56 Effect of dietary protein to 28 days of age on broiler performance. B. Lentfesty*, S. D. Peak, and J. Brake, North Carolina State University, Raleigh, NC USA.

Previous research has suggested that broiler chickens can respond positively to dietary protein and amino acid levels in excess of National Research Council (1994) suggested minimums. As increased levels of dietary protein have an associated cost, it is important to know the ideal levels of protein and the age at which the broiler is most sensitive. This study was designed to delineate the effects of increasing protein level on the early growth and feed conversion of male broiler chickens. Broilers were placed randomly in 24 battery cages, 10 birds per pen, and fed a common starter feed (3.2 kcal ME/g diet, 23% CP) from 0 d to 7 d. At 7 d of age, eight uniform birds were selected to remain in the cage and be placed on one of three dietary treatments with eight replicates of each treatment. Two diets were formulated to provide 100% (A) and 130% (C) of NRC (1994) recommended levels of protein and essential amino acid. The third diet (B) was a 50/50 blend of diets A and C. The three diets were analyzed to contain 21.9%, 25.0%, and 28.2% CP, respectively at a calculated ME of 3.05 kcal/g. Feed consumption and BW were measured on a replicate basis at 7 d, 14 d, 21 d, and 28 d and feed conversion ratio (FCR) calculated. Both BW and weekly BW gain were significantly increased for diet B at 14 d and 21 d when compared to diet A, but not different from diet C. An increase in BW for diet B at 28 d approached significance as compared to diets A and C. There was a significant improvement in FCR from 7 d to 14 d for diet B compared to diet A, but diet B was not different from diet C. However, a further numerical improvement in feed conversion was observed with diet C as compared to diet B. This study suggests that broiler growth and FCR are most sensitive to higher protein levels between 7 d and 21 d. Therefore, protein in the broiler diet is most critical during the first few weeks of age and should range between 115% and 130% of the recommended NRC values.

Key Words: Protein, Broilers, Body weight, Feed conversion

57 Iron overload and ascorbic acid metabolism in chickens. Jennifer Cosgrove* and Denzil Maurice, Clemson University, Clemson, SC 29634-0361, USA.

A previous study from this laboratory reported that excess dietary iron affects ascorbic acid (AA) metabolism by decreasing plasma concentration and increasing synthesis in 3-week-old chickens. The present study determined the effects of age and duration of feeding high dietary iron on AA metabolism. Day-old chicks were assigned to three treatment groups; the controls received a corn-soy diet with 340 mg/kg iron. The experimental diets, based on the control diet, contained 1100 (medium) and 3200 (high) mg/kg iron supplied as ferrous sulfate. At three weeks, the control birds were divided into three groups and continued on the control diet, or switched to the excess iron diets, resulting in five treatment groups. Samples of blood, liver, and kidney were taken at three and seven weeks. Hepatic and renal iron concentration increased with the amount of dietary iron and time spent on the diet (p<0.01). Iron was preferentially deposited in the liver (10-14x the renal content) in birds fed the high iron diet. Plasma and hepatic AA concentration were lower (p<0.02) in males at 3 wk., were decreased (p<0.01) in birds fed the high iron diet at both time periods, and not affected by the duration of feeding. There was a concurrent increase in AA synthesis, measured by renal gulonolactone oxidase activity, in birds switched to the high iron diet (p<0.01); a trend toward this increase in activity was evident after three weeks on the high iron diet. The medium iron diet increased (p<0.01) renal and hepatic iron concentration when fed for 7 weeks and had no detectable effect on other responses. These results show that the high iron diet increased AA utilization with a concomitant stimulation of synthesis as a protective mechanism against excess iron. Hepatic lipid peroxides were elevated (p<0.02) in birds fed the high iron diet for 7 weeks. Measuring changes in fatty acid composition and carbonyl addition/ modification of hepatic proteins assessed oxidative damage due to excess iron.

