



Special points of interest:

- Probiotic products help with Salmonellosis in dairy calves, but not in pigs.
- Our new swine building will allow for expanded research capabilities.
- Prenatal immune stimulation in beef cattle with endotoxin.
- LIRU conducted over 24 cattle and swine studies from 2012-2017.

Probiotic mitigates some effects of *Salmonella* in dairy calves



Salmonella is a significant issue within the beef and swine industries, and has important food safety implications due to previous research suggesting the bacteria can be harbored in peripheral lymph nodes and synovial fluid. Infections in young dairy calves can negatively impact growth and performance. There are many products that have been developed

aimed at reducing the negative impacts of *Salmonella* in calves. Scientists from the Livestock Issues Research Unit in Lubbock, Texas collaborated with Kemin Industries in a preliminary study to determine if a natural probiotic product would alter the immune response to an oral *Salmonella* challenge. Our research found that this bacterial probiotic significantly reduced the fever response compared to non-supplemented control calves. Additionally, *Salmonella* counts from tissues collected 2 days post-challenge, when *Salmonella* colonization peaks, were reduced in the calves supplemented with the bacterial probiotic, and were also numerically reduced in supplemented calves 4

days after *Salmonella* inoculation. This product has the potential to reduce fever and tissue *Salmonella* colonization in young dairy calves, thus improving dairy calf health, performance, and overall well-being. Considering the impact of federal regulations that went in to effect in January 2017, this product may be an alternative to antibiotics in the dairy calf industry.



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LIRU Impact

Conducted over 24 cattle and swine studies over the lifespan of the 2012-2017 CRIS project.

LIRU scientists authored or co-authored 24 publications this year, including 10 abstracts, 12 peer-reviewed journal articles, and 2 technical/proceedings reports.

There were over 45 visits and inquiries from industry and university representatives expressing interest in research conducted by the LIRU since 2012.

Developed indwelling rectal and vaginal temperature monitoring devices that have been placed in over 1,400 bull/steer calves and over 1,000 heifer calves in the U.S. and Canada since 2007.

Based on LIRU Research, immune and heat stress studies using yeast and yeast-based products conducted in cattle

have resulted in several feedlots, representing approximately 400,000 head of cattle annually, and dairy calf ranches incorporating these products into their feeding strategy.

Two commercial dairies, and four dairy calf ranches, representing over 500,000 head of calves annually, have incorporated bacterial probiotic products based on research conducted by the LIRU on mitigation of negative effects of Salmonellosis.

The LIRU has established a repeatable *Salmonella* typhimurium model in dairy calves which allows for the monitoring of immune function and pathogen migration, colonization and translocation within the body.

Yeast and bacterial fermentation products less effective during Salmonellosis

Salmonella is a pathogen of concern in the swine industry because it is responsible for animal illness and mortality. Also, *Salmonella* poses a food safety threat in pork products; therefore, mitigation of this pathogen is important to both producers and consumers. Our previous research demonstrated that *Salmonella* inoculated orally can colonize in the gastrointestinal tract, and can also migrate from the intestines into the lymphatic system and into joint fluid. *Salmonella* translocation into lymph nodes and joints presents a challenge for food producers and may lead to cross contamination during fabrication and processing. Therefore, monitoring migration and colonization patterns is beneficial in elucidating host-pathogen interactions for swine health and food safety. Following up on our prior research, scientists



from ARS' Livestock Issues Research Unit in Lubbock, TX and from Diamond V conducted a preliminary study to evaluate the ability of both a yeast fermentation product and a bacterial fermentation product as a means to mitigate the negative impact of an oral *Salmonella* challenge on weaned pigs. Specifically, weaned pigs were supplemented for 16 days with varying inclusion rates of either a yeast or bacterial fermentation product and then orally challenged with a labeled *Salmonella* typhimurium. The *Salmonella* was monitored in feces and a plethora of tissues and organs. Results from this preliminary study indicated that these products had little effect on pathogen migration, colonization, and translocation in weaned pigs. However, there was some evidence that the inclusion rates of both the yeast and bacterial fermentation products may not have been optimal in this preliminary study.

