of a two-tier separation, basophils were classified as “resting” or “reactive”. In a further separation, reactive basophils were sub-classified as dendriform, dysgranulosis, dysplastic, dwarf, lake, mesomyelocyte, metamyelocyte, net, oncosis, and toxic on differences from resting cells. The two tiers complete a basophil differential count (BDC) when 100 cells are sorted. As an example, 18 wk and 77 wk commercial hens had ~63% and ~65% resting types. The remainder, at 18 wk, was 2.2% lake, 16 % dendriform, and 17 % dysplastic. At 77 wk the non-resting distribution was 10.3% lake, 10.5% dendriform, and 2.5% dysplastic. Dwarf forms found in chickens, ducks, and turkeys; were smaller than standard sized cells by ~50%. Projections from the cell body of dendriform basophils contained granules. These forms are reminiscent of Ehrlich's original interpretation of mast cells acting as feeder/donors to nearby cells. The term “basophilia” is applied when basophils compose ~5% of a standard differential count. If >25% of basophils are non-resting atypical types, the blood is described as “basophiliosis”. As analogy it is proposed basophilia: basophiliosis :: leukocytosis: leukemia. Basophilia/basophiliosis commonly occur in the context of bacteremia/fungemia and like high heterophil/lymphocyte ratios (H/L) are indications of stress or disease.

Key Words: basophil, basophilia, basophiliosis, stress, fungemia

M72 Effect of fan induced photoperiod on live performance and yield of male broiler chickens J.L. Purswell*, H.A. Olanrewaju ARS - USDA

Increasing broiler house size and ventilation capacity have resulted in increased light leakage into the house. Light ingress may alter the effective photoperiod for broiler chickens and create local increases in light intensity. This study examined live performance and processing yields in male broilers reared to 63 d of age exposed to either a constant light intensity or a variable light intensity to mimic light ingress through tunnel fans. A total of 960 male broiler chicks was obtained from a commercial hatchery and allocated to 16 groups of 60 chicks; initial body weight (BW) was equated across groups. Groups were randomly distributed to each of 16 rooms in an environmentally controlled lighting research facility. Each room was equipped with fresh pine shavings, nipple drinkers, and tube feeders. Birds were provided a commercial-style four phase corn-soy diet. BW and feed consumption (FC) data were obtained at each feed phase change. Lighting was provided with broad spectrum 6W LED bulbs. Identical lighting programs were used for both treatments until 35 d when treatments were initiated. Treatments consisted of a constant light intensity at 2.5 lux for 18L:6D and a variable light intensity based on field measurements near tunnel fans in a commercial broiler house; the resulting variable lighting treatment was 18L:6D with a peak intensity of 35 lx. Each treatment was represented by eight replicate rooms. Data were analyzed using PROC MIXED in SAS in a completely randomized design with pen serving as the experimental unit. Mortality data were subjected to arcsin transformation prior to analysis. Treatment means were separated using Fisher’s least significant difference, with significance considered at P<0.05. BW, body weight gain, and mortality were not different between treatments. Feed conversion ratio and feed consumption were significantly increased for the variable light treatment, with a difference of 0.06 g feed:g gain (P=0.01) and 228 g/bird (P=0.02), respectively. The data illustrate the need to mitigate light ingress through ventilation system components to improve live performance in broilers. In addition, research trials employing constant photoperiods may not adequately mimic the commercial broiler house environment.

Key Words: ventilation design, housing management, lighting

M73 Effect of light intensity adjusted for species specific spectral sensitivity on live performance in broiler chickens J.L. Purswell*, H.A. Olanrewaju ARS - USDA

Providing adequate lighting for establishment and maintenance of circadian rhythms, eating and drinking, and reproductive behavior is critical for health and well-being. The spectral response of the chicken eye differs from that of humans and as such, lighting needs may also differ. This study examined live performance in broilers subjected to lighting systems which were designed for both human and poultry vision adjusted for each species’ spectral response curve.

Two trials were conducted, each using a total of 352 straight-run broilers obtained from a commercial hatchery. Chicks were randomly allocated to eight rooms at 44 chicks per room. Rooms were equipped with tube feeders and nipple drinkers; feed and water were available ad libitum. Birds were provided a four phase corn-soy diet. Lighting was provided with either a red-supplemented LED bulb designed for poultry rated at 8W or a broad spectrum LED bulb rated at 6W. Intensity levels were adjusted according to human or poultry spectral response. A precision photometer was compared against a poultry specific spectroradiometer to determine appropriate offsets to achieve proper poultry-specific intensity levels. Treatments were arranged in a 2x2 factorial design with main effects of lighting source (RS or WL) and spectral response curve (CIE or CLUX). Each treatment combination was represented by two replicate pens per trial. Data were analyzed as a randomized complete block design with ANOVA using PROC MIXED. Means were separated using Fisher’s LSD.

Mean body weight among all treatments was 3969 g and FCR was 1.76. No differences in any live performance variables were detected for any main effects or their interactions. The lack of differences observed in the current study illustrate the ability of broilers to adjust to, and flourish in, a variety of lighting environments. Furthermore, the differences in lighting output when adjusting for species’ sensitivities can be quite subtle, especially at typical broiler house intensities.

