5 yr since, some observers express further concern about the market being overstretched and poised for a sharp pullback—consistent with the behavior of most commodity markets. The upshot being discussion about the need for renewed analysis of current production systems, industry value incentives, and their subsequent impact upon consumer prices. Ground beef is the industry's volume leader, representing upwards of 50 to 60% of all beef consumed in the United States, and often positioned as the primary price-category offering for beef directly comparable with pork and poultry. Given those considerations, dialogue has arisen around the prudence of tilting the production emphasis towards ground beef. However, beginning in 2014, new USDA boxed beef reports indicate ground beef and trimmings comprise only about 20% of the cutout value. Moreover, the industry's move away from a less-commoditized perspective have paid significant dividends during the past several years and served to underpin beef's competitiveness. Primarily, high-quality, differentiated beef products are accounting for an ever-larger portion of the beef industry's total revenue. The sales mix of Prime and Branded categories have gained market share during the past 5 yr. That results in customers buying more beef at higher prices on a consistent basis. That occurrence inherently helps to break free from a more traditional commodity business and buffer it against quality shortfalls that historically hampered the beef business.

**Key Words:** beef industry, beef prices, cattle prices

## NONRUMINANT NUTRITION: FEED ADDITIVES

089 **Salmonella surrogate mitigation in poultry feed using a dry acid powder.** R. A. Cochrane[1,*], C. R. Stark[1], A. R. Huss[1], G. Aldrich[1], C. J. Knueven[2], C. K. Jones[1], J. S. Pitts[3], *[1]Kansas State University, Manhattan, [2]Jones-Hamilton Co., Walbridge, OH, [3]Jones-Hamilton Co., Weatherford, TX.*

*Salmonella* contamination is a prevalent concern for the feed industry. Heat treatment is commonly used to mitigate pathogens, but it is a point-in-time strategy that does not prevent recontamination. Chemical alternatives may limit recontamination, but are often difficult to mix effectively or corrode equipment. A dry acid powder, such as sodium bisulfate (SBS; Jones-Hamilton, Co., Waldridge, OH), may be a practical option for pathogen mitigation. Therefore, the objective of this experiment was to evaluate the effectiveness of SBS to mitigate postprocessing contamination of a *Salmonella* surrogate, *Enterococcus faecium* ATCC 8459, in poultry feeds. Treatments were arranged in a 2 × 6 factorial with 2 feed forms (nonprocessed mash vs. pelleted feed) and 6 levels of SBS (0, 0.175, 0.35, 0.70, 1.4, and 2.8% w/w). A standard, broiler grower feed was inoculated with *E. faecium*, treatments mixed with SBS, and pelleted at 70°C on a pilot scale (California Pellet Mill, Crawfordsville, IN). Pellet production test was the experimental unit and there were 3 pellet production replicates. Treatments were randomized prior to pelleting and a noninoculated flush was utilized between each treatment to prevent crossover contamination. Mash samples before thermal processing and corresponding pelleted samples were collected. Samples were analyzed for *E. faecium* on d 0, 2, 4, 7, and 14. All main effects and interactions were significant ($P < 0.0001$). Specifically, pelleting resulted in a 3-log reduction in *E. faecium* ($P < 0.0001$; $6.6\times10^5$ vs. $2.3\times10^2$ CFU/g for mash vs. pelleted, respectively). In both pelleted and mash feeds, there was a linear decline in *E. faecium* with increasing SBS inclusion ($P < 0.0001$; $1.3 \times 10^4$, $9.8 \times 10^3$, $8.5 \times 10^3$, $7.7 \times 10^3$, $7.6 \times 10^3$, $2.5 \times 10^3$ CFU/g for 0, 0.175, 0.35, 0.70, 1.4, and 2.8% SBS, respectively for mash feeds on d 14). There was also a linear decrease in *E. faecium* over time ($P < 0.0001$, $6.7 \times 10^5$, $6.9 \times 10^4$, $6.0 \times 10^4$, $5.0 \times 10^3$, and $1.3 \times 10^3$ CFU/g for the negative control on d 0, 2, 4, 7, and 14, respectively). In summary, this research suggests that thermal processing, time, and SBS concentration all impact pathogen levels in poultry feeds, and that including a dry acid powder may be an effective pathogen mitigation strategy.