Key Words: Ascorbic acid metabolism, Chicken, Dietary iron, Hepatic iron, Plasma ascorbic acid

Saturday, AM, NUTRITION B

58 A Time Dependant Evaluation of the Broilers’ 0 to 42 day Dietary Protein Requirement . A. Corzo1, R. G. Teeter1, and C. Wiernusz2, 1Oklahoma State University, Stillwater, OK, 2Cobb-Vantress, Inc., Siloam Springs, AR.

Dietary requirements for nutrients such as indispensable amino acids generally decline with age as the bird approaches physiological maturity. In contrast, classical nutritional requirement tables (NRC) express dietary needs in blocks of time i.e. starter, grower and finisher. Within such periods nutrients are provided in a constant quantity and when period is switched to the next feeding phase, an immediate reduction in nutrient content occurs. However, the question remains regarding the applicability of daily ration adjustment (termed dynamic) to satisfy bird nutrient need. For that purpose, an experiment was conducted whereby classical versus a dynamic adjustment was compared. The experiment was comprised as a 2x3 factorial composed of three different protein levels, high (NRC +2.2%), medium (NRC requirement), and low (NRC - 2.2%) and two feeding systems (classical or constant; dynamic or gradual daily supply reduction). Feed ingredients used in the study were tested for MEn, amino acid and protein content. Diets were then formulated to be isocaloric during the various feeding periods. Male Cobb 500 birds were randomly allocated in 54 floor pens. Birds in dynamic treatments had higher FI at all the phases of the study (P<0.01) but BW did not differ. Liver elements were dissected (P<0.01). Body weight and FI was higher (P<0.01) for birds consuming low protein diets (P<0.01). When protein intake was quantified, dynamic treatments had significantly lower intakes and a more efficient utilization of the nutrient with regard to BW, carcass weight, breast weight and breast as a percentage of carcases (P<0.01). However, birds on dynamic feeding system as well as low protein diets had a higher abdominal fat (P<0.01) and total carcass fat (P<0.01). In conclusion, dynamic protein feeding has the potential to elevate protein utilization efficiency, but fails to optimize overall feed conversion.

Key Words: Protein, Requirement, Broiler, Carcass, Composition

59 Application of Egg By-Products as High Quality Protein and Bactericidal Supplements in Animal Nutrition. L.D. Schmidt*, B.A. Slominski1, G. Blank2, and W. Guenter1, 1Department of Animal Science, University of Manitoba, 2Department of Food Science, University of Manitoba.

Technical grade egg albumen and whole egg by-products are produced in substantial quantities by many egg-breaking facilities across North America. The by-products are recovered during processing and, for various reasons, are not approved for human consumption. Both products are known to be rich in fat, maternal antibodies, protein (a well-balanced amino acid profile) and lysozyme (a bactericidal enzyme). The objective of this research was to explore the potential use of egg by-products as a valuable protein, energy and due to the presence of lysozyme, a novel alternative to antibiotic supplements in animal nutrition. To optimize the conditions for improving the nutritive value of technical albumen and whole egg by-products, the spray-dried samples were heat treated at various temperatures. The effect of heat treatment on digestible protein content was determined in vitro using a pepsin-pancreatin digestion/dialysis system. The optimum protein digestibility value for technical albumen was found to approach 80% when heated at 105°C for 10 minutes. Only 50-55% of the protein was digestible for the spray-dried (unheated) products. Commercially viable heat treatments (i.e. storage of spray-dried albumen in a hot room) showed minimal improvements in digestible protein content (60%). The beneficial effect of heat treatments was further explored using pure lysozyme preparations. In this study, the survival rate of the pathogenic bacteria Escherichia coli 0157:87 and Salmonella typhimurium 266, was lowered from 87.3 and 80.9% when incubated with native lysozyme to 0.1 and 11.3% when incubated with thermally modified lysozyme, respectively. In addition, γ-radiation of technical albumen produced a 40% reduction in the growth of E. coli as compared to the untreated control. Animal trials are underway to assess the effect of different heat treatments on egg by-product utilization as well as the effect of lysozyme on gastrointestinal bacteria.

Key Words: Technical albumen, Protein quality, Lysozyme, Bactericidal activity
60 Effect of dietary fat source and fatty acid composition on immune responses of male growing broiler chicks. M. Torki1, A. Galian1, J. Arshami1, and J. Tavakkol2. 1 Ferdowsi University Of Mashhad, 2 Bo-Ali Immunology Research Center.

