

## Nonruminant Nutrition: Feed Additives

**W157 Effects of dietary Aviplus-S supplementation on growth performance, fecal characteristics, and blood profiles in weanling pigs.** J. H. Cho,\* L. Yan, and I. H. Kim, *Department of Animal Resource & Science, Dankook University, Cheonan, Choongnam, South Korea.*

A total of 150 weanling pigs [(Landrace × Yorkshire) × Duroc, BW = 6.76 ± 0.61 kg] were used in a 42-d trial to investigate the effects of dietary Aviplus-S supplementation on growth performance, fecal score, fecal moisture, fecal pH, and blood profiles. Pigs were randomly assigned to 1 of 5 treatments according to BW. Dietary treatments were NC, basal diet (without antibiotics); PC, NC + 39 mg/kg tiamulin; AS1, NC + 0.05% Aviplus-S; AS2, NC + 0.1% Aviplus-S; AS3, NC + 0.2% Aviplus-S. Aviplus-S is based on a mixture of citric (25%) and sorbic (16.7%) acids, thymol (1.7%) and vanillin (1.0%). All pigs were housed in an environmentally controlled room and allowed ad libitum access to feed and water. All statistical analyses were conducted in accordance with a randomized complete block design, using the GLM procedures of SAS software package (1996). During d 0–7, ADFI was reduced ( $P < 0.05$ ) in AS1 treatment compared with PC treatment, and G/F in AS1, AS2 and AS3 treatments were higher ( $P < 0.05$ ) than those in NC and PC treatments. During d 7–21, lower ( $P < 0.05$ ) ADFI was noted in AS1 and AS2 treatments than that in PC treatment, and no differences ( $P > 0.05$ ) in ADG and G/F were observed among treatments. During d 21–42, pigs fed the PC diet had a higher ( $P < 0.05$ ) ADG than those fed the NC diet, and the G/F was higher ( $P < 0.05$ ) in PC treatment than those in NC and AS1 treatments. Overall, the ADG and G/F in PC treatment were higher ( $P < 0.05$ ) than that in NC treatment. Fecal scores were reduced ( $P < 0.05$ ) in AS2 treatment compared with NC treatment. Fecal moisture was unaffected ( $P > 0.05$ ) by dietary treatments. Fecal pH was decreased ( $P < 0.05$ ) in AS1 and AS2 treatments compared with NC treatment at d 7, and fecal pH was reduced ( $P < 0.05$ ) in AS1, AS2 and AS3 treatments compared with NC and PC treatments at d 21. No differences ( $P > 0.05$ ) were observed in blood profiles among dietary treatments. In conclusion, Aviplus-S could be used as an alternative for antibiotics in weanling pigs.

**Key Words:** Aviplus-S, growth performance, weanling pigs

**W158 Effects of Alcopro supplementation as energy source on growth performance, nutrient digestibility, and blood characteristics in growing pigs.** J. H. Cho\*<sup>1</sup>, P. Y. Zhao<sup>1</sup>, K. D. Yang<sup>2</sup>, S. W. Han<sup>2</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>*Dankook University, Department of Animal Resource & Science, Cheonan, Choongnam, South Korea.* <sup>2</sup>*WooGene B&G, Seoul, South Korea.*

A total of 96 growing pigs [(Landrace × Yorkshire) × Duroc, BW = 26.12 ± 1.21 kg] were randomly allotted to 1 of 3 dietary treatments (8 replicate pens per treatment with 4 pigs per pen) to investigate the effects of Alcopro supplementation as energy source on growth performance, nutrient digestibility, and blood characteristics. This experiment lasted for 42 d. All the pigs were housed in an environmentally controlled room with a slatted plastic floor in 24 adjacent pens (1.8 × 1.8 m). Dietary treatments included: 1) CON (basal diet with 4% tallow), 2) A1 (basal diet with 2% tallow + 1% Alcopro + 1% corn), 3) A2 (0% tallow basal diet + 2% Alcopro + 2% corn). Alcopro is based on ethyl

alcohol containing energy source (about 10,000 kcal/kg ME) and digestive enzymes for livestock. Data were analyzed using GLM procedures of SAS (1996), with each pen being used as the experimental unit, and the means of the treatments were compared by Duncan multiple range test. No significant difference ( $P > 0.05$ ) was observed on the energy level changed between A1 (1% Alcopro) and A2 (2% Alcopro) diets during 4 d storage at the room temperature. No difference ( $P > 0.05$ ) was observed on ADG, ADFI, and G/f throughout the experiments. However, pigs fed the A1 and A2 diets led to 72g (5%) and 65 g (4%) higher ADFI than those fed the CON diet, although the difference did not reach the significant level. No difference ( $P > 0.05$ ) was observed on the apparent total tract digestibility of DM, N, and energy among treatments. There was no difference ( $P > 0.05$ ) in the concentrations of WBC, RBC, BUN, creatinine, and Lymphocyte percentage during the experimental period. In conclusion, no negative effects were observed when Alcopro<sup>®</sup> was supplemented as energy source in growing pigs. This study indicated that Alcopro<sup>®</sup> could be used as an energy source for growing pigs and could partly replace tallow in the pig industry.

