

**ABSTRACTS**  
**Wednesday, July 28, 2004**

**POSTER PRESENTATIONS**

\* Author Presenting Paper

**PSA - Nutrition II**

**W1 Gluconeogenesis and Krebs Cycle metabolism in 2-day-old fed and fasted chicks.** N. E. Sunny\*, S. W. El-Kadi, M. Oba, S. L. Owens, R. Angel, and B. J. Bequette, *University of Maryland, College Park*.

Neonatal chicks rapidly adapt their metabolism from the nutrient environment in ovo to exogenous feed at hatch. Our aim was to profile evolution of metabolism and gluconeogenesis by 2-d-old chicks (45 g), and to determine the influence of a 48-h starvation on this metabolism. Broiler hatchlings were assigned to Fed (n=5) or Starved (n=7) groups. Fed (1.5 g/d) chicks were given by gavage (3×/d) a solution (1.5 ml) containing 65% dextrose (43% as [U-<sup>13</sup>C]glucose), 24% casein, 3% soy oil and a mineral-vitamin mix. Starved chicks were dosed (1.5 ml, 3×/d) with water containing [U-<sup>13</sup>C]glucose (50 mg/dose). After 48 h, chicks were killed and plasma collected. Gluconeogenesis and Krebs cycle metabolism were determined from <sup>13</sup>C-mass isotopomer distribution analysis and isotope dilution of plasma glucose, aspartate (oxaloacetate, OAA) and glutamate (α-ketoglutarate, α-KG), and liver free alanine (3-carbon pool). Rates of gluconeogenesis plus glycogenolysis (112 g glucose/kg BW/d) did not differ, but these accounted for less (P<0.0001) of total glucose entry in Fed than in Starved chicks (82 vs. 96%). Irrespective of feeding regime, glucose carbon recycling accounted for 80% of gluconeogenesis. Glucose metabolized by the Krebs cycle was similar for Fed and Fasted chicks with 26% of acetyl CoA and 6% of OAA flux derived from glucose. Thus, >70% of Krebs metabolism via acetyl-CoA and maintenance of anaplerotic reactions at OAA and α-KG required catabolism of amino acids and lipids. A greater (P<0.001) proportion of glutamate synthesis derived from glucose in Fed (41%) than in Starved (23%) chicks. Proline synthesis from glutamate was 16% for Fed and 22% for Starved chicks. For Fed chicks, the balance (84%) must derive from dietary proline. These data suggest that glucose is not the major substrate for energy metabolism in neonatal chicks. Thus, new criteria may be needed to define protein quality for neonatal chicks that considers requirements for protein synthesis and for energy metabolism.

**Key Words:** Poultry, Amino Acids, Gluconeogenesis

**W2 Effect of decreasing levels of protein in the diet on growth performance of Japanese quail fed fattening diets.** R. Barajas\*, J. J. Lomeli, J. F. Obregon, and J. J. Portillo, *FMVZ - Universidad Autonoma de Sinaloa, Carr. Culiacan - Mazatlan*.

With the objective of determine the effect of decreasing levels of protein in the diet on growth performance of Japanese quail fed fattening diets, a four week feeding experiment was performed. Six hundred Japanese quail one day old were used. They were randomly divided in 12 groups of 50 animals; each group was placed in elevated metal wire cages (0.9 x 0.9 x 0.5 m). In agreement with a complete randomized experiment design, three feeding programs treatments were assigned: 1) Diet with 24 % of CP (2.92 Mcal ME/kg) during the four weeks (Control); 2) Diet with 24 % CP during the first two weeks, and with 21% CP the last two weeks; and 3) Diet with 28 % CP in the first week, 24 % CP in the second, and with 21 % CP the last two weeks. Food and fresh clean drinking water were free access available. Crude protein levels effect were compared by orthogonal contrasts. Ending body weight (198 ± 2.1 g) was not affected (#8805 0.35) by treatments. In week 3 average weekly weight gain was lower (P= 0.03) with 21 % CP than 24 % CP. Body weight gain of experiment (179.5 ± 3.74 g) was not modified (P= 0.24) by treatments. Food intake was not altered (P= 0.08) by feeding programs. Feed efficiency (gain/feed ratio) during first week was better (P=0.03) with 28 % CP diets than 24 % CP diets (0.748 vs. 0.799 g gain/g food). Feed efficiency of experiment (0.395 ± 0.01 g/g) was similar (P= 0.94) for all treatments. Carcass weight was not affected (P=0.56) by treatments (119.3 ± 2.57 g). Carcass dressing was equal (P= 0.10) across treatments (59.7 ± 0.58 %). These results suggest, that is possible feeding Japanese quail during the last two weeks of fattening period with diets containing 21 % of crude protein without demerits of its growth performance response.

**Key Words:** Growth Performance, Protein Level, Coturnix Coturnix Japonica

**W3 2-Hydroxy-4-(methylthio) butanoic acid (HMTBA) and DL-methionine yield equal growth and carcass performance under Thailand tropical conditions.** S. Attamangkune\*<sup>1</sup> and S. Chamrusspollert\*<sup>2</sup>, <sup>1</sup>*Poultry Research and Development Center, Kasetsart University, Thailand*, <sup>2</sup>*Novus International Co.,Ltd, Thailand*.

Two trials compared the performance and carcass quality of broilers fed HMTBA (Alimet(r) feed supplement, Novus International, Inc.) or DLM (dry 99%) as methionine (M) sources in corn-SBM diets. Tropical conditions predominated in both studies with average temperature and relative humidity values of 31 °C and 70%, respectively. In Trial 1, d-old, male and female Ross x Ross chicks were assigned to three dietary treatments consisting of 14 replications of 50 birds each. Basal diets reflected Thai commercial conditions and met the requirements of all nutrients except for total sulfur amino acids (TSAA). TSAA levels were 0.72, 0.67, and 0.62% for the starter (1-21d), grower (22-42d), and finisher (43-49d) diets, respectively. Basal diets were supplemented with HMTBA or DLM equimolar meeting TSAA requirements at 0.92, 0.85, and 0.80% for the starter, grower, and finisher periods, respectively. Birds responded to M addition by improving weight gain and FCR at all times ( $P < 0.05$ ), indicating diets were deficient in TSAA. Performance parameters were similar between M sources at all times ( $P > 0.10$ ) however, there was a trend for higher mortality in the DLM treatments during the finisher period (1.26 vs. 0.66 and 0.18% for birds fed DLM, HMTBA and the control diets, respectively). At 49d, the body weight gain and FCR observed were 2393 and 2387g; and 2.02 and 2.02, for birds fed HMTBA and DLM, respectively. Trial 2 comprised 8 replicates of 50 birds each, fed equimolar HMTBA or DLM added at 100 or 105% of TSAA commercial levels. Weight gain and FCR improved by the addition on M sources ( $P > 0.05$ ). No differences in performance and carcass quality were found between M sources ( $P > 0.10$ ). To conclude, performance and carcass quality data confirm that HMTBA and DLM are equivalent as M sources when fed to broilers under tropical Thai commercial conditions.

**Key Words:** Tropical Conditions, 2-hydroxy-4-(methylthio) Butanoic Acid, Broilers

**W4 Dietary glycine needs of broiler chicks.** A. Corzo\*<sup>1</sup>, M. T. Kidd<sup>1</sup>, D. J. Burnham<sup>2</sup>, S. L. Branton<sup>3</sup>, and B. J. Kerr<sup>3</sup>, <sup>1</sup>*Mississippi State University, Mississippi State*, <sup>2</sup>*Ajinomoto-Heartland*, <sup>3</sup>*United States Department of Agriculture*.

Research delineating Gly needs for broilers is sparse. Dietary Gly might become a limiting factor in all-vegetable diets fed to broiler chicks when CP is low. A study was conducted to evaluate dietary Gly needs in broiler chicks from 7 to 20 d of age. Ross 508 male chicks were placed in 32 floor pens (15 chicks/pen; 5 pens/trt) of a closed-curtain sided house. Chicks were fed a common pre-starter corn-soybean meal based diet (3100 kcal ME/kg; 23.1% CP; 1.32% Lys) from 1 to 7 d of age, and then fed a titration diet that contained progressive amounts of 0.12% dietary Gly ranging from 0.62% (1.40% Gly+Ser) to 1.22% (2.00% Gly+Ser) from 7 to 20 d of age. Experimental diets were accomplished by supplementing Gly at the expense of a filler. Using regression analysis (95% of minimum or maximum response) it was determined that chicks optimized BW gain and feed conversion at 0.98% (1.76% Gly+Ser) and 1.02% (1.80% Gly+Ser) dietary Gly, respectively. Blood plasma free threonine and serine were unaffected by Gly supplementation, but plasma Gly linearly increased. Dietary Gly may need to be considered as a limiting nutrient in the young chick, especially if CP is low and only vegetable ingredients are used. Present results also suggest that current NRC (1994) recommendations for Gly+Ser of 1.25% may be low.

**Key Words:** Glycine, Threonine, Plasma amino acids

**W5 Effect of chromium methionine supplementation on internal egg quality preservation in Japanese quail.** F.G. Rios\*, C. Angulo, G. Contreras, and J.J. Portillo, *FMVZ - Universidad Autonoma de Sinaloa (Mexico), Carr. Culiacan-Mazatlan*.

To determinate the effect of chromium methionine supplementation on internal egg quality preservation in Japanese quail, were used 680 eggs from 320 Japanese quail (240 females and 80 males), and allocated in two batteries, each battery containing with five levels, each level with 4 metal wire cages, and each cage with six females and two males. In

agreement of a complete randomised block design experiment, the animals were assigned to receive one of two treatments: 1) Diet with 21 % of CP and 2,900 kcal of ME/kg (control); and 2) Diet control but supplemented with 100 ppb of Cr from Cr-Met. 170 eggs from every treatment were collected and packed in vinyl film and stored to 4 ° C, and other 340 eggs stored to environment at 33 ° C. To 0, 3, 6, 9 and 12 d of storage time were measurement weight, dense albumin height, yolk height, width and yolk color ( $L^*a^*b^*$ ). From this data Haugh Units and Yolk index, were calculated. Haugh Units and Yolk index were affected ( $P < 0.01$ ) by day collection, environment preservation and storage time, but not was affected by treatment ( $P > 0.10$ ).  $L^*$  was affected ( $P < 0.01$ ) by environment preservation and storage time, but not was affected ( $P > 0.05$ ) by day collection and treatment;  $a^*$  was affected ( $P < 0.01$ ) by collection and environment preservation, but not by storage time and treatment ( $P > 0.05$ );  $b^*$  was affected ( $P < 0.01$ ) by day collection, environment preservation and storage time, but not treatment ( $P > 0.05$ ). It is concluded, than supplementation of 100 ppb of Cr, as source chromium methionine, not delayed damage the internal egg quality in Japanese quail.

**Key Words:** Chromium, Egg Quality, Coturnix Coturnix Japonica

**W6 Breeder hen and broiler dietary carnitine: Carry-over and dietary effects on progeny growth and carcass traits.** M. T. Kidd\*<sup>1</sup>, C. D. McDaniel<sup>1</sup>, E. D. Peebles<sup>1</sup>, S. J. Barber<sup>1</sup>, A. Corzo<sup>1</sup>, S. L. Branton<sup>2</sup>, and J. C. Woodworth<sup>3</sup>, <sup>1</sup>*Mississippi State University, Mississippi State*, <sup>2</sup>*United States Department of Agriculture*, <sup>3</sup>*Lonza Inc*.

L-carnitine is involved in energy metabolism and membrane function: specifically that of long-chain fatty acid transfer into mitochondria and subsequent oxidation. Although Lys and Met are its precursors for in vivo synthesis, its content in grains, of which constitute a large portion of poultry diets, is thought to be limited. Ross 308 breeder hens were fed (beginning at 21 wk) test diets (0 or 25 mg L-carnitine/kg of diet), and progeny (via insemination with Ross males) were evaluated at 30, 35, and 37 wk of age representing Experiments (Exp)1, 2, and 3, respectively. Breeder pen was progeny experimental unit. All progeny were feather sexed at hatch. In Exp 1, chicks were placed in batteries (d 1 to 35) and treatments (16 replications with two subplots each) consisted of hen diet and progeny gender. In Exp 2, chicks were placed in floor pens (d 1 to 42) and treatments (16 replications with four subplots each) consisted of hen diet, progeny gender, and progeny diet (0 or 50 mg L-carnitine/kg of diet). In Exp 3, chicks were placed in floor pens equally by gender (d 1 to 42) and treatments (16 replications with two subplots each) consisted of hen diet and progeny diets (high or low nutrient density). Live performance and carcass traits were measured. Females had less ( $P < 0.05$ ) BW gain and breast meat, but more ( $P < 0.05$ ) abdominal fat and breast yield than males in Exp 1 and 2. Hen diet did not affect live performance, but hens supplemented with L-carnitine had progeny with reduced ( $P < 0.05$ ) abdominal fat in Exp 3. Increasing nutrient density increased ( $P < 0.05$ ) BW gain and carcass weights in Exp 3. Dietary L-carnitine (hen and progeny) increased ( $P < 0.05$ ) male mortality. Additional interactive results indicated that L-carnitine in the hen diet decreased ( $P = 0.07$ ) carcass fat and increased ( $P = 0.10$ ) breast meat in the presence of high nutrient density. In conclusion, dietary hen L-carnitine impacted carcass traits of progeny.

**Key Words:** Broiler Breeder, L-Carnitine, Progeny

**W7 Methionine, cystine, phenylalanine, tyrosine, and non-essential AA maintenance requirements for broiler breeders.** J. M. Sun<sup>1</sup>, M. Debeer\*<sup>1</sup>, N. K. Sakomura<sup>2</sup>, and C. N. Coon<sup>1</sup>, <sup>1</sup>*University of Arkansas, Fayetteville*, <sup>2</sup>*Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil*.

Two hundred and fifty 22 week old Cobb-Vantress broiler breeders were used to determine the maintenance requirement and efficiency of utilization of dietary digestible methionine, cystine, phenylalanine, tyrosine and non-essential AA in a 21 day experiment. The breeders were given crystalline amino acid diets containing graded levels of methionine, cystine, phenylalanine, or tyrosine representing 0, 10, 20, 30, 40% of their suggested requirement level (NRC, 1994) with all other amino acids maintained at 40% of their suggested requirement level. Non-essential AA maintenance requirements was determined with graded levels of glutamic acid to provide 12, 19, 26, 33, 40% of suggested CP

requirement (NRC, 1994) with all other amino acids maintained at the previously determined maintenance requirement level (Sakomura et al, 2003). The slope of methionine, cystine, phenylalanine, tyrosine, and CP accretion regression line indicated that 46% methionine, 29% cystine, 56% phenylalanine, 21% tyrosine, and 9% non-essential AA were retained. The digestible methionine, cystine, phenylalanine, tyrosine and non-essential AA requirements for zero protein accretion (maintenance) were calculated to be 101.8 mg/d, 55.3mg/kgBW.75/d or 200.2mg/kgCP/d; 30.5 mg/d, 17.0mg/kgBW.75/d or 75.4mg/kgCP/d; 229.6 mg/d, 111.7mg/kgBW.75/d or 414.4mg/kgCP/d; 65.9 mg/d, 37.2mg/kgBW.75/d or 175.6mg/kgCP/d; and 3715.2 mg/d, 2003.2mg/kgBW.75./d or 9453.0mg/kgCP/d, respectively. The net requirements of digestible methionine, cystine, phenylalanine, tyrosine and non-essential AA for protein accretion were calculated by applying a constant of specific AA in tissue protein content (10.56 mg methionine, 19.2 mg cystine, 14.28 mg phenylalanine, 24.8 mg tyrosine, 452.6 mg CP per gram of protein) and the utilization coefficient of 0.46, 0.29, 0.56, 0.21, and 0.09 resulting in the requirement of 22.96 mg of digestible methionine, 66.2 mg of digestible cystine, 25.5 mg of digestible phenylalanine, 118.1 mg of digestible tyrosine, and 5028.89 mg of digestible non-essential AA per gram of body protein accretion.

