

FOUNDATION FOCUS



BOARD APPROVES RESEARCH RECOMMENDATIONS

The Foundation's Board of Directors met in January 2021 to review and approve an ambitious research agenda for 2021. The Foundation's Research Advisory Committee recommended five projects addressing meat and poultry safety and nutrition sciences research. The April 2021 newsletter provides summaries of three of the projects. Two additional projects received approval for funding.

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 be employed to 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.

Funded in part by the National Pork Checkoff.

Effects of deep cleaning sanitation on biofilms and pathogens, USDA-ARS US Meat Animal Research Center

The overall goal of this project is to examine the disruption and reformation of natural biofilm communities present in processing plants and attempt to correlate biofilm phenotypes, such as mass, sanitizer resistance, and pathogen protection with their microbial community structures.

Funded by the Beef Checkoff and administered by the Foundation

2021-2022 RESEARCH PRIORITIES IDENTIFIED

The Foundation's Research Advisory Committee met in June to identify industry research needs and establish the Foundation's 2021-2022 research priorities, which will serve as the basis for its request for proposals (RFP). [These priorities](#) address; pathogens on minimally and further processed meat and poultry products; other food safety issues; product quality; and nutritional sciences. The priorities are used when communicating with government agencies, stakeholders and the general public, and are intended to show the broad scope and diverse research needs of the industry. The 2021-2022 RFP will be issued separately for meat and poultry safety; product quality; and nutrition sciences later this summer. Please check the Foundation website (www.meatpoultryfoundation.org) for more details.

BEEF SAFETY RESEARCH

The Foundation, through its post-harvest beef safety research contract with the Beef Checkoff, awarded three grants in response to the Expedited Beef Safety Request for Proposals issued in late winter 2021. When discussing these projects, the Foundation's Senior Science Advisor, KatieRose McCullough said, "These projects are leaps not steps" to advancing our understanding around *Salmonella* in ground beef. Overviews of the newly funded projects follow. Additional projects are still under consideration.

Risk assessment model to assess the impact on public health of ground beef lots based on the contamination level and presence of highly virulent or multidrug resistant strains, University of Minnesota

This project will develop a risk assessment model using existing Food Safety and Inspection Service prevalence and enumeration data to assess the impact of ground beef lots characterized by contamination level and presence of highly virulent or multidrug resistant strains on public health. Results of this model could be used to evaluate potential impact on public health of model performance standards based on *Salmonella* spp. enumeration level (CFU/g) and strain characteristics to reduce the number of human cases due to ground beef consumption.

Evidence-based, quantitative risk assessment to control salmonellosis attributable to ground beef: Evaluating and mitigating the contribution of lymph nodes to *Salmonella* contamination, University of Nebraska-Lincoln, U.S. Meat Animal Research Center, USDA ARS, Michigan State University, The University of Vermont, University of California

This project will characterize the distribution of both prevalence and concentration of *Salmonella enterica* in bovine deep tissue lymph nodes (DTLNs) by lymph node type, production source, region and season using systematic review and meta-analysis approaches. The relative contributions of DTLNs and the efficacy of their removal at processing on salmonellosis risk associated with ground beef consumption will be evaluated using a quantitative microbial risk assessment approach.

Using empirical evidence, modeling, and risk assessment methods to estimate the public health impact of incorporating enumeration and virulence as part of the criteria for evaluation of *Salmonella* contamination in ground beef in the US, EpiX Analytics, Colorado State University

This project will develop a quantitative microbial risk assessment to assess the potential public health impact of incorporating enumeration and virulence evaluation strategies as part of the criteria for evaluation of *Salmonella* contamination in ground beef in the U.S. Additionally, using existing surveillance data the effect of season and regional sources of the live cattle on changes in *Salmonella* prevalence, virulence, and enumeration in ground beef and trim will be estimated.

RECENT COMPLETED RESEARCH SUMMARIES

The final reports for two research projects were recently submitted to the Foundation. Summaries of the findings are provided below pending publication in peer-reviewed journals.

How Does Analytic Approach Impact Pathogen Population Structure When Analyzing Whole Genome Sequence Data?, University of Minnesota, IBM

The overall goal of this project was to support an accurate, reproducible, transparent and uniform approach to whole-genome sequence (WGS) analysis for purposes of pathogen surveillance and outbreak detection, with a focus on *Salmonella enterica*, *E. coli/Shigella*, and *Listeria monocytogenes*. The overarching objective was to undertake a systematic comparison of several WGS analysis approaches in order to characterize how these differing approaches impact downstream results. The study found that differences in analytic approach significantly altered the results of WGS and subsequent phylogenetic trees, suggesting that these differences may change inferred pathogen population structure in some -- but not all -- cases. The results of this project contribute to a deeper understanding of the limitations of current WGS analyses, and demonstrate that different pipelines can produce discrepant results about relationships between a given set of pathogen isolates with unknown epidemiological links.