**Key Words:** Alcopro, growing pigs, growth performance

**W159 Effects of Calibrin-Z on weanling pigs fed diets with no mycotoxin contamination.** F. Chi<sup>1</sup>, S. L. Johnston\*<sup>1</sup>, and D. C. Mahan<sup>2</sup>, <sup>1</sup>*Amlan International Inc., Chicago, IL.* <sup>2</sup>*The Ohio State University, Columbus.*

Some clay-based mycotoxin binders have been shown to bind nutrients. However, in previous research Calibrin-Z (CAZ) has been shown to increase nutrient digestibility and has shown a tendency to improve feed efficiency. This would seem to indicate that CAZ either did not bind nutrients or might bind nutrients and release them during passage through the digestive tract leading to higher availability. In the current experiment 160 weanling pigs were used to evaluate the effects of CAZ in diets that had no mycotoxin challenge. The treatments were: 1) control diet; and 2) the control diet with 0.2% CAZ added. Treatment diets were fed from d 0 to d 35 post-weaning (average initial wt = 6.79 kg). There were 16 pens of 5 pigs each on each treatment, pen was the experimental unit. Diets were complex nursery feeds with 3 dietary phases: d 0–7, d 7–21, and d 21–35. The responses to CAZ added at 0.20% of the diet were analyzed in all replicates, the 7 lightest weight replicates, and the 9 heavier weight replicates. There was a numerical advantage ( $P = 0.11$ ) for average daily gain in the 7 to 21 d period when CAZ was fed to all pigs, with values of 513 and 538 g per day for pigs fed the control diet or the control diet + CAZ, respectively. This was mainly due to a numerical advantage ( $P = 0.06$ ) when CAZ was fed to the heaviest pigs. There was no other effect on growth performance with overall values for average daily gain of 525 g or 532 g, for daily feed intake of 783 g or 785 g, or gain:feed of 672 g/kg or 679 g/kg, for pigs fed the control diet or the control +CAZ respectively. At d 21 and 35 of the experiment pigs in 6 replicates were bled and plasma urea nitrogen concentrations were analyzed. There was no difference ( $P = 0.19$ ) between plasma urea nitrogen concentrations on d 21 but it was significantly ( $P < 0.01$ ) higher on d 35 in pigs fed diets containing CAZ, with values of 33.0 and 38.7, mmol/l. These results may indicate that there was higher amino acid availability when pigs were fed CAZ.

**Key Words:** feed efficiency, Calibrin-Z, plasma urea nitrogen

**W160 Bovine lactoferrampin-lactoferricin produced by *Pichia pastoris* fed-batch fermentation improves intestinal microflora in weaned piglets.** X. S. Tang and Y. L. Yin,\* *Institute of Subtropical Agriculture, the Chinese Academy of Sciences, Changsha, China.*

The chimera of bovine lactoferrampin and lactoferricin, a promising alternative to antibiotics, namely lactoferrampin-lactoferricin (LFA-LFC) has stronger activity than its constituent peptides. In this study, LFA-LFC was produced by fed-batch fermentation in recombinant strain *P. pastoris* (KM71) XS10 constructed by our group. Uniform design U6(64) was used to optimize the fermentation conditions. The target peptide was purified by cation-exchange and size-exclusion chromatography, and identified by antimicrobial activity assay and MALDI-TOF MS. Then the purified sample was added into diet for weaned piglets at 21 d of age. After the following 21 d experimental period, lactobacilli, bifidobacteria and *E. coli* of gut were quantified by real-time PCR. The data were subjected to one-way ANOVA and least significant difference was performed to identify differences among the groups using the SPSS 15.0 program. Results showed that approximately 85 mg of LFA-LFC was secreted into 1 L of medium under the optimized conditions. Purified peptide with a purity of 91% showed antimicrobial activities against all the tested *E. coli* and had the same molecule mass as target peptide. Compared with control group, LFA-LFC group increased the ratio of lactobacilli and bifidobacteria ( $P < 0.01$ ) in gut of piglets including stomach, duodenum, jejunum, ileum, colon and cecum. LFA-LFC group decreased the ratio of *E. coli* in stomach, duodenum and jejunum. These results show that diet supplementation with LFA-LFC can improve gut microbiota in weaned piglets.

**Key Words:** pig, antimicrobial peptide, microflora

**W161 Effects of feeding capsicum oleoresin, garlison, or turmeric oleoresin on gene expression of ileal mucosa of pigs.** Y. Liu\*<sup>1</sup>, M. Song<sup>1</sup>, T. M. Che<sup>1</sup>, J. A. Soares-Almeida<sup>1</sup>, J. J. Lee<sup>1</sup>, D. Bravo<sup>2</sup>, C. W. Maddox<sup>1</sup>, and J. E. Pettigrew<sup>1</sup>, <sup>1</sup>*University of Illinois, Urbana*, <sup>2</sup>*Pancosma SA, Geneva, Switzerland.*

