

oviduct, ovary, and ovarian stroma recorded. Timing of sexual maturity, frame size, breast muscle fleshing, and ovarian morphology traits were assessed, and variation in BW and timing of sexual maturity calculated.

As age at PS increased, the time from PS to sexual maturity decreased. Mean time to SM was 49 d in PS17 birds compared to 24 d in PS23 birds. In this study, the highest variation in age at SM was recorded for PS17 birds (CV=4.9) and the lowest value for PS21 birds (CV=3.0). Body weight, girth, ovary weight and fat pad weight at SM were increased with later PS. Body weight at SM differed among all but the PS19 and PS21 birds. The relative abdominal fatpad weight

increased incrementally between 17 to 23 weeks PS ages (1.57%, 1.69%, 1.91%, 2.01%). At SM, ovary and oviduct were heavier in the later photostimulated groups. Ovary weight of PS17 (49.1g) and PS19 (49.7g) birds were less than that of PS21 (55.6g) or PS23 (56.4g) birds. Large yellow follicle (LYF) number at SM also increased between the 17 and 21 wk PS ages (PS17=6.7, PS19=6.9, PS21=7.6, PS 23=7.3 LYF). Later PS in modern broiler breeders appeared to be more advantageous than the early PS — particularly with regard to development of the reproductive tract. These differences have grown larger than what has been reported in previous studies. Interestingly, the birds PS at 21 wk of age had the most uniform onset of lay.

Key Words: broiler breeder, photostimulation, ovarian morphology

Metabolism and Nutrition: Nutrition A - Protein and Amino Acids

144 Effects of a reduction of dietary crude protein on performance and economics in commercial Ross 308 broilers. E. A. Guaiume*¹, J. Firman¹, D. Hoehler², P. B. Tillman³, D. Burnham⁴, and J. Parcell¹, ¹University of Missouri, Columbia, ²Degussa Corporation, Kennesaw, Georgia, ³Ajinomoto Heartland LLC, Chicago, Illinois, ⁴Aviagen Inc., Huntsville, Alabama.

A study was conducted to determine the effects of reduced dietary crude protein (CP) on biological and financial performance of Ross 308 broilers fed from hatch to week 7. 1440 straight-run broiler chicks were randomly assigned to 4 treatments with 12 replicate pens containing 30 birds each. Diets were formulated to be isocaloric and to have the minimum digestible level for lysine (Lys), and the same minimum ideal amino acid ratios to lysine for total sulfur amino acids (TSAA), threonine (Thr), valine (Val), isoleucine (Ile), arginine (Arg), and tryptophan (Trp) across the four phases [starter (0-2wks), grower (2-4wks), finisher (4-6wks), and withdrawal (6-7wks)]. An industry standard diet served as the control (A) and the benchmark for performance. The remainder of the treatments (A-0.5%, A-1.0%, and A-1.5%) had CP reduced in 0.5% increments. Birds were weighed at 2, 4, 6, and 7 weeks of age for feed to gain calculation. At week 7, 4 birds per pen (48/trt) were sacrificed and had fat pad and carcass weighed, and carcass and meat yield determined. Feed cost savings (FCS) per metric ton (MT) of live body weight (BW), FCS/MT carcass, FCS/MT breast meat, income over feed cost/MT carcass, and income over feed cost/MT breast meat, were calculated. Treatments had no effect ($P>.05$) on performance throughout the 7-week period. At week 7, birds fed A-1.5% had a higher ($P<.05$) percentage of fat pad when compared to A (2.98% versus 2.52%, respectively for A-1.5% and A). The remainder of the treatments did not differ from the control ($P>.05$). In addition, treatments had no effect ($P>.05$) on carcass and breast meat yield at 7 weeks of age. For BW, relative to A, FCS was \$2.50/MT when A-1.5% was fed; for carcass, \$3.42/MT; and for breast meat, \$15.01. Therefore, birds fed A-1.5% CP resulted in an increased income of \$3.42/MT carcass and \$15.00/MT breast when compared to A. Overall, these results a decrease of CP by 1.5%, as compared with industry standards, did not affect performance, carcass, and meat yield, and resulted in significantly higher revenues.

