

Nonruminant Nutrition: Amino Acids 1

137 Dietary supplementation of L-glutamine and L-glutamate to newly hatched broiler chickens. Y. Zhao^{*1}, P. R. Ferket¹, G. Wu², K. Nakagawa³, and S. W. Kim¹, ¹North Carolina State University, Raleigh, ²Texas A&M University, College Station, ³Ajinomoto Co. Inc., Tokyo, Japan.

This study was conducted to evaluate effects of supplemental L-glutamine (Gln) and L-glutamate (Glu) on growth and physiological responses in broiler chickens. Within 8 h after hatching (36.1 ± 1.1 g BW), 480 broiler chickens were allotted randomly to 6 dietary treatments: NC (without Gln or Glu), GN5 (with 0.5% Gln), GN10 (with 1.0% Gln), GU5 (with 0.5% Glu), GU10 (with 1.0% Glu), and AG10 (with 1.0% AminoGut, consisting of L-Gln >10% & L-Glu >10%, Ajinomoto). Each treatment had 8 replicates with 10 birds per cage. Diets were fed ad libitum for 6 wk. Body weight and feed intake were measured weekly. At the end of wk 1 and 6, one bird per cage was selected randomly to measure the weights of gut, breast muscle, thigh muscle, liver, and abdominal fat pad, and to obtain blood samples. Jejunum samples from wk 1 were used to measure villus height and crypt depth. Blood samples from wk 1 and 6 were used to measure plasma IgG and IgA concentration. Initial BW did not differ among treatment groups. During the entire period, weight gain of GN10 was greater ($P < 0.05$) than those of GN5, GU5, and NC. The weight gain of AG10 was greater ($P < 0.05$) than that of NC. Feed intake of birds did not differ among treatment groups during starter, grower, and finisher phases. There was no difference in feed:gain among treatment groups during the entire period. At the end of wk 1, villus height or crypt depth of birds did not differ among treatment groups. There were no difference in the % weight of each tissue among treatment groups when measured at the end of wk 1 and wk 6. Plasma IgA concentration of AG10, GN5, and GU5 were greater ($P < 0.05$) than that of NC at wk 6. Plasma IgG concentration of AG10 was greater ($P < 0.05$) than that of other treatment groups at wk 6. This study shows potential benefits of supplemental glutamine or AG to broiler chickens.

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Key Words: broilers, glutamate, glutamine

138 The digestible lysine requirement of Cobb 500 x Hubbard M99 male broilers from 35 to 49 days. M. D. Dimova^{*1}, R. B. Shirley², J. L. Usry², P. B. Tilman², M. E. Freeman¹, and A. J. Davis¹, ¹University of Georgia, Athens, ²Ajinomoto Heartland, LLC, Chicago, IL.

An experiment was conducted to determine the digestible lysine (dLys) requirement of the male, Cobb 500 fast-feathering female \times Hubbard M99 male cross during the withdrawal period (35 to 49 d of age). Day-of-hatch birds were randomly allotted to 96 floor pens (4 rooms, 24 pens per room, 50 chicks per pen) and reared on used litter from 3 previous flocks. All chicks were fed the same starter (0 to 7 d), grower (7 to 21 d), and finisher (21 to 35 d) diets and these diets were formulated to exceed the Cobb 500 guidelines. On d 35 the number of birds was adjusted to 42 birds per pen and the 96 pens were assigned to one of 8 dietary treatments (12 replicates per treatment, 3 replicate pens per treatment in each room). The treatment diets were derived from a common base diet and common summit diet. The common base diet supplied 3,215 kcal/kg, 13.71% crude protein (CP) and 0.62% dLys, and the common summit diet supplied 3,215 kcal/kg, 23.59% CP and 1.24% dLys. By blending the base and summit diets, 6 intermediate levels of dLys were

produced (0.71, 0.80, 0.89, 0.97, 1.06, and 1.15%). The minimum ideal essential amino acid ratios were maintained between the 8 diets; however, the dietary CP changed by an increment of 1.41% as the level of dLys changed. Broken-line regression analyses estimated the dLys requirement per bird in the withdrawal phase to be 24.45 g for body weight gain, 28.56 g for feed consumption, 25.61 g for feed conversion, and 25.28 g for total white meat yield (Pectoralis major and minor). The dLys requirement as a % of diet for body weight, feed consumption, feed conversion and total white meat was 0.86, 1.07, 0.91 and 0.90, respectively. This study aids in further defining the dLys requirement of the 35–49 d-old male, Cobb 500 fast-feathering female \times Hubbard M99 male cross.

