542 Growth response of broilers to lysine levels and hydrolyzed porcine digestive mucosa (Palbio) inclusion in diet from 1 to 21 d of age. M. Frihka1, S. Mirzaie1, H. Irandoust1, M. Mohiti-Asli1, C. Chetri2, and G. G. Mateo*1. 1Departamento de Producción Animal, Universidad Politécnica de Madrid, Madrid, Spain, 2I+D Nutrition and Health Care, Bioibérica S.A., Palafolls, Barcelona, Spain.

Palbio (PAL, Palbio 50 RD, Bioibérica, Spain) is a protein concentrate based on hydrolyzed porcine digestive mucosa dried under a fluid bed system over a soybean carrier, currently used in piglet feeds. The digestibility of PAL is very high and the product may be an excellent source of protein for young chicks. An experiment was conducted with 1,280 straight-run one-d-old Ross 308 chicks to evaluate the growth response of broilers to dietary inclusion of PAL. The experiment was conducted as a completely randomized design with 8 treatments arranged as a 2 × 4 factorial with 2 levels of PAL (0 vs. 2.5%) and 4 levels of lysine (1.1, 1.2, 1.3, and 1.4%). All diets contained 3,020 kcal ME/kg and the ratio of indispensable amino acids to Lys was maintained constant. From 21 to 32 d of age all the birds received a commercial commoner finisher diet without any PAL inclusion. Each treatment was replicated 5 times and the experimental unit was a pen with 32 chicks from 1 to 21 d of age and with 15 chicks from 21 to 32 d of age. Body weight gain (BWG), average daily feed intake (ADFI), and feed conversion ratio (FCR) were recorded weekly. From 1 to 21 d of age, PAL inclusion reduced ADFI (P ≤ 0.05) and improved FCR (P ≤ 0.001) and BWG (P ≤ 0.01) and improved Metabolism and Nutrition: Feed Ingredient Posters

544 Feeding plant extract to chickens reared under different hygienic conditions: effects on metabolizable energy, nutrient digestibility and endogenous losses. V. Pirgozliev*1 and D. Bravo2, 1SAC, Ayr, Scotland, UK, 2Pancosma S.A., Geneva, Switzerland.

Plant extracts are often added to poultry diets to improve nutrient availability, growth performance and flock uniformity. Although it has been hypothesized that dietary plant extracts work better when fed to birds reared under “less hygienic” conditions, there is a lack of consistent data to support this hypothesis. Two experiments were conducted to investigate whether the response of broilers to supplementation of plant extract, a mixture of carvacrol, cinnamaldehyde and capsaicin (XT, Pancosma S.A.) depend on the rearing environment using dietary apparent metabolizable energy corrected for nitrogen retention (AMEn), coefficients of dry matter (DMD), nitrogen (ND) and fat digestibility (FD), and endogenous secretions (measured as sialic acid (SA)) as response criteria. In Exp. One birds were reared in cages (high hygiene) whereas birds were reared in floor pens (low hygiene) with used litter in Exp. 2. In both experiments, a corn-soybean meal control diet adequate in protein (215 g/kg diet) but slightly lower in AME (2890 kcal/kg) than breeders’ recommendation and slightly high in non-starch polysaccharides, achieved by inclusion of ~10% barley and rye were fed to the birds with or without XT (100 g XT/tonne). The birds were allocated to dietary treatments in a randomized complete block design, each diet was fed to 12 cages or 10 floor pens. In Exp. 1, feeding XT decreased (P < 0.05) ND, and tended (P < 0.10) to decrease DMD (P = 0.072) and SA secretions although dietary AME and FD did not differ (P > 0.05) between treatment. However, feeding XT to the birds reared on used litter improved FD (P < 0.05), and tended (P < 0.10) to improve AMEn whereas dietary DMD, ND and endogenous secretions remained unchanged (P > 0.05). The current data support the hypothesis from previous research that dietary plant extracts are more efficient when fed to birds reared in less hygienic conditions.

Key Words: amino acids, digestibility, broilers, heat treatment, rapeseed meal

545 Prediction model of digestible amino acid in sorghum. M. Sedghi1, M. R. Ebadi2, A. Golian*1, and H. Ahmadi1, 1Ferdowsi University of Mashhad, Iran, 2Isfahan Research Center of Agriculture and Natural Resources, Isfahan, Iran.
The accurate knowledge of true digestible amino acid (TDAA) contents of feedstuff is necessary to formulate the more accurate poultry diets for a profitable production. Several experimental approaches have been used to determine available amino acids which are highly expensive and time consuming. Prediction of nutritive value of a feed ingredient from its chemical composition via regression method has been attempted for many years. Artificial neural network (ANN) model is the powerful method which may describe the relationship between digestible amino acid contents and chemical composition. Therefore we developed multiple linear regressions (MLR) and ANN models for predicting the TDAA contents of sorghum grain based on chemical composition. The precision fed assay trials using cecemized roosters were performed to determine the TDAA contents in 48 sorghum samples from 12 sorghum varieties differing in chemical compositions. The input variables for both MLR and ANN models were CP, ash, crude fiber (CF), ether extract (EE), and total phenols whereas the output variable was the each individual TDAA for every sample. The results of this study revealed that it is possible to satisfactorily estimate the TDAA of sorghum grain through its chemical composition. The chemical compositions of sorghum grain seems to highly influence the TDAA contents when considering components such as CP, CF, EE, ash and total phenols. It is also possible to estimate the TDAA contents through multiple regression equations with reasonable accuracy depending on compositions but, a more satisfactory prediction may be achieved via ANN for all amino acids. The R2 values corresponding to testing and training of the ANN model showed a higher accuracy of prediction than established by MLR method. In addition, the current data confirmed that the chemical composition, often considered in total amino acid prediction, could be also a useful predictor of true digestible values of selected amino acids for poultry.

Key Words: prediction model, sorghum, true digestible amino acid

546 Relationship between chemical composition and total amino acid contents in pearl millet hybrid. P. Soleimani, M. Sedghi, and A. Golian*, Ferdowsi University of Mashhad, Iran.