This experiment was designed to determine effects of dietary fat source and n-3: n-6 polyunsaturated fatty acids ratio on performance characteristics and primary antibody responses in chicks. Five day-old male commercial Ross broiler chicks were assigned to 35 pens (20 chicks/pen) and fed isocaloric-isonitrogenous corn-soybean diets containing 0.75, 1.5, and 2.25 g/100g of either fish oil or cottonseed oil without supplemental fat as the control diet. Subsets of chicks within each dietary treatment were randomly selected and either vaccinated with Newcastle Disease Virus (NCD) or injected (intramuscular) with 1 ml of a 5% suspension of Sheep Red Blood Cells (SRBC) at 12 and 36 days of age, respectively. Blood samples were taken prior to immunization and every 3 to 6 days postimmunization for 3 weeks. Subsets of SRBC-injected and non-injected chicks within each diet treatment were killed at 47 or 49 days of age and spleen, thymus and bursa of Fabricius were weighed. Performance was measured on days 21, 42, and 49 of age on pen based. Antibody titers against NCD and SRBC were assayed by hemmaglutination assay or hemmaglutinin-inhibition test, respectively. There was no effect of diet on body weight (BW) gain, feed intake, and feed efficiency. Diet and SRBC inoculation have no effect on immune tissues weight (percentage of BW) (P>0.05). Chicks fed the diet with the highest level of fish oil produced the highest anti-SRBC titers on days 3, 7, 10 and 13 days after injection (P<0.01); however, there was no significant differences between diet treatments on antibody production of NCD-vaccinated chicks (P>0.05). There was a negative correlation between BW and anti-SRBC titer on days 3 and 7 after injection (P<0.05). No significant correlation was found between dietary n-3:n-6 polyunsaturated fatty acids ratio and antibody production (P>0.05). In conclusion, antibody production against SRBC of chicks fed a diet with a higher level of fish oil were superior to those of chicks fed a diet with lower level of fish oil or cotton seed oil.

Key Words: Broilers, Antibody, Fish Oil, Cottonseed Oil, n-3:n-6 Polyunsaturated Fatty Acids Ratio

61 The effect of varying dietary oil, crude protein, and metabolizable energy on performance and carcass yield of female broiler chickens. G.W. Barbour1, M.T. Farran2, and A.H. Darwish1. 1Agriculture Research Institute, 2American University of Beirut.

Two experiments were conducted to study the effect of varying CP, oil, and ME in a corn-soybean meal diet on performance and carcass yield of female broilers. In experiment 1, day old Avian chicks were fed nine isocaloric diets (3000 Kcal/Kg) in a factorial arrangement with 3 levels of CP (18.8, 20.8, and 22.8%) and 3 levels of soybean oil (0, 2, and 4%) for 6 wk. Each treatment was allocated to 5 battery cages with 8 birds per cage. Weight gain (WG) and feed intake (FI) of birds on the 4% oil diet increased (P<0.05) at 3 and 6 wk of age without affecting percent abdominal fat weight (%BW). Moreover, carcass weight was improved by the addition of oil (P<0.05). Increasing CP from 18.8 to 22.8% improved WG and reduced feed conversion (FC) of birds at market age (P<0.05). No significant correlation could be replaced by FTM when AA were supplemented. Shrimp fed a diet containing FTM supplemented with AA to replace 33.3% fishmeal grew significantly faster than those fed the fishmeal control diet (P<0.05). However, completely replacing fishmeal with FTMs significantly reduced shrimp weight even when AA were supplemented (P<0.05).

Key Words: crude protein, metabolizable energy, oil, female broiler, performance

62 Supplementing feather meals with synthetic lysine and methionine improved the biological performance of juvenile Pacific white shrimp (Litopenaeus vannamei). Z. J. Cheng1, K. C. Behnke1, and W. G. Dominy2. 1 Kansas State University, Manhattan, Kansas, USA, 2 The Oceanic Institute, Waimanalo, Hawaii, USA.

