meat to cancer, AMI Foundation sent a letter to the president of CNN and the health and medicine reporter and activated a grassroots letter writing campaign. The Foundation was successful in generating a follow-up story that included its side of the story on camera.

Through these and other proactive and reactive communications efforts, AMI Foundation and its experts have built a reliable

reputation with the news media by offering expert comment in print, on radio and TV to help educate and empower consumers. On topics ranging from food safety innovations to BSE testing, H1N1 outreach to sodium nitrite safety, Foundation experts have provided information that makes technical details accessible and understandable to the public.

One of those proactive communication efforts occurred in September 2004, as Texas Tech University rolled out the red carpet treatment and hosted 12 broadcast and print reporters for the inaugural Beef Baccalaureate program held in Lubbock, Texas. The program featured an interactive lecture series by several Texas Tech professors, as well as industry experts in meat science. The two-day event was partially underwritten by grants from AMI Foundation. Reporters were provided an overview of the beef industry, which included presentations covering pathogen research, intervention advancements, prevention and management of animal diseases. The program also included hands-on fabrication of beef carcasses, sensory evaluation and tours of beef processing and feedlot facilities.



AMIF hosted a media education program at Texas Tech University to educate journalists about beef processing and safety.

Conclusion: Looking Towards the Future

Through the support of its members and careful collaboration with leading scientists and research institutions, the AMI Foundation has harnessed the power of science to enhance the safety of meat and poultry products.

Our efforts are much like a race to keep up with the challenges that continually confront us. In our case, the race has no finish line, but our work has conditioned us for the challenges of the future and there are many challenges that present significant opportunities for the industry.

Several high profile food recalls have focused attention on the way food is grown, processed and distributed to the consuming public. Too often the debate lacks the benefit of a reasoned, factual and scientifically based perspective. AMIF has and will continue to provide that perspective in the future.

We will continue to apply research based solutions and a non-competitive spirit to our efforts because our mission is clear and unwavering: to produce the safest, most wholesome meat and poultry possible for our customers, our consumers around the world and for our own families.

Food Safety Initiative Funded Research Projects

***E. coli* O157:H7 Pre-Harvest Research**

Role of Super-shedders in Determining Feedlot Pen Prevalence of *E. coli* O157:H7

Rowland Cobbold, Dale Hancock, Tom Besser, Washington State University; Janice Berg, Lakeside Research

This research confirmed the role of super-shedders cattle in the transmission of *E. coli* O157:H7 to other cattle in a feedlot environment. Removing a super-shedder from a pen resulted in a decrease in shedding and/or pen prevalence; however the effect was not statistically significant. The addition of a super-shedder to a naïve pen did lead to a statistically significant increase in shedding and prevalence.

Funded in part by the National Cattlemen's Beef Association.

Inactivation of *E. coli* O157:H7 in Drinking Water of Cattle by Sodium Caprylate

Kumar Venkitanarayanan, University of Connecticut

This research evaluated the addition of sodium caprylate, a natural eight-carbon fatty acid, to cattle drinking water in order to inactivate *E. coli* O157:H7. The addition of sodium caprylate proved to significantly reduce the presence of *E. coli* O157:H7 in water for a sustained period of time even in the presence of fecal matter or residual feed.

Reduction of *E. coli* O157:H7 in Beef Feedlot Cattle Using Varying Doses of a Direct-Fed Microbial

Mindy Brashears, Michael Galyean, Spring Younts Dahl, Texas Tech University; Guy Loneragan, West Texas A&M Univ. This research evaluated three

different doses of *Lactobacillus acidophilus* strain NP 51 and a combination treatment of NP 51 and NP45 on the prevalence of *E. coli* O157:H7 in finishing beef cattle. The highest concentration of NP51 was the most effective in reducing fecal shedding. There were no detrimental effects of the treatments used in these studies on animal performance.

Funded in part by the National Cattlemen's Beef Association.

***E. coli* O157:H7 Intimin Expressed by Transgenic Plant Cells as a Candidate Oral Vaccine for Cattle**

Alison O'Brien, Uniformed Services University of the Health Sciences

This study focused on the development of a vaccine that would be delivered orally through corn using intimin^{O157} to prevent cattle from becoming infected with *E. coli* O157:H7. Further studies are being conducted on intimin.

