FOUNDATION FOCUS
July 2023

Meat Industry Food Safety Conference

Join us at the annual Meat Industry Food Safety Conference. Every year, food safety professionals gather to share best practices and research updates and provide expert education on the most critical food safety-related topics in the meat industry. Topics include species-specific (pork, beef, chicken) food safety topics like *Salmonella*, irradiation, non-traditional interventions, and navigating a food safety assessment. The Meat Industry Food Safety Conference provides processors and academia the opportunity to elevate the food safety program, grow your network, and contribute to advancing food safety best practices. Join us August 17-18 in Denver, Colorado. Go here to register.

Dietary Guidelines Advisory Committee Holds Second Meeting

The second meeting of the 2025 Dietary Guidelines Advisory Committee (DGAC or committee) was held on May 10 to discuss the prioritization of scientific questions and draft protocols as well as plans for future committee work. A videocast of the second meeting is available here. The committee shared the draft protocols that will be used to evaluate the evidence for the identified scientific questions via the NESR Systematic Review; food pattern modeling; and data analysis. The committee will continue to draft protocols for the remainder of the questions and implement the protocol once finalized. The next meeting will be held on September 12-13 and will provide the opportunity for public oral comment. Registration for the meeting and oral comment opens on August 10 at 10 a.m. ET. More information is available at https://www.dietaryguidelines.gov/.

CDC Report Shows Foodborne Illnesses Increased in 2022

The Centers for Disease Control and Prevention (CDC) published the Morbidity and Mortality Weekly Report, which found that in 2022, illnesses caused by foodborne germs generally returned to or exceeded levels observed in 2016–2018, before the COVID-19 pandemic. During 2022, FoodNet identified higher incidences of Shiga toxin-producing *Escherichia coli, Yersinia, Vibrio,* and *Cyclospora* infections compared with 2016–2018. *Campylobacter, Salmonella, Shigella,* and *Listeria* incidences did not change. The report concluded that "Collaboration among food growers, processors, retail stores, restaurants, and regulators is needed to reduce pathogen contamination during poultry slaughter and to prevent contamination of leafy greens." More details are available here.

Newly Approved Research Summaries

The Foundation's Board of Directors met in early 2023 to review and approve an ambitious research agenda. Several of the projects are now underway. Summaries follow.

Creating Alternative Support for Lethality and Stabilization for Heat Treated and Fully Cooked Meat and Poultry Products, University of Wisconsin, HansonTech

Nearly all meat processors in the United States utilize USDA, FSIS Appendices A and B to ensure adequate thermal lethality and stabilization is achieved for partially and fully cooked products. Through the development and release of updated versions in 2017 and 2021, and the realization that a host of potential food safety vulnerabilities exist, the widespread usefulness and in-plant practical application of these guidance documents has become a significant concern and practical challenge to implement. The primary objective of this study is to develop a scientific-based, regulatory-supported, and industry-useful thermal processing and cooling resource (e.g. cooking and cooling food safety handbook) for validating pathogen destruction and control, and regulatory compliance for partially and fully cooked meat products that can be used in conjunction with or in lieu of USDA, FSIS Appendices A & B.

Funded in part by the Beef Checkoff.

Revealing mechanisms for internal *Salmonella* colonization and persistence in porcine lymphoid and fat tissue, USDA-ARS-NADC - Food Safety and Enteric Pathogens Research Unit

Swine can become persistently infected with *Salmonella*, shedding little to no bacteria in the feces, until subjected to a stressful event, which increases fecal shedding. A clear understanding of the mechanisms of *Salmonella* persistence in porcine immune cells is needed to developing targeted intervention strategies to significantly reduce Salmonella carriage in swine and the risk of contamination of products and the environment. The overall hypothesis is that *Salmonella* resides in myeloid-lineage cells in porcine lymphoid tissues and fat, and subsequently modulates the cellular state to limit bacterial clearance. The objectives of this project is to identify the cell types harboring *Salmonella* in pig lymphoid and adipose tissue at various stages of colonization; characterize the cellular response; and identify mechanisms of intracellular colonization.

Funded in part by the National Pork Checkoff.

Enhanced Characterization of Sequence Differences Among *Salmonella* isolates within SNP Clusters Identified by the NCBI Pathogen Detection System, USDA-ARS, Meat Animal Research Center

This research intends to better understand the full picture of relatedness within critical *Salmonella* serovars of interest by performing a comparative genomic analyses on currently available data within the Pathogen Detection Isolates Browser (PDIB). An analysis pipeline will be developed to catalogue *Salmonella* SNP cluster diversity in the NCBI PDIB with the goal of producing a white paper to enhance industry use and understanding of this tool, and to enhance public health actions and general understanding of *Salmonella* genomics by identifying isolates for closed genome sequencing that are within 50 SNP differences.

