92 Effects of controlling mycotoxin exposure from Fusarium-infected grain on broiler performance and health. Michael E. Kautzman*, Mark L. Wickstrom, and Tom A. Scott, University of Saskatchewan, Saskatoon, SK, Canada.

This study used individual kernel sorting technology to provide controlled mycotoxin exposure (primarily deoxynivalenol, DON) from Fusarium-damaged grain. Fusarium-damaged kernels (FDK) are associated with lower CP through Fusarium infestation and higher mycotoxin levels. The BoMill TriQ can predict variation in individual kernel CP by near infrared transmission technology and sort grains into 3 commercial fractions. Three wheat sources downgraded for FDK were sorted into outliers (10%); high FDK (low CP; 20% of source); and low FDK (high CP; 70% of source). These fractions were incorporated at 70% (starter, 0 - 21 d) and 75% (grow/finisher, 21 to 35 d) into 4 diet ratios based on high FDK inclusion: M0 (0%); M20 (20%); M40 (40%); and M60 (60%); providing increasing DON levels compared with the original unsorted grain. This provided a 3 (wheat source) × 4 (diet ratios) factorial design. Effects on performance and immuneology of broilers were evaluated from 0 - 35 d. Broiler performances (BW, feed intake (FI), feed conversion ratio (FCR), mortality) and digestibility (AME and nitrogen retention; NR) were recorded for 0 to 21 d and 21 to 35 d. Three immune responses were evaluated: cell-mediated response to phytohemagglutinin (PHA); humoral response to bovine serum albumin (BSA) antigen; and relative weights of immune tissues. There were no differences (P > 0.1) between diets for BW, FI, FCR, or mortality at 21 or 35 d. There were interactions between wheat source and diet ratio for AME and NR (P < 0.0001) at 21 and 35 d, but not in a consistent pattern. Although DON levels in some diets were greater than 5 ppm, there were no differences on PHA (P = 0.3038) or BSA (P = 0.2845) assessments. There were no differences in relative weights of liver, spleen or bursa of Fabricius between diets at either 21 or 35 d. This demonstrates the potential of the TriQ to produce naturally contaminated diets with varying mycotoxin concentrations from a single wheat source. This technology could be used to reduce variation in future evaluations of end-point responses and evaluate methods to mitigate lost productivity.

Key Words: broiler, performance, mycotoxicosis, deoxynivalenol, Fusarium

93 Nutritional evaluation of canola meal produced from a new variety of canola seeds in broiler chickens and laying hens. Matthew F. Gorski*, Pamela L. Utterback, and Carl M. Parsons, University of Illinois at Urbana-Champaign, Urbana, IL.

Two broiler chicken experiments and one laying hen experiment were conducted. The first experiment evaluated a conventional canola meal (Conv CM) in broiler chicken diets from 2 to 37d of age. Treatments were replicated 8 times using 5 chicken per replicate. Treatment diets were corn and soybean meal based and contained 0, 10, 20, 30 or 40% Conv CM from 2 to 21d of age and 0, 10, 20 or 30% Conv CM from 21 to 37d of age. In the starter phase (2–21d), there was a significant negative effect (P < 0.05) in weight gain and feed intake for CM levels in excess of 10% CM. The second broiler experiment evaluated both Conv CM and a new increased protein: reduced fiber Test CM. Seven treatments were replicated 8 times using 5 chickens per replicate. For the starter phase (2–19 d), the Treatment 1 diet contained no CM, Treatment 2–4 diets contained 8% Test CM and Treatment 5–7 diets contained 8% Conv CM. At d 20, the chicks were switched to grower diets, which contained either no CM or 8, 16, or 24% of test CM or Conv CM. These diets were fed until 44 d of age. There were no significant differences among dietary treatments in weight gain, feed intake, or feed efficiency for either phase of the experiment. The third experiment examined the effects of the new test CM and Conv CM in laying hen diets from 33 to 49 wk of age. Seven treatments were replicated 8 times using 14 caged hens per replicate. Corn-soybean meal diets again contained either no CM or 8, 16, or 24% Test CM or Conv CM. No significant differences were observed among treatments for feed intake, egg production, egg weight, egg mass, feed efficiency, or body weight over the duration of the experiment. The results of this study indicated that a new increased protein; reduced fiber Test CM can be used effectively in broiler chicken and laying hen diets when diets are formulated to be equal in ME and digestible amino acids.

Key Words: canola meal, broiler chicken, laying hen, high protein, reduced fiber

94 A slope-ratio precision-fed rooster assay for estimating relative metabolizable energy values for fats and oils. Matthew P. Aardsma* and Carl M. Parsons, University of Illinois, Urbana, IL.