Methods to Control *E. coli* O157:H7 in Drinking Water for Cattle

Michael Doyle, University of Georgia

This study developed practical interventions for use on-farm and feedlots to control *E. coli* O157:H7 in cattle drinking water. Specific competitive exclusion microorganisms were highly effective in reducing the presence of *E. coli* O157:H7.

Competitive Exclusion of *E. coli* O157 using Non-Pathogenic Colicin Producing *E. coli* Strains

Chobi DebRoy, Pennsylvania State University

This research evaluated the ability of various non-pathogenic colicin producing strains of *E. coli* to inhibit the growth of *E. coli* O157 and Shiga-toxin producing strains. Selected strains were able to inhibit the growth of O157:H7 in a laboratory environment.

The Use of Egg Yolk Anti-O157:H7 Immunoglobulin to Clear *E. coli* O157:H7 from the Intestinal Tracts of Cattle

Charles Kaspar, University of Wisconsin

The research demonstrated that egg antibodies were an effective antibody production method. It also showed, unexpectedly, that chitosan, the carrier of the antibody, showed a statistically significant reduction in shedding *E. coli* O157:H7.

Testing of Probiotic Bacteria for the Elimination of *E. coli* O157:H7 in Cattle

Mindy Brashears, Texas Tech University

Probiotic bacterium (*Lactobacillus acidophilus*; NPC 747 and NPC 750) was added to cattle feed to determine its effect on the elimination or reduction of *E. coli* O157:H7 in cattle. The probiotic bacterium significantly decreased the number of cattle shedding *E. coli* O157:H7, and had either no effect or slightly improved the feedlot performance of finishing beef steers.

Evaluation of the Efficacy of a Bacteriophage System in Preventing or Modulating *E. coli* O157:H7 Infection of Cattle

Dale Hancock, Washington State University

This research evaluated a specific bacteriophage treatment intended to

Food Safety Initiative Funded Research Projects

reduce the probability of infection with *E. coli* and/or the amount shed if an infection was present. The bacteriophage treatment was not effective in reducing shedding of *E. coli* O157:H7 in calves. A "Trojan calf" model was developed which showed that all animals that come in contact with an animal shedding *E. coli* in a confined space will test positive.

Post-Harvest Research

Effect of Traditional and Modified Enhancement Solution Ingredients on Survival of *E. coli* O157:H7 during Storage and Cooking of Moisture-Enhanced Beef

Ifigenia Georganas, John Sofos, Colorado State University

This research identified ingredients used in brining solutions that may have antimicrobial effects during storage and/or enhance thermal inactivation of *E. coli* O157:H7 during cooking of moisture-enhanced beef products.

Elimination of *E. coli* O157:H7, Generic *E. coli*, and *Salmonella* spp. On Beef Trimmings Prior to Grinding Using a Controlled Phase Carbon Dioxide System

Randall Phebus, James Marsden, Abbey L. Nutsch, Curtis L. Kastner, Carlos Arturo Tanus, Kansas State University

This study validated that controlled phase carbon dioxide was an effective method for reducing *E. coli* O157:H7, *Salmonella* and aerobic spoilage bacteria on beef trim and ground beef. This method had little or no impact on quality or sensory attributes.

Use of Warm (55°C) 2.5% or 5.0% Lactic Acid for: (A) Reducing Microbial Counts on Beef Subprimal Cuts and Beef Trimmings Following Fabrication, and (B) Reducing Incidence of *E. coli* O157:H7 in Combo-Bins of Beef Trimmings and Inside (in the interior) Beef Cuts Subjected to Blade/ Needle or Moisture Enhancement Tenderization

John Scanga, J.N. Sofos, K.E. Belk, G.C. Smith Colorado State University

This research demonstrated that hot water and warm lactic acid were effective at reducing *E. coli* O157:H7 at high inoculation levels. It also showed that needle enhancement resulted in greater internalization of O157 when compared with blade tenderization. The results provided the necessary data for FSIS to allow use of this organic acid intervention on primals.

Effects of Low-Dose, Low-Penetration Electron Beam Irradiation of Chilled Beef Carcass Surface Cuts on *E. coli* O157:H7 and Meat Quality

Terrance Arthur, Tommy Wheeler, Steve Shackelford, Joseph Bosilevac, Xiangwu Nou, Mohammad Koohmariae, USDA-ARS MARC

This series of studies demonstrated that surface electron-beam irradiation on beef dramatically reduced levels of *E. coli* O157:H7 while having no measurable impact on organoleptic, shelf life or nutritional status or resulting beef products.