Pearl millet is tolerance to harsh growing conditions such as drought. It is at least equivalent to maize and generally superior to sorghum in protein content and metabolizable energy levels. Thus it can be important for poultry feeding. Amino acid (AA) determination is expensive and time consuming. Therefore nutritionists have prompted a search for alternatives to estimate AA levels. Traditionally, 2 methods of predicting AA levels have been developed using multiple linear regression (MLR) with an input of either CP or proximate analysis. Artificial neural networks (ANN) may be more effective to predict AA concentration in feedstuff. Therefore a study was conducted to predict the AAs level in pearl millet with either MLR or ANN. Fifty 2 data lines contained chemical compositions and AAs which collected from literature were used to find the relationship between chemical analysis and AA contents. For both MLR and ANN models chemical composition (dry matter, ash, crude fiber, crude protein, ether extract) was used as inputs and each individual AA was the output in each model. The results of this study showed that it is possible to predict AAs with a simple analytical determination of proximate analysis. Furthermore ANN models could more effectively identify the relationship between AAs and proximate analysis than linear regression model.

Key Words: amino acid, neural network model, pearl millet

547 Application of mathematical models for true metabolizable energy determination in sorghum grain for poultry. M. Sedghi1, M. R. Ebadi2, A. Golian*, and P. Soleimani1, 1Ferdowsi University of Mashhad, Iran, 2Research Center of Agriculture and Natural Resources, Isfahan, Iran.

Sorghum grain is an important ingredient in poultry diets. Nitrogen-corrected true metabolizable energy (TMEn) content of sorghum grain is a measure of its quality. As for the other feed ingredients, the biological procedure used to determine the TMEn value of sorghum grain is costly and time-consuming. Therefore, it is necessary to find an alternative method to accurately estimate the TMEn content of sorghum grain. Artificial neural networks are the powerful method which widely used in agriculture and poultry nutrition. Therefore In this study, an artificial neural network (ANN) and a multiple linear regression (MLR) models were used to predict the TMEn of sorghum grain based on its acid detergent fiber (ADF) and total phenols content. The accuracy of the models was calculated by R2, MS error and bias. The predictive ability of an ANN was compared with a MLR model using the same training data sets. The results of this study showed that it is possible to estimate sorghum grain TMEn with a simple analytical determination of ADF and phenolic content. The R2 values corresponding to testing and training of the ANN model showed a higher accuracy of prediction than that established by regression method (R2 = 0.84 vs 0.56 for training and R2 = 0.83 vs 0.47 for testing data sets respectively). In conclusion, the ANN model may be used to accurately estimate the TMEn value of sorghum grain from its corresponding chemical composition (ADF and total phenols content).

Key Words: metabolizable energy, neural network model, sorghum

548 Feeding the meal or full fat seeds of Camelina sativa or flax to laying hens: Effects on egg production, egg quality and fatty acids. G. Cherian*, A. E. Aziza, and N. Quezada, Oregon State University, Corvallis.

Two experiments were conducted to investigate the effect of feeding the meal or full fat seeds of Camelina sativa or flax to layer birds on egg production, egg quality and egg fatty acid content. Seventy-five 26-week-old (n = 75) laying birds were kept in cages and were fed a corn-soybean meal diet (Control) or Control diet with Camelina meal (CAM-Meal) or Flax meal (Flax-Meal) added at 10%. The diets were fed for a period of 4 mo. Birds were taken off the experimental diets for 6 weeks and were fed a corn-soybean meal diet (Control) or Control diet with Camelina seed (CAM-Seed) or Flax seed (Flax-Seed) added at 10% for another 4 mo period. Hen-day egg production was highest for the Camelina and Flax meal and seed in both experiments (P < 0.05). A reduction in egg and albumen weight was observed for CAM-Meal and CAM-Seed when compared with Control and Flax-Meal or Flax-Seed eggs in both experiments (P < 0.05). Shell thickness was lowest for Flax-Meal and Flax-Seed eggs (P < 0.05). There was no difference in yolk weight or yolk:albumen ratio upon inclusion of CAM-Meal, CAM-Seed or Flax meal (Flax-Meal) added at 10%. The diets were fed for a period of 4 mo. Birds were taken off the experimental diets for 6 weeks and were fed a corn-soybean meal diet (Control) or Control diet with Camelina seed (CAM-Seed) or Flax seed (Flax-Seed) added at 10% for another 4 mo period. Hen-day egg production was highest for the Camelina and Flax meal and seed in both experiments (P < 0.05). A reduction in egg and albumen weight was observed for CAM-Meal and CAM-Seed when compared with Control and Flax-Meal or Flax-Seed eggs in both experiments (P < 0.05). Shell thickness was lowest for Flax-Meal and Flax-Seed eggs (P < 0.05). There was no difference in yolk weight or yolk:albumen ratio upon inclusion of CAM-Meal, CAM-Seed or Flax meal (Flax-Meal) added at 10%. The diets were fed for a period of 4 mo. Birds were taken off the experimental diets for 6 weeks and were fed a corn-soybean meal diet (Control) or Control diet with Camelina seed (CAM-Seed) or Flax seed (Flax-Seed) added at 10% for another 4 mo period. Hen-day egg production was highest for the Camelina and Flax meal and seed in both experiments (P < 0.05). A reduction in egg and albumen weight was observed for CAM-Meal and CAM-Seed when compared with Control and Flax-Meal or Flax-Seed eggs in both experiments (P < 0.05). Shell thickness was lowest for Flax-Meal and Flax-Seed eggs (P < 0.05). There was no difference in yolk weight or yolk:albumen ratio upon inclusion of CAM-Meal, CAM-Seed or Flax meal (Flax-Meal) added at 10%. The diets were fed for a period of 4 mo. Birds were taken off the experimental diets for 6 weeks and were fed a corn-soybean meal diet (Control) or Control diet with Camelina seed (CAM-Seed) or Flax seed (Flax-Seed) added at 10% for another 4 mo period. Hen-day egg production was highest for the Camelina and Flax meal and seed in both experiments (P < 0.05). A reduction in egg and albumen weight was observed for CAM-Meal and CAM-Seed when compared with Control and Flax-Meal or Flax-Seed eggs in both experiments (P < 0.05). Shell thickness was lowest for Flax-Meal and Flax-Seed eggs (P < 0.05). There was no difference in yolk weight or yolk:albumen ratio upon inclusion of CAM-Meal, CAM-Seed or Flax meal (Flax-Meal) added at 10%.
549  Metabolizable energy values of corn distillers grains and corn distillers grains with solubles for 6-week-old broiler chickens. O. Adeola and H. Zhai*, Purdue University, W. Lafayette, IN.

