Do we properly formulate pelleted rations for broiler chickens? F. C. Tavernari1, G. J. M. Lima1, V. R. S. M. Barros2, R. C. Maia3, and L. F. T. Albino1, 1Embrapa Swine and Poultry, Concordia, Santa Catarina, Brazil, 2Federal University of Viçosa, Viçosa, Minas Gerais, Brazil.

Most diets for broilers are pelleted in Brazil. However, knowledge about feed ingredients and nutritional requirements are still obtained using mash diets. Therefore, the objective of this research was to evaluate amino acid digestibility and apparent metabolizable energy (AME) of a diet, both mash and pelleted, for male broilers (COBB-500) in the initial (8 to 21 d) and finishing (22 to 42 d) phases. In the first trial, AME determination was performed by total excreta collection (12 to 16 and 30 to 34 d of age) with 2 treatments (mash or pelleted diets, based on corn and soybean meal) and 30 6 replicates with 10 birds per treatment. In the second trial, amino acid apparent digestibility coefficients (AADC) were determined after slaughtering and ileal digesta collection on d 14 and 32, in 6 replicates of 4 birds per treatment each time. Both trials were in RCB design and F test was used. In the initial phase, pelleted diet AME was higher (P < 0.01) on dry matter basis (DM) than mash diet AME (3,384 and 3,352 kcal/kg), but there were no differences (P > 0.05) in the finishing phase (3,515 and 3,513 kcal/kg). Pelleted diet AME were lower (P < 0.01) than mash diets in as-fed basis in both phases. This can be explained by the decrease in DM with the use of steamed heat during pelleting. Higher (P < 0.05) AADC were observed for all amino acids evaluated, except cystine and tyrosine, in pelleted rations in the initial phase, either in DM or as-fed basis. On the other hand, there were no differences (P > 0.05) in AADC between the 2 diet forms, both in DM and as-fed basis during the second phase, except for tyrosine. Differences between phases may be partially explained by the development of the gastrointestinal tract with age. Therefore, pelleted diets show better AADC and AME for young broilers and it is necessary to correct nutritional values during feed formulation when feeds are pelleted, especially due to differences between DM and as-fed basis.

Key Words: cottonseed meal, laying hens, ME, amino acid digestibility, NIRS

Assessment of metabolizable energy and amino acid digestibility of cottonseed meal on Lohmann hens by NIRS. M. D. Hui1, G. Jia2, K. Y. Zhang1, X. M. Ding1, A. Sarsour2, and E. O. Oviedo-Rondon1, 1Animal Nutrition Institute of Sichuan Agricultural University, Sichuan, Ya’an, China, 2North Carolina State University, Raleigh, NC.

Near-infrared spectroscopy (NIRS) can minimize cost and reduce time to estimate nutrient values. One experiment was conducted using laying hens to determine ME and total-tract apparent amino acid digestibility (TAAAD) of 30 different sources of cotton meals (CSM). Additionally, the NIRS calibrations were established to predict ME and TAAAD of CSM for layer feeds. The experiment was conducted using the substitution method and total excreta collection. A completely randomized design was used with a total of 248 Lohmann laying hens (40 wk old) with initial BW of 1.71 ± 0.12 kg. Hens were divided into 31 treatments with 8 replicates each. Hens were housed individually in metabolic cages. The control diet consisted of a corn-soybean meal diet and the 30 test diets were supplemented with 30 different CSM sources at a concentration of 200 g/kg. After 7 d of dietary adaption, excreta was collected 3 times a day and lasted for 4 d, freeze-dried, and analyzed for dry matter (DM), nitrogen, gross energy, and amino acids. The ME and TAAAD were calculated using the general procedure and a predictive model was built using NIRS readings. Results of the experiment showed no significant effects of treatments on laying rate (89.30 ± 0.06%) and egg quality. The average ME of the 30 sources of CSM was 3,129 ± 459 kcal/kg DM, ranging from 2,290 kcal/kg to 3,562 kcal/kg. The TAAAD was 92 ± 2%, ranging from 86.2% to 94.7%. The prediction equations estimated to calibrate NIRS for ME and TAAAD had R2 of 0.98, 0.95, and 0.91 for AME, CP and TAAAD, respectively. The R2 for essential TAAAD such as threonine, isoleucine, leucine, phenylalanine, histidine, and arginine were 0.96, 0.98, 0.99, 0.99, 0.99 and 0.98, respectively. The R2 of the models for lysine and total sulfur amino acids were lower than 0.50 and not used for predictions. The ME and TAAAD of the 30 sources of CSM for laying hens were significantly different. NIRS can be used to establish accurate prediction models to rapidly estimate ME and TAAAD of CSM from different sources to be used in layer diets.

Key Words: cottonseed meal, laying hens, ME, amino acid digestibility, NIRS

Improved prediction of amino acids digestibility and metabolizable energy content in soybean meal and full-fat soybean for broilers. S. F. Castro1, A. G. Bertechina2, L. V. Teixeira1, H. Mazzuco2, and B. G. Amorin1, 1Universidade Federal de Lavras, Lavras, MG, Brazil, 2EMBRAPA, Concordia, SC, Brazil.