This study was conducted to characterize the effects of 3 plant extracts on gene expression in ileal mucosa of weaned pigs. Weaned pigs ( $n = 64$ ,  $6.3 \pm 0.2$  kg BW, 21 d old) were housed in individual pens for 15 d: 4 d before and 11 d after the first inoculation (d 0). Treatments were in a  $2 \times 4$  factorial arrangement: with or without an F-18 *E. coli* challenge and 4 diets (a nursery basal diet (CON), 10 ppm of capsicum oleoresin (CAP), garlison (GAR), or turmeric oleoresin (TUR)). Total RNA (4 pigs/treatment) was extracted from ileal mucosa of pigs at d 5. Double-stranded cDNA was amplified, labeled, and further hybridized to the Affymetrix GeneChip Genome Array. Microarray data were analyzed in R using packages from the Bioconductor project. Differential gene expression was tested by fitting a mixed linear model equivalent to a  $2 \times 4$  factorial ANOVA using the limma package. Bioinformatics analysis was conducted by DAVID Bioinformatics Resources. Three pairwise comparisons were made in the sham group: CAP vs. CON, GAR vs. CON, and TUR vs. CON. Compared with the CON, feeding CAP altered the expression of 490 genes (280 up, 210 down), feeding GAR altered the expression of 35 genes (17 up, 18 down), while feeding TUR altered the expression of 327 genes (232 up, 95 down). Compared with the CON, feeding CAP and TUR increased ( $P < 0.05$ ) the expression of genes related to membrane and tight junctions, suggesting enhanced gut mucosa health, but decreased ( $P < 0.05$ ) the pathway of cell cycle. Feeding GAR and TUR enhanced ( $P < 0.05$ ) the expression of genes associated with immune responses, indicating feeding these plant extracts may stimulate the immune responses of pigs in the normal conditions. These findings may explain, at least partially, why diarrhea

was reduced in pigs fed plant extracts in the sham group. In conclusion, plant extracts regulated the expression of genes in ileal mucosa of pigs, perhaps providing benefits by enhancing the gut mucosa health and stimulating the immune system.

**Key Words:** gene expression, plant extracts, weaned pigs

**W162 Productive performance in post-weaned pigs conditioned by pre and postnatal porcine digestive peptides (PDP) exposure through maternal diet.** J. Figueroa\*<sup>1</sup>, D. Solà-Oriol<sup>1</sup>, E. Borda<sup>2</sup>, S. A. Guzmán-Pino<sup>1</sup>, and J. F. Pérez<sup>1</sup>, <sup>1</sup>*Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain*, <sup>2</sup>*Bioibérica, Barcelona, Spain.*

Piglets present neophobia to unfamiliar ingredients at weaning. Preferences for a novel feed or flavor may be acquired as a result of the transmission of volatile compounds of maternal diet to the amniotic fluid and milk. The aim of the present study was to explore the influence of pre- and postnatal exposure to porcine digestive peptides (PDP) via maternal diet on the productive performance of post-weaned piglets fed a diet containing the same PDP. A total of 240 male/female post-weaned pigs were used in this experiment. Half of animals came from mothers that during late gestation (14d) and lactation (28d) ate 2% PDP in their diets. The other 120 piglets came from mothers fed an iso-caloric and iso-proteic diet but without PDP inclusion in these periods. Piglets were distributed into 4 blocks by initial weight. Within each block, pigs were distributed in pens for a balanced body weight. Each block consisted of 6 pens of 10 animals. All animals received a common weaning diet containing 2% of PDP in the pre-starter (0–14d) and starter (15–35d) specification during the transition period. Feed intake and body weight were weekly measured to calculate average daily feed intake (ADFI), average daily gain (ADG) and feed:gain ratio (FGR). Data were analyzed by using the GLM procedure of SAS. Piglets coming from sow's diets supplemented with PDP tend to showed higher ADFI during the 15–35d period (740 vs. 693g;  $P = 0.07$ ). Similarly results were observed for ADG in piglets coming from PDP-treated sows during the 0–14d period (144 vs. 137g) and during the 15–35d period (502 vs. 471g;  $P < 0.06$ ). No differences were observed for FCR along the experimental period. Therefore the final body weight at the end of the starter phase tended to be higher for those animals coming from mothers fed PDP supplemented diets (20.1 vs. 19.3kg;  $P = 0.1$ ). These results suggest that pre and postnatal exposure to PDP via maternal diet may influence piglet performance in the presence of the same cues probably due to the positive association of the uterine or milk experience with these feed components.

