

A similar interaction was not observed for IgG. Averaged across all time points, P3 progeny had greater ( $P < 0.009$ ) concentrations of circulating IgG than P1 progeny. Piglet BW did not differ between parities. These results suggest that circulating Ig concentrations in neonatal pigs may be affected by dam parity. It remains to be determined whether the increase in circulating Ig observed in P3 progeny occurred because P3 females had greater capacity to provide passive transfer of Ig during lactation. Additional work is needed to determine whether these effects afford the progeny of dams of increasing parity advantages in health and performance during subsequent growth phases.

**Key Words:** Dam Parity, Immunoglobulins, Swine

**695 Impact of ochratoxin A and zearalenone on weaning piglets and counteracting.** V. H. Starkl\*<sup>1</sup> and M. Forat<sup>2</sup>, <sup>1</sup>Biomim GmbH, Herzogenburg, Lower Austria, Austria, <sup>2</sup>Instituto Internacional de Investigacion Animal, Queretaro, Mexico.

Mycotoxins are ubiquitously present, secondary metabolites of different fungal species. Ochratoxin A (OTA) is nephro- and hepatotoxic, carcinogenic and immunosuppressive at low concentrations. Zearalenone (ZON) is known to mimic estrogen and thus leading to hyperestrogenism. A trial was performed to evaluate the effects of 500ppb OTA and 250ppb ZON on health and performance of weaned piglets. The trial started at day 21 and ended on day 63. 96 piglets were randomly separated into 4 treatments. As both, OTA and ZON, are only partly adsorbable, Mycofix<sup>®</sup> Plus (MP) a product based on biotransformation was tested. The product consists of two microorganisms, *BBSH 797* and *Trichosporon mycotoxinivorans*, that produce specific enzymes to biotransform trichothecenes, ZON and OTA. The following four treatments were applied: T-1 Control diet; T-2 500ppb OTA + 250ppb ZON, no MP; T-3 500ppb OTA + 250ppb ZON, 500g MP/ton of feed; T-4 500ppb OTA + 250ppb ZON, 1000g MP/ton of feed. Non-purified toxins provided by Biomin<sup>®</sup> were used. ANOVA was used for statistical evaluation. Measured parameters included performance parameters (feed consumption, body weight, mortality) and histopathology of liver, kidneys and uterus. Daily weight gain over trial period and subsequently final bodyweight were significantly lower in T-2, whereas both treated groups T-3 and T-4 did not show any difference to the control group in performance parameters. No clinical signs were diagnosed in treatment T-1. In treatment T-2 swollen vulva (41,6%), swollen prepuce (50,0%), rectum prolapse (25,0%), vomiting (4,1%) diarrhea (4,1%) and frequent urination (50,0%) were diagnosed. Symptoms in MP-treated

groups T-3, T-4 were significantly reduced or completely overcome. Histopathology showed clear impact of ochratoxin A as kidney- and liver-toxin. Remarkable was the effect of 250ppb zearalenone on the epithelia of uterus of piglets of 63 days of age: Focal squamous cells and mitotic cells were observed in epithelia of uterus of piglets in T-2. As a conclusion can be stated that OTA and ZON strongly affected weaning piglets and that Mycofix<sup>®</sup> Plus was able to overcome the negative impact.

**Key Words:** Ochratoxin A, zearalenone, Piglet

**696 Dietary supplementation with *acanthopanax senticosus* extracts beneficially modulates the gut microflora in weaned pigs.**

X. F. Kong\*<sup>1</sup>, Y. L. Yin<sup>1</sup>, W. Y. Chu<sup>2</sup>, F. G. Yin<sup>1</sup>, H. J. Liu<sup>1</sup>, F. F. Xing<sup>1</sup>, Q. H. He<sup>1</sup>, T. J. Li<sup>1</sup>, R. L. Huang<sup>1</sup>, P. Zhang<sup>1</sup>, S. W. Kim<sup>3,4</sup>, and G. Y. Wu<sup>1,4</sup>, <sup>1</sup>Institute of Subtropical Agriculture, The Chinese Academy of Sciences, Changsha, Hunan, China, <sup>2</sup>Nanjing Agricultural University, Nanjing, Jiangshu, China, <sup>3</sup>Texas Tech University, Lubbock, <sup>4</sup>Texas A&M University, College Station.