**Key Words:** Amino Acids, Maintenance Requirement, Broiler Breeder

**W8 Comparison of methionine requirements between an alternative slow-growing genotype and a commercial genotype during the starter period.** A. C. Fanatico\*, P. B. Pillai, and J. L. Emmert, *University of Arkansas, Fayetteville.*

Slow-growing genotypes may be utilized in organic or natural production systems, and it is important to assess their amino acid requirements to allow more accurate and appropriate dietary formulation. Because these birds are less heavily muscled, it is theorized that their MET requirement is lower, potentially increasing their suitability for outdoor production systems where diets are not generally optimized. Further, supplemental MET is being phased out of the USDAs National Organic Program, increasing the need for understanding MET requirements. The objective of this experiment was to assess the MET requirement of slow-growing broilers, and to examine the efficacy of HMB in this alternative genotype. A MET-deficient corn-peanut meat basal diet was formulated to contain excess cysteine (CYS), and eight graded levels of DL-Met (0, 0.035, 0.070, 0.105, 0.140, 0.175, 0.210, 0.245%) were added to the basal diet and fed to two genotypes: slow-growing (S) and fast-growing (F). Each of the sixteen dietary treatments was fed to five replicate pens (containing five male chicks) from 8-21 days of age. In addition, two levels of MET (0.04, 0.08%) from HMB were fed to the S genotype. There was a linear response ( $P < 0.05$ ) of gain and feed efficiency to incremental additions of MET below requirements. Using broken-line analysis, weight gain data revealed a digestible MET requirement of 0.30% for the S broilers, and 0.32% for the F broilers. Using slope-ratio methodology, in which weight was regressed versus supplemental MET source intake, HMB was found to be 55.2% as efficacious as DL-Met on a weight basis and 62.7% on a molar basis ( $P < 0.05$ ), which is less than values previously observed in fast-growing commercial broilers fed a diet containing excess CYS. These data suggest that this slow-growing genotype has a MET requirement slightly below that of commercial broilers, and may use HMB less efficiently than commercial broilers.

**Key Words:** Organic, Methionine, Slow-Growing

**W9 Effect of tap water taurine supplementation upon mortality rate by PHS; ascites, body weight and haematocrit in broiler chickens in northern Mexico.** N. E. Dominguez-Avila\*<sup>1</sup>, R. Rodriguez-Martinez<sup>1</sup>, M. Arenas-Vargas<sup>2</sup>, R. Villegas-Vizcaino<sup>1</sup>, J. H. Del Rio-Martinez<sup>1</sup>, F. Sanchez y Garcia Figueroa<sup>2</sup>, and R. Bañuelos-Valenzuela<sup>3</sup>, <sup>1</sup>Universidad Autonoma Agraria Antonio Narro Unidad Laguna Periferico y Carretera a Santa Fe, <sup>2</sup>Universidad Autonoma Metropolitana Unidad Xochimilco Mexico, D.F., <sup>3</sup>Unidad Academica de Medicina Veterinaria y Zootecnia, UAZ El Cordobel, Enrique Estrada, Zacatecas, Mexico.

Previous studies have suggested the taurine role in response to hypoxemia (low blood oxygen levels) during the pathogenesis of pulmonary hypertension syndrome (PHS; ascites), because has been proposed that cardiac taurine depletion serves to defend the heart against injury caused by regional ischemia in mammals. However, The role of taurine has not

been well documented in broilers, particularly in relation to PHS; ascites. In the present study, 500 male broiler chickens were provided tap water (control group -CON- n=250), and tap water supplemented with taurine (taurine group -TAU- 0.013% n=250) to determine the effect of taurine supplementation on tap water upon the mortality rate by PHS; ascites, body weight and haematocrit in broilers in Northern Mexico (25° NL 103° WL and 1120 masl) reared under natural conditions during the winter season. Chickens from both groups were fed according with NRC requirements and housed in two different places in the same pen. Body weight was recorded in 15, 22, 29, 36 and 41 experimental days and carcass weight and hematocrit were measured in 41 day when chicken was killed, and PHS, ascites mortality was recorded throughout the experimental period. Haematocrit, body weight were evaluated by GLM procedure and LSD test, and mortality rate by PHS ascites was evaluated by  $\chi^2$ . Neither body weight nor Hematocrit were affected by treatment ( $P > 0.05$ ) (Table 1), but we found a statistical difference ( $P < 0.05$ ) between treatments respect to mortality rate by PHS; ascites (10.1 in CON group vs 7.2 in TAU group). These findings suggest that taurine plays an important role in the PHS; ascites prevention in broiler chickens under winter natural conditions in Northern Mexico, because the low mortality rate by PHS; ascites although we do not differences in haematocrit, one of the most reliable indicators for this syndrome. More trial to identify in a wide way the possibilities to use this amino acid in broiles chicken industry are needed.

Means of mortality rate (MR), haematocrit and body weight (BW) at 15, 22, 29, 36 and 41days in poultry chickens with tap water (CON n=250) and tap water and taruine at 0.13% (TAU n=250)

Treatment	MR	Haematocrit	BW15	BW22	BW29	BW36	BW41
CON	10.1 <sup>a</sup>	42.0 <sup>a</sup>	413 <sup>a</sup>	792 <sup>a</sup>	1210 <sup>a</sup>	1780 <sup>a</sup>	2100 <sup>a</sup>
TAU	7.2 <sup>b</sup>	39.3 <sup>a</sup>	413 <sup>a</sup>	794 <sup>a</sup>	1220 <sup>a</sup>	1750 <sup>a</sup>	2170 <sup>a</sup>

<sup>a,b</sup>Means within columns with different superscript differ significantly ( $P < 0.05$ )

**Key Words:** PHS; Ascites, Taurine, Broilers

**W10 Broiler performance and carcass parameters of broiler fed diets containing lysine maize.** M. L. Taylor\*<sup>1</sup>, B. George<sup>2</sup>, Y. Hyun<sup>1</sup>, M. A. Nemeth<sup>1</sup>, K. Karunanandaa<sup>1</sup>, T. T. Lohmann<sup>3</sup>, and G. F. Hartnell<sup>1</sup>, <sup>1</sup>Monsanto, Co., LLC, St. Louis, MO, <sup>2</sup>Colorado Quality Research, Inc., Wellington, <sup>3</sup>Reussen, LLC, Bannockburn, IL.

Modern agricultural biotechnology holds great promise for meeting animal feed needs for crops that are deficient in certain essential nutrients. Two Lysine maize (LM) events called LY038 and LY049 express a lysine feedback insensitive version of dihydrodipicolinate synthase (cDHDPs) predominantly in the germ of corn kernels, resulting in accumulation of free lysine in the grain. Two 42-day broiler feeding studies using Cobb 500 male broilers were undertaken to compare the feeding value of corn hybrids containing these LM events compared to the feeding value of their respective near isogenic conventional counterparts and several conventional commercial corn hybrids. LM diets and control diets that were supplemented with crystalline lysine were formulated to have all essential nutrients except lysine above their dietary requirements so that birds would be growth responsive to changes in dietary lysine quantity and availability. Unsupplemented lysine diets were formulated to be approximately 0.08% lower in total lysine than the supplemented diets that were targeted to contain 1.06 % and 0.90% total lysine on an "as-fed" basis for the starter (0-21 days) and grower/finisher (day 21 to study end) phases, respectively. A randomized complete block design was used in the study consisting of 14 treatments that were assigned randomly to pens within 10 blocks of 14 pens each (10 males/pen). Gain, FE, and carcass yield observed with broilers fed diets containing LM were not statistically different ( $P > 0.05$ ) from broilers fed crystalline lysine supplemented diets and were superior ( $P < 0.05$ ) to that of broilers fed diets with conventional maize and no supplemental lysine. Therefore, the bioefficacy of the increased levels of lysine in grain from corn hybrids containing both LM events was not different from that of diets composed of conventional corn supplemented with crystalline lysine.

**Key Words:** Maize, Broilers, Lysine

**W11 Effect of protein level and dietary germanium Biotite(Biotite V<sup>®</sup>) on egg production, egg quality and fecal volatile fatty acid in laying hens.** W. B. Lee\*<sup>1</sup>, O. S. Kwon<sup>1</sup>, B. J. Min<sup>1</sup>, K. S. Son<sup>1</sup>, J. W. Hong<sup>1</sup>, Y. K. Han<sup>2</sup>, I. H. Kim<sup>1</sup>, and Y. K. Jung<sup>3</sup>, <sup>1</sup>Department of Animal Resource & Science, Dankook University, Cheonan, Korea, <sup>2</sup>Livestock Research Institute, National Agricultural Cooperatives Federation Korea, <sup>3</sup>Seobong BioBestech Co., Ltd, Seoul, Korea.

This study conducted to investigate the effect of dietary germanium biotite(Biotite V<sup>®</sup>) by protein level in laying hen diets. One hundred forty four, 51 weeks old ISA brown commercial layer, were used in experiment. Dietary treatments were 1) low protein diet(LPD), 2) high protein diet(HPD), 3) LPD-GB(LPD + 1.0% germanium biotite) and 4) HPD-GB(HPD + 1.0% germanium biotite). Hen-day egg production tended to be increased ( $P < 0.01$ ) as the concentration of protein in diets increased. Egg weight tended to decrease by supplementation germanium biotite in the diets( $P < 0.01$ ). Egg shell breaking strength was not influenced by germanium biotite supplementation( $P > 0.05$ ). Large band of egg was decreased as increasing of germanium biotite supplementation in the diets( $P < 0.02$ ). Sharp and middle band of egg were not influenced by germanium biotite supplementation. Egg yolk index tended to decrease as increasing of germanium biotite supplementation in the diets( $P < 0.01$ ). Fecal propionic acid( $P < 0.01$ ) and butyric acid( $P < 0.03$ ) were decreased as the concentration of germanium biotite in the diet was increased. Also, butyric acids increased( $P < 0.02$ ) as the concentration of protein in diets increased. Supplementation germanium biotite in the diet reduced the fecal acetic acid( $P < 0.01$ ). Fecal NH<sub>3</sub>-N of hens fed HPD-GB diet was decreased( $P < 0.05$ ) compared to that of LPD-GB diet. In conclusion, germanium biotite supplementation to layer diets can be reduced fecal volatile fatty acid components.

**Key Words:** Germanium Biotite, Egg Quality, Laying Hens

**W12 Interrelationship of threonine and glycine in growing broilers.** A. Corzo\*<sup>1</sup>, M. T. Kidd<sup>1</sup>, D. J. Burnham<sup>2</sup>, S. L. Branton<sup>3</sup>, and B. J. Kerr<sup>3</sup>, <sup>1</sup>Mississippi State University, Mississippi State, <sup>2</sup>Ajinomoto-Heartland, <sup>3</sup>United States Department of Agriculture.

Threonine has the capability of partially sparing Gly in chickens. However, there is little information regarding this interconversion and the impact it has on growing broilers. A study was conducted to evaluate possible Thr and Gly interactions in growing broilers. Day-old Ross 508 male chicks were placed into 30 floor pens of a curtain sided house (14 chicks/pen). Chicks were given a common corn-soybean meal starter diet (3100 kcal ME/kg; 23.0% CP) from 0 to 21 d of age. At 21 d of age, floor pens were equalized in bird number (12 broilers/pen). Birds were fed a corn-soybean meal basal diet (3150 kcal ME/kg; 18.2% CP) with two total Gly+Ser levels (1.55 vs 1.65% of diet) and three digestible Thr levels (0.57, 0.61, and 0.65% of diet) from 21 to 42 d of age. Dietary treatments were generated by the addition of crystalline Gly or L-Thr at the expense of a filler. Two-way interactions ( $P < 0.05$ ) were observed for BW gain where broilers fed the 1.55% Gly+Ser diet increased BW gain with Thr supplementation, while those fed 1.65% Gly+Ser were unaffected by dietary Thr. Similarly, whole carcass weight and yield increased ( $P < 0.05$ ) with Thr supplementation when broilers were fed 1.55% Gly+Ser, but not observed when Gly+Ser was incremented to 1.65%. In parallel with previous effects, total breast meat weight responded in a similar fashion ( $P < 0.05$ ), while its yield as well as percentage abdominal fat were unaffected by either Gly+Ser or Thr. Plasma free concentrations of Ser and Gly were increased ( $P < 0.01$ ) as Gly was supplemented, but Thr was unaffected by Gly. As expected, plasma free Thr only increased ( $P < 0.01$ ) with Thr supplementation. There appears to be an interrelationship between Gly+Ser and Thr, but practical implications are elusive at this point. Further research is warranted to clarify such effects.

**Key Words:** Glycine, Threonine, Plasma Amino Acids

**W13 Dietary spray-dried plasma protein improves feed utilization, BW uniformity, and breast-meat yield of broilers raised in a relatively unsanitary environment.** K. Bregendahl<sup>1</sup>, D. Ahn<sup>1</sup>, D. Trampel<sup>1</sup>, J. Campbell<sup>2</sup>, and J. Crenshaw\*<sup>2</sup>, <sup>1</sup>Iowa State University, Ames, <sup>2</sup>APC.

Two identical experiments (each with 480 1-d-old Ross × Ross 308 male broiler chicks) were conducted in series to evaluate effects of spray-dried plasma (SDP) on performance. Each of 40 floor pens (1.7m<sup>2</sup>, 12 chicks/pen) was assigned to a dietary treatment according to a randomized complete block design. Treatments consisted of 0.0, 0.5, 1.0, 1.5 and 2.0% dietary AP920 SDP in the starter phase (wk 1-2). The dietary SDP contents were halved in the grower phase (wk 3-4) and again in the finisher phase (wk 4-6). The corn-soy-based diets were isocaloric, met or exceeded NRC and pelleted. The dirty litter from Exp. 1 was reused in Exp. 2. The pen average daily BW gain (ADG), feed intake (FI) and feed utilization (GF) were evaluated weekly. Individual BW was recorded on d 41 and all broilers were processed on d 42 of age, after which BW uniformity (pen CV), dressing percentage (pct) and pct breast-meat were determined. Data were analyzed by ANOVA and treatment effects assessed by linear, cubic and quadratic contrasts. Mortality was lowest in Exp. 1 (5% vs. 12%), indicating a less sanitary environment in Exp. 2. SDP did not affect ADG, FI, GF or BW uniformity ( $P > 0.1$ ) in Exp. 1, although GF decreased quadratically ( $P < 0.05$ ) in the grower phase. SDP increased dressing pct linearly ( $P < 0.05$ ) by 1.2 points and decreased the pct breast-meat linearly ( $P < 0.05$ ) by 1.3 points. The decrease was attributed to person-to-person variability in the cut-up process, which was changed in Exp 2. In Exp. 2, SDP increased ADG quadratically ( $P < 0.05$ ) in the grower phase and overall, resulting in 3.7% higher end-BW. Overall FI increased quadratically ( $P < 0.05$ ), but GF was improved ( $P < 0.05$ ) in the starter (quadratic effect) and grower (linear effect) phases by 5.0 and 3.4%, respectively. SDP increased BW uniformity quadratically ( $P < 0.05$ ) by 4.2 points and increased the breast-meat pct cubically ( $P < 0.05$ ) by 0.5 points. Thus, SPD improved performance and breast-meat pct.

**Key Words:** Broilers, Spray-Dried Plasma, Growth

**W14 Comparison of biological efficacy of Alimet feed supplement and DL-methionine in broilers.** K. M. Chee\*<sup>1</sup>, J. H. Choi<sup>1</sup>, and M. K. Chung<sup>2</sup>, <sup>1</sup>College of Life Sciences and Biotechnology, Korea University, Seoul Korea, <sup>2</sup>Novus International Pte Ltd, Singapore.

Two methionine sources, Alimet feed supplement (Novus International, Inc.) and DL-methionine (DL-M), were added equimolar at two levels of supplementation to basal diets in order to estimate their relative bioefficacy in broilers. Added levels of Alimet or DL-M were 0.075 and 0.150% for the starter and 0.04 and 0.08% for the grower diets on dry weight basis, respectively. The higher supplemental levels were set to provide total sulfur-containing amino acids (TSAA) at requirements (NRC, 1994). Basal diets for starter and grower phases were deficient in TSAA and isocaloric (3,100 kcal AMEn/kg), containing 21 and 19% crude protein, and 0.67 and 0.62% TSAA, respectively. Diets were formulated in agreement with local commercial practice for broilers, and to provide other essential amino acids at a level at least 10% higher than recommended (NRC, 1994) when expressed as % of protein. Total 960, day-old, male and female (1:1) Ross broilers were allotted into four treatments with six replications each and 40 birds per pen. Overall bird performance during the starter phase (0-21 days) was not significantly different among dietary groups. However, during the grower phase (21-35 days) birds had higher weight gain ( $P < 0.05$ ) when fed either methionine source at 0.08% compared to those fed at 0.04%. Weight gain and feed/gain ratios were not different ( $P > 0.10$ ) at any time for any level of supplementation between birds fed Alimet or DL-M. Breast muscle and abdominal fat as % of body weight were not different among the treatments ( $P > 0.05$ ). Cumulative performance (0-35 days) followed the same pattern of that observed during the grower stage. In conclusion, based on growth performance and carcass quality data, the bioefficacy of Alimet was not different from that of DL-M for broilers when compared on dry weight basis.