**Key Words:** pigs, flavors, maternal-transference

**W163 Effects of chitosan nanoparticles loaded with chromium ions on growth, blood metabolites, immune traits and tissue chromium in finishing pigs.** M. Q. Wang,\* C. Wang, H. Li, Y. J. Du, W. J. Tao, S. S. Ye, and Y. D. He, *Animal Science College of Zhejiang University, Hangzhou, Zhejiang, China.*

Nanocomposite materials have a higher surface area and smaller size than typical materials, and they exhibit electrical, magnetic, mechanical and biological characteristics which may enhance mineral absorption. The present study was conducted to investigate the effects of chitosan nanoparticles loaded with chromium ions (CNP-Cr) on carcass characteristics, pork quality and lipid metabolism in finishing pigs. A total of 120 crossbred barrows ( $66.06 \pm 1.01$  kg initial BW) were randomly divided into 4 treatment groups, with 4 pens of 10 pigs per group. Pigs were fed a basal diet (corn-soybean meal, 10.5 g/kg of Lys) supplemented without

(control), or with 100, 200 or 400 µg/kg Cr from CNP-Cr. All pigs were given free access to feed and water. Eight pigs from each treatment were selected to collect blood and tissue samples after 35 d on trial for analysis of blood metabolites, immune traits, and tissue chromium concentrations. Results suggested no significant differences in growth performance between control and CNP-Cr-treated groups. Supplementation of 200 µg/kg CNP-Cr decreased serum glucose ( $P < 0.05$ ). Serum immunoglobulin A was increased with supplementation of CNP-Cr ( $P < 0.05$ ). Serum immunoglobulins G and M in pigs receiving 400 µg/kg CNP-Cr and serum complement in pigs receiving 100 µg/kg CNP-Cr were increased ( $P < 0.05$ ). CNP-Cr supplementation increased chromium content in blood, longissimus muscle, heart, liver, kidney and pancreas in a linear fashion ( $P < 0.05$ ). These results suggest that dietary supplementation of Cr as CNP-Cr affects serum glucose and immune status, and increases tissue Cr content of muscle and selected organs in finishing pigs.

**Key Words:** chromium, immune trait, blood metabolite

**W164 Effects of fermented chlorella supplementation on growth performance, nutrient digestibility, and blood characteristics in growing pigs.** B. R. Lee<sup>\*1</sup>, J. Li<sup>1</sup>, S. U. Lim<sup>2</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>Department of Animal Resource & Science, Dankook University, Cheonan, Choongnam, South Korea, <sup>2</sup>Ace M&F Ltd., Seoul, South Korea.

A total of 96 growing pigs [(Landrace × Yorkshire) × Duroc, BW = 26.58 ± 1.41 kg] were used in a 6-week feeding trial to evaluate the effects of fermented chlorella (FC) supplementation on growth performance, nutrient digestibility, and blood characteristics. Pigs were randomly allotted into 1 of 4 dietary treatments with 6 replicate pens per treatment and 4 pigs per pen. Dietary treatments were: 1) NC, basal diet (without antibiotics); 2) PC, NC + 0.05% tylosin; 3) FC01, NC + 0.1% FC, and 4) FC02, NC + 0.2% FC. All diets were formulated to meet or exceed NRC (1998) recommendations for growing pigs. All the pigs were housed in an environmentally controlled room with a slatted plastic floor. Each pen was equipped with a 1-sided self-feeder and a nipple drinker, pigs were allowed ad libitum access to feed and water throughout the experimental period. Pigs fed the PC diet had a higher ( $P < 0.05$ ) ADG than those fed the NC diet. No differences ( $P > 0.05$ ) were observed in ADFI and G/F among dietary treatments throughout the experimental period. The apparent total tract digestibility (ATTD) of DM in PC treatment was higher ( $P < 0.05$ ) than that in NC treatment. However, no difference ( $P > 0.05$ ) was noted in the ATTD of N and energy among treatments. The concentrations of RBC, WBC, IgG, AST, ALT, and lymphocyte percentage were unaffected ( $P > 0.05$ ) by dietary treatments. Fecal moisture content and fecal pH were also not affected ( $P > 0.05$ ) by dietary supplementation with FC. In conclusion, the application of FC had no negative effects on growth performance, nutrient digestibility, and blood profiles in growing pigs, further studies should be conducted to confirm the growth promoting effect of FC in growing pigs.

**Key Words:** fermented chlorella, growing pigs, growth performance

**W165 The efficacy of using the external marker LIPE to predict digestibility values in Nile tilapia (*Oreochromis niloticus*) fed contrasting diets.** R. Jones<sup>1</sup>, O. Evans<sup>1</sup>, E. A. Teixeira<sup>2</sup>, E. O. S. Saliba<sup>2</sup>, V. B. Silva<sup>2</sup>, K. C. M. Filho<sup>2</sup>, J. S. Saliba<sup>2</sup>, S. J. Meale<sup>\*1</sup>, and A. V. Chaves<sup>1</sup>, <sup>1</sup>Faculty of Veterinary Science, University of Sydney, Sydney, NSW, Australia, <sup>2</sup>Laboratório de Aquacultura da Universidade Federal de Minas Gerais, Escola de Veterinária, Departamento de Zootecnia, Belo Horizonte, MG, Brazil.