Funded in part by America's Beef Producers

Comparison of Rapid Test Methods and Validation of Composite Sampling for Detection of *E. coli* O157:H7 in Raw Beef Trims and Raw Ground Beef

Ann Marie McNamara, Silliker Laboratories

This study evaluated the effect of compositing on detection of *E. coli* O157:H7 in raw beef trim and raw ground beef by four 8 hour test kits. The study provided valuable insight on *E. coli* O157:H7 testing programs for beef processors.

 Funded in part by America's Beef Producers

Develop Optimal Methods for Sampling/Colonal Feces, Hides and Carcasses to Test for the Presence of *E. coli* and *Salmonella* spp.

Keith Belk, Colorado State University

This research identified optimal methods to test for the presence of *E. coli* O157:H7 and *Salmonella* spp. on the hides, carcasses and feces of cattle.



Food Safety Initiative Funded Research Projects

Risk Assessment Enhancement Research

White Paper on Non-O157:H7 Shiga-toxin producing *E. coli* from Meat and Non-Meat Sources

Ellin Doyle, Charles Kaspar, University of Wisconsin

This white paper will examine the data on outbreaks caused by non-O157 STEC *E. coli* and for information on prevalence of these bacteria in meat, meat-producing animals, and other potential food and non-food vectors. Information will also be sought on the effectiveness of current interventions for controlling these foodborne pathogens and on recently devised methods for detecting these bacteria.

Inhibition of Growth of *E. coli* O157:H7 and *Salmonella* in ground beef using modified atmosphere packaging systems

Mindy Brashears, Chance Brooks, Texas Tech University

This study determined if selected strains of *E. coli* O157:H7 and *Salmonella* could grow under extreme temperature abuse conditions in a carbon monoxide MAP packaging environment.

Impact of Ground Beef Packaging Systems and Temperature Abuse on the Safety and Quality of Ground Beef

Chance Brooks, Mindy Brashears, Mark Miller, Adam Tittor, Texas Tech University

This study determined the impact of packaging methods, including low-oxygen MAP with carbon monoxide, and temperature abuse on the pathogen loads in ground beef inoculated

with *E. coli* O157 and *Salmonella*. It also evaluated the effect of packaging methods and temperature abuse on the spoilage characteristics and shelf life of ground beef.

Funded in part by the National Cattlemen's Beef Association.

Human Illness Caused by *E. coli* O157:H7 from Food and Non-Food Sources

Charles Kaspar, Ellin Doyle, Ronald Weiss, University of Wisconsin

This white paper compiled all outbreak data and illness cases attributed to *E. coli* O157:H7 from both food and non-food sources. It provided a historical timeline summarizing the major events occurring from the first recognized illness to the produce outbreak in late 2006.

Implement Hide and Carcass Survey to Verify Effectiveness of Slaughter Procedures and Carcass Interventions in Controlling *E. coli* O157:H7

Gary Smith, Colorado State University

A study conducted in 12 beef slaughtering plants validated the feasibility of testing carcasses as an alternative to testing ground beef in production and distribution channels. The incidence of *E. coli* O157:H7 on carcasses was reduced by the slaughter process and application of microbial intervention steps.

Distribution of Virulent and Avirulent Subclones of *E. coli* O157:H7 in the U.S.

Andrew Benson, University of Nebraska

The ability to distinguish between virulent and avirulent subclones of *E. coli* O157:H7 was determined by genetic fingerprinting. Methods were

developed and refined to improve the analysis of data in this field.

Listeria monocytogenes Innovative Pathogen Intervention Technologies

Role of Protozoa in the Persistence of *Lm* in a RTE Poultry Processing Plant

Richard Meinersmann, Mark Berrang, Tim Hollibaugh, Joseph Frank, Agricultural Research Service, USDA, University of Georgia

This research will determine if bacterivorous protozoa contribute to shaping bacterial communities in food processing plants and influence the survival of *Lm* in floor drains. The project is designed to identify *Listeria*-lytic protozoa and isolate them for further research in the use of naturally decontaminating floor drains.