Research is funded by the Beef Checkoff and Administered by the Foundation.

Summarizing the current knowledge and existing knowledge gaps for pre-harvest and post-harvest *Salmonella* contamination in pork, Kansas State University, Triumph Foods

Research on pre-harvest and post-harvest measures to prevent or reduce pathogen contamination have been published. However, knowledge gaps still remain, and a thorough literature review is necessary to fully understand what steps should be taken to address *Salmonella* concerns both preharvest and post-harvest in the swine. Therefore, this project will conduct a thorough search of pre-harvest and post-harvest *Salmonella* research in swine; compile the literature and prepare a written review of the existing knowledge. Knowledge gaps and research recommendations will be identified. NAMI members/volunteers will serve as focus group participants to ensure all current knowledge is considered.

Funded in part by the National Pork Checkoff.

Characterizing *Salmonella* Isolates from Ground Beef in the United States, Texas Tech University, Kansas State University, University of Georgia, USDA-ARS, Meat Animal Research Center, Food Safety Net Services

It is hypothesized that *Salmonella* serotypes and presence of highly pathogenic *Salmonella* (HPS) in ground beef will vary by geographic location and season depending on the facility. Samples obtained from a separate study will be analyzed to determine the *Salmonella* serotype(s) present in each positive sample and the presence of HPS associated with U.S. ground beef.

Funded in part by the Beef Industry Food Safety Council.

Recently Completed Research Summaries

Findings from a recently completed study funded by the Pork Checkoff and administered by the Foundation are provided in the following summary. Research was conducted by the University of Minnesota.

Ground Pork Risk Assessment

The goal of this project was to assess the public health impact of ground pork contaminated with nontyphoidal *Salmonella* in the US. Ground pork lots from market hogs and sows were characterized by contamination level and presence of highly virulent or multidrug resistant serotypes. Results of these models may be used to evaluate potential impact on public health of model performance standards based on *Salmonella* spp. enumeration level (MPN/g) and strain characteristics to reduce the number of human cases due to ground pork consumption. The risk assessment model was developed and populated with FSIS prevalence and enumeration data.

This study used quantitative microbial pathogen enumeration to estimate the annual cases of salmonellosis due to consumption of contaminated ground pork in the US. It also investigated the use of contamination thresholds as a risk mitigation method that could inform ground pork performance standards moving forward to meet national salmonellosis reduction goals. In total, it's estimated that there are currently 10,590 (6,484 – 16,005, 90% CI) annual cases of salmonellosis attributable to ground pork consumption. Risk models indicated that relatively small reductions of highly contaminated ground pork production lots would result in nearly a 50% reduction in annual illnesses. Most ground pork is generally contaminated at very low concentrations and the majority of *Salmonella* serotypes present are not considered highly virulent. However, human illnesses are driven by high levels of contamination and highly virulent *Salmonella* serotypes. Identifying and removing or redirecting ground pork product that is contaminated above a 1 MPN/g threshold or is contaminated with *Salmonella* serotypes commonly associated with human illness and outbreaks are effective risk prevention strategies according to these risk models.

Future research should focus on closing data gaps such as US ground pork cooking practices and preferences, cross-contamination coefficients, and product transportation conditions (time and temperature) to improve model precision.

Findings from a recently completed study funded by the Beef Checkoff and administered by the Foundation are provided in the abstract on the following page.

Impact of Sanitization and Natural Biofilm Communities on *Salmonella* Prevalence at Processing Plants

