

reared under standard management conditions throughout the experimental period of eight weeks. Aloe vera juice was applied through drinking water in four treatments T2, T3, T4 and T5 according to the concentrations of 15, 20, 25 and 30 cm³ per dm³ of water respectively, while T1 was the control without aloe vera inclusion. The idea was to carry out further study on higher concentration of aloe vera. Result of the experiment showed that the final weight and weekly weight gain were significantly ($p < 0.05$) increased by the aloe vera extract supplementation. And as the concentration of aloe vera increases the weight gain increases, (T2, 243.42g; T5, 289.08g). The feed consumption follows the same trend which shows that the weight gain were strongly influenced by the feed intake. Aloe vera treated groups showed better

feed conversion ratio as compared to the control though not significant (0.48 for T1 and 0.90 for T5). There were significant difference ($p < 0.005$) in dressing percentage, breast and gizzard weight among treatments. The trained sensory assessors were able to detect differences ($p < 0.05$) in sensory characteristics between broiler meats from broiler fed control and those fed aloe vera supplementation. The result revealed that aloe vera improved the acceptability of broiler meat. There is also increase in blood protein. Aloe vera juice has no harmful effect on boiler health and performance even with higher concentration. Also, aloe vera might increase digestion and utilization when applied through drinking water.

Key Words: aloe vera, performance, drinking water, carcass

Metabolism and Nutrition IV: Nutrition and Feed Manufacturing

134 Predicting variability in poultry excreta moisture and nutrient level by near-infrared reflectance spectroscopy. J. E. De Oliveira*, V. Larat, E. Hangoor, and T. A. Scott, *Provimi Research and Innovation Centre, Brussels, Belgium.*

Evaluations of poultry excreta composition can give not only an indication of digestive efficiency but supply a means of evaluating bird welfare and environmental impact. Near Infrared Reflectance (NIR) spectrometry technology has been extensively used to predict chemical and nutritional composition of feeds and feed ingredients in commercial operations. Our objective was to develop a rapid diagnostic tool using NIR to measure excreta moisture (i.e. wet litter) and to establish the prediction of nutrient excretion. A total of 216 samples of broiler chicken excreta were collected, homogenized and scanned in two NIR systems (FT and dispersive). They were also analyzed for moisture, nitrogen, mineral and fiber content by chemical assay. The nutrient composition was utilized to develop NIR calibrations using the partial least squares method. For each calibration, a coefficient of determination (R^2) and standard errors of cross validation (SECV) were calculated. Both NIR systems showed similar results and could accurately predict moisture (mean=71.6, SD= 7.18, range=32.9-83.5, $R^2=0.97$, SECV=1.12), nitrogen (mean=1.4, SD=1.8, range=0.8-2.8, $R^2=0.94$, SECV=0.069), NDF (mean=7.03, SD= 2.0, range=4.19-18.15, $R^2=0.91$, SECV=0.54), potassium (mean=0.66, SD=0.18, range=0.39-1.57, $R^2=0.91$, SECV=0.053), and phosphorus (mean=0.4, SD=0.16, range=0.18-1.67, $R^2=0.87$, SECV=0.041) in fresh samples, but need to be improved for calcium (mean=0.54, SD=0.25, range=0.29-2.66, $R^2=0.72$, SECV=0.062) and sodium (mean=0.09, SD=0.05, range=0.05-0.53, $R^2=0.57$, SECV=0.017). Similar calibrations are being developed for other poultry species, and all values are being added to a database from which we can now look for correlation between excreta composition and other parameters like diet composition, animal performance, litter scores and health status.

Key Words: excreta, wet litter, chemical composition, NIR

135 Characterization of turkey growth profiles through mechanistic modeling. V. C. Rivera Torres*^{1,2}, P. R. Ferket³, and D. Sauvant², ¹Techna, Couëron, France, ²AgroParisTech, Paris, France, ³North Carolina State University, Raleigh.

