

in the presence of starch (prebiotic), and to evaluate its efficacy in an *in vitro* competition and in an *in vivo* piglet growth assay. From 463 environmental strains of *E. coli*, two strains (UM-2 and UM-7) with enhanced colicinogenic properties and rapid growth on starch were selected. Results of *in vitro* competition assays revealed that UM-2 and UM-7 suppressed *E. coli* K88 growth in the presence of starch. In the *in vivo* assay, 40 piglets with an initial BW of  $4.82 \pm 0.6$  kg were assigned to 4 wheat-soybean meal-based diets consisting of a control with an antibiotic (C) and three diets with no antibiotics but containing UM-2 and UM-7 as the probiotics (PRO), 14% potato starch (PS), or a combination of 14% potato starch and probiotics (PRO-PS). PRO and PRO-PS diets were prepared each morning by mixing 50 ml of  $9 \times 10^{10}$  cfu/ml overnight probiotic cultures with fresh feed. Pigs were adapted to experimental diets from d 1 to 7. On d 8, pigs were orally inoculated with a 6 ml dose of  $2 \times 10^9$  cfu/ml *E. coli* K88. ADFI, ADG, gain:feed ratio and fecal consistency scores (FCS) were monitored. ADFI and ADG before and after *E. coli* K88 infection were higher for the PRO-PS treatment compared with the other dietary treatments ( $P < 0.05$ ). Gain:feed ratio was higher ( $P < 0.05$ ) for the PRO-PS diet than C diet before infection and was similar to the C treatment after infection. PRO-PS and C fed piglets had a lower FCS ( $P < 0.05$ ) than the PS and PRO fed piglets. In conclusion, colicinogenic probiotics and potato starch acted synergistically to reduce the negative effects of *E. coli* K88 infection in piglets.

**Key Words:** Pigs, Probiotics, *E. coli* K88

**91 Dosage and efficacy of a novel *Saccharomyces cerevisiae* strain to enhance piglets productivity.** M. Lucero P<sup>4,1</sup>, G. E. Lanz A<sup>4,1</sup>, A. A. Martinez A<sup>2</sup>, and J. A. Cuaron I<sup>3</sup>, <sup>1</sup>PAIEPEME A.C., Querétaro, México, <sup>2</sup>CNID-Microbiología, México, <sup>3</sup>CNID-Fisiología Animal, INIFAP, Querétaro, México, <sup>4</sup>FESC UNAM, Ajuchitlan, Querétaro, Mexico.

An advantage of using yeast as a probiotic is that as an eucariotic is compatible with antibiotherapies, Use of live yeast in piglets feed is an effective ADG enhancer (40 a 60 g) as long as *Saccharomyces cerevisiae* (SC) is from known effective strains, viable in the intestine and at doses greater than  $8 \times 10^9$  cfu/g of product, or, a least,  $1 \times 10^7$  cfu/g of feed, but some authors will defend effectiveness based on the immune-stimulant potential of the cell wall. This novel strain of yeast (Biocel) is of interest because the cell size ( $20 \times 10^9$  cfu/g) is about 50% of a normal SC, thus cell wall concentration is potentially doubled. An experiment using 600 piglets (a total of 60 experimental units) was conducted, from  $10.19 \pm 2.96$  kg of initial weight during 5 weeks to measure growth performance effects of 5 yeast inclusion levels:

0, 0.25, 0.5, 1.0 and 2 kg/MT. The experiment was a Randomized Complete Block (2 nurseries) design. No differences ( $P \geq 0.33$ ) were detected in feed intake ( $0.75 \pm 0.142$ ), morbidity or mortality ( $12.45 \pm 3.45$ ) but, noted after 28 days, Biocel quadratically increased ( $P \leq 0.01$ ) ADG (380, 400 440, 470 and 460, SEM = 15.6 g) and feed efficiency (500, 530, 610 600 and 600, SEM = 15.86 g/kg). The inflection point of the curve showed that most effective levels of Biocel are between 1.25 y 1.50 kg/MT of feed ( $2.5$  to  $3 \times 10^7$  cfu/g).

**Key Words:** Yeast, Piglets, *Saccharomyces Cerevisiae*

**92 Strategies for enhancing microbiological gut's barrier: BMD y BioPlus 2B.** D. Munoz V<sup>\*1</sup>, G. E. Lanz A<sup>1</sup>, M. Lucero P<sup>1</sup>, A. Soria F<sup>1</sup>, J. A. Renteria F<sup>3</sup>, J. A. Cuaron I<sup>3</sup>, S. Correa N<sup>4</sup>, and S. Martinez<sup>2</sup>, <sup>1</sup>Paiepeme, A.C., Queretaro, Mexico, <sup>2</sup>Alpharma, Mexico, <sup>3</sup>Fisiología Animal, INIFAP, Queretaro, Mexico, <sup>4</sup>Synbios, Mexico.