Rong Wang and Joseph M. Bosilevac, USDA-ARS-U.S. Meat Animal Research Center

Salmonella enterica is a leading cause of foodborne illness in the United States. Biofilm formation by certain S. enterica strains or serovars has been found to potentially contribute to product contamination at meat processing plants. Further, the composition of the environmental biofilms and their interactions with foodborne pathogens may affect pathogen tolerance and survival, demonstrating the importance of proper sanitization for biofilm control. To address this challenge, a multicomponent sanitizer approach has been designed to take advantage of the synergistic effects by combining multiple chemical reagents with different functional mechanisms to penetrate and inactivate biofilm cells. In addition, various alternatives other than traditional sanitizers have been proposed, including the antibiofilm enzyme–based disruption that targets the integrity of the biofilm structure. However, current studies mostly focus on single-species pathogen biofilms but do not take into consideration that pathogens may be harbored in natural mixed biofilms. Sanitizer effectiveness can vary significantly due to the interactions between the environmental microorganisms and the pathogens. In addition to biofilm cell inactivation, post-treatment pathogen survival control and recolonization prevention are all essential for reducing biofilm–related contamination. Here we evaluated the effectiveness of three multicomponent sanitizers against S. enterica harbored in environmental biofilms collected from various areas at three beef plants and two pork plants. The biofilm-forming ability of the beef plant samples varied significantly while most of the pork plant samples formed strong biofilm matrices. Using an S. enterica cocktail containing five common *Salmonella* serovars, we showed that the *Salmonella* strains were able to integrate into the mixed biofilms efficiently even under low temperatures (e.g. 7oC) commonly seen in processing facilities. Using the foam coverage method, the multicomponent sanitizers reduced environmental bacteria and *Salmonella* cells in most samples to a non-enumerable level and also inhibited the pathogen post-sanitization recovery growth. In comparison, fog treatment was less effective as enumerable viable *Salmonella* cells were detected in multiple treated samples. Moreover, an overall higher survival and post-sanitization S. enterica prevalence were observed in the treated pork plant mixed biofilms than those in the beef plant samples. Scanning electron microscope analysis showed that the two tested enzyme-based detergents reduced the mixed biofilm matrix and weakened the bacterial extracellular connection with the contact surfaces. Biofilm morphology was altered after the treatment as in most cases the extracellular structures were dissolved and intact mature biofilm architecture was not found. Instead, scattered clusters of bacterial aggregates or individual cells were observed. A 2nd step following the detergent treatment using quaternary ammonium compounds (QAC) or peracetic acid (PAA) was applied. PAA alone or applied with the detergents exhibited higher effectiveness compared to the QAC applications. While applied alone at higher concentrations, the detergent effectiveness was not significantly enhanced in terms of inactivating pathogen cells in mixed biofilms. However, the higher detergent concentration better prevented *Salmonella* prevalence after the follow-up treatments by QAC or PAA. Metagenomic analysis of the environmental communities showed no significant difference in species diversity between beef and pork plants or among the drain areas. However, variations in the percentages of species' relative abundance were observed among the samples. The natural microbial community at the processing plants and the resulting species interactions might affect the tolerance level of the pathogens integrated into the environmental biofilms and subsequently the effectiveness of sanitization with regard to pathogen inactivation and prevalence prevention.

Salt Substitutes Proposed Rule

The U.S. Food and Drug Administration (FDA) is proposing to amend the standards of identity (SOIs) to permit the use of salt substitutes in foods for which salt is a required or optional ingredient. Foods with SOIs are often referred to as standardized foods. The proposed rule would provide manufacturers with flexibility and facilitate industry innovation to reduce sodium in standardized foods. The proposed rule is part of the Biden-Harris Administration's National Strategy on Hunger, Nutrition, and Health, which provides a roadmap of actions the federal government will take to end hunger and reduce diet-related diseases by 2030 – all while reducing disparities. The proposed rule also complements the goals of the FDA's voluntary sodium reduction targets for processed, packaged and prepared foods. Comments are due August 8, 2023.

USDA FSIS Fellowship Program

A paid PhD student fellowship and research opportunity is currently available with the U.S. Department of Agriculture's (USDA) Office of Food Safety (OFS). The appointment will be served at the selected participant's location. OFS is the USDA mission area that houses the Under Secretary for Food Safety and is charged with carrying out the Administration's food safety priorities. FSIS is a science-based agency and applies the latest advances in food safety technologies to monitor chemical, microbiological, and physical hazards in meat, poultry, and egg products. FSIS has identified several food safety research priorities that support its mission. These are listed at the link: https://www.fsis.usda.gov/science-data/research-priorities. Under the guidance of a university mentor, the participant will create a project that is directly or indirectly supportive of FSIS research priorities. The participant will choose one of the topics listed on the FSIS Food Safety Research Studies page or on another project related to food safety. To apply or find more information go to https://www.zintellect.com/Opportunity/Details/USDA-FSIS-2023-0235. Applications are due on August 18, 2023.

FOUNDATION EDUCATION SCHEDULE

Meat Industry Food Safety Conference
August 17 - 18, 2023
Grand Hyatt Denver, CO

Protein PACT Summit
October 4 - 6, 2023
San Diego, CA

Click here to learn more about these events, or visit www.meatinstitute.org and click the "Events & Education" tab on the navigation bar.

2023 RESEARCH ADVISORY COMMITTEE MEMBERS

The Foundation's Research Advisory Committee (RAC) develops meat and poultry research priorities which serve as the basis for the Foundation's research agenda and also communicates the areas of greatest research needs to the government, public and interested stakeholders. The RAC is made up of four subgroups across minimally processed (fresh) meat and poultry safety, further processed meat and poultry safety, nutrition sciences and product quality.