This study was conducted to investigate the effects of *acanthopanax senticosus* extracts (ASE) as a dietary additive on gut microflora in weaned pigs. Sixty pigs weaned at 21 d of age were randomly assigned to one of the three 3 treatments (20 pigs/treatment), representing supplementation with 0 or 0.1% ASE, or 0.02% colistin (an antibiotic) to a corn- and soybean meal-based diet. On d 0, 7, 14 and 28 after initiation of the supplementation, five 5 pigs from each treatment were euthanized/sacrificed to obtain the luminal contents of the ileum, jejunum, and cecum. The intestinal luminal samples were analyzed for the gut microflora using the polymerase chain reaction-denaturing gradient gel electrophoresis technique. The concentrations of lactobacillus and *E. coli* were determined using the in vitro culture methodology. The results indicated that the gut microflora of ASE-supplemented piglets was more diverse than the other 2two groups of piglets ( $P < 0.05$ ). Particularly, the number of lactobacillus was higher ( $P < 0.05$ ) and the number of *E. coli* was lower ( $P < 0.05$ ) in ASE-supplemented pigs, compared with the other 2two groups of pigs. These findings suggest that dietary supplementation with ASE beneficially modulates the development of the gut microflora, suppresses the number of bacterial pathogens, and promotes a healthy intestinal environment in weaned pigs. We suggest that ASE is an effective alternative to a feed antibiotic for young pigs. (Supported by NSFC and CAS)

**Key Words:** *Acanthopanax senticosus* Extracts, Weaned Pigs, Gut Microflora

## Nonruminant Nutrition: Poultry Nutrition - Ingredient and Mineral Nutrition

**697 Investigation of antagonism and absorption of zinc and copper when different forms of minerals were fed to chicks.** T. Ao\*, J. L. Pierce, R. Power, A. J. Pescatore, K. A. Dawson, A. H. Cantor, M. J. Ford, and B. L. Shafer, *Alltech-University of Kentucky Nutrition Research Alliance, Lexington, KY.*

The aim of this study was to investigate the antagonism of Zn and Cu when organic or inorganic forms of these minerals were fed to chicks. A practical corn-soybean meal diet without Cu and Zn supplementation,

containing 31 mg Zn/kg diet and 5.4 mg Cu/kg diet, was used as a basal diet. Bioplex Zn<sup>®</sup> (a chelated Zn proteinate) and Bioplex Cu<sup>®</sup> (a chelated Cu proteinate) were used as the organic sources. Reagent grade sulfate salts provided the inorganic sources of Zn and Cu. Supplements provided 20 ppm Zn and 8 ppm Cu. Ten groups of six day-old male broilers were assigned to each of seven treatments. Tap water with no detectable Zn and Cu (<0.001 ppm) and feed were supplied on an *ad libitum* basis during the 3 wk trial. Treatments consisted of the following dietary supplementation: 1) none, 2)

inorganic Cu, 3) inorganic Zn, 4) inorganic Zn + inorganic Cu, 5) inorganic Zn + Bioplex Cu, 6) Bioplex Zn + inorganic Cu, and 7) Bioplex Zn + Bioplex Cu. The luminal mucus layer of the chick's duodenum was separated from the mucosa by filling the lumen with agar to observe the Zn and Cu uptake of mucus in the agar cast and the mucosa. Weight gain and feed intake were increased by Cu ( $P < 0.01$ ) and were further increased by Zn or Zn + Cu ( $P < 0.01$ ). Gain to feed ratio was decreased ( $P < 0.01$ ) by Zn + Cu provided as inorganic forms but not as the organic forms, compared with Zn alone. Zinc supplementation increased ( $P < 0.01$ ) tibia and plasma Zn concentrations. Tibia Zn and Cu levels were higher ( $P < 0.01$ ) for the organic Zn + Cu treatment than for the inorganic Zn + Cu treatment. The Cu content in the mucosa of chicks fed both organic Zn and Cu was significantly higher ( $P < 0.01$ ) than that of chicks given no supplementation or both inorganic Zn and Cu. This suggests that the Bioplex form of Cu is more efficiently absorbed from the lumen and that the antagonism between Zn and Cu can be avoided through using proteinated forms of these minerals.