Key Words: lighting, housing management, spectrum

Metabolism & Nutrition I

M74 Impact of increased dietary threonine on egg quality and component yield in older laying hens. John Padgett*,†1, Rachel Blount, Micky Clary, John Carey Texas A&K University

An experiment was undertaken to evaluate the influences of increased levels of dietary threonine on egg quality and component yield in older commercial laying hens. Beginning at 65 weeks of age, 162 laying hens were randomly assigned to three experimental treatments. Sixty hens in 20 replicate units served as the control (CON) group and received a standard laying hen diet with 2900 kcal/kg, 16% Crude protein, 0.48% total methionine, 0.71% total sulfur amino acids, 0.82% total lysine, 4.5% calcium, 0.67% total phosphorus and 0.62% total threonine. Fifty one hens in 17 replicate units received the control diet with 0.2% supplemental synthetic threonine (THR L). The remaining 51 hen (17 replicate units) received the control diet with 0.4% supplemental synthetic threonine (THR H). Hens were housed in individual cages in a tunnel ventilated laying facility. Replicate units consisted of three hens in consecutive cages sharing access to a common feed trough. Beginning at 69 weeks of age eggs from two consecutive day’s production were evaluated every 28 days for egg weight, USDA size, shell thickness, shell breaking strength and specific gravity. Beginning at 67 weeks of age eggs one day’s production were sampled weekly for egg component yield. Egg weight, albumen weight and yield, specific gravity and shell yield were not affected by the treatments. Shell thickness was significantly (P < 0.016) greater in eggs from hens fed THR-H compared to CON. Shell breaking strength was significantly greater (P < 0.018) in eggs from hens fed THR L compared to CON. Shell weight was significantly higher (P < 0.044) in eggs from hens fed THR H compared to those fed THR L. Yolk weight was significantly higher (P < 0.017) in eggs from hens fed THR H compared to both CON and THR L. Yolk yield of eggs from hens fed THR_H was significantly higher (P < 0.014) than CON.
This experiment demonstrates that supplemental threonine in diets of older laying hens can improve shell quality and egg composition in terms of yolk weight and yield. Improved shell quality will reduce losses due to breakage in collection, packaging and transport. Greater yolk weight and yield improves the functional quality and value of eggs marketed in liquid form.

Key Words: Laying hens, Threonine, Egg Quality, Egg Component Yield

M75 Evaluating the effect of yeast cell wall supplementation on ideal threonine to lysine ratios in broilers as measured by performance, intestinal mucin secretion, morphology, and goblet cell number

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The objective of this study was to investigate whether or not a prebiotic yeast cell wall previously shown to improve performance in challenge studies, effects threonine requirements by measuring performance, morphology, mucin secretion and goblet cell number per villi in the intestine. Two hundred forty 1-day-old Ross 308 broiler chickens were distributed in two Petersime battery brooder units (48 pens; 5 birds per pen). Different threonine to lysine ratios (0.65, 0.70, and 0.75) with 1.23 available lysine with and without yeast cell wall (YCW) at 250 ppm was fed for a 21-day trial. A basal diet with 22% protein and 2980 Kcal/Kg ME was used for the dietary treatments. The calculated lysine concentration was 1.35 while threonine was 0.88, 0.95, and 1.02 respectively. Birds and feed were weighted by pen and the weights recorded at day 1, 7, 14 and 21 of the experiment for general performance data. At day 21, samples from excreta and small intestine (jejenum and ilium) were collected. Crude mucin was analysed from excreta samples while villi height, crypt depth, villi width, muscular thickness and goblet cell number were measured in intestinal sections. The yeast cell wall did not show any significant effect with respect to the variables evaluated in this non-challenge study. Threonine to lysine ratio 0.75:1 showed numerically higher body weight throughout the study with significant main effect for jejunum villi height, villi width, crude mucin and goblet cell number. Increasing the ratio between threonine and lysine led to an increase the mucin secretion probably due to the increase in the number of the goblet cells per villi.

Key Words: Threonine, Prebiotic, broilers, intestine, mucin

M76 Effects of various levels of synthetic arginine supplementation on growth response and fat deposition in broilers