**Key Words:** Comparative Bioefficacy, Alimet and DL-methionine, Broiler

**W15 AA requirements for broiler breeders at peak production.** J. M. Sun, M. Debeer\*, K. Bramwell, and C. N. Coon, *University of Arkansas, Fayetteville.*

Four hundred and eighty 32 week old Cobb-Vantress broiler breeders with similar body weight ( $3714 \pm 172$ g) and all laying were selected to determine the production requirement of dietary digestible methionine, lysine, phenylalanine, isoleucine, arginine, and CP in a 42 day feeding study. The average hen day egg productions for the beginning and for the 6 weeks period were 80% and 70%, respectively. The breeders were given a corn-soy basal diet plus crystalline amino acids with 8 graded levels of methionine, lysine, phenylalanine, isoleucine, and arginine representing 40% 130% of highest suggested requirement between NRC (1994) and Fisher (1998). All other amino acids were maintained at 100% of their suggested requirement level. The basal experimental diets utilized to determine the methionine and phenylalanine requirements contained added cystine and tyrosine, respectively, to supply the non-essential AA component of TSAA and phenylalanine plus tyrosine requirements. Glutamic acid was added to the basal diet containing 100% of essential amino acids to provide 80% 140% of suggested CP requirement (NRC, 1994). The breeders were fed 154 g feed (467 kcal ME) daily. Each treatment contained ten birds. The average egg weight multiplied by average hen day egg production multiplied by average daily wt gain was defined as g egg mass BW gain product. The average feed consumption divided by the product was defined as feed/product ratio. The digestible methionine, lysine, phenylalanine, isoleucine, arginine, and CP requirement for product and feed/product ratio was calculated to be 427.39 mg/d and 476.34mg/d, 888.91 mg/d and 899.02 mg/d, 643.53 mg/d and 667.54mg/d, 844.59 mg/d and 828.16 mg/d, 1059.45 mg/d and 1022.04 mg/d, 19880.72 mg/d and 18927.56 mg/d, respectively. Fertility was measured 4 times and the results showed that different AA levels had significant effects on fertility.

**Key Words:** AA Requirement, Broiler Breeder, Performance

**W16 Dietary protein regulates short-term adaptations in lipogenic gene expression.** R. W. Rosebrough\*, B. A. Russell, S. M. Poch, and M. P. Richards, *Growth Biology Laboratory, ARS, USDA, Beltsville, MD.*

The purpose of these experiment was to determine possible relationships between certain indices of lipid metabolism and specific gene expression in chickens fed graded levels of dietary crude protein. Male, broiler chickens growing from 7 to 28 days of age were fed diets containing 12 or 30% protein ad libitum. Both groups were then switched to the diets containing the opposite level of protein. In Experiment 1, birds were killed on days 28 (basal values prior to the switch), 29, 30 and 31. Measurements taken included in vitro lipogenesis, malic enzyme activity the expression of the genes for malic enzyme, fatty acid synthase and acetyl coenzyme carboxylase. In Experiment 2, birds were sampled, again prior to the switch and at 3, 6, 9 and 24 hr. following the switch in protein levels. Measurements taken were confined to malic enzyme activity and the expression of the genes for malic enzyme, fatty acid synthase and acetyl coenzyme carboxylase. In vitro lipogenesis and malic enzyme activity were inversely related to dietary protein levels (12 to 30%) and to acute changes from 12 to 30%. In contrast, expression of malic enzyme, fatty acid synthase and acetyl CoA carboxylase genes appear to be constant over a dietary protein range of 12 to 21%, but are decreased by feeding a 30% protein diet (acute or chronic feeding). Results of the present study demonstrate a continued role for protein in the regulation of broiler metabolism. It should be pointed out that metabolic regulation at the gene level only occurs when feeding very high levels of dietary protein.

**Key Words:** Lipogenesis, Gene, Metabolism

**W17 Efficacy of enzyme supplementation in laying hens fed diets based mainly on barley.** M. I. Gracia\*<sup>1</sup>, A. Flores<sup>2</sup>, E. McCartney<sup>3</sup>, M. Cortés<sup>1</sup>, and J. Sánchez<sup>1</sup>, <sup>1</sup>*Imasde Agropecuaria, S.L., S.L. Spain*, <sup>2</sup>*Nutreco PRC, Spain*, <sup>3</sup>*Pen&Tec Consulting, Spain.*

The aim of the present study was to evaluate the efficacy of a feed enzyme additive (Endofeed DC, EC No 25) containing 1,100 U/g of Endo-1,3(4)- $\beta$ -glucanase (EC 3.2.1.6) and 1,600 U/g of Endo-1,4- $\beta$ -xylanase (EC 3.2.1.8) in laying hens from 34 to 58 wks of age. A completely randomized design was applied using two experimental treatments: 1) basal

diet (control), and 2) basal diet with 125 mg/kg of enzyme, the recommended dose. Each treatment was replicated 10 times with 20 laying hens (400 Isa Brown in total) constituting the experimental unit. Egg production, average egg weight, and feed efficiency were calculated every 4 wks. Haugh Units, yolk color, and eggshell strength were measured every 8 wks. There were no significant differences between treatments in egg production or feed efficiency, but there were significant improvements in egg quality in hens supplemented with enzyme. For the overall period (34 to 58 wks of age), the addition of enzyme significantly increased mean egg weight ( $68.51$  vs  $69.71$  g;  $P < 0.05$ ) with no loss of shell quality. Enzyme supplementation increased both albumen height ( $8.70$  vs  $7.27$  mm;  $P < 0.01$ ) and Haugh Units ( $101.5$  vs  $95.0$ ;  $P < 0.01$ ) at 42 wks of age. There were significant improvements in yolk color due to enzyme, measured by both Roche Color Fan (RCF) and Minolta Colorimeter (L, a, and b values). Values were similar for both treatments at study start, but by 58 wks of age, hens supplemented with enzyme had significantly higher RCF values ( $13.34$  vs  $12.46$ ;  $P < 0.01$ ), lower luminosity (L) value ( $56.46$  vs  $57.66$ ;  $P = 0.06$ ), and significantly higher red color (a) value ( $6.26$  vs  $4.79$ ;  $P < 0.01$ ) than controls. Moreover, the a/b ratio, indicative of more intense color, was also increased significantly by enzyme supplementation ( $P < 0.01$ ). The data from this study provide convincing evidence that enzyme improves egg weight and yolk color.

**Key Words:** Glucanase, Xylanase, Laying Hens

**W18 Metabolizable energy of meat and bone meal processed differently in broiler diets.** M. Moschini\*<sup>1</sup>, C. Cerioli<sup>1</sup>, L. Fiorentini<sup>1</sup>, M. Morlacchini<sup>2</sup>, and G. Piva<sup>1</sup>, <sup>1</sup>*Universita' Cattolica del Sacro Cuore Via Emilia Parmense, Piacenza-Italy*, <sup>2</sup>*CERZOO San Bonico, Piacenza-Italy.*

The meat and bone meal (MBM) processed according to the 96/449/EC directive can still be used in animal diets in Europe. The safety of the processing may be improved when an alkaline step is added to the heat treatment. The apparent metabolizable energy (AME) and the AME corrected to zero nitrogen retention (AMEn) were assessed for differently processed MBM. The physical setting for MBM processing were: MBMA ( $100^{\circ}\text{C}$ , 20 minutes, 3.5% CaO), MBMB ( $125^{\circ}\text{C}$ , 20 minutes), MBMC ( $133^{\circ}\text{C}$ , 20 minutes) (EC treatment) and MBMD ( $141^{\circ}\text{C}$ , 20 minutes). 72 male broiler chickens (Ross),  $1.8 \pm 0.1$  kg body weight, were individually housed and randomly assigned to 9 dietary treatments. The bulk of the base diet (Control) was corn (50%), soybean meal (33%), corn oil (3.4%) plus synthetic amino acids, minerals, trace minerals and vitamins. The MBM were used at two levels of substitution (L1=7%, L2=14%) of the protein from soybean of the base diet. Data were analyzed with the Dunnett type I experimentwise error comparison against the control diet. Diets with MBM were analyzed as a factorial experiment. The AME and AMEn of diets were 12.42, 11, 9.76, 12.87, 13.35, 10.46, 11.99, 12.36, 10.72 and 11.83, 10.24, 9.15, 12.19, 12.7, 9.77, 11.31, 11.67, 10.13 MJ/Kg dry matter, respectively for the control diet, MBMA L1, MBMB L1, MBMC L1, MBMD L1, MBMA L2, MBMB L2, MBMC L2 and MBMD L2. When compared to the control diet, no differences were detected. However, when analyzed as a factorial experiment, there were MBM ( $P < 0.05$ ) and MBM by level interaction ( $P < 0.05$ ) effects on the diet AME and AMEn contents. No level effect was observed. Contrast analysis for the AMEn within the L1 indicates 3.3 MJ/Kg dry matter difference ( $P < 0.01$ ) of diets with MBM processed according to the EC treatment or at higher temperature versus the MBMB containing diet. Also, at the same level of substitution there was a -2.2 MJ/kg dry matter difference ( $P < 0.05$ ) when comparing the diet containing the alkaline treated MBM versus diets containing MBM produced according to the EC treatment or at higher temperature. Using MBM processed according to EC treatment or at higher temperature did not negatively affect the AME or AMEn content of diets.

**Key Words:** Meat and Bone Meal, Metabolizable Energy, Poultry

**W19 True metabolizable energy and amino acid digestibility of distillers dried grains with solubles.** A. B. Batal\* and N. M. Dale, *University of Georgia Poultry Science Dept., Athens.*

In recent years, policies encouraging the production of ethanol have stimulated an enormous increase in the production of distillers dried grains with solubles (DDGS). The ingredient which is becoming increasingly available differs from that of previous decades in that it is derived almost entirely from corn and is dried under less severe conditions.

Twelve DDGS samples were obtained from six different plants in the Midwest from 2002 to 2004. Each sample was analyzed for TME<sub>n</sub> and four representative samples were analyzed for total and available amino acid content by using the precision-fed rooster assay with conventional or cecectomized single comb white leghorn roosters, respectively. Metabolizable energy (TME<sub>n</sub>) ranged from 2379-3079 kcal/kg, with a mean of 2831 kcal/kg. Marked variation was noted between samples presumably reflecting modest differences in processing procedure. However, a reasonable consistency was observed in samples from the same suppliers. Considerable differences were observed between the true amino acid digestibilities of the DDGS samples. The majority of samples were golden in color and true amino acid digestibility values were relatively consistent among these samples. Total concentration and percent availability, of several critical amino acids for the golden DDGS samples were: lysine, 0.85% (75); methionine, 0.56% (89); cystine, 0.62% (75); threonine, 1.05% (76); and arginine, 1.25% (84). One DDGS sample was very dark in color, appearing to have been severely overheated during the drying process. The level of total amino acids and percent availability was much lower than that observed for the golden colored samples. Total concentration and percent availability, respectively, of several critical amino acids for the dark DDGS sample were: lysine, 0.64% (58); methionine, 0.047% (83); cystine, 0.50% (63); threonine, 0.92% (64); and arginine, 0.95% (75). The variation observed between samples strongly indicates that confirmatory analyses should be conducted prior to utilizing samples from a new supplier.

**Key Words:** Distiller's Dried Grains with Solubles, TME, Amino Acid Digestibility

**W20 Modelling energy utilization in laying-type pullets.** N. Sakomura<sup>\*1</sup>, R. Neme<sup>1</sup>, F. Fialho<sup>2</sup>, E. Carrilho<sup>1</sup>, and K. Resende<sup>1</sup>, <sup>1</sup>Faculdade de Ciências Agrárias e Veterinárias-Universidade Estadual Paulista Jaboticabal-SP - Brazil, <sup>2</sup>EMBRAPA Bento Gonçalves -RS.

Three trials were conducted to elaborate the ME requirement models for two commercial laying-type pullet strains. In the first trial, 128 pullets with 9 weeks of age, Hy line Brown (HLB) and Hy line W36 (HLW36), were used to determine the efficiencies of energy utilization (kg) by the comparative slaughter method. In the second trial, the effect of temperature (12, 18, 24, 30, and 36°C) and feathering (0, 50, and 100%) were determined on ME maintenance requirements (ME<sub>m</sub>) of two strains. The ME<sub>m</sub> was determined by ME<sub>m</sub>=MEI - RE/kg, MEI=ME intake, RE=retained energy. In the third trial, the ME requirement for weight gain was estimated based on body energy content per gram and kg. The lower critical temperatures (LCT) changed according to feathering levels (19, 22, and 24°C for 100, 50, and 0% of feathering). According to the equation ME<sub>m</sub>=W<sup>0.75</sup> 92.40+6.73(LCT-T), at temperatures below LCT, the ME<sub>m</sub> increases 6.73 kcal/W<sup>0.75</sup> /d for each increase of 1°C. At temperatures above LCT, the ME<sub>m</sub> increases 0.88 kcal/W<sup>0.75</sup> /d for each increase of 1°C (ME<sub>m</sub>=W<sup>0.75</sup> 92.40+0.88(T-LCT)). Considering these results, the following models were elaborated: ME=W<sup>0.75</sup>92.40+6.73(LCT-T)+3.22WG (TLCT) and ME=W<sup>0.75</sup>92.40+0.88(T-LCT) + 3.22WG (TLCT) for HLW36 and HLB from 1 to 6 wk-old; ME=W<sup>0.75</sup>92.40+6.73(LCT-T) + 4.94WG (TLCT) and ME=W<sup>0.75</sup>92.40+0.88(T-LCT) + 4.94WG (TLCT) from 7 to 12 wk-old, for HLB and ME=W<sup>0.75</sup>92.40+6.73(LCT-T) + 5.19WG (TLCT) and ME=W<sup>0.75</sup>92.40+0.88(T-LCT) + 5.19WG (TLCT) for HLW36; ME=W<sup>0.75</sup>92.40+6.73(LCT-T) + 6.32WG (TLCT) and ME=W<sup>0.75</sup>92.40+0.88(T-LCT) + 6.32WG (TLCT) from 13 to 18 wk-old for HLB and ME=W<sup>0.75</sup>92.40+6.73(LCT-T) + 9.49WG (TLCT) and ME=W<sup>0.75</sup>92.40+0.88(T-LCT) + 9.49WG (TLCT) for HLW36, ME=ME requirement (kcal/b/d), W=body weight (kg), LCT=24.54-5.65E (E is the feathering score from 0 to 1), T=temperature, WG=body weight gain (g).

**Key Words:** Energy Requirement Model, Laying Type-Pullets, Temperature

**W21 Effect of different feedstuffs on endogenous energy losses of roosters.** S. Zhaj<sup>\*1</sup>, G. Qi<sup>2</sup>, and F. Liu<sup>1</sup>, <sup>1</sup>College of Animal Science, Northwest Sci-Tech University of Agriculture and Forestry, Yangling Shaanxi, China, <sup>2</sup>Feed Research Institute, Chinese Academy of Agriculture Science, Zhongguancun, Beijing, China.

This study was conducted to determine the endogenous energy losses (EEL) in intact roosters tube-fed Normal Corn (NC), Soybean Meal (SB)

and Fish Meal (FM), the levels of CP in NC, SB and FM were 8.7%, 43.5% and 64.5%, fed basis. Twenty-four adult roosters (3.0±0.1kg, Body Weight) were allotted to three treatment groups, each of which included four replicates of 2 birds and kept in individual cages under a daily light period of 16h. Following a 48h period without feed, birds were given 50g of one of experimental feedstuffs via a crop intubation and their endogenous excreta were collected for the 48h-96h after intubation. The average EEL and nitrogen losses of per bird fed NC, SM and FM were found to be 83.78KJ and 1.75g, 92.04KJ and 1.9g, 97.80KJ and 2.11g, respectively. EEL and nitrogen losses of SB group and FM group were significantly higher than that of corn grain group (P < 0.01), EEL of FM group was significantly higher than that of SB group (P < 0.05). The EEL corrected to zero-nitrogen balance (EEL<sub>n</sub>) for the NC, SM and FM group were 20.00KJ, 19.76KJ and 20.06KJ, there were not significant difference between each group (P > 0.1). The result showed that EEL would be affected by the protein level of the tube-fed feedstuffs significantly, but the EEL<sub>n</sub> was independent of the tube-fed feedstuffs.

**Key Words:** Roosters, Endogenous Energy Losses, Endogenous Energy Losses Corrected to Zero-Nitrogen Balance

**W22 Meeting metabolizable energy needs of broilers with corn-soy enzymes.** A. N. Figueiredo<sup>1</sup>, R. L. Dari<sup>\*1</sup>, E. E. M. Pierson<sup>2</sup>, M. Hruby<sup>3</sup>, J. C. Remus<sup>2</sup>, A. M. Penz<sup>1</sup>, and T. H. D'Alfonso<sup>3</sup>, <sup>1</sup>Nutron Animal Nutrition Research Center Campinas, Sao Paulo, Brazil, <sup>2</sup>Danisco Animal Nutrition, St. Louis, MO, <sup>3</sup>Danisco Animal Nutrition, Marlborough, Wiltshire, UK.

