

## Nonruminant Nutrition: Immune support

**787 Evaluating the efficacy of chemicals to mitigate *Salmonella* cross contamination in rendered protein meals.** Roger A. Cochrane\*, Anne R. Huss, and Cassandra K. Jones, *Kansas State University, Manhattan, KS.*

*Salmonella* is a potential feed safety hazard that is destroyed during rendering, but this does not eliminate the potential for cross contamination. The objective of this experiment was to evaluate the effectiveness of chemicals to mitigate *Salmonella* cross-contamination in rendered proteins. Treatments were arranged in a 6 × 4 factorial with 6 chemical treatments: (1) chemically negative control, (2) 0.3% commercial formaldehyde, (3) 2% essential oils (1:1 garlic, turmeric, capsicum, oregano, and rosemary), (4) 2% medium chain fatty acids (1:1 caproic, caprylic, and capric acid 1:1), (5) 3% organic acids (1:1 lactic, propionic, formic, and benzoic), (6) 1% sodium bisulfate in 4 rendered proteins: (a) feather meal, (b) blood meal, (c) meat and bone meal, and (d) poultry by-product meal. Matrices were chemically treated, then inoculated with *Salmonella* Typhimurium, and enumerated on d 0, 1, 3, 7, 14, 21, and 42 post-inoculation. Analyzed values represent colony forming units per gram (cfu/g). All main effects and interactions were significant ( $P < 0.05$ ). *Salmonella* concentration in ingredients treated with medium chain fatty acid and commercial formaldehyde were similar to one another ( $P = 0.23$ ), but 2 logs lower than the control ( $P < 0.05$ ;  $3.20 \times 10^0$  and  $4.45 \times 10^0$  vs.  $3.65 \times 10^2$  cfu/g, respectively). Ingredients treated with organic acid and essential oils had less *Salmonella* than the control ( $P < 0.05$ ;  $1.58 \times 10^1$  and  $1.26 \times 10^2$  cfu/g, respectively). However, treating ingredients with sodium bisulfate resulted in similar *Salmonella* concentrations as the control ( $P < 0.05$ ;  $2.42 \times 10^2$  cfu/g). Time played a role in *Salmonella* mitigation as all days ( $P < 0.05$ ) except d 14 and 21 ( $P = 0.92$ ) were different from one another ( $3.14 \times 10^4$ ,  $4.48 \times 10^2$ ,  $5.57 \times 10^1$ ,  $8.98 \times 10^0$ ,  $3.07 \times 10^0$ ,  $3.16 \times 10^0$ ,  $1.35 \times 10^0$  cfu/g for d 0, 1, 3, 7, 14, 21, and 42, respectively). Matrix also affected *Salmonella* stability as concentrations in meat and bone meal and blood meal and were similar to one another ( $P = 0.36$ ;  $6.54 \times 10^1$  and  $5.32 \times 10^1$  cfu/g, respectively), but greater than ( $P < 0.05$ ) levels in feather meal and poultry by-product meal ( $2.29 \times 10^1$  and  $2.31 \times 10^1$  cfu/g, respectively). In summary, chemical treatment and time both mitigated *Salmonella*, but their effectiveness was matrix dependent. Chemical treatment with medium chain fatty acids or a commercial formaldehyde product was most effective at mitigating *Salmonella* in rendered protein meals.

**Key Words:** *Salmonella*, chemical treatment, feed safety

**788 Supplemental effects of herbal additive on growth performance, health status, and carcass quality in finishing pigs as alternatives to the use of antibiotics.** W. Parnsen\*, S. H. Zhang, and S. W. Kim, *Department of Animal Science, North Carolina State University, Raleigh, NC.*

This study was conducted to determine the effect of herbal additive (AV/AGP/10, Ayurved Limited, Baddi, H.P., India, based on extracts of garlic, ginger, menthol, cinnamon, and thyme) on the growth performances, health status, and carcass quality of finishing pigs fed diets. Ninety-six pigs (48 barrows and 48 gilts) at 84 d of age ( $41.5 \pm 2.7$  kg BW) were allotted to 4 treatments (2 × 2 factorial arrangement with 0 and 0.05% Tylan40 (Elanco) and herbal additive (0 and 0.05% AV/AGP/10) based on a randomized complete block design with 8 pens (3 pigs per pen, 4 barrow and 4 gilt pens) per treatment. Body weight and feed intake were measured weekly. Blood samples were taken on d 37 to obtain