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Arginine is an essential amino acid for birds. Poultry are highly dependent on arginine dietary supply, as they are incapable of its synthesis de novo due to the lack and low activity of the key enzymes. Several studies in different species demonstrated that arginine can influence positively desirable performance traits, such as body weight, carcass yield and reduced fat deposition. For this reason, the objective of the study was evaluate the effects of crystalline arginine on performance traits and fat content in male broilers. A total of 690 one-day-old Ross 308 broiler chicks were allocated in floor pens, distributed in a completely randomized design, with five treatments, six repetitions and 23 birds per pen. The treatments were given as a percentage of the Ross 308 requirement, and defined as T1=170% of arginine (basal diet; 77% Arg:Lys ratio); T2=90% of arginine (85% Arg:Lys ratio); T3=90% of arginine (95% Arg:Lys ratio); T4=100% of arginine (Ross 308 requirement; 106% Arg:Lys ratio); T5=110% of arginine (116% Arg:Lys ratio). The diets were based on corn/soybean meal and divided for starter (1-10d), grower (11-24d) and finisher (25-42d) periods. Body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) were measured at 10, 24 and 42 days of age, and at 42 days abdominal fat weight was measured from three birds per pen. The means were subjected to ANOVA and, when significant (p<0.05), means were compared by Duncan test. For the overall period, T4 and T5 showed similar and the highest BWG and FI. T3 presented higher values for these traits when compared to T2, and T1 had the lowest BWG and FI (p<0.0001). T3, T4, and T5 improved FCR compared to T1 and T2 (p<0.0001), whereas there was no significant difference among T3, T4 and T5. The mortality percentage in T1 was significantly higher than the one in the other treatments (p<0.0001). Fat pad weight corrected for body weight was higher for T1 when compared to T2, T3, T4 and T5 (p<0.0012). In conclusion, the levels recommended by Ross 308 guideline (T4; 106% Arg:Lys ratio) are enough to ensure good performance results, and the use of 70% of the requirement (T1; 77% Arg:Lys ratio) resulted in decrease in performance traits as well as in increase in fat deposition.

Key Words: Arginine, Broilers, Performance, Fat depotition

M77 Effects of guanidinoacetic acid supplementation on carcass, cut up yields, and meat quality of broilers fed corn and sorghum-based diets

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Carcass and cut up yields are affected by nutrition. This experiment was conducted to evaluate the effects of guanidinoacetic acid (GAA) supplementation as a precursor of creatine in broilers fed corn or sorghum based diets on carcass and cut up yields. The treatments consisted of corn or sorghum-based diets with or without the addition of GAA (600 g/ton) as CreAMINO®. A total of 800 male Ross 708 chicks were randomly placed in 40 floor pens. At 51 and 55d of age, 4 birds per pen were processed; carcass and cut up parts yield were obtained. Breast fillets were evaluated for drip and cook loss, shear force, and pH was measured 1, 4 and 24 h post-slaughter. Data were analyzed as a randomized complete block design in a 2 × 2 factorial arrangement of treatments with grain type and GAA supplementation as main effects with 10 replicates/treatment combination. At 51d, leg quarter yield increased (P < 0.05) by GAA supplementation. No significant effects of GAA supplementation (P > 0.05) were detected in carcass, wings, and breast meat yield at 51d. However, carcass yield was reduced (P < 0.05) in broilers fed sorghum diets (78.08 vs. 78.44%). At 55d of age, an interaction effect (P < 0.05) was observed on breast meat yield. Broilers fed corn diets with GAA had more breast meat (39.15% vs. 38.19%) than the non-supplemented corn diet, and broilers fed sorghum diets were intermediate (38.37 and 38.68%). Wing yield decreased (P < 0.05) in broilers fed sorghum diets (9.28 vs. 9.52%). Wing and leg quarter weights increased (P < 0.05) by GAA supplementation. Drip loss, cook loss, and shear force were not affected (P > 0.05) by GAA supplementation in any processing day. At 55d, breast meat pH 4h post-slaughter decreased due to GAA supplementation. Likewise, breast meat pH 24h post-slaughter decreased (P < 0.05) due to GAA supplementation at 51 (6.01 vs. 6.08) and 55 d (5.95 vs. 5.99). In conclusion, GAA supplementation increased leg quarter at 51 d of age independently of grain type, and breast meat yield only in broilers fed corn diets at 55 d. Sorghum diets decreased carcass yield at 51 d and wing yield at 55 d of age. GAA supplementation did not affect drip or cook loss properties or shear force, and decreased breast meat pH.

Key Words: Guanidinoacetic acid, carcass, cut up yields, meat quality, broilers

M78 Effects of feeding reduced crude protein diets to broilers on growth performance and carcass characteristics from 15 to 35 d of age

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An experiment was conducted to determine the effects of feeding reduced crude protein (CP) diets while providing adequate essential amino acid (AA) concentrations on growth performance and carcass characteristics of broilers from 15 to 35 d of age. Fifteen hundred Ross × Ross 708 male chicks were distributed into 60 floor pens (25 birds/pen; 0.09 m²/bird). From 1 to 14 d of age, birds were fed a common starter diet formulated to contain 1.25% digestible lysine and 3.053 kcal/kg apparent metabolizable energy using of corn and soybean meal as the primary ingredients. During