Key Words: broiler performance, meat yield, amino acid requirement

139 The effect of dietary pea and amino acid levels on the performance of broiler chickens. S. M. Ebsim^{*1}, T. D. Warkentin², and H. L. Classen¹, ¹Department of Animal and Poultry Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada, ²Crop Development Centre, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Pea is an important crop in Western Canada with considerable potential as a feed ingredient for broilers. Pea has also been recognized for its slowly degraded starch, which has been suggested to reduce the amino acid requirement of broilers. Therefore, an experiment was designed to investigate maximum inclusion levels of pea in broiler diets and the interaction of dietary pea and amino acid inclusion. A growth trial with 3,480 broiler chickens was conducted in a 6×2 factorial arrangement evaluating 6 levels of pea inclusion (0, 150, 300, 450, 600, 750 g/kg) and 2 levels of amino acids (100% and 85% of Ross \times Ross 308 requirement). Each treatment was offered to 5 pens of 58 males from 0 to 35 d. No interactions were found between pea inclusion and amino acid level for all studied parameters. The higher level of amino acids increased breast meat ($P = 0.0267$) and improved mortality corrected feed efficiency ($P = 0.0437$). Pea inclusion level affected performance in an age dependent manner. Body weight gain from 0 to 10, 10 to 25 and 25 to 35 d decreased when pea level exceeded 300, 600 and 600 g/kg, respectively. Mortality corrected feed to gain ratio was increased by pea inclusion when values exceeded 600 and 300 g/kg for 0 to 10 and 10 to 25 d periods but was unaffected by pea level from 25 to 35 d. Broilers fed pea levels above 450 g/kg had reduced carcass and breast weight ($P = 0.0001$) as a proportion of live weight. High levels of pea inclusion decreased proportional breast (600 and 750 g/kg) and drum skin (750 g/kg) weight. In conclusion, maximum pea inclusion levels increase with broiler age and no interactions were found between dietary treatments at the levels of amino acids used in this research.

Key Words: broilers, pea, starch, amino acid

140 Effect of a mono component protease on true amino acid digestibility of full fat soy for broiler chickens using different methods. R. K. G. Messias¹, L. F. T. Albino¹, J. O. B. Sorbara^{*2}, and H. S. Rostagno¹, ¹Universidade Federal de Viçosa, Viçosa, MG, Brazil, ²DSM Nutritional Products, São Paulo, SP, Brazil.

Different methods have been used to determine the true amino acid digestibility (TAAD) of feed ingredients. All methods were always used to estimate the TAAD of only one ingredient and were not developed to determine the effect of an additive (ex. enzymes) on a single ingredient.

Based on this, a digestibility trial was conducted to determine the effect of 2 different methods on TAAD of full fat soy (FFS) when using a mono component protease. The trial was conducted with 336 broiler chicks from 12 to 22 d of age placed on wire cages, in a complete randomized experimental design with 8 treatments and 6 replicates of 7 birds each. The first 4 treatments were used to evaluate the classic method using a protein free diet (PFD) where FFS replaced 30% of starch in the PFD with and without the protease addition. Treatments 5 to 8 were used to evaluate a second method. Treatment 5 was a corn soy basal diet with 30% starch and treatment 6 was the basal diet (T5) but FFS replaced the starch. Treatments 7 and 8 were the same T5 and T6 with protease addition. The mono component protease used (dose 200 ppm) was RONOZYME ProAct with 75000 Prot Units/g. At 22 d all birds were sacrificed and ileal digesta collected. Acid insoluble ash (Celite) was used as inert marker. Feed and water were provided ad libitum. At 22 d of age all birds were sacrificed and ileum content collected. The samples were freeze-dried at -40°C for 72 h. No interaction was observed between method and protease addition. Protease addition increased ($P < 0.05$) TAAD of FFS by 3%, 3%, 9%, 7%, 2%, 7%, 4%, 5%, 6%, 12%, 8%, 7%, 8%, 8% for Lys, Met, M+C, Thr, Val, His, Arg, Phe, Gly+Ser, Asp, Glu, Ala, Pro, Tyr, respectively. The method with the basal diet plus FFS showed 18% lower TAAD (mean sum of AAs) as compared with the PFD method. In conclusion the protease supplementation improved TAAD of FFS on average 6% independently of the method used.