This study evaluated if a modification method for energy and AA digestibility analysis can predict more accurately apparent metabolizable energy (AME), nitrogen-corrected apparent metabolizable energy (AMEn), apparent ileal digestible energy (AIDE) and apparent ileal AA digestibility (AIAAD) for all AA values of soybean meal and full-fat soybean (toasted and ground) for broilers. Two experiments run with a total 256 birds each, being 160 birds with 14 to 21d of age, and 96 birds with 35 to 42d of age, testing the ingredients. The test ingredients were measured by total excreta and ileal digesta collection and replaced in 30% a corn-soybean meal basal diet including nutritional adjustments to energy, Ca, P, Na, vitamins and microminerals of soybean meal diet and, to Ca, P, Na, DL-Met (99%), vitamins and microminerals of full-fat soybean diet. Celite marker was used for ileal digestibility. Birds were randomly allocated in a 2 × 2 factorial scheme (age vs. method), 8 replicates and 5 or 3 birds/replicate. No significant differences (P > 0.05) were found on age by method interaction. Higher values (P < 0.05) were observed for evaluations with 42 d of age. Using nutritional adjustments (method), increments (P < 0.05) in the following variables were observed at 21 d: AME (2,383 vs. 2,301 kcal/kg), AMEn (2,294 vs. 2,244 kcal/kg), AIDE (3,043 vs. 2,934 kcal/kg), AIAAD (85.93 vs 83.44%) for soybean meal, and AME (3,462 vs. 3,371 kcal/kg); AMEn (3,323 vs. 3,236 kcal/kg), AIDE (3,079 vs. 2,306 kcal/kg), AIAAD (86.00 vs. 83.37%) for soybean meal. In the following variables were observed at 35 d: AME (2,383 vs. 2,301 kcal/kg), AMEn (2,294 vs. 2,244 kcal/kg), AIDE (3,043 vs. 2,934 kcal/kg), AIAAD (85.93 vs 83.44%) for soybean meal, and AME (3,462 vs. 3,371 kcal/kg); AMEn (3,323 vs. 3,236 kcal/kg), AIDE (3,079 vs. 2,306 kcal/kg), AIAAD (86.00 vs. 83.37%) for soybean meal and for full-fat soybean, AME (3,481 vs. 3,376 kcal/kg), AMEn (3,306 vs. 3,251 kcal/kg), AIDE (4,069 vs. 3,868 kcal/kg) and AIAAD (88.66 vs. 87.05%). The nutritional adjustments during the measurement of energy and AA digestibility provide more suitable values to be applied in practical formulation diets for the broilers industry.

Key Words: ileal digestibility, AMEn, practical formulation
The presented work is the result of further exploration of “Light Turkey Syndrome” (LTS) from a nutrition standpoint. Observations from field trials indicated that heavier poultse appeared to have a faster maturing and healthier immune system. Access to food and appropriate nutrition are critical to the development of gut for digestion and immunity. The objectives were to determine the influence of Threonine (Thr) and amino acid density on performance of male poultse originating from early (E) and late (L) lay breeders. The design of each study (CRD with 6 replicate pens per treatment combination) was similar with 2 formulation periods (0–2 and 2–6 wk) followed by rearing the turkeys (Nicholas, Large White) in a group setting and fed commercial diets after 6 wk of age to market. BW was taken at the end of each period and at 18 wks. The gastrointestinal tract was weighed and length measured to assess growth; jejunal sections were taken for histology. Performance was analyzed using ANOVA. In experiment 1, different ratios of Thr to Lysine (Lys) (digestible, d) were used to formulate corn-soy based diets with a range in ratio of 54 to 66% using supplemental Thr. In experiment 2, 4 diets with different amino acid densities were formulated using the ratio of dThr to dLys of 58%. Diets were formulated on an ideal amino acid basis with dThr ranging from NRC (1994) and increasing to Nicholas recommendations (L1, L2, L3, L4). In experiment 1, no interaction of Thr and poult source was detected. BW was affected by the ratio (P < 0.0001) to 2 wk of age with no carry over effect at 18 wk of age. The optimal ratio of dThr to dLys was 58%. Poultse from E had lowered BW at placement and 18 wk (P < 0.0001). In Experiment 2, amino acid density affected BW to 6 wk of age and then to 18 wk (P < 0.001). Intestinal weight and length responded in a non-linear manner. BW at 2 wk was maximum for E poultse fed L2 and L poultse fed L3 diet. At 6 wk, E and L poultse responded with maximum BW when fed L3. Poultse from E had lowered BW at placement but BW at 6 and 18 wks was not different from L poultse. Starting diet amino acid density played the largest role in terms of early nutrition affecting market BW.