Key Words: low crude protein, Ross 308, economics

145 Influence of grower period length and amino acid level in the finisher period on broiler performance and economics. D. Hoehler*¹, A. Lemme¹, C. Fisher², and C. Kemp², ¹Degussa Corporation, Kennesaw, Georgia, ²Aviagen Ltd., Edinburgh, Scotland.

Broiler nutritionists need to make decisions about the energy and nutrient content of feed during the grow-out period, and the length of time or amount each feed should be fed as part of the feeding program. This trial considered two sexes x 4 finisher diets x 3 times of change from grower to finisher diets x 4 replicates which resulted in a total of 96 pens with 90 Ross 308 birds per pen. All birds received the same feed up to 21 d. Male birds were fed 80, 90, 100, and 120%; female birds were fed 70, 80, 90, and 100% balanced amino acid (AA, related to the Ross recommendations) diets in the finisher period. Age at change from grower to finisher diets were 21, 28, or 35 d. Broilers were weighed at 10, 21, 28, 35, 42, and 49 d; processing samples were taken at 28, 35, and 42 d. Both AA level and the age when birds are changed from grower to finisher feed significantly affected rates of growth, feed conversion, carcass yield, breast meat yield and bird fatness. There were no effects on mortality or on the yield of leg or wing portions. When the protein content of the finisher is low there is a large effect of age at change from grower to finisher. If the AA content of the finisher is higher or the change from grower to finisher is made at a later age, then the effects are smaller. This is because the degree of AA deficiency being caused by the change (if any) is smaller. In males the effects of time of change disappear at 120% AA and in females it appears that this would occur at about 110% AA. Economic inputs and revenue outputs were combined with the bird performance data to give an estimate of margins and costs. In males the treatment 120% AA/21 d change produced the highest margin at all weights. In females, the highest AA level tested (100%) also produced the highest margin in small birds (1.7 kg), but the 70% AA feed introduced at 28 or 35 d tended to produce higher margins in higher body weight females. The results demonstrate that effective phase feeding can only be achieved by the application of a simple economic model customized for local broiler production conditions.

Key Words: broiler, amino acids, economics

146 Improved performance of Cobb 500 birds fed increased amino acid density in wheat or maize based diets. R. B. Shirley^{*1}, D. S. Parker¹, M. Vazquez-Anon¹, C. D. Knight¹, and A. G. Marangos², ¹*Novus International, Inc., St Louis, Missouri*, ²*Nutrition Solutions, Winchester, United Kingdom*.

The objective of this experiment was to evaluate the impact of increasing amino acid density of commercial broiler diets that are based on either wheat or maize. There were three dietary regimes: Diet 1 was formulated to be similar to the Cobb Broiler Nutrition Guide (2004) for minimum feed cost (FC); Diet 2 was based on the Cobb guidelines for maximizing white meat yield (WM) and Diet 3 was similar to WM but had the addition of higher amino acid levels (AA). Diets were fed in three phases and ME levels for the Starter (2968 kcal/kg), Grower (3053 kcal/kg) and Finisher (3154 kcal/kg) were calculated to be the same across all treatments. The starter diets were fed crumbled and the Grower and Finisher diets were fed pelleted to eight replicates of 24, 1-day old Cobb 500 chicks that were randomly allocated to 96 floor pens and grown until 36 days of age. Since there were no significant gender \times diet, gender \times level, or diet \times level interactions for any of the production parameters, only the main effects are presented. As expected male birds outperformed female birds in most parameters across diet type and amino acid supplementation level. Body weight gain (BWG) and feed consumption were significantly influenced by amino acid density. Broilers consuming the FC diet had the lowest BWG and poorest feed conversion, while broilers consuming the AA diet had the greatest BWG ($p=0.0315$) and best feed conversion ($p\leq 0.001$). Despite the latter differences, feed intake was not affected by amino acid density. On a dietary ingredient basis birds fed the wheat based diets tended to have lower gains ($p\leq 0.0285$) and lower feed consumption ($p\leq 0.0041$), resulting in no net change in feed conversion when compared to birds fed maize based diets. Carcass analysis showed a significant reduction ($p\leq 0.0008$) in fat pad weight and a significant increase ($p\leq 0.0082$) in breast meat yield at the highest level of amino acid inclusion. Economic analysis of the trial also illustrated an improved return over feed costs when Cobb 500 broilers were fed a high amino acid diet.