The objective of this study was to determine the ileal digestible energy (IDE), ME, and MEn contents of corn distillers grains (DDG) and corn distillers grains with solubles (DDGS) for 6-week-old broiler chickens using multiple linear regression method. The birds were fed a standard broiler starter diet from d 1 to 21 post-hatch and a standard broiler grower diet from d 22 to d 35 post hatch. The analytical composition of DDG and DDGS used in this study was 4,879 and 4,762 kcal of gross energy/kg, 315 and 287 g of CP/kg, and 921 and 901 g DM/kg, respectively. The DDG and DDGS were incorporated into a reference diet at 3 levels (0, 300, or 600 g/kg) by replacing the energy-yielding ingredients. These 5 diets were fed to 240 male Ross 308 from d 35 to 42 post hatch with 6 birds per cage and 8 replicate cages per diet in a randomized complete block design. The inclusion of DDG or DDGS to the reference diets linearly (P < 0.001) decreased ileal digestibility of DM and energy, total tract digestibility of DM, N, and energy, and IDE, ME, and MEn in assay diets. By regressing the DDG and DDGS-associated IDE intakes in kilocalories against kilograms of intakes of DM in DDG and DDGS, the IDE regression equation was established as Y = −12 + 2,125 * DDG + 2,589 * DDGS, r² = 0.96, which indicates IDE values of 2,125 kcal/kg for DDG and 2,589 kcal/kg for DDGS. Similarly, the ME regression equation was Y = −17 + 1,988 * DDG + 2,460 * DDGS, r² = 0.97, which implies ME values of 1,988 kcal/kg for DDG and 2,460 kcal/kg for DDGS. For MEn, the regression equation was Y = −14 + 1,891 * DDG + 2,360 * DDGS, r² = 0.97, which alludes to MEn values of 1,891 kcal/kg for DDG and 2,360 kcal/kg for DDGS. Based on these results, we calculated the advantages in IDE, ME, and MEn of DDG and DDGS, r² = 0.97, which implies ME values of 1,988 kcal/kg for DDG and 2,589 kcal/kg for DDGS.

Key Words: broiler chicken, corn distillers grains, corn distillers grains with solubles, ileal digestible energy, metabolizable energy

550  Effects of the inclusion of oat hulls or sugar beet pulp in the diet on gizzard characteristics, apparent ileal digestibility of nutrients, and microbial count in the ceca in 36-day-old broilers reared on floor. E. Jimenez–Moreno*, C. Romero, J. D. Berrocoso, M. Frikha, and G. G. Mateos, University Politecnico de Madrid, Madrid, Spain.

The effects of the inclusion of oat hulls (OH) and sugar beet pulp (SBP) in the diet on gizzard characteristics, apparent ileal nutrient digestibility (AID), and Clostridium perfringens, Enterobacteriaceae, and Lactobacillus proliferation in the ceca were studied in 36 d-old broilers. There were a control diet with a low CF content (1.61%) and 2 additional diets that resulted from the dilution of this feed with 5% of either OH or SBP. Each treatment was replicated 7 times (10 chicks each) and birds were kept on pens with straw as bedding. Only one of the chicks of each of the replicates was used for microbiology counts. Broilers fed additional fiber had heavier gizzards (P ≤ 0.001) with higher digesta contents (P ≤ 0.001) and lower pH (P ≤ 0.01) than those fed the control diet. More digesta was retained in the gizzard with SBP than with OH inclusion, a finding that was presumably related with the higher water holding and swelling capacity of the SBP. Neutral detergent fiber, acid detergent fiber, and acid detergent lignin content of gizzard digesta were increased (P ≤ 0.001) with OH but not with SBP inclusion. The AID of starch was higher (P = 0.05) with OH than with SBP inclusion, with that of the control diet being intermediate. However, the AID of CP was not affected by diet. The inclusion of OH but not of SBP, reducedecal counts of Cl. perfringens (P ≤ 0.05), Enterobacteriaceae (P ≤ 0.01), and Lactobacillus (P = 0.08). The data suggest that the inclusion of OH, a lignified insoluble fiber source, improves gizzard function and AID of starch and reduced cecal pathogen microbial count in 36 d-old broilers. Under practical conditions, feeding OH may be used to improve nutrient digestibility and control microbial growth in the gastrointestinal tract of broilers.

Key Words: fiber sources, gizzard characteristics, ileal nutrient digestibility, cecal microbial count, broiler


The increased interest in becoming ‘green’ for consumers and companies is driving groups to develop innovative ways to become more efficient and reduce their waste. Foods past their expiration dates are large sources of waste and are causing food-manufacturing companies to develop waste disposal strategies. Integrating by-products of these companies into animal diets, specifically that of laying hens, could be significantly more cost effective for both the human food manufacturers and the agricultural producers. The study’s objective is to evaluate laying hen diets containing snack food by-product, consisting mostly of expired potato chips, and the impact on hen performance and feeding behavior. One hundred and 92 white Leghorn laying hens (45 wks old) were selected from the MSU Poultry Farm. Hens were housed in conventional cages (3 birds/cage) and received one of 4 diets for 4 wks: 1) industry standard corn-soybean meal control 2) control with 3% by-product 3) control with 6% by-product and 4) control with 9% by-product. Diets were formulated to be isocaloric, isonitrogenous, and balanced for sodium. Feed intake was measured for 3 consecutive days each wk. During the first wk, feed intake was significantly higher in birds fed the 6% and 9% diets compared with those fed control (P < 0.05). Birds feed the 9% had a higher feed intake than control again during the fourth wk (P < 0.01). Egg production, egg weight, and specific gravity were measured weekly. Hen body wt was measured on day one and every 2 weeks thereafter. Egg production, egg wt, specific gravity, and body weight were not significantly affected by the addition of snack food by-products to the diet. In conclusion, the addition of expired snack food by-product into poultry diets does not significantly effect laying hen egg production and has the potential to be used as an alternative feed stuff in the future.