The aim of this experiment was evaluating 2 strategies for clostridium control: a non absorbable antibiotic, bacitracine (BMD 0.3 kg/Mt), and a bacterial probiotic, BioPlus 2B (BP2B 0.5 kg/Mt), in finishing pigs. A total of 1125 pigs (half gilts and barrows) were used. Pigs were allotted in 56 pens, considering each pen as an experimental unit. Pigs were offered a single diet, containing therapeutical levels of antibiotic (AB) for respiratory diseases prevention (Clortetraciline 2 kg/Mt). Treatments (TRT) were: 1) NEGCON, 2) BMD (first 21d), 3) BP2B (first 21d), 4) BMD + BP2B (first 21d). From day 22 to 41 AB was withdrawn from all diets and at day 42, experimental units were divided to form three new treatment: 5) AB + BMD, 6) AB + BP2B, and 7) AB + BMD + BP2B (each treatment with 8 experimental units) until day 84. Pigs were weighed every 21 days, ADFI, ADG, and Gain:Feed were estimated weekly. Feces samples were collected every feeding phase change for total anaerobians, coliforms, and salmonella counts. Mortality and its causes were registered the day they happened. After 84 d on trial there was a difference ( $P \leq 0.05$ ) on ADFI, BMD or BP2B pigs were better than CON; for ADG there was an interaction ( $P \leq 0.03$ ) between BMD and BP2P compared to CON pigs; there were no differences ( $P \geq 0.05$ ) between treatments for Gain:Feed. When AB was added to the diets, growth performance was improved (ADFI, 2.8 vs. 2.1 kg/day; ADG, 0.874 vs. 0.778 kg/day; Gain:Feed, 0.439 vs. 0.406 kg/day;  $P \leq 0.02$ ). There were no differences ( $P \geq 0.05$ ) in total coliforms, anaerobians or salmonella counts in feces. A few clostridium deaths were presented but were not associated to TRT. Combining the use of BMD and BP2B may help prevent clostridium infection and improve growth performance, thus the use of a therapeutical AB may enhance the effects of obtained by the other 2 products.

**Key Words:** Clostridium, Probiotic, Antibiotic

## Nonruminant Nutrition: Poultry Nutrition - Protein and Amino Acids

**93 Ileal amino acid digestibility of protein feed ingredients at 5 and 21 days of age by broiler chickens.** J. M. Rynsburger<sup>\*1</sup>, D. Hoehler<sup>2</sup>, and H. L. Classen<sup>1</sup>, <sup>1</sup>University of Saskatchewan, Saskatoon, SK, Canada, <sup>2</sup>Degussa Corporation, Kennesaw, GA.

The amino acid (AA) digestibility of feed ingredients by broiler chickens has most often been determined using older birds. However, these values are unlikely to predict AA digestibility in chicks during the initial period post-hatch because of their immature digestive tracts and lower nutrient utilization. Therefore, the objective of this research

was to compare the ileal AA digestibility of selected protein sources using 5 and 21 d old broilers. Twenty two Ross x Ross 308 broilers were randomly assigned to eight battery cages per treatment. After sampling on d 5, remaining birds for 21 d sampling were distributed into 6 replicates of 7 birds. A 2 x 6 factorial arrangement was used to examine the effect of age on the ileal AA digestibility of six protein feed ingredients. Ingredients examined included canola meal, a canola protein concentrate, fishmeal, meat meal, peas and soybean meal. Diets were formulated to derive crude protein (approximately 18%) and

AAs solely from the test ingredient. AA digestibility was higher for 21 d old broilers than their 5 d old counterparts for most ingredients. Exceptions were all the AA digestibilities for soybean meal and the digestibility of CYS, MET + CYS, THR, ARG, VAL, HIS, GLY, SER, ALA and ASP for fish meal, which did not change significantly with age. The age-associated improvement in digestibility was highly variable and dependent on feed ingredient and amino acid with the percentage improvement ranging from -1.6 to 169%. In conclusion, ileal AA digestibility generally improves with age between 5 and 21 d of age but the response to age differs among ingredients and AAs. Therefore, accurate formulation of starter diets requires the use of AA digestibility values obtained in age-appropriate birds to ensure that diets meet AA requirements of broiler chicks for growth and other performance criteria.