**Key Words:** Zinc, Copper, Antagonism

**698 Body weight, carcass yield and intestinal clearance of broilers having Na and K salts in the drinking water during pre slaughter feed removal.** H. A. Gomes, S. L. Vieira\*, D. M. Freitas, and C. A. Torres, *Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.*

Ideally, pre slaughter feed removal in broilers should take between 8 and 12 hours. This time allow the intestinal contents to be cleared out, however body and carcass weight are reduced. In this study, Na and K salts were added to the drinking water and given to 46 d old broilers during a 24 hour pre slaughter period. From these, the last 12 hours corresponded to the feed removal period. Six hundred and forty eight Cobb X Cobb 500 broilers were placed in drinking water treatments having tap water or graded increases of 0.15, 0.30, and 0.45% sodium bicarbonate or potassium chloride. In a last treatment, birds were not allowed access to water. The 8 treatments had 9 replications of 9 birds each and were placed in 2.8 m<sup>2</sup> floor pens at start. Each pen had one feeder and 3 nipple drinkers connected to a 20 L water tank with a volume scale, full at the beginning. Since one d old placement o 46 d all birds were on a ad libitum feed and water program. They were then kept out of feed for 3 hours and then allowed one hour access to feed after which the feed withdrawal period started. All birds were weighed at this time and one bird per pen was randomly sacrificed, eviscerated and had its entire gastro intestinal system weighed. Intestinal contents were collected from the crop through proventriculus and from the duodenum through the cloacae. Followed a standard carcass and cut up processing. This procedure was repeated every 2 hours until a total of 12 hours was attained and 7 birds per pen were sacrificed. Water intake was estimated at 2 hour intervals by checking the amount left in the tank compared to the amount in the immediately former period. At the end of the study, water intake demonstrated to be linearly increased with the use of salts in the water ( $P < 0.05$ ), regardless of the salt type. Body weight loss increased linearly through the feed removal period, however, it was higher with birds without access to water ( $P < 0.0001$ ). There were no effect of treatments on carcass and cut up yields as well as on the intestinal dry matter mass at any evaluated moment.

**Key Words:** Broiler, Feed Withdrawal, Drinking Water

**699 The effect of dietary glycine and *Clostridium perfringens* challenge on whole blood chemiluminescence responses in broiler chickens.** Z. Papp, J. P. Dahiya, G. Widyaratne, J. E. G. Smits, and M. D. Drew\*, *University of Saskatchewan, Saskatoon, SK, Canada.*

Whole blood chemiluminescence (WBCL) is a simple and rapid method of measuring the production of reactive oxygen species by circulating polymorphonuclear leukocytes. WBCL was used as a method of assessing innate immune function in broiler chickens fed ideal-protein balanced diets with different protein and glycine concentrations and orally challenged with *Clostridium perfringens*. In Experiment 1, one-day-old male broiler chicks (Ross 308; N=144) were housed in two separate rooms with 12 cages of 6 birds per room. On day 14, four cages of birds in each room were randomly assigned to one of 4 diets containing 16 or 18% digestible crude protein and 0.98 or 1.75% glycine (gly) in a 2 x 2 factorial arrangement. All diets contained 9.80 MJ/kg net energy and 1.11% digestible lysine with all other essential amino acids at ideal protein levels. Birds in one room were challenged with 1 ml of an overnight culture of *C. perfringens* on days 14-21 and in the other room, birds were challenged with sterile PBS. On day 28, blood samples were collected for measurement of WBCL. Challenged birds had significantly higher WCBL responses than unchallenged birds (36,640 vs 26,370 cpm) and those receiving the 1.75% gly diets had significantly higher WCBL responses than birds fed the 0.98% gly diets (34,400 vs 28,374 cpm;  $P < 0.05$ ). Digestible protein level had no significant effect on WCBL responses. In Experiment 2, two cages of 6 birds each were fed 1 of 4 diets containing 0.76, 2.10, 3.43 or 4.77% of gly. Net energy, amino acid levels and oral challenge with *C. perfringens* were as described for Experiment 1. On day 28 blood samples were collected for measurement of WBCL. The birds fed the 0.76% gly diet had significantly lower WCBL responses compared to birds fed the other 3 diets. The results demonstrate that dietary gly level and challenge of birds with *C. perfringens* significantly alters innate immune status of broiler chickens measured using WBCL.

**Key Words:** Glycine, *Clostridium perfringens*, Chemiluminescence

**700 Live performance of broilers fed diets supplemented with the plant extract Sangrovit or a blend of organic and inorganic acids.** S. L. Vieira\*<sup>1</sup>, D. M. Freitas<sup>1</sup>, J. L. B. Coneglian<sup>1</sup>, A. F. Klein<sup>1</sup>, P. X. Silva<sup>1</sup>, and O. Figueiró<sup>2</sup>, <sup>1</sup>*Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil,* <sup>2</sup>*Phytobiotics, Londrina, PR, Brazil.*