Key Words: snack, egg, laying, hen

552  Different levels of biodiesel glycerin in the diets of broiler chickens. K. C. Zavarize*, J. F. M. Menten, R. Pereira, L. L. Freitas, C. L. S. Silva, Y. K. Carvalho, and S. R. A. Rosa, 1University of São Paulo, Piracicaba, São Paulo, Brazil, 2Federal University of
Glycerin obtained from biodiesel production using soybean oil as its feedstock has been shown to be a highly available energy source for animals. It can potentially be used as a substitute for other energy sources such as corn. The objective of this study was to determine the effects of diets containing different levels of glycerin on chicken performance and litter moisture. In this trial, 1,620 poults of broiler chickens (Cobb 500) were assigned to 6 experimental diets with 6 replicates of 45 birds each in a completely randomized design. Treatments consisted of a control diet without glycerin and diets formulated with increasing levels of biodiesel glycerin (2.5, 5.0, 7.5, 10.0 and 12.5%). The glycerin was analyzed to contain 80.7% glycerol, 12.6% moisture, 2.3% sodium and 80 ppm methanol; its metabolizable energy content had been previously determined to be 3,145 kcal/kg. The diets were isonitritive and were based on corn, soybean meal and corn oil and were supplemented with nutrients to meet the nutritional requirements of chickens. The chickens were raised in floor pens with rice hulls as litter material. Live weight (LW), feed conversion (FC) and feed intake (FI) were determined at weekly intervals until 40 d of age. Birds were checked twice daily for mortality with the weight of dead birds used to adjust FC. Litter moisture was determined at 21, 28, 35 and 40 d of the growth period. At 7 d, LW (176 vs. 171 g) and FI (143 vs. 138 g) were increased with 12.5% glycerin compared with control (P < 0.05). At 21 d, LW increased with 7.5% glycerin (927 vs. 900 g, P < 0.05) without affecting FI. At 40 d, LW (avg. 2.58 kg) and FI (avg. 4.33 kg) were not affected by glycerin levels, but the highest inclusion level was detrimental to FC (1.737 vs. 1.702, P < 0.05). At 40 d, the 10.0 and 12.5% glycerin treatments resulted in increased litter moisture (52% and 57%, respectively) compared with control (42%, P < 0.05). The results of this study demonstrated that glycerin may be incorporated to a level of 10.0% in the diet of broilers without any detrimental effect on performance, but there is an increase in litter moisture.

Key Words: alternative feeds, biodiesel glycerin, litter quality, chicken growth

554 Use of the corn germ meal in diets of laying hens. C. S. Albuquerque1, C. B. V. Rabello*1, D. A. T. Silva1, M. B. Lima2, T. S. Lima1, D. P. V. Silva1, C. C. Lopes1, and E. P. Silva3, 1Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil, 2Esaq, USP, Piracicaba, São Paulo, Brasil, 3Unesp, Campus de Jaboticabal, Jaboticabal, São Paulo, Brasil.

The purpose of this study was to evaluate the effect of increasing levels of corn germ meal (CGM) on diets of laying hens on productive performance and egg quality. 200 laying hens, Dekalb White line, were used at 29 weeks of age. The fowls were distributed in a completely randomized design with 5 treatments and 5 replicates of 8 fowls each. The treatments were consisted of a reference diet based corn, soybean meal and oil soybean and 4 diets with the following levels of inclusion of CGM: 2.0, 4.0, 6.0 and 8.0%. The CGM used in this research had the following chemical and energetic composition: 10.09% of crude protein, 0.03% of calcium, 0.08% of available Phosphorus, 0.02% of sodium, 0.62% of potassium, 0.46% of lysine, 0.19 of methionine, 0.34% of methionine and cystine, 0.33% of threonine, 0.09% of tryptophan and 5.670 kcal/kg transformed energy. The results were submitted to ANOVA and means were subjected to the Dunnett test at 5% probability for the reference treatment compared with the other and a regression analysis was used to verify the effect of inclusion of CGM on the performance and egg quality parameters. The inclusion levels of GIM did not affect the feed intake (g/b/d), egg production (%) and egg mass (g/b/d). However, the egg weight and feed conversion were affected. The inclusion of up to 6% did not affect the performance parameters of laying hens when compared with the reference treatment. Regarding the regression analysis there was a linear effect for both variables (weight and feed conversion). The parameters studied regarding the eggs (shell percentage, albumen and yolk, albumen height, specific gravity and yolk color) weren't affected by increasing levels of CGM. The inclusion of CGM in diets of laying hens in 2% did not influence the production performance and egg quality and that higher levels can increase the weight of eggs, with levels up to 6% can be maintained and feed conversion in some cases may be recommended depending on their price of CGM.

Key Words: egg production, egg quality, feed conversion, feed intake

555 Energetic and nutritional values of sugar cane yeasts for broilers post-hatch. E. N. R. Barbosa1, C. B. V. Rabello*1, W. R. L. Medeiros1, R. V. S. Júnior1, L. R. Custódio1, K. L. A. Carvalho1, A. M. A. T. Samay1, C. C. Lopes1, and E. P. Silva2, 1Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil, 2Unesp, Campus Jaboticabal, Jaboticabal, São Paulo, Brasil.

The objective of this work was to determine the chemical composition and energetic of sugar cane yeasts (Saccharomyces cerevisiae) from different ethanol distilleries for broilers. The digestibility assay was conducted using 180 broilers, male Cobb 500, in the period from 11

553 Determination of metabolizable energy contents of barley and wheat for broiler chickens using regression method. O. A. Bolarinwaw and O. Adeola, Purdue University, West Lafayette, IN.

Broiler chickens were used in an experiment to determine the metabolizable energy (ME) contents of barley and wheat using the regression method. The respective gross energy, crude fiber, and crude fat contents of the barley or wheat samples used were 4,567 or 4,407 kcal/kg, 23.8 or 55.4, and 16.6 or 15.7 g/kg DM. The assay diet was fed for 7 d and excreta was collected twice daily on d 20 and 21. Average weight gain and feed efficiency were between 321 to 350 g and 678 to 729 g/kg, respectively for the 7-d period. The ME content of the barley or wheat sample was determined from the slope of the regression of barley or wheat contribution to apparent ME intake against amount of barley or wheat intake. Metabolizable energy values for barley and wheat samples derived from the regression analyses were 3,665 and 3,746 kcal/kg DM, respectively. The result suggests that barley and wheat have high metabolizable energy and can be used to partly replace corn and SBM in diets fed to broiler chickens.

Key Words: broiler chickens, barley, wheat, metabolizable energy, regression
557 Metabolizable energy of castor bean meal through broiler metabolism trial. J. C. N. Santana1, M. C. M. M. Ludke*1, J. V. Ludke2, A. S. Silva1, C. B. V. Rabello1, and G. R. Bertani3. 

