RESEARCH UPDATE

Current Research Projects

Understanding the impact of the farm and lairage environments on *Salmonella* contamination in market hogs, University of Wisconsin-Madison, Kansas State University, Texas Tech University, USDA-ARS

Salmonella contamination in market hog tonsils, lymph nodes, feces, and cecal contents likely occurs rapidly, and previous research suggests that the lairage period provides risk for cross contamination to occur. The study objectives are to detect and quantify *Salmonella* from market hogs on-farm, at lairage, carcass swabs, and lymph nodes. The *Salmonella* isolates will be characterized to determine their serotype and the presence of highly pathogenic *Salmonella* at the different stages of sampling. *Salmonella* concentration and serotypes in post-harvest samples will be evaluated to determine if it most closely represents *Salmonella* contamination on-farm or from lairage, and the impact of time spent in lairage.
Funded in part by the National Pork Checkoff.

Survival of African swine fever in pork and processed pork products, Canadian Food Inspection Service, Agriculture and Agri-Food Canada

African Swine Fever (ASF) is a contagious, haemorrhagic viral disease of pigs that is currently spreading westwards throughout Europe and eastwards into China, with significant economic losses along its path. While strict regulatory guidelines are in place to prevent the spread of this virus, little is known about the effectiveness of current meat processing methods in inactivating ASF. In addition, the matrix effect of individual meat products and ingredients on ASF survival is not well documented. This project aims to explore the survival of ASF in different meat products from ASF infected pigs as well as investigate the effect of different ingredients, cooking temperature, storage time and high pressure processing on ASF inactivation in different meat model systems.
Funded in part by the National Pork Checkoff under an ASF Partnership and administered by the Foundation.

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 Appendix 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 Appendix A & B.
Funded in part by the Beef Checkoff.

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.

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 are 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.

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.

A surveillance of *Salmonella* in the lymph nodes of sows and boars, Kansas State University, Texas Tech University
Salmonella contamination remains the leading food safety concern for pork products. The contribution of *Salmonella* in the lymph nodes in sows and boars is unknown. This study will determine *Salmonella* prevalence and concentration in the lymph nodes (subiliac, mesenteric, tracheobronchial, inguinal, axillary, pre-scapular) and tonsils of sows and boars at harvest. The impact of season and region on *Salmonella* prevalence and concentration in the lymph nodes of sows and boars will be evaluated. Positive samples will be serotyped.

Effect of minimally processed animal protein within the Dietary Guidelines for Americans on biomarkers for cognitive decline, South Dakota State University
Investigators will leverage an ongoing well-designed, randomized, controlled, crossover, feeding study following USDA Dietary Guidelines for Americans to establish the role of lean animal protein in cognitive health promotion. A minimally processed lean meat incorporated diet will be compared with an isocaloric lacto-ovo-vegetarian control. It is expected the addition of animal protein will enhance nutrient adequacy and reduce markers associated with cognitive decline and neurodegenerative diseases.

Research Funded By the Beef Checkoff and Administered by the Foundation
Analysis of beef *Salmonella* outbreaks using the USMARC SNP analysis pipeline, USDA-ARS, Meat Animal Research Center
Using the pipeline developed in a previously funded project (*see* Enhanced Characterization of Sequence Differences Among *Salmonella* isolates within SNP Clusters Identified by the NCBI Pathogen Detection System), genomes from previous beef *Salmonella* outbreaks will be evaluated to characterize the genomic variation between sequenced isolates related to the outbreak. The findings will detail the reliability of Beef *Salmonella* outbreak traceback.

Developing a Quantitative *Salmonella* Baseline 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
The *Salmonella* level in ground beef across the U.S. is unknown. As a result, risk assessments and understanding the public health impact of potential *Salmonella* control programs across the industry are not always accurate. This study intends to conduct a representative *Salmonella* baseline and develop a blinded quantitative *Salmonella* baseline for the U.S. beef industry representing season and geographical waves.

Recently Completed Research

A Cross-Sectional Investigation of *Salmonella* in Market Hog Lymph Nodes & Leveraging a current market hog lymph node study to further understand *Salmonella* transmission and internal colonization, Kansas State University, Texas Tech University, Triumph Foods

A cross-sectional study design was employed to evaluate which lymph node (LN) type presented the highest risk for containing *Salmonella* and at what level of contamination, while also investigating the seasonal and regional variability of *Salmonella* in market hog LNs. Findings show *Salmonella* prevalence varies by LN type in different seasons and regions. Tonsils and mesenteric LNs were associated with the greatest overall *Salmonella* prevalence and concentration; however they are not commonly associated with ground pork contamination. The highest prevalence was observed in tonsils during the spring in the eastern region. The results from this study reinforced data previously reported in the literature by indicating that market hog LNs harbor *Salmonella* in various lymphoid tissue. The risk of *Salmonella* contaminated LNs is greatest when the interior of a LN is exposed.
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 implemented a high-throughput miniature assay to evaluate *Salmonella* reduction after pork carcass wash with antimicrobial treatments. Response surface methodology (RSM) was used to determine synergistic or antagonistic interactions between antimicrobials and optimize combinations to reach desired *Salmonella* reductions. The RSM model predicted, later validated and confirmed in a lab setting, that the tested antimicrobials do not have a significantly higher inhibitory effect against *Salmonella* on pork when added in combination. The tools developed in this study can be used to screen other compounds that can be potentially effective alone and/or in combination to further the understanding of antimicrobial activity and to ensure the food safety of pork products in a time- and cost-effective manner.
Funded in part by the National Pork Checkoff.

Recently Completed Research funded by the Beef Checkoff and Administered by the Foundation

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 intended 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 was developed to catalogue *Salmonella* SNP cluster diversity in the NCBI PDIB. Relatedness analysis performed using the pipeline closely approximated the SNP differences reported by the PDIB and showed that the analysis can be done outside the database. The pipeline allows for a more complete understanding of the sequence similarity between isolates by identifying novel or missing elements in the genomes and cataloguing the sequence diversity.

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 standardized and validated assays for the specific detection of virulent strains of *E. coli* O26, O103, O111, and O121 with significant accuracy. These assays can be used as a molecular confirmation tool to reduce product and financial losses from misleading positive results caused by avirulent strains.