Nitrogen-corrected true metabolizable energy (TMEn) values for fats and oils (lipids) frequently exceed their gross energies. Experiments were conducted to determine if a slope-ratio precision-fed roaster assay would yield more useful TMEn values for lipids. All TMEn values were obtained by tube-feeding adult roosters graded levels of lipids in a ground corn basal diet. In experiment 1, refined corn oil (RCO) was evaluated as a reference by feeding RCO to roosters at 0, 5, 10, 15, and 20%. In all other experiments, test lipid(s) and RCO were fed at 0, 5, and 10%. In experiment 2, 2 animal/vegetable lipid blends (A/V blends) were evaluated. In experiment 3, a 2:1 blend of stearic acid with RCO (Blend A), 1:1 blend of stearic acid with RCO (Blend B), tallow (T), poultry fat (PF), and corn oil from distillers dried grains with solubles (DDGSCO) were evaluated for TMEn. In experiment 4, the treatments were the same as in experiment 3, but were evaluated for relative available energy via a restricted-feed-intake growth assay with 10- to 20-d-old broiler chicks. The TMEn from roosters or BW gain of chicks were regressed on supplemental lipid level using multiple regression. Relative bioavailability values (RBV) were calculated as the regression coefficient of the test lipid divided by the regression coefficient for RCO. In experiment 1, TMEn values for RCO were highly linear (R² = 0.97) and suitable as a reference. Experiment 2 yielded significant differences (P < 0.05) for RBV between one of the A/V blends and RCO. In experiments 3 and 4, the ranking of the RBV for the lipids was similar for the roosters and the broiler chicks, with PF and DDGSCO not significantly different than RCO, and T and Blend A significantly lower than RCO (P < 0.05). The RBV of Blend B was not calculated for the TMEn data due to non-linearity. These results indicate that the slope-ratio precision-fed roaster assay was sensitive for detecting differences in relative energy values among lipids and yielded similar results as data from broiler chicks.

Key Words: fat, oil, true metabolizable energy

95 The effect of feeder space access and crumble/pellet composition on broiler performance. Mark E. Lemons* and Joseph S. Moritz III, West Virginia University, Morgantown, WV.

Research utilizing small floor pens and industry style feed pans frequently provide much greater feeder space access than broilers receive.
in commercial barns. Feeder space access could be an important variable influencing research results, especially when coupled with crumble/pellet composition variations. The objective of the current study was to assess the effects of feeder space and crumble/pellet composition on broiler performance. The study utilized a 2 × 2 factorial arrangement in a randomized complete block design using the main effects: high or low crumble/pellet composition (80% vs. 40%) and increased or industry feeder space access (0.059 m²/bird vs. 0.012 m²/bird). Diets met Agristat recommendations and were pelleted at the West Virginia University pilot feed mill. A total of 1,840 Hubbard × Cobb straight-run broilers obtained from a commercial hatchery were randomly placed in 1 of 40 pens with 10 replications per treatment. Broilers were individually weighed and feed consumed was recorded at the end of each growth phase to calculate feed intake per bird (FI), live weight gain per bird (LWG), and mortality-corrected feed conversion ratio (FCR). Feed intake from d 1–38 was influenced by a main effect interaction (P < 0.05), demonstrating that birds increased intake when presented a high crumble/pellet composition, especially when provided increased feeder space access. Broilers fed a high composition of crumbles/pellets from d 1–38 demonstrated increased LWG and decreased FCR (P < 0.05). Broilers provided industry feeder space access from d 1–38 demonstrated lower LWG and FCR (P < 0.05). Multiple comparison data demonstrated a 2-point FCR and 130-g LWG advantage (P < 0.05) providing a high composition of crumbles/pellets using industry feeder space access and a 3-point FCR and 75-g LWG advantage (P < 0.05) using increased feeder space access. These data suggest that feeder space access affects broiler performance and advantages of providing a high composition of crumbles/pellets may be extrapolated from research utilizing industry feeder space access.

**Key Words:** feeder space, pellet composition, broiler, nutrition, feed manufacture

96 The effects of Spirulina algae inclusion and conditioning temperature on feed manufacture and pellet quality, John W. Boney* and Joseph S. Moritz, West Virginia University, Morgantown, WV.