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Castor bean meal (CB) submitted to different processing methods resulted in 5 different CB types and were evaluated for metabolizable energy values using 210 broilers in a standard metabolism trial with 7 treatments (n = 5/treatment with 6 broilers per replicate). The trial lasted 10 d. The 5 CB types were: CBA obtained by mechanical oil extracting process and the other CB were generated from the same industrial process and additionally submitted to an ethanol bath followed by an alcohol recuperation either with 80°C during 20 min (CBB) and 6 min (CBD and CBF) or with 110°C during 15 min (CBF). Additionally CBD and CBE were neutralized with NaOH at 5% and submitted either for solar drying during 2 d (CBD) or submitted to pelletization (CBE). Metabolism trial were established using 20% substitution of a reference diet (a standard corn soybean meal diet). The 5 CB types (CBA, CBB, CBD, CBE and CBF), soybean meal and the reference diet were evaluated. Apparent metabolizable energy (AME, Kcal/kg as is) and AME corrected to nitrogen retention (AMEn, Kcal/kg as is) mean ± standard deviation values were, respectively, for soybean meal (2,555 ± 78 and 2,408 ± 82), CBB (2,787 ± 169 and 2,781 ± 181), CBD (2,603 ± 32 and 2,709 ± 42), CBE (2,759 ± 80 and 2,709 ± 79) and CBF (2,849 ± 64 and 2,739 ± 71). CBA were toxic (lethal to 26.6% of broilers, no weight gain of survivors) and gave negative EMA and EMAn values. All other CB had higher EMAn values than soybean meal (P ≤ 0.05) and were not different (P ≥ 0.05) between each other. The nutritional characteristics of CB (respectively CBA, CBB, CBD, CBE and CBF) were: for crude protein (Nx6.25, % as is) 32.7; 28.2; 29.9; 31.0 and 29.8; for ether extract (% as is) 11.9; 10.9; 8.4; 9.2 and 9.1; for crude fiber (%) as is 24.2; 26.9; 29.7; 28.4 and 27.7; for acid detergent fiber (% as is) 30.4; 33.5; 31.0; 31.0 and 36.3; for Gross Energy (Kcal/kg as is) 4,884; 4,757; 4,680; 4,734 and 4,700. Considering the simplicity of industrial processing and metabolism trial results of CBF may need to undertake more research.

Key Words: alternative feedstuff, industrial by-product, alternative protein source, poultry nutrition

558 Effects of dietary content of corn distillers dried grains with solubles (DDGS) on chemical composition and nutrients of eggs. H. Sun1, E. J. Lee*1, M. Persia1, H. S. Ragheb2, and D. U. Ahn1. 

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The objective of this study was to determine the effects of DDGS as a feed ingredient on egg yolk chemical composition and important nutrients of yolk. Four levels of corn DDGS (0, 17%, 35%, and 50%) were used in a corn and soybean meal-based diet. A total of 256 60-week-old single-comb White Leghorn laying hens were randomly selected, 2 birds were placed in a cage, and 3 consecutive cages were assigned as a pen. Each pen was randomly assigned to one of the 4 diets and fed

to 18 d of age using the method of total excreta collection. The broilers were distributed to metabolism cages, in a completely randomized design with 5 treatments, 6 replications and 6 birds for experimental units. The treatments consisted of a reference diet (RD) based on corn and soybean meal and 4 test diets with replacement of 30% of RD by different yeasts (A, B, C and D). Chemical composition of yeasts were determined: dry matter(DM,%), crude protein (CP,%), ether extract (EE,%), ash (%), neutral detergent fiber (NDF,%) and gross energy (GE, kcal/kg). The metabolism assay was used for determining the apparent metabolizable energy (AME, kcal/kg), apparent corrected for nitrogen balance (AMEn, kcal/kg), apparent metabolizable coefficients of dry matter (AMCDM,%) and gross energy (ACMGE,%) of yeasts. The data were subjected to ANOVA and means compared by Tukey test at 5% probability. The composition in DM, CP, EE, ash, NDF and GE of the yeasts were, respectively: 90.71, 17.11, 0.37, 7.54, 6.86 and 4.214 for yeast A; 88.84, 18.05, 0.44, 8.05, 7.65 and 4.268 for yeast B; 89.99, 14.94, 0.49, 9.1, 3.02 and 4.011 for the yeast C; and 90.47, 21.12, 0.30, 9.0, 12.13 and 4.095 for yeast D. The values were: 1.229c, 1.285c and 1.571b AME; 1.070d, 1.670a, 1.197c and 1.527b AMEn; 19.38a, 19.88a, 20.35a and 20.11a AMCDM; 25.41c; 39.13a, 29.84 and 37.30a ACMGE, for yeast A, B C and D, respectively. The higher values AME and AMEn value were shown for yeast B; the CMAGE values of the yeast B and D were similar and higher than the others, and the values of CMADM were not significantly different between yeasts. The variability in the chemical and energetic composition has influence in the digestibility values of the yeasts.

Key Words: chemical composition, digestibility, metabolizable energy, Saccharomyces cerevisiae


The objective was to evaluate the effect of increasing levels of sugar cane yeast in the diets of broiler chickens post-hatch, from one to 8 d of age, on the morphological development of the intestinal mucosa. The experiment utilized 450 one day old chicks, male Cobb 500, housed in a brick shed divided into boxes of 1.95m2. A completely randomized design was used consisting of 5 treatments and 6 replicates of 15 birds per experimental unit. The sugar cane yeast was included in diets at levels of 0, 1.25, 2.5, 3.75 and 5.0%. At the end of experiment, 2 birds from each replicate were randomly selected and sacrificed by cervical dislocation for collection of approximately 2-cm of fragments of the duodenum, jejunum, and ileum. Subsequently 2 slides were prepared for each segment of each animal to evaluate the parameters of villus height, crypt depth and villus: crypt ratio. The data obtained for all variables were tested for their homogeneity, with the aid of the Bartlett’s Test and transformed by log-transformation of (x). Finally, all data were submitted to the regression analysis. The villus height values (1163.5 μm), crypt depth (243.6 μm) and villus: crypt ratio (4.9) did not show significant differences between all treatments in duodenum mucosa. The villus height and crypt depth in jejunal showed quadratic effect as the maximum height and depth in the levels of 2.09 and 2.06%, respectively, without exerting influence on the villus:crypt ratio in this segment. In ileal mucosal, the levels of yeast did not influence the villus height, however, crypt depth was reduced from the level of 2.56%, and also provide an increase in villus: crypt. The results of this research suggest that the inclusion of yeast in the diets of broiler chickens post-hatch promote increases in villus height and crypt depth in jejunum and increased villus: crypt ration in the ileum, important features that favor absorption of nutrients from the diet, recommending the use of 2% inclusion of sugar cane yeast.