**Key Words:** Chick, Ileal Amino Acid Digestibility, Protein

#### **94 Effects of a reduction of dietary crude protein on performance and economics in commercial Ross 708 broilers.**

E. A. Guaiume<sup>\*1</sup>, J. D. Firman<sup>1</sup>, D. Hoehler<sup>2</sup>, P. B. Tillman<sup>3</sup>, D. Burnham<sup>4</sup>, J. Parcell<sup>1</sup>, L. B. Linares<sup>1</sup>, and A. Kamyab<sup>1</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Degussa Corporation, Kennesaw, GA, <sup>3</sup>Ajinomoto Heartland LLC, Chicago, IL, <sup>4</sup>Aviagen Inc., Huntsville, AL.

A study was conducted to determine the effects of reduced dietary crude protein (CP) on biological and financial performance of Ross 708 broilers fed from hatch to week 8. 1440 straight-run broiler chicks were randomly assigned to 4 treatments with 12 replicate pens containing 30 birds each. Diets were formulated to be isocaloric and to have the minimum digestible level for lysine (Lys), and the same minimum ideal amino acid ratios to lysine for total sulfur amino acids (TSAA) and threonine (Thr) across the four phases [starter (0-2wks), grower (2-4wks), finisher (4-6½wks), and withdrawal (6½-8wks)]. An industry standard diet served as the control (CT). The remainder of the treatments (CT-0.7%, CT-1.4%, and CT-2.1%) had CP reduced in 0.7% increments. Birds were weighed at 2, 4, 6½, and 8 weeks of age for feed to gain calculation. At week 8, 4 birds per pen (48/trt) were sacrificed and had fat pad and carcass weighed, and carcass and meat yield determined. Feed cost savings (FCS) per metric ton (MT) of carcass, FCS/MT breast meat, income over feed cost/MT carcass, and income over feed cost/MT breast meat, were calculated. Treatments had no effect ( $P > .05$ ) on performance throughout the 8-week period. There was a linear increase ( $P < .05$ ) in fat pad as CP decreased. Treatments had no effect on carcass yield ( $P > .05$ ); however, there was a linear decrease ( $P < .05$ ) in breast meat yield as CP decreased. For carcass, relative to CT, FCS was \$5.59/MT when CT-2.1% was fed; and for breast meat, FCS was \$5.78 for CT-0.7%; \$11.57 for CT-1.4%. However, when CT-2.1% was fed, there was an increase in feed costs (\$14.07) per MT of breast meat when compared to CT. Overall, these results suggested a decrease of CP by 2.1%, as compared with industry standards, did not affect performance and carcass yield, but it decreased breast meat yield when CT-2.1% was fed.

**Key Words:** Low Crude Protein, Ross 708, Economics

#### **95 Effects of dietary protein concentration and age on gut morphology, crude mucin, and sialic acid contents of ileal digesta of turkey poults.**

S. A. Adedokun<sup>\*</sup>, D. M. Karcher, and T. J. Applegate, Purdue University, West Lafayette, IN.

The determination of the effects of age and dietary crude protein (DCP) concentration on factors contributing to the amount of amino acids of endogenous origin is important. The effects of DCP on crude mucin (CM), sialic acid (SA), and rate of gut turnover in turkey poults were measured at d 5 and d 21. Poults were fed a nitrogen-free diet (NFD), a diet containing 10% casein (completely digestible protein, CDP), and a corn-soybean meal (C-SBM) based diet. Each diet was fed to four replicate pens containing 60 and 12 birds which were sampled on d 5 and d 21, respectively. Crude mucin and SA (d 5 and d 21: n=4) contents as well as goblet cell number (GCN), villi height (VH), crypt depth (CD), and the ratio of GCN:VH (d 5 and d 21, n = 16 and 12, respectively) were determined. The amount of CM and SA (g/100 g of dry digesta) on d 5 was higher ( $P < 0.05$ ) than on d 21 (NFD) but there was no difference in both CM and SA when CDP diet was fed. The C-SBM diet resulted in a higher ( $P < 0.05$ ) CM concentration on d 5 than d 21 but the SA content was not different between the two ages. For all the dietary treatments, values for GCN, VH, and CD were higher ( $P < 0.05$ ) on d 21 than on d 5. However, the GCN:VH for birds fed the NFD was 18% or 27% lower than birds fed the CDP or C-SBM diets, respectively. Therefore, previous results showing higher endogenous amino acid losses on d 5 relative to d 21 (NFD) could be attributed to higher CM and SA production.