Key Words: turkey, threonine, early nutrition, breeder


Implementation of the factorial method depends on the determination of the coefficients that express the requirements for maintenance of dietary amino acids obtained from nitrogen balance studies. Thus, this study aimed to estimate the essential amino acid profile for maintenance of poultry using the deletion method. A nitrogen balance trial was conducted using 138 Cobb roosters, housed individually in metabolic cages. The treatments were 23 purified diets being 11 diets providing a high protein intake of 500 mg N/kg<sup>0.75</sup>/d and 11 diets providing a low protein intake of 250 mg N/kg<sup>0.75</sup>/d, in each one amino acid was made specifically deficient (50% of amino acid requirements from Leveille studies) and a protein-free diet was also provided. Each treatment had 6 replicates. After 48 h of fasting, the roosters were fed 40 g of the diets by forced feeding once a day for 3 d. The excreta were collected within 7 h after the first feeding. The diets and excreta were analyzed for nitrogen content. For each amino acid studied a linear regressions was fitted by nitrogen balance (nitrogen intake - excretion) and amino acid intake. The maintenance requirements were estimated as the amino acid intake to maintain the nitrogen balance equal to zero. The daily amino acid requirements for maintenance were estimated to be (mg/kg<sup>0.75</sup>): Lys 10, Met 39, Thr 27, Trp 7, Arg 50, Val 26, His 3, Gly 37, Phe 31, Leu 53 and Ile 29. However, because amino acid requirements for maintenance are more closely related to body protein (BP) content (estimated in the present study to be 160 g/kg) the scale mg/ BP<sup>0.73</sup>/d (which accounts for metabolic protein weight) was preferred for expressing maintenance requirements because there is no demand of amino acids for maintenance of lipid reserves. Therefore, the daily amino acid requirements were concluded to be Lys 38, Met 140, Thr 98, Trp 27, Arg 181, Val 95, His 12, Gly 134, Phe 111, Leu 193 and Ile 107. The methodology used in this study provides a more considered theoretical and metodological basis for measuring essential amino acid profile for maintenance of poultry.

Key Words: amino acid, maintenance, nitrogen balance, purified diet, rooster
The aim of this study was to determine the digestible total sulfur amino acid (TSAA) requirement of light pullets from 1 to 6 wk of age by their effect on the histophysiological parameters. A total of 1,080 birds were distributed in a completely randomized block design with 6 treatments and 6 replicates of 30 birds each. Dietary treatments included one positive control diet formulated to meet the NRC (1994) recommendation for digestible TSAA, and 5 other diets formulated with 80, 90, 100, 110, and 120% of the digestible TSAA requirement level suggested by the Brazilian Tables for Poultry and Swine. Measurement of the organs (liver and spleen), histopathological examination of the liver, intestine, magnum, uterus and kidney and serological analysis (serum albumin, creatinine, protein, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma-glutamyltransferase (GGT)) were assessed during experimentation. The histological studies revealed that high Met + Cys supplementation (110 and 120% groups) increased glycogen storage in the liver (hepatic way of energy storage). Those treatments also showed an increased serum protein content and higher spleen weight. Conversely, increase in methionine supplementation does not induce hepatic damage because the hepatic enzymes (AST, ALT) were not affected even at higher levels and GGT was even decreased with 120% of methionine plus cystine supplementation. The serum creatinine level in the different treatments demonstrated lack of renal lesions. Digestible methionine plus cystine requirement was thus estimated at 0.702% for light pullets in the period from 1 to 6 weeks of age.

Key Words: sulfur amino acids, reproductive system, tract digestive, laying hens, nutritional requirements

342P Determination of dietary methionine + cystine requirements in pullets through on histophysiological parameters: 7 to 12 weeks of age. F. G. P. Costa*, 1 J. P. F. Junior, 1 P. A. Geraert 2, Y. Mercier 2, M. L. Ceccantini 2, M. H. M. Santana 1, S. B. Neto 1, and R. R. Guerra 3, 1Federal University of Paraíba, Areia, Paraíba, Brazil, 2Adisseo France SAS, Antony, France, 3Adisseo South America, São Paulo, SP, Brazil.

The aim of this study was to determine the digestible total sulfur amino acid (TSAA) requirement of light pullets from 7 to 12 wk of age by their effect on the histophysiological parameters. A total of 540 birds were distributed in a completely randomized block design with 6 treatments and 6 replicates of 15 birds each. Dietary treatments included one positive control diet formulated to meet the NRC (1994) recommendation for digestible TSAA, and 5 other diets formulated with 80, 90, 100, 110, and 120% of the digestible TSAA suggested by the Brazilian Tables for Poultry and Swine. Measurement of the live weight, weight without viscera and organs (liver and spleen), histopathological examination of the liver, intestine, magnum, uterus and kidney and serological analysis (serum albumin, creatinine, protein, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma-glutamyltransferase (GGT)) were assessed during experimentation. Animals receiving the higher methionine supplementation tends to have lighter body weight, heavier liver as well as larger spleen. In addition, the weight without viscera tended to be greater with the methionine supplementation. There was an increase of goblet cells number (mucus producer) and production in the epithelium of intestinal villi with the increase of methionine

Key Words: antibiotic, broiler, total sulfur AA

340P Digestible lysine and methionine + cystine levels on carcass yield and morphology of pectoral muscle of broilers at 22 to 42 days old. C. H. F. Domingues*1, K. F. Duarte1, E. T. Santos1, T. C.O. Quadras1, D. M. C. Castilhanob1, S. Gavilib1, T. G. Petrollib1, J. Roccon1, H. S. Noagueira1, and O. M. Junqueirab2, 1Universidade Estadual Paulista Julio de Mesquita Filho, São Paulo, Brazil, 2Universidade Federal de Goiás, Goiás, Brazil.