Key Words: broiler chicken, intestinal morphology, sugar cane yeast


The objective was to evaluate the effect of increasing levels of sugar cane yeast in the diets of broiler chickens post-hatch, from one to 8 d of age, on the morphological development of the intestinal mucosa. The experiment utilized 450 one day old chicks, male Cobb 500, housed in a brick shed divided into boxes of 1.95m2. A completely randomized design was used consisting of 5 treatments and 6 replicates of 15 birds per experimental unit. The sugar cane yeast was included in diets at levels of 0, 1.25, 2.5, 3.75 and 5.0%. At the end of experiment, 2 birds from each replicate were randomly selected and sacrificed by cervical dislocation for collection of approximately 2-cm of fragments of the duodenum, jejunum, and ileum. Subsequently 2 slides were prepared for each segment of each animal to evaluate the parameters of villus height, crypt depth and villus: crypt ratio. The data obtained for all variables were tested for their homogeneity, with the aid of the Bartlett’s Test and transformed by log-transformation of (x). Finally, all data were submitted to the regression analysis. The villus height values (1163.5 μm), crypt depth (243.6 μm) and villus: crypt ratio (4.9) did not show significant differences between all treatments in duodenum mucosa. The villus height and crypt depth in jejunal showed quadratic effect as the maximum height and depth in the levels of 2.09 and 2.06%, respectively, without exerting influence on the villus: crypt ratio in this segment. In ileal mucosal, the levels of yeast did not influence the villus height, however, crypt depth was reduced from the level of 2.56%, and also provide an increase in villus: crypt. The results of this research suggest that the inclusion of yeast in the diets of broiler chickens post-hatch promote increases in villus height and
for 24 weeks. Two values of amino acid digestibility were used to form 2 diet formulas of which all meet or exceed the National Research Council nutrient recommendations for laying hens. Each diet formula was fed for 12 weeks. The chemical composition and nutrient contents of egg yolk were measured bi-weekly. Protein, lipids, moisture, fatty acid composition, cholesterol, lutein, and choline content of yolk were measured. The results showed that egg from hens fed diets containing higher DDGS levels had higher fat but lower protein content. Total polyunsaturated fatty acids, and linoleic acid and arachidonic acid content increased linearly as DDGS level in the diet increased. Choline and cholesterol content in yolk were not influenced by the DDGS content in the diet. Lutein content in egg yolk increased linearly as DDGS level in the diet increased. The results indicated that feeding high levels of DDGS increased the content of lutein, linoleic acid and arachidonic acid, but did not affect cholesterol and choline content in egg yolk.

Key Words: corn distillers dried grains with solubles, laying hen, nutrient content, fatty acid composition, lutein

559 Effect of Mexican sunflower leaf meal (MSLM) based diets on carcass characteristics of turkey (Meleagris gallopavo). A. H. Ekeocha*, University of Ibadan, Ibadan, Oyo, Nigeria.

A study was conducted for 16 weeks to investigate the effect of feeding Mexican Sunflower Leaf Meal (MSLM) based diets on carcass characteristics of male turkey. One hundred and 50 male poults were randomly assigned to 5 treatments A, B,C,D and E of 30 birds per treatment such that each treatment had 3 replicates of 10 poults. Treatments A served as control while birds in treatments B, C, D and E received Mexican sunflower meal based diets at 3.5, 7.0, 10.5 and 14.0% respectively as graded replacement (w/w) for maize, soymeal and groundnut cake (GNC). Feeds and water were provided ad-libitum and the routine vaccination/medication followed the standard procedures. The results shows a significant (P < 0.05) decrease in all the parameters measured for carcass characteristics (shank, gizzard, head, thigh, crop, drumstick, wings, breast, back, neck, abdominal fat, spleen, heart, lung, liver, intestine and proventriculus) where cut parts of birds on the control diet were significantly (P < 0.05) higher than the MSLM inclusion diets. The carcass weight were also significantly decrease (P < 0.05) except for the breast weights where birds on treatments B (3.5% MSLM) obtained the highest breast weight as a percentage of dressed weight (21.91%). The result of this study shows that inclusion of MSLM at 3.5, 7.0, 10.5 and 14.0% has almost no effect on both the carcass characteristics and carcass quality of the turkey under study.

Key Words: Mexican sunflower, carcass characteristics, turkey


In a completely randomized designed one hundred eighty 28-week old Nigerian local hens were randomly allotted to 6 experimental diets that contained 0, 10, 20, 30, 40, and 50% dietary palm kernel cake (PKC) for 12 weeks. The diets also contained varying levels (0.5, 1.48, 3.35, 5.22, 7.11 and 8.89% respectively) of palm oil. Each diet was replicated 10 times and the hens were housed one per cage cubicle. Feed (20% crude protein and 2700 kcalME/kg) and water were offered ad libitum. After 12 week in lay, 2hens per replicate (120 hens) were tagged and starved overnight with access to water. These were individually weighed, slaughtered, stunned, de-feathered, dissected, eviscerated, cut into parts and weighed. Data obtained were analyzed (P = 0.05) using SAS (1999). Carcass weights (460 – 510g) were similar (P > 0.05) across board. Dressing out percentage increased significantly from 48.93% for hens fed 10% PKC-based diet to 50.41 and 50.89% for those on 30 and 40% PKC-based diets. Hens raised on 10 – 50% PKC-based diets with up to 7.11% added palm oil had higher (P < 0.05) abdominal and gizzard fat (2.69 – 2.90) than those on control diet (0% PKC). The gizzard weight and %gizzard increased significantly with increasing level of PKC in local hens’ diet while higher values (16.62 – 22.45g and 1.77 – 2.30% respectively) were obtained for hens fed 10 – 50% PKC-based diets. Dietary PKC with palm oil increased the abdominal and gizzard fat and gizzard weight of Nigerian local hen. Feeding up to 40% dietary palm kernel cake had no adverse effect on carcass weight and carcass qualities of Nigerian local hen.