plasma to measure tumor necrosis factor  $\alpha$  (TNF- $\alpha$ ), protein carbonyl, and immunoglobulins. On d 40, 32 pigs (1 pig from each pen and 8 pens per treatment) were euthanized to collect duodenal and jejunal mucosa layers for TNF- $\alpha$ , protein carbonyl, IgA, and IgG concentrations. Gut tissues from middle part of jejunum were obtained to measure villus height (VH), crypt depth (CD), villus width and VH/CD. Carcass traits were measured including backfat thickness (10th rib), loin pH, marbling score, loin color, and drip loss. Data were analyzed using the MIXED procedure in SAS with pen as the experimental unit (treatment and sex as fixed effects and BW as a random effect). Overall, antibiotic supplementation increased ( $P < 0.05$ ) final BW (88.0 to 90.4 kg), ADG (1.176 to 1.225 kg/d), hot carcass weight (62.0 to 63.8 kg), and cold carcass weight (60.0 to 61.7 kg). Herbal supplementation tended to reduce ( $P = 0.079$ ) ADFI (2.829 to 2.785 kg/d), tended to enhance ( $P = 0.060$ ) G:F at wk 5 (0.430 to 0.460), and enhanced ( $P < 0.05$ ) G:F at wk 6 (0.612 to 0.643). Backfat thickness, loin weight, loin color, marbling score, plasma TNF- $\alpha$ , and tissue TNF- $\alpha$  were not affected by factors. There were no interactions between 2 factors in all measurements. Collectively, antibiotic supplementation improves growth performance and carcass weight whereas herbal additive can potentially enhance feed efficiency if it is fed to finisher pigs longer than 4 wk regardless of the use of antibiotics.

**Key Words:** carcass quality, gut health, herbal additive

**789 Effect of additives on survival of swine delta coronavirus (SDCoV) in complete feed.** Katie M. Cottingim\*<sup>1</sup>, Harsha Verma<sup>2</sup>, Fernando Sampedro<sup>2</sup>, Pedro E. Urriola<sup>1</sup>, Gerald C. Shurson<sup>1</sup>, and Sagar M. Goyal<sup>2</sup>, <sup>1</sup>Department of Animal Science, University of Minnesota, St. Paul, MN, <sup>2</sup>Veterinary Population Medicine, University of Minnesota, St. Paul, MN.

Swine delta coronavirus was first discovered in 2012 in China, and the first confirmed case in the US was in Ohio in 2014. Feed contaminated with feces from infected pigs is a potential route of transmission of SDCoV. Organic acids (OA) and feed additives are included in diets to improve nutritional value. The objectives of our study were to determine if OA or additives at recommended or twice the recommended concentrations are effective in reducing the survival of SDCoV in feed. Five g aliquots of complete feed were placed in scintillation vials followed by addition of 1 of 8 additives at recommended concentrations of 150mg Ultracid P (orthophosphoric, citric, fumaric, and malic acid; Nutriad), 20mg Activate DA (organic acids and 2-hydroxy-4-methylthio butanoic acid; Novus Intl.), 10mg KEM-GEST (phosphoric, fumaric, lactic, and citric acid; Kemin Agrifoods), 10mg Acid Booster (phosphoric, citric, and lactic acid; Agri-Nutrition), 56 $\mu$ L Luprosil (propionic acid; BASF), 46 $\mu$ L formic acid (formic acid; BASF), 20mg salt, or 20mg sugar. Virus was grown and titrated in swine testicular (ST) cells and was added to all vials at 1mL/vial (initial virus titer =  $3.2 \times 10^5$  TCID<sub>50</sub>/mL) followed by vortexing and storage of vials at room temperature (25°C) for 5 wk. Exp. 2, twice the recommended concentration of additives was added to aliquots and experimental conditions were identical to those used in Exp. 1 except that virus survival was evaluated on d 0, 1, 3, 7, and 10 of storage. Samples were eluted with 3% beef extract-0.05M glycine solution and inoculated in ST cells to calculate TCID<sub>50</sub>/mL. Data were analyzed using Weibull inactivation kinetics model. In Exp. 1, we observed that it takes 0.86 d to reduce the concentration of virus by 1 log. None of the additives tested reduced the inactivation kinetics of the virus at recommended doses. However, adding twice the recommended concentration reduced the time for 1 log inactivation in feeds with Acid