**Key Words:** Goblet Cell, Mucin, Poults

#### **96 Protein and amino acid retention in growing White Pekin ducks receiving graded levels of dietary crude protein.**

N. L. Horn<sup>\*</sup> and O. Adeola, Purdue University, West Lafayette, IN.

Protein and AA accretion in growing male White Pekin ducks receiving 19, 21, 23, or 25 % dietary CP were investigated. On d 0, 16 ducklings were killed as an initial slaughter group. Two groups of 96 ducklings were assigned to the 4 dietary treatments, with 6 cages per treatment and 4 birds per cage, in randomized complete block design. One group was sacrificed on d 7 and the other group on d 14. There were linear increases ( $P < .05$ ) in gain and G:F for 7-d and 14-d old ducklings. Ash and fat accretion were not significantly affected by graded levels of dietary crude protein in 7-d old ducklings, for 14-d there was a linear decrease ( $P < .05$ ) in fat accretion as dietary CP increased, but no significant differences for ash accretion. Body protein accretion increased linearly from 2.83 g/d to 3.51 g/d for 7-d old birds, and from 2.35 g/d to 3.59 g/d for 14-d old birds ( $P < 0.0001$ ). Body lysine accretion increased from 180 mg/d to 224 mg/d for 7-d old birds, and from 150 mg/d to 220 mg/d for 14-d old birds ( $P < 0.0001$ ). Body threonine accretion increased from 104 mg/d to 129 mg/d for 7-d old birds, and from 85 mg/d to 130 mg/d for 14-d old birds ( $P < 0.0001$ ). There was a linear relationship between crude protein intake and accretion rate of body protein in 7-d and 14-d old ducks. Lysine and threonine accretion also showed a linear relationship with body protein accretion in 7-d or 14-d old ducks. The results from this experiment showed that 30% or 28% of dietary protein was deposited in the body of 7-d or 14-d old ducks, respectively. Additionally, approximately 62 mg and 34 mg of lysine and threonine, respectively were accreted for every g of protein accretion.

**Key Words:** Dietary Crude Protein, Ducks, Protein Accretion

**97 Effect of strain and immune status on dietary lysine requirements in broilers as determined by indicator amino acid oxidation.** R. D. Kirschenman\* and D. R. Korver, *University of Alberta, Edmonton AB, Canada.*

The effect of recovery from an acute-phase inflammatory response on lysine requirements was determined in random-bred (since 1957;R) and modern (Ross 308;M) broilers. At 10 d of age, 8 birds (4 R and 4 M) were placed in individual chambers and adapted to one of 7 diets containing 6.07, 7.18, 8.38, 9.38, 10.49, 12.14 or 13.24g/kg of dietary Lys (55% to 120% of NRC level for birds of this age). At 13 or 14 d of age, two birds per strain were either injected with lipopolysaccharide (LPS; I) or not injected (C) 12 hours prior to each 4-h oxidation. This time frame was based on prior data assessing changes in febrile response during recovery from LPS. There were 4 replicates per strain-LPS group at each level of Lys. Individual bird weights were taken before injection and before and after each oxidation. The M strain had higher BW than the R strain at all points ( $P \leq 0.0001$ ). Injection caused the MI birds to have a lower final BW than the MC birds ( $P=0.0056$ ) while the BW of R birds was not affected. BW of all birds increased during the oxidations. Mean Lys requirements for the MI and MC birds were  $11.95 \pm 1.09$  g/kg diet and  $10.14 \pm 1.14$  g/kg diet, respectively ( $P=0.7307$ ). The mean Lys requirements for RI and RC birds were  $9.98 \pm 0.26$  g/kg diet and  $8.32 \pm 0.11$  g/kg diet, respectively ( $P=0.0231$ ). The M birds had a higher requirement than the R birds ( $P \leq 0.0001$ ). The results of this study demonstrate that M and R birds had different responses to an inflammatory challenge. LPS injection has been observed to decrease Lys requirement of birds during an immune challenge, however we observed an increase during the recovery phase in R birds. It is possible that the higher requirement is required to simultaneously support the diminishing inflammatory response as well as a recovery in growth rate. The lack of an LPS effect on Lys requirement in the M strain may indicate more rapid redistribution of nutrients back to growth or a different time course of recovery from the acute phase than the R strain. As this is a novel area of study, to date the mechanisms behind these changes are unknown.