**Key Words:** *Enterococcus faecium*, feed safety, pathogen, poultry, *Salmonella*, sodium bisulfate

090 **Evaluating chemical mitigation of porcine epidemic diarrhea virus in swine feed and ingredients.** R. A. Cochrane*, J. C. Woodworth, S. S. Dritz, A. R. Huss, C. R. Stark, R. A. Hesse, M. D. Tokach, J. F. Bai, C. K. Jones, *Kansas State University, Manhattan.*

Porcine epidemic diarrhea virus (PEDv) is transmitted by fecal-oral contamination. Research has confirmed swine feed or ingredients as potential vectors of transmission, so strategies need to be developed to mitigate PEDv presence in feed. Therefore, the objective of this experiment was to evaluate the effectiveness of various chemicals to mitigate PEDv in swine feed and ingredients. Treatments were arranged in a 5 × 4 factorial with 5 chemical treatments and 4 feed matrices. The chemical treatments included: 1) negative control with no chemical addition, 2) 0.003% commercial formaldehyde, 3) 1% sodium bisulfate, 4) 1% sodium chlorate, and 5) 3% organic acid blend. The 4 matrices included: 1) complete swine diet, 2) blood meal, 3) meat and bone meal, and 4) spray-dried animal plasma. Matrices were first chemically treated, then inoculated with $5.6 \times 10^4$ TCID50/g PEDv, stored at room temperature, and analyzed by real-time PCR on d 0, 1, 3, 7, 14, 21, and 42. Data were analyzed by the GLIMMIX procedure of SAS with day as a repeated measure. The analyzed values represent threshold cycle (CT) at which the virus was detected, and thus lower values indicate greater nucleic acid presence, not infectivity. All main effects and interactions were

significant; however, only main effects are discussed in this abstract due to space limitations ($P < 0.0001$). Both commercial formaldehyde treatment and organic acid addition decreased RNA concentration of PEDv compared with the control ($P < 0.05$), with the commercial formaldehyde treatment being the most effective on d 0 by decreasing the CT by 1.4 to 2.8 CT compared with the control. Feed matrix appears important in retention of PEDv as RNA concentrations were 1.2 to 3.8 CT higher in the complete swine diet and blood meal than meat and bone meal or spray-dried animal plasma on d 0 ($P < 0.05$). Additionally, PEDv stability over time was influenced by matrix as RNA concentrations only improved 0.7 and 2.9 CT by d 42 for spray-dried animal plasma and meat and bone meal, respectively, compared with 4.1 and 5.6 CT for the complete swine diet and blood meal. In summary, time, formaldehyde, and organic acid treatments all enhance the RNA degradation of PEDv in swine feed and ingredients, but their effectiveness varies within matrix. More research is needed to relate RNA concentration to infectivity and to elucidate the appropriate chemical concentration for each feed ingredient or diet.

**Key Words:** chemical treatment, feed matrix, PEDv, swine

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091 **Effects of dietary inclusion of direct-fed microbials on gut health and growth of nursery pigs orally challenged with F18-positive enterotoxigenic *Escherichia coli*.** Y. Sun, I. Park*, C. H. Stahl, S. W. Kim, *North Carolina State University, Raleigh.*