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the grower (from 15 to 25 d of age) and finisher (from 26 to 35 d of age) periods, broilers received 1 of 6 dietary treatments varying in CP content. Diet 1 (control) was formulated with DL-Met, L-Lys, and L-Thr (21.7 and 19.8% CP in the grower and finisher periods, respectively), while additional L-Val, Gly, L-Ile, L-Arg, and L-Trp were sequentially supplemented in the order of limitation respective of diets 2 through 6. These additions were intended to meet the essential AA requirements as CP percentage was reduced in diets 1 to 6 by 2.5 and 2.3% points in the grower and finisher periods, respectively. Digestible Lys concentrations in the grower and finisher diets were formulated to 1.10 and 1.00%, respectively, whereas digestible TSAA, Thr, Val, Ile, Arg, Trp, and total Gly + Ser were formulated to 77, 68, 77, 67, 105, 17, and 170% of digestible Lys, respectively. Broilers fed diets supplemented with DL-Met, L-Lys, L-Thr, L-Val, Gly, L-Ile, L-Arg, and L-Trp had similar (P > 0.05) body weight gain, feed intake, and feed conversion compared with those provided the control diet from 15 to 25 and 26 to 34 d of age. Likewise, the use of DL-Met through L-Trp to reduce dietary CP content did not decrease (P > 0.05) total breast meat yield at 35 d of age compared with those receiving the control diet. However, a reduction (P < 0.05) in thigh yield at 35 d of age was observed with broilers fed diets supplemented with L-Ile and L-Trp when compared with birds receiving the control diet. Results from this study indicated that sequential addition of AA in the order of limitation from DL-Met to L-Trp allowed reduction of dietary CP content beyond 2.0% points without depressing growth performance and total breast meat yield of broilers from 15 to 35 d of age.

Key Words: broiler, crude protein, amino acid, glycine

M79 Bioavailability of non-phytate phosphorus in diets formulated with various animal protein blends or meat and bone meal sources fed to Ross × Ross 708 male broilers from 8 to 21 d of age

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An experiment was conducted to evaluate the bioavailability of non-phytate phosphorus (P) in diets formulated with various sources of animal protein blends (APB) or meat and bone meals (MBM) fed to Ross × Ross 708 male broilers from 8 to 21 d of age. Seven commercially available APB sources of mixed species origin and three MBM sources of either porcine, bovine, or mixed bovine and porcine origins were evaluated. Crude protein, ash, calcium, and P composition of the APB and MBM sources ranged from 41.7 to 61.8, 16.8 to 45.0, 5.9 to 19.9, and 3.1 to 9.4%, respectively. Four identical trials were conducted to achieve a total 8 replications per treatment. In each trial, 680 chicks were randomly distributed into 68 battery cages (10 per cage; 0.046 m²/bird) and a common corn-soybean meal starter diet was fed from 1 to 7 d of age. From 8 to 21 d of age, 34 experimental diets were fed to 2 replicate cages per treatment. A corn-soybean meal negative control diet was formulated to contain 0.15% non-phytate P Monosodium phosphate (MSP), 7 APB, and 3 MBM sources were added to the negative control diet to achieve non-phytate P levels of 0.25, 0.35, and 0.45%.

Bioavailability of P was estimated using the slope-ratio technique by regressing tibia shear strength and ash weight on added P intake relative to MSP. Tibia shear strength, ash weight, and relative P bioavailability did not differ (P ≥ 0.05) among broilers fed diets containing the MBM or APB sources. Relative P bioavailability of MBM and APB sources ranged from 98 to 128% and 92 to 137%, respectively, for tibia shear strength and ash weight. Broilers fed low ash MBM or APB sources had higher (P ≤ 0.05) tibia ash weight than broilers fed high ash MBM or APB sources. However, comparisons of tibia shear strength and relative P bioavailability between broilers fed the low and high ash APB or MBM sources were not different (P ≥ 0.05), thus, indicating little difference in bioavailability due to ash content. These results indicate that P from MBM and APB sources are readily available to broilers.

Key Words: broilers, phosphorus, bioavailability, MBM

M80 Effects of dietary protein source, digestible threonine to lysine ratio, and coccidiosis vaccination on the growth performance and processing characteristics of broiler chickens at 33 d of age

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Coccidiosis is the economically damaging disease affecting commercial poultry in the United States. Although the complications of coccidiosis have been successfully managed through the use of coccidiostats and antibiotics, growing consumer pressure has begun to limit the application of these compounds in poultry production. Vaccinating against coccidia at hatch is an effective alternative to the use of traditional coccidiostats. However, vaccination inherently elicits a mild enteric challenge, which may alter the birds’ need for amino acids critical to the production of mucin and the integrity of the intestinal mucosa, such as Thr. Furthermore, some producers have opted to remove ingredients of animal origin from formulation, limiting the array of ingredients available as dietary protein sources. An experiment was conducted to determine the impact of these increasingly popular nutrition and management strategies on the performance and processing characteristics of broilers at 33 d of age. Male broilers were allocated into 120 floor pens (26 birds/pen; 0.09 m²/bird) at placement with each pen assigned to 1 of 12 treatments representing a 2 × 2 × 3 factorial arrangement of vaccination status [vaccinated (C+) and non-vaccinated (C-)], protein source [animal (AP) and vegetable]; and digestible Thr to Lys ratio (dThr:dLys; dThr was formulated at 65, 68, and 72% of dLys concentration) with 10 replicate pens per treatment. Non-vaccinated birds received feed containing salinomycin as an anticoccidial. Prior to placement, C+ chicks were spray-vaccinated with live oocysts following manufacturer recommendations. At 33 d of age, 6 birds per pen were randomly selected for processing and subsequent measurement of carcass characteristics. Vaccinated birds had reduced BWG and poorer FCR at 14, 24, and 32 d (P < 0.001). Birds receiving AP diets had increased BWG and improved FCR at 14 and 24 d of age (P < 0.001). At each age, increasing dThr:dLys improved (P < 0.005) FCR in C+ birds receiving AP, but did not affect (P > 0.05) FCR in C- birds, regardless of diet. Vaccination resulted in reduced carcass and breast meat yield at 33 d of age (P < 0.001). These results indicate that C+ birds may require increased dThr:dLys to support growth performance, particularly when receiving diets formulated with AP.