**Key Words:** Immunity, Requirements, Lysine

**98 Dietary protein quality and feed restriction influence abundance of PepT1 mRNA in the small intestine of two lines of broilers.** E. Gilbert\*<sup>1</sup>, H. Li<sup>1</sup>, D. Emmerson<sup>2</sup>, K. Webb, Jr.<sup>1</sup>, and E. Wong<sup>1</sup>, <sup>1</sup>*Virginia Polytechnic Institute and State University, Blacksburg,* <sup>2</sup>*Aviagen®*, *Huntsville, AL.*

The objective of this study was to evaluate the effect of dietary protein quality on chicken intestinal peptide transporter 1 (cPepT1) mRNA abundance in two lines of broilers (A and B). Intestinal samples were collected from chicks at day of hatch (doh), and d 1, 3, 7 and 14 posthatch. At doh, chicks from both lines were randomly assigned to corn-based diets containing 20% CP with either soybean meal (SBM), a higher quality protein, or corn gluten meal (CGM), a lower quality protein, as the supplemental protein source. Birds were given ad libitum access to feed and water. Groups of chicks from both lines were also assigned to the SBM diet at a quantity restricted to that consumed by the Line A chicks fed CGM (diet consumed the least). PepT1 mRNA abundance was assayed by real time PCR using the absolute quantification method. Feed intake and BW were greater

( $P < 0.0001$ ) for Line A compared with Line B. Chicks fed SBM had the greatest, while chicks fed CGM had the lowest BW and feed intakes ( $P < 0.0001$ ). Chicks fed restricted amounts of the SBM diet had intermediate BW ( $P < 0.0001$ ). With feed and protein intakes equal, greater BW in chicks fed restricted amounts of SBM compared with chicks fed CGM is reflective of SBM being a higher quality source of protein. Abundance of PepT1 mRNA was greater in Line B than Line A ( $P = 0.03$ ). PepT1 mRNA was highest on d3, d14, and d7 and d14, in chicks fed diets containing SBM, CGM, and restricted SBM, respectively ( $P = 0.005$ ). When feed intake was equal (CGM vs restricted SBM), a greater abundance of PepT1 mRNA was associated with the higher quality SBM ( $P < 0.04$ ). When feed intake was restricted (SBM vs restricted SBM), a greater abundance of PepT1 mRNA was associated with the restricted intake ( $P < 0.04$ ). These data suggest that both dietary protein quality and feed restriction influence expression of PepT1 mRNA in the small intestine of broiler chicks.

**Key Words:** Broiler, PepT1, Protein

**99 Cysteine toxicity in chicks.** R. N. Dilger\* and D. H. Baker, *University of Illinois, Urbana.*

Previous work in our laboratory showed that 2.5% or more excess dietary L-cysteine (Cys), but not L-cystine, was lethal when fed to young chicks. Mortality resulting from ingestion of excess Cys was unique due to its acute nature; chicks began to perish after just 72 h of feeding. Our overall objective was to further characterize the unique phenomenon of Cys toxicity in chicks. Because Cys is a strong reducing agent, we attempted to counteract its effect using a strong oxidant (i.e., H<sub>2</sub>O<sub>2</sub>) in drinking water. Over a 9-d growth assay, chicks were provided corn-soybean meal diets containing 0 or 2.5% excess Cys, with or without 0.05% H<sub>2</sub>O<sub>2</sub> in the water (i.e., the highest tolerable concentration as determined previously). Provision of H<sub>2</sub>O<sub>2</sub> caused no untoward effects, but excess Cys reduced weight gain 24% and caused 44% mortality. The combination of excess Cys and H<sub>2</sub>O<sub>2</sub>-supplemented water still reduced weight gain 20%, but remarkably, no chick mortality was observed. Next, we evaluated the well-known principle that increased dietary CP concentration may minimize the noxious effects of consuming a single excess amino acid. Excess dietary Cys at 2.5% depressed ( $P < 0.05$ ) weight gain in chicks fed corn-soybean meal diets containing 18% or 24% CP, but had no effect on chicks fed 30% CP diets. Cys-induced mortality, approximately 50%, was not affected by dietary CP concentration. Finally, we hypothesized that chick eating behavior (i.e., constant nibbling, many small meals) may impact the pernicious effect of excess Cys. Thus, food-deprived chicks were oral-gavaged with distilled water or a water solution providing 600 mg Cys (4.0 g/kg BW) in a bolus dose. On average, control chicks gained 21 g BW and consumed 56 g of diet during the 24-h post-intubation period, and no mortality occurred. In stark contrast, chicks gavaged with 600 mg Cys lost 28 g BW and consumed only 1 g of diet, and 83% of these chicks died (10 of 12 total) during the 24-h observation period. Collectively, these data highlight the unique phenomenon of dietary Cys toxicity, a finding potentially important for humans where over-the-counter Cys supplements are freely available without regulatory control.

**Key Words:** Cysteine, Toxicity, Chick

**100 Digestibility and availability of the creatine source guanidino acetic acid in broilers.** A. Lemme\*<sup>1</sup>, J. Tossenberger<sup>2</sup>, and J. Ringel<sup>1</sup>, <sup>1</sup>*Degussa GmbH - Feed Additives, Hanau, Germany*, <sup>2</sup>*University of Kaposvár, Kaposvár, Hungary*.