Diet formulation and manufacturing techniques dictate pellet quality, ultimately affecting bird performance; however, this relationship can be complex. For example, high conditioning temperature has been shown to increase pellet quality but also decrease amino acid digestibility and subsequent bird performance. Spirulina algae inclusion has also been suggested to influence pellet quality. The objective of the current study was to determine manufacturing effects of practical corn and soybean meal based broiler diets with varying inclusions of Spirulina algae and steam conditioning temperature. Treatments were arranged in a 5 × 3 factorial arrangement in a randomized complete block design varying in algae inclusion (0, 0.5, 1.5, and 10%) and conditioning temperature (74, 82, 91°C). Each treatment was replicated 3 times across 3 d of manufacture. Pelleted samples were used to determine pellet durability using 3 methods that varied in aggressiveness. Data were collected during the manufacture of each replicate and each pellet durability analysis was run in duplicate. Hot pellet temperature was increased by both algae inclusion (P < 0.0001) and high conditioning temperature (P < 0.0001). Pellet mill motor amperage increased with increased algae inclusion (P = 0.013) and conditioning temperature (P < 0.0001). Electrical energy usage increased (P < 0.0001) when conditioning temperature was elevated from 74 or 82°C to 91°C, likely associated with high moisture addition from steam that decreased efficiency of mash extrusion. However, production rate was not affected by treatment (P = 0.499), indicating no throughput detriment. Pellet durability analyses revealed interactions between algae inclusion and conditioning temperature (P < 0.0001) demonstrating that algae inclusion was more beneficial to pellet durability at low conditioning temperature. The combination of algae inclusion and low steam conditioning temperature may improve pellet quality without subsequent detriment to nutrient availability.

**Key Words:** Spirulina, algae, performance, pellet quality, conditioning temperature

97 Effect of whole corn and pellet diameter on feed manufacturing parameters and broiler live performance from 16 to 42 days of age, J. T. Pope*, A. C. Fahrenholz, and J. Brake, North Carolina State University, Raleigh, NC.

The effects of 3 particle sizes of corn and pellet dies producing 2 different pellet diameters on feed manufacturing and broiler live performance from 16 to 42 d of age were studied. All birds in the experiment were fed 908 g of a common starter made with fine corn (FC) that transitioned to 1 of 6 different dietary treatments at approximately 16 d of age. The milling and diet treatments continued with either all FC, 31% of the diet as coarse corn (CC), or 10% of the diet as whole corn (WC) pelleted through either a 3.5-mm or 4.37-mm die. The geometric mean diameter of the FC and CC was 326 and 1324 µm, respectively. The dietary treatments were assigned to 36 pens of 16 males each as a randomized complete block 3 × 2 design, resulting in 6 replicates per diet. BW and feed consumption were determined at 14, 28, 35, and 42 d of age and feed conversion ratio (FCR) calculated on the respective days. At 43 d, 2 birds per pen near the house average BW were necropsied for gizzard and proventriculus weights. No significant differences in pellet quality, measured as pellet durability index, were detected among the diets. No significant differences in energy utilization at the pellet mill, measured as kWh/Ton, were detected among the diets. The WC and CC diets increased gizzard weight relative to FC diets at 43 d of age and improved FCR at 28, 35, and 42 d of age (P < 0.05). It was concluded that WC could substitute for CC in broiler diets and reduce feed milling costs due to the absence of grinding while maintaining live performance.

**Key Words:** whole corn, pellet diameter, particle size, feed mill energy utilization, gizzard function

98 Phosphorus bioavailability in conventional canola meal and canola meals produced from new varieties of canola seeds, Christina D. Hanna*, Chelsie K. Parr, Pamela L. Utterback, and Carl M. Parsons, University of Illinois at Urbana-Champaign, Urbana, IL.

Two chick bioassays were conducted to determine relative P bioavailability in 3 new test canola meals (TCM 1–3) containing increased protein and reduced fiber, a conventional canola meal (CCM), and a dehulled soybean meal (SBM). A phosphorus-deficient cornstarch-dextrrose-SBM basal diet was fed as Diet 1. Diets 2 and 3 had 0.05% and 0.10% P added from KH₂PO₄, respectively. The remaining diets had 12.5% or 25% TCM, CCM, or SBM added in place of cornstarch and dextrrose. Two additional chick bioassays were conducted to determine the effect of phytase enzyme (Optiphos, Huvepharma, Sofia, Bulgaria) on bioavailability of the P in the CMs. Diet 1 was a P-deficient CM-cornstarch-dextrrose diet, with one of the CMs as the only source of dietary P. Diets 2–4 had 0.05%, 0.10%, or 0.15% P added from KH₂PO₄, respectively. Diets 5 and 6 were the same as Diet 1 with 250 or 500 (experiment 3) or 125 or 250 (experiment 4) units phytase added per kg of diets, respectively. Chicks were fed the experimental diets from 8 to 21 d posthatch and bioavailability of P was estimated using the multiple-regression slope-ratio method where tibia ash was regressed on supplemental P intake. A linear increase in tibia ash was observed as the P level was increased by