A 35% crude protein control experimental shrimp diet containing 24.5% fishmeal was modified by substituting regular hydrolyzed feather meal, FTM, or a high digestible feather meal, FTMD, at 33.3, 66.7 and 100% replacement for fishmeal on a w/w basis. Additionally, synthetic amino acids (AA), lysine and methionine, were added to FTM and FTMD so that their total lysine and methionine contents were the same as fishmeal. The modified FTMD diets also were formulated to replace fishmeal at 33.3, 66.7 and 100% levels on a w/w basis. Thirteen diets (including feather meal control diet) were fed to 936 shrimp (initial weight 0.17 ± 0.05 g) according to a 2 x 2 x 3 factorial design. We used 3 tanks/diet and 24 shrimp/tank. After an 8-week growout period, final body weight (BW) ranged from 0.92 to 2.83 g, cumulative gain varied from 468.2 to 1576.3%, specific growth rate ranged from 3.10 to 5.03%, feed conversion ratio (FCR) varied from 3.66 to 6.43 g feed/g gain, and survival rates ranged from 58.3 to 76.4%. Three-way ANOVA analyses revealed that there was no BW difference between shrimp fed diets based on FTM and FTMD (P = 0.178). However, BW difference existed between shrimp fed FTMD with and without AA supplementation (P = 0.023). Shrimp fed diets with 33.3% fishmeal replacement grew faster than those fed 66.7 or 100% fishmeal replacement (P = 0.043 and P = 0.012, respectively). Shrimp fed 66.7% fishmeal replacement diets grew faster than those fed 100% fishmeal replacement diets (P = 0.045). Results demonstrated that 33.3% fishmeal could be replaced by FTM without significantly reducing shrimp weight gain, FCR or survival (P > 0.05). Additionally, 66.7% fishmeal could be replaced by FTM when AA were supplemented. Shrimp fed a diet containing FTM supplemented with AA to replace 33.3% fishmeal grew significantly faster than those fed the fishmeal control diet (P < 0.05).

Key Words: feather meal, lysine, methionine, fishmeal, shrimp

63 Lysine and Sulfur Amino Acid Bioavailability in Meat and Bone Meal as Affected by Pressure Processing. R.B. Shirley* and C.M. Parsons, University of Illinois, Urbana, IL, USA.

Pressure processing of meat and bone meal (MBM) may become necessary to reduce concerns associated with bovine spongiform encephalopathy (BSE). In a prior study from our laboratory, it was found that processing MBM at 15 to 60 psi reduced the digestibility of amino acids as determined by the precision-fed cecctomized roaster assay. In the current study, two chick growth assays were conducted to determine the effect of pressure processing on the bioavailability of Lys and sulfur amino acids (SAA) in MBM from two different sources and to confirm the results of the earlier digestibility study with roosters. The MBM from Source 1 was processed in an experimental batch cooker and the MBM from Source 2 was processed in a commercial feather meal cooker. Both chick assays utilized a crystalline amino acid diet that was deficient in either Lys (.4%) (Assay 1) or SAA (.075% Met and .075% Cys) (Assay 2). Two levels of Lys or SAA were added to the deficient basal diets to produce a linear growth response. The other treatments in each assay consisted of adding one level of MBM that had been processed at 0, 30, 45 or 60 psi for 20 min. Bioavailability of Lys and SAA was estimated using the standard curve method. All diets were fed to New Hampshire x Columbian Plymouth Rock chicks from 8 to 18 days of age. As processing pressure increased from 0 to 60 psi, bioavailability of Lys decreased from 72 to 46% for MBM from Source 1 and from 60 to 50% for MBM from Source 2. Bioavailability of SAA decreased from 62 to 42% for MBM from Source 1 and from 70 to 52% for MBM from Source 2 as processing pressure increased from 0 to 60 psi. The results indicated that pressure processing of MBM decreases bioavailability of amino acids. The reductions in bioavailability were generally similar to those observed in an earlier digestibility study with cecctomized roosters.