Prenatal programming of the calf immune response

A previous study in our laboratory investigated whether administering endotoxin to pregnant beef cows during late gestation would prenatally program their calves to produce a better response when exposed to endotoxin after weaning. Data from this study found that indeed, prenatally immune stimulated calves produced a reduced body temperature response, enhanced stress hormone and immune responses, and improved weaning weight. Based on this initial study, scientists from ARS' Livestock Issues Research Unit in Lubbock, Texas and scientists from the University of Florida performed a second study to determine if administration of endotoxin three times during gestation would produce similar or better results.

Pregnant cows were administered low-dose endotoxin during each third of gestation, and female calves born to the cows were challenged with endotoxin after weaning. The data from this study suggest that administering endotoxin three times during gestation does not improve the immune response. In contrast, the immune response may have been negatively impacted as indicated by no difference in body temperature and enhanced and prolonged pro-inflammatory cytokine responses. Thus, it is believed that administration of endotoxin three times during gestation may either overstimulate the immune response, or perhaps causes cows to acclimate to the multiple low-dose endotoxin administration.



LIRU Invited Presentations

Dr. Broadway gave a presentation on making the most of your graduate career at the Southern Section meeting of the American Society of Animal Science on February 7th in Franklin, TN.

Dr. Burdick Sanchez gave a guest lecture on use of antibiotics in the livestock industry to undergraduate students in the Animal Science Department at Sul Ross State University, a Hispanic-Serving Institution, on April 20th.

Dr. Carroll gave an invited presentation at the TVMDL seminar on Recent Advances in Understanding the Bovine Respiratory Disease Complex, July 8th in Amarillo, TX.

Dr. Burdick Sanchez gave two guest lectures to graduate students at West Texas A&M University on Polymerase Chain Reaction, and followed up with a lab conducted at the LIRU laboratory on October 2nd, 4th, and 5th.

Dr. Carroll gave an invited presentation at the 2017 Liquid Feed Symposium held September 12th through 14th in Louisville, KY.

Dr. Carroll was invited to give a presentation at the Stocker Health Conference.

Dr. Carroll gave an invited presentations at the University of Arkansas' 7th Annual Symposium entitled "Current Topics in Food Animal Welfare".

Dr. Carroll gave an invited presentation at the Micronutrients Research Meeting in Atlanta, GA on November 7th, 2017.

Drs. Broadway and Carroll were invited to present at the Phileo Animal Care Annual Meeting in Brazil on December 4th and 5th.