Creatine plays a central role in the cell energy metabolism and is considered semi-essential. Exogenous supplementation might be meaningful under certain conditions. In this context guanidino acetic acid (GAA, CreAmino™), which is a natural precursor of creatine in the metabolism, is a suitable feed additive. Knowledge on the metabolism of supplemental GAA is scarce and therefore an experiment with 24 fistulated male broilers (cannula fitted in colon) was conducted in order to investigate the digestibility and availability of supplemental GAA. A basal corn-soybean meal based diet was added with either no (CON), 0.06 % (recommended, T-B), or 0.60 % (overdose, T-C) GAA. Diets were offered for free consumption to 8 birds per treatment from 34-42 days of age. Feed intake was recorded and feces and urine were quantitatively collected twice a day from day 38-42. Samples of the four days were pooled per bird. All samples (feed, feces, urine) were analyzed for GAA, creatine, and creatinine, the latter being the excretion product of creatine. Subsequently, digestibility and utilization of digested GAA were calculated. No GAA was found in the basal diet while analytical results of the experimental diets confirmed the expected values. GAA excretion in feces was small in all treatments ( $p > 0.05$ ) resulting in true fecal digestibilities of 99.4 % and 98.9 % in T-B and T-C, respectively, suggesting a complete absorption. GAA, creatine, and creatinine were found in urine from CON birds as a result of de-novo synthesis. Consequently, utilization of the digested supplemental GAA was calculated by difference. Due to the fact that creatine and creatinine are derived from GAA, not only GAA, but also enhanced creatine and creatinine excretions must be attributed to the GAA supplementation and were thus all included in the calculations. Urinary GAA, creatine, and creatinine excretion were enhanced in T-B ( $p > 0.05$ ) and were significantly higher in T-C ( $p < 0.05$ ) compared to that of CON. Consequently, utilization of digested GAA was 77.1 % in birds of T-B, but only 46.4 % in those of T-C suggesting an effective excretion mechanism in case of overdosing GAA.

**Key Words:** Guanidino Acetic Acid, Availability, Broiler

**101 Effect of amino acid formulation and synthetic amino acid supplementation on turkey tom performance.** T. Applegate\*<sup>1</sup>, W. Powers<sup>2</sup>, and R. Angel<sup>3</sup>, <sup>1</sup>*Purdue University, West Lafayette, IN*, <sup>2</sup>*Michigan State University, East Lansing*, <sup>3</sup>*University of Maryland, College Park*.

A two by two factorial experiment was conducted to determine whether diets formulated with either two (Lys and Met) or three (Lys, Met, and Thr) synthetic AA to 100% or 110% of NRC (1994) AA recommendations would affect performance of turkey toms. Diets were formulated with corn, soybean meal (SBM), and six percent meat and bone meal. Diets were formulated to maximize SBM inclusion when formulated with two synthetic AA thereby resulting in 2.0, 1.5, 1.4, and 1.0 %-units more CP than diets containing three synthetic AA at 4 to 8, 8 to 12, 12 to 16, and 16 to 20 wk of age, respectively. Each diet was fed to 12 replicate pens of birds with 10 birds per pen. Body weight, feed intake, and feed/gain was not affected by AA formulation or synthetic AA supplementation (average 20 wk BW = 20.7 kg). Similarly, the weight of the Pectoralis (P) major at 20 wk of age was not different between birds fed different diet regimens (left P. major = 1.88 kg; 9.13% of BW). Calculated nitrogen (N) intake were affected

by diet with birds fed 100% NRC AA consumed 139 g (7.05%) less N than those fed 110% NRC AA ( $P < 0.0001$ ). Similarly, birds fed three versus two synthetic AA consumed 146 g less feed N (7.4%) to 20 wk of age ( $P < 0.0001$ ). These data suggest that diets containing AA formulations above NRC (1994) recommendations do not provide any additional performance or P. major yield benefits. In addition, formulation with three synthetic AA results in a considerable reduction in N consumed.

**Key Words:** Amino Acid, Crude Protein, Turkey Tom

**102 Increased dietary balanced protein levels at varying length of application during the starter period of broilers.** A. Lemme\*<sup>1</sup>, M. G. T. Janssen<sup>2</sup>, P. J. A. Wjitten<sup>2</sup>, J. K. W. M. Sparla<sup>2</sup>, and M. S. Redshaw<sup>1</sup>, <sup>1</sup>*Degussa GmbH - Feed Additives, Hanau, Germany*, <sup>2</sup>*Provimi B. V., Rotterdam, The Netherlands*.