A mechanistic and dynamic turkey growth model was developed to simulate turkey growth kinetics. In this study, experimental data of male and female growing turkeys of different strains were used to test

the adaptability of the model and to determine different growth profiles. The compartments defined in the model corresponded to the protein, lipid, ash, and water content in carcass, viscera and feathers. Ash and water in carcass, viscera and feathers were allometrically described relative to protein. Circulating glucose and total amino acids constituted 2 pools, which enabled incoming and outgoing flows of each body compartment. Glucose constituted the source for energy metabolism, whereas total circulating amino acids corresponded to a transient pool for protein metabolism. Both protein and lipid fractional rates constituted the driving force of the model: the fractional rates of anabolism and catabolism of protein and lipid decreased exponentially until they reached a common asymptotic value, which corresponded to maturity. The fractional rates were fitted through experimental data published on broilers and turkeys. Feather growth was defined as an irreversible loss resulting from anabolic flows. The outputs of the model were defined as daily body weight, feed intake and the mass of the different compartments in carcass, viscera and feathers. The computations of the growth kinetics of the body compartments helped define different growth profiles. Protein and lipid deposition in the carcass constituted the main flows. The inflexion of protein deposition in viscera was observed before the corresponding inflexion in carcass. Protein deposition in the feathers should not be neglected because it reached higher values than protein deposition in the viscera. This model constituted a basis for the study of the effect of environment and diet on the response of growing turkeys.

Key Words: model, growth, metabolism, energy, protein

136 Quantitative analysis of microbial flora in cecum of coccidia infected broilers. A. Nalian*¹, E. Oviedo-Rondón², S. Dowd³, and A. Martynova-Van Kley¹, ¹Stephen F Austin State University, Nacogdoches, TX, ²North Carolina State University, Department of Poultry Science, Raleigh, ³Research and Testing Laboratory, Lubbock, TX.

Coccidiosis is considered to be one of the most economically important diseases in poultry. Coccidiosis causes mucosal damage and predisposes the birds to bacterial infections such as necrotic enteritis. In this study we examined the effect of coccidiosis infection on the microflora of broilers grown on diets supplemented with either antibiotic (BMD[®]) plus an ionophore (Coban[®]) or specific essential oil blends (Crina[®]). We collected DNA samples from the cecum of broilers before and after an infection with mixed *Eimeria* spp. (*E. acervulina*, *E. maxima* and *E. tenella*) and used a 454 FLX pyrosequencer and 16S universal primers

to obtain quantitative profiles of the bacterial species present in each sample. Sequencing produced approximately 5,000 reads per sample. Taxonomic classification of sequences was done with rdpClassifier and BLAST. Relative percent abundance and species richness of the identified taxa was calculated and analyzed using General Additive modeling and Principal Component analysis which showed that species composition was significantly correlated with average feed intake per group. We found that the unmedicated group, when infected with coccidiosis, sustained a complete collapse of micro-flora with the remaining three species being pathogenic. The essential oil blends showed a beneficial effect on micro-flora in post-infection samples where approximately 10 taxa were found. This is the first study to quantitatively investigate the effects of coccidia on broiler intestinal micro-flora. The methodology used proved effective in better understanding the effects of feed additives on intestinal micro-flora.

Key Words: coccidiosis, *Eimeria*, pyrosequencing

137 Influence of starter feed allocation on broiler performance and processing yield. J. P. Blake*, J. B. Hess, B. Saenmahayak, R. R. Thanissery, X. Dong, and A. L. Shaw, *Auburn University, Department of Poultry Science, Auburn, AL.*

A total of 1920 mixed-sex broiler chicks (Hubbard M99 x Cobb 500) were randomized among 64 floor pens (1.8 x 2.1 m) with 30 birds each. Eggs were obtained from 30-week-old breeders. Treatments were two levels of protein (22.0 or 23.5%) with 3087 kcal ME/kg for the starter diet provided at four allocation levels of either 0.454, 0.545, 0.636, or 0.726 kg/bird (1.0, 1.2, 1.4, or 1.6 lbs/bird). After the starter allocation was consumed, a grower diet (20% CP; 3186 kcal ME/kg) was fed through 28 days of age followed by a withdrawal diet (17.5% CP; 3219 kcal ME/kg) to 35 days of age for all treatments. Each of the 8 treatments was assigned to 8 replicate pens. Feed and water were provided ad libitum with 23 hours of light. Birds and feed were weighed at 14, 28, and 35 days to determine growth performance. Carcass yield (front and rear halves) was evaluated at 42 days of age for five broilers per pen.