The aim of this study was to evaluate different levels of digestible lysine and methionine + cystine on carcass yield and morphology of pectoral muscle of broilers at 42 d of age. A total of 3,200 one-day-old male Cobb x Cobb 500 chicks were used, distributed in a completely randomized design in a factorial arrangement 2 × 5 (2 digestible lysine levels, 1.100 and 1.210%, × 5 digestible methionine + cystine levels: 0.724, 0.764, 0.804, 0.844 and 0.886%) and 8 replicates of 40 birds each. At 42 d of age, 480 birds were culled by cervical dislocation to evaluate parameters of carcass yield, breast yield, breast fillet yield, thigh and drumstick yield, wings and back. Calculations of carcass yield were based on live body weight and carcass weight. Live BW was determined individually on platform before slaughter and carcass weight by 0.1% of digestible lysine. For the pectoral muscle parameters there was no effect (P > 0.05) observed for the different digestible lysine and methionine + cystine levels studied. Therefore it is recommended to use digestible methionine + cystine levels of 0.724% to a lower cost of production for broilers at 22 to 42 d old.

Key Words: digestible amino acids, breast, fillet, length
supplementation, mainly in the 110 and 120% groups. The higher methionine level treatment led to increased serum albumin content and tended to increase serum protein content. GGT level was the lowest with 100% methionine supplementation. Digestible methionine+cystine requirement was estimated at 0.547% for light pullets in the period from 7 to 12 weeks of age.

**Key Words:** essential amino acids, high performance, immune system, layer, reproductive development

### 343P Determination of digestible methionine + cystine requirements in layers through histophysiological parameters: 13 to 18 weeks of age.


The aim of this study was to determine the digestible total Sulfur Amino Acid (TSAA) requirement of light pullets from 13 to 18 wk of age by their effect on the histophysiological parameters. A total of 480 birds were distributed in a completely randomized block design with 6 treatments and 10 replicates of 8 birds each. Dietary treatments included one positive control diet formulated to meet the NRC (1994) recommendation for digestible TSAA, and 5 other diets formulated with 80, 90, 100, 110, and 120% of the digestible TSAA suggested by the Brazilian Tables for Poultry and Swine. Measurement of the live weight, weight without viscera and organs (liver and spleen), histopathological examination of the liver, intestine, magnum, uterus and kidney and serological analysis (seric albumin, creatinine, protein, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and gamma-glutamyltransferase (GGT)) were assessed during experimentation. Livers from hens fed 100 and 110% digestible TSAA levels tended to be lighter with better zootechnical index and with less mucus produced. The positive control tended to show higher celenomatic fat accumulation when compared with the other groups with methionine supplementation. Spleen weight was not affected beyond 90% TSSA supplementation. The increase of methionine supplementation increased plasmatic creatinine concentration with the highest level obtained at 110% M+C. Higher dietary methionine (100 and 110%) also tended to increase ALT and AST whereas, both parameters decreased with 120% TSAA dose. The total serum protein and albumin analyses increased with the increasing doses of methionine comparatively to positive control. Albumin of glands present in the magnum of pullets fed with diets containing 110 and 120% of methionine showed better formation and development. Digestible methionine plus cystine requirement was thus estimated at 0.436% for light pullets in the period from 13 to 18 wk of age.

**Key Words:** Dekalb White, histology, immunity, limiting amino acids, and poultry

### 345P Effect of dietary methionine + cystine and threonine on nitrogen excretion by broilers.

D. C. Z. Donato, N. K. Sakomura, A. R. Tromi, E. P. Silva, L. Vargas, L. R. Meda, Universidade Estadual Paulista-Faculdade de Ciências Agrárias e Veterinárias, Jaboticabal, São Paulo, Brazil, INRA UR083, Poultry Research Unit, Unité de Recherches Avicoles, Nouzilly, France.

The intensification and regional conglomeration of livestock have significantly increased the emission of pollutants to the environment, leading to a growing interest for seeking alternatives that minimize these emissions. This study investigated the effect of dietary methionine+cystine (MC) and threonine (THR) on nitrogen excretion (NE) and nitrogen deposition (ND) by broilers during initial (1–14d), grower (15–28d) and finisher (29–42d) phases. 1,120 broilers were used to compose the 14 treatments distributed in a completely random design for each trial, according to a 7 × 2 factorial (7 levels of MC or THR and 2 sexes), with 4 replicates. The experimental diets were formulated using the dilution technique with amino acids on a digestible basis. The range of the studied amino acid contents in the diets were: MC 3.05 to 10.88 (initial); 2.72 to 9.79 (grower), and 2.50 to 9.03 g/kg (finisher) and THR 1.49 to 9.96 g/kg (finisher). ND (g/bird d) was determined using the comparative slaughter technique, and NE (g/bird d) was calculated as the difference between the nitrogen intake and ND. To estimate the rate of NE, an exponential regression model was fitted to NE data in function of amino acid intake for each phase and for each sex. To determine the maximum ND (g/bird d), and the amino acid intake for maximum ND, in each phase and for each sex, was fitted a linear response plateau model. The amino acid intakes estimated for maximum ND for female and male broilers were: MC 239 and 233; 486 and 512; 728 and 960 mg/bird d, and for THR 174 and 213; 533 and 598; 735 and 1010 mg/bird d, to initial, grower and finisher phases. Using the exponential regressions, it was observed, in average, that for a reduction in intake of each mg of MC or THR exceeding those for maximum ND, there is a reduction in 0.5% of NE. Although this reduction seems low, when considered that it corresponds to changes in one amino acid only, the effect on a large scale would be significant.