Key Words: broiler chicken, dietary amino acid density, Cobb 500

147 Individual arginine requirements in Ross 308 broilers at 7, 21 and 42 days of age. R. A. Coleman^{*1,2}, R. D. Kirschenman¹, S. Moehn¹, and D. R. Korver¹, ¹*University of Alberta, Edmonton, AB, Canada*, ²*University of Queensland, Gatton, Queensland, Australia*.

Traditional techniques to determine amino acid (AA) requirements in poultry use growth as an indicator when diet AA levels increase from deficient to sufficient. The Indicator Amino Acid Oxidation (IAAO) technique has been developed to determine Arginine requirements in poultry by measuring the change in oxidation rate of a radiolabelled AA_{indicator} (L-[1-¹⁴C] Phenylalanine) when the bird is fed different levels of Arginine. Arginine requirements were determined during 4-hr indicator oxidations in which each bird received a priming dose of 111 kBq/kg BW followed by repeated oral doses of the AA_{indicator} of 64 kBq per 0.5 h per kg BW. Ross 308 broilers at 7 (BW = 93.5 ± 1.55 g, n = 31), 21 (BW = 733.91 ± 16.90 g, n = 19) and 42 (BW = 2486.59 ± 40.73 g, n = 34) d of age were adapted to a pelleted, purified test diet formulated to be isoenergetic, isonitrogenous and complete except for Arginine. Six test diets ranging from deficient to in excess (6.05

to 17.88g Arginine/kg diet) of NRC recommendations were fed to each test age group. New protocols were developed to determine the selection criteria and adaptation period; birds were adapted to the environmental chambers for 4 days, followed by 3 days of adaptation to the test diet. Mean Arginine requirements (bicarbonate retention factor (BRF) corrected) for Ross 308 broilers at d 21 and 42 were 14.75 ± 0.12 and 8.56 ± 0.04 g/kg diet, respectively. The Arginine requirement at d 7 (non-BRF corrected) was 14.80 ± 0.68 g/kg diet. NRC recommendations for 0 to 3 and 3 to 6 wks old broilers are 12.5 and 11.0 g Arginine/kg diet respectively. To date, we have had difficulty obtaining BRF for broilers with <100g BW due to variability in water and feed consumption in birds < 7 d of age. Controlling for these factors will allow future IAAO studies in very young birds to be appropriately corrected for BRF. The IAAO technique allows for determination of individual bird AA requirements at specific ages and for different types of birds over short periods of time and gives poultry nutritionists a valuable tool to allow for more accurate diet formulation.

Key Words: Arginine, broiler, requirement

148 Comparison of endogenous ileal amino acid and total nitrogen flow in turkey poults and broiler chicks. S. A. Adedokun^{*1}, C. Parsons², M. Lilburn³, O. Adeola¹, and T. J. Applegate¹, ¹*Purdue University, West Lafayette, Indiana*, ²*University of Illinois, Urbana*, ³*The Ohio State University, Columbus*.

Ileal endogenous amino acid (IEAA) and N flow in turkey poults and broiler chicks at three ages (5, 15, and 21 d) were compared by feeding a N-free diet (NFD) or graded levels of casein (CDP). The semi-purified diets contained 0 (NFD), 50, 100, or 150 g casein/kg diet as the only source of amino acids. Each diet was fed for 5 d prior to the collection of ileal digesta. Each diet was fed to six replicate cages containing 30 (5 d), 10 (15 d), or 8 (21 d) birds per cage. At d 5, IEAA and N flow (mg/kg DM intake) in poults fed the NFD, and graded levels of casein at d 5 was higher ($P < 0.05$) in poults than in chicks (NFD: Met, poult=391 and chick=153; Thr, poult=1,173 and chick=567; 5% casein: Met, poult=339 and chick=276; Thr, poult=1,081 and chick=870; 10% casein: Met, poult=472 and chick=346; Thr, poult=1,425 and chick=998; 15% casein: Met, poult=539 and chick=399; Thr, poult=1,595 and chick=1,208). Within each species, there were differences ($P < 0.05$) in IEAA and N flow between 5 d and 21 d. The IEAA flow (mg/kg DM intake) in poults on d 15 (Met, 86; Thr, 427) and d 21 (Met, 85; Thr, 442) were not different from that of chicks fed the NFD on d 5 (Met, 153; Thr, 567). Similar trends were observed in the remaining three diets. An interaction between species and age was observed for most of the amino acids and N in birds fed NFD (Met, $P=0.06$, Thr, $P=0.01$), 5% casein (Met, $P=0.23$; Thr, $P=0.02$) 10% casein (Met, $P=0.02$, Thr, $P=0.0002$) and 15% casein (Met, $P=0.09$; Thr, $P=0.04$). The results from this study suggest that at younger ages poults have significantly higher concentration of IEAA and N relative to chicks, however, by 15 d and 21 d, the species differences in IEAA and N flow were not significant. The increased IEAA flow observed at the younger age should be taken into consideration when formulating starter diets on digestible protein basis.