**Table 1 (Abstr. 791).** Serum CK, AST, and LDH (U/L) concentrations for weeks 1 to 11 (wk 0 = baseline)

Item <sup>1</sup>	Adaptation period				Exercise				Rest		No supplementation	
	0	1	2	3	4	5	6	7	8	9	10	11
CK	180.5 <sup>bc</sup>	164.4 <sup>c</sup>	182.5 <sup>bc</sup>	224.8 <sup>a</sup>	168.7 <sup>bc</sup>	186.3 <sup>bc</sup>	227.9 <sup>a</sup>	199.5 <sup>bc</sup>	194.8 <sup>b</sup>	159.4 <sup>c</sup>	197.1 <sup>bc</sup>	217.5 <sup>ab</sup>
AST	319.8 <sup>ab</sup>	261.8 <sup>c-f</sup>	226.6 <sup>f</sup>	330.4 <sup>a</sup>	284.0 <sup>b-e</sup>	301.0 <sup>a-c</sup>	332.3 <sup>a</sup>	322.5 <sup>ab</sup>	276.7 <sup>c-e</sup>	250.4 <sup>ef</sup>	256.9 <sup>d-f</sup>	292.2 <sup>a-d</sup>
LDH	469.6 <sup>de</sup>	469.5 <sup>de</sup>	504.5 <sup>c-e</sup>	606.8 <sup>a</sup>	514.5 <sup>b-d</sup>	506.5 <sup>cd</sup>	524.3 <sup>bc</sup>	490.0 <sup>c-e</sup>	424.2 <sup>e</sup>	391.8 <sup>f</sup>	473.7 <sup>c-e</sup>	563.3 <sup>ab</sup>

<sup>a-f</sup>Mean values within a line with different letters are different ( $P < 0.05$ ).

<sup>1</sup>SEM: CK, 10.4; AST, 13.3; LDH, 24.48.

Booster (0.28 d) ( $r^2 = 0.93$ ), Activate DA (0.12 d) ( $r^2 = 0.72$ ), and salt (0.09 d) ( $r^2 = 0.91$ ). Thus, using these feed additives may reduce virus survival in complete feed faster.

**Key Words:** feed additive, organic acid, swine delta coronavirus

**790 Infection with porcine reproductive and respiratory syndrome virus (PRRSV) affects body protein deposition and alters amino acid metabolism in growing pigs.** Whitney D. Stuart<sup>\*1</sup>, Thomas E. Burkey<sup>2</sup>, Nicholas K. Gabler<sup>3</sup>, Kent Schwartz<sup>3</sup>, Thu Dinh<sup>4</sup>, Cornelius F. M. de Lange<sup>5</sup>, David Klein<sup>1</sup>, John A. Dawson<sup>1</sup>, and Anoosh Rakhshandeh<sup>1</sup>, <sup>1</sup>Texas Tech University, Lubbock, TX, <sup>2</sup>University of Nebraska-Lincoln, Lincoln, NE, <sup>3</sup>Iowa State University, Ames, IA, <sup>4</sup>Mississippi State University, Mississippi State, MS, <sup>5</sup>University of Guelph, Guelph, ON, Canada.

Changes in plasma free amino acid (AA) kinetics reflect modification of AA metabolism in different metabolic states. Infectious diseases in growing pigs redistribute AA from body protein deposition (PD) toward processes involved in immune response. The aim of the current study was to quantify the effects of PRRSV infection on PD and AA metabolism. Twenty PRRSV-negative gilts (BW 9.4 ± 0.9 kg) were blocked by time, surgically catheterized, housed in metabolism crates, fed a corn-SBM based diet (ME 14 MJ/kg, SID Lys 11.5 g/kg), feed-restricted (550 g/d), and then inoculated intramuscularly with a live PRRSV. Blood samples were collected via the catheters at 0, 2, 4, 6, 8, and 10 d post inoculation, and assayed for blood chemistry, hematology, and serum viral load. Body temperature (BT) was monitored on a daily basis. N-balances were determined during a 3 d pre inoculation period and a 3 d post inoculation period. At the end of each N-balance period a single dose of [U-13C, U-15N] AA mixture (Lys, Met, Thr, Trp, Ile, Leu, Val, Phe, Gln) was infused intravenously to study plasma AA kinetics. For each pig and AA, an irreversible loss rate (ILR; disappearance of AA from plasma pool) was determined. Data were analyzed using a randomized complete block design (PROC MIXED in SAS). Blood chemistry, hematology, BT, and serum viral load results indicated that PRRSV injection induced effective immune system stimulation in pigs ( $P < 0.05$ ). The PRRSV challenge reduced PD from 59.4 to 38.1 g/d, SE 4.56, but increased the ILR (μmol/kg BW/h) for Met (from 108 to 228, SE 26.7) and Thr (from 83 to 129, SE 11.5;  $P < 0.05$ ). The ILR for other AA was not affected by PRRSV. These results suggest that PRRSV infection reduces PD and alters metabolism of Met and Thr in growing pigs. The increased ILR for Met and Thr in PRRSV challenged pigs could be associated with enhanced utilization of Met and Thr for synthesis of immune system metabolites and increased catabolism of these AA. This may increase dietary Met and Thr requirements of health challenged pigs, relative to requirements for other AA.