**Key Words:** amino acid, environmental pollution, nutrition, performance, poultry

Methionine is the first limiting amino acid in broiler diets and its requirement should be continuously assessed due to the genetic improvement of birds. The trial was carried out to determine the requirement of digestible methionine for broiler chickens at 8 to 21 d of age based on its effect on performance and carcass traits. A total of 630 males Cobb broilers were distributed in a completely randomized design into 7 treatments (digestible methionine levels), 5 replicates of 18 birds. Six α-methionine supplementation levels (0.0; 0.06; 0.12; 0.18; 0.24; 0.30 and 0.36%) were added to methionine-deficient basal diets to originate the 7 treatments (0.279; 0.339; 0.399; 0.459; 0.519; 0.579 and 0.639%). Synthetic dl-methionine replaced glutamic acid and diets were isonitrogenous (21.2% CP) and isoenergetic (3,050 kcal ME). The cystine requirement was maintained with l-cystine supplementation, enabling the determination of only the digestible methionine requirement. Estimates of digestible methionine requirements of broilers at 8 to 21 d were established by quadratic regressions after ANOVA (P < 0.05). The levels of digestible methionine had no effect (P > 0.05) on feed intake, thighs and drumsticks yield, and carcass yield. Daily gain, feed conversion, carcass and breast yield were improved quadratically (P < 0.05) by increasing the levels of digestible methionine in diets, with better responses respectively to 0.499, 0.469, 0.494 and 0.498% of digestible methionine. The chicken requirement of digestible methionine at 8 to 21 d of age for better breast yield (0.498%) is 6% higher than requirement of digestible methionine for better feed conversion (0.469%).

Key Words: breast yield, nutritional requirements, performance, sulfur amino acids

347P  Relative bioefficacy of methionine hydroxy-analog compared with α-methionine for Japanese quail (Coturnix coturnix japonica). P. B. Lacerda, J. H. Vilar-Da Silva*, A. N. Silva, J. M. F. Brito, and J. Jordão Filho, Department of Animal Science, Federal University of Paraíba, Areia, PB, Brazil.

One trial was carried out to estimate the relative bioefficacy (RB) of liquid DL-methionine hydroxy analog-free acid (MHA-FA) compared with DL-methionine (dl-Met) for quail of 1 to 7 and 1 to 14 d of age. A total of 550 females of Japanese Quails were placed in according to a completely randomized design into 11 treatments, with 5 replicates with 10 birds each. Isonitrogenous and isoenergetic corn-soybean meal diets supplemented with dl-Met (99%) or MHA-FA (88%) in place of glutamic acid. Cystine requirement was fulfilled using l-cystine (99%) supplementation, theoretically enabling the RB of MHA-FA-88% separate from cystine influence. The total methionine levels were 0.23% (basal diet) and 0.29, 0.35, 0.41, 0.47 and 0.53% for diets formulated with either dl-Met (99%) or MHA-FA (88%). Weight gain (kg) and feed conversion (kg/kg) were assessed at 7 and 14 d of age. ANOVA was performed (P ≤ 0.05) and RB was calculated by slope ratio technique by the relationship between the multiple regression coefficients for MHA-FA by the regression coefficient for dl-Met. For weight gain and feed conversion from 1 to 7 d, RB of MHA-FA to dl-Met was 86.53 (R² = 0.70) and 91.25% (R² = 0.49), respectively. From 1 to 14 d, estimates were 73.89 (R² = 0.63) and 64.67% (R² = 0.49) respectively. The average RB of MHA-FA for Japanese quails was 88.89% from 1 to 7 d and 69.28% from 1 to 14 d.

Key Words: bioavailability, Japanese quail, performance, sulfur-amino acid

349P  Betaine and folic acid supplementation improves growth and feather development of chickens fed diets deficient in methionine to 21 days. J. H. Vilar-Da Silva*, C. I. Izogwe, J. D. Vaughn, B. Lett, R. A. Alhotan, F. González-Cerón, and S. E. Aggrey, 1Department of Poultry Science, University of Georgia, Athens, GA, 2CAES Undergraduate Research Initiative, University of Georgia, Athens, GA.

We studied the effects of betaine (BET), folic acid (FA), and methionine (Met) supplementation on performance and feather weight in broilers hatch to 21 d old. Three hundred male chicks were placed in completely randomized design heated batteries and fed 5 dietary treatments (starter), with 4 replicates and 15 chicks per replicate. The diets were treatment 1 (basal-negative control, NC): 0 mg/kg BET, 1.57 mg/kg FA, and 0.35% l-Met; treatment 2: NC + 1 mg/kg FA; treatment 3: NC + 0.19 mg/kg BET; treatment 4: NC + 0.19 mg/kg BET + 1 mg/kg FA; and treatment 5 (positive control PC): supplemented with 0.19 mg/kg BET + 1 mg/kg FA + 0.19 mg/kg dl-Met. Weekly pen weight and feed intake were measured and at d 21, the eighth primary covert feather was unplugged and weighed. The NC group has significantly worse growth compared with all other treatments. Supplementing NC with either BET or FA significantly improved growth but did not match the positive control. FCR was 12% better between NC and PC. Differences in treatment for feather weight were similar to that of growth. Supplementation of methionine deficient diets with either FA or BET can significantly improve early body weight and feather growth in broiler chickens.