This study was to determine the effect of direct-fed microbials (DFM, PrimaLac, Star Labs, Clarksdale, MO) on the growth performance and gut health on newly weaned pigs with an oral challenge of F18+ enterotoxigenic *Escherichia coli* (ETEC). PrimaLac includes *Lactobacillus acidophilus* ($2.5 \times 10^7$ cfu/gram), *L. casei* ($2.5 \times 10^7$ cfu/gram), *Bifidobacterium thermophilum* ($2.5 \times 10^7$ cfu/gram), and *Enterococcus faecium* ($2.5 \times 10^7$ cfu/gram). Thirty-two pigs (16 barrows and 16 gilts at 6.99 ± 0.33 kg BW) in individual pens were randomly allotted to 4 treatments (2 × 2 factorial arrangement: first factor was DFM and the second factor was ETEC). Pigs were fed experimental diets based on 2 phases (10 and 15 d, respectively). Direct-fed microbials were supplemented in the feed for Phase 1 (0 or 0.15%) and Phase 2 (0 or 0.10%). Pigs were challenged with ETEC (0 or $2 \times 10^9$ CFU) on d 13 of the study. Body weight and feed intake were measured on d 5, 9, 13, 19, and 25. Fecal scores were measured based on the 0 to 3 scale (0 = normal, to 3 = severe diarrhea) on d 2, 3, 5, 9, 12, and daily from d 13. Blood samples were taken on d 19 and 24 to measure tumor necrosis factor-alpha (TNF-α) and malonedealdehyde (MDA). On d 25, all pigs were euthanized to obtain tissues (jejunum and ileum) to measure TNF-α, MDA, and morphological evaluation. Digesta (jejunum, ileum, and colon) were also obtained to measure pH. Data were analyzed using the Mixed procedure in SAS except for occurrence of diarrhea, which was analyzed by Chi-square. Overall, DFM increased ($P < 0.05$) ADG (193 to 308 g/d) and ADFI (354 to 491 g/d). Fecal scores were increased ($P < 0.05$) by ETEC (0.45 to 1.03). The number of pigs with diarrhea was increased ($P < 0.05$) by ETEC (1 to 6 pigs) from d 13 to 25. The crypt depth (255 to 284 μm) in ileum was increased ($P < 0.05$) by ETEC. There were interactions ($P < 0.05$) between DFM and ETEC on villus height and villus height:crypt depth, indicating that DFM increased villus height and villus height:crypt depth when pigs had ETEC. There was an interaction ($P < 0.05$) on serum TNF-α concentration on d 19 indicating that DFM decreased TNF-α when pigs had ETEC. Collectively, ETEC increased occurrence of diarrhea and caused mild issues on gut health, whereas DFM improved growth performance without affecting gut health.

**Key Words:** direct-fed microbials, *Escherichia coli*, growth performance, gut health, nursery pigs

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092 **Effect of standardized ileal digestible tryptophan : lysine ratio on growth performance of 11 to 20 kg nursery pigs.** M. A. Goncalves[1,*], M. D. Tokach[1], S. S. Dritz[1], N. M. Bello[1], K. J. Touchette[2], J. M. DeRouchey[1], J. C. Woodworth[1], R. D. Goodband[1], [1]*Kansas State University, Manhattan,* [2]*Ajinomoto Heartland, Inc., Chicago, IL.*

Two experiments were conducted to determine the standardized ileal digestible (SID) Trp:Lys ratio requirement for 11 to 20 kg pigs. Experiment 1 was conducted to validate the dietary approach, and Exp. 2 was a dose titration. Both experiments used corn-soybean meal based diets with 30% DDGS. Experiments 1 and 2 used 1,188 and 1,088 pigs (PIC 337 × 1050; initially 13.0 ± 0.16 and 11.2 ± 0.55 kg BW), were 21 d in duration, and had 11 and 6 pens/treatment with 24 to 27 pigs/pen, respectively. In Exp. 1, different SID Trp:Lys ratios (14.5 vs. 20%), CP (26.1 vs. 22.9%), and SID Lys levels (0.97 vs. 1.29%) combined into the following dietary treatments: High CP, High Lys, and High Trp:Lys (HHH); Low CP, High Lys, and High Trp:Lys (LHH); Low CP, Low Lys, and High Trp:Lys (LLH); and Low CP, Low Lys, and Low Trp:Lys (LLL). Lowering CP (HHH vs. LHH) did not significantly influence ($P > 0.05$) ADG, but G:F was greater in HHH compared with LHH. Decreasing lysine (LHH vs. LLH) and Trp:Lys (LLH vs. LLL) reduced ($P < 0.05$) ADG and G:F, respectively. Thus, low-CP diets formulated at 0.97% SID Lys appear to ensure pigs are below their Lys requirement when determining the optimal SID Trp:Lys ratio. In Exp. 2, dietary treatments consisted of SID Trp:Lys ratios of 14.5, 16.5, 18.0, 19.5, 21.0, 22.5, and 24.5% formulated to 0.97% SID Lys and 18.1% CP. Response variables, ADG and G:F, were each fitted using general linear and nonlinear mixed models with heterogeneous residual variances and pen as the experimental unit. Competing models included quadratic polynomial (QP), broken-line linear (BLL), and broken-line quadratic (BLQ).