Enzyme use (excluding phytase) in corn-soybean meal diets is relatively low in corn-sorghum-soy diets; this may be due to a lack of understanding of their practical application. A 24-pen, 42 day-D study was conducted to evaluate the effect of a corn-soy enzyme product (Avizyme<sup>®</sup> 1502: alpha-amylase, endo-xylanase and subtilisin protease; 1502) to meet the energy needs of broilers at different stages of growth. Each of four dietary treatments was randomly allocated to 6 replicate pens of Cobb 500 broilers (20 females:20 males/pen; 640 total). A four-phase feeding (pre-starter Brazilian broiler industry nutrient levels) program was used: (type-starter (PS; 00-07D); starter (S; 08-21D); Grower (G; 22-38D), and Finisher (F; 39-42D). There were two dietary treatments (Trts) in the PS and S phases: diets without (WO) and with (W) 0.05% 1502 added over-the-top. In the G and F phases, metabolizable energy (ME) was reduced (down specification; DS) by 3%. Performance of DS and normal ME diets W and WO 0.05% 1502 was compared. Calculated ME (kcal/kg) for the Trts were: PS-2950, S-3080; G-3085 or 3180; F-3153 or 3250. No significant differences between the Trts W and WO 1502 were observed at 7 and 21D. At 38 and 42D, there were significant effects (P < 0.01) of reducing ME on feed intake (FI) and FCR, and the addition of 1502 at each ME increased (P < 0.15) FI by ~ 40g and BW (P < 0.20) by ~ 25g. The average ME (highest ME diet, no 1502) intake (kcal/day) per phase was: PS (62), S (158), G (466), and, F (546). These data suggest that: the broiler to 21D may respond differently to 1502 than it does after this age; there is room for improving the predictability of dietary response to 1502; addition of 1502 OTT through 21D and then to diets with ME reduced 3% is a viable tool to economically meet the energy needs of the broiler.

**Key Words:** Corn-Soy Enzymes, AME, Over the Top

**W23 Validation of dual energy X-ray absorptiometry (DXA) bone mineralization measures in broilers as an alternative to bone ash and breaking measures.** R. Angel<sup>\*1</sup>, A. D. Mitchell<sup>2</sup>, and M. Christman<sup>1</sup>, <sup>1</sup>Univ. of Maryland, College Park, <sup>2</sup>USDA, Agricultural Research Service, Beltsville, MD.

Bone mineralization status of chickens has traditionally been measured using techniques that generate values such as bone ash, bone breaking strength and force, etc. Most traditional techniques are time consuming and require extensive work related to bone removal and further laboratory work. Use of DXA allows for quick measures of bone mineral content (BMC, g) and density (BMD, g/cm<sup>2</sup>) on the whole carcass, carcass parts or excised bones. The objective of this study was to determine whether DXA measures can be used to predict traditional measures such as bone ash and breaking strength in whole carcasses as well as in excised bones. Traditional measures used included ash (done on toes, shank, tibia and femur), breaking strength and breaking force (done on tibia and femur). Whole carcasses (270) and excised bones from these carcasses were obtained from a study where broilers were fed diets with

different calcium and phosphorus levels. Broilers were sampled at different ages between 18 and 53 d and within each age, were subdivided at random into two subsets (85 and 15% of the data set). Using the 85% subset (n=225), regressions of each adjusted ash and strength variables were run against each adjusted BMC and BMD variable and regression equations and R<sup>2</sup> values obtained. These equations were used to predict bone ash and strength variables based on measured DXA variables in the remaining 15% of the data set (n=45). The partial R<sup>2</sup> values were high between DXA whole body BMC and g of femur (0.82) and tibia (0.80) ash. When DXA measures were used to predict bone ash in the 15% subset based on the regression relationships, correlations between predicted and actual values were high. When DXA whole body and femur BMC measures were used to predict femur ash the R<sup>2</sup> between predicted and actual was 0.86 and 0.89, respectively. DXA generated BMC values can be used to predict bone ash.

**Key Words:** Bone Mineralization, Dual Energy X-ray Absorptiometry

**W24 A novel organic selenium source (zinc-L-selenomethionine, Availa®Se) for broilers.** B. George<sup>1</sup>, S. Davis<sup>1</sup>, and T. L. Ward\*<sup>2</sup>, <sup>1</sup>Colorado Quality Research, Wellington, <sup>2</sup>Zinpro Corporation, Eden Prairie, MN.

There is renewed interest in Se supplementation of livestock due to research showing forms of organic Se are more bioavailable than sodium selenite (NaSe). The objective of this research was to evaluate zinc-L-selenomethionine (ZnSeMet; Availa®Se, Zinpro Corp.) in broilers. A randomized complete block design experiment was conducted using day-old RossxRoss 508 male and female chicks. Chicks were fed: 1) corn-SBM diet without Se supplementation (Control), 2) Control + 0.3 ppm Se as NaSe, or 3) Control + 0.3 ppm Se as ZnSeMet. Twelve pens (6 female and 6 male) were used per treatment with 50 females or 45 males per pen. Diets were fed for 49 d in three phases (starter, 0-16 d; grower, 17-35 d; finisher, 36-49 d). Three birds per pen were bled at the end of the study to determine plasma glutathione peroxidase activity (GSH-Px) and Se concentrations, and pectoralis muscle samples were collected to determine Se content. Birds fed NaSe had lower final BW (2.543, 2.408, 2.505 kg for Control, NaSe, ZnSeMet, respectively) and higher feed/gain (1.740, 1.776, 1.733) than birds fed Control or ZnSeMet. Muscle moisture loss was higher numerically in birds fed NaSe compared to birds fed Control or ZnSeMet (1.27, 1.42, 1.25%). Plasma GSH-Px activities were lower (P<0.05) in birds fed Control vs Se-supplemented diets (10.4, 14.0, 15.4 U/mg protein). Birds fed NaSe had lower (P<0.05) plasma GSH-Px than birds fed ZnSeMet. Plasma Se was higher (P<0.01) in birds fed NaSe or ZnSeMet than in birds fed Control (0.113, 0.144, 0.179 ppm). Plasma Se was higher (P<0.05) in birds fed ZnSeMet than birds fed NaSe. Breast muscle Se concentration was higher (P<0.01) in birds fed ZnSeMet compared to birds fed Control or NaSe (0.393, 0.422, 1.20 ppm DM). Higher Se concentration in muscle of broilers fed ZnSeMet is consistent with selenomethionine being incorporated into proteins in place of methionine. Increased muscle stores of Se when feeding ZnSeMet, indicate a more bioavailable Se source relative to NaSe. Zinc-L-selenomethionine is an efficacious source of Se for poultry.

**Key Words:** Broiler, Selenium, Zinc-L-Selenomethionine

**W25 Interactive effects of Zn, Cu, and Mn supplementation in diets for chicks.** J. L. Shelton\* and L. L. Southern, Louisiana State University Agricultural Center, Baton Rouge.

Previous research in our lab with pigs indicated that removing the dietary trace mineral premix, which contained Zn, Mn, Cu, Se, Fe, and I, resulted in an increase in Mn and a decrease in Zn concentrations in various tissues. Therefore, an experiment was conducted to determine the interactive effects of Zn, Cu, and Mn addition to diets of 0 to 14-d old chicks on growth performance, bone strength, bone ash percentage, and tissue mineral concentrations. Two levels of Zn (0 and 75 ppm, as Zn sulfate), two levels of Mn (0 and 100 ppm, as Mn sulfate), and two levels of Cu (0 and 7 ppm, as Cu sulfate) were supplemented to corn-soybean meal diets in a 2x2x2 factorial arrangement. Each treatment had six replications with five chicks each, and the initial and final BW were 46 and 382 g. Daily gain, daily feed intake, gain:feed, bone strength, bone ash percentage, and bone and pancreatic Zn concentrations were increased (P < 0.07) in chicks fed the diets with supplemental Zn. Daily gain was decreased and bone, liver, and pancreatic Mn levels were increased in chicks fed diets with Mn addition (P < 0.09). Bone

strength was increased when Zn was added to the diets with or without Cu addition but the increase was greater in chicks fed the diets without Cu addition (Zn x Cu, P < 0.05). Bone ash percentage was increased in chicks fed the diets with Zn, Mn, or Cu addition but the increase was not additive (Zn x Mn x Cu, P < 0.03). Liver Cu level was increased (P < 0.01) in chicks fed the diets with Cu addition. Bone and liver Cu levels were decreased (P < 0.07) in chicks fed the diets with Zn addition. Liver and pancreatic Mn levels were increased (P < 0.07) in chicks fed the diets with Zn addition. This study indicated that Zn addition is necessary for normal growth performance and bone strength of chicks, and that Zn addition had a negative effect on tissue Cu levels and a positive effect on tissue Mn levels.

**Key Words:** Chicks, Growth, Trace Minerals

**W26 Phosphorus availability of distiller's dried grains plus solubles for male turkey poults.** J. L. Kalbfleisch\* and K. D. Roberson, Michigan State University, East Lansing.

Two experiments were conducted to determine the P availability of distiller's dried grains plus solubles (DDGS) using the slope ratio method. In each experiment, 360 male turkey poults were started at one day of age and fed a low P diet (0.5% non-phytate P (nPP)) for 7 or 6 days, respectively. In both experiments, diets were isocaloric, isonitrogenous and calcium was kept constant at 1.2%. DDGS was analyzed to contain 0.69% TP and 0.29% nPP. In Experiment 1, 8 to 9 poults were randomly sorted into 42 brooder cage pens and fed 1 of 7 dietary treatments from 7 to 14 days of age. Treatments were formulated on nPP basis and consisted of the following composition: (1) corn-soybean meal basal (nPP=0.25%), (2) basal + 0.04% nPP from dicalcium P (DP), (3) basal + 0.08% nPP from DP, (4) basal + 0.12% nPP from DP, (5) basal with 15% DDGS (0.29% nPP), (6) basal with 30% DDGS (0.33% nPP), (7) basal with 45% DDGS (0.37% nPP). Body weight (BW), feed intake, ricket scores and bone ash were measured. At the highest level of nPP in Experiment 1, bone ash was significantly greater with DDGS than DP (P<0.0001). Based on nPP intake, P availability was determined to be 76.5% for bone ash (%), 70% for gain and 81% for gain:feed. In Experiment 2, 7 to 8 poults were randomly sorted into 42 brooder cage pens and fed 1 of 7 dietary treatments from 6 to 14 days of age. Treatments were formulated for total P (TP) and consisted of the following composition: (1) corn-soybean meal basal (0.58% TP), (2) basal + 0.05% P from DP, (3) basal + 0.1% P from DP, (4) basal + 0.15% P from DP, (5) basal with 13% DDGS (0.63% TP), (6) basal with 26% DDGS (0.68% TP), (7) basal with 40% DDGS (0.73% TP). At 0.73% TP, ricket score and bone ash (%) were significantly greater with DDGS than DP (P<0.002; P<0.0001). Based on TP intake per gm gain, regression analysis showed P availability from DDGS was repeatedly greater than DP. Based on total P formulation, dicalcium P may not be the appropriate standard to measure P availability of DDGS and suggests P in DDGS is greater than 85% available.

**Key Words:** DDGS, P Availability, Turkeys

**W27 Effect of supplementing selenium yeast in diets of laying hens on egg selenium content.** P. Utterback\*<sup>1</sup>, C. Parsons<sup>1</sup>, I. Yoon<sup>2</sup>, and J. Butler<sup>2</sup>, <sup>1</sup>University of Illinois, Urbana, <sup>2</sup>Diamond V Mills, Inc, Cedar Rapids, IA.

An eight-week experiment was conducted using 90 Hy-Line W-98 hens (26 wk of age) to evaluate the use of organic selenium (Se) from Se yeast as a Se source for laying hens. At 22 wk of age, the hens were placed on a low Se corn-soybean meal pretest diet for four weeks. At the end of the pretest period, hens were placed on one of three experimental treatments; the low Se diet without supplementation (basal diet), basal diet with 0.3 ppm of Se added from sodium selenite, or basal diet with 0.3 ppm of Se added from Se yeast (SelenoSourceAF#8482, Diamond V Mills, Inc. Cedar Rapids, IA). The diets contained 0.11, 0.38 and 0.34 ppm of Se, respectively. Each of the experimental diets was fed to 10 replicate groups of three hens for eight weeks (26 to 34 weeks of age). Selenium levels in eggs (mg per kg of whole egg) were analyzed at the end of the pretest period (Week 0), Week 4, and Week 8. Initial egg Se contents at Week 0 were similar among treatments (Table 1). Eggs from hens fed the two Se-fortified diets had higher (P < 0.01) Se concentrations than did eggs from hens fed the low Se control diet at both Week 4 and Week 8. The Se yeast diet also yielded egg Se levels that were significantly higher (P < 0.01) than those from the sodium selenite diet at Week 4 and Week 8. The Se yeast resulted in a 4.8-fold increase

in egg Se concentration compared to a 2.8-fold increase for the sodium selenite diet over the unsupplemented diet at Week 8. There were no differences in egg production, egg weight, feed intake, or mortality among treatments. The results of this study indicate that use of Se yeast in laying hens diets is very effective for increasing the Se content of eggs. Effect of sources of Se on egg Se content.

Egg Se content ppm	Diet			SEM
	Basal	Sodium Selenite	SelenoSourceAF™	
Week 0	0.101 <sup>a</sup>	0.104 <sup>a</sup>	0.103 <sup>a</sup>	0.005
Week 4	0.087 <sup>c</sup>	0.180 <sup>b</sup>	0.301 <sup>a</sup>	0.015
Week 8	0.065 <sup>c</sup>	0.182 <sup>b</sup>	0.311 <sup>a</sup>	0.010

<sup>a-c</sup>Means within a row with different superscripts differ significantly ( $P < 0.01$ ).

**Key Words:** Selenium, Se Yeast, Sodium Selenite

**W28 Effects of withdrawing vitamin and or trace mineral premixes from grower and finisher diets of broiler.** A. Kamyab, A. M. Hosseini\*, R. Mohammadzadeh, and K. Taherpour, *University of Tehran, Karaj, Iran.*

Supplementing broiler diets with vitamin and mineral premixes are of concern. This concern is warranted due to the relative quantities needed and due to the adverse effects on the broilers that occur when inadequate dietary levels are fed. The objective of this experiment was to evaluate the effect of withdrawing vitamin and or mineral premixes from the grower and finisher diets of broilers. This experiment was arranged as a 2x4 factorial design. The factors being; a) supplement (ctrl) or non-supplementing one or both premixes in the diets and, b) two withdrawal times, 28 to 49 and 35 to 49d. Birds from each of the eight treatment combinations were assigned to four replicate pens of 30 birds each. Withdrawing of one or both premixes between 28 to 35 days of age had no significant ( $P > 0.05$ ) effects on body weight gain (BWG), feed efficiency (FE), and feed intake (FI). At the second withdrawing period, FI for birds fed diet with no vitamin supplement was statistically lower ( $P < 0.05$ ) than other treatment groups. Likewise, BWG for group without vitamin supplement and those, which lacked both premixes, were lower ( $P < 0.05$ ) than other groups. Birds fed diet lacking mineral supplement had the worst FE, but this difference was only statistically significant ( $P < 0.05$ ) with the group fed lacking both vitamin and mineral supplement. Other criteria such as carcass characteristics, mortality and incidence of leg disorders were not statistically affected by treatments in the entire of this experiment ( $P > 0.05$ ). Our finding indicates that withdrawing premixes between the ages of 28 to 35 has little or no carry over effect on broiler performance.