Key Words: methionine, growth, feather weight, betaine, folic acid


Broiler rearing in high density as a way to reduce costs and increase productivity per area can cause intense stress and impair welfare and performance. Ascorbic acid and tryptophan have been used to minimize the effect of stress in poultry. This study evaluated the effect of vitamin C (VC) and L-tryptophan (Trp) levels on performance of broilers reared in high density. A total of 2,244 male Cobb-500 broiler chicks were assigned in completely randomized design factorial 2 × 5 + 1 (VC: 150% Trp and feather weight in broilers) were supplemented according to Rostagno et al. (2011). At 42 d of age weight gain (WG), feed conversion ratio (FCR) and productive efficiency index (PEI) were evaluated. There was no interaction between Trp and VC (P > 0.05). WG was not different (P > 0.05) between broilers that received VC and Trp with LD (2,827 g), except for the treatments 150% Trp (2,535 g) and 100% Trp+VC (2,542 g). FCR of the broilers that received VC in the diet (1.620) were improved (P < 0.05) compared with unsupplemented (1.640). Only broilers supplemented with 200%
Trp+VC showed FCR (1.597) similar to LD (1.552), and FCR of all other treatments were worse when compared with LD. No difference (\( P > 0.05 \)) was observed for PEI between broilers of the LD (418.7) and supplemented with 150% Trp+VC (382.6), 175% Trp+VC (382.8), 200% Trp (382.8) and 200% Trp+VC (380.9). In sum, VC associated with Trp at 150% above requirement improved broilers performance reared in high density.

**Key Words:** amino acid, ascorbic acid, performance, poultry

350P  **Physiological indicators of broilers reared in high density and fed diets supplemented with vitamin C and tryptophan.** M. M. Aoyagi*1,2, J. R. Sartori1, V. B. Fascina1, J. C. R. Rezende1, J. C. Russo1, M. K. Maruno1, N. M. G. Caussõ1, P. G. Serpa1, D. A. Berto1, G. A. M. Pasquali1, and A. L. Silva1, 1São Paulo State University, College of Veterinary Medicine and Animal Science, Botucatu, Brazil, 2FAPESP, São Paulo, Brazil.

The poultry farm industry has been aware of the necessity of enhancing poultry resistance, to diminish the economic loss caused by stress under intensive system production. Therefore, this study evaluated the effect of vitamin C (VC) and \( \alpha \)-tryptophan (Trp) levels on physiological-stress indicators (PSI) of broilers reared in high density. A total of 2,244 male Cobb-500 broiler chicks were assigned in completely randomized design in factorial 2x5+1 (VC levels: 0, 250 mg/kg diet × Trp levels: 100, 125, 150, 175 and 200%) of the requirement associated to stock density (17 birds/m\(^2\)) × low density control (LD): diet without VC+100% of Trp requirement and 12 birds/m\(^2\)) with 11 treatments and 6 replicates. Source of vitamin C: ascorbic acid conjugated with biopolymer (Biogenic) and 100% Trp were supplemented according to Rostagno et al. (2011). PSI evaluated: plasma glucose (GL, mg/dl) and heterophil/lymphocyte ratio (H/L) at 21 and 42 d post-hatch. Density did not affect PSI (\( P > 0.05 \)). There was no interaction (\( P > 0.05 \)) between Trp and VC levels on PSI. GL values for broilers at 21 d of age without (268.4) and with (271.5) VC did not differ from LD (267.2, \( P > 0.05 \)). At 42 d of age, the GL values without (276.4) and with (270.3) VC did not differ from LD (264.4, \( P > 0.05 \)). H/L at 21 d of age was 0.349 and 0.325 for broilers without and with VC, respectively, did not differ from LD (0.419; \( P > 0.05 \)). At 42 d of age H/L was 0.368 and 0.363 for broilers without and with VC, respectively, did not differ from LD (0.492) (\( P > 0.05 \)). Trp did not affect GL and H/L. Values of GL and H/L can be considered normal at 21 and 42 d post-hatch. Therefore, supplementation of VC and Trp had no effect on the welfare of broiler reared in high density.

**Key Words:** amino acid, ascorbic acid, stress


To develop factorial models for nutrition is essential to know the requirement for maintenance of the amino acids. The objective of this study was to determine the maintenance requirement of tryptophan for poultry. Forty-eight Cobb 500 adult roosters were individually housed in metabolic cages for the nitrogen balance trial. Seven treatments (level of tryptophan from 0 to 38 mg/kg), with 6 replicates, were randomly distributed. Dietary levels were obtained by diluting a summit diet, limiting in tryptophan, with a nitrogen-free diet. An eighth treatment was added to confirm the limitation of tryptophan (0.097 g of \( \alpha \)-tryptophan /kg added in the second level). After 48 h of fasting, the birds were fed 40 g of the experimental diet by tube, every morning, during 3 d. A nitrogen-free diet was available ad libitum. The collection of the excreta started 24 h after the first intubation. Feed and excreta samples were analyzed for dry matter and total nitrogen. The variables obtained were tryptophan intake (ITrp) and nitrogen balance (NB). Tryptophan was confirmed to be the first limiting amino acid in this study. The requirement for maintenance was obtained by linear regression between NB and ITrp, defined as the amount of ITrp corresponding to NB = 0. The equation obtained was: \( NB = -39.57(±7.37) \times 6.89(±0.33) \times I_{Trp} \quad R^2 = 0.92 \). Because there is no amino acid cost to maintain lipid reserves, the maintenance requirement is mostly related to the body protein content than body weight. Therefore, the tryptophan required for maintenance, in the present study, was scaled in terms not of body weight but according to the degree of maturity of the animal, and on this basis the amount of tryptophan required for maintenance was calculated to 33.5 mg per unit of maintenance protein (Pm\(^{0.72} \)) per day.