Results indicate no significant effects ($P>0.05$) on bodyweight, bodyweight gain, feed consumption, or feed efficiency due to protein level or amount of starter allocation. Average 35-day body weight, feed consumption, and feed efficiency were 2.063 kg, 3.144 kg, and 1.52, respectively. Processing performance at 35 days of age was not significantly ($P>0.05$) affected by starter diet protein level or allocation amount. The weight or yield of chilled carcass, abdominal fat, front half, wing, breast, and tender were not significantly influenced ($P>0.05$) by treatment regimen. A decrease ($P<0.05$) in back half yield was noted for birds fed the two higher allocations (0.636 and 0.726 kg/bird) of starter feed regardless of protein level. Results indicate that higher protein and/or an increased allocation of starter feed failed to positively influence growth and processing performance in 35-day broilers.

Key Words: feed allocation, protein, broilers

138 The storage of glycogen in the yolk of the prenatal broiler embryos. Z. Uni*, L. Yadgary, and O. Kedar, *Robert H. Smith Faculty of Agriculture Food and Environment, Hebrew University, Rehovot., Israel.*

Maintenance of glucose homeostasis during late-term embryonic development is dependent upon the amount of glucose held in reserves

primarily in the form of glycogen and upon the degree of glucose generated by gluconeogenesis from protein and glycerol.

In the current study we examined the glycogen concentration in the yolk sac membrane (YSM), yolk content, liver, pectoral muscle and hatching muscle in broiler embryos from E11 until day of hatch (DOH).

Results show the presence of glycogen in the YSM from E11 where values are 8.18 -5.64 mg/g tissue between E11 and E15; 17.88 mg/g at 19E and 12.65 at DOH. The yolk content shows trace amounts of glycogen until E13 (0.22 mg/g). Then, a consistent elevation in glycogen concentration per gram of yolk is demonstrate. At DOH glycogen concentration is 19.7 mg/g of yolk.

Multiplying the glycogen concentration in 1 gr. of tissue by the total grams of the tissue shows that at E17, E19, E20 the YSM contains 79.16; 97.08 and 64.26 mg of glycogen and the yolk contains 120.7; 132.8 and 149.3 mg of glycogen (respectively).

The period of 19E and 20E is the "pick" period of glycogen storage in the various organs of the developing embryo where the YSM and the yolk contains 213- 229 mg of glycogen, the liver contains 20-25 mg, the pectoral muscle contains 12-15 mg and the hatching muscle has 2-4 mg glycogen.

The data points toward the YSM and the yolk as a major glycolytic organ of the embryo. The data imply that free amino acids, apparently derived by the action of proteolytic enzymes on yolk protein, and glycerol (derived from the metabolism of triglycerides and phospholipids) may be built into glycogen by the entodermal cells in the YSM.

Key Words: broiler, embryo development, yolk, glycogen

139 Saturated and monounsaturated fatty acid metabolism in broilers: Effects of diet, age and gender. R. Poureslami*¹, G. M. Turchini², K. Raes¹, G. Huyghebaert³, and S. De Smet¹, ¹*Ghent University, Melle, Belgium*, ²*Deakin University, Victoria, Australia*, ³*Institute for Agricultural and Fisheries Research, Melle, Belgium.*