Key Words: Meat and Bone Meal, Amino Acid, Bioavailability, Pressure Processing, Poultry
64 Commercial desolventization-toasting conditions reduce the content and availability of amino acids in canola meal, R. W. Newkirk, H. L. Classen, T. A. Scott, and M. J. Edney, 1 University of Saskatchewan, Saskatoon, SK, Canada, 2 Pacific Agri-Food Research Center, Agassiz, BC, Canada, 3 Grain Research Laboratory, Canadian Grain Commission, Winnipeg, MB, Canada.

The content and availability of amino acids in canola meal is variable and a previous study, involving only one commercial crushing plant, reported that the content and availability of amino acids were reduced during desolventization-toasting. However, it is not known if this is an isolated case. Therefore, the objective of this study was to determine if the desolventization-toasting conditions used commercially in Western Canada are affecting content and availability of amino acids in canola meal. Samples, before and after desolventization-toasting were collected from seven canola-crushing plants located in Western Canada. A total of 26 non-toasted and 31 toasted canola meals samples were collected. Apparent ileal amino acid availability of toasted and non-toasted canola meals samples was determined using broiler chickens between 21 and 28 d of age. Prior to the desolventizer-toaster (DT), the lysine content was 6.0 g/16g N (range 5.7-6.3) but after it was reduced to 5.6 g/16 g N (range 5.3-5.9). Likewise, prior to the DT lysine availability ranged from 87% to 92% (mean = 89.7%) but after it ranged from 65.5 to 85.7% (mean = 77.9%). The DT affected the content and availability of most amino acids (except Glu) as the total available amino acid content of canola meal (not including tyrosine and tryptophan) was reduced from 77.6 (range 73.1-82.0) to 69.6 g/16 g N (range 56.6-75.6) by desolventization-toasting. Total glucosinolate content was also reduced by the DT from 20.5 (range 15-27) to 10 µmol/g meal (range 2-19) by desolventization-toasting. In conclusion, commercial desolventization conditions used in Western Canada at the time of this study reduced the content and availability of most amino acids in canola meal.

Key Words: Amino Acid, Availability, Lysine, Toasting, Rapeseed

65 Nutritional Evaluation of Dried Tomato Seeds, M.E. Persia* and C.M. Parsons, University of Illinois, Urbana, IL USA.

Tomato seeds, a by-product of the tomato canning industry, were evaluated for proximate analysis, true dry matter digestibility, TMEΔ, and amino acid digestibility. The tomato seeds were obtained from a canning facility in California. The tomato seeds were found to contain 28.5% protein, and 3.9% ash on a dry matter basis. The true dry matter digestibility, TMEΔ, and true digestibility of the amino acids in the tomato seeds were determined using the precision-fed-cecectomized rooster assay. Cecectomized Single Comb White Leghorn males were fasted for 24 h and then four roosters were tube fed 25 g of the dried ground tomato seeds. Excreta from each bird were quantitatively collected over a 24 h period, lyophilized and analyzed for dry matter, gross energy and amino acid content. Endogenous excretion of dry matter, energy and amino acids were estimated using roosters that were fasted for 48 h. The mean true dry matter digestibility (± SE) for the tomato seeds was 44.7 ± 1.4%. The TMEΔ was determined to be 3265 ± 93 kcal/kg, on a dry matter basis. The total concentrations (on dry matter basis) of lysine, methionine, threonine and valine in the tomato seeds were 1.60, 0.48, 0.97 and 1.25, respectively. True digestibility of amino acids averaged approximately 69%, but varied among individual amino acids. For example, true amino acid digestibility (%) for selected amino acids were: lysine, 58 ± 19; methionine, 78 ± 1.6; threonine, 82 ± 1.2 and valine, 72 ± 1.9. The results of this study indicate that tomato seeds contain significant amounts of TMEΔ and digestible amino acids for poultry.

Key Words: Tomato Seeds, Metabolizable Energy, Amino Acid Digestibility, Poultry

66 Quantitative Detection of Lysine Supplementation in Poultry Feeds using a Rapid Bacterial Bioluminescence Assay. I.B. Zubala Diaz* and S.C. Riche, Texas A&M University, College Station, Texas, USA.