Genetic Attributes Associated with the Ability of Different Serotypes of *Lm* to Colonize the Meat Processing Plant Environment and to Contaminate RTE Meat Products (Chicken, Turkey, Pork, and Beef)

Sophia Kathariou, Dana Hanson, North Carolina State University

The study will characterize the genetic basis for the apparent differences in prevalence of different serotypes and strain types of *Lm* in the processing plant environment and in foods, specifically if genes mediating adaptations are highly relevant to the ability of the pathogen to colonize the processing plant and contaminate RTE meats.

Food Safety Initiative Funded Research Projects

Evaluation of anti-Listerial Properties of Natural and/or Organic Ingredients in Ready-to-Eat Meat and Poultry Products

Kathy Glass, Jeff Sindelar, University of Wisconsin

The study will identify ingredients to suppress growth of *Lm* RTE, deli-style, meat and poultry products that meet “natural” or organic requirements defined by USDA.

Validation of Levulinic Acid for Topical Decontamination of Meat Surfaces

Charles Carpenter, Jeffrey Broadbent, Utah State University

This project assessed if levulinic acid, as a topical treatment, was effective against pathogenic bacteria. It evaluated whether topical application imparts residual protection against pathogen growth. This research was a follow up to previous research on the anti-listerial action of levulinic acid.

Minimum Nitrite Levels Required to Control *Lm* RTE Poultry Products Manufactured with Lactate and Diacetate

Kathleen Glass, James Claus, University of Wisconsin

This project identified the minimum level of sodium nitrite required to suppress growth of *Lm* in RTE meat and poultry products manufactured with lactate and diacetate.

Anti-Listeria Action of Levulinic Acid

Charles Carpenter, Jeff Broadbent, Utah State University

This research evaluated the extent to which levulinic acid, a 5-carbon organic

acid, inhibited growth of *Lm* in RTE meat products as compared to, and in combination with, lactate and diacetate.

Controlling *Lm* on RTE Meat and Poultry Products Using Food-Approved Antimicrobials Benzoate, Propionate, and Sorbate

Kathleen Glass, James Claus, University of Wisconsin

This research followed up on previous research that demonstrated the effectiveness of antimycotic agents in controlling *Listeria*. The resulting data has been used to obtain provisional FSIS approval of sorbate, benzoate and propionate.

Comparison of Use of Activated Lactoferrin with Use of a ‘Gold Standard’ Combination/Concentration of Antimicrobials for Post-Processing Control of *Lm* in RTE Meat Products

John Sofos, Ioanna Barmpalia, Patricia Kendall, Keith Belk, John Scanga, Gary Smith, Colorado State University

This study showed that lactoferrin added as a formulation ingredient in bologna was not as effective as the combination of other antimicrobials, but when used in frankfurters, lactoferrin combined with other antimicrobials was effective.

Inactivation of *Lm* on RTE Meat Products (Deli Turkey Breast and Frankfurter) by Monocaprylin

Kumar Venkitanarayanan, Cameron Faustman, David Dzurec, University of Connecticut

The research determined that surface treatment using monocaprylin with acetic acid was effective in reducing

Lm on frankfurters. As an ingredient added to the product, monocaprylin was only moderately effective.

Controlling *Lm* on RTE Meat and Poultry Products using Food-Approved Antimicrobials

Kathy Glass, Eric Johnson, University of Wisconsin

This study evaluated the efficacy of antimycotics (sorbate, propionate and benzoate) to control the growth of *Lm* in uncured turkey and cured bologna. The addition of 0.1% combined antimycotic agents effectively delayed or prevented growth of *Lm* in cured processed meat.

Antimicrobial Effects of Surface Treatments and Ingredients on Cured RTE Meat Products

Jimmy Keeton, Texas A&M University

Combinations of a novel ingredient called Safe₂OTMHOH were evaluated along with lactic acid, potassium lactate and propionic acid to determine the inhibitory effects of each of these products singly and in combination to retard and/or eliminate the growth of *Lm* in packaged RTE meat and poultry products.

Pathogen Inhibition and Shelf-Life of Raw and Precooked Meat with Protamine

Kenneth McMillin, Jack Losso, Louisiana State University

This project determined the antimicrobial activity of different levels of protamine, a natural antimicrobial, on *Salmonella*, *E. coli* and *Lm* on meat and poultry before and after cooking.