Key Words: enzyme, nutrition, method

141 Ileal digestibility of the amino acids of soybean meals of different origin in broilers. M. Frikha¹, M. P. Serrano¹, D. G. Valencia², C. Centeno³, R. Lázaro¹, and G. G. Mateos*¹, ¹Universidad Politécnica de Madrid, Madrid, Spain, ²Nutral S.A., Madrid, Spain, ³CSIC, Madrid, Spain.

A trial was conducted to determine the apparent (AID) and standardized (SID) ileal digestibility of CP and AA of 22 soybean meals (SBM) from 3 different origins; USA, Brazil (BRA), and Argentina (ARG) in 21-d-old broilers. There were 7 to 8 samples of SBM per origin and 6 replicates (6 chicks each) per each SBM sample. On DM bases, the average CP was 53.5, 55.3, and 52.3% for USA ($n = 8$), BRA ($n = 7$), and ARG ($n = 7$) meals, respectively. The concentration of Lys and Met per unit of protein was highest ($P < 0.01$) for the USA meal and lowest for the BRA meal with ARG meal being intermediate. The KOH solubility was higher for USA than for BRA and ARG meals (86.5, 82.8, and 80.0%; ($P < 0.05$) but trypsin inhibitor activity (TIA) was similar for all origins (3.0 mg/g DM). Chicks were fed a commercial corn-soybean meal diet from 1 to 17 d and then, their respective experimental diets, with the SBM tested as the only source of CP (20%), from 18 to 21 d of age. In addition, a N-free diet was used to estimate ileal endogenous losses of the AA in 6 extra replicates. The AID of the 22 SBM samples ranged from 82.9 to 88.0 for CP, from 85.0 to 90.5 for Lys, and from 66.4 to 75.0 for Cys. In general, the AID of CP and of most indispensable AA were similar for USA and BRA SBM meals and for both higher ($P < 0.01$) than for ARG meal (i.e., 88.2 and 88.1 vs. 86.7 for Lys and 88.0 and 89.1 vs. 86.6 for Met, respectively). The SID values of the 22 SBM samples ranged from 89.3 to 94.6 for CP, from 90.1 to 94.9 for Lys, and from 78.5 to 85.4 for Cys. The SID values of most indispensable AA were similar for USA and BRA meals and higher for both ($P < 0.05$) than for the ARG meal (i.e., 93.0 and 92.7 vs. 91.8 for Lys and 95.6 and 96.9 vs. 94.9 for Met). It is concluded that the ileal digestibility of CP and AA varies considerably among commercial SBM samples. In fact, in this study, USA and BRA SBM had a higher AID and SID than ARG SBM.

Key Words: soybean meal origin, ileal amino acid digestibility, broilers

142 Nutrient density and balanced amino acids to ME ratio are drivers of growth, feed efficiency and carcass yield in broiler chickens. L. F. Romero*¹ and V. Ravindran², ¹Danisco Animal Nutrition, Marlborough, UK, ²Massey University, Palmerston North, New Zealand.

Broiler nutritionists typically consider ME, CP (%), and essential amino acids (%) as criteria for diet formulation based on a set of recommended values per unit of feed mass. However, nutrient density, and balanced amino acids to ME ratio may be better explanatory variables of animal performance. Two 42-d performance trials, each with a total of 480 male broilers (Ross 308) were conducted to evaluate growth, feed efficiency, and carcass yield in response to 2 levels of nutrient density (Starter: 2,875 or 3,200 kcal ME/kg; Finisher: 3,020 or 3,315 kcal ME/kg; other nutrients proportional to ME), and 3 levels of digestible lysine (dlys) to ME ratios (Starter: 3.5, 3.9, 4.3 g dlys/Mcal ME; Finisher: 3.0, 3.5, 3.9 g dlys/Mcal ME). Diets were based on corn, soybean meal, corn gluten (= <5%), wheat middlings (= <5%), and A/V fat blend (0.5–7.5%). Other amino acids were balanced relative to lysine. Data were analyzed as a factorial design using the Mixed Procedure of SAS. Significance was evaluated at $P < 0.05$. Birds fed the low density diet exhibited a lower BW gain from 0 to 42 d compared with birds on the high density diet (3,252 g vs. 3,346 g; $P < 0.05$). Increments of dlys:ME resulted in significant increments of BW gain from 3,133 to 3,328 and 3,435 g. Increasing dlys:ME resulted in linear reductions of feed per gain, both in high and low density diets, ranging from 1.66 g/g in low dlys:ME \times low ME to 1.44 g/g in high dlys:ME \times high ME diets. High density increased caloric intake (16.22 Mcal/bird) versus low density diets (15.29 Mcal/bird). Low density diets had reduced caloric conversion (4.71 kcal/g BW) compared with high density diets (4.85 kcal/g BW). Caloric conversion linearly decreased with increments in dlys:ME (4.97, 4.77 and 4.60 kcal/g BW). Carcass and breast yields increased, and abdominal fat yield decreased with increasing dlys:ME ratios, in both low and high ME diets. More predictable responses of broiler performance by the use of nutrient density and dlys:ME as flexible criteria in diet formulations will enable accurate profit optimization of broiler operations.