Key Words: amino acid, endogenous, nitrogen-free diet

149 Standardized ileal amino acid digestibility of meat and bone meal in broiler chicks using a nitrogen-free or casein diet. S. A. Adedokun¹, C. Parsons², M. Lilburn³, O. Adeola¹, and T. J. Applegate¹, ¹Purdue University, West Lafayette, Indiana, ²University of Illinois, Urbana, ³The Ohio State University, Columbus.

The aim of this study was to determine the effect of bird age and meat and bone meal (MBM) source on standardized ileal amino acid (SIAA) digestibility. The SIAA digestibility coefficients (DC) were standardized using basal endogenous amino acid and nitrogen (N) flow values obtained from chicks fed a N-free diet (NFD) or a diet containing 10 % casein (CDP). Each of 4 diets was formulated to contain 20 % CP using MBM as the only source of CP and fed for 5 d prior to collection of ileal contents (6 cages of 30 or 8 birds/cage at 5 and 21 d, respectively). Using NFD for standardization, the SIAA DC for Met (MBM1, all beef) was 74.9 % (d 5) or 67.8 % (d 21), and for CDP was 81.6 % (d 5) or 72.9 % (d 21). The SIAA DC for Thr (NFD: MBM1) was 72.4 % (d 5) and 60.7 % (d 21), and for CDP was 79.8 % (d 5) and 64.1 % (d 21). The SIAA DC for Met (NDF; MBM2, all pork) increased from 54.1 % (d 5) to 76.3 % (d 21), and for CDP from 58.9 % (d 5) to 79.9 % (d 21). The SIAA DC for Thr (NFD) increased from 48.4 % (d 5) to 70.7 % (d 21), and for CDP from 54.1 % (d 5) to 73.3 % (d 21). The SIAA DC for Met for MBM3 (NFD; mixed species) increased from 50.0 % (d 5) to 70.6 % (d 21), and for CDP from 55.0 % (d 5) to 74.3 % (d 21). The SIAA DC for Thr for MBM3 (NFD) increased from 46.7 % (d 5) to 66.3 % (d 21), and for CDP from 52.9 % (d 5) to 69.1 % (d 21). The SIAA DC for Met for MBM4 (NDF; MBM4, mixed species) increased from 60.1 % (d 5) to 75.3 % (d 21), and for CDP were from 64.2 % (d 5) to 78.3 % (d 21). The SIAA DC for Thr from MBM4 (NFD) increased from 51.0 % (d 5) to 69.0 % (d 21), and for CDP from 56.6 (d 5) % to 71.5 % (d 21). The coefficient of variation between the two sources of standardization was 6.5 to 9.4 % on d 5 and 3.9 to 7.1 % on d 21 for Met and 9.7 to 12.4 on d 5 and 3.6 to 5.4 % on d 21 for Thr. Results from this study showed that standardization using NFD or CDP diets resulted in different SIAA DC with a reduction in the margin of variation with age.

Key Words: amino acid, meat and bone meal, standardized ileal digestibility

150 Responses of fast and slow growth rate female broiler grillers to all vegetable diets with graded increases in the ideal protein profile. A. R. Olmos, S. L. Vieira*, J. Berres, J. L. B. Coneglian, and D. M. Freitas, *Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.*