Key Words: broiler, coccidiosis, vaccine, threonine, animal protein

M81 Measuring whole body CO2 production using an intragastrically and intravenously administered bolus dose of [1-13C] sodium bicarbonate as validated by indirect calorimetry

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In measuring substrate oxidation and energy expenditure, it is first important to know total CO₂ production. There are two methods for measuring CO₂ production; one is to use an infusion of [1-13C] sodium bicarbonate while the other is to use indirect calorimetry. A total of 160 male broilers, at 21 days of age, were infused with [1-13C] sodium bicarbonate in a 100μM/Kg dose. 80 birds were infused intragastrically (IG) and 80 birds were infused intravenously (IV). For birds infused through IV, the isotope solution was given in a 5ml dose. Birds infused through IG were given the solution in a 1ml dose. To determine the entire kinetic curve of the [1-13C] sodium bicarbonate was infused and blood samples were taken via the jugular vein at 2, 5, 10, 15, 30, 45, 60, and 120 minutes post-infusion. Whole blood [1-13C] enrichment was analyzed by GC-IRMS. Data were analyzed using JMP Pro 12 pharmacokinetic modeling. Additionally, 12 birds were placed in metabolic chambers to determine total CO₂ production via indirect calorimetry. This data was then compared to the two infusion methods of [1-13C] sodium bicarbonate to determine a correction factor for calculating the total volume of CO₂ (VCO₂). The following equation for finding VCO₂ was developed for both IG and IV infusion methods: VCO₂ =
M82 Comparison of two net energy calculations of two broiler strains
fed varying levels of amino acids and varying levels of metabolizable energy
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Two studies were conducted. The purpose of study one was to determine the effect of feeding diets with varying dietary amino acid levels to two modern broiler strains on net energy (NE) from d 22 to d 43. The purpose of experiment two was to determine the effect of feeding varying levels of dietary metabolizable energy (ME) on NE from d 22 to d 43. Chicks from two genetic lines were fed three experimental diets starting on day 22. Experiment one diets were iso-caloric and formulated to AMINOChek1. 2.0 recommendations for dLYs and were formulated at 80, 100 and 120% of the dLYs. All other amino acids were formulated as a ratio to dLYs. In experiment two, all diets were iso-nitrogenous and true metabolizable energy (TME) values of diets determined in vivo were 2819, 3137, and 3452 kcal/kg. Birds were moved to the respiratory chambers 1d before evaluation for a period of adaptation. Heat production (HP) Kcal=3.872*VO2 (L/d) was measured for 1d. After HP was measured, fasting heat production (FHP) was measured for 24h. Heat increment was determined (HI)=HP – FHP (Farrell, 1974). Body compositional parameters were measured, including lean mass and fat mass. The dLYs were held at a constant ratio to dLYs level: Met+Cys, 0.76; Thr: 0.65; Val: 0.80; Ile: 0.71; Arg: 1.05, and Trp: 0.16. At 42 d 90 birds per strain/diet were processed. There were no strain x diet interactions for any performance parameters in either trial, however there was significant energy diet x season interactions (p=.0416) at 42d. A strain x season effect (p<.0001) was observed in the dietary energy trial; strain A performance was affected more by temperature than strain B. Increasing either dietary AA (p<.0001) or metabolizable energy (p=.001) significantly affected 42d BW. Strain B was significantly heavier (p=0.0113) at 42d in the energy trials while the AA trial showed strain A significantly heavier (p=.0012) at 42d. These trials suggest that broiler strains’ performance were affected more by increasing AA density than dietary energy and environmental temperatures affect strain performance.

Key Words: Amino Acid, Processing yield

M84 Effects of feed form during the starter period on productive and processing performance of broilers
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Feed form during the starter period has the potential to influence the subsequent performance of broilers. The objective of this study was to evaluate the effects of feed form during the starter period on live performance and processing yields of broilers. One thousand 1-d-old male Ross x Ross 708 broiler chicks were randomly placed in 40 floor pens (25 birds per pen; 0.12 m2/bird). The birds were raised on used litter that was top-dressed with new wood-shavings at the start of the study. Broilers received 5 dietary treatments (8 replicate pens per treatment) that consisted of a combination of 3 dietary feed forms provided over the starter period (1 to 14 d): mash, crumbles, and/or 3.3 mm micro pellets. The 5 treatment combinations were as follows: 1) mash from 1 to 14 d, 2) crumbles from 1 to 14 d, 3) mash pellets 1 to 4 d and then crumbles to 14 d, 4) micro pellets 1 to 7 d and then crumbles to 14 d, and 5) micro pellets from 1 to 14 d. Common grower and finisher diets were offered in a 4.4 mm pelleted form from 15 to 35 d of age. Feed consumption and BW were determined at 4, 7, 14, 25, and 35 d of age. At 36 d, 10 birds per pen were processed for the determination of carcass characteristics. After processing, carcasses were chilled in slush ice for 4 hours before chilled carcass weights were determined. At 37 d, chilled carcasses were deboned to determine total breast meat yield (pectoralis major and minor muscles). Birds fed mash diets during the starter period had the lowest BW (P<0.01) and feed consumption (P<0.01) at 4, 7, 14, 25, and 35 d of age compared to the birds that received either crumbles and/or micro pellets. Moreover, birds fed mash diets during the starter period had the poorest FCR (P<0.01) at 4, 7, 14, 25, and 25 d of age compared to the birds that received either crumbles and/or micro pellets during the starter period. Birds fed micro pellets from 1 to 7 and 1 to 14 d had higher breast meat weight (519 vs. 488 g, P<0.01) compared with the birds fed mash diets during the starter period. The results of this experiment indicate that feed form during starter period has an impact on bird subsequent performance.