**Key Words:** amino acid, kinetic, PRRS

**791 Effect of selenium and vitamin E supplementation on muscular damage enzymes in horses under moderate exercise.**

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Twenty-four horses (450 kg, 5–15 yr) were involved in an 11-wk trial to study the effect of both selenium (Se, Se-yeast) and vitamin E (E, α-tocopheryl) supplements on serum concentration of muscle damage enzymes (creatinine phosphokinase, CK; aspartate aminotransferase, AST and lactate dehydrogenase, LDH) in horses under moderate exercise. Horses were not exercised for a month before this study; they were housed in individual stables and assigned into a factorial trial arrangement (2 × 2; Se, E levels; n = 6) with repeated measures. Basal ration was deficient in Se and vitamin E (<2 μg; 14.4, IU/kg DM). The supplementation levels met NRC 2007 requirements: low (L: Se, 0.1 mg/kg DM; E, 1.6 IU/kg BW) and high (H: Se, 0.3 mg/kg DM; E, 2 IU/kg BW) for horses under moderate or intense exercise, respectively. Hence, treatments were: LSeLE, HSeLE, LSeHE and HSeHE. Exercise was done from wk 4 to wk 7: 3 consecutive days for 30 min (5–20–5), including: warm up-moderate gallop-cool down. Serum samples were taken every week (wk 4-wk 7, at the end of last exercise day). Creatine phosphokinase, AST and LDH were quantified by spectrophotometry. Data were analyzed using the SAS PROC MIXED procedure (SAS Inst. Inc., Cary, NC) for the design described above. Fixed effects were Se, E, wk, and their interactions, while horse nested within treatment was the random effect. Tukey-Kramer test was used to compare LSM. Neither Se nor vitamin E levels affected enzymes concentrations ( $P < 0.01$ ). An effect of wk was observed for CK and AST at wk 6, exercise explained this fact; CK, AST and LDH increased at wk 3 and wk 11 (un-supplemented horses)

**Key Words:** exercise, antioxidant, horse

**792 Effect of Sal CURB on digestibility of energy and nutrients by growing pigs.** Yanhong Liu\* and Hans H. Stein, *Department of Animal Sciences, University of Illinois, Urbana, IL.*

Sal CURB brand ASF liquid antimicrobial is a blend of aqueous formaldehyde 37% solution and propionic acid. An experiment was conducted to determine the effects of Sal CURB on apparent total-tract digestibility (ATTD) of energy, Ca, and P, and apparent ileal digestibility (AID) of CP and AA in a diet fed to growing pigs. Eight barrows (initial BW: 26.81 ± 1.77 kg) had a T-cannula installed in the distal ileum and were allotted to a 2-period switch back design with 2 diets and 8 replicates per diet. A saline treated base mix or a Sal CURB treated base mix was added to the diet that were based on corn, soybean meal, distillers dried grains with solubles, and oats (10.0%). Each period lasted 7 d and fecal samples were collected on d 5 and 6 and ileal digesta were collected

on d 6 and 7 of each period. Three random samples from each of the 2 base mixes were analyzed for phytase and vitamins on d 0, 7, 28, and 49 after sampling to determine stability of vitamins and phytase in the base mixes. Data were analyzed by ANOVA using PROC MIXED of SAS in a randomized complete block design with diet as fixed effect and pig and period as random effects. Pigs fed Sal CURB diet had greater ( $P < 0.05$ ) ATTD of Ca (69.33%) and P (61.72%) than pigs fed the control diet (63.80 and 57.53%, respectively). No differences were observed in the ATTD of DM and GE and the AID of CP and all AA between the control diet and the Sal CURB diet, with the exception that the AID of Met was greater ( $P < 0.05$ ) in the Sal CURB diet (89.56%) than in the control diet (88.41%). The Sal CURB treated base mix contained less ( $P < 0.05$ ) phytase than the saline treated base mix on d 0, 7, 28, and 49. The Sal CURB treated base mix contained more ( $P < 0.05$ ) vitamin B3 and B9 on d 0, more ( $P < 0.05$ ) vitamin B1 on d 28, and more ( $P < 0.05$ ) vitamin B1, B2, and D3 on d 49, compared with the saline treated base mix. In conclusion, supplementation of Sal CURB to diets for growing pigs does not affect the digestibility of energy and AA, but increases the digestibility of Ca and P in phytase containing diets. However, Sal CURB treatment reduces the concentration in the base mix of phytase by approximately 20%, but concentrations of vitamins are not reduced.