**Key Words:** Broiler, Mineral, Vitamin

**W29 Use of phytase and an enzyme complex containing  $\alpha$ -amylase, xylanase and protease in commercial layers.** J. González\*, S. Cornejo, E. Contreras, B. Díaz, and L. Vera, *Universidad de Chile, Facultad de Ciencias Veterinarias y Pecuarias, Santa Rosa, La Pintana Santiago Chile.*

A 35-wk study was conducted to evaluate the effects of 3-phytase (5000 FTU/g from *Trichoderma reesei*) and an enzyme complex (EC=Avizyme<sup>R</sup> 1502) in layer diets based on corn, soy and wheat bran on performance, egg quality and ileal nutrient digestibility. One hundred forty-four 18-wk-old layers (HyLine W-36) were randomly assigned to 4 treatments with 3 replicates each (4 hens/cage) in a 2 x 2 factorial design. The treatments: 1) no enzyme supplementation, 2) Phytase (300 FTU/kg), 3) EC ( $\alpha$ -amylase 300 U/kg, xylanase 225 U/kg and protease 3000 U/kg) and 4) Phytase + EC. All diets provided 86% and 92% of the daily AMEn and CP requirements of layers, respectively. Phytase inclusion provided the equivalent of .11% available P and .1% Ca in treatments 2 and 4. The use of phytase increased ( $p < .05$ ) egg production (EP) and cumulative eggs/h/h (CE) by 1.16% and 2.45 eggs, respectively. The use of the EC decreased ( $p < .05$ ) EP by .66%. Interactions ( $p < .05$ ) were observed for egg weight (EW) and feed intake (FI). In the absence of EC, EW was not affected ( $p < .05$ ) by phytase, however in the presence of EC, phytase decreased EW by .89g. Phytase + EC did not affect FI, however FI decreased when both phytase

and EC were added. Specific gravity was decreased ( $p < .05$ ) while yolk color, yolk weight, yolk/albumen ratios by weight and volume, were increased ( $p < .05$ ) by EC. Phytase decreased ( $p < .05$ ) shell thickness and breaking strength. The EC improved ( $p < .05$ ) AME (10%), P (30%) and protein (6%) digestibilities, but phytase did not influence ( $p > .05$ ) nutrient digestibility. The parameters measured were not further improved ( $p > .05$ ) by the combined use of both phytase and EC. In the present study, phytase improved layer performance but decreased egg shell quality. The EC improved egg quality and nutrient digestibility. The effect of  $\alpha$ -amylase, xylanase and protease on P ileal digestibility deserves further research.

**Key Words:** Laying Hen, Enzymes, Ileal Digestibility

**W30 Effect of microbial phytase in low phosphorus and calcium level diet on the performance and nutrient digestibility in laying hens.** B. J. Min\*<sup>1</sup>, O. S. Kwon<sup>1</sup>, W. B. Lee<sup>1</sup>, K. S. Son<sup>1</sup>, J. W. Hong<sup>1</sup>, T. H. Moon<sup>2</sup>, Y. K. Han<sup>3</sup>, and I. H. Kim<sup>1</sup>, <sup>1</sup>*Department of Animal Resource & Science, Dankook University Cheonan, Korea,* <sup>2</sup>*InterMax System, Inc., Korea,* <sup>3</sup>*Livestock Research Institute, National Agricultural Cooperatives Federation, Korea.*

This study conducted to investigate the effects of microbial phytase in low phosphorus and calcium level diet on the performance and nutrient digestibility in laying hens. One hundred ninety two, 50-wks old, ISA brown commercial layers were used in a 12 weeks feeding trial after 7-d adjustment period. Four dietary treatments included CON(control; corn-soybean meal basal diet contained available P and Ca to meet the NRC requirement), P1(0.01% PHYTEX, Agranco, Co.), P2(0.06% Natuphos, BASF) and P3(0.06% PHOSMAX, GENOFOCUS). Ca and available P concentrations of P1, P2 and P3 were 90% and 50% of NRC recommendations to accentuate difference in response to phytase availability. In whole period, egg production was not affected by treatments. At 12 weeks, egg weight was significantly increased in adding phytase treatments ( $P < 0.05$ ). Egg shell thickness was increased in P1, P2 and P3 treatments compared with control ( $P < 0.05$ ) at 9 weeks. Ca concentration of serum was tended to decrease in P1 treatment without significant difference ( $P > 0.05$ ). Ca and P concentrations of tibia were higher in layers fed dietary phytase than layers fed control diet without significant difference ( $P > 0.05$ ). Digestibilities of DM, N and ash were improved in P1 treatment compared with P2 and P3 treatments ( $P < 0.05$ ). Ca and P digestibilities were the highest in P2 treatment ( $P < 0.05$ ), however, there was not significant difference between control and P1 treatments.

**Key Words:** Microbial Phytase, Performance, Laying Hens

**W31 Market tom turkey performance and dietary phytase inclusion.** S. L. Noll\*<sup>1</sup>, J. Brannon<sup>1</sup>, and J. S. Sands<sup>2</sup>, <sup>1</sup>*University of Minnesota, St. Paul,* <sup>2</sup>*Danisco Animal Nutrition, Marlborough, Wiltshire, UK.*

Inclusion of dietary phytase has been identified as a means to reduce dietary phosphorus content and ultimately the environmental impact of poultry manure by reducing its phosphorus content. Appropriate inclusion levels need to be determined in commercial type diets. A novel 6-phytase expressed in yeast (Phyzyme XP, Danisco Animal Nutrition) was assayed for efficacy in market tom turkey diets in a 16-wk trial. Turkey poults (Large White, Nicholas strain) were randomized into floor pens (12 /pen, six replicate pens per treatment) at d of age and were fed one of eight test diets to 16 wks of age. The eight dietary treatments were: 1) positive control (PC) with NRC (1994) levels of calcium and available phosphorus; 2) negative control (NC) with calcium and available phosphorus reduced by .2%. For Treatments 3-6, the NC diet series was supplemented with phytase and contained analyzed phytase levels of 160, 325, 500 and 650 FTU/kg feed, respectively. Adjustments in the nutrient content of the corn-soybean based basal diet were made for each 4-wk feeding period. The turkeys were weighed initially at the start of the trial and at 4, 8, 12, and 16 wks of age with corresponding measurements of feed intake. At 16 wks of age, four birds from each pen were euthanized for toe ash determination. Body weight (BW) at 8, 12, and 16 wks and toe ash was poorer for NC in comparison to PC turkeys as was cumulative feed intake and feed efficiency (FE) through 16 wks of age ( $P > .05$ ). Phytase supplementation improved performance over NC. Performance equivalent to PC was obtained although optimal level of supplementation changed with the age of the bird. Through 8 wks of age, BW and FE for turkeys fed 160 FTU/kg resulted in performance similar to PC while through 16 wks of age, 500 FTU/kg resulted



in performance similar to the positive control. In conclusion, phytase supplementation restored performance in turkeys fed diets deficient in calcium and phosphorus. Optimal performance to 16 wks of age was obtained when the diet was supplemented with 500 FTU/kg of Phyzyme XP.

**Key Words:** Turkey, Phosphorus, Phytase

**W32 Market turkey performance and inclusion level of corn distillers dried grains with solubles.** S. L. Noll\*<sup>1</sup>, J. Brannon<sup>1</sup>, and V. Stangland<sup>2</sup>, <sup>1</sup>University of Minnesota, St. Paul, <sup>2</sup>Stangland Feed Consulting, Willmar, MN.

Inclusion of corn distillers dried grains with solubles (DDGS) in poultry diets is usually limited to less than 10% of the diet. Depending on price of DDGS and other ingredients, inclusion levels may exceed 10% in ration formulation. A study was conducted with market tom turkeys to determine if higher levels could be fed without negative effects on performance and if dietary protein regime would change the response. A factorial design of inclusion level (0, 10, 15, and 20% DDGs) and protein regime (95 and 100% NRC threonine (thr)) was used to determine if an interaction existed between DDGs inclusion level and dietary protein regime. Male turkeys (Large White) were randomly assigned to pens (10 birds/pen) at 8 wks of age and were fed one of the test diets to 19 wks of age (7 replicate pens per treatment). Diets were formulated to be isocaloric and with similar levels of digestible lysine and TSAA. Diets were adjusted for nutrient content at 3-wk intervals. Turkeys were weighed individually at 8, 11, 14, 17, and 19 wks age. Feed intake was measured for each feeding period. Level by protein regime was significant for body weight (BW) at 11, 14, and 17 wks of age ( $P < .05$ ). At 100% NRC thr, turkeys fed 10 and 15% DDGS tended to have better performance than 100% NRC thr. At 95% NRC thr, 10% and 15% inclusion tended to depress BW at 14 and 17 wks of age. Feed efficiency responses were similar to those of body weight. Based on live performance, up to 20% DDGS can be incorporated into market turkey diets. At the higher protein regimen, inclusion of 10 and 15% DDGS improved weight over that of the control.

**Key Words:** Turkey, Corn, Distillers Grains

**W33 Efficacy of Phyzyme<sup>®</sup> XP phytase in broiler diets containing different levels of calcium and non-phytate phosphorus: nitrogen retention and ileal amino acid digestibility.** D. R. Ledoux\*<sup>1</sup>, J. N. Broomhead<sup>1</sup>, and J. S. Sands<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>Danisco Animal Nutrition, Marlborough, Wiltshire, UK.

A six-week floor pen study was conducted to determine the efficacy of Phyzyme<sup>®</sup> XP, in diets containing different Ca & P levels, on nitrogen retention, and ileal amino acid digestibility in broiler chickens. A 3 X 4 factorial arrangement of dietary treatments from hatch to week 3 included 3 Ca & non-phytate P (npP) levels (0.80 & 0.25%, 0.85 & 0.30%, and 0.90 & 0.35%) and 4 levels of Phyzyme<sup>®</sup> XP (0, 250, 500, and 750 U/kg diet). From week 3 to 6, dietary phytase levels were kept the same but Ca & npP levels were reduced (0.70 & 0.15%, 0.75 & 0.20%, and 0.80 & 0.25%). The starter basal diet contained 21.74% CP and 2920 kcal ME/kg, and the grower basal diet contained 19.5% CP and 3010 kcal ME/kg. Six pens of 25 chicks each were assigned to each dietary treatment from day 1 to 42. Significant ( $P < 0.05$ ) interactive and main effects were observed for 3 week nitrogen retention, whereas at 6 weeks there was only a significant ( $P < 0.05$ ) phytase effect. Phytase supplementation improved nitrogen digestibility by an average of 4.3% at week 3, and by 4.4% at week 6. With the exception of tryptophan and serine, significant ( $P < 0.05$ ) interactive and main effects were observed for ileal digestibility of both essential and nonessential amino acids. Ileal digestibility of tryptophan and serine, were affected ( $P < 0.05$ ) by phytase level and by the interaction of Ca & npP and phytase level. For the essential amino acids, phytase supplementation improved average ileal digestibility by 2.2%, whereas for the nonessential amino acids improvements in ileal digestibility averaged 3.2%. These results indicate that Phyzyme<sup>®</sup> XP was effective in improving nitrogen and amino acid utilization, and the efficacy was influenced by Ca & npP level.

**Key Words:** Phytase, Amino Acid Digestibility, Broilers

**W34 Effects of phytase on the bioavailability of phosphorus in diets containing conventional or low-phytate corn and soybean meal for chicks.** E. G. Xavier, G. L. Cromwell\*, and M. D. Lindemann, University of Kentucky, Lexington.

An experiment was conducted to assess the effects of phytase (Natuphos<sup>®</sup>, BASF; 750 units/kg) on the bioavailability of P in normal (N) corn and N soybean meal (SBM) or near-isogenic, low-phytate (LP) corn and LP, low-oligosaccharide SBM from near-isogenic soybeans. The corn and SBM were provided by Pioneer Hi-Bred International. The N-corn, LP-corn, N-SBM and LP-SBM contained 0.25, 0.26, 0.70, and 0.77% total P and 0.05, 0.17, 0.22, and 0.55% non-phytate P. Chicks (3-d-old, 85 g initial weight) were fed a low P (0.24% P) phytate-free, casein-dextrose-sucrose-starch basal diet (1.36% lysine, 0.91% methionine) or the basal with 0.08 and 0.16% added P from monosodium phosphate (MSP). Eight additional diets consisted of the basal with 0.08 or 0.16% added P from a 2:1 blend of N-corn and N-SBM or a 2:1 blend of LP-corn and LP-SBM. These eight diets were fed either without or with phytase. All diets contained 1.0% Ca and 3.56 Mcal ME/kg. Diets were fed for 14 d to five replications of six chicks per pen in batteries. Rate and efficiency of gain, and bone strength and ash increased linearly ( $P < 0.05$ ) with increasing level of dietary P. At the end of the study, all chicks were killed and tibias were removed for breaking strength and ash determinations. Because of low feed intake (thus low P intake) along with uncharacteristically low bone strengths and ash in chicks fed the basal and MSP diets, we were unable to use slope-ratio procedures for determining P bioavailability. However, based on relative responses in tibia strength and ash weight, and assuming from previous studies in our laboratory that the bioavailability of P in the 2:1 blend of N-corn + N-SBM diet without phytase was 20% and in the 2:1 blend of LP-corn + LP-SBM without phytase was 55%, the addition of phytase to these two diets increased the estimated bioavailability of P to 43% and 73%, respectively. The results indicate that phytase, at 750 units/kg, converted approximately one-third of the unavailable P in both types of corn-SBM diets to an available form.

**Key Words:** Chicks, Phosphorus, Phytase

**W35 Influence of phytase enzyme supplementation on the growth performance of broiler chicks.** A. S. Hussein\* and A. M. Yousif, United Arab Emirates University College of Food Systems, Al-Ain, UAE.

The influence of phytase enzyme supplementation on the performance of broiler chicks fed starter diets containing varying levels of a commercial phytase enzyme (phyzyme, Finnfeeds Danisco Cultor) was investigated using low-phosphorus diets. Four replicate groups of eighteen commercial broiler chicks, one day old, were randomly assigned to each of the four dietary treatments. The diets were isonitrogenous (22.25% CP) and isocaloric (3.05 Mcal/kg). Diet 1 (Control) was a corn-soybean starter diet containing 1.0% Ca and 0.45% available P without added phytase enzyme. Diets 2, 3, and 4 were corn-soybean diets containing 1.0% Ca and 0.26% available P with 0, 500 and 1000 added phytase units/kg, respectively. Average body weight and feed intake were measured after 3 weeks and feed conversion ratio was calculated. Blood samples were obtained at the end of the three-week trial in order to measure plasma inorganic P, total Ca, Mg, K, Zn, Fe and Cu. Body weight gain of broiler chicks receiving a diet deficient in phosphorus (Diet 2) with no added phytase enzyme was significantly decreased ( $P < 0.05$ ) compared to the Control and the other treatments. Also, body weight gain of broiler chicks fed the Control (Diet 1) and the low-phosphorus diets with added phytase enzyme (Diets 3 and 4) was similar. Total feed intake and feed conversion ratio were not significantly affected between treatments. However, these parameters were depressed in the phosphorus-deficient treatment (Diet 2). The data showed that graded levels of phytase enzyme added to phosphorus-deficient broiler starter diets significantly increased body weight in a linear fashion.

**Key Words:** Phytase, Broilers, Growth Performance

**W36** The use of near-infrared reflectance spectroscopy to predict the moisture, dry matter, nitrogen, total phosphorus, and phytase phosphorus contents in broiler litter. R. I. Bakalli<sup>1</sup>, T. J. Frost<sup>2</sup>, G. M. Pesti\*<sup>1</sup>, J. P. Driver<sup>1</sup>, and H. M. Edwards, Jr.<sup>1</sup>, <sup>1</sup>University of Georgia Poultry Science Dept., Athens, <sup>2</sup>Gold Kist, Inc, Atlanta, GA.

One hundred thirteen litter samples were obtained from 9 commercial broiler houses in Georgia to develop calibrations for NIRS predictions of moisture, dry matter, total nitrogen, total phosphorus, and phytate phosphorus. The samples were scanned in a Feed & Forage Analyzer Model 5000 with near-infrared reflectance spectroscopy using routine operation and calibration software WIN ISI-IIc.

Table legend: n = Number of samples used in calibration set for regression. Means = Mean is the average of the constituent lab values used in the calibration. RSQ (R<sup>2</sup>) = Coefficient of determination. SD = Standard deviation among laboratory values. SEC = Standard error of calibration. SECV = Standard error of cross validation. 1-VR = Is 1 minus the variance or a correlation between the laboratory data and the cross validation results.

The sample compositions by chemical assay versus NIRS predictions were (mean±SE, CV%): moisture 6.15±0.18, 30.78 vs 5.99±0.16, 28.46; total dry matter 71.56±0.76, 28.46 vs 72.51±0.74, 10.85; total nitrogen 3.91±0.07, 17.98 vs 3.84±0.06, 15.89; total phosphorus 1.61±0.03, 22.16 vs 1.59±0.03, 22.21; phytate phosphorus 0.70±0.02, 31.00 vs 0.67±0.02, 25.02. NIRS can be a useful tool in the prediction of moisture, total dry matter, total nitrogen, total phosphorus and phytate phosphorus in litter samples from commercial broiler houses.

Results of the near-infrared reflectance spectroscopy calibration set for broiler litter composition

Constituent (%)	n	Mean	RSQ	SD	SEC	SECV	1-VR
Sample Moisture	49	5.83	0.917	1.936	0.559	0.800	0.838
House Dry Matter	49	71.15	0.943	10.049	2.399	4.043	0.845
Total Nitrogen	47	3.85	0.880	0.623	0.216	0.376	0.637
Total Phosphorus	46	1.55	0.966	0.354	0.066	0.098	0.926
Phytate Phosphorus	46	0.62	0.928	0.170	0.046	0.069	0.840

**Key Words:** Litter, Phosphorus, Nitrogen

**W37** Bioefficacy of probiotics in broiler diets. M. I. Gracia\*<sup>1</sup>, R. M. Engberg<sup>2</sup>, A. E. Espinel<sup>3</sup>, M. Cortés<sup>1</sup>, and F. Baucells<sup>1</sup>, <sup>1</sup>Imasde Agropecuaria, S.L., Spain, <sup>2</sup>Danish Institute of Agricultural Sciences, Denmark, <sup>3</sup>Norel, S.A., Spain.