Measuring diet digestibility of formulate feeds is essential to determining which diets will maximize growth and feed conversion ratios

(FCR). Inert dietary digestibility markers are one such method used to determine dry matter digestibility (DMD), organic matter digestibility (OMD), crude protein digestibility (CPD) and the digestibility of digestible energy (DDE) within diets. The main objective of this study was to determine whether the dietary marker LIPE can be successfully utilized as a digestibility marker in fish nutritional studies, by examining its efficacy in predicting digestibility values of juvenile Nile tilapia (*Oreochromis niloticus*) fed contrasting diets. Three treatment diets were formulated (low fat/low starch, high fat, high starch) each containing LIPE and chromic oxide at 0.1 g/kg and 1 g/kg respectively. Diets were randomly assigned to 12 tanks suitable for collection of feces via the Guelph method. Four replicates were used and each tank contained 15 juvenile tilapia. The experiment itself was a split-plot design with diets allocated to the main plots and method of assessing digestibility to the subplots. Data were analyzed using the MIXED model of SAS. Means analysis was used to assess the effect of diet, marker and diet × marker interaction on marker performance. LIPE<sup>®</sup> and chromic oxide were evaluated against actual values across all treatment groups using 2 statistical methods; linear regression and measures of deviation. Diet × marker interaction was found to be significant ( $P \leq 0.05$ ) for DMD ( $P = 0.02$ ), OMD ( $P < 0.01$ ) and DDE ( $P = 0.05$ ), but was not significant for CPD ( $P = 0.06$ ). CPD was influenced by method ( $P < 0.01$ ). Linear regression showed both LIPE<sup>®</sup> and chromic oxide predicted values to be weakly correlated with actual values for DMD, OMD, CPD and DDE. Measures of deviation analysis suggested both LIPE<sup>®</sup> and chromic oxide to overestimate DMD, OMD, CPD and DDE. It can be concluded that both LIPE and chromic oxide were poor markers of apparent energy and nutrient digestibility in juvenile Nile tilapia fed contrasting diets.

**Key Words:** feed formulation, Nile tilapia, marker performance

**W166 Validation of the external marker Nanolipe as an indicator of apparent nutrient and energy digestibility in juvenile Nile Tilapia (*Oreochromis niloticus*).** O. Evans<sup>1</sup>, R. Jones<sup>1</sup>, E. A. Teixeira<sup>2</sup>, E. O. S. Saliba<sup>2</sup>, V. B. Silva<sup>2</sup>, K. C. M. Filho<sup>2</sup>, J. S. Saliba<sup>2</sup>, S. J. Meale<sup>\*1</sup>, and A. V. Chaves<sup>1</sup>, <sup>1</sup>Faculty of Veterinary Science, University of Sydney, Sydney, NSW, Australia, <sup>2</sup>Laboratório de Aquacultura da Universidade Federal de Minas Gerais, Escola de Veterinária, Departamento de Zootecnia, Belo Horizonte, MG, Brazil.

Nanolipe is a new, never before tested, external marker created for use in fish digestibility studies. Nanolipe was evaluated in juvenile Nile Tilapia (*Oreochromis niloticus*) against the traditional methodologies of total collection and titanium(III) oxide. The experiment was a split plot design with 3 contrasting diets (low fat/low starch, high fat, high starch) representing the main plots and 3 different marker methods (total collection, titanium(III) oxide, Nanolipe) representing the subplots, with 4 replicates. Twelve tanks were used, each containing 15 juvenile fish (35 ± 6.6 g). Feces were collected via the Guelph method. Dry matter, organic matter, crude protein and digestible energy digestibilities were assessed. Means analysis was used to assess the effect of diet, marker and diet × marker interaction on marker performance. Nanolipe and titanium(III) oxide were evaluated against actual values using 3 statistical methods; concordance correlation, linear regression and measures of deviation. Nanolipe was found to overestimate digestibility for all dietary components assessed in the low fat/ low starch and high fat diets, but underestimated digestibility for the high starch diet. Titanium(III) oxide was found to underestimate digestibility for all dietary components assessed in the low fat/low starch, high fat and high starch diets. Diet × marker interaction was found to be significant ( $P > 0.05$ ) for both Nanolipe and titanium(III) oxide for all dietary components assessed in all of the low fat/ low starch, high fat and high starch diets. Both Nanolipe

and titanium(III) oxide predicted values of estimate digestibility, for all dietary components, were poorly correlated with actual values by concordance correlation. Linear regression showed a significant correlation between Nanolipe and actual values for dry matter digestibility ( $R^2 = 0.54$ ), but a poor correlation between Nanolipe and actual values for digestible organic matter ( $R^2 = 0.37$ ), crude protein ( $R^2 = 0.38$ ), and digestible energy ( $R^2 = 0.17$ ). Measures of deviation analysis showed Nanolipe to over predict the digestibility of dry matter, organic matter, crude protein and digestible energy compared with actual values, while titanium(III) oxide consistently under predicted the digestibility of all dietary components assessed. It can be concluded that both Nanolipe and titanium(III) oxide were poor markers of apparent nutrient and energy digestibilities in feeds utilized by juvenile Nile tilapia. Further studies are evidently needed to understand the exact mechanisms of diet  $\times$  marker interactions.