Using the whole-body (WB) fatty acid (FA) balance method, a study was conducted to estimate saturated and monounsaturated FA (SFA & MUFA) metabolism in broilers as a function of diet, age and gender. Four dietary fat sources (palm fat, P; soybean oil, S; linseed oil, L; fish oil, F) were added to a basal diet at 3% in addition to 5% palm fat. Mass ingestion, accumulation and excretion of FA were recorded in 2 subsequent periods; 7-21d and 21-42d of age. FA digestibility was measured, FA net intake (μmol) was calculated and the difference between FA intake and accumulation in the WB resulted in the overall appearance or disappearance of individual FA. The FA balance was computed following backward calculations along the SFA & MUFA metabolic pathway; the number of μmol of longer chain or desaturated FA that appeared was subtracted from the number of μmol of the previous FA in the pathway. Consequently, after balancing each FA, the number of μmol of longer chain or desaturated appeared FA was used to estimate elongase and Δ -9 desaturase activity, respectively. Net FA disappearance was considered as FA oxidation, while FA *ex novo* production was estimated by total net appearance. Eventually, the fate of individual FA was reported as percentage of FA net intake plus *ex novo* production. Diet and age affected deposition, elongation, Δ -9 desaturation, and oxidation of 12:0, 14:0, 16:0, 18:0, 20:0, 22:0, 16:1n-7, 18:1n-9, 18:1n-7, 20:1n-9 ($P<0.05$), while gender had no effect ($P>0.05$). FA deposition and oxidation was higher in P fed birds, while elongation and desaturation was higher in L fed birds compared to other dietary treatments ($P<0.05$). FA deposition,

elongation and desaturation were higher in 21-42d, while oxidation was higher in 7-21d of age ($P < 0.05$). On average, 5.5% of net intake and *ex novo* synthesized SFA & MUFA were oxidized and 94% deposited, of which 33% were elongated and 14% desaturated.

Key Words: fatty acids, metabolism, broiler

140 Removed

and P600 diets was 88% and 84%, respectively. Feed consumption and BW were determined at 14, 21, 35, and 44 d of age and adjusted feed conversion (AdjFCR) calculated by using the weights of all dead birds. The 44 d BW of the male and female birds fed the pelleted diets were higher (3,228 and 2,616 g) as compared to the BW of the male and female birds fed mash diets (2,733 and 2,239 g), respectively. No difference was detected in BW due to particle size. The overall AdjFCR of birds fed the M300 (1.94) and M600 (2.11) diets were poorer than the birds that received the pelleted diets. There was no difference in AdjFCR of birds fed the P300 (1.87) and P600 (1.84) diets. The results of the study confirm that broilers perform better when fed pelleted diets.

Key Words: mash, pellet, broilers, particle size, chicken

142 Increasing mixer-added fat improves exogenous enzyme efficacy and broiler performance. C. K. Gehring*, K. G. S. Lilly, L. K. Worley, K. R. Beaman, S. A. Loop, and J. S. Moritz, *West Virginia University, Morgantown.*

Reduction of added fat in broiler diets has been implemented to decrease diet cost. Although diets may be less expensive, there is potential for nutrient destruction because of greater frictional heat in the pellet die. In an effort to improve pellet quality, much of the added fat may be applied using post-pellet spray application and the amount of fat added in the mixer may become negligible. Thermal inactivation of exogenous enzymes and occurrence of non-favorable reactions (e.g., Maillard reaction, vitamin oxidation, etc.) may be abated by additional mixer-added fat (MAF). This study evaluated the effects of MAF (1, 2.5 or 4%) with or without exogenous enzyme addition (carbohydrase, protease and phytase), and at different conditioning temperatures (82.22 or 85°C), on feed manufacture and finisher phase broiler performance variables, and processing yields. Increasing MAF reduced the electrical energy usage required to manufacture broiler feed ($P < 0.0001$). Feed intake and live weight gain were increased with enzyme addition ($P < 0.0001$). Enzyme addition, conditioning temperature and MAF interacted in their effects on feed conversion ratio ($P = 0.0093$). Overall, enzyme addition decreased feed conversion ratio, but the effect was greatest with 1% MAF and 82.22°C or 4% MAF and 85°C. Increasing MAF ($P = 0.0259$) and conditioning temperature ($P = 0.024$) reduced abdominal fat pad yield. Exogenous enzyme addition increased carcass yield ($P = 0.0433$), but there was no difference in breast or dark meat yield due to any of the factors ($P > 0.05$). It is likely that increased MAF improved exogenous enzyme retention and nutrient utilization by broilers. Subject to current fat prices, increasing MAF may reduce the total cost of broiler production, particularly when reduction of electrical energy usage is considered.