Food Safety Initiative Funded Research Projects

Elite Herb Extracts Containing High Rosmarinic Acid and Inhibition of *Lm* In Meat and Poultry Products

Kalidas Shetty, University of Massachusetts
This study investigated herbal extracts high in rosmarinic acid (rosemary antioxidants) as *Lm* inhibitors.

Use of Pediocin with Other Barriers for Control of *Lm* in RTE Processed Meats

Joseph Sebranek, Iowa State University
Pediocin, a natural antimicrobial, was evaluated as a topical treatment for finished ready-to-eat products to determine if it will retard *Lm* growth. The results indicated that the pediocin significantly reduced the number of *Lm* on packaged frankfurters and delayed growth of the remaining cells during storage.

Control of *Lm* in RTE Meats using Cetyl Pyridinium Chloride (CPC) and Shelf Life Extension of RTE Meats Treated with CPC

Harshavardhan Thippareddi, Kansas State University
Cetyl pyridinium chloride (CPC) was evaluated through various application parameters for its antimicrobial effects on ready-to-eat meat and poultry products in an effort to retard growth of and/or eliminate *Lm*.

Operational Control and Monitoring of the Processing Environment

Cost Effective Treatments to Minimize In-Store Deli Meat Slicer Cross Contamination of RTE Meats by *Lm*, Phase II

Phil Crandall, John Marcy, Steve Ricke, Mike Johnson, Betty Martin, Corliss O'Bryan, Sara Rose Milillo, University of Arkansas

This study is the 2nd phase of this research, and will further evaluate deli slicers to reduce the risk of listeriosis in commercial settings. Best practices will be validated, as well as, the comparison of cleaning and sanitizing compounds used on deli slicers.

Cost Effective Treatments to Minimize In-Store Deli Meat Slicer Cross Contamination of RTE Meats by *Lm*, Phase I

Phil Crandall, John Marcy, Steve Ricke, Mike Johnson, Corliss O'Bryan, Betty Martin, University of Arkansas

This study focused on current cleaning and sanitizing methods of the deli slicer to determine if more effective methodologies are needed to further reduce the risk of listeriosis. Best practice and employee training materials were also developed.

Pre-and Post-package Pasteurization of RTE Meats for Reduction of *Lm*

Peter Muriana, J. Roy Escoubas, Oklahoma State University

This research showed that combinations of pre- and post-packaging processing were effective in reducing levels of *Lm*. Research also demonstrated that some pre-packaging antimicrobials were more effective

than others, with most not effective on uncured turkey products.

Improving the Utilization of Microbial Pathogen Computer Models for Validating Thermal Processes in the Meat Industry

Bradley Marks, Alden Booren, Elliot Ryser, Michigan State University

This research provided a complete secondary model for log-D with temperature, fat content and moisture content as independent variables. It also expanded thermal inactivation parameters for *Salmonella* lethality models. The results led to improved user interface and functionality for the AMI Process Lethality Spreadsheet.

The Role of Aerosols in Transmission of Microorganisms (including *Listeria*) to RTE Meat/Poultry Products

Michael Doyle, University of Georgia

This study demonstrated that aerosol particle size, relative humidity and distance from the air handling unit impacted settling rate and potential that exposed RTE products may become contaminated.

Plasma-Enhanced Disinfection of Surfaces, Air, and Water in RTE Meat and Poultry Processing Environments

Ferencz Denes, University of Wisconsin-Madison

This research focused on developing advanced atmospheric-pressure Array Electrode Reactor plasma-aided technologies for an in-line, continuous disinfection of product contact surfaces in RTE meat and poultry processing facilities.

Food Safety Initiative Funded Research Projects

Development of Ion Mobility Spectrometry (IMS) Applications for *Listeria* Detection and Monitoring In-Plant Food Processing Plants

Robert Vinopal, Claudia Koerting,

University of Connecticut

This research continued the development of IMS for detection of *Listeria*. It also focused on developing sample mechanisms for direct and aerosol sampling that would allow the samples to be analyzed directly by IMS techniques.

Development and Validation of Thermal Surrogate Micro-organisms in Ground Beef for In-Plant Critical Control Point Validation Studies

Michael Doyle, University of Georgia

This study identified a non-pathogenic bacterium that has heat resistance properties similar to *Listeria* and *Salmonella* in meat and poultry. Research developed protocols for the use of a non-pathogenic surrogate organisms in processing facilities to validate thermal processing.