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addition of KH₂PO₄, CCM, TCMs or SBM in the first 2 chick bioassays. Mean bioavailability values of P in the CCM, TCMs, and SBM relative to KH₂PO₄ were 15, 20, and 38%, respectively. A linear increase in tibia ash was also observed with addition of KH₂PO₄ or phytase in the last 2 bioassays. It was estimated that the addition of 150–500 units/kg of phytase greatly increased the bioavailable P content of the CMs by 0.10–18% and the response to phytase was similar for the CCM and TCMs. In conclusion, the bioavailable P content of the new TCM was statistically equal to or numerically higher than the CCM. Phytase greatly and similarly increased the bioavailability of P in the CCM and the new test high protein, reduced fiber CMs.

Key Words: canola meal, chick, digestibility, phosphorus availability, fiber

99 Effects of total sulfur amino acids on performance and carcass yield in broilers fed diets with and without an antibiotic growth promoter. Pratima Acharya Adhikari* and Woo K. Kim, University of Georgia, Athens, GA.

Total sulfur amino acids (TSAAs) requirements have been estimated in corn-soybean based diets for broiler chicks. However, growth performance and carcass yield of broiler chicks either with or without antibiotic growth promoters (AGP) in reference to TSAAs have not been documented. An experiment was conducted to evaluate effects of different levels of TSAAs on performance and carcass yield in broiler chicks fed diets with or without AGP (Bacitracin). A total of 900 one-day-old Cobb 500 broiler chicks were randomly distributed to 6 dietary treatments in a 2 x 3 factorial arrangement, with 2 levels of AGP (0 and 0.05%) and 3 levels of TSAAs either for starter (0.7, 0.8, and 0.9%) or finisher chicks (0.52, 0.62, and 0.72%). For the starter period (0 to 21d), body weight gain (BWG) and feed conversion ratio (FCR) were improved (P < 0.001) as dietary TSAAs levels increased. However, there were no differences between AGP supplemented or unsupported dietary treatments. For the finisher period (22 to 42d), feed intake (FI), BWG, and FCR were significantly improved by dietary TSAAs levels, and chicks fed diets with AGP showed better FI and BWG compared with those fed diets without AGP (P < 0.001). Moreover, there were interactions between TSAAs and AGP in FI and BWG (P < 0.001). Chilled carcass and pectoralis major were affected by both levels of TSAAs (P < 0.001) and AGP (P = 0.015), with the highest values at 0.72% TSAAs with AGP. Lowest yield in all the carcass parts were observed for lowest level of TSAAs with or without AGP. There were no differences in thigh and wing yield for both 0.62 and 0.72% TSAAs either with or without AGP. In conclusion, broilers fed diets supplemented with TSAAs at recommended levels (0.9% for starter and 0.7% for finisher) gave the best growth performance. TSAAs levels in finisher diets without AGP need to be increased to achieve the optimal growth performance in broilers.

Key Words: antibiotics, broiler, total sulfur amino acids

101 The effect of feed mixing and sampling variables on nutrient analysis. Danielle A. Reese*, Kolby L. Foltz, and Joseph S. Moritz, West Virginia University, Morgantown, WV.

Proper poultry feeding requires a homogeneous mixture of macro and micro ingredients to ensure feed nutrients are being supplied to meet bird requirements. Samples of complete feed may be taken during manufacture and analyzed for nutrient content to estimate if nutrients are present in feed in accordance to diet formulation. However, variables associated with mixing and feed sampling may influence the results of nutrient analysis, thus over or under estimating the formula comparison. The objective of this study was to vary mix time, sample location, sample number, and sample blending technique on nutrient analysis. Treatments were applied in a 2 x 2 x 2 x 2 factorial arrangement in a completely randomized design. Ingredients were mixed in a single screw vertical mixer for either 30 s or 10 min. Samples were taken from either the pellet die or from the finished feed post cooling, conveyance, and bagging. Samples were blended together from 2 or 10 samples during manufacture. Blending occurred from either combining samples and mixing by hand or using a sample splitting device. Proximate analysis was determined on each blended sample and standardized for moisture content. Crude fat was increased when mix time was 30 s compared with 10 min (P = 0.003) and when samples were taken from the pellet die compared with samples from finished feed (P = 0.06). A trend toward a mix time x sample location x sample number interaction was demonstrated for crude protein and ash (P < 0.09 and 0.07 respectively). Crude protein was greatest for the 10-sample blend and lowest for the 2-sample blend when feed was mixed for 30 s and samples were taken from the pellet die. Ash was greatest for samples mixed for 10 min and lowest for samples mixed for 30 s when taken from a blend of 2 samples at the pellet die. These data suggest that mixing and sampling variables can effect nutrient analysis and sampling protocols should be utilized to best estimate if nutrients present in feed are in accordance to diet formulation.