Key Words: mixer-added fat, nutrient destruction, enzyme efficacy, feed manufacture, broiler performance

141 Effect of feed form and particle size on broiler performance.

C. G. Chewning*, C. R. Stark, and J. Brake, *North Carolina State University, Raleigh.*

A study was conducted to evaluate the effect of feed form and particle size on broiler performance. Previous research has shown an improvement in feed conversion with pelleted broiler diets as compared to mash diets. However, research on particle size is not as clear as to the effect that particle size has on broiler performance. One advantage to a fine grind is better pellet quality and fewer fines at the feeder. The experiment was a 2 x 2 factorial of feed form (pellet and mash) and particle size (300 and 600 microns). A total of 1,024 broiler chicks, 512 males and 512 females, were randomly assigned to one of the four treatments with eight replicate pens per treatment. There were 32 birds per pen, 16 males and 16 females, and a total of 32 pens. Birds were fed corn-soy diets in either pellet (P) or mash (M) form. The starter P diet was crumbled; the grower and finisher P diets were fed as pellets. The corn was ground with a hammermill equipped with either a 7.9 mm or 1.6 mm screen to produce the two particle sizes. The average particle size in the 300 and 600 treatment diets was 267 and 570 microns, respectively. Pellet quality as measured by pellet durability index of the three P300 diets

143 Examining the relationship between pellet quality, broiler performance and bird sex. K. G. S. Lilly*, C. K. Gehring, K. R. Beaman, and J. S. Moritz, *West Virginia University, Morgantown.*

Pelleted feed increases weight gain and feed efficiency in comparison to mash feed. However, improvement in broiler performance is reliant upon pellet quality. The objective of this study was to explain variations of feed form on modern day broilers correcting for sex. Treatments were arranged in a 4x3 factorial design consisting of four variations of feed form and tested with either all males, all females or straight run pens

of broilers. All feed was manufactured at West Virginia University's pilot feed mill over a two day period. High quality pellets were created by running the mill at a slow production rate and utilizing a thick die (44.45mm x 4.83mm), high steam conditioning pressure (551.58kpa) and high steam conditioning temperature (93.33°C). In order to create variations in pellet quality, a portion of high quality pellets were ground with a roller mill to fine particle feed (fines) and mixed with intact pellets to create different pellet:fine compositions. Treatments consisted of high pellet quality (HPQ) 90:10, medium pellet quality (MPQ) 60:40, low pellet quality (LPQ) 30:70 and mash 0:100. Male and straight run broilers had decreased feed conversion when fed pelleted treatments ($P < 0.05$). This effect was consistent when all birds were pooled together ($P < 0.05$). Males fed HPQ had higher carcass weight than all other treatments ($P < 0.05$). Female broilers fed HPQ had higher carcass weights than those fed mash ($P < 0.05$). Straight run broilers fed HPQ and MPQ had higher carcass weight than those fed LPQ and mash ($P < 0.05$). When all birds were pooled together, carcass weights improved significantly ($P < 0.05$) when fed HPQ in comparison to all other treatments. An economic model using all data collected and feed costs set at \$300/ton (multiplied by feed intake / carcass weight) found a savings of \$0.0073 per pound of carcass weight when feeding HPQ versus mash.

Key Words: feed manufacturing, pellet quality, broiler performance, economic analysis, bird sex

144 Influence of main cereal of the diet and particle size of the cereal on growth performance and digestive traits of brown pullets from 1 to 120 days of age. M. Frikha¹, H. M. Safaa², D. G. Valencia³, M. P. Serrano¹, and G. G. Mateos^{*1}, ¹Universidad Politécnica de Madrid, Madrid, Spain, ²Cairo University, Faculty of Agriculture, Egypt, ³Nutral S.A., Madrid, Spain.