Reduction of *Lm* Biofilm Formation in RTE Meat Processing Environments

Amy Lee Wong, University of Wisconsin

This research investigated methods to reduce biofilms of *Lm* on equipment and floor surfaces in RTE meat processing environments, by removal and inhibition of initial attachment and biofilm formation. The research evaluated the efficacy of cleaners and sanitizers on *Lm* biofilms, including the assessment of various surface coatings that will inhibit attachment.

Optimum Radiation Dose to Eliminate *Lm* in Packaged RTE Processed Meats and Survival of *Lm* RTE Processed Meats after Irradiation Processing

James Dickson, Iowa State University

This study investigated the optimal radiation dose required to eliminate defined loads of *Lm* in packaged RTE meat products.

Validation of the Use of Composite Sampling for *Lm* in RTE Meat and Poultry Products

Michael Curiale, Silliker Laboratories

This study determined what were the most reliable methods for detection of *Listeria* spp. and *Lm* in RTE products and if RTE meat products could be composited into analytical units greater than 25g as a means of reducing the labor and cost.

Control of *Lm* in Food Processing Facilities by Competitive Exclusion Microorganisms

Michael Doyle, University of Georgia

This research determined whether the introduction of harmless bacteria in the food processing facilities would reduce and/or eliminate *Lm* via competitive exclusion.

Risk Assessment Enhancement Research

Refinement of *Lm* Low Dose Data from Pregnant Guinea Pigs for Human Risk Assessment

Mary Alice Smith, Joseph Frank, University of Georgia

This research will use animal models to develop dose response information

for human listeriosis risk assessment modeling. It will gather information on the low dose region of the dose response curve and attempt to identify mechanisms by which *Lm* causes illness and death.

Review of FSIS Risk Assessment for *Lm* in Deli Meats

Barbara Petersen, Leila Barraj,

Eponent®, Inc.

This project reviewed the FSIS Risk Assessment for *Lm* in Deli Meats and examined the model assumptions and model construct to determine whether they were appropriate and applicable to actual industry “what if” scenarios.

Expert Scientific Review Panel on *Lm* In Foods

International Life Sciences Institute Risk Science Institute

This comprehensive review by an international panel of experts focused on use of a risk-based approach to identify strategies that will have the greatest impact on reducing foodborne listeriosis. The resulting report was submitted to the Codex Committee on Food Hygiene and the *Journal of Food Protection*.

Review of Scientific Literature Related to Survival of Pathogenic Foodborne Bacteria during Cooling of Heat-treated, RTE Meat and Poultry Products and Thawing of Frozen Raw Meat and Poultry

Ellin Doyle, University of Wisconsin

A review of the scientific literature on the survival of pathogenic foodborne bacteria during the cooling of heat-treated, RTE meat and poultry products and the thawing of frozen raw meat and poultry products.

Food Safety Initiative Funded Research Projects

Review FDA-CFSAN's and USDA-FSIS's "Draft Assessment of the Relative Risk to Public Health from Foodborne *Lm* Among Selected Categories of RTE Foods," and "Reducing the Risk of *Lm* – Joint Response to the President"

Novigen Sciences, Inc.

This review analyzed the assumptions and modeling techniques by FDA and USDA and provided for the submission of new data on consumer handling of RTE meats.

Literature Survey of the Various Techniques Used in *Listeria* Intervention

Ellin Doyle, University of Wisconsin

A review of the scientific literature on the role of various intervention strategies on the control of *Lm* in processed meats.

1999 U.S. Cold Temperature Evaluation

Richard Daniels, Audits International

This project conducted a national survey of temperatures of processed meat products at retail and upon arrival at home, after shopping. Data from this study was used in the FDA/USDA Risk Assessment for *Listeria monocytogenes*.

Salmonella

Reduction of *E. coli* O157:H7 and *Salmonella* in Ground Beef

Michael Doyle, Tong Zhao, University of Georgia

The use of levulinic acid and sodium dodecyl sulfate has been shown to be effective in reducing *E. coli* O157:H7 and *Salmonella* contamination in culture and non-meat food products. This study will examine their effectiveness when applied to ground beef as a surface treatment method to substantially reduce *E. coli* O157:H7 and *Salmonella* contamination.