International market for small broiler carcasses is usually supplied with female broiler chickens. Theoretically female grillers with higher initial growth rate are more efficient feed converters. Growth rate differences of strain crosses currently grown are very pronounced and there is an ongoing discussion presently on the positive interaction between genetics and dietary protein. This interaction is expected to benefit strain crosses with slower initial growth rate narrowing their body weight differences with faster growth rate birds. In this study, 2,100 female broilers from two strain crosses (Fast and Slow growth rate) from similar breeder ages were placed in 70 floor pens, 30 birds per pen. Broilers were fed programs with a pre-starter to 6 d, a starter to 21 d, a grower to 31 d and a finisher to 37 d. Dietary program was composed by 3 ideally balanced protein levels (Dig. SAA:Lys = 75%; Dig. Thr:Lys=65%), which were set by Dig. Lys levels 15% apart (Low, Medium, High). Digestible Lysine of the Medium protein

feeding program was, respectively: 1.23, 1.10, 1.00, 0.95%. At day 21, half of the broilers from Low protein were given High protein and half of those in High protein were given Low protein to 37 d. Birds on Medium protein were kept in the same ideal protein program. Six broilers from each pen averaging its mean were processed at 31 and 37 d of age. Body weight was higher and FC was better for broilers of Fast growth rate strain at both processing ages. Feeding Low protein diets from placement or at 21 d resulted in poorer BW and FC at both processing ages; however, there were no differences between birds receiving High protein from placement or from 21 d on when compared to Medium protein. Broilers from Slow growth rate strain produced a higher percentage of breast fillets at 31 d but no differences were observed at 37 d. Feeding Low protein from placement or at 21 d led to a reduction in breast meat yield, but High protein given from 21 d on and Medium protein given during the entire study produced similar results. There were no interactions between diet and Strain Cross for any response. Therefore, improvements provided by increased dietary protein were similar for the two strain crosses studied.

Key Words: broiler, lysine, ideal protein

151 Responses of fast and slow growth rate male broilers to all vegetable diets with graded increases in the ideal protein profile. J. L. B. Coneglian, S. L. Vieira*, J. Berres, T. C. K. Bortolini, and G. X. Silva, *Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.*

Growth rate differences of strain crosses currently grown are very pronounced. Presently, there is an ongoing discussion on the positive interaction between genetics and dietary protein. This interaction is expected to provide a greater benefit for strain crosses with slower initial growth rate, narrowing their performance differences with faster growth rate birds. In this study, 1,890 male broilers from two strain crosses (Fast and Slow initial growth rate) from similar breeder ages were placed in 70 floor pens, 27 birds per pen. Broilers were fed programs with a pre-starter to 7 d, a starter to 21 d, a grower to 34 d and a finisher to 40 d. The dietary program was composed by 3 ideally balanced protein levels (Dig. SAA:Lys = 75%; Dig. Thr:Lys=65%), which were set by Dig. Lys levels 15% apart (Low, Medium, High). Digestible Lysine of the Medium protein feeding program was, respectively: 1.26, 1.14, 1.05, 1.00%. At day 21, half of the broilers from Low protein were given High protein and half of those in High protein were given Low protein to 40 d. Birds on Medium protein were kept in the same ideal protein program. Six broilers from each pen averaging its mean were processed at 34 and 40 d of age. Body weight was higher and FC was better for broilers of Fast growth rate strain at both processing ages. Feeding High protein diets throughout the experiment led to a higher BW and better FC, whereas broilers fed Medium protein during the total experimentation had similar responses to High-Low and Low-High protein diets. Low protein diets given for the total period resulted in poorer BW and FC at both processing ages. Fast growth rate strain produced a higher percentage of breast fillets at 40 d with a significant reduction in abdominal fat; however, no strain differences was seen at 34 d. High protein diets provided from placement to the end of the experiment or starting at day 21 resulted in reduced abdominal fat at 40 d, whereas Low protein given in the total period or starting at day 21 had the higher percentage and Medium protein was intermediate. Breast fillets were negatively affected by the Low protein diets; all the other combinations resulted in similar breast meat yields. Tenders were more sensitive to changes in protein resulting in better yields when High protein was provided regardless

of period. Mortality was not affected by the treatments. In the majority of responses there were no significant interactions between Strain and Dietary Protein. Exceptions were abdominal fat and total breast meat, which had the Fast growth strain with increased proportions of fat and breast meat as protein intake increased at 34 d.