A total of 864 brown-egg laying pullets was used to study the effect of the main cereal of the diet (corn vs. wheat) and mean particle size of the cereal (MPS; hammer milled to pass through a 6-, 8-, and 10-mm screen) on performance and digestive traits. The 6 diets (factorial 2×3) were based on soybean meal and contained 50% of either corn or wheat. All of the diets were supplemented with an enzyme complex with β glucanase and xylanase activity. Each treatment was replicated 6 times (24 pullets per replicate). No interactions between main cereal and MPS were found for any growth performance trait studied. Type of cereal did not affect pullet performance at any age. From 1 to 45 d of age BW gain was reduced ($P \leq 0.001$) and FCR was impaired ($P \leq 0.05$) as the MPS of the cereal increased. However, no effects on performance were observed after this age. Type of cereal did not affect relative weight (RW, g/kg BW) or relative length (RL, cm/kg BW) of any organ of the gastro intestinal tract at 45 d of age. However, the RW of the digestive tract and the RL of the small intestine (SI) increased with increases in MPS ($P \leq 0.05$). At 120 d of age, dietary treatment did not affect gizzard pH or the RW of any of the organs of the gastro intestinal tract studied. However, the length of the SI was higher for pullets fed wheat than for pullets fed corn ($P \leq 0.01$) and was reduced with increases in the MPS of the cereal ($P \leq 0.01$). We concluded that wheat can be used successfully at levels of up to 50% in pullet feeds from 1 to 120 d of age. The MPS of the cereal influences pullet performance during the first 45 d of life but not thereafter. It is recommended to grind the cereal of the feed used during the first period of life with a screen of no more than 8 mm.

Key Words: corn, wheat, mean particle size, brown-egg pullets performance, digestive traits

145 Single screw extrusion and enzyme supplementation improve nutrient digestibility in triticale dried distiller's grains and solubles for broilers. M. Oryschak^{*1}, D. Korver², M. Zuidhof², F. Hernandez¹, and E. Beltranena^{1,2}, ¹Alberta Agriculture and Rural Development, Edmonton, AB, Canada, ²University of Alberta, Edmonton, AB, Canada.

At present, wheat predominates as the feedstock of choice for Western Canadian ethanol plants. Triticale has potential to replace wheat as a feedstock for ethanol production, but little is known about the feeding value of triticale dried distiller's grains and solubles (DDGS) for broilers. The present study tested the effect of single-screw extrusion and enzyme supplementation on nutrient digestibility in triticale DDGS for broilers. Approximately 1100 male broilers housed in battery cages were fed one of 10 test diets either supplemented or without a multi-enzyme complex (Superzyme DDGS[®]) that included either 15 or 30% triticale DDGS (extruded or not) compared to a basal ration. All test diets included 2% Celite[®] as an indigestible marker. Each treatment was fed to a single test pen in each of the 5 blocks for a randomized complete block design, with pen as the experimental unit. In each 2-week period of the study, a basal ration was fed for the first 7 days and then a subset of birds was placed onto one of ten experimental diets for the next 7 days. At the end of each two week period, ileal digesta was collected from birds fed experimental diets and pooled by pen. Apparent ileal nutrient digestibility (AID) in test ingredients was estimated using the difference method, which compared digestibility in respective test diets to that in the basal ration. Complete amino acid (AA) profiles were developed for samples from the grower period (d28) to estimate AID. Extrusion resulted in modest improvements in AID of GE (0.51 vs. 0.46) and CP (0.69 vs. 0.67) in triticale DDGS ($P < 0.05$), but no impact on AID of Lys, Met or Thr ($P > 0.05$). In contrast, enzyme supplementation improved AID of GE, CP and all essential amino acids in triticale DDGS, with the exception of Arg and Trp ($P < 0.05$). These improvements included 11% and 20% increases in AID of GE (0.51 vs. 0.46) and Lys (0.66 vs. 0.55), respectively. Our results suggest that both extrusion and enzyme supplementation improve nutrient digestibility in triticale DDGS for broilers.