Key Words: mixing time, blending technique, sample number, sample location, proximate analysis
102 Neuroendocrine regulation of autophagy by leptin in chicken. Peter Ishola*1, Alissa Piekar$ki1, Elizabeth Greene1, Walter Bottje1, Mark Cline2, Takeshi Ohkubo1, and Sami Dridi1, 1University of Arkansas, Fayetteville, AR, 2Virginia Polytechnic Institute and State University, Blacksburg, VA, 3Ibaraki University, Ibaraki, Japan.

Autophagy or cellular self-digestion, plays a pivotal role in the adaptation of cells to a plethora of distinct stressors including starvation. Autophagy has been extensively studied in mammals and yeast, but little is known in avians. Thus, the major objective of the present study was to determine the effects of leptin on autophagy-related genes and proteins in chicken hypothalamus. Leptin is an adipocytokine that is mostly produced by white adipocytes in mammals, and functions as a hormonal sensing mechanism for fat deposition. Mammalian adipocytes secrete more leptin as fat storage increases, signaling the brain via leptin receptor-mediated signal transduction to inhibit feed intake and increase energy expenditure. In the present study, both recombinant chicken and ovine leptin (625 pmol, 10 µL) diluted in artificial cerebrospinal fluid were separately injected intracerebroventricularly (ICV) in 1-wk-old Hubbard × Cobb 500 chicks (n = 10) and feed intake was recorded at 30, 60 and 180 min after injection. At the end of the experiment, hypothalami were collected, and kept at −80°C until total RNA and protein were extracted. Leptin significantly reduced feed intake after 30 min compared with the control group. Real-time PCR analysis showed that administration of both Chicken leptin and Ovine leptin appeared to significantly ($P < 0.05$) regulate autophagy in hypothalamic tissue, including downregulation of Atg2b, Atg3, Atg12, Atg13, Lamb2, Rab7 genes. Also, the result from Western blot shows the downregulation of Atg3 and LC3B proteins in ovine and chicken leptin treatments respectively. Our results support a novel link between metabolic control and autophagy that warrant further investigations.

Key Words: leptin, autophagy, hypothalamus, gene expression, ICV injection

103 Effects of modest improvements in pellet quality and experimental pen size on broiler chicken performance. Brian G. Glover* and Joseph S. Moritz, West Virginia University, Morgantown, WV.

Improving the crumble/pellet percentage of feed has been argued to be difficult to obtain in the commercial industry due to the necessity of feed mills producing adequate feed volume within a time constraint. Broiler performance research often utilizes small numbers of birds per pen or experimental unit that may affect the estimation of variance components, potentially producing pen performance metrics that are less valuable for industry guidance. The objective of this study was to compare the performance of straight-run Hubbard × Cobb broiler chickens receiving a standard crumble/pellet percentage (50%) vs. a modestly improved crumble/pellet percentage (70%), in either large pen (46 birds) or small pen (23 birds) experimental units. All diets were batched, mixed, steam conditioned to approximately 82°C, extruded through a 4.8 × 38.1 mm pellet die, and crumbled at the West Virginia University pilot feed mill. Crumble/pellet percentage differences were obtained by grinding a portion of the complete feed then remixing. Treatments were replicated 10 times and applied for 1–38 d using a 2 × 2 factorial arrangement in a randomized complete block design to measure growth performance. Bird density and feeder space access was 0.06 m2/bird and 1.2 cm/bird, respectfully for all experimental units. Crumble/pellet percentage and pen size main effects did not interact for any growth performance metric. Broilers consuming improved crumble/pellet percentage had a tendency toward decreased feed intake ($P = 0.07$) and feed conversion ratio by 3 points ($P = 0.1$), but maintained a similar weight gain ($P = 0.3$). Large pens tended to decrease live weight gain ($P = 0.06$). Improved crumble/pellet percentage increased pen coefficient of variation for ending weight ($P = 0.05$) likely due to competitive feeding behavior. These data suggest that modest improvements in crumble/pellet percentage may provide performance benefits, and feed quality variation effects on growth performance can be satisfactorily evaluated utilizing small pen experimental units.

Key Words: crumble, pellet, broiler, pen size, feed conversion ratio