**Key Words:** dilution technique, linear regression, nitrogen balance, units of maintenance protein


The objective of this study was to determine the optimal intake of valine for broiler breeder hens. Sixty-four broiler breeder hens of Cobb500 genotype were individually housed in laying cages. The treatments were 7 levels of valine with 8 replicates distributed into a random design. A summit diet and a nitrogen-free diet were formulated. The diets had the same level of minerals, vitamins and energy. The content of valine in the summit diet was 9.85 g/kg, obtained considering 130% of the valine requirement recommended by the Brazilian Tables and 150% for the remaining amino acids, creating a relative deficiency of 20% of valine. The intermediary valine levels (1.97, 2.95, 3.94, 4.92, 5.91, 6.89, 9.85 g/kg) were obtained by successive dilutions of the summit diet with the nitrogen-free diet. An eighth treatment was added (0.102 g of L-valine/ kg + 1.97 g/kg) to confirm if valine was the first limiting amino acid. The trial lasted 9 weeks (5 weeks of adaptation and 4 weeks of data collection). The additional response seen with the supplementation of 0.102 g of L-valine confirmed that valine was the first limiting amino acid. The polynomial quadratic and broken-line models were adjusted for valine intake (X) and egg output (Y) data. The resulting equations were: \( Y = -0.00003X^2 + 0.0771X + 18.6 \) and \( Y = 45.43 - 0.06(652.4 - X) \), estimating an optimal level of 1,133 and 652 mg/bird d for polynomial quadratic and broken-line models, respectively. The optimal level was determined by the first intercept of the polynomial quadratic with broken-line plateau estimating the requirement of 712 mg/bird d. The valine requirement herein, based on the first intercept X value of the broken-line plateau and the quadratic fitted curve predicts a requirement value close to that predicted by taking 63% of the upper asymptote value of the quadratic equation being an excellent representation of the requirement.

**Key Words:** amino acid, broken-line, dilution technique, egg mass, polynomial quadratic
Valine is an essential amino acid, currently recognized as the fourth limiting amino acid for broiler diets based on corn and soybean meal. This study aimed to evaluate Val:Lys ratios in diets with reduced crude protein (CP) and the effects of this reduction on performance and carcass yield of broiler chickens. 1,200 Cobb-500 male chicks were allocated to a completely randomized design with 6 treatments and 6 replicates (except control with 10 replicates to complete all experimental units) of 30 birds each. The control treatment (CT - T1) was formulated following the levels of CP and amino acids (Lys, Met, Thr, Val, Trp, Arg, and Ile) recommended by Rostagno et al. (2011) with CP levels of 22.4, 21.2, 19.8, 18.4, and 17.6% for pre-starter, starter, grower i, grower ii, and finisher, respectively, and the other treatments (T2 to T6) had reduced levels of CP (4% less compared with CT) and with respect Val:Lys ratios, with 5 levels in equidistant intervals of 0.07:1 ranging from 0.63:1 to 0.91:1 (diets up to 21 d – CT was 0.77:1), and then from 0.64:1 to 0.92:1 (diets after 21 d – CT was 0.78:1). The levels of AA were maintained in all treatments, except for Val, by the inclusion of crystalline AA. Performance characteristics evaluated were weight gain, feed intake, feed conversion (FC), viability and productive efficiency index. At 46 d of age 6 birds per replicate were slaughtered for determination of carcass yield and commercial cuts. The averages were compared by Tukey test (5%), and contrast between control and other treatments, and regression analyses were used. The different Val:Lys ratios did not affect performance (P > 0.05) for any characteristic evaluated. CP reduction decreased FC (P < 0.05) until 21 d. Breast yield was the only carcass parameter affected by the Val:Lys ratio, which was optimized at 0.75:1. The results suggest that the levels of Val used do not affect performance, only breast meat yield, and CP reduction is not recommended during the first three weeks of rearing.

Key Words: amino acids, crude protein, ideal protein, nutritional requirement, poultry

354P Valine, isoleucine, arginine, and glycine deficiency of low-protein diets for broiler chickens during the starter phase. I. C. Ospina-Rojas¹, A. E. Murakami², C. Eyng³, R. V. Nunes³, and C. A. L. Oliveira¹, ¹Universidade Estadual de Maringá, Maringá, Paraná, Brazil, ²Universidade Federal do Grande Dourados, Dourados, Mato Grosso do Sul, Brazil, ³Universidade Estadual do Oeste do Paraná, Marechal Cândido Rondon, Brazil.