Key Words: DDGS, extrusion, enzyme, digestibility, broiler

146 Twin screw extrusion improves nutrient digestibility in wheat and corn dried distiller's grains and solubles for broilers. M. Oryschak^{*1}, D. Korver², M. Zuidhof¹, F. Hernandez², and E. Beltranena^{1,2}, ¹Alberta Agriculture and Rural Development, Edmonton, AB, Canada, ²University of Alberta, Edmonton, AB, Canada.

Dried distiller's grains and solubles (DDGS) is a co-product of ethanol production and has value as a cost-competitive ingredient for livestock feeding. While information is available on the feeding value of corn DDGS, published information for wheat DDGS from Western Canadian ethanol plants is scarce. The present study tested the effect of twin-screw extrusion on nutrient digestibility in wheat and corn DDGS in diets that included either 15 or 30% of each DDGS type (extruded or not) compared to a basal ration. Test diets included 2% Celite[®] as an indigestible marker and were fed to male broilers (~1100) group housed in test batteries subdivided into 5 blocks. Each treatment was fed to a single test pen in each block for a randomized complete block design, with pen as the experimental unit. In each 2-week period of the study, a basal ration was fed for the first 7 days and then a subset of birds was placed onto one of nine test diets for the next 7 days. At the end of each two week period, ileal digesta was collected from birds fed experimental diets and pooled by pen. Apparent ileal nutrient digestibility (AID) in test ingredients was estimated using the difference method, which compared

digestibility in respective test diets to that in the basal ration. Complete amino acid (AA) profiles were developed for samples from the grower period (d28) to estimate AID. Extrusion and inclusion level were significant model components for all nutrients ($P < 0.05$). At 15% inclusion, extrusion improved AID of GE, Lys and Met in wheat DDGS by 27% (0.70 vs. 0.55), 34% (0.78 vs. 0.58) and 8% (0.90 vs. 0.85), respectively. Similarly, extrusion improved AID of GE, Lys and Met in corn DDGS (15% inclusion) by 45% (0.86 vs. 0.59), 28% (0.91 vs. 0.71) and 13% (0.96 vs. 0.85), respectively. Similar improvements in digestibility were observed for both DDGS types at 30% inclusion in the diet. Our results suggest extrusion is an effective strategy for improving AID of GE and AA, in particular Lys, in corn and wheat DDGS for broilers.

Key Words: DDGS, extrusion, broiler, digestibility

147 Economic modeling for optimizing broiler profitability on nutrient density. N. Sriperum*, G. M. Pesti, and M. E. Wetzstein, *University of Georgia, Athens.*

It has been stated that the goal of feed formulation should be to maximize profits. Associated cost minimization is a necessary condition for maximizing profits but by itself may not maximize profits. It has also been noted by several researchers, formulating diets to maximize profitability, rather than to maximize body weight gain or breast meat yield can increase the profitability of a broiler production system.

Thus, formulating diets to minimize feed costs might not be the most cost effective means of maximizing profitability. Early approaches of applying economics to feed formulation focused on reducing feed cost per bird, per unit of meat or per unit of breast (Pesti et. al, 1986). The concept behind maximizing profitability through nutrition is to formulate to the profit maximizing nutrient level and this study illustrates the methods used to apply this concept. Using data from a previously published lysine requirement paper, the broken-line quadratic (BLQ) model or the Saturation Kinetic (SK) model provided the best fit, based upon minimizing residual values. While it was noted the BLQ model best describes the concept of a nutritional requirement, it can be difficult to fit. Conversely, the SK model fits economic and diminishing marginal productivity data quite well while offering the concept of a 'most economical feeding level' versus the concept of 'requirement' *per se*. According to the reference paper, two diets were formulated based on digestible lysine (dLys) levels of 0.72 or 1.19%, which gave calculated CP levels of 15.02 and 22.53% respectively, although no crude protein minimum was specified. Feed ingredient prices from February 2008 and 2009 were used, which represents an elasticity of feed prices between high and low. The pricing scenario for 2009 predicted a higher dLys to maximize profits versus the situation from 2008. In general, when feed costs decline, it is more economical to feed a higher nutrient dense diet versus what was previously considered best. This emphasizes the point that formulation constraints should ideally be based upon economics and not just strict technical measurements.