**Key Words:** digestibility, pigs, Sal CURB

**793 Effect of a 3-strain *Bacillus*-based direct-fed microbial on growth performance, volatile fatty acid production, carcass characteristics, and gastrointestinal tract weights in growing-finishing pigs fed low or high fiber diets.** Neil W. Jaworski<sup>\*1</sup>, Augustine Owusu-Asiedu<sup>2</sup>, Ajay Awati<sup>2</sup>, Alastair Thomas<sup>2</sup>, and Hans H. Stein<sup>1</sup>, <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, IL, <sup>2</sup>Danisco Animal Nutrition, DuPont Industrial Biosciences, Marlborough, UK.

The effect of a 3-strain *Bacillus*-based direct-fed microbial (DFM) on growth performance, VFA production, carcass characteristics, and gastrointestinal tract weights in growing-finishing pigs was evaluated. A total of 160 pigs (initial BW: 26.61 ± 2.17 kg) were randomly allotted to a 2 × 2 factorial design with 2 diet types [low fiber (LF) or high fiber (HF)] and 2 levels of DFM [0 or 60 g DFM (2.4 × 10<sup>12</sup> cfu/kg feed)/t of feed] and 4 pigs per pen. Grower and early finisher diets were fed for 5 weeks and late finisher diets were fed for 24 d. The LF diets contained corn and soybean meal as main ingredients and HF diets contained corn, soybean meal, corn distillers dried grains with solubles (30%) and wheat middlings (10%). One pig/pen was harvested at the conclusion of the experiment. Cecum and rectum contents were analyzed for VFA, and carcass characteristics and gastrointestinal tract weights were measured. Data were analyzed as a 2 × 2 factorial with DFM level, diet type, and the interaction of DFM and diet type as fixed effects and rep as a random effect using the Mixed procedure of SAS. Results indicated that for the overall growing-finishing period, there was no difference in ADG between pigs fed LF and HF diets, but pigs fed HF diets had greater ( $P < 0.01$ ) ADFI (2.5 vs. 2.4 kg/d), reduced ( $P < 0.01$ ) G:F (0.36 vs. 0.37 kg/kg), reduced ( $P < 0.05$ ) dressing percentage (77.5 vs. 78.2%), and increased ( $P < 0.05$ ) weight of empty intestinal tract ( $P < 0.05$ ) compared with pigs fed LF diets. Pigs fed LF diets had a greater ( $P < 0.05$ ) concentration of propionate in cecum contents and greater ( $P < 0.05$ ) concentrations of all VFA in rectal contents compared with pigs fed HF diets. Pigs fed diets supplemented with DFM had greater ( $P \leq 0.05$ ) HCW (88.5 vs. 84.3 kg) and backfat thickness than pigs fed diets with no DFM, but fat-free lean percentage was reduced ( $P < 0.05$ ). In conclusion, pigs fed HF diets had greater overall ADFI, lower G:F, and a lower dressing percentage than pigs fed LF. The addition of

this DFM to LF or HF diets had no effect on growth performance, but increased HCW.

**Key Words:** direct-fed microbial, fiber, pig

**794 Effect of a 3-strain *Bacillus*-based direct-fed microbial on growth performance and volatile fatty acid production in nursery pigs fed low or high fiber diets.** Neil W. Jaworski<sup>\*1</sup>, Augustine Owusu-Asiedu<sup>2</sup>, Ajay Awati<sup>2</sup>, Alastair Thomas<sup>2</sup>, and Hans H. Stein<sup>1</sup>, <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, IL, <sup>2</sup>Danisco Animal Nutrition, DuPont Industrial Biosciences, Marlborough, UK.