Key Words: broiler, ideal protein, strain cross

152 Changes in tissue accretion during the acute phase response. P. Sirimongkolkasem* and K. C. Klasing, *University of California, Davis.*

The acute phase response (APR) to inflammation is characterized by decreased appetite, increased hepatic protein synthesis and muscle wasting. Previously, we found that diets containing essential amino acid (EAA) above NRC recommended levels (120%, 130% and 140%) did not lessen the decrease in growth performance during an APR, nor did they promote compensatory growth after an APR. This indicates that dietary EAA is not a factor limiting growth during APR. The present experiment was conducted to determine quantitatively the impact of APR on liver, pectoralis, semitendinosus and immune tissue weights and growth performance. APR was activated by injecting 2 mg/kg BW of lipopolysaccharide (LPS), s.q., into 8 d old male broilers. Body weight, feed intake and organ weights were measured on d 0 (prior to injection), 12 hrs, 24 hrs and 4 days post-injection. Uninjected birds were used as a negative control. Each treatment-time combination was replicated in 4 pens with 4 birds per pen. APR activation resulted in a significant decrease in average daily gain (66%), feed intake (28%) and feed efficiency (50%) 12 hrs post LPS injection. The depression in growth performance as a result of LPS injection was not significant at later times. A significant interaction between treatment and time was observed for both actual and relative liver weight ($P < 0.05$). LPS-induced increases in both actual (28%) and relative (26%) liver weights persisted for 24hrs after injection, but were no longer significant by d 4. No treatment by time interaction was observed for other organs. The absolute, but not relative, semitendinosus weights of LPS injected birds were significantly lower (10%) than controls at 24 hrs post injection ($P < 0.05$). Actual and relative weights of pectoralis, bursa, thymus or spleen were not affected by LPS. These results indicate that activation of APR results in an increase in liver weight concomitant with a decrease in skeletal muscle accretion. Assuming no major change in AA composition within organs occurs during an APR, dietary nutrients are repartitioned from growth toward hepatic immune functions.

Key Words: acute phase response, broiler, tissue accretion

153 The effects of different nutrient regimes on Ross broilers during stress and post-stress recovery. W. S. Virden*, A. C. DeLeon, A. Corzo, and M. T. Kidd, *Mississippi State University, Mississippi State.*

Two experiments were conducted to determine the effects of different nutrient regimes on corticosterone (CS) stress response, and post-stress recovery of broilers. Experiment 1 examined the effects of diets with increased glucogenic or ketogenic amino acids (AA), or L-carnitine. Ross x 308 broilers (432) were placed in 36 floor pens and given a common starter diet from 1 to 20 d of age. From d 21 to 30, broilers were given *ad libitum* access to the following dietary treatments: 1) Control (digestible (d) TSAA, 0.75 %; d Lys 1.00%; d Thr 0.67%; d Trp 0.21%); 2) control + 15 mg CS/kg diet; 3) as 2 + L-Lys HCl

(1.15% d Lys); 4) as 2 + DL-Met (0.82% d TSAA) and L-Thr (0.74% d Thr); 5) as 2 + L-Trp (0.24% d Trp); 6) as 2 + L-Carnitine (50 mg/kg L-Car); (6 treatments/6 replications). Experiment 2 measured the effects of feeding stressed broilers diets varying in Trp or AA density. Ross x 308 (360) broilers were placed in 30 floor pens and fed a common starter diet from d 1 to 20. From d 21 to 25, chicks were given *ad libitum* access to dietary treatments: 1) Control diet (d TSAA, 0.75%; d Lys 1.00%; d Thr 0.67%; d Trp 0.21%); 2) control diet + 15 mg CS/kg diet; 3) as 2 + L-Trp (0.25% d Trp); 4) moderate AA density (18.5% CP; d TSAA, 0.82%; d Lys, 1.10%; d Thr, 0.74%); 5) low AA density (18.5% CP; d TSAA, 0.79%; d Lys, 1.00%; d Thr, 0.67%); (5 treatments/6 replications). From d 26 to 46, broilers received the control diet. Live performance was measured on d 30 and 48 for experiment 1, and d 25 and 46 in experiment 2.

During stress, BW gain was lower ($P < 0.05$), and feed conversion was higher ($P < 0.05$) for broilers given all treatments containing CS than birds given control in both experiments. However, in experiment 1, broilers receiving treatment 3 had higher ($P < 0.05$) BW gain than broilers given treatments 4 or 6, but feed intake (FI) did not differ. However, in experiment 2, FI was higher ($P < 0.05$) for all treatments fed CS than control. Deleterious effects on 26 to 46 d BW gain and feed intake were ameliorated ($P < 0.05$) only by supplemental Trp, but feed conversion differences did not occur.