Key Words: broiler, modeling, profitability, nutrient density

Environment and Management III

148 Effect of rate of preincubation temperature increase on hatchability of broiler hatching eggs. O. Elibol*¹, M. Gucbilmez¹, and J. Brake², ¹Ankara University, Faculty of Agriculture, Department of Animal Science, Ankara, Turkey, ²North Carolina State University, Department of Poultry Science, Raleigh.

This study investigated the effect of rate of preincubation temperature increase and broiler breeder flock age on fertile hatchability. In the trial 1 hatching eggs were obtained from Ross 344 male x Ross 308 female broiler breeders at 37 and 52 wk of age. Eggs were collected from the same flocks 4 wk later for trial 2 when the flocks were 41 and 56 wk of age. Eggs were collected from two different flocks at 34 and 47 wk of age in trial 3. Thus, there were younger (34-41 wk) and older (47-56 wk) flocks studied in each trial. All eggs were stored for 6 d at 18 C and 75% RH. Two preincubation treatments were applied with the eggs placed in two Petersime incubators that achieved the preincubation temperature of 26 C in either 1 h or 4 h. The total preincubation period from leaving the cooler to setting was 9 h. The eggs were then set in a single incubator that reached the incubation temperature of 37.8C in 8 h. In all trials each tray of 150 eggs constituted a replicate and 16 replicate trays (2400 eggs) were set per preincubation treatment at each flock age in each trial. Infertile and early deads (0-6 d) were identified by candling and removed at 14 d. At the time of removing the chicks from the hatchers, all unhatched eggs were opened and examined macroscopically to determine remaining embryonic mortality (middle (7-17 d) and late (18-21 d plus pipped)), and percentage fertile hatchability. Fertile hatchability was significantly better for the younger flocks. There were significant interactions of flock age X preincubation treatment for fertile hatchability and percentage early dead embryos because it was only the younger flocks that responded in a significantly positive manner to the more rapid rate of preincubation temperature increase.

These data show that reaching the preincubation temperature faster reduced early embryonic mortality and increased fertile hatchability in younger flocks.

Key Words: broiler hatching eggs, hatchability, preincubation

149 Strain and incubation temperature effects on embryonic and post-hatch growth of broilers. K. Kroesen*, J. Anderson, and M. S. Lilburn, *The Ohio State University, Wooster.*

In a series of experiments, eggs from two broiler strains, a commercial strain (C) and a slow-growing heritage strain (BR) were used. In Experiment 1, egg weight at set was greater in the C (59.3 g) vs BR (55.6 g) lines. Embryo dry weight increased progressively in both strains from 1.44 g (BR) and 1.84g (C) at day 14 to 6.20 g (BR) and 6.39 g (C) at day 19, respectively. In Experiment 2, the eggs were incubated at 38.0 C and 38.5 C from 0 to 10 days and then half the eggs in each initial treatment were switched to the other temperature through 19 days. There were no significant strain differences in embryo dry weight on day 17 but in both strains, embryo dry weight was increased by initial exposure to 38.5 C. Whole embryo staining at 17 days allowed for the determination of strain and temperature effects on the length of the entire torso, tibia, and shank. The length of each of these skeletal components was significantly greater in C versus BR embryos. Exposure to the 38.5 C temperature from 0 to 10 days also resulted in a significant increase in tibia length in both strains but no consistent effects on overall torso or shank length.

Key Words: embryo, broiler, incubation, temperature