Evaluation and Performance of the PremiTest™ *Salmonella* Serotyping System on Pork and Poultry Isolates from Commercial Sources

Margaret Hardin, Jayne Stratton, Marcos Sanchez-Plata, Texas A&M University, University of Nebraska-Lincoln, Inter-American Institute for the Cooperation in Agriculture

This study will validate the Premi-Test® *Salmonella*, a rapid serotyping methodology, to identify strains of *Salmonella* spp. isolates collected from pork and poultry source. This method is rapid and convenient for processors to identify the types of strains of *Salmonella* present at different stages in their processing environments.

A Workshop to Develop Reporting Guidelines for Interventions Studies in Food Safety and Production Animal Science: Modifying the CONSORT Statement

Annette O'Connor, Iowa State University

The objective of this workshop is to improve the quality and utility of intervention research, by modifying

the CONSORT statement (Consolidated Standards of Reporting Trials). CONSORT statement is intended to improve the reporting of randomized controlled trials, enabling readers to understand a trial's design, conduct, analysis, and interpretation, and to assess the validity of its results.

Evaluation of Alternative Cooking and Cooling Procedures for Large, Intact Meat Products to Achieve Lethality and Stabilization Microbiological Performance Standards

Jeffrey Savell, Kerri Harris, Alejandro Castillo, Wesley Osburn, Texas A&M University

This project validated the safety of slower cooking and cooling times for large whole-muscle meat products to meet FSIS lethality and stabilization microbiological performance standards.

A Systematic Review of Literature on Pork Chain Epidemiology

Annette O'Connor, Iowa State University

This systematic review identified areas in the pork production chain where research was repetitive or lacking, and can be used as a resource allocation tool to "fill in the gaps" in risk assessment models. The process of systematic review reduces bias in the selection of research studies by the comprehensiveness and reproducibility of the search strategy and the transparent selection of articles included in review.

Funded in part by the National Pork Board.

Food Safety Initiative Funded Research Projects

Beyond Intent: Assessment and Validation of On-pack-age Handling and Cooking Instructions for Uncooked, Breaded Meat and Poultry Products to Promote Consumer Practices that Reduce Foodborne Illness Risks

Randall Phebus, Douglas Powell, Kansas State University; Harshavardhan

Thippareddi, University of Nebraska

This research created a representative inventory of consumer handling and cooking recommendations on packages of heat treated not fully cooked, not shelf stable poultry products available at retail and for food service in the U.S. Observation of product preparation by consumers and food service employees and in-depth interviews was used to identify gaps between the intention of the handling statements and actual behavior.

Determining the Likelihood That *Salmonella* Develops Heat Resistance During Thermal Processing of Commercial, Whole-Muscle, RTE Meat Products

Bradley Marks, Alicia Orta-Ramirez, Alden Booren, Elliot Ryser, Michigan State University

This research adapted and validated a model to predict the rate of *Salmonella* thermal inactivation as a function of both product temperature and prior sublethal thermal history. It also evaluated whether any resulting increase in *Salmonella* thermal resistance would have an impact on the compliance of typical commercial cooking operations with USDA-FSIS lethality performance standards for RTE products.

White Paper on Human Illness Caused by *Salmonella* from All Food and Non-Food Vectors

Charles Kaspar, M. Ellin Doyle, John Archer, University of Wisconsin

This white paper examined current methods for surveillance, and the collection of epidemiological information related to foodborne outbreaks caused by *Salmonella* spp. were analyzed to assess their effectiveness and limitations. Information on illness caused by *salmonellae* was critically evaluated with research projects and modifications of epidemiological data collection needed to close gaps in our understanding of these issues were suggested.

Projected was co-funded with National PorkBoard.

Sodium Nitrite

A National Survey of the Nitrite/ Nitrate Concentrations in Cured Meat Products and Non-meat Foods Available at Retail

Jimmy Keeton, Wes Osburn, Margaret Hardin, Texas A&M University

This research analyzed samples of the major categories of cured meat products and highly consumed raw vegetables for residual nitrite/nitrate. The survey showed that nitrite/nitrate contents of U.S. cured meat products have remained low since the last survey in 1997.

Projected was co-funded with National Pork Board.