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Ben Stellmacher, Johnsonville Sausage, LLC
Tommy Wheeler, USDA, ARS, U.S. Meat Animal Research Center
Barry Wiseman, Triumph Foods

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The Foundation for Meat and Poultry Research and Education is governed by a Board of Directors, which provides scientific leadership and financial oversight, and acts upon recommendations from the Foundation's Research Advisory Committee. The North American Meat Institute's Executive Board is afforded the opportunity to serve on the Foundation's Board of Directors or appoint a designee to serve on their behalf. In an effort to broaden the scope of influence and direction, representatives from the livestock (beef, pork, poultry and egg), retail, academic, government agency and consumer sectors, among others, are invited to serve on the Board of Directors. Terms are for one year.

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THANK YOU TO THE FOUNDATION'S 2023 CONTRIBUTORS

The Foundation is supported through generous contribution of companies and individuals. Company names with an asterisks (*) indicate NAMI Board of Directors companies. 2023 fundraising efforts are now underway.

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Novel TaqMan assays for the specific detection and simultaneous differentiation of virulent and avirulent non-O157 Shiga toxin-producing *Escherichia coli* strains, Florida State University, USDA-ARS, U.S. Meat Animal Research Center

This study intends to standardize six multiplex TaqMan assays for the identification of virulent strains of *E. coli* O26, O111, O45, O103, O121, and O145 serogroups. Further, it will demonstrate the applicability of the standardized assays in inoculated food samples and red meat enrichments from national red meat surveillance programs through a direct comparison with the FSIS MLG 5C.01 reference method.

Leveraging a current market hog lymph node study to further understand *Salmonella* transmission and internal colonization, Kansas State University, Texas Tech University, Triumph Foods
This project will probe a possible relationship between *Salmonella* antibodies in oral fluids and internal colonization of market hog carcasses by determining if antibody testing of oral fluids can be used as an effective antemortem screening tool to assess a group/lot of pigs for *Salmonella* risk. Further, it will characterize internal colonization within market hogs by detecting and enumerating *Salmonella* in lymph nodes and tonsils, cecal contents, spleen, and oral fluids.
Research funded in part by the National Pork Checkoff.

Development and validation of an antimicrobial database to predict microbial load reduction on raw pork components against *Salmonella*, University of Illinois at Urbana-Champaign
This study will implement a high-throughput miniature assay to evaluate *Salmonella* reduction after pork carcass wash with antimicrobial treatments. Response surface methodology will be used to determine synergistic or antagonistic interactions between antimicrobials and optimize combinations to reach desired *Salmonella* reductions. The results are intended to validate the predicted interactions between antimicrobials in laboratory experiments, as well as build an antimicrobial database in which additional antimicrobial treatments data can be added as new compounds become relevant against *Salmonella* in pork.
Research funded in part by the National Pork Checkoff.

Exploring the use of Probicon as a direct-fed microbial to reduce the *Salmonella* burden in market hogs, Kansas State University, USDA-ARS-U.S. Meat Animal Research Center, Triumph Foods
This study will evaluate the influence of direct fed microbials (DFM) on pig performance, morbidity, and mortality throughout the feeding period. The feces and mesenteric lymph nodes of market hogs fed a control or DFM augmented diet will be collected to establish the impact of each diet on *Salmonella* internalized in the lymphatic system. By determining *Salmonella* serotype and presence of highly pathogenic *Salmonella* (HPS), it evaluates whether *Salmonella* diversity and/or presence of HPS is impacted by probiotic administration.
Research funded in part by the National Pork Checkoff.

A Cross-Sectional Investigation of *Salmonella* in Market Hog Lymph Nodes, Kansas State University, Texas Tech University, Triumph Foods, LLC, Smithfield Foods, Inc., JBS Foods, Clemens Food Group
A cross-sectional study design will investigate the prevalence and concentration of *Salmonella* in up to 6 lymph nodes and tonsils of market hogs. Prevalence and concentration data will be subsequently used to design a risk-assessment mapping of the carcass for prioritization of node-removal for pathogen control. The study also intends to address knowledge gaps regarding *Salmonella* prevalence by region and/or season in the United States.
Research funded in part by the National Pork Checkoff.

Effects of proportioning meat and plant-based protein-rich foods within the U.S. Healthy Eating Pattern on cardiovascular disease risk factors, Purdue University
This project will assess the effects of consuming different proportions of red meat and plant-based, protein-rich foods incorporated into a U.S. Healthy Eating Pattern on cardiovascular disease risk factors in adults at high risk of developing a heart-related disease.
Research funded in part by the Beef Checkoff.

FOUNDATION FOR MEAT & POULTRY RESEARCH & EDUCATION