Two experiments were conducted to evaluate the efficacy of dietary supplementation with probiotics on performance of broiler chickens. In each experiment, 720 Ross 208 d-old broilers distributed at random in 8 replicates of 30 birds per treatment were used. The experimental design was applied to a grower (0 to 21 d) and a finisher diet (21-42 d), both pelleted and based on wheat, barley and corn. In experiment I, there were three treatments, a basal diet (control) and two levels of inclusion of *Enterococcus faecium* CECT 4515 (containing 10<sup>9</sup> CFU/g product): 100 and 1,000 g/t. At 21 d of age, *E. faecium* supplementation at the higher dose significantly improved ADG (P<0.05) and feed conversion (FC) (P<0.001) (28.2, 28.9, 29.5 g/d, and 1.46, 1.43, 1.40 g feed/g gain; for control, 100g/t, and 1,000 g/t, respectively). However, significant differences disappeared thereafter. In experiment II, the same experimental design as in experiment I was applied with two levels of inclusion of *Bacillus coagulans* CECT 5940 (containing 10<sup>9</sup> CFU/g product): 100 and 1,000 g/t. At 21 d of age, *B. coagulans* supplementation at the higher dose significantly improved ADG (P<0.05) and FC (P<0.001) (28.2, 28.2, 29.2 g/d, and 1.46, 1.44, 1.42 g feed/g gain; for control, 100g/t, and 1,000 g/t, respectively). However, no differences between treatments were found at 42 d of age. These results indicate that the probiotics tested improve growth and FC until 21 d of age, but these improvements were not maintained thereafter.

**Key Words:** Probiotics, Performance, Broilers

**W38** Effect of a probiotic containing two *Lactobacillus* strains on growth performance and population of bacteria in the ceca and carcass rinse of broiler chickens. A. C. Murry, Jr.\*<sup>1</sup>, A. Hinton, Jr.<sup>2</sup>, and R. J. Buhr<sup>2</sup>, <sup>1</sup>The University of Georgia, Athens, <sup>2</sup>USDA/ARS.

This study was conducted to examine the effect of feeding a botanical probiotic (Feed Free™) containing two strains of *Lactobacillus* (*L. salivarius* and *L. plantarum*) on growth performance and bacteria populations in the ceca and carcass rinse of broiler chickens. Four hundred fifty day of hatch high yield strain male broiler chicks were placed into 20 pens with 30 broilers per pen. The dietary treatments were the basal diet (control with coccidiostat and antibiotic), basal diet without coccidiostat and antibiotic and supplemented with 0.10%, or 0.20% probiotic. The results showed that from 1 to 49 d of age body weight gain for broilers fed diets supplemented with 0.10% or 0.20% probiotic was not different (P > 0.05) from birds fed diets with or without coccidiostat and antibiotic. Feed intake and feed to gain ratio from 1 to 42 d of age were higher (P < 0.001) for broilers fed the control diet than for those fed 0.10% or 0.20% probiotic and those without coccidiostat and antibiotic. Feed intake and feed to gain ratio were not different (P > 0.05) between broilers fed 0.10% or 0.20% probiotic and those fed diets with and without coccidiostat and antibiotic. The population of *Campylobacter jejuni* and *Escherichia coli* recovered from carcass rinses at 56 d of age were not different (P > 0.05) due to treatment. Also, *Lactobacilli* and *Escherichia coli* recovered from ceca contents at 56 d of age for were not different (P > 0.05) due to treatment. These results suggest that diets supplemented with the natural probiotic containing *L. plantarum* and *L. salivarius* supports growth for broilers similar to the basal diet supplemented with antibiotic and coccidiostat, and with lower feed to gain ratio.

**Key Words:** Probiotic, Broiler Chickens, Growth Performance

**W39** Comparison of broiler performance when fed diets containing insect-protected (MON 88017 or MON 88017 x MON 810), control, or commercial corn. M. L. Taylor\*<sup>1</sup>, B. George<sup>2</sup>, Y. Hyun<sup>1</sup>, M. A. Nemeth<sup>1</sup>, K. Karunanandaa<sup>1</sup>, and G. F. Hartnell<sup>1</sup>, <sup>1</sup>Monsanto, Co., LLC, St. Louis, MO, <sup>2</sup>Colorado Quality Research, Inc, Wellington.

A 42-day study using Ross x Ross 508 broiler chickens was undertaken to compare the nutritional value of diets containing MON 88017 or MON 88107 x MON 810 corn as compared to those containing the genetically similar control corn or commercially available conventional varieties of corn. MON 88017 corn produces a variant of the wild-type Cry3Bb1 protein, that protects against feeding damage caused by corn rootworm larvae (CRW; *Diabrotica* sp.) and also produces the 5-enolpyruvylshikimate-3-phosphate synthase protein from *Agrobacterium* sp. strain CP4 (CP4 EPSPS), that confers tolerance to glyphosate, the active ingredient in the Roundup family of agricultural herbicides. MON 88017 was also conventionally bred with MON 810, which produces Cry1Ab protein from *Bacillus thuringiensis* subsp. *kurstaki* strain HD-1, protecting against feed damage from the European corn borer (*Ostrinia nubilalis*). Broilers were fed approximately 55% w/w corn grain in their diet for the first 20 days and approximately 60% w/w corn grain in their diet from day 21 to day 42. The only sources of dietary protein were corn and soybean meal supplemented with methionine and lysine. Feed and water were offered *ad libitum*. Eight treatments (5 male and 5 female pens/treatment with 10 birds/pen) were assigned using a randomized complete block design. The standard randomized block (ANOVA) statistical model was used to analyze the data. Performance parameters (gain, feed intake, and feed efficiency) and carcass measurements were not different (P > 0.05) across treatments. Likewise there were no differences for percentages of moisture, protein, and fat in breast meat and percentages of moisture and fat in thigh meat. Therefore, the diets containing grain of MON 88017 or MON 88017 x MON 810 were nutritionally equivalent to diets containing the conventional control or commercial corn grain when fed to broilers in this 42 day study.

**Key Words:** Corn, Broilers, Carcass

**W40 Comparison of broiler performance when fed diets containing corn with a combination of insect-protected (MON 863, MON 810) and glyphosate-tolerant (NK603) traits, control, and commercial corn.** M. L. Taylor<sup>\*1</sup>, B. George<sup>2</sup>, Y. Hyun<sup>1</sup>, M. A. Nemeth<sup>1</sup>, K. Karunanandaa<sup>1</sup>, and G. F. Hartnell<sup>1</sup>, <sup>1</sup>Monsanto Company, LLC, St. Louis, MO, <sup>2</sup>Colorado Quality Research, Wellington.

Growth performance and carcass measurements were evaluated in a 42-day study in which broilers (Ross x Ross 508) were fed either diets containing genetically modified corn containing transformation events MON 863, NK603, and MON 810 or MON 863 and NK603 (each combination produced by traditional breeding), a genetically similar conventional control, or five commercially available varieties of corn. MON 810 produces Cry1Ab protein isolated from *B. thuringiensis* that provides protection from feeding damage by the European corn borer (*Ostrinia nubilalis*), and MON 863 produces a variant of the wild-type Cry3Bb1 protein isolated from *B. thuringiensis* that protects against corn rootworm (CRW, *Diabrotica sp.*) root feeding damage. NK603 produces the 5-enolpyruvylshikimate-3-phosphate synthase protein from *Agrobacterium sp.* strain CP4 (CP4 EPSPS), which confers tolerance to glyphosate, the active ingredient in the Roundup family of agricultural herbicides. Broilers were fed approximately 55% w/w corn grain in their diet for the first 20 days and approximately 60% w/w corn grain in their diet from day 21 to day 42. Broilers were assigned to eight treatment groups, each consisting of 10 pens (5 male and five female) containing 10 birds/pen, using a randomized complete block design. No differences ( $P < 0.05$ ) were detected among treatment groups for feed intake, gain, feed conversion, adjusted feed conversion, thigh and breast meat composition and most carcass parameters. Breast weight (kg) and wing weight (% of chill weight) were different ( $P < 0.05$ ), however no differences were observed when breast weight and wing weight were expressed on % chill weight basis and weight basis, respectively. The diets containing MON 863 x MON 810 x NK603 or MON 863 x NK603 were nutritionally equivalent to diets containing the control and commercial corn grain when fed to broilers.

**Key Words:** Corn, Broilers, Carcass

**W41 Influence of cereal, heat processing of the cereal, and inclusion of fiber in the diet on performance of broilers.** E. Jimenez-Moreno<sup>1</sup>, J. M. González-Alvarado<sup>2</sup>, D. G. Valencia<sup>1</sup>, R. Lázaro<sup>1</sup>, and G. G. Mateos<sup>\*1</sup>, <sup>1</sup>Universidad Politécnica de Madrid, Spain, <sup>2</sup>Universidad Autónoma de Tlaxcala, Mexico.

We studied the effects of cereal, heat processing of the cereal (HP), and inclusion of fiber in the diet on productive performance of broilers from 1 to 21 d of age. The experimental design was completely at random with twelve treatments arranged factorially with two cereals (60% corn and 60% rice), two HP (raw and cooked at 90 C during 50 min and then rolled), and three fiber sources (absence, 3% oat hulls, and 3% soybean hulls). Each treatment was replicated three times (12 chicks caged together). Birds and feed consumption were recorded at 0, 4, 8, 14, and 21 d of age. The two control diets were based on soy protein concentrate, soy oil, and either corn or rice, and had 2.45 % and 1.54 % of crude fiber, respectively. In the fiber diets, hulls replaced the same quantity of an inert material. Broilers fed rice had better feed conversion (FC) throughout the trial than broilers fed corn (1.30 vs 1.35 at 21 d of age;  $P < 0.05$ ) but no significant differences were found for daily gain (ADG) (34.1 vs 33.6 g) or feed intake (44.3 vs 45.2 g). From 0 to 4 d of age HP of the cereal reduced ADG (12.3 vs 12.9 g;  $P < 0.01$ ) and impaired FC (1.25 vs 1.16;  $P < 0.01$ ) but the effects disappeared thereafter. It was observed that broilers fed rice wasted more feed than broilers fed corn. The inclusion of hulls in the diet tended to improve FC (1.19 vs 1.24,  $P < 0.10$ ) but the difference disappeared with age. From 0 to 4 d of age a significant interaction between cereal and HP was observed; HP reduced ADG and impaired FC in the corn diet but had opposite effect in the rice diet ( $P < 0.01$ ). We conclude that rice can be used successfully in diets for broilers and that HP of the cereal does not improve performance in corn-based diets. Also, the inclusion of additional fiber improves productive performance in chicks, specially during the first stages of life. Therefore, a minimum of dietary fiber is required in broiler diets.

**Key Words:** Rice, Heat Processing, Fiber Source

**W42 Effect of varied levels of expander cone pressure and dietary energy level on apparent metabolizable energy, nitrogen retention, and turkey poult performance during the period day 7 to 21.** K. J. Wilson<sup>\*</sup>, K. R. Cramer, J. S. Moritz, and R. S. Beyer, Department of Animal Science and Industry, Kansas State University, Manhattan.

Three levels of dietary energy consisting of 2557, 2690, and 2800 kcal ME/kg were combined with three levels of expander cone pressure consisting of 0, 200, and 400 lbs/in<sup>2</sup> (0, 14, and 28 kg/cm<sup>2</sup>). A conditioning temperature of 180° F (82° C) was used for all treatments. The pelleted feed was re-ground to a fine mash consistency using a hammermill equipped with a 1/8 in. (3.18mm) screen. The turkey poults were obtained from a commercial hatchery and placed on a low dietary energy ration for a 7-day pretest period. The experimental period consisted of day 7 through day 21 post hatching. There were 5 replicate pens containing 5 poults per pen. The poults were housed in Petersime battery brooders located in an environmentally controlled room. The poults were allowed ad libitum access to food and water. The calorie to protein ratio was not held constant in this experiment. Dietary crude protein levels were approximately 28 percent. There was a significant dietary energy effect on nitrogen corrected apparent metabolizable energy (AMEn), nitrogen retention (NR), and feed conversion (FC). The improvement in nitrogen retention as dietary energy increased was most likely due to a protein sparing effect. Feed conversion was improved by increasing the dietary energy level as has been previously demonstrated. Nitrogen retention was also improved by increasing the expander cone pressure level during feed manufacturing. Dietary AMEn tended to improve in the lower energy treatments as the level of cone pressure was increased during feed manufacturing although this was not statistically significant. Overall the results of this experiment indicate that hydrothermal processing of turkey starter diets may improve nutrient utilization and the potential improvement should be accounted for when formulating the diets to avoid any nutrient imbalances.

**Key Words:** AMEn, Expander Cone Pressure, Nitrogen Retention

**W43 Bioavailability of lysine and methionine in a broiler starter diet subjected to varied levels of expander cone pressure.** K. J. Wilson<sup>\*</sup>, K. R. Cramer, J. S. Moritz, and R. S. Beyer, Department of Animal Science and Industry, Kansas State University, Manhattan.

Five expander cone pressure levels were used in this experiment including 0, 100, 200, 300, and 400 pounds per square inch (PSI). The conditioning temperature for all treatments was 180 °F (82 °C). An unprocessed mash control was also included in this experiment. The 0-PSI treatment served as the standard feed conditioning/pelleting control. The pelleted feed was re-ground to a fine mash consistency and blended into semi-purified diets. Diets deficient in lysine and methionine were fed to establish standard curves in order to calculate bioavailability. Experiment 1 was conducted to evaluate the effect of increasing expander cone pressure on lysine bioavailability as measured by a broiler chick growth assay. Broiler performance responded favorably to increasing dietary lysine levels supplied either as synthetic lysine or from the test feed ( $P = 0.0001$ ). The relative bioavailability of lysine as measured by the standard curve methodology was unaffected by level of expander cone pressure or by thermal processing. Experiment 2 was conducted to evaluate the effect of increasing expander cone pressure on methionine bioavailability as measured by a broiler chick growth assay. Broiler performance responded favorably to increasing dietary methionine levels supplied either as synthetic methionine or from the test feed ( $P = 0.0001$ ). There were no significant differences in relative methionine bioavailability as measured by the standard curve method. Based on the results of these experiments the bioavailability of lysine and methionine was not affected by the feed processing levels used in these experiments.

**Key Words:** Bioavailability, Expander Cone Pressure, Lysine

**W44 Influence of expander cone pressure on apparent metabolizable energy, nitrogen retention and broiler performance during the starter phase.** K. J. Wilson<sup>\*</sup>, J. S. Moritz, K. R. Cramer, and R. S. Beyer, Department of Animal Science and Industry, Kansas State University, Manhattan.

In previous research, subjecting feed to increasing levels of expander cone pressure has resulted in an improvement in the physical quality

of the feed. In turn the improved feed physical quality has led to improvements in broiler performance. While the effects of annular gap expansion on feed physical quality and broiler performance have been shown, at this time, there is very little information concerning the nutritional effects of broiler feed subjected to annular gap expansion. Five expander cone pressure levels were used in this experiment including 0, 100, 200, 300, and 400 pounds per square inch (PSI). The conditioning temperature for all treatments was 180 °F (82 °C). An unprocessed mash control was also included in this experiment. The 0-PSI treatment served as the standard feed conditioning/pelleting control. The pelleted feed was re-ground to a fine mash consistency and blended in to a semi-purified diet at an inclusion level of 40 percent. The evaluation criteria included testing for treatment differences with respect to nitrogen corrected apparent metabolizable energy (AMEn) and nitrogen retention (NR). Broiler performance measurements were also collected during the experiment. Nitrogen retention was significantly improved by subjecting the feed to thermal processing compared to the mash control. There were no significant differences among treatments for AMEn or broiler performance measurements. Based on the results of this experiment, hydrothermal processing of broiler starter diets may improve nitrogen retention. The improvement in nitrogen retention might have important environmental implications due to the relationship between excess nitrogen excretion and ground water pollution.