Lysine is an essential amino acid supplemented in poultry feeds. However, biological availability of lysine in feeds can vary depending on the processing of the protein sources and alter the expected final lysine content in feed formulation. A rapid bacterial assay has been developed for the detection of lysine in poultry feeds, based on a luminescent Escherichia coli lysine auxotroph. The use of this strain allows the analysis of feed without prior sterilization and reduces the assay time to 4-6 hours for accurate assessment of biological availability of lysine. Feed grade lysine was added to commercially available poultry feeds and samples were used to test the rapid bioluminescent method. To grow the bacterial inoculum for the assay, a fresh colony was selected and incubated on a flask containing Luria broth supplemented with antibiotics. Culture was incubated and cells grown in a defined minimal media (M9) to deplete cells of endogenous stores of lysine. To initiate the assay, samples of spiked feeds were diluted with M9 media supplemented with a variety of antistatic agents, placed on microtiter plates and inoculated with the starved bioluminescent E. coli cells. After an incubation period of 4 hours, bioluminescence was measured as relative light units (RLU) using a luminometer. A linear standard curve was generated (R²=0.98) using a lysine concentration range between 0.1 to 0.5 µg/mL. Detectable differences in bioluminescence were observed (R²=0.93) and lysine concentrations added to the feeds could be predictably estimated. The assay has potential for rapid determination of bioavailable lysine in non-sterilized poultry feeds.

Key Words: bioluminescence, lysine availability, microbiological assay, lysine auxotroph, rapid method

67 Tomato byproducts as a feed ingredient and source of carotenoids for laying hens. Monika Knoblich* and J. David Latshaw, 1 The Ohio State University.

Tomato skins and tomato seeds were evaluated for their use as a potential feed ingredient and source of egg carotenoids for laying hens. Both tomato byproducts were obtained from a canning facility and dried and then ground. Moisture content was approximately 91% for both byproducts. Proximate analysis determined the values for crude protein (20.3%, 10.0%), ADF (53.79%, 29.94%), and fat (6.37%, 3.22%) to be higher in seeds than skins, respectively. Twenty Single Comb White Leghorn (SCWL) laying hens were allotted to one of four dietary treatments to determine the effect of seeds and skins on the pigmentation of egg yolks. Diet 1 was formulated as a typical commercial corn-soy diet. Diet 2 was formulated by replacing half of the corn in Diet 1 with wheat. Diet 3 and Diet 4 were formulated by replacing 7.5% of the wheat in diet 2 with skins (Diet 3) and seeds (Diet 4). Visual appraisal of yolks indicated that yolks from hens fed the diet supplemented with skins (Diet 3) were darker in color than yolks from hens fed the diet supplemented with seeds (Diet 4). Carotenoid analysis indicated the presence of lycopene (73.4 µg/g, 130.8 µg/g), lutein (14.5 µg/g, 6.48 µg/g), zeaxanthin (3.73 µg/g, 0.97 µg/g), α-carotene (0.0, 0.40 µg/g), β-carotene (29.30 µg/g, 14.35 µg/g), and cis-β-carotene (11.65 µg/g, 5.57 µg/g) in both the skins and seeds, respectively. Lycopene levels were significantly different in yolks from hens fed Diet 3 (0.86 µg/g) and Diet 4 (0.90 µg/g) than yolks from hens fed Diet 2 (µg/g) (p<0.05). The lutein level in yolks from hens fed Diet 4 (16.68 µg/g) was significantly different in yolks from hens fed Diet 2 (14.00 µg/g) (p<0.05). Levels of zeaxanthin, α-cryptoxanthin, and β-cryptoxanthin in yolks from Diet 3 and Diet 4 were not significantly different than the levels of these same carotenoids in Diet 2. α-carotene, β-carotene, and cis-β-carotene were not seen in yolks from hens fed Diet 1, 2, 3, or 4 although these carotenoids were present in both the skins and seeds. True amino acid availability (TAA) and true metabolizable energy (TME) determined via crop intubation of SCWL cockerels indicated that neither skins nor seeds are a good source of protein or energy for poultry.

Key Words: layers, egg, carotenoid, tomato byproducts