Key Words: amino acid, broiler chicken, diet optimization

143 Digestible lysine requirements of Cobb \times Cobb 700 male broilers from twenty-eight to forty-two days of age. W. A. Dozier III*¹, A. Corzo², M. T. Kidd², and P. B. Tillman³, ¹Auburn University, Auburn, AL, ²Mississippi State University, Mississippi State, ³Ajinomoto Heartland LLC, Chicago, IL.

Research addressing digestible (dig) Lys requirement data of modern broilers from 4 to 6 wk of age is limited. This study examined growth and meat yield responses of broilers provided experimental diets varying in dig Lys, to determine the dig Lys requirements, from 28 to 42 d of age. Three-thousand male Cobb \times Cobb 700 chicks were randomly distributed into floor pens at 1 d of age and were fed common starter and grower diets until 28 d of age. At 28 d of age, all pens were equalized with 23 birds (0.09 m²/bird) and fed the experimental diets until 42 d of age. Two diets (dilution and summit) consisting of corn, soybean meal, meat and bone meal, and peanut meal were formulated to be adequate in all other amino acids. The dilution and summit diets were blended to create 7 intermediate diets, for a total of 9 titration diets. A control diet containing adequate dig Lys was used for comparison with the titration diets. Each treatment was represented by 12 replicate pens. Body

weight gain, feed intake, dig Lys intake, dig Lys intake/BW gain, feed conversion, mortality, carcass yields, and physiological parameters were assessed during experimentation. Dig Lys requirements were estimated using a quadratic broken-line model. Dig Lys requirement for male Cobb × Cobb 700 broilers ranged from 0.965 to 1.030% for BW gain, feed conversion, carcass weight, total breast meat weight, and total breast meat yield. Dig Lys requirements for male Cobb × Cobb 700 broilers were estimated at 0.995% based upon averages of live performance and meat yield responses. These data support a higher dig Lys requirement of male broilers from 28 to 42 d of age on a percentage basis than previous research as noted by less feed intake per unit of BW gain and a greater meat accretion rate.

Key Words: amino acid, broiler, lysine

144 Maximizing the use of supplemental amino acids in diets for 7-kg pigs. V. D. Naranjo^{*1}, T. D. Bidner¹, R. L. Payne², and L. L. Southern¹, ¹LSU Agricultural Center, Baton Rouge, ²Evonik-Degussa Corporation, Kennesaw, GA.