Key Words: broiler, stress, tryptophan

154 Developmental regulation of peptide and amino acid transporter mRNA in the small intestine of broiler chicks. E. R. Gilbert*¹, H. Li¹, D. Emmerson², E. A. Wong¹, and K. E. Webb, Jr.¹, ¹*Virginia Tech, Blacksburg,* ²*Aviagen, Huntsville, Alabama.*

The objective of this research was to investigate the mRNA abundance of peptide and amino acid transporters in the small intestine of two genetic lines of broilers, selected on corn-soybean (line A) or wheat (line B) based diets. The genes examined included the peptide transporter, PepT1, nine amino acid transporters (rBAT, b^{0,+}AT, ATB^{0,+}, CAT1, CAT2, LAT1, y⁺LAT1, y⁺LAT2, and EAAT3), and a digestive enzyme, aminopeptidase N (APN). Intestine was collected from four male birds from both lines at the following times: embryo day 18 (e18) and 20 (e20), day of hatch (doh), and d 1, d 3, d 7 and d 14 after hatch. Birds were given *ad libitum* access to a low-protein, corn-soy based diet, as this has been shown to accentuate differences in body weight between the two lines. At e18 total intestine was collected, and thereafter, intestine was divided into duodenum, jejunum, and ileum. Total RNA was isolated and mRNA abundance was assayed using real time PCR and the absolute quantification method. For PepT1, Line B had greater quantities of mRNA ($P = 0.0007$) compared to Line A, suggesting that Line B may exhibit a greater capacity to assimilate amino acids as peptides. The PepT1 mRNA was greatest in the duodenum ($P = 0.0001$), while EAAT3, b^{0,+}AT, rBAT, and APN mRNA were greatest in the ileum ($P = 0.0001$). Quantities of APN mRNA increased linearly with age ($P = 0.0001$), and were greatest compared to other genes. Quantities of CAT1, CAT2, and LAT1 mRNA decreased linearly with age ($P = 0.0001$), suggesting relatively more important roles in the embryo. In conclusion, these results demonstrate that nutrient transporter and digestive enzyme mRNA are expressed differentially among intestinal segments and with age, and between genetic lines.

Key Words: amino acid transporter, PepT1, real time PCR

155 Intestinal *Clostridium perfringens* and lactobacilli populations in broiler chickens fed protected glycine and proline based diets. J. P. Dahiya^{*1}, D. Hoehler², A. G. Van Kessel¹, and M. D. Drew¹, ¹University of Saskatchewan, Saskatoon SK, Canada, ²Degussa Corporation, Kennesaw, Georgia.

Previous work in our laboratory showed that certain protein sources used in broiler diets increased gut *C. perfringens* populations and may predispose birds to necrotic enteritis (NE). When gelatin was used as protein source a positive correlation between dietary protein-bound glycine (Gly) content and gut *C. perfringens* counts was confirmed, however, since gelatin also contains high levels of proline (Pro), a causative link between Gly and NE could not be conclusively established. A study was therefore conducted to determine if there is a causative relationship between dietary Gly and NE in broiler chickens. Since crystalline Gly is rapidly absorbed in the duodenum, it is largely unavailable to *C. perfringens* populations in the distal gut. Fat encapsulated Gly was used to slowly release the amino acid along the entire length of the gut. An initial study showed that Gly concentrations were significantly higher ($P < 0.05$) in jejunum and ileum of birds fed encapsulated glycine (1.26% and 1.05%) compared to free glycine (0.98% and 0.62%). In the main study, two cages of 6 birds (14 d post-hatch) were assigned to one of 3 ideal protein-balanced diets: a control diet containing 19% crude protein and 1.15% lysine, the control diet with 4% encapsulated Gly added or the control diet with 4% encapsulated Pro added. All diets contained 3.30 Mcal/kg ME. The birds were orally challenged with *C. perfringens* type A on d 14-21 and killed on d 28. The majority of birds were dull, depressed and diarrheic during first 5 days after gavaging with 4% mortality. There was a significant increase ($P < 0.05$) in *C. perfringens* populations in ileum and cecum of birds which received the encapsulated Gly diet compared to those receiving the control or encapsulated Pro diets. Lactobacilli counts in ileum declined significantly ($P < 0.05$) in the ceca of birds fed the encapsulated glycine diet compared to other 2 groups. We conclude that Gly is an important determinant of *C. perfringens* growth in the intestinal tract of broiler chickens.