Key Words: carcass, crumple, mash, micro, pellets, pellets
process on nutrient digestibility are not as well understood. Nutrient digestibility may be dependent on diet formulation and degree of feed processing. The objective of the study was to assess performance of broilers fed diets that differed in formulation and exposure to thermal influences of feed processing. Dietary treatments consisted of a basal formulation that included corn, soybean meal, and distiller’s dried grains with solubles, basal with meat and bone meal, or basal with bakery byproduct meal. Diet formulations were balanced to be similar in energy and digestible amino acids based on published values. Feed processing treatments consisted of unprocessed mash, ground pellets exposed to the pelleting thermal process once, or ground pellets exposed to the pelleting thermal process twice. The pelleting thermal process consisted of 82°C conditioning for 10 sec and extrusion through a 4.8 x 38.1 mm pellet die. Prior to feeding, diets did not differ in moisture content or particle size by more than 150 µm. Diets were fed to nine replicate raised wire cages of 10 straight-run Hubbard x Cobb broilers for 18 d. Performance data were analyzed using a 3 x 3 factorial arrangement in a randomized complete block design. Diet formulations containing meat and bone meal improved feed conversion ratio (FCR) (P=0.0046). In addition, thermal processing in general improved FCR (P=0.0003). Diet formulation and feed processing interacted to affect live weight gain (LWG) (P= 0.0349). Processing in general improved broiler LWG for meat and bone meal containing diets but not bakery byproduct meal or the basal diet (P<0.05). The meat and bone meal may have contained greater digestible amino acids compared to the published values used for diet formulation. Thermal processing may have improved ingredient digestibility. The combination of improved ingredient digestibility due to thermal processing and meat and bone meal inclusion likely enhanced broiler performance. These data suggest that thermal processing within the specific study parameters does not negatively affect digestibility of these particular ingredients.

Key Words: thermal processing, diet formulation, nutrient digestibility, performance

M86 Effects of environment, feed form, and caloric density on energy partitioned to performance and immune response Brian Glover*, Jessalyn Hadfield, John Boney, Ariel Bergeron, Joseph Moritz West Virginia University

Performance benefits noticed from feeding broilers an improved pellet quality have been well documented. Energy savings from an improved crumble/pellet percentage via feed prehension could affect dietary caloric requirements, performance, yield, and health. The objective of the study was to assess the effect of variations of crumble/pellet percentages, dietary caloric density, and broilers’ rearing environment on performance, carcass yield, and immune response. All diets were manufactured at the West Virginia University pilot feed mill. Treatments were organized in a split-plot consisting of a 2 x 2 factorial arrangement in a randomized block design. Whole plot treatments were considered one room (11 x 7.32m) of either clean shavings or built-up litter; divided into 16 treatment replications of either standard (30% crumble/pellet) or improved feed form (80% crumble/pellet), and 16 replications of either standard or increased caloric density (+110 kcal/kg) comprising the 2 x 2 factorial arrangement. On day 39 representative birds per pen were processed and yield data was calculated. Ileum samples were collected at the end of the finisher phase for RNA extraction. Immune response was determined through gene expression of TLR2, IFNy, and IL-8 by RT-qPCR. Linear contrasts demonstrated that broilers provided improved feed form at standard energy increased feed intake, and live weight gain, (P ≤ 0.05) while maintaining feed conversion ratio (P ≤ 0.05) compared to broilers provided standard feed form at increased energy regardless of environment. Improved feed form increased breast yield for broilers reared on clean shavings (P ≤ 0.05). An environment x feed form interaction (P ≤ 0.05) showed up-regulation of TLR2 for birds fed standard feed form and reared on built-up litter and down-regulation of IL-8 for birds fed improved feed form and reared on built-up litter; TLR2 and IL-8 did not vary by feed form for birds reared on clean shavings. These data suggest that improved feed form may conserve maintenance energy requirements and benefit performance, yield, and immune response.