**Key Words:** AMEn, Annular Gap Expansion, Nitrogen Retention

**W45 Effect of dietary putrescine (1, 4-diaminobutane) on the small intestine protein and deoxyribonucleic acid concentration and morphometric indices in turkey poults challenged with a mixed coccidial infection.** S. R. Girdhar\*, J. R. Barta, and T. K. Smith, *University of Guelph, Ontario, Canada.*

High cell turnover rates and recovery following mucosal damage to the intestinal epithelium is dependent on sustained supplies of mammalian polyamines. Supplemental dietary putrescine is known to partially overcome the adverse effects produced by anti-nutritional factors. Two experiments were conducted, therefore, to determine the potential for dietary putrescine to promote gastrointestinal tract development and overcome the effects of artificially induced subclinical coccidiosis using a mixed infection. In the first experiment, 450 day-old male poults were fed starter diets supplemented with 0.0 (control), 0.1, 0.2, 0.3 and 0.4% putrescine (30 birds per pen, 3 pens per diet) for 21 days. At the end of each week twelve poults per diet were sampled and intestinal tissue was excised for protein, DNA and morphometric analysis. In the second experiment 160 day-old male poults starter diet supplemented with 0.0 (control), 0.1, 0.2 and 0.3% putrescine (8 birds per pen, 5 pens per diet) for 24 days. At day 14, half the birds were infected with approximately 42,000 sporulated oocysts. Ten birds per diet from each of the unchallenged and challenged groups were sampled on day 6 and day 10 post-infection and tissues were excised and analyzed as described in the previous experiment. In experiment 1 and for the unchallenged group of experiment 2, the feeding of increasing concentrations of dietary putrescine resulted in no significant change in concentrations of protein or DNA. Significant morphometric changes from the feeding of increasing concentrations of putrescine were seen in various segments of the small intestine. In the challenged group of experiment 2, significant dietary effects were seen in protein and DNA concentrations as well as in the morphometric indices. It was concluded that supplementation of starter diets with up to 0.3% putrescine may minimize the adverse effects of coccidial infection.

**Key Words:** Putrescine, Coccidia, Turkey

**W46 Effect of conjugated linoleic acid on antioxidant enzyme activities and lipid peroxidation in the intestine and liver of growing broiler chickens.** I. S. Jang\*, Y. H. Ko, H. Y. Yang, and C. Y. Lee, *RAIRC, Jinju National University, Jinju, Korea.*

The present study was designed to investigate whether dietary conjugated linoleic acid (CLA) would affect the intestinal and hepatic antioxidant enzyme activity and lipid peroxidation in growing chickens. A total of twenty-four 3-wk-old male broiler chickens were fed one of three isocaloric grower-finisher diets containing 1.5% corn oil (Con), 0.75% corn oil plus 0.75% CLA, or 1.5% CLA for 2 wk beginning from d 22 of

age. The activities of superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), catalase (CAT) and glutathione S transferase (GST) and the concentrations of malondialdehyde (MDA), a marker of lipid peroxidation, in the intestine and liver of these animals were measured at sacrifice. The activities of SOD, GSH-Px, CAT, and GST in the small intestine were not influenced by the level of dietary CLA supplementation. Nor the concentrations of MDA in the mucosa of the proximal and distal segments of small intestine were affected by the dietary CLA supplementation. Hepatic SOD, GSH-Px, and GST activities and the MDA concentration of the 0.75%- and 1.5%-CLA groups also were not different from those of the Con diet group. However, supplementation of 1.5% CLA resulted in an increase in peroxisomal CAT activity and a marked decrease in concentrations of total lipid and non-esterified fatty acids in the liver compared with those of the Con diet group. This suggests that dietary CLA may influence the hepatic antioxidant defense system as well as lipid metabolism in growing chickens.

**Key Words:** CLA, Antioxidant, Chicken

**W47 Effect of early feed restriction on egg quality characteristics of Japanese quail.** G. Contreras\*, P. C. De la Rosa, C. B. Castro, J. J. Portillo, and F. G. Rios, *FMVZ-Universidad Autonoma de Sinaloa (Mexico, Carr. Culiacan-Mazatlan).*

One experiment was conducted to determine the effect of early feed restriction on egg quality characteristics of Japanese quail. The breeders were restricted in rearing during three weeks (two to five weeks old) at 0, 10, 20, and 30 %. After the feed restriction, the quails were allocated in two batteries with five levels, and each level with four cages. Each cage allocated six females and two males. Birds were fed a diet containing 21 % CP and 2.9 Mcal ME/kg. This size sample was determined by randomized sample with  $B = 0.04$  (estimation error) and  $\sigma^2 = 0.002$ , resulting 20 eggs measurement for treatment each week. The data were analyzed in a complete randomly design, and comparison means by orthogonal polynomials. Egg weight, dense albumin height and width, was not affected ( $P > 0.10$ ). Feed restriction increased ( $P < 0.01$ ) egg width by 1.07 % (26.58 vs. 26.86 mm), egg yolk height by 2.8 % (9.67 vs. 9.94 mm) and egg albumin height by 5.6 % (4.56 vs. 4.8 mm). Feed restriction increased ( $P < 0.01$ ) Haugh Units by 1.7 % (87.97 vs. 89.45), yolk index by 3.2 % (39.38 vs. 40.66), and shape index by 1 % (77.04 vs. 77.8). Shell weight and yolk width were different ( $P < 0.01$ ) between feed restriction levels, 1.99 vs. 1.92, and 1.9 g (10 vs. 20 and 30 %), and 24.35 vs. 24.69 and 24.78 mm (10 vs. 20 and 30 %), respectively. It is concluded, than early feed restriction at 10, 20 and 30 % levels, modifies the egg quality internal characteristics of Japanese quail.

**Key Words:** Food Deprivation, Egg Quality, *Coturnix coturnix japonica*

**W48 Effect of early feed restriction on productive performance and carcass characteristics of Japanese quail.** C. B. Castro, G. Contreras\*, F. G. Rios, and J. J. Portillo, *FMVZ - Universidad Autonoma de Sinaloa (Mexico) Carr. Culiacan-Mazatlan.*

This study was conducted to determine the effect of feed restriction (FR) during rearing period (two at five weeks old) on productive performance and carcass characteristics of Japanese quail. The experiment used sixty hundred Japanese quails (408 females and 192 males), two week old with an initial BW of  $79.89 \pm 8.2$  g. Treatments consisted of: 1) Feeding ad libitum (FA); 2) FR 10%; 3) FR 20 %, and 4) FR 30%, during three weeks, and each treatment with three repetitions. Quails were allocated in metallic wire crates (1 x 1 x 0.6 m) and were fed a diet containing 28 % CP and 2.9 Mcal ME/kg (Codoestartina#8482, Purina Mills, Co.). Feed intake was recorder daily and quails were weighted at starter and weekly (five weeks old). Weight gain was calculated by crate. At end of experiment ten quails from each treatment were slaughtered and carcass traits measured. The data body weight and carcass components were analyzed a completed randomized design experiment. BW was similar ( $P > 0.10$ ) with FA and FR 10 % (214.01 vs. 204.8 g) and diminished ( $P < 0.05$ ) by 18 % with FR 30 % (214.01 vs. 175.16 g). FR 10% and FR 20% shown similar values (204.8 vs. 200.3 g). Carcass weight was similar with FA and FR 10% (128.16 vs. 119.26 g), but decreased ( $P < 0.05$ ) by 10.8 % with FR 20% (128.16 vs. 114.36 g), and 26 % with FR 30% (128.16 vs. 94.87 g). Total lean weight was diminished ( $P < 0.05$ ) by 29 % with FR 30% (77.07 vs. 54.48 g). Total fat weight was decreased ( $P < 0.05$ ) by FR. Total bone weight was no affected ( $P > 0.10$ ) by treatments (33.31 g). Its concluded than early

feed restriction of 10 % maintain the productive response and carcass characteristics of Japanese quail.

**Key Words:** Food Deprivation, Carcass Composition, Coturnix Coturnix Japonica

**W49 Adding thymol to a broiler diet influences in vitro cecal fermentation and in vivo growth performances.** A. Piva\*, E. Grilli, G. Casadei, and G. Biagi, *DIMORFIPA - University of Bologna, Ozzano Emilia-Italy.*

Thymol and other essential oils have antimicrobial properties and may be considered among the alternatives to antibiotic growth promoters. We evaluated the effect of thymol in broiler in vitro cecal fermentations and broiler growth performances. In the in vitro study, broiler cecal inoculum was incubated for 24h in graduated syringes and vessels containing a standard predigested diet without or with thymol at 75, 150, 300, 600, 900, or 1200 ppm. Compared to control, total gas production was reduced by thymol at every concentration ( $P < 0.01$ ), being almost completely inhibited by thymol at 900 and 1200 ppm. The rate of gas production was reduced only when thymol was used at 900 and 1200 ppm ( $P < 0.01$ ). Ammonia concentration was lower than in control vessels ( $P < 0.01$ ) at 4 h when thymol was used at 1200 ppm (-27%) and at 8 h with thymol at 600 (-20%), 900 (-25%), and 1200 ppm (-21%); at 24 h, thymol at 150 (+29%), 300 (+28%), and 900 ppm (+33%) resulted in higher ammonia than control ( $P < 0.01$ ). In the vivo trial, 2160 female broilers (Ross 508) were divided immediately after birth into 4 groups (9 cages of 60 birds per group) and received a commercial diet with or without (control) the addition of thymol at 300, 600, or 900 ppm. Birds were fed ad libitum until the slaughtering age (39 d). Compared to control, the final live weight was higher when thymol was fed at 600 ppm (+2%) but lower when thymol was added at 300 (-5%) and 900 ppm (-2%;  $P < 0.01$ ). Feed efficiency was lower in birds receiving thymol at 300 (-6%) and 900 ppm (-2%;  $P < 0.01$ ) than in control birds. Daily feed intake and dressing out percentage were not influenced by thymol dose. Thymol influenced in vitro cecal fermentation, reducing total gas production and controlling proteolysis in the first 8 h of fermentation. Thymol at 600 ppm enhanced birds growth. Nevertheless, thymol had a negative effect on broiler growth and feed to gain ratio when used at 300 and 900 ppm.

**Key Words:** Broiler, Thymol, Essential Oils

**W50 Palm fatty acid distillate calcium soap as vegetable fat source for broiler diets.** J. Sánchez<sup>1</sup>, A. Gutiérrez<sup>2</sup>, J. I. Fernández<sup>3</sup>, D. Menoyo<sup>4</sup>, and P. Medel\*<sup>1</sup>, <sup>1</sup>*Imasde Agropecuaria, S.L., Spain*, <sup>2</sup>*Nutreco PRRC, Spain*, <sup>3</sup>*Norel, S.A., Spain*, <sup>4</sup>*Universidad Complutense de Madrid, Spain.*

A total of 1,170 Ross broilers (50 % male and 50 % female) were used to determine the effect of inclusion of palm fatty acid distillate (PFAD) calcium soap in the diet on performance and carcass quality. There were three treatments based on fat source: T1) control diet including soya oil (4.8 %), T2) PFAD calcium soap (5.1 %) and T3) PFAD calcium soap + glycerol (5.1 %). Treatments were applied to both starter (2,975 kcal AME/kg and 1.32 % lys, from 0 to 21 d) and grower (3,050 kcal AME/kg and 1.18 % lys, from 22 to 42 d) diets, which were calculated to be isonutritive among treatments. Each treatment was randomly assigned to 10 pens of 39 broilers each. From 0 to 21 d, control chicks grew 3 % more and showed better feed conversion than animals on T2 and T3 (38.5, 36.8 and 37.9 g/d and 1.33, 1.39 and 1.39 g/g for T1 to T3, respectively;  $P < 0.05$ ), but dietary treatment did not affect performance between 22 to 42 d. For the overall period, chicks on T3 ate 2.5 % more than chicks on T1 and T2 (110.2, 110.1 and 112.9 g/d for T1 to T3, respectively;  $P < 0.05$ ), but broilers fed soya oil showed 3 % better feed conversion (1.72, 1.76 and 1.77 g/g for T1 to T3, respectively,  $P < 0.05$ ). Animals fed T2 had lower BW and carcass weight than the others (2,688, 2,763 and 2,740 g and 2,165, 2,227 and 2,212 g for T1 to T3, respectively;  $P < 0.05$ ) but carcass yield did not differ among treatments (80.6, 80.6 and 80.7 %, for T1 to T3, respectively;  $P > 0.05$ ). It is concluded that i) PFAD calcium soap can be used as an alternative to soya oil, and ii) glycerol addition improves the feeding value of the PFAD calcium soap for broilers.

**Key Words:** PFAD Calcium Soap, Vegetable Fat Sources, Broilers

**W51 Use of palm fatty acid distillate calcium soap as a vegetable fat source for broiler diets.** M. I. Gracia\*<sup>1</sup>, A. Flores<sup>2</sup>, J. I. Fernández<sup>3</sup>, J. Peinado<sup>1</sup>, and C. López-Bote<sup>4</sup>, <sup>1</sup>*Imasde Agropecuaria, S.L., Spain*, <sup>2</sup>*Nutreco PRRC, Spain*, <sup>3</sup>*Norel, S.A., Spain*, <sup>4</sup>*Universidad Complutense de Madrid, Spain.*

A total of 1,170 Ross broilers (50 % male and 50 % female) were used to determine the effect of inclusion of palm fatty acid distillate (PFAD) calcium soap on performance and carcass quality. From 21 to 42 d of age there were three treatments (T1 to T3) depending on the level of substitution of 4.8 % soya oil by PFAD calcium soap in fat basis: 0, 50 and 100 %, respectively. All the birds were fed with a common starter diet from 0 to 21 d (2,975 kcal AME/kg and 1.32 % lys) and the experimental treatments were applied in the grower period under isoenergetic basis (3,200 kcal AME/kg and 1.18 % lys). Each treatment was randomly assigned to 10 pens of 39 broilers each. At 21 d BW was similar for all groups (851 g;  $P > 0.05$ ). From 22 to 42 d, chicks on T1 (soya oil) ate 4 % less than birds on T2 and T3 (162.4, 168.7 and 168.7 g/d for T1 to T3, respectively;  $P < 0.05$ ) and grew less than T2 animals, showing birds on T3 intermediate results (87.5, 90.2 and 88.8 g/d for T1 to T3, respectively;  $P < 0.05$ ). However, birds on T3 showed the worst feed conversion (1.86, 1.88 and 1.91 g/g for T1 to T3, respectively;  $P < 0.05$ ). Consequently, animals on T2 showed higher BW and carcass weight (2,709, 2,756 and 2,724 g and 2,183, 2,227 and 2,194 g for T1 to T3, respectively;  $P < 0.05$ ). However, carcass yield did not differ among treatments (80.8, 80.6 and 80.5 %, for T1 to T3 respectively;  $P > 0.05$ ). It is concluded that PFAD calcium soap could partially or totally replace the soya oil with limited effects on performance.

**Key Words:** PFAD Calcium Soap, Vegetable Fat Sources, Broilers

**W52 Processed Mucuna (*Mucuna pruriens*) seeds for broiler production.** E. A. Iyayi\* and M. Rodehutsord, *Institut für Ernährungswissenschaften, Halle, Germany.*

The ability of Mucuna (an unconventional plant protein source) to replace the conventional soy bean meal was the subject of this study since Mucuna seeds have recently been receiving attention as a potential feed for non-ruminants and food for man. Mucuna seeds were processed by dry heating (roasting) and milled. The meal was used to replace soy bean meal in a commercial broiler diet such that the diets had 0, 6, 12 and 18 g/kg of the roasted mucuna seed meal (RMSM). These levels corresponded to 0, 33.3, 66.7 and 100 % replacement of soy bean meal in the diets. Forty (40) one-week old broiler chicks were randomly allocated to each of the diets after their weights were equalized. Each diet had 5 replicates of 8 birds each. Incorporation of 6 g/kg RMSM in place of soy bean meal gave similar feed intake, body weight gain and efficiency of feed utilization in birds as the soy bean meal diet. But above this level (i.e. at 12 and 18 g/kg) these parameters were significantly ( $P < 0.05$ ) depressed. At the 6 g/kg inclusion level, the weights of air sacs, small and large intestines and ceaca were reduced significantly ( $P < 0.05$ ) while those of liver and spleen were significantly ( $P < 0.05$ ) increased. Histological examination of the organs showed that the higher inclusion levels of RMSM caused various degenerative syndromes in the organs possibly as a result of the disruptive properties of the antinutritional factors in Mucuna when fed at higher levels. Results of the study showed that Mucuna when roasted can replace only a third of the amount of soybean meal in broiler diet. Above this level, Mucuna exerts a negative effect on the performance of the birds.

**Key Words:** Mucuna, Broilers, Performance

**W53 Fat quality assessment of feed and pet food-grade poultry by-product meals.** W. A. Dozier, III\*<sup>1</sup>, N. M. Dale<sup>2</sup>, and A. F. Giesen<sup>3</sup>, <sup>1</sup>*USDA-ARS Poultry Research Unit, Mississippi State, MO*, <sup>2</sup>*The University of Georgia, Athens*, <sup>3</sup>*Novus International, Inc, St. Louis, MO.*

Poultry-by product meal (PBM) has long been a valuable protein source for poultry feeds. However, in recent years pet-food manufacturers have mandated to renderers that PBM be manufactured without "lower quality" by-product fractions, such as feathers, heads and paws. This has resulted in a higher protein "pet food-grade" product over conventional feed-grade PBM. It is presumed that the current "feed-grade" PBM is of lower quality and more variable, nutrient value, since the highest quality offal components have been diverted to pet food meals. In addition,

information is limited on the variation of fat quality between pet food and feed-grade PBM sources.