Three (14-d) experiments were conducted to determine the Lys requirement of 7-kg pigs and then to determine the maximum level of supplemental L-Lys along with DL-Met, L-Thr, and L-Trp that can be added in these diets. In all experiments, pigs were fed a common diet during wk-1 post-weaning. On d 7, pigs were blocked by initial BW and sex, and littermates were balanced across treatments. In Exp. 1 (5 reps of 3 or 4 pigs per pen; initial BW = 7.4 ± 1.2 kg), pigs were fed corn-soybean meal-peanut meal (C-SBM-PM) diets containing 0.754, 0.879, 1.004, 1.129, and 1.254% standardized ileal digestible (SID) Lys. A positive control (PC) diet without PM contained 1.254% SID Lys. Daily gain (257, 329, 364, 399, 440; 449 g/d), ADFI (620, 781, 700, 737, 804; 782 g/d), and G:F (0.42, 0.42, 0.52, 0.54, 0.55; 0.57) were linearly increased ($P < 0.01$) as SID Lys increased. Based on ADG, the SID Lys requirement was estimated at 1.221% ($P = 0.02$). In Exp. 2 (5 pens of 4 pigs per pen; initial BW = 6.30 ± 0.8 kg) and Exp. 3 (5 reps of 4 pigs per pen; initial BW = 6.9 ± 1.0 kg), C-SBM diets were formulated to contain 1.221% SID Lys. Only supplemental Met, Thr, and Trp were added to the diets to keep a constant ratio to Lys. In Exp.2, dietary treatments included 6 levels of supplemental L-Lys: 0, 0.049, 0.099, 0.149, 0.198, and 0.248%. There were no linear or quadratic effects ($P > 0.10$) in ADG (358, 361, 386, 357, 351, and 356 g/d), ADFI (861, 786, 856, 822, 819, and 893 g/d), or G:F (0.42, 0.47, 0.46, 0.44, 0.43, and 0.41) of supplemental L-Lys. In Exp. 3, dietary treatments included 5 levels of supplemental L-Lys: 0.198, 0.248, 0.298, 0.347, and 0.397%. Daily gain (376, 384,

379, 351, and 344 g/d; $P = 0.03$) and G:F (0.62, 0.54, 0.56, 0.52, and 0.50; $P < 0.01$) were linearly decreased, but ADFI (615, 718, 682, 675, and 696 g/d) was not affected. The results of this research indicate that up to 0.298% supplemental L-Lys along with supplemental Thr, Met, and Trp can be added in diets for 7-kg pigs without affecting ADG, but G:F is reduced at levels greater than 0.198% supplemental Lys.

Key Words: amino acids, pig, nursery

145 Well-fed piglets prefer amino acids that elicit umami taste. G. Tedo^{*1}, E. Roura¹, M. Reina², J. L. Ruiz-de la Torre³, and X. Manteca³, ¹Lucta SA, Barcelona, Spain, ²Celltec-University of Barcelona, Barcelona, Spain, ³Autonomous University of Barcelona, Barcelona, Spain.

Pigs perceive the umami taste via the pT1r1/pT1r3 receptor present in their tongue. In vitro studies, using a proprietary cell reporter system (CRS) that expresses this heterodimer, showed that it is tuned to detect amino acids (AA). The objectives of this work were (1) to evaluate preferences of piglets for AA and (2) to correlate preference data with outcomes from the CRS for the same AA. Forty-eight weaned piglets (10.7 ± 1.20 Kg of BW, mixed sexes) were distributed in pairs/pen, with ad libitum access to water and pelleted starter feed (2521Kcal NE/Kg, 19.1% CP, 1.32% Lys). Preferences were assessed using a double-choice model that consisted of 10-min training sessions conducted twice daily (9AM, 12PM) over 2 consecutive days followed by 2-min test sessions conducted twice daily (9AM, 12PM) over 5 d. During training, plain and sweetened (500mM sucrose) water were offered simultaneously in stainless steel containers (250g/container); whereas, in test sessions, water was offered along with water (control) and 50mM solutions of monosodium glutamate (MSG), D,L-Met, Gly, L-Ala, L-Gln, L-Glu, L-Lys, L-Thr and L-Trp. Preference (%) data [(g test solution / (g test solution + g water) × 100)] were analyzed using a mixed model approach that included the effects of pen (random), day, time, and treatment. Preferred solutions ($P < 0.01$) were MSG (79.6 ± 2.03), Glu (79.8 ± 2.45), Lys (77.2 ± 3.91), Gln (73.4 ± 3.37) and Ala (67.6 ± 4.46), whereas Trp (25.6 ± 4.40) was rejected. Additionally, solutions of Met (64.4 ± 9.58), Gly (59.9 ± 4.41) and Thr (49.5 ± 10.05) were not different from control (46.1 ± 3.18). Results from CRS were positively correlated ($R = 0.92$, $P < 0.05$) with preferences of Ala, Gln, Glu and MSG. Lys was also preferred but did not stimulate the umami receptor. In summary, well-fed piglets mainly preferred AA that stimulated the umami taste receptor expressed in the CRS. Therefore, the umami taste has a positive hedonic (pleasant) valence (value) for pigs.

Key Words: umami, amino acids, intake