A study was conducted to determine whether the addition of crystalline Val, Arg, Arg, or Gly in diets with a 3% CP reduction could support optimal broiler performance, and evaluate their effects on serum parameters and litter characteristics of broiler chickens in the starter phase. A total of 1,320 male Cobb broiler chickens were distributed in a completely randomized design with 12 treatments and 5 replicates of 22 broilers each. The control diet was based on corn-soybean meal and formulated with 22% CP. A second diet with a 3% reduction in CP was formulated to meet the requirements of all digestible amino acids (AA) supplied by the control diet except for digestible Val, Ile, Arg, and Gly. The other experimental diets were formulated with individual or combined supplementation of crystalline Val, Ile, Arg or Gly in the low-CP diet to resemble digestible AA levels of the control diet, as follows: Val; Ile; Arg; Gly; Val+Ile; Val+Arg; Val+Gly; Val+Ile+Arg; Val+Ile+Gly and Val+Ile+Arg+Gly. All data were analyzed by the GLM and differences among means were separated using Tukey’s test by the LSMEANS procedure of SAS. Low-CP diet resulted in birds with a poorer (P < 0.05) weight gain and feed conversion and exhibited higher (P < 0.05) serum concentrations of uric acid than those of the birds that received the control diet. Individual supplementation with Val and Gly, but not Ile and Arg, restored the weight gain of the birds. The feed conversion was restored to the level of the control diet in birds that received diets with added Val+Gly, Val+Ile+Arg, Val+Ile+Gly and Val+Ile+Arg+Gly. All diets with reduced CP, regardless of AA supplementation, resulted in poultry litter with reduced (P < 0.05) ammonia emissions and nitrogen contents in comparison to those of the litter of birds that received the control diet. The supplementation of Val and Gly in low-CP diets is sufficient to avoid adverse effects in the performance and serum parameters of broilers in the starter phase. The use of low-protein diets with the correct AA supplementation promotes the reduction of nitrogen excretion and ammonia emission from the litter of broiler chickens in the starter phase.

Key Words: amino acid, ammonia, performance

355P Dietary supplementation of enzymes in naked oat based organic diets to improve methionine digestibility and broiler performance. S. Li¹, P. H. Patterson¹, R. M. Hulet¹, H. K. Burley¹, and M. Alp², ¹Pennsylvania State University, State College, PA, ²İstanbul University, İstanbul, Turkey.

The object of this study was to assess the value of naked oats, which are richer in methionine (Met) than corn, as a replacement ingredient for corn as the major dietary energy source in organic broiler diets when enzymes are supplemented to improve nutrient digestibility. A total of 350 d-old Cobb 500 male broilers were allocated randomly to 5 dietary treatments, with 7 replicate battery cages per treatment (10 birds/replicate). From 1 to 21 d of age, the following experimental diets were fed: (1) corn soy control (CS), (2) naked oats in place of corn (O), (3) naked oats + 500 g/metric ton Rovobio Excel AP10 (an organically approved combination of 19 enzymes) (O+R), (4) naked oats + 250 g/metric ton Optiphos (a phytase) (O+O), and (5) naked oats + 500 g/metric ton Rovobio Excel AP10 + 250 g/metric ton Optiphos (O+R+O). All naked oat diets contained 0.1% lower Met level than the CS diet and the enzymes were added in an effort to improve digestibility of these deficient diets. On d 21, all birds were euthanized and ileal digesta was collected. Growth, processing yields, and apparent nutrient digestibility of the diets were evaluated. Data analysis used a one-way ANOVA with Tukey’s test for mean comparisons and P ≤ 0.05 was deemed statistically significant. Birds fed the O+R and O+R+O diets had d 21 body weight gain (BWG), d 10–21 feed conversion ratios (FCR), overall BWG and FCR that were significantly improved compared with those fed the O diet. Live bird, breast, leg, wing, cage and carcass weights were also significantly increased for the O+R and/or O+R+O diets compared with the O diet. Supplementing Rovobio and/or Optiphos to the naked oats diets significantly improved the digestibility of crude protein (P < 0.0001) and all amino acids (Met, Cys, Lys, Thr, etc; P < 0.0001). In conclusion, Rovobio alone or in combination with Optiphos enhanced digestibility of Met in organic naked oat based diets and improved broiler growth performance equal to that of the CS control.

Key Words: methionine, broiler chicken, naked oats, enzyme, digestibility


Methionine (Met) is typically the limiting amino acids in poultry diets. To meet the dietary methionine requirement without over feeding total protein synthetic Met is added to commercial poultry diets. Limited levels of synthetic Met are currently allowed in organic poultry diets in the United States, with the plan to prohibit it completely in the future.
There has been some speculation that dual-purpose breeds have lower Met requirements making them an alternative breed for use in organic chicken meat and egg production. This study looked at the Met requirement of 3 alternative breeds – Black Australorp (BA), Rhode Island Red (RIR) and Black Plymouth Rock (BPR). There were 4 dietary treatments with Met levels analyzed as 0.31, 0.36, 0.48 and 0.52% Met in a low density diet (3,047 kcal of ME/kg of diet). There were 5 replications per diet and breed combination with 10 chicks (straight run) per replication. The feed was available ad libitum for 4 wk and the body weight and feed consumption measured daily and feed efficiency calculated. At placement the RIR chicks were statistically larger than the BA and BPR chicks but the lowest at wk 1. There were no significant differences in body weight for the remainder of the trial. There were no significant differences in feed efficiency with regards to breed or diet. There was no significant effect of Met level on body weight or feed efficiency. At 4 wk of age, chicks from all breeds reached body weights of 300 g and overall feed efficiency of 2.48. The level of 0.31% Met of diet 1 was the lowest level of dietary Met that could be achieved with the corn/soybean meal low-density diets. Typical Met requirements range from 0.28% for brown egg layers and 0.50% for broilers. The growth and feed efficiency achieved in this study indicated that for dual purpose breed chicks, the Met requirement for a diet containing 3,047 kcal of ME/kg is less than 0.31%. Unfortunately the poor overall performance of the dual purpose breeds does not make them an economically viable alternative for organic chicken meat production. However, they may be necessary if synthetic Met cannot be added in the future.

Key Words: methionine, heritage breed, organic