Diet and Health Research

Analysis of Heterocyclic Amines (HCAs) Formation in Various Cooked Meat Products

J. Scott Smith, Terry Houser, Melvin Hunt, Kansas State University

This research will examine the occurrence and levels of heterocyclic amines (HCA) in various meat products, including meat products with antioxidant containing marinades and enhancement with various ingredients. An extensive literature review and evaluation of potential exposure and risk will be undertaken during the course of this research.

Projected is co-funded with National PorkBoard.

Assessment of the Potential Human Exposure to Heterocyclic Amines from Various Cooked Meat Products

Arthur Miller, Leila Barraj, Nga Tran, Terry Troxell, Exponent, Inc.

This study reviewed major categories of fresh and processed meat products that are candidates for heterocyclic amine (HCA) formation and developed a matrix of levels of HCA among the major consumed meat products. An exposure assessment was also conducted based on known dietary consumption patterns.

Projected was co-funded with National Pork Board.



Food Safety Initiative Funded Research Projects

Other Food Safety Activities

White Paper on Effectiveness of Existing Interventions on Virus Inactivation in Meat and Poultry Products

Ellin Doyle, Kathy Kurth, Andrew Milkowski, University of Wisconsin

This white paper will cover information on the distribution of viruses in infected animals, shedding of animal and human viral pathogens, persistence of viruses in foods and the environment, thermal and non-thermal methods for destruction of viruses, and other industry practices, including GMPs and SSOPs, designed to prevent contamination of meat.

Evaluation and Analysis of Meat Products Contaminated by Low Levels of Ammonia

Randy Wehling, Michael Zeece, Harshavardhan Thippareddi, University of Nebraska

This project will develop a practical method for measuring ammonia contamination levels in meat products. The method will then be used to study the uptake of ammonia by meats, and the effectiveness of methods designed to decrease contamination levels.

Destruction of H5N1 Avian Influenza in Meat and Poultry Products

M. Ellin Doyle, Ronald Weiss, Stacey Schultz-Cherry, University of Wisconsin; Michael Robach, Cargill, Inc

This white paper determined the generally accepted time and temperature requirements for inactivation of the H5N1 virus in meat and poultry products. It reviewed non-thermal methods for inactivation of the

H5N1 virus and their effectiveness and practicality in meat and poultry matrices. Finally, data gaps regarding inactivation of these viruses were identified.

Microbial Risk Factors and Consequences Associated With Condensation in Fresh and RTE Processing Facilities

Mindy Brashears, Mark Miller, Chance Brooks, John Blanton, Christine Alvarado, Texas Tech University; Guy Loneragan, West Texas A&M University

This study determined the microbial risk associated with condensation and identified controllable risk factors associated with its formation. The risk factors of condensation in processing environments where both fresh and ready-to-eat products are produced was examined.

Efficacy Of Chlorine Dioxide Against *Lm* In Brine Solutions

Catherine Cutter, Ed Mills, W. B. Valderrama, Pennsylvania State University

This study evaluated the survival of *Lm* in brine solutions containing chlorine dioxide. It was not determined to be an effective antimicrobial.

AMR Baseline Study

Glenn Schmidt, Colorado State University

This study documented that R-bio-pharm test kits were a reliable field method of estimating the presence of the fluorescent glial fibrillary acidic protein (GFAP). These test kits may have the ability to be used as a process control tool for ensuring that GMPs for spinal cord removal are effective.

Co-funded by National Meat Association

Economic Analysis of Measures Proposed by FSIS to Reduce Human Exposure to the BSE Agent in Human Food

William Motes, Mark Jekanowski, Sparks Companies, Inc.

This report analyzed and quantified potential food industry costs from anticipated regulatory changes resulting from a BSE discovery in the U.S. cattle herd.

AMIF Research Advisory Committee

As of 2009, a number of leading industry professionals currently oversee AMIF's research agenda. They include:

Rob Allen
Bob Evans Farms

Kathleen Krantz
Greater Omaha Packing Co., Inc.

Thomas Powell
American Meat Science Association

Sharon Beals
Smithfield

John Labrador
Smithfield Foods, Inc.

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Phil Minerich
Hormel Foods Corporation

Peter Taormina
John Morrell & Co.

Michael Doyle
University of Georgia, Center for Food Safety

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