**Key Words:** diet composition, Nile tilapia, markers

**W167 Total serum cholesterol and triglycerides concentrations in broilers fed with diets containing different sources of oil associated with conjugated linoleic acid (CLA).** V. C. da Cruz\*<sup>1</sup>, R. F. de Oliveira<sup>1</sup>, G. do Valle Polycarpo<sup>2</sup>, V. B. Fascina<sup>3</sup>, L. H. Zanetti<sup>1</sup>, G. A. M. Pasquali<sup>1</sup>, R. Crivellari<sup>1</sup>, L. C. Carvalho<sup>1</sup>, and C. C. do Valle Polycarpo<sup>4</sup>, <sup>1</sup>São Paulo State University, Dracena Campus, Dracena, São Paulo, Brazil, <sup>2</sup>University of São Paulo, Pirassununga Campus, Pirassununga, São Paulo, Brazil, <sup>3</sup>São Paulo State University, Botucatu Campus, Botucatu, São Paulo, Brazil, <sup>4</sup>São Paulo State University, São José do Rio Preto Campus, São José do Rio Preto, São Paulo, Brazil.

This study was carried out at São Paulo State University, Dracena Campus, Brazil, to evaluate total serum cholesterol and triglycerides concentrations of broilers at 21 and 42-d of age, fed with diets containing 2 levels of CLA (0.5% and 1.0%) associated to 3 oil sources (soybean oil, fish oil and linseed oil). A total of 840 1-d-old male Cobb chicks were distributed in a completely random design with 7 treatments and 4 replications. Broilers received the following treatments: T1- control diet without adding oils and CLA; T2- diet containing soybean oil associated to 0.5% CLA; T3- diet containing fish oil associated to 0.5% CLA; T4- diet containing linseed oil associated to 0.5% CLA; T5- diet containing soybean oil associated to 1.0% CLA; T6- diet containing fish oil associated to 1.0% CLA; T7- diet containing linseed oil associated to 1.0% CLA. At 21 and 42-d of age, 8 birds per treatment were killed for collection of 5 mL of blood through the wing brachial vein. No significant effects of treatments were observed for total serum cholesterol ( $P > 0.05$ ) and triglycerides ( $P > 0.05$ ) concentrations in the periods of 21 and 42 d of age. These results can be explained by the good nutritional quality of oil sources used in this research, which are rich in unsaturated and polyunsaturated fatty acids. The inclusion of CLA in the feeding of broilers seems to have influence on lipid metabolism, with positive effects or not, depending on the supplementation phase and the oil source used. In conclusion, the total serum cholesterol and triglycerides concentrations are not altered by CLA and by dietary lipid sources. The mechanisms of action of CLA about the metabolism of fats are not completely known; therefore further research related to cholesterol and triglyceride levels in broiler diets is needed.

**Key Words:** poultry, oil sources, serum lipids

**W168 Effect of dietary oregano (*Origanum vulgare* L.) essential oil on growth performance of broiler chickens fed with diets of different metabolizable energy levels.** E. van Eerden<sup>1</sup>, L. Star<sup>1</sup>, P. van

der Aar<sup>1</sup>, and L. Z. Jin\*<sup>2</sup>, <sup>1</sup>Schothorst Feed Research, Lelystad, the Netherlands, <sup>2</sup>Meriden/Meritech Biotech, Guangzhou, China.

This study was to investigate the effect of dietary oregano (*Origanum vulgare* L.) essential oil on body weight, feed conversion rate and mortality of broiler chickens fed with diets of the 4 different metabolizable energy levels. A total of 960 one-day-old male Ross 308 broiler chickens were divided into 8 treatments and each treatment had 6 replicates with 20 broilers each. The 8 treatments were arranged to  $2 \times 4$  factorial trial design with supplementation of an oregano essential oil (Orego-Stim, Meriden, UK) at 2 levels (0 and 150 g per ton of feed) and 4 energy levels (standard, standard minus 0.33%, 0.66% and 1.0% fat). During the starter phase (d 0 to 15), all diets had the same energy level. The energy treatments were implemented in the grower phase (d 15 to 30) and the finisher phase (d 31 to 36). All parameters were evaluated by ANOVA using Genstat statistical software. Treatment means were compared by the least significant difference (LSD). The results demonstrated that the addition of oregano essential oil resulted in a significantly ( $P < 0.05$ ) higher body weight gain and lower feed conversion ratio in the starter phase. Feed conversion ratio showed a significant effect of energy level ( $P = 0.041$ ) and a near-significant trend of oregano essential oil ( $P = 0.052$ ) in the grower phase. The lowest energy levels had the highest feed conversion ratios, whereas addition of oregano essential oil tended to result in a lower feed conversion ratio in the grower phase. In the overall production period the result showed that there is no significant differences of body weight gain, feed conversion ratio, final body weight, or mortality between the control group and the treatment group of broilers fed with ME-reduced diet supplemented with the oregano essential oil.