The effect of a 3-strain *Bacillus*-based direct-fed microbial (DFM) on growth performance and VFA production in weaning pigs fed low or high fiber diets was evaluated. Two hundred pigs (initial BW: 6.31 ± 0.73 kg) were allotted to 1 of 4 dietary treatments with 5 pigs/pen. Treatments were arranged in a 2 × 2 factorial design with 2 diet types [low fiber (LF) or high fiber (HF)] and 2 levels of DFM [0 or 60 g DFM (2.4 × 10<sup>12</sup> cfu/kg)/t of feed]. Phase 1 diets were fed for 2 weeks post-weaning and phase 2 diets for the following 29 d. The LF diets contained corn and soybean meal as main ingredients and HF diets contained corn, soybean meal, corn distillers dried grains with solubles (7.5 and 15.0% in phase 1 and 2, respectively) and wheat middlings (10.0%). The NE in phase 1 LF and HF diets was 2,525 and 2,463 kcal/kg, respectively. The NE in phase 2 LF and HF diets was 2,483 and 2,414 kcal/kg, respectively. No diets contained antibiotic growth promoters. Pigs and feed were weighed at the start and at the end of each phase, and ADG, ADFI, and G:F were calculated. At the conclusion of phase 2, 1 pig/pen was killed. Cecum and rectum contents were collected and analyzed for VFA. Data were analyzed as a 2 × 2 factorial with DFM, diet type, and the interaction of DFM and diet type as fixed effects and rep as a random effect using the Mixed procedure of SAS. During phase 1, a reduction ( $P < 0.05$ ) in ADFI of pigs fed HF diets and a tendency for pigs fed diets supplemented with DFM to have an improved ( $P = 0.10$ ) G:F were observed. Pigs fed LF diets had a greater ( $P = 0.05$ ) BW (27.06 kg) at the end of phase 2 compared with pigs fed HF diets (26.31 kg). The concentration of acetate, propionate, and isovalerate in rectum contents were greater ( $P < 0.05$ ) in pigs fed LF diets, and there was a tendency for addition of this DFM to increase ( $P = 0.10$ ) isovalerate concentration in cecum content. For the entire experimental period, HF diets decreased ( $P = 0.05$ ) ADFI and ADG of pigs by 32.5 and 17.5 g/d, respectively, and the addition of this DFM improved ( $P < 0.05$ ) G:F. In conclusion, the 3 strain *Bacillus*-based DFM improved overall G:F by 0.8 and 7.3% in LF and HF diets, respectively.

**Key Words:** direct-fed microbial, fiber, pig

**795 Effect of L-DOPA on performance and serum cholesterol of broiler.** Babatunde R. Omidawura<sup>\*</sup>, Adebisi F. Agboola, and Eustace A. Iyayi, University of Ibadan, Ibadan, Oyo, Nigeria.

The L-DOPA found in mucuna seed, when present with other antinutritional factors, has been implicated in nutritional disorders of monogastric animals. It is also reputed to influence muscular development. However, information on its effect on the hydrolysis of triglycerides is scanty. Therefore, the effect of L-DOPA on growth performance and serum cholesterol in broiler chickens was investigated. Two hundred forty 1-d-old chicks were allotted to 6 treatments containing positive control (PC) with normal energy, negative control (NC) with high energy, NC+0.1, NC+0.2, NC+0.3 and NC+0.4% L-DOPA. All treatments had 4 replicates in a completely randomized design. Feed intake (FI), final weight (FW), body weight gain (BWG), feed conversion ratio (FCR),

dressed weight (DW), serum total cholesterol (TC), triglyceride (Tg), high density lipoprotein (HDL), low density lipoprotein (LDL) and very low density lipoprotein (VLDL), were determined following standard procedure. Data were analyzed using descriptive statistics and ANOVA at  $\alpha_{0.05}$ . The body weight gain and final weight of birds fed PC were 1791.0 and 1830.0 g, NC+0.1% L-DOPA were 1827.7 and 1866.7 g and NC+0.2% L-DOPA were 1871.9 and 1910.9 g, respectively, and the feed intake of PC (3231.5 g), were better than other treatments. The serum total cholesterol were 125.0, 129.4, and 131.5 mg/dL of PC, NC and NC+0.4% L-DOPA, respectively, and LDL were 75.1 and 75.7 mg/dL of PC and NC, respectively. The values observed were similar but higher than other treatments with lowest LDL observed in birds fed NC+0.2% (61.2 mg/dL) and NC+0.3% L-DOPA (62.4 mg/dL). The VLDL values observed, 19.8, 22.0, 22.3 and 22.7 mg/dL of birds fed NC+0.1%, NC+0.2%, NC+0.3% and NC+0.4% L-DOPA, respectively, were similar, lower than 26.8 mg/dL of NC but higher than 15.7 mg/dL of PC. The dressed weight at 1375.0 g and 1357.1 g of NC+0.1% and NC+0.2% L-DOPA, respectively, were similar but better than other treatments. Triglyceride and HDL were not affected across treatments. L-DOPA extract, at levels tested, had no detrimental effect on broilers; rather, the serum cholesterol profile was improved and better bird performance was observed especially at 0.1 and 0.2% L-DOPA inclusion rates. Therefore, 0.2% inclusion is recommended in diets of broiler chickens for improved performance, carcass characteristics and cholesterol profile.