Key Words: crumble, immune response, pellet, broiler, feed form

M87 The effect of diets varying in commercial phytase product subjected to increasing steam conditioning temperature on broiler performance and tibia mineralization Victoria Homan*, John Boney, Joseph Moritz West Virginia University

Phytases are commonly added to diet formulations prior to pelleting to support phosphorus requirements in broilers. Commercial phytase products vary in thermal stability, site of action, mode of action, and manufacturer suggested protocols for determining activity. The objective of this study was to evaluate three commercial 6-phytase products within a phosphorus deficient corn and soybean meal based diet subjected to increasing steam conditioning temperature on broiler performance and tibia mineralization. Commercial phytase products included a Buttiauxella phytase expressed in Trichoderma reesei (B Trich), an E. coli phytase expressed in Pichia pastoris (E Pichia), and an E. coli phytase expressed in Trichoderma reesei (E Trich). Conditioning temperatures included 82, 88, and 93°C for a duration of 10 seconds prior to extrusion through a 5 x 38 mm pellet die. Commercial phytase products were analyzed for activity using the AOAC 2000.12 method at two different laboratories. The lower obtained activity was utilized to include each product at 1,000 FTU/kg of the diet prior to pelleting. Post extrusion, diets were ground to eliminate any variations in feed form and stored in a dehumidified room to ensure diets were of a similar moisture level, i.e. 12 percent. Diets containing the three commercial phytase products and a negative control diet without phytase were subjected to each conditioning treatment and fed to eight replicate raise wire cages of 10 Hubbard x Cobb straight-run broiler chicks for 20 d. Treatments were blocked by cage location within room. Broiler performance and tibia mineralization were analyzed using a 4 x 3 factorial arrangement within a randomized complete block design. The main effect product was significant for feed intake (FI), live weight gain (LWG) and feed conversion ratio (FCR). Broilers fed diets without phytase had the lowest FI and LWG (P<0.05), Broilers fed E Trich had the highest FI and LWG (P<0.05). Broilers fed B Trich and E Pichia had lower FCR compared to broilers fed diets without phytase and E Trich fed broilers were not distinguishable from other treatments (P>0.05). The main effect conditioning temperature was significant for FI and LWG. Increased conditioning temperature sequentially decreased both FI and LWG (P<0.05). Main effect interactions were not apparent (P>0.05). Commercial products demonstrated differences in supporting the phosphorus requirement in broilers and increasing conditioning temperature was detrimental to broiler performance. Increased conditioning temperature may have decreased nutrient availability per se, denatured phytase products, or both factors contributed to performance detriment.

Key Words: phytase, thermostability, tibia mineralization

M88 Effect of corn particle size on nutrient utilization and growth performance of commercial broilers and pullets Lisa Kitto*, Paul Patterson, R. Michael Hulet Pennsylvania State University

Dietary particle size for poultry diets has been debated for years, as it is related to pellet durability, fines, growth, feed conversion, and carcass characteristics for broiler chickens. In hens and pullets, less information is available regarding the impact of particle size, though research is equally important to maximize nutrient uptake, pullet growth, and hen performance. Two projects evaluated the impact of particle size. Both studies utilized corn ground to a mean particle size (PS) of 600, 900, 1200, or 1500µm, and all diets were formulated to contain the same level of nutrients across all treatments. The broiler study compared diet digestibility, feed intake, growth and conversion, while the pullet study measured growth, feed conversion, and physiologic parameters before transition to the hen house. Day old Cobb-500 male broilers (196) were placed into 17 battery cages with 10-16 birds per cage. Birds were fed a standard starter and grower diet...
to 29 d. At 14 days of age, birds were redistributed into 35 battery cages with 5 birds per cage for all corn particle size diets and 8 birds per cage for the protein-free (PF) diet. From days 29-30 birds transitioned to one of the five treatment diets (600µm, 900µm, 1200µm, 1500µm, or PF). The PF diet contained only dextrose monohydrate as the sole energy source. At 35 d birds were killed and intestine harvested for apparent digestibility determination.

Day old Hy-Line W-36 chicks (325) were placed 25 birds per cage and fed standard treatment diets with 600µm, 900µm, and 150µm corn. At 5 and 10 weeks of age, birds were weighed and feed intake and feed conversion were calculated.

All data for both studies were analyzed using a one-way ANOVA with the mixed procedure of SAS 9.4 and Tukey’s range test for means comparison.

Metabolism & Nutrition II

M89 Effect of oil source and peroxidation status on broiler performance and oxidative stress Stephanie Lindblom*, Elizabeth Bobeck1, Brian Kerr2 Iowa State University; 3USDA-ARS