Quaternary benzo[c]phenanthridine alkaloids (QBA) sanguinarine and chelerythrine are plant extracts which have antimicrobial and anti-inflammatory properties usually present in the ratio of 3 to 1. Blends of organic and inorganic acids are used due to their antimicrobial properties in animal feeds. This study evaluated broiler performance when fed Sangrovit, a commercial extract marketed in several countries (1.5% sanguinarine) or a Blend of Acids (40% lactic, 7% acetic, 5% phosphoric and 1% butyric). One thousand five hundred and forty Cobb X Cobb 500 one day old male broiler chicks were placed in 44 floor pens, 35 per pen. All birds were fed corn-soybean meal feeds w/o traditional antibiotic growth promoters or anticoccidials. Feeds were provided as follow: 1 to 7 d, 8 to 21 d, 22 to 35 d and 36 to 42 d with 4 treatments and 11 replications in a RBD as follow: T1: Control Treatment w/o any additive; T2: Sangrovit 50 ppm added from 1 to 21 d and then 25 ppm to 42 d; T3: a Blend of Acids at 8 kg/ton from 0 to 7 d, 6 kg/ton from 8 to 21 d, 4 kg/ton from 22 to 35 d, and 2 kg/ton

from 36 to 42 d; T4: Sangrovit as in T2 + a Blend of Acids at 6 kg/ton from 0 to 7 d, 4.5 kg/ton from 8 to 21 d, 2 kg/ ton from 22 to 35 d, 1 kg/ton from 36 to 42 d. Birds were vaccinated for coccidiosis at placement with Paracox. All diets had nutrients and ME to meet or exceed NRC (1994). Body weight, feed intake and feed conversion were weekly evaluated. One bird per pen was sacrificed for evaluation of intestinal lesion scores as well as villi height and crypt depth at 7, 14 and 21 d, whereas 6 birds per pen were processed at 42 d. When compared to the Control Treatment, body weight was improved at 21 d when Sangrovit or the Blend of Acids was used ( $P < 0.05$ ). Improvements in feed conversion were shown weekly and also in the overall period when using Sangrovit alone as well as when a combination with the Blend of Acids ( $P < 0.05$ ). No differences due to the treatments were observed in terms of intestinal lesion scores or villi height and crypt depth at 7, 14 and 21 d, or for the yield of carcass and commercial cuts at 42 d.

**Key Words:** Broiler, Sanguinarine, Sangrovit

**701 Effects of tannin concentration on nutritional value of sorghum grain in broiler chicks.** C. R. Monge\*<sup>1</sup>, J. D. Hancock<sup>1</sup>, C. Feoli<sup>1</sup>, R. C. Kaufman<sup>1,2</sup>, M. R. Tuinstra<sup>1</sup>, S. R. Bean<sup>1,2</sup>, S. Beyer<sup>1</sup>, and B. P. Ioerger<sup>2</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>USDA/ARS, Manhattan.

A total of 192 broiler chicks (Cobb x Cobb, 7 d of age, and average initial body weight of 131 g) was used in a 7-d metabolism experiment to determine the effects of tannin concentration on nutrient utilization. A reference diet with 50% cornstarch was formulated to meet or exceed the nutrient concentrations recommended in the 1994 NRC for poultry. Sorghum grain was then substituted for cornstarch in the reference diet. The sorghum treatments were created by mixing 60% endosperm from non-tannin sorghum (Mycogen 627) with blends of pericarp from the non-tannin sorghum and a tannin sorghum (Sumac) as 40% of the composite. The pericarps were blended so the sorghum composites had none, 0.34, 0.68, 1.36, 2.72, and 5.44 mg of catechin equivalents/100 mg of DM (i.e., % CE). The birds were adjusted to treatment for 4 d followed by 3 d collection of excreta. The excreta were dried, ground, and analyzed for DM, N, and GE with Cr<sub>2</sub>O<sub>3</sub> used as an indigestible marker. There was a linear decrease ( $P < 0.03$ ) in average daily gain (ADG) and a trend (quadratic effect,  $P < 0.08$ ) for decreased gain to feed ratio (G:F) as tannin in the sorghum was increased from none to 5.44% CE. The trend in G:F was consistent with quadratic responses ( $P < 0.001$ ) in percentage retention of DM, N, and GE with concentration of tannins greater than 1.35% CE resulting in decrease nutrient utilization. For the none, 0.34, 0.68, 1.36, 2.72, and 5.44% CE treatments, ADG was 27.9, 26.7, 26.9, 26.8, 25.4, and 25.7 g/d, G:F was 811, 804, 854, 812, 786, and 757 g/kg, retention of DM was 72.8, 73.0, 74.3, 73.4, 68.9, and 65.2%, retention of N was 59.3, 57.3, 60.7, 58.7, 52.2, and 48.5%, and retention of GE was 78.8, 77.4, 79.9, 78.2, 74.6, and 70.6%, respectively. In conclusion, our experiment suggests that some tannin (up to 1.35% CE) is tolerated by growing broiler chicks without loss in nutrient utilization.