**Key Words:** L-DOPA, serum cholesterol, broiler

**796 Effect of high caloric diet enriched in medium-chain triglycerides and arginine supplementation on cholesterol and lipid metabolism in finishing pigs.** Z. H. Zhou, D. W. Chen, P. Zheng, G. Tian, B. Yu\*, and Y. Yao, *Animal Nutrition Institute, Sichuan Agricultural University, Chengdu, Sichuan, China.*

A total of 60 DLY pigs ( $88.16 \pm 8.03$  kg) were used in a 28-d study to determine the effects of high caloric diet enriched in medium-chain triglycerides (HCD-MCT) and L-arginine (Arg) supplementation on cholesterol and lipid metabolism in a  $2 \times 2$  factorial design. Data were analyzed by ANOVA using the GLM procedures of SPSS with the main effects of diet (10% corn starch vs. 10% coconut oil, coconut oil is enriched in MCT, dietary DE were 3.40 Mcal/kg and 3.87 Mcal/kg), supplemented Arg (0 vs. 1%) and their interaction. HCD-MCT increased serum triacylglycerol (+35.48%), total cholesterol (+34.80%) and HDL-C (+66.05%) levels ( $P < 0.05$ ), decreased the ratio of LDL-C to HDL-C (-35.24%,  $P < 0.05$ ). Moreover, HCD-MCT upregulated mRNA expression of 3-hydroxy-3-methylglutaryl coenzyme A reductase (+30.69%) and lecithin cholesterol acyltransferase (+53.06%) in liver ( $P < 0.05$ ), downregulated mRNA expression of fatty acid synthase (FAS) in backfat (-50.72%,  $P < 0.05$ ) and peroxisome proliferator-activated receptor- $\gamma$  (PPAR- $\gamma$ , -23.93%) in liver ( $P < 0.05$ ), accompanied by decreased backfat thickness and fat content in liver (-11.91% and -12.76%,  $P < 0.05$ ). Arg supplementation suppressed gene expression of FAS in backfat (-47.41%,  $P < 0.05$ ) and PPAR- $\gamma$  in liver (-19.50%,  $P < 0.05$ ), elevated gene expression of hormone-sensitive lipase (HSL) and carnitine palmitoyltransferase 1 (CPT-1) in backfat (+78.20% and +30.53%,  $P < 0.05$ ), while reduced backfat thickness (-11.48%,  $P < 0.05$ ) and fat content in liver (-7.18%,  $P < 0.05$ ). There was a diet  $\times$  supplemented Arg interaction observed for FAS, CPT-1 and PPAR- $\gamma$  mRNA abundance in backfat and liver ( $P < 0.05$ ), in which pigs fed control diet had less mRNA expression of FAS (-62.00% in backfat, -59.00% in liver) and PPAR- $\gamma$  (-37.00% in liver), and greater CPT-1 expression (+66.00% in liver) compared with pigs fed HCD-MCT diet. In conclusion, our results indicated that HCD-MCT was helpful to

reduce fat deposition in backfat and liver, and improve serum HDL-C concentration. Arg supplementation also prevented fat deposition by regulating lipid metabolism without any effects on cholesterol profile.

**Key Words:** medium-chain triglyceride, arginine, metabolism

**797 Effects of lactulose on growth, carcass characteristics, fecal microbiota, and blood constituents in broilers.** M. Mohammedi\*, S. Shanmugam, H. Y. Shin, S. Mohana Devi, and I. H. Kim, *Department of Animal Resource & Science, Dankook University, Cheonan, Chungnam, South Korea.*