Amino acid supply during early stage of life is supposed to have a strong impact on the development of broilers. Question about the optimum level of dietary balanced protein and the optimum duration of supply was raised. Therefore, experimental corn-wheat-soybean meal based diets with graded levels of balanced protein (BP) corresponding to 11.0 (control), 12.6, 14.2, 15.7, and 17.3 g true fecal digestible lysine per kg feed were produced. Amino acid profiles were kept identical in all diets. While the control was fed from day 1 through day 14, diets with higher BP were fed from day 1 either for two, four, eight, or twelve days of life (4x4). A total of 1728 male Ross 308 broilers were equally assigned to the 17 treatments comprising either eight (control) or four cages with 24 birds each. After feeding the experimental pelleted diets, dietary BP was reduced to the control level (11.0 g dig. Lys/kg) in two steps (2-day transition period) in order to avoid too strong changes in amino acid supply especially in the treatments with higher BP supply. At 14 days of age weight gain and feed conversion were significantly improved by increasing BP levels (both  $p < 0.05$ ). This non-linear effect was most pronounced when feeding the diets over 12 days (gain: numerically; FCR: interaction  $p < 0.05$ ) suggesting optimum performance at 15.7 g dig. Lys. At day 14 two birds per pen were selected for dissection. Weight and length of the empty small intestine were determined. Prolonging the length of feeding the experimental diets containing 12.6 g dig. Lys/kg and more from 2 to 12 days significantly increased the weight of the duodenum and jejunum (% of body weight,  $p < 0.05$ ) whilst dietary BP itself had no effect. However, small intestine weight of the control treatment was similar compared with that of birds receiving the experimental diets for 8 and 12 days.

**Key Words:** Balanced Protein, Broiler, Phase Length

**103 Response of vaccinated starting broilers to the inclusion of NEAA as gelatin to high and low CP feed while maintaining EAA requirements.** R. Lehman\* and E. T. Moran, *Auburn University, Auburn, AL*.

Vaccination for coccidiosis is now common as producers remove antibiotics from broiler feeds. Because of the extensive use of NEAA for mucin formation, the use of low CP may exacerbate vaccination response during the first three weeks. Inclusion of NEAA, particularly glycine and proline, as gelatin was evaluated for any recuperative advantage when vaccinated and non-vaccinated birds received high

and low CP diets. Ross X 708 chicks (1280; 64 pens) were sexed; half were vaccinated with Coccivac-D, and placed in floor pens while the other half received Salinomycin. Two low CP corn-soybean meal diets (21% CP and 21% CP containing 2% gelatin) and two high CP diets (23% CP and 23% CP containing 2% gelatin) were fed. Birds that were vaccinated had significantly lower body weight gain ( $P < .001$ ) and higher feed conversion ( $P < .001$ ) compared to those that were not vaccinated. However, vaccinated birds with gelatin in their diets had a greater BW gain ( $P < .05$ ) and lower feed conversion ( $P < .01$ ) than vaccinated birds with no gelatin in their diets. Gelatin present in diets increased BW gain ( $P < .05$ ) and greatly lowered feed conversion ( $P < .001$ ). The growth performance of the broilers was not affected by the amount of crude protein in the diet. The presence of gelatin in diets of vaccinated broilers appears to aid in BW gain and feed conversion during the first three weeks.

**Key Words:** Crude Protein, Coccidiosis, NEAA

**104 Evaluation of isoleucine and valine limitation in diets for heavy high-yield broilers.** A. Corzo<sup>\*1</sup>, M. T. Kidd<sup>1</sup>, J. Collier<sup>1</sup>, W. A. Dozier, III<sup>2</sup>, and D. Hoehler<sup>3</sup>, <sup>1</sup>Mississippi State University, Mississippi State, <sup>2</sup>USDA-ARS, Mississippi State, MS, <sup>3</sup>Degussa Corporation, Kennesaw, GA.

Two studies were conducted from 35 to 54 d of age using Ross × Ross 708 males. The first study was composed of three dietary treatments designed to evaluate the impact on performance of broilers when neglecting the Val and Ile nutrient minimums during formulation:

a control diet formulated to meet or exceed all critical amino acid needs (0.80% dig Val and 0.71% dig Ile); a diet formulated to meet the minimum needs of all critical amino acids and allowing L-Thr to enter formulation (0.74% dig Val and 0.65% dig Ile); a third diet with no nutrient minimum given to dietary Val and Ile (0.67% and 0.58% dig, respectively). All treatments contained eight replicate pens (12 broilers/pen). The second study was a factorial design with three Ile (61, 64.5 and 68) and three Val (70, 74 and 78) ratios to Lys, for a total of nine treatments, each containing eight replicate pens (12 broilers/pen). Data was analyzed for two-way interactions first, and then main effects. In the first study, feed conversion was minimized ( $P < 0.05$ ) with the control diet when compared to the Val/Ile deficient diet, while the second diet had an intermediate value. The same statistical response was observed when expressing BWG as a function of feed cost. The Val/Ile deficient diet was economically less profitable ( $P = 0.06$ ) than the control diet, while the second diet had an intermediate value. The data from the second study showed that no two-way interactions were observed. A main effect for Ile was observed on BWG, where an increase ( $P = 0.06$ ) in the weight gain was observed as the Ile level increased in the diet. Feed conversion values showed that the Ile/Lys ratio of 61% was poorer ( $P < 0.01$ ) when compared to the other two treatments. No Val main effect was observed for live performance. No main effects for either Val or Ile were observed for carcass traits. It was shown how neglecting critical amino acid needs beyond Thr can be detrimental to performance and profitability. It can also be said that during latter phases critical amino acid needs can be met via feed consumption making it difficult to comprehend the limitation of critical amino acids.

**Key Words:** Broiler, Isoleucine, Valine

## Nonruminant Nutrition: Swine Mineral Nutrition and Metabolism

**105 Dietary selenium regulation of the rat liver and kidney selenoproteomes.** K. M. Hargrave<sup>\*</sup>, J. K. Evenson, A. M. Rotherth, and R. A. Sunde, *University of Wisconsin, Madison.*

The rodent selenoproteome consists of 24 selenoproteins. Using microarray analysis, we have identified 8 liver and 5 kidney selenoprotein mRNAs, including glutathione peroxidase-1 (GPX1), that were significantly down-regulated in mice fed a selenium (Se)-deficient diet. Our current objective is to identify the rat liver and kidney selenoproteins expressed, and regulated by dietary Se. We conducted 2 studies; in Study 1, male rats were fed a torula yeast based diet deficient in Se, or containing 0.02, 0.05, 0.075, 0.1, 0.15, 0.2, or 0.3 µg Se/g diet for 28 d following weaning. Total liver and kidney RNA from 3 rats per diet were analyzed by quantitative real-time RT-PCR for the mRNA abundance of the selenoproteins regulated in the mouse. Study 2 was conducted with the addition of diets containing 0.5 and 1.0 µg Se/g diet. Se status of these animals was determined by plasma GPX3 and red blood cell GPX1 activities. In Study 1, rat liver GPX1, Selenoprotein (Sel) H, and SelW were highly down-regulated ( $P < 0.001$ ) by dietary Se, similar to the mouse. In each case, mRNA abundance neared a plateau by 0.075 µg Se/g diet. Furthermore, rat SelK, SelP, and Thioredoxin Reductase-1 (TR1) were moderately and significantly ( $P < 0.01$ ) regulated, whereas, GPX4, SelM, and TR2 were not. In the kidney, GPX1 was highly ( $P < 0.05$ ) and SelW moderately ( $P < 0.05$ ) down-regulated by dietary Se. Unlike in the mouse, kidney SelH, SelM, and GPX3 were not regulated, similar to GPX4. In Study 2, plasma GPX3 and red blood cell GPX1 activities

in Se-deficient rats were dramatically down-regulated ( $P < 0.001$ ) compared to Se-adequate levels. In summary, GPX1 mRNA, when assayed by RT-PCR, as well as activity are decreased dramatically in Se-deficient rats, indicating that this is a good model in which to test mRNA regulation of the complete selenoproteome. No selenoprotein tested thus far has exhibited a pattern of regulation different or more dramatic than for GPX1. In the rat model, however, there appears to be fewer selenoproteins under significant dietary Se regulation than previously observed in the mouse (6 vs 8 in the liver and 3 vs 5 in the kidney).

**Key Words:** Selenium, mRNA Expression, Rat

**106 Copper can be absorbed as a Cu-peptide chelate through the PepT1 transporter in the jejunum of weanling pigs.** B. E. Aldridge<sup>\*</sup>, K. L. Saddoris, and J. S. Radcliffe, *Purdue University, West Lafayette, IN.*

Jejunal tissue was harvested from eighty-four pigs on d 6,8,10 or 14 post-weaning and mounted in modified Ussing chambers to investigate the route of Cu absorption from Bioplex<sup>®</sup> Cu and CuSO<sub>4</sub>. Tissues were challenged in a 2 x 2 factorial arrangement with two Cu sources (Bioplex<sup>®</sup> Cu and CuSO<sub>4</sub>) with and without an inhibitor (valacyclovir) of the di- and tri-peptide transporter, PepT1. Active ion transport was measured by changes in short circuit current (I<sub>sc</sub>) following the