**Key Words:** Poultry, Sorghum, Tannin

**702 Effects of tannins from different sorghums on nutrient utilization in broiler chicks.** C. R. Monge\*<sup>1</sup>, J. D. Hancock<sup>1</sup>, C.

Feoli<sup>1</sup>, R. C. Kaufman<sup>1,2</sup>, M. R. Tuinstra<sup>1</sup>, S. R. Bean<sup>1,2</sup>, S. Beyer<sup>1</sup>, and B. P. Ioerger<sup>2</sup>, <sup>1</sup>Kansas State University, Manhattan, <sup>2</sup>USDA/ARS, Manhattan, KS.

A total of 96 broiler chicks (Cobb x Cobb, 7 d of age, and initial body weight of 128 g) was used in a 7-d metabolism experiment to determine the effects of tannin source on nutrient utilization. A reference diet with 50% cornstarch was formulated to meet or exceed the nutrient concentrations recommended in the 1994 NRC for poultry. Sorghum treatments were created by mixing endosperm (60% of the composite) from non-tannin sorghum (Mycogen 627) with blends of pericarp (40% of the composite) from the non-tannin and tannin sorghums (Koro Kollo, Sumac, and SC599). The pericarps were blended to provide 0.6 mg catechin equivalents/100 mg DM from each sorghum source. The sorghum treatments were substituted for cornstarch in the reference diet on a wt/wt basis. The birds were adjusted to treatment for 4 d followed by 3 d collection of excreta. The excreta were dried, ground, and analyzed for DM, N, and GE with Cr<sub>2</sub>O<sub>3</sub> used as an indigestible marker. Compared to birds fed pericarp from Mycogen, birds fed the Koro Kollo treatment had less ( $P < 0.05$ ) average daily gain (ADG). Birds fed pericarp from Mycogen had greater retention of DM ( $P < 0.03$ ), N ( $P < 0.02$ ), and GE ( $P < 0.01$ ) compared to birds fed pericarp from Sumac and SC599. However, retention of DM, N, and GE were similar among birds fed pericarp from the different tannin sorghums with only a trend ( $P < 0.09$ ) for greater GE retention in birds fed Koro Kollo rather than SC599. Means for Mycogen, Koro Kollo, Sumac, and SC599 were 27, 23, 27, and 26 g/d for ADG, 804, 779, 798, and 793 g/kg for G:F, 82, 78, 77, and 76% for retention of DM, 71, 67, 63, and 63% for retention of N, and 86, 82, 81, and 79% for retention of GE. In conclusion, pericarp from the various sorghums having tannins reduced nutrient utilization with only minor indication of differences in biological activity of the tannins from different sorghums.

**Key Words:** Sorghum, Tannins, Poultry

**703 Quality characteristics of newly developed flaxseed: Chemical evaluation.** B. A. Slominski\*<sup>1</sup>, T. Davie<sup>1</sup>, A. Rogiewicz<sup>1</sup>, W. Jia<sup>1</sup>, C. M. Nyachoti<sup>1</sup>, O. Jones<sup>2</sup>, J. Dean<sup>3</sup>, and P. Dribnenki<sup>3</sup>, <sup>1</sup>University of Manitoba, Winnipeg, Canada, <sup>2</sup>Canadian Bio-Systems, Calgary, Canada, <sup>3</sup>Agricore United, Winnipeg, Canada.

Flaxseed is being widely used in laying hen nutrition for omega-3 enriched egg production and is currently being considered as a valuable source of fatty acids in swine and broiler chicken finishing rations. A comprehensive evaluation of the nutritive profiles of two newly developed yellow-seeded lines NuLin™ CR12 and NuLin™ CR50 in comparison with the conventional brown-seeded flax var. CBC Bethune was undertaken. On average, more oil ( $P \leq 0.01$ ) was found in NuLin CR12 (47.8% DM) and NuLin CR50 (47.1% DM) than in the conventional flaxseed (43.9% DM). Even a higher magnitude of difference was noted for linolenic acid (omega-3) which, on seed basis, averaged 31.4 and 29.7% for NuLin CR12 and NuLin CR50, respectively, and was higher by 9-10 percentage points than that of Bethune (21.3% DM). Similar amounts of crude protein (23.5 and 21.6 vs 21.6% DM), sucrose (2.1 and 1.8 vs 1.9% DM), oligosaccharides (1.7 and 1.4 vs 1.8% DM), and phytate (1.3 and 1.0 vs 1.0% DM) were observed for NuLin CR12 and NuLin CR50 in comparison to Bethune. The yellow-seeded characteristic was reflected in the lower fiber content only for NuLin CR12 showing the mean total fiber value of 25.8% which differed significantly ( $P \leq 0.001$ ) from that of NuLin