Forty-six PBM samples (25 = feed grade and 21 = pet food grade) were collected from commercial feed mills located in DE, GA, NC, SC, and VA during the winter and summer months of 2003. Sub-samples were analyzed for Initial Peroxide (IPV) (meq/kg), 4 and 20-hr active oxygen method peroxides (AOM) and Ethoxyquin (ppm). Average fat quality measurements for the Pet Food and Feed Grade PBM by season are shown below with their respective STD. The seasonal effect of high temperatures was apparent with extent of fat oxidation, regardless of PBM source. In those samples obtained in the winter, which had similar antioxidant content, the feed-grade samples were characterized by poorer fat stability. In the samples received in summer, when higher temperatures would be expected to negatively affect stability, the residual antioxidant present in the pet food meals was less than half that found in the feed-grade samples (64 vs. 164 ppm). All indicators of fat stability showed increased potential for rancidity in these pet food-grade samples, confirming that the highly unsaturated poultry fat in PBM requires adequate concentrations of antioxidant protection, even when meals are derived from prime offal components.

PBM	Season	IPV (meq/kg)	4-hr AOM (meq/kg)	20-hr AOM (meq/kg)	ETH (ppm)
Pet Food					
Grade	Winter	3.3±8.1	2.1±3.7	1.2±1.1	138.8±142.9
	Summer	123.9±118.1	68.4±62.6	59.5±55.9	63.8±62.2
Feed					
Grade	Winter	72.8±118.8	3.0±2.3	3.2±1.9	115.9±106.8
	Summer	20.4±42.6	2.57±5.1	7.4±9.1	164.0±134.8

**Key Words:** Poultry By-Product Meal, Pet-Food, Feed

#### W54 Influence of boiling, Biogen or spices mixture to Mangrove leaves on performance of egg type pullets.

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450 Lohmman Egg strain female chicks were randomly distributed to 15 dietary treatments each contained 3 replicates of 10 pullets and 3 levels of Mangrove leaves (ML) (0, 5 and 10%), which was included as raw or boiled for 15 minutes. Therefore, there were 5 main isocaloric and isonitrogenous experimental diets. Each diet was fed with or without Biogen or a spice mixture (SM) (1:1:1) of cardamom, cumin, hot and black pepper supplementation. ML had no adverse effect on pullets growth, feed consumption (FC), feed conversion ratio (FCR) and mortality rate during 8-20 wks of age. However, including 10% of ML in pullet diets significantly increased FC of ML and increased water consumption significantly. Boiling treatment increased significantly growth and improved FCR of pullets by 3% and did not significantly affect FC. Boiling treatment significantly increased water consumption by 11.9%. Biogen or SM had no enhancing effect on growth and FC of pullets; however FCR and water consumption tended to improve insignificantly due to addition of Biogen and SM with spices being more effective. ML at 5 and 10% resulted in 16.7 and 31% reduction in laying rate, egg mass and FCR, respectively. The improvements in egg laying rate due to Biogen and SM equaled 11.7, 11.5, 19 and 17.4% for groups fed diet containing 5 and 10% ML, respectively with egg mass and FCR following a similar trend. SM increased egg weight significantly compared to the control and Biogen groups. SM significantly decreased weight and percentage of ovary and only weight of oviduct, while increased the weight and percentage of spleen. ML had no adverse effect on interior quality of eggs stored for 8 weeks in the fridge. In conclusion, ML could be included in the pullet and laying diets at 5% when supplemented with SM without adversely affecting performances.

**Key Words:** Mangrove Leaves, Feed Additives, Spices

#### W55 Effects of Hippophae Rhomnoides fruit extract supplementation on egg quality and performance of layers in the wheat-based diet. F. Liu\*, J. Fu, and Z. Niu, *North-west sci-tech university of agriculture & forestry, Yangling, China.*

The objective of this experiment was to evaluate the effect of a natural pigment additive (AY) extracted from Hippophae Rhomnoides fruits on egg quality and performance of laying hens in the wheat-based diet. 480 Lohmann commercial layers at 53 weeks of age were divided into five groups, each of three replicates. The diets were based wheat-soybean meal supplemented with 0.0%, 0.5%, 1.0%, 2.0%, 4.0% resp.. The birds were reared in cages for 21 days. The results showed that: (1) The RFC value was significantly improved when AY in diet was more than 1.0% ( $p < 0.05$ ), and achieved 6.6 at AY 4.0%. L-value was decreased with increase in level of AY ( $p < 0.01$ ), but both a-value (red) and b-value (yellow) were significantly increased ( $p < 0.01$ ). (2) The carotenoid content in egg yolk was linearly increased with the level of AY in the diets ( $p < 0.01$ ), but the concentration of cholesterol was significantly reduced ( $p < 0.05$ ). (3) There were no significant influences of addition of AY on laying rate, egg size, egg mass, feed intake, and feed conversion of laying hens in the wheat-based diet ( $p > 0.05$ ).

**Key Words:** Natural Pigment Additive, Egg Quality, Laying Hen

#### W56 The effects of inclusion of a fermented fish by product meal in Guinea fowl (*Numida meleagris*) diets on performance and carcass quality. M. Argüelles\*, H. L. Santiago, and A. A. Rodríguez, *Department of Animal Science, University of Puerto Rico - Mayaguez Campus, Mayaguez.*

Guinea fowl (*Numida meleagris*) is a poultry species suitable for use in meat production to expand and diversify the local poultry industry due to its consumer acceptance, resistance to common poultry diseases, and tolerance to poor management conditions. However, the poor feed conversion of this species increases feed costs and limits production. To reduce feed costs it is imperative to find feedstuffs of low cost but with adequate nutritional value. The use of a fermented fish by-product meal (FFBPM) as a protein source in guinea diets could satisfy these criteria and reduce feed costs. The objective of this study was to evaluate the effects of the inclusion of a FFBPM in guinea diets on bird performance and carcass quality. Treatments consisted of FFBPM inclusion at 0 (control), 5, and 10% in each of the starter, grower, and finisher rations. Feed and birds were weighed at 0, 35, 63, and 84 d to determine body weight (BW) and feed conversion (FC). At 84 d, 90 birds were processed to evaluate carcass composition and to determine yields of carcass and major cuts. Their fasted live BW, plucked and dressed carcass weights were recorded and yields calculated. No differences in BW were observed among treatments at 0, 63, and 84 d. At 35 d BW was lower ( $P < .05$ ) in birds with a 10% FFBPM inclusion. FC was also higher with 10% FFBPM and lower in control birds, while those receiving 5% FFBPM did not differ from the other treatments. Birds fed 10% FFBPM showed lower ( $P < .05$ ) live, plucked, and dressed weights than control and 5% FFBPM birds. No differences ( $P = .05$ ) among treatments were observed in yields of dressed carcass, major cuts, and the proportion of flesh, skin, and bone. However, the percentage of abdominal fats was lower ( $P < .05$ ) in birds fed a 10% FFBPM when compared to the control and 5% FFBPM level. The results of this study indicate that the inclusion of up to 5% FFBPM in guinea diets has no detrimental effect on bird performance and carcass quality. Thus, FFBPM could be a valuable feed ingredient to supply part of the dietary protein requirements of guinea fowl.

**Key Words:** Guinea Fowl, Growth, Fermented Fish

#### W57 Inclusion of coconut meal in broiler initial diets. S. Bastos, M. de F. Fuentes\*, and E. Freitas, *Universidade Federal do Ceará Departamento de Zootecnia, Fortaleza, CE, Brazil.*

Coconut meal (CM) is considered an alternative to soybean meal as a protein ingredient for animal feed. The objective of this work was to evaluate the performance of broiler in the initial period (7 to 21 days of age) fed diets containing different levels of CM. 576 broilers males from a commercial line with seven days of age and similar body weight were distributed at random among six treatments with eight replicates of twelve birds each. Treatments consisted of six diets containing 0; 3.5;

7.0; 10.5; 14.0 and 17.5% of CM. Diets were based on corn and soybean meal and were isoproteic (21% CP) and isocaloric (2950 kcalME/kg). Regression analysis excluding diet with 0% of CM showed that feed intake ( $y = 1047 - 0.004x$ ;  $R^2 = 24.67$ ) and weight gain ( $y = 684.89 - 7.20x$ ;  $R^2 = 68.57$ ) decreased linearly as CM increased in diets. However for feed conversion there was a quadratic effect ( $y = 1.66 - 0.02x + 0.002x^2$ ;  $R^2 = 53.75$ ) and 5% was the maximum level of CM inclusion according to this variable. In relation to diet without CM, Dunnett's test (5%) indicated that all levels of CM used reduced weight gain and feed conversion. These results can be attributed in part to the high fiber content of CM, which lowered feed consumption and nutrient absorption by birds. It can be concluded that CM can be included in levels up to 5% in diets for broilers with 7 to 21 days of age.

**Key Words:** Coconut Meal, Weight Gain, Feed Intake

**W58 Pea, Faba beans and Lupin as an alternative protein source in broiler diet.** M. Moschini<sup>1</sup>, F. Masoero<sup>1</sup>, A. Prandini<sup>1</sup>, M. Morlacchini<sup>2</sup>, G. Fusconi<sup>2</sup>, and G. Piva<sup>1</sup>, <sup>1</sup>Università Cattolica del Sacro Cuore, del Sacro Cuore Via Emilia Parmense, Piacenza, Italy, <sup>2</sup>CERZOO, San Bonico, Piacenza, Italy.

The problems of meat and bone meal and transgenic feeds poses a challenge to animal nutritionist in Europe. The challenge is to find home-grown protein-rich feedstuffs, making sure no antinutritional factors are present that could interfere in the animals' performance. The raw Pea (*Pisum sativum*) (RP), raw Faba beans (*Vicia faba*, variety minor) (RFb) and raw Lupin (*Lupinus albus*, variety multitalia) (RL) were evaluated as an alternative protein sources in broiler diets. 630 Ross 1 d-old male Marek vaccinated chicks were randomly assigned to seven dietary treatments (5 pens per treatment/18 birds per pen). Chicks were floor housed, ad libitum fed isocaloric and isonitrogenous diets and had free access to water. Artificial light was provided 10 h/d. The bulk of the base diet (control diet) was corn (48.7%, 56.6% and 57%), solvent-extracted soybean meal (42.8%, 37.3% and 33.4%), corn oil (4.4%, 5.2% and 6.3%), plus synthetic amino acids, minerals, trace minerals and vitamins, respectively for the 1-10 d-old, 11-28 d-old and 29 to 42 d-old growing periods. The RP, RFb and RL entered the diets in substitution of the soybean and corn according to the cost optimization in diet formulation (P100, Fb100 and L100, respectively for RP, RFb and RL) and at the half of the optimized quantity (P50, Fb50 and L50, respectively for RP, RFb and RL). The amount used as fed basis were: P100: 350 g/kg for all diets; Fb100: 480 g/kg (1-10 d-old) and 500 g/kg (11-42 d-old); L100: 360 g/kg (1-10 d-old) and 300 g/kg (11-42 d-old). At the end of the trial (42d) the percentage yields of breast meat and leg quarters were measured in one animal for each experimental unit for all treatments. Bird mortality was recorded daily and dead birds were removed and weight was recorded. The pen average daily intake (ADI) and average daily gain (ADG) were calculated and adjusted feed to gain ration (F:G) was obtained. The ADG, ADI, F:G, breast yield and leg quarter were not statistically affected by the treatment diets. Data suggest partial substitution of soybean with RP, RFb or RL had no effect on animal performance and could represent an alternative valuable protein source in broiler diet formulation.

**Key Words:** Alternative, Protein Source, Poultry

**W59 Influence of a paprika extract supplementaion on egg yolk color and performance of laying hens.** Z. Niu\*, J. Fu, and F. Liu, College of Animal Science & Technology, Northwest Sci-Tech University of Agriculture & Forestry, Yangling, China.

This experiment was conducted to evaluate the effects of AR(pigment additive extracted from paprika) on egg yolk color, and laying performance of hens in a wheat-based diet. 480 Lohmann commercial layers at 53 weeks of age were divided into 5 groups, each of 6 replicates, to feed for 21 days. The experimental diets were based on wheat-soybean meal supplemented with 0%, 0.1%, 0.2%, 0.4%, 0.8% AR resp.. The results showed that: (1) AR caused an increase in egg yolk pigmentation. RFC

achieved 9.9 when added 0.8% AR in diet. (2) with an increase in adding AR from 0 to 0.8%, a-value (red) increased quickly ( $p < 0.01$ ), L-value decreased largely ( $p < 0.05$ ), and b-value reduced slightly ( $p > 0.05$ ). (3) The total carotenoids deposition in egg yolk showed a proportionally greater increase with increasing AR level in diet. There were no significant influence of AR supplementation on laying rate, egg size, and feed conversion of hens.

**Key Words:** Paprika Pigment, Egg Yolk Color, Laying Hen

**W60 Fermenting sludge from a broiler processing plant: Effect of inoculation with lactic acid-producing bacteria.** S. Pagán\*, R. Sanabria, A. A. Rodríguez, and M. Pagán\*, University of Puerto Rico - Mayaguez Campus, Department of Animal Science, Mayaguez.

The effects of adding a commercial lactic acid-producing bacterial inoculant (LAPBI) on the fermentation characteristics of sludge from a broiler processing plant (SBPP) was determined. The SBPP was mixed with 20% (w/w) cane molasses and assigned to two treatments: no additive (control) and LAPBI applied at 106 cfu/g of fresh material. Mixtures were placed in lab micro-silos (1.2 kg capacity) under anaerobic conditions and maintained at room temperature (28-30°C). Three samples per treatment were collected after 0, 4, 8, 12, 15 and, 21 d and analyzed for pH, chemical composition, microbial succession and fermentation products. Data was analyzed as a completely randomized design with a 2 (with or without LAPBI) x 6 (fermentation periods) factorial arrangement of treatments. The Bonferroni t-test was used for mean separation. Final pH of SBPP fermented with or without LAPBI was similar ( $P < .05$ , 3.8 vs 3.87) after 21 d of fermentation. For both treatments, coliforms and lactic acid producing bacteria populations were similar ( $P < .05$ ) at the end of the fermentation process, but yeast and molds were higher ( $P < .05$ ) in SBPP with LAPBI. Chemical composition of the final product indicates no differences between treatments. Lactic and acetic acid content were higher ( $P < .05$ ) in non inoculated sludge compared to sludge with LAPBI. However, for both treatments values for lactic acid at the end of fermentation were indicative of good quality silage. In summary, utilization of LAPBI may not be necessary to ferment SBPP with cane molasses to obtain a stable product.

**Key Words:** Lactic Acid-Producing Bacteria, Sludge, Anaerobic Fermentation

**W61 Assessment of essential oils as potential substitutes for dietary antibiotics.** W. Si<sup>1</sup>, J. Gong<sup>1</sup>, R. Cao<sup>1</sup>, T. Zhou<sup>1</sup>, H. Yu<sup>1</sup>, C. Poppe<sup>2</sup>, R. Johnson<sup>2</sup>, and W. Du<sup>3</sup>, <sup>1</sup>Food Research Program, Agriculture and Agri-Food Canada, Guelph, Ontario, <sup>2</sup>Laboratory for Foodborne Zoonoses, Health Canada, Guelph, Ontario, <sup>3</sup>Ontario Ministry of Agriculture and Food, Guelph, Canada.

The concerns over the use of antibiotics in-feed and their contribution to the development of antibiotic resistance have stimulated research in developing antibiotic-replacement. Some essential oils have demonstrated strong antimicrobial activity. In this study, *Salmonella typhimurium* DT104, *E. coli* O157:H7 and K88 were used as target pathogens to evaluate the effect of essential oils. Among 66 essential oils and related chemicals, 14 exhibited more than 80% inhibition against both pathogens. Minimum Inhibitory Concentrations were determined for 9 essential oils/compounds. Cinnamon, clove, geraniol, and thymol were most potent against both pathogens. The effect of the essential oils/compounds on the isolates of beneficial bacteria, such as *Lactobacilli*, was also examined. No significant inhibition was observed. The influence of selected essential oils on the normal gut flora and their potency to inhibit the target pathogens in the presence of digesta are under investigation. Our in vitro assessment suggests the potential of essential oils and related chemicals as the substitutes for dietary antibiotics although in vivo studies are required to verify our in vitro observations

**Key Words:** Essential Oil, E. Coli, S. Typhimurium