**Key Words:** oregano essential oil, broilers, energy level

**W169 Growth performance, nutrient digestibility, and carcass traits of rabbits fed diets added with DDGS or hemicellulases and glucanases.** H. Bernal Barragán\*<sup>1,4</sup>, J. E. Gallegos Balderas<sup>1</sup>, M. A. Liñán González<sup>1</sup>, C. A. Hernández Martínez<sup>1</sup>, F. G. Ríos Rincón<sup>2,4</sup>, M. A. Cerrillo Soto<sup>3,4</sup>, N. C. Vásquez Aguilar<sup>1</sup>, and A. S. Juárez Reyes<sup>3,4</sup>, <sup>1</sup>Universidad Autónoma de Nuevo León, Fac. de Agronomía, San Nicolás de los Garza, NL, México, <sup>2</sup>Universidad Autónoma de Sinaloa, Fac. de Medicina Veterinaria y Zootecnia, Culiacán, México, <sup>3</sup>Universidad Juárez del Estado de Durango, Durango, México, <sup>4</sup>Red Internacional de Nutrición y Alimentación en Rumiantes, México.

A trial was conducted to evaluate the effect of 2 levels of DDGS (0 and 30%) and of enzymes hemicellulase+glucanase, (Hemicell, ChemGen, MD, USA; and Porzyme tp100, Danisco, Marlborough, UK), added either at 0 or 0.50 kg/ton of each enzyme, upon growth, nutrient digestibility and carcass traits of rabbits. Twenty-two 53-d old (initial BW = 1.178 kg) crossbred rabbits (California  $\times$  New Zealand) of both sexes were individually allocated in cages, according to a  $2 \times 2$  factorial arrangement of treatments, in a complete randomized design, with 5 or 6 replicates per treatment. Water and pelleted diets (17.4–18.5% CP, 16.9–25.4% NDF, 3.5–4.9% fat) based on alfalfa hay, grounded sorghum grain, soybean meal and a commercial vit+min mix, were fed ad libitum. During the third week, feces were quantitatively collected for determination of nutrient digestibility. After 28 d, rabbits were slaughtered and carcasses evaluated. There was an interaction ( $P < 0.05$ ) for average daily gain (ADG), since enzymes caused an increase of ADG (26 to 32 g/d) in the diets with DDGS, but a reduction (from 31 to 25 g/d) in the DDGS-free diets. Feed intake and feed conversion rate were not influenced by main factors. No differences ( $P > 0.05$ ) were detected in dry matter digestibility (avg. 71.6%), NDF (avg. 28.4%) and ADF (23.6%). However, enzyme increased lignin digestibility (15–19 percentage units) depending upon DDGS level of the diet (interaction  $P < 0.05$ ). Protein digestibility was higher (74.8 vs. 70.5%;  $P < 0.05$ ) with DDGS inclusion.

Carcass yield nor *Longissimus dorsi* were not different among treatments ( $P > 0.05$ ). Enzyme addition to DDGS-free diets resulted in higher ( $P < 0.05$ ) proportion of carcass forequarter (12.6%) compared with rabbits fed DDGS-diets (11.2%), but forequarter was similar (avg. 12.2%) in both enzyme-free diets (Interaction  $P < 0.05$ ). Rabbits fed diets without DDGS or enzyme had less hindquarter (27.1% of carcass) than other diets (avg. 29.3%; Interaction  $P < 0.05$ ). Results help to understand action mechanisms of hemicellulases and glucanases enzymes added to DDGS containing diets for growing rabbits.

**Key Words:** rabbits, DDGS, carcass traits

**W170 Evaluation of n-3 fatty acid and probiotic supplementation on growth performance, nutrient digestibility, blood characteristics, relative organ weight, and breast meat characteristics in broilers.** L. Yan,\* S. M. Hong, and I. H. Kim, *Department of Animal Resource & Science, Cheonan, Choongnam, South Korea.*

A total of 720 1-d-old broilers were used in a 28 d experiment to determine the effects of n-3 fatty acid and probiotic supplementation on growth performance, blood characteristics, relative organ weight and breast meat characteristics. Birds were randomly allotted to 1 of 4 treatments in a  $2 \times 2$  factorial arrangement with 2 levels of fish oil (0 or 3%) and probiotics (0 or 0.2%) ( $1.0 \times 10^{10}$  viable spores/g of *Bacillus subtilis* endospores and  $1.0 \times 10^9$  viable spores/g of *Clostridium butyricum*). Each treatment was fed to 12 replications with 15 broilers per replication. Diets were isolytic and isocaloric by manipulation of soybean meal and soy oil. In this study, supplementation of salmon oil did not affect ( $P > 0.05$ ) the growth performance and nutrient digestibility throughout the experiment. Dietary probiotic supplementation increased ( $P < 0.05$ ) the body weight gain, feed conversion and apparent total tract of DM digestibility. No difference was observed ( $P > 0.05$ ) in the relative weight of liver, spleen, bursa and breast muscle to the body weight; however, abdominal fat was significantly reduced ( $P < 0.05$ ) with the inclusion of salmon oil or probiotic supplementation. Broiler fed the probiotic supplemented diet had a lower ( $P < 0.05$ ) cholesterol and triglyceride concentration than the non-probiotic diets, whereas the inclusion of salmon oil did not affect the cholesterol and triglyceride concentration. An interactive effect ( $P < 0.05$ ) was observed on the cholesterol concentration. Furthermore, dietary supplementation of salmon oil led to a higher ( $P < 0.05$ ) eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), total n-3 fatty acid, total polyunsaturated fatty acid but lower n-6:n-3 ratio. The inclusion of probiotics increased ( $P < 0.05$ ) EPA concentration compared with non-probiotic supplemented diets. An interactive effect of probiotic and salmon oil was observed on the EPA concentration. In conclusion, dietary salmon oil supplementation could alter the fatty acid composition in breast muscle of broilers without affecting its growth performance. Dietary probiotics could increase the growth performance and affect the fatty acid concentration in breast muscle. A synergistic effect of salmon oil and probiotic could be observed on the fatty acid composition in broilers.