CR50 (32.0%) and Bethune (32.3%). On a fat free and DM basis, the total fiber content of NuLin CR12 and NuLin CR50 averaged 51.0 and 62.6%, respectively, and was followed by the same magnitude of difference ( $P \leq 0.001$ ) in the content of lignin and polyphenols (9.2 vs 12.7%), glycoprotein (10.4 vs 16.1%) and ash (1.3 vs 2.8%). There was no difference in the non-starch polysaccharide (NSP) content between the two lines (30.2 vs 31.0%), although NuLin CR12 was lower ( $P \leq 0.001$ ) in water-insoluble (15.8 vs 18.15%) and higher in water-soluble (i.e., mucilage) NSP (14.5 vs 12.9%). No major differences in essential amino acids and phytate and non-phytate P contents were observed among the samples.

**Key Words:** Yellow-seeded Flax, Chemical Composition, Omega-3

**704 Evaluation of a dynamic model of calcium and phosphorus metabolism in layers.** E. Kebreab<sup>\*1</sup>, J. Dijkstra<sup>2</sup>, R. P. Kwakkel<sup>2</sup>, and J. France<sup>1</sup>, <sup>1</sup>University of Guelph, Guelph, ON, Canada, <sup>2</sup>Wageningen University, Wageningen, The Netherlands.

Phosphorus (P) is an essential nutrient involved in most metabolic processes of the body. Most of the interest in calcium (Ca) metabolism relates to eggshell formation. Although the eggshell is composed of calcium carbonate, metabolism of both Ca and P are closely related such that a deficiency in one can interfere with proper utilization of the other. Depending on time and availability, P can be mobilized in excess amounts in the laying hen which ends up being excreted in urine and contributes to build-up of P in the soil and water. Reduction and timing of P availability can mitigate pollution. To understand Ca and P metabolism properly, modeling can be of paramount importance. A new dynamic model of P and Ca metabolism in layers has been developed using ACSL to simulate diurnal changes in Ca and P and the layer's hourly requirement for those minerals. The model consists of 8 state variables representing Ca and P pools in the crop, stomachs, plasma and bone. The duodenum is represented as a zero pool in the model. An experiment that measured Ca and P uptake in layers fed different Ca levels during shell-forming days was used to compare with model simulations. The experiment showed that the percentage of Ca retained in body and egg decreased from 62.5 to 50.5% when the Ca in diet was increased. The model simulations were in agreement with the trend. Predictions were 63.2, 56.1 and 55.3% for low, medium and high Ca levels in the diet. The experimental results showed that P retention increased significantly from 11.5% at the lowest Ca inclusion level to 24.1% at the highest. The model also predicted an increase in P retention from 8.4 to 25.4% at lowest and highest level of Ca inclusions, respectively. The advantage of the model is that absorption and utilization (or excretion in urine) can be monitored on hourly basis and adjustments to the diet can be made based on the times where Ca is mobilized for eggshell formation. The model successfully showed how the availability of one mineral affects the utilization of the other and is a useful tool to evaluate feeding strategies aimed at reducing P excretion to the environment in poultry manure.

**Key Words:** Phosphorus, Pollution, Model

**705 Impact of dietary available phosphorus levels on growth and tibia ash of male broilers to 21 d.** L. A. Oden<sup>\*1</sup>, S. D. Frankenbach<sup>2</sup>, N. Augspurger<sup>2</sup>, and J. B. Carey<sup>1</sup>, <sup>1</sup>Texas A&M University, College Station, TX, <sup>2</sup>JBS United, Inc., Sheridan, IN.