Funded in part by the Foundation for Meat and Poultry Research and Education and Beef Checkoff.

Using whole genome sequencing to evaluate short- and long-term genetic variation of Shiga toxin-containing *Escherichia coli* O157:H7 in cattle to improve interpretations of isolate relatedness in outbreak investigations, USDA-ARS-Meat Animal Research Center

This study used a combination of whole genome sequencing and complete whole genome sequencing to characterize short- (31 days) and long-term (22 years) genetic variation of STEC O157 in cattle to improve interpretations of isolate relatedness in outbreak investigations. The data from the short-term study showed several groups of STEC O157 can exist within a feedlot and each evolves at a different rate over time. The findings indicate that regardless of tools used or sequencing method, the results were the same as current WGS best practice results. This indicated that if best practices are used for studying DNA, the results will be similar and provide the same information during a foodborne outbreak.

Funded by the Beef Checkoff and administered by the Foundation.

RECENT RESEARCH FINDINGS

Research funded by the Foundation and Beef Checkoff was recently accepted for publication in the *Journal of Food Protection*. The abstract follows:

Recent revisions to USDA FSIS compliance and safe harbor guidelines for ready-to-eat meat and poultry products addressed process humidity requirements. Given the lack of prior data for impingement-cooked products, this project aimed to evaluate the impact of process humidity on *Salmonella* lethality at the product core and surface, and compliance of the results with USDA FSIS lethality performance standards. Whole muscle beef strips, ground beef patties, whole muscle chicken breast fillets, and breaded ground chicken patties were inoculated with an 8-serovar cocktail of *Salmonella*. Beef and chicken samples were cooked in a pilot-scale moist-air impingement oven to a core temperature of 70.0 or 72.8°C, respectively, immediately quenched in liquid nitrogen, and dissected to obtain core and surface samples. Variables included oven temperature (218, 232°C), air velocity (0.7 and 2.8 m/s), and oven humidity (0.7, 15, 30, or 70% moisture by volume (% v/v)). Additional treatments were performed to examine the impact of supplemental critical control processes, such as increased endpoint temperature, post-oven carryover time, and pre- or post-oven steam treatments. *Salmonella* reductions of >7 log were reliably achieved in chicken patties regardless of the processing variables; however, none of the treatments reliably ensured >6.5 log reductions of *Salmonella* in ground beef. A majority of whole-muscle samples failed to meet the required performance lethality when processed at 0.7% v/v; however, *Salmonella* inactivation was significantly improved ($P < 0.05$) at oven humidities of > 30% v/v. Dry oven conditions achieved greater *Salmonella* lethality at the core than at the surface for multiple products ($P < 0.05$). The efficacies of minimal and supplemental critical controls were product-, process-, and humidity-dependent ($P < 0.05$). Overall, process humidity and product variability should be considered in regulatory requirements and process validations.

Hildebrandt IM, Hall NO, James MK, Ryser ET, Marks BP. 2021. Process humidity affects *Salmonella* lethality at the surface and core of impingement-cooked meat and poultry products. *J. Food Prot.* Accepted for publication. <https://doi.org/10.4315/JFP-21-058>

FOUNDATION EDUCATION SCHEDULE

Meat Industry Food Safety Conference
August 25-26, 2021
Chicago, IL

Animal Care and Handling Conference
October 14-15, 2021
Kansas City, MO

For more information on these programs, please visit the events page at www.meatinstitute.org.

2021 BOARD OF DIRECTORS

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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2020-2021 RESEARCH ADVISORY COMMITTEE

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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B - Minimally Processed Beef Safety Subgroup

FP - Further Processed Meat and Poultry Safety Subgroup

CT - Minimally Processed Poultry Safety Subgroup

Q - Product Quality Subgroup

N - Nutrition Sciences Subgroup

CURRENT FOUNDATION RESEARCH PROJECTS

Current Knowledge and Gaps on the Mechanistic Development of Cancer in Humans Associated with Processed Meat and Poultry Product Components, University of Wisconsin-Madison

The overall goal of this proposed project is to deliver a comprehensive, current, and objective review of the mechanisms by which components found specifically in processed meat and poultry products have been proposed to influence the development of human cancers. A key supporting objective is to identify potential gaps in mechanistic knowledge to inform future research in this area.

Research funded in part by the Beef Checkoff.



Effect of clean label antimicrobials on the inhibition of *Clostridium perfringens* and *Bacillus cereus* during extended cooling of uncured beef and poultry products, University of Wisconsin-Madison, Cargill

This study will compare the effect of clean label antimicrobial ingredients on the inhibition of *Clostridium perfringens* and *Bacillus cereus* in model uncured beef and poultry products, having different moisture, pH, and salt contents, with a primary focus on extending Phase 1 cooling from 120 to 80°F.