A total of 324 one-day-old Ross 308 mixed-sex broiler chicks with an average initial body weight of 38 g were used in a 35-d growth assay to determine the effect of supplementing diets with lactulose on growth performance, carcass characteristics, fecal microbiota, and blood constituents. There were 18 birds/pen and 6 pens/treatment with food and water consumed ad libitum. Treatments were a corn-soybean-meal-based diet with none, 0.25 and 0.5% of lactulose. Data were analyzed as a completely randomized design using the mixed procedures of SAS (SAS Institute, 1996), orthogonal polynomial contrasts were used to look for linear and quadratic effects of Lactulose dose in the diet. Results indicated that gain of body weight (BWG; 1,715 vs. 1,765 vs. 1,843 g/d) and feed conversion ratio (FCR; 1.63 vs. 1.58 vs. 1.54) were improved linearly ( $P < 0.05$ ). As for results increasing concentration of lactulose in the diet from none to 0.5% increased ( $P < 0.05$ ) BWG and decreased FCR for d 8 to 21, 21 to 35, and 0 to 35. Also chickens fed supplemented diet with 0.5% lactulose showed higher relative weight of breast meat compared with other groups (7.26 vs. 8.50 vs. 8.64%). Inclusion of lactulose decreased the count of *Salmonella* (2.73 vs. 2.50 vs. 2.47 log<sub>10</sub>cfu/g) and *E. coli* (6.57 vs. 6.39 vs. 6.40 log<sub>10</sub>cfu/g) of feces in chickens fed diets containing 0.25 and 0.5% lactulose ( $P < 0.05$ ), but the count of *Lactobacillus* was not affected. Addition of 0.5% lactulose decreased drip loss percentage on d 1 ( $P < 0.05$ ; 3.98 vs. 2.94 vs. 2.35%) but there wasn't any significant effect on meat color. Blood characteristics were not influenced. Thus it was concluded that inclusion of lactulose improved growth performance and altered fecal microbial populations with no negative effect meat quality and blood profile.

**Key Words:** broiler, carcass characteristic, lactulose

**798 Effect of supplying a nucleotide product (Ascogen) to sow diets on growth performance of the offspring in the nursery.** I-Fen Hung\*<sup>1</sup>, Klaus Hoffmann<sup>2</sup>, Peter Koeppel<sup>2</sup>, and Merlin D. Lindemann<sup>1</sup>, <sup>1</sup>University of Kentucky, Lexington, KY, <sup>2</sup>Chemoforma Ltd., Augst, Switzerland.

Nucleotides are not classified as essential nutrients as animals can synthesize them to a limited extent. However, studies have demonstrated their ability to improve biological responses including growth, immunity, and stress resistance. This experiment was conducted with a subset of sows in a commercial farm in China to evaluate the effects of late gestation and lactation supplementation with nucleotides and the performances of pigs post weaning. Sows ( $n = 40$ ) around d 87 of gestation were randomly assigned to 2 dietary treatments: 1) the farm standard gestation and lactation diets (corn and soybean meal based,) or 2) the standard diets blended with 0.05% Ascogen (NT; Chemoforma, Switzerland) during gestation and 0.1% during lactation. At weaning, piglets ( $n = 112$ ) from sows on each diet were split into 2 groups and fed diets that contained either 0 or 0.1% NT in a 42-d study which resulted in a  $2 \times 2$  factorial arrangement. The data were analyzed by ANOVA using GLM program of SAS. Supplying NT to sow diets tended to

reduce piglet mortality at birth (2.4 vs. 9.5%,  $P = 0.10$ ) and the days to rebreeding (5.4 vs. 9.6d,  $P = 0.10$ ). The individual piglet weight at birth and weaning as well as milk and serum immunoglobulin profile (IgA, IgG, IgM by ELISA) were not affected by NT. However, pigs from NT sows were heavier than those from control sows at Week 3 (13 vs. 12kg,  $P = 0.02$ ) and Week 6 post weaning (22 vs. 20 kg,  $P = 0.01$ ). They also had increased ADG (353 vs. 320 g,  $P = 0.01$ ) and ADFI (592 vs. 539 g,  $P = 0.04$ ) throughout the nursery period. Nursery treatments had no effect on growth performance. Piglets from NT sows had higher serum

IgA levels at weaning (0.17 vs. 0.13 mg/mL,  $P = 0.01$ ) and 1 week post weaning (0.20 vs. 0.17 mg/mL,  $P = 0.05$ ), but no effect on serum IgG and IgM levels was observed. In conclusion, adding NT to the sow diets had beneficial effects on mortality of birth, days to rebreeding, and the growth of piglets during nursery in the commercial environment of this study. However, dietary NT supplementation in nursery may have no effect on growth.

**Key Words:** nucleotide, sow, nursery