An experiment was conducted to evaluate the available phosphorus requirement of contemporary male broilers through 21 days of age. The basal diet was estimated to have 0.15% available phosphorus. Six additional diets were formulated with incremental 0.05% increases in available phosphorus with 0.45% the highest level of available phosphorus. Supplemental available phosphorus was provided in the form of Potassium phosphate. Eight replicate pens of each of the seven diets were arranged in a randomized block design with fifteen birds per battery pen for a total of 840 birds. Pens of birds were group weighed on day 1. Feed and water were provided ad libitum. Mortalities were removed, weighed and recorded twice per day. At 21 days, individual bird weights were recorded and the right tibia was removed, weighed and frozen until analyzed for ash content. There were no differences in 21d body weight, feed consumption, mortality, feed:gain, tibia weight or tibia as a % of body weight among birds fed 0.35, 0.40 and 0.45% available phosphorus. Lower levels of phosphorus resulted in significant decreases in feed consumption, body weight, and tibia weight. Level of phosphorus below 0.35% resulted in significant increases in mortality and feed:gain. The lowest level of phosphorus did not support normal growth performance. Based on these data dietary levels of 0.35% available phosphorus appear adequate for 21d male broilers reared in battery pens.

**Key Words:** Available Phosphorus, Broilers, Tibia Ash

**706 Apparent calcium and phosphorus retention with different levels and source of vitamin D.** J. A. G. Brito<sup>1</sup>, A. G. Bertechini<sup>1</sup>, J. C. C. Carvalho<sup>1</sup>, A. Geraldo<sup>1</sup>, J. O. B. Sorbara<sup>\*2</sup>, and F. J. Piraces<sup>2</sup>, <sup>1</sup>Universidade Federal de Lavras, DZO, Lavras, MG, Brazil, <sup>2</sup>DSM Nutritional Products, Sao Paulo, SP, Brazil.

Vitamin D is highly related with calcium and phosphorus retention. A metabolism trial was performed with four levels of vitamin D (800; 1500; 3500 and 5500 IU/ton feed) provided by two sources of vitamin D and an additional two treatments with 2000 IU of vitamin D3 plus 37.5 mg of 25(OH)D3/ton feed and 2000 IU of vitamin D3 plus 70 mg of 25(OH)D3/ton feed fed to 18-d-old broiler chicken. The feed was based on corn soybean meal with 500 FTU/ton feed. Three days of total excrete collection was performed on wire cage. The treatments had five replications with 15 birds per replication in a complete randomized design. Calcium and phosphorus intake and calcium and phosphorus excreted were determined. The apparent calcium and phosphorus retention was calculated ( $\text{intake} - \text{excreted} / \text{intake} \times 100$ ). No interaction was observed ( $P > 0.05$ ) between vitamin D supplementation levels and vitamin source to apparent calcium retention (ACaR), apparent phosphorus retention (APR) and phosphorus excreted (PE). Comparing the treatments that received just one source of vitamin D with the treatments with both sources of vitamin D showed a better apparent calcium and phosphorus retention for the treatments that received both sources of vitamin D. And comparing the two treatments with both sources of vitamin D showed a better apparent calcium retention and calcium excreted to the treatment with higher level of 25(OH)D3.

**Table 1. Apparent Ca and P retention and total Ca and P excreted.**

Source	Level	ACaR	APR	CaE	PE
D3	20	57.8	63.0	1.55b	1.03
D3	37.5	58.4	62.5	1.53	1.04
D3	87.5	58.2	63.6	1.54	1.01
D3	137.5	59.1	63.3	1.49	1.01
Mean D3		58.4	63.1b	1.53	1.023b
25(OH)D3	20	59.3	63.3	1.48a	1.01
25(OH)D3	37.5	59.0	64.5	1.54	1.01
25(OH)D3	87.5	59.0	64.4	1.50	0.98
25(OH)D3	137.5	59.0	64.6	1.51	0.98
Mean 25(OH)D3		59.1	64.2a	1.51	0.995a
D3+25(OH)D3	50+37.5	58.8b	64.2	1.535b	1.00
D3+25(OH)D3	50+70	60.8a	65.7	1.465a	0.97
Mean D3+25(OH)D3		59.8a	64.9a	1.500	0.985a
Mean Factorial		58.7b	63.6b	1.518	1.009b

a, b=P<0.05

**Key Words:** Metabolism, Vitamin, Excretion

**707 Differences in amino acid digestibility in soybeans processed by different methods.** T. Shi<sup>1,2</sup>, H. M. Edwards, Jr.<sup>2</sup>, G. M. Pesti<sup>\*2</sup>, and R. I. Bakalli<sup>2</sup>, <sup>1</sup>Shandong Academy of Agricultural Sciences, Jinan, Shandong, China, <sup>2</sup>University of Georgia, Athens, GA, USA.

Three samples were obtained to investigate the influence of soybean processing method on the chicks' response to phytase supplementation.