PHOTO BY PROF. SHERIN

Publications

- Burdick Sanchez, N. C., P. R. Broadway, J. A. Carroll, E. V. Gart, L. K. Bryan, and S. D. Lawhon. 2017. Weaned pigs experimentally infected with *Salmonella* display sexually dimorphic innate immune responses without affecting pathogen colonization patterns. *Trans. Anim. Sci.* 1:69-76. **
- Carroll, J. A., N. C. Burdick Sanchez, J. D. Arthington, C. D. Nelson, A. L. Benjamin, F. T. Korkmaz, D. E. Kerr, and P. A. Lancaster. 2017. *In utero* exposure to lipopolysaccharide alters the postnatal acute phase response in beef heifers. *Innate Immunity.* 23:97-108.
- Harris, T.L., Y. Liang, K.P. Sharon, M.D. Sellers, I. Yoon, M.F. Scott, J.A. Carroll, and M.A. Ballou. 2017. Influence of *Saccharomyces cerevisiae* fermentation products, SmartCare in milk replacer and Original XPC in calf starter on the performance and health of preweaned Holstein calves challenged with *Salmonella enterica* serotype Typhimurium. *J. Dairy Sci.* 100: 1 – 11.
- Hughes, H. D., J. A. Carroll, N. C. Burdick Sanchez, S. L. Roberts, P. R. Broadway, N. D. May, M. A. Ballou, and J. T. Richeson. 2017. Effects of dexamethasone treatment and respiratory vaccination on rectal temperature, complete blood count, and functional capacities of neutrophils in beef steers. *J. Anim. Sci.* 95:1502-1511.
- Littlejohn, B.P., M.C. Roberts, M.N. Bedenbaugh, A.W. Lewis, D.A. Neuendorff, D.G. Riley, J.A. Carroll, R.C. Vann, M. Amstalden, R.D. Randel, and T.H. Welsh. 2017. Evaluation of the influence of prenatal transportation stress on GnRH-stimulated luteinizing hormone and testosterone secretion in sexually mature Brahman bulls. *J. Anim. Sci.* 95:129-138.
- Posadas, G.A., P.R. Broadway, J.A. Carroll, A. Lawrence, J.R. Corley, A. Thompson, and J.R. Donaldson. 2017. Yeast pro- and paraprobiotics have the capability to bind pathogenic bacteria associated with animal disease. *Trans. Anim. Sci.* 1:60-68. **
- Young, T.R., F.R. Ribeiro, N.C. Burdick Sanchez, J.A. Carroll, M.A. Jennings, J.T. Cribbs, R.J. Rathmann, J.R. Corley, and B.J. Johnson. 2017. Yeast cell wall supplementation alters the performance and health of beef heifers during the receiving period. *Prof. Anim. Sci.* 33:166-175.
- Burdick Sanchez, N.C., Carroll, J.A., J.D. Arthington, and P.A. Lancaster. 2017. Exposure to lipopolysaccharide in utero alters the postnatal metabolic response in heifers. *J. Anim. Sci.* 95:5176-5183.
- Buntyn, J.O., D. Steffen, N.C. Burdick Sanchez, S.E. Sieren, S.J. Jones, G.E. Erickson, J.A. Carroll, P.R. Broadway, and T.B. Schmidt. 2017. Serum blood metabolite response and evaluation of select organ weight, histology, and cardiac morphology of beef heifers exposed to a dual corticotropin-releasing hormone and vasopressin challenge following supplementation with zilpaterol hydrochloride. *J. Anim. Sci.* 95:5327-5338.
- Capik, S.F., B.J. White, B.L. Larson, J. Coetzee, N. Van Engen, N. Cernicchiaro, T.J. Engelken, J. Lakritz, M.A. Ballou, L.E. Hulbert, R. Vann, J. Caswell, and J.A. Carroll. 2017. Effect of oral administration of meloxicam prior to transport on the inflammatory mediators and leukocyte function of cattle at feedlot arrival. *American Journal of Veterinary Research* 78(12):1426-1436.

Symposium on Gut Health
in Production of Food Animals
November 13-15, 2017, St. Louis, Missouri



Sharing our Research: Meeting Presentations & Attendance

Southern Section of the American Society of Animal Science annual meeting, Feb 5-8 in Franklin, TN. Scientists authored or co-authored 4 abstracts presented. Dr. Carroll served as Secretary-Treasurer for the Southern Section and Dr. Broadway was invited to serve on a panel at the Graduate Student Lunch and Learn.

Plains Nutrition Council Spring Conference in San Antonio, TX April 13-14. Scientists were co-authors on 2 graduate student posters presented.

Western Section of the American Society of Animal Science annual meeting. Scientists co-authored 1 abstract presented June 20-23 in Fargo, ND.

American Society of Animal Science Annual Meeting and Trade Show, Baltimore, MD July 8-12. Scientists authored

and presented 2 abstracts and were co-authors on 4 additional abstracts presented.

Scientists attended the Symposium on Gut Health in Production of Food Animals, Nov 13-15 in St. Louis, MO.



New Swine Research Building Nearing Completion

The LIRU is putting the finishing touches on a new research building focusing on swine. Similar to the beef and dairy calf research buildings, the new swine building is a 5,000 ft² building that includes space for animal housing, wet laboratory for processing samples, and a break room. Additionally, the building has three showers, allowing for 'shower in, shower out' procedures. The building also hosts features that are unique to the swine building. Environmental conditions are controlled solely by

HVAC with single-pass air circulation. The facility can hold up to 80 pigs individually housed or 200 pigs in group pens. The building contains a dedicated surgery area for placement of intraperitoneal

temperature measuring devices and other surgical procedures. There is also a necropsy room for collection of tissues and samples from animals housed across the research buildings.





Nutritional Intervention and Management Strategies to Reduce Stress and Improve Health and Well-being in Cattle and Swine

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