Key Words: broilers, *Clostridium perfringens*, glycine

156 Effect of low protein diets on necrotic enteritis in broiler chickens. T. E. Warren^{*1}, D. C. Wilkie¹, J. P. Dahiya¹, A. G. Van Kessel¹, D. Hoehler², and M. D. Drew¹, ¹University of Saskatchewan, Saskatoon, SK, Canada, ²Degussa Corporation, Kennesaw, Georgia.

Necrotic enteritis is a worldwide poultry disease caused by *Clostridium perfringens*. Previous studies in our laboratory have shown a significant effect of protein source and high protein concentrations on *C. perfringens* growth in intestinal tract of broiler chickens. This experiment was conducted to examine the effect of low protein diets, formulated on net energy basis, on necrotic enteritis in broiler chickens. A total of 144 day-old male broiler chicks were kept in two battery brooders in separate rooms (12 cages of 6 birds) and were provided with a medicated, ideal-protein balanced starter diet for first 2 weeks after hatch. From d 14 onwards, 4 cages in each battery brooder were randomly assigned to one of 3 different ideal-protein balanced diets

containing 16, 18 or 20% crude protein. Diets were isoenergetic and met NRC nutrient requirements. All birds were orally challenged with either a *C. perfringens* type A broth culture or sterile cooked meat broth from d 14 to 20 and euthanized on d 28. The majority of the birds gavaged with *C. perfringens* broth culture became dull, depressed and diarrheic. There was 8.33% and 1.39% mortality in the challenged and unchallenged groups, respectively. No significant differences were observed in the ileal or cecal *C. perfringens* populations among different diets or between challenged and unchallenged birds. *Lactobacillus spp.* counts in the ileum and cecum declined significantly ($P < 0.05$) in the birds which were challenged with *C. perfringens* culture. Necrotic enteritis intestinal lesion scores were significantly higher in the birds fed 18 and 20% crude protein in the challenged birds. In conclusion, all diets supported very low intestinal colonization by *C. perfringens* however, a reduction in *C. perfringens*-associated lesion scores suggested that low protein diets may lower incidence of necrotic enteritis.

Key Words: necrotic enteritis, *Clostridium perfringens*, broiler

157 An examination of the role of feeding regimens in regulating metabolism during the broiler breeder grower period. M. de Beer^{*1}, C. N. Coon¹, R. W. Rosebrough², B. A. Russel², S. M. Poch², and M. P. Richards², ¹University of Arkansas, Fayetteville, ²USDA-ARS, Beltsville, Maryland.

Skip-a-day feeding programs are commonly used in broiler breeder rearing to reduce flock variation. A trial was conducted to determine the effects of skip-a-day feeding programs on various metabolic parameters. A total of 120, 16-week old Cobb-Vantress broiler breeder pullets were used, of which, 48 had been fed using an everyday restriction program from four weeks of age, and 72 had been fed using a skip-a-day restriction program from four weeks of age. All pullets were fed to reach the same body weight at 16 weeks of age. At 112 d 48 pullets from the everyday group were fed 74 g of standard breeder grower diet and 72 pullets from the skip-a-day group were fed 148 g of the same feed. Livers from four sacrificed pullets were collected at 0, 12, and 24 (everyday) and 0, 12, 24, 36 and 48 (skip-a-day) hours after feeding. These times represented one full feeding cycle for each group. RNA was isolated from livers using Trizol[®] reagent and quantitatively measured by noting the OD 260/280 ratio and qualitatively by gel electrophoresis. The expressions of certain regulatory genes in metabolism (acetyl CoA carboxylase, ACC; fatty acid synthase, FAS; malic enzyme, ME; isocitrate dehydrogenase, ICD and aspartate aminotransferase, AAT) were determined by real time PCR. ACC, FAS and ME were increased in skip-a-day birds compared to those birds fed daily. In contrast, skip-a-day decreased ICD and AAT gene expression, paralleling findings noted in fasting-refeeding experiments conducted with much younger birds. Feeding regimens practiced during the grower period may predispose the broiler breeder hen to high rates of lipogenesis during the subsequent reproductive cycle.

Key Words: breeder, restriction, lipogenesis