Key Words: Nigerian local hens, palm kernel cake, carcass traits, vegetable oil

561 Metabolizable energy of different soy products. T. Loeffler* and A. B. Batal, University of Georgia, Athens.

To determine the metabolizable energy (ME) of 8 soy products, a precision-fed rooster TME assay and a chick AME assay were conducted. The soybean (SB) products can be grouped into 3 categories: cold pressed soybean meal (SBM), defatted SB, and full-fat SB. Of the cold pressed varieties (unheated), there was an ultra-low trypsin SBM, a low-trypsin SBM, and both a heated and unheated commodity SBM. The defatted SBM was a heated commodity blend. In full-fat SB varieties, there was a high protein ultra-low oligosaccharide, a high-protein and a commodity SB. The TME and AME values were compared between each category: cold-pressed, defatted and full-fat SB, as well as between the 2 assays. Semi-purified diets containing dextrose as the main energy source were formulated to meet the bird’s nutrient requirements, with each diet containing a different SB product. The TME assay was a traditional precision-fed rooster assay in which 5 birds per diet were fasted for 24 h, crop intubated with 35 g of the test diet containing 46.58% cold-pressed or defatted SBM, or 75% full-fat SB, and excreta was then collected for 48 h. For the chick assay, 480 one-day-old chicks were fed a standard corn-SBM starter diet until 17 d of age, and on d 18, the chicks were allowed ad libitum access to the SB-dextrose diets. There were 6 pens of 10 chicks per replication assigned to the 8 SB-dextrose diets. Excreta was collected on d 22, dried, ground and analyzed for gross energy and crude protein to determine metabolizable energy. The SBM samples that were genetically modified to have lower trypsin levels and higher protein had higher ME values than the commodity cold pressed SBM samples. However, the genetic reduction in the oligosaccharide content of the SB increased the TME and AME due to removal of anti-nutritional factors. Superior feed efficiency was attributed to the higher ME value of the full-fat soy products. Genetic modification of SB can have positive effects on the metabolizable energy value for both roosters and chicks.

Key Words: soybean meal, TME, AME, roosters

562 Effects of heating and drying on xanthophyll levels of distillers grains. C. M. Rude*, F. Karim, M. A. Barrios, J. S. Smith, and R. S. Beyer, Kansas State University, Manhattan.

Dried distillers grains (DDG) are an important component of poultry diets, but at times suffer from a fluctuation in protein quality based
on drying conditions. Less is understood about how xanthophylls are affected by the drying of distiller’s grains. Two experiments were conducted to investigate effects of heating and drying on lutein and carotenoids due to interest in developing nutraceutical egg products. In Experiment 1, 500 g of DDG was autoclaved from 0 to 60 min, in 5 min intervals. Samples were collected, and lutein and β-carotene were extracted and analyzed using an HPLC. Experiment 2 was designed to simulate the drying conditions that are similar to industrial drying of DDGS. Wet distillers grains (WDG) (32.38% moisture) were obtained from a local ethanol plant. A Fisher Scientific Isotemp oven was set to 175°C, a temperature between reported DDG dryer entry and discharge temperatures. Five g samples of WDG were placed inside and removed at 5, 10 and 20 min. Three replications were conducted and duplicates were used. Sample weights were recorded after drying, and were analyzed for lutein and β-carotene using same method as experiment 1. Experiment 1 regression analysis showed a strong negative linear effect of time on lutein (R² = 0.8453), and a reduced linear effect on β-carotene (R² = 0.5255). In experiment 2 a significant effect (P < 0.001) was observed on loss of mass, water and other volatiles, of WDG and a negative linear effect (P < 0.001) was observed. Drying time had an effect on lutein (P < 0.05) and β-carotene (P < 0.01) concentrations, but unlike autoclaving a positive linear effect was observed for lutein (P < 0.05) and β-carotene (P < 0.01). When lutein and β-carotene levels were adjusted for loss of mass, there were no effects (P > 0.10) observed. Autoclaving DDG reduced lutein levels, while the dryer, set to a higher temperature, had no effect. Only autoclaved DDG were observed to brown, indicative of Maillard reactions and over-processing. Results indicate over-processing DDG reduces lutein and xanthophyll content, and decreases xanthophyll levels of feed ingredients in poultry rations.

Key Words: distillers, drying, xanthophyll


The inclusion of distillers dried grains with solubles (DDGS) in poultry diets has become more prevalent as a cost-cutting strategy in response to the high demand of corn for fuel ethanol production. Previous work in our lab has indicated that inclusion of up to 23% DDGS in layer diets has negative effects on egg quality which can be corrected by the addition of an exogenous enzyme. An experiment was conducted to evaluate the effect of feeding up to 30% DDGS with an enzyme supplement (Allzyme SSF, Alltech, Nicholasville, KY). This experiment utilized 288 Hyline W36 hens that were randomly allotted to 5 dietary treatments (12 hens per rep). Dietary treatments were fed through 29 weeks of production and include a 1) positive control (corn-soybean meal), 2) 15% DDGS, 3) 15% DDGS + 150 g/ton Allzyme SSF, 4) 30% DDGS, 5) 30% DDGS + 150 g/ton Allzyme SSF. In comparison to the positive control diet, diets containing DDGS had reduced levels of ME (2877 vs. 2794.04 Kcal/kg), Ca (4.42 vs. 4.10%), and available P (0.29% vs. 0.17% for the 15% DDGS diet, and 0.23% for the 30% DDGS diet). Six eggs from each pen were randomly selected every 4 weeks for determination of egg quality. The addition of 30% DDGS and Allzyme SSF to the diet resulted in an increase in Haugh unit values. Shell breaking strength at 6 weeks of production was significantly lowered in the 2 diets containing 30% DDGS. There was no effect of dietary treatment on egg weight, egg shell weight, yolk weight, albumen weight, average daily feed intake, average body weight, hen day production and feed conversion through 29 weeks of production. The current study suggests that DDGS can be included up to 30% in layer diets with limited detrimental effects on hen performance or egg quality. Shell quality in the early stages of production warrants further study.

Key Words: DDGS, egg quality, enzyme, layers

564 Effect of pearl millet in broiler diets fed until 21 days of age: Carcass characteristics and organ weights. T. R. Torres1, M. C. M. M. Ludke*1, J. V. Ludke2, E. J. O. Souza1, M. R. Lima1, J. E. Serafin1, and G. M. Silva1, 1Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil, 2Embrapa Suínos e Aves, Concórdia, Santa Catarina, Brasil, 3UAST - Universidade Federal Rural de Pernambuco, Serra Talhada, Pernambuco, Brasil.