Corn (53.61%), soybean meal (37.47%), & soybean oil (5.49%) based diets (with 0.1 % Cr2O3) were fed to 3 replicate pens of 10 broiler chicks each in battery brooders for 16 days. Solvent extracted, expeller or extruded soybean meals were substituted for 50% of the entire diet. On day 16, ileal contents were gently removed from the posterior two-thirds of the ileum. The samples were freeze dried and assayed for amino acids. Only LYS, MET, CYS, THR, TRP & ARG were included in these analyses. If the amino acids were considered separately (11 error degrees of freedom), only LYS digestibility appeared to be affected by phytase (p<0.006), and there was no significant source by phytase interaction (p>0.20). However, if the amino acids were considered together in one ANOVA (66 error degrees of freedom), there were clear differences in amino acid digestibilities (ARG=88.2±1.5, CYS=57.0±4.0, LYS=87.2±2.0, MET=82.0±2.9, THR=73.7±3.0, TRP=84.5±1.9, p<0.013) and a very significant source by phytase interaction (p<0.002). There were no significant differences in chick growth or feed utilization between chicks fed the three soybean meals.

**Table 1. Avg. amino acid digestibility in 3 SBM's (LYS, MET, CYS, THR, TRP & ARG)**

Phytase	Solvent	Expeller	Extruded
0	84.5±3.4	72.1±5.0	75.8±3.8
1200	74.3±5.3	82.0±5.3	81.6±4.6
Avg	79.4±2.6	78.1±3.2	78.7±2.3

**Key Words:** Amino Acids, Digestibility, Phytase

## Production, Management & the Environment - Livestock and Poultry: Poultry Management, and Environment

**708 Evaluation of hydrated lime as a litter treatment at three application rates for broiler chickens.** J. P. Blake\*, J. B. Hess, K. S. Macklin, and C. A. Wilson, Auburn University, Auburn, AL.

A total of 1120 commercial broiler chicks (Cobb X Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 × 2.44 × 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter treatment and hydrated lime (HL) at a commercial application rate equivalent to 50, 100, or 150 lbs/1,000 ft<sup>2</sup> of floor space with each treatment assigned to four chambers. New pine shavings (54.42 kg) were placed in each pen. Feed and water were provided ad libitum under 24 hrs continuous light. Birds and feed were weighed at 21, 42 and 49 d to determine growth and feed performance. Litter and air quality samples were obtained for analysis initially and on day 7, 14, 21, 28, 35, 42 and 49 of the experiment. Ammonia measurements were conducted using a closed container of specified dimension inverted over the litter bed and determined using a Drager CMS Analyzer equipped with a remote air sampling pump. No differences (P>0.05) in growth performance (body weight, feed consumption, or feed efficiency) occurred during the 49-d experimental period due to treatment. Litter pH for the HL treatments was significantly higher (P<0.05) through day 21 as compared to the CON. Initial pH of the litter on day 0 for CON and HL at the 50, 100, or 150 rates were 6.35, 12.45, 12.82, and 12.82,

respectively. By day 21 pH measurements were 7.25, 8.92, 9.38, and 9.45 for the CON and HL at the 50, 100, and 150 rates, respectively. Afterwards, there were no differences in pH due to treatment. Results indicated no significant (P>0.05) changes in ammonia levels due to the HL treatments. Results indicate that the application of HL on clean shavings resulted in an initial increase in litter pH (c.a. 50% higher) that continued through day 21 (c.a. 21% higher). HL failed to support any reduction in ammonia volatilization. Litter sample analysis did not indicate an increase in the amount of nutrients retained due to treatment. Litter moisture increased from a low of 8.9% to 26.4% by day 49 with no differences between treatments.

**Key Words:** Hydrated Lime, Litter Treatment, Ammonia

**709 Evaluation of Poultry Guard™ litter treatment at three application rates for broiler chickens.** J. P. Blake\*, J. B. Hess, K. S. Macklin, and C. A. Wilson, Auburn University, Auburn, AL.

For each of two experiments a total of 1120 commercial broiler chicks (Cobb × Ross) were randomized with 70 birds assigned to each of 16 environmental chambers (2.44 × 2.44 × 2.44 m). Birds were fed a corn-soybean meal starter (1.5 lbs/bird; 22% CP, 3087 kcal/kg), grower (3.0 lbs/bird; 20% CP, 3131 kcal/kg), finisher (4.0 lbs/bird; 17.5% CP, 3197 kcal/kg) and withdrawal (c.a. 3.0 lbs/bird; 16.5% CP, 3219 kcal/kg). Treatments comprised a control (CON) with no litter