Oil source has been shown to affect broiler performance and oxidative status. Lipid peroxidation may also affect animal performance and oxidative status through the generation and degradation of peroxidation compounds which differ according to oil source and temperature and length of heating. The objective of the study was to evaluate the effect of oil source and peroxidation status on broiler performance and measures of oxidative stress. Broilers (initial BW 85.1 ± 7.8 g) were allotted to 40 battery cages in a completely randomized 4 × 2 factorial arrangement of treatments. Treatments consisted of oil source (palm oil, soybean oil, flaxseed oil, and fish oil) in combination with lipid quality (fresh or peroxidized oil). Peroxidation was achieved by thermally processing each oil at 90°C for 72 h with a constant air flow of 3 L/min. Oils were analyzed for peroxide value, anisidine value, hexanal, 2,4-decadienal, and total polymers as measures of oil peroxidation. Each treatment was replicated 5 times with 5 birds/cage (200 birds), with birds fed their respective diets for 20 d to measure performance criteria. On d 21, plasma was harvested from 2 birds from each cage for analysis of oxidative status, which included thiobarbituric acid reactive species (TBARS), protein carbonyls (PC), 8-hydroxy-2′-deoxyguanosine (8-OH-2dG), and glutathione peroxidase activity (GPx). An interaction between oil source and peroxidation status was noted for ADFI, ADG, and F:G (P = 0.01), where birds fed the peroxidized oil reduced ADFI, ADG, and F:G in all oil sources except for birds fed the fish oil. There were no interactions noted between oil source and peroxidation status for TBARS, PC, 8-OH-2dG, or GPx (P > 0.10). Oil source increased plasma TBARS and 8-OH-2dG (P = 0.01), and tended to increase plasma PC (P = 0.09), but did not affect plasma GPx (P > 0.44). Although lipid peroxidation had no effect on plasma TBARS or PC (P > 0.15), plasma 8-OH-2dG and GPx were affected by lipid peroxidation (P < 0.01). In conclusion, oil source and peroxidation status differentially affected growth performance, oil source increased plasma TBARS, PC, and 8-OH-2dG, and lipid peroxidation increased plasma 8-OH-2dG and decreased plasma GPx.

Key Words: lipid peroxidation, oxidative stress, broilers, oil source

M90 Effect of fat oxidation on male broiler performance, yield, and muscle quality Cody Flores1, Hunter Walters1, Danny Portillo1, Rob Shirley2, M. Briens1, Christine Alvarado3, Jason Lee1 Department of Poultry Science, Texas A&M AgriLife Research; 2Adisseo USA; 3Adisseo France SAS (CERN)

The current study evaluated the impact of oxidized fat on broiler growth performance, processing yield, and meat quality. Canola oil was the source of fat in the current study. Fat oxidation procedure included heating fat to 95°C for 60 hours, with air percolating thru at approximately 12 L/min in order to achieve a target peroxide value of 129 meq/kg fat. On day-of-hatch, 2752 Cobb 500 male broilers were placed in floor pens with 43 birds/replicate pen and 32 replicate pens/treatment. The two treatments fed throughout the duration of the trial were corn/35% DDGS/MBM-based with the inclusion of either oxidized or non-oxidized (NO) fat. The feeding program was divided into a starter (d 0-14: crumble), grower (d 15-28: pellet), and finisher (d 29-42: pellet) diets. Body weight (BW) and feed consumption (g/bird/d) measurements were taken at each feed changeover for determination of body weight gain and feed conversion ratio. Following an 8 hour feed withdrawal on d 42, 8 birds/replicate pen were selected for processing yield (+/- 300 g of the mean pen weight). Furthermore, tissues from 6 birds/replicate pen were then used for meat quality measurements, which consisted of muscle pH, drip loss, and color. Inclusion of oxidized fat significantly reduced feed consumption compared to NO fat during the grower phase, as well as cumulatively through d 28 (0.7% and 1.8%, respectively). On d 14 and 28, inclusion of oxidized fat significantly reduced average BW compared to NO fat (2.3% and 2.1%, respectively). No significant differences in FCR were observed throughout the trial. A correction factor of 27g of BW per kg of BW was applied to the cumulative d 41 FCR in an effort to standardize treatment means. A significant impact on cumulative d 41 BW-corrected FCR was observed when oxidized fat was fed, resulting in a higher FCR when compared to the inclusion of NO fat. No significant impacts were observed on carcass or parts yield; however, color of the breast filet was unexpectedly impacted, as oxidation increased the redness (a*) of the tissue. In conclusion, feed manufactured with an oxidized fat source can negatively impact broiler growth performance and alter breast tissue color.

Key Words: meat quality, Oxidized fat, Broiler, Canola oil, Performance

M91 The effect on performance of turkey pouls fed various levels of yellow grease in pre-starter rations Corey Johnson*1, Jeffre Firman University of Missouri

Nutritional intervention in the early growing poult can be a valuable strategy to staves the stress experienced during the transition from endogenous yolk sac lipid reserves to an exogenous feed source. The objective of the present study was to evaluate the performance effects on a high addition rate of yellow grease (YG) in pre-starter rations fed to tom turkeys. The 140-day long experiment was a 2 × 3 factorial arrangement, where pouls were fed treatment diets consisting of a control (least cost addition of YG), 6% YG or 8% YG to 10 or 14 days of age. Each treatment consisted of 8 replicates containing 12 toms per pen in a randomized complete block design with location as the blocking factor. Diets were composed of a commercial type corn-soy-DDGS-meat meal base and were adjusted to maintain a consistent ME:CP and ME:AA ratios, as the three dietary treatments were not isocaloric. Birds were weighed and diets were changed at 10 or 14 days, and at 21 days; thereafter, these processes were repeated every 21 days until harvest. At completion, birds were processed and carcass composition was evaluated. The resulting performance data, which included livability, body weight, feed intake, feed to gain and adjusted feed to gain,