**Key Words:** broilers, n-3 fatty acid, probiotic

**W171 Effects of YGF-251 extract supplementation on egg production, egg weight, egg quality, blood characteristics, and fecal noxious gas emission in laying hens.** S. C. Kim,\* S. Zhang, and I. H. Kim, *Department of Animal Resource & Science, Dankook University, Cheonan, Choongnam, South Korea.*

A total of 288 46-week-old ISA-brown laying hens were used in a 6-week trial to evaluate the effects of YGF-251 extract supplementation on the

egg production, egg weight, egg quality, blood characteristics, and fecal noxious gas emission. Hens were randomly assigned to 4 treatments with 6 replications (12 layers per replication) per treatment. Dietary treatments were: 1) CON, basal diet; 2) T1, CON + 0.05% YGF-251 extract; 3) T2, CON + 0.1% YGF-251 extract, and 4) T3, CON + 0.15% YGF-251 extract. YGF-251 extract consists of *Phlomis umbrosa* Turcz., *Cynanchum wilfordii* Hemsl, *Zingiber officinale* Rosc., *Platycodi Radix* with 5% active ingredient. All diets were formulated to meet or exceed NRC (1994) recommendations for laying hens, protein levels and amino acid compositions were adjusted according to the compositions of YGF-251 at the expense of corn and soybean meal. All statistical analyses were conducted in accordance with a randomized complete block design, using the GLM procedures of SAS software package (1996). Overall, egg production in T3 treatment was higher ( $P < 0.05$ ) than that in CON treatment. No differences ( $P > 0.05$ ) were observed in eggshell color, gravity, shell strength, yolk height, yolk color, haugh unit, shell thickness among dietary treatments. Egg weight was unaffected ( $P > 0.05$ ) by YGF-251 extract treatments. Total protein concentration in blood was higher ( $P < 0.05$ ) in T1 treatment than those in CON and T3 treatments at 2 week. However, there were no differences ( $P > 0.05$ ) in the concentrations of RBC, WBC, IgG, and lymphocyte percentage among dietary treatments throughout the experiment. Supplementation with YGF-251 extract in diets decreased ( $P < 0.05$ ) fecal ammonia emission compared with CON treatment at 6 week. However, hydrogen sulfide, total mercaptans and acetic acid emission were not affected ( $P > 0.05$ ) by dietary treatments. In conclusion, dietary supplementation with 0.15% YGF-251 extract could improve egg production, and decrease fecal ammonia emission in laying hens.

**Key Words:** egg quality, laying hens, YGF-251 extract

**W172 Growth performance and carcass characteristics of Japanese quail fed different levels of zeolite.** J. J. Portillo,\* J. L. Bolado, A. Estrada-Angulo, B. I. Castro, D. Urias-Estrada, A. Aguilar-Hernandez, C. B. Castro-Tamayo, and F. G. Rios, *FMVZ-UAS, Culiacan, Sinaloa, Mexico.*

This study was conducted to determine the effect of dietary zeolite addition on productive performance of Japanese quail (*Coturnix coturnix japonica*) during the fattening phase. A total of 256 chicks (1 d of age; unsexed, BW 10.2 g) were allotted to 16 cages (16 quail/pen) in a completely randomized design. Four dietary treatments were based on an isoproteic (28% CP fed d 1 to 14, and 21.5% CP fed d 15 to 35) and isocaloric (2900 ME kcal/kg) basal diet composed of ground corn, soybean meal, soybean oil, sea salt, limestone, orthophosphate, methionine, lysine, Ca, P, vit + min premix. Zeolite was added to the basal diet at 0, 0.5, 1.0 or 1.5% to produce the 4 dietary treatments. After 35 d of feeding, quail were selected based on weight and dressing percentage, with 4 females and 4 males per treatment. ANOVA was performed for a model of completely randomized design with repeated measures for productive response variables, and additionally, slaughter weight was included as a covariate for analysis of carcass variables. Results suggest the inclusion of zeolite in finishing diets does not improve growth performance ( $P > 0.50$ ), although the response changes with time of fattening ( $P < 0.01$ ). Hot carcass weight (127 to  $130 \pm 2.15$  g), dressing percentage ( $57.6$  to  $59.3 \pm 0.45\%$ ) and liver weight per 100 g of quail BW ( $2.14$  to  $2.38 \pm 0.10$  g) were unaffected by the inclusion of dietary zeolite. These results suggest that zeolite supplementation up to 1.5% in fattening diets of quail does not improve growth performance or carcass responses.

**Key Words:** zeolite, *Coturnix coturnix japonica*, carcass