Research funded in part by the Beef Checkoff.



Maximizing the dietary pattern of older adults: the effects of protein intake on protein kinetics, University of Arkansas for Medical Sciences

The overall project goal is to demonstrate how easily prepared animal-based protein-rich food sources can be used by older adults to increase protein intake within pre-existing dietary patterns. The current dietary pattern of older Americans will be augmented by readily available quality protein sources and the effects of recommended and common protein intakes on the maintenance of whole-body protein balance and potential for muscle protein anabolism will be assessed.

Research funded in part by the Beef 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 be employed to 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.



CURRENT FOUNDATION RESEARCH PROJECTS (CONT.)

Improving Validation Methods of *Salmonella* Lethality on the Surface of Multiple Impingement - Cooked Meat and Poultry Products, Michigan State University, University of Wisconsin

The study will identify critical limits (i.e., humidity, air velocity, surface time-temperature), relative to achieving target *Salmonella* lethality on the surface of impingement-cooked products. A spreadsheet-based solution for calculating surface lethality of *Salmonella* on multiple products will be developed and cross-validated. Findings are intended to improve the ability of the meat and poultry industry to comply with Appendix A requirements.

Research funded in part by the Beef Checkoff and the Pork Checkoff.



Validation of a novel method for the detection of select *Salmonella* serovars in raw meat enrichments, USDA-ARS-Meat Animal Research Center

The project will evaluate the sensitivity and specificity of a novel multiplex PCR assay for the detection of four of the leading disease causing *Salmonella* serotypes, including Enteritidis, Typhimurium, (1,4,[5],12:i:-), and Newport, as well as the invasive serotype Dublin. This assay will be used to detect *Salmonella* in raw meat enrichment samples that will be analyzed using current industry methods so that the results are readily applicable to the needs of the meat industry.

Research funded in part by the Beef Checkoff and the 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.



Using Rapid Evaporative Ionization Mass Spectrometry (REIMS) as a novel, minimally invasive, real time method for characterization of metabolic variation contributing to flavor, tenderness, and color stability of beef, Texas Tech University, USDA-ARS-Meat Animal Research Center

This project will explore the ability of REIMS as a real time predictor of beef tenderness and sensory attributes, including flavor and evaluate the ability of REIMS as a real time measure and predictor of color stability of beef longissimus steaks.

CURRENT FOUNDATION RESEARCH PROJECTS (CONT.)

Effects of Red Meat Consumption on Gut Microbiota in Young Adults, Purdue University, University of Colorado

Gut microbiota are an important contributor to human metabolic health and the impact of animal-based foods, unprocessed and processed red meat in particular requires investigation. Results from a recent study with rats suggest that consuming processed vs. unprocessed red meats may differentially influence gut microbiota profile. This project intends to determine the effect of unprocessed and processed red meat on gut microbiota.

Research funded in part by the Beef Checkoff.



Meat as a First Solid Food on Risk of Overweight and Neurodevelopment in Infants, University of Colorado Anschutz Medical Campus, University of Colorado Denver

Early complementary feeding is a unique and malleable period to prevent rapid weight gain and later obesity, and is also a critical phase for neurodevelopment. Meat is an excellent source of high-quality protein and micronutrients, which are critical for the normal development of older infants. This research will conduct a randomized controlled trial to comprehensively evaluate the effect of meat on growth, body composition, risk of overweight and neurodevelopment, with a protein intake at the reported population median. Findings from this study will be generalizable and help inform future dietary guidance.

Research funded in part by the Beef Checkoff.



Pathogen Growth in Alternatively Cured Ham and Bacon during Cooking, Cooling, and Process Deviations, Iowa State University and Smithfield Foods

The overall goal of the project is to determine the inhibitory effect of nitrite from a natural source (i.e., pre-converted celery juice powder) in processed meat products with a natural label during “real world” cooking and chilling procedures, which often include instances of process deviation, as well as non-continuous cooling.

Tests of *Salmonella* Sub-unit Proteins as Vaccines for Broiler Chickens, USDA-ARS U.S. National Poultry Research Center

This project will identify the *Salmonella* protein antigens that are able to induce humoral immune response in broilers, and consequently these antibodies can prevent *Salmonella* colonization in the broiler gastrointestinal tracts.

Detection of African swine fever virus (ASFV) in pork meat products by PCR assay, Iowa State University

The study is intended to validate PCR assay tests for ASFV in various pig offal and pork products, including blood, and meat to determine the best sample(s) for testing and monitoring.

THANK YOU TO THE FOUNDATION'S 2021 CONTRIBUTORS

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