A trial was established to evaluate the effect of diet type (DT) presented in 2 physical forms (PF) fed to broilers. Six treatments were established with 3 diets (CSM: corn soybean meal diet, WMG: diet with 20% whole millet grain or GMG: diet with 20% ground millet grain) either in mash (M) or pellet (PEL) form. The trial lasted 21 d with 300 Ross male broilers being used (n = 5/treatment, 10 birds/replicate). Diet Apparent Metabolizable Energy (AME, Kcal/kg) and crude protein (CP) from 1 to 7 were 3,000 and 22.1%, respectively. From d 8 to 21 the AME value was changed to 3,050 with 21.1% CP. At 21 d of age one bird per replicate, representing plot average weight, was slaughtered. Live weight was not different (P ≥ 0.05) between DT with average values of 959 g for CSM; 938 g for WMG and 938 g for GMG. Diet PF had only a slight effect (P = 0.057) on weight with 931 g for MHS and 959 g for PEL diets. Carcass weight was affected (P ≤ 0.05) by PF with values of 710 g for MSH and 730 g for PEL. Carcass yield and carcass parts (leg + thigh, chest, wings and drumstick) were not affected (P ≥ 0.05) by treatments. Liver, pancreas, lung, spleen and intestines weight expressed as percentage of live weight were not affected (P ≥ 0.05). Heart and gizzard percentages were affected (P ≤ 0.05) only by PF with MSH and PEL diets having gizzard percentages of 2.87% x 2.62%, respectively. Heart percentage values were 0.80% for MSH diets and 0.67% for PEL diets. Total abdominal fat weight percentage were only affected by DT (P = 0.025 and P = 0.018, respectively) with values of 18.4 g and 1.83% for WMG, 18.6 g and 1.88% for GMG, 13.9 g and 1.39% for CSM diet. Use of MHS diets resulted in higher gizzard and heart percentages. The use of millet at 20% level in the diets resulted in higher abdominal fat. Physical form of diet had effect of internal organs while the use of millet in diets had effect on broiler fat deposition.

Key Words: alternative feedstuffs, diet physical form, whole and ground millet


As the supply of distillers dried grains with solubles continues to grow there is increased interest in using higher levels of DDGS in poultry diets. Previous studies have indicated that inclusion of up to 23% DDGS in layer diets has negative effects on egg quality which can be corrected by the addition of an exogenous enzyme. Therefore an
experiment was conducted to evaluate the effect of feeding up to 30% DDGS with an enzyme supplement (Allzyme SSF, Alltech, Nicholasville, KY) to brown laying hens on performance and egg quality parameters. This experiment utilized 288 Hyline Brown hens that were randomly allotted to 5 dietary treatments. Dietary treatments were fed through 30 weeks of production and included 1) positive control (corn-soybean meal), 2) 15% DDGS, 3) 15% DDGS + 150 g/ton Allzyme SSF, 4) 30% DDGS, 5) 30% DDGS + 150 g/ton Allzyme SSF. In comparison to the positive control diet, diets containing DDGS had reduced levels of ME (2877 vs. 2794.04 Kcal/kg), Ca (4.22 vs. 4.10%), and available P (0.29% vs. 0.17% for the 15% DDGS diet, and 0.23% for the 30% DDGS diet). Six eggs per rep were randomly selected every 4 weeks for egg quality. Dietary inclusion of DDGS resulted in a decrease in egg shell weight when compared with the positive control. There was no difference in egg shell weight between the control and the 15% DDGS with Allzyme SSF. Haugh unit values were increased by the addition of DDGS to the diets. The DDGS diets resulted in decreased shell breaking strength overall, however the addition of Allzyme SSF to the 15% DDGS diet resulted in better shell breaking strength compared with the others treatments. Body weight was reduced as a result of DDGS inclusion, but was corrected by inclusion of Allzyme SSF. Dietary treatment had no effect on egg weight, yolk weight, albumen weight, average daily feed intake, hen-day production and feed conversion. The addition of Allzyme SSF to diets containing high levels of DDGS may help alleviate the detrimental effects on shell quality and body weight.

Key Words: DDGS, brown egg layers, egg quality, shell quality

566 Cost analysis of poultry feed formulated with insect larvae. R. Holser and D. Samuel*, Russell Research Center, Athens, GA.

Sustainable agricultural practices reflect the current interest in managing resources both effectively and economically with minimum environmental impact. Modern commercial poultry production follows an integrated approach which offers an effective strategy to minimize operating costs. However, the cost of inputs such as poultry feed is not easily controlled and subject to market fluctuations. For example, the demand for biofuels that occurred over the past few years in response to petroleum generated significant increases in the cost of feed components derived from corn and soybean crops. Such price increases drive the search for inexpensive feed components. Fly larvae were previously investigated as an alternative protein source with a proximate analysis of 55 wt% protein (db) and 14 wt% lipids (db). The composition of the larval protein and lipid fractions display favorable amino acid and fatty acid profiles, respectively. The larvae also contain numerous trace elements and vitamins. An economic analysis was performed to examine the benefit of formulating a poultry feed ration with fly larvae. The results indicated that when larvae were used as an alternative ingredient the cost could be reduced by 17% per kg feed. This assumed that larvae were available on-site and obtained as a by-product from a novel litter treatment system at no cost. The additional benefits provided by the litter treatment system were not factored into the analysis. This example demonstrates the potential economic advantage of using insect larvae to replace commodity feed ingredients and supports the sustainable agricultural initiative.

Key Words: economics, feed, larvae, protein, sustainable

567 Effect of canola on the growth performance and carcass composition of heavy hen turkeys. J. L. MacIsaac* and D. M. Anderson*, 1Atlantic Poultry Research Institute, Truro, Nova Scotia, Canada, 2Nova Scotia Agricultural College, Truro, Canada.

There is increased consumer demand for choice in poultry meat based on what the birds are fed. Choice may include all plant-based ingredients in the diet. To determine the effect of black and yellow seeded canola products on the growth performance and carcass composition of heavy hen turkeys, a one-way ANOVA in a completely randomized design with protein/energy sources (soybean meal/poultry by-product meal/poultry fat (Control), commercial black-seeded canola meal/canola oil (BCM), yellow-seeded canola meal/canola oil (YCM), full-fat black-seeded canola/canola oil (BCC), full-fat yellow-seeded canola/canola oil (YCS)) as the main effect was conducted. Isocaloric and isonitrogenous diets were fed for phases 0–14d, 15–28d, 29–56d and 57–70d. Feed consumption and weight gains were not affected (P ≥ 0.05) by canola treatment for the entire trial. At 56 d of age, turkeys fed YCM (3163 g bird−1) and YCS (3127 g bird−1) were heavier (P ≤ 0.05) than those fed the other treatments (3060, 2920, 3098 g bird−1). At 70 d age, turkeys fed YCM (5651 g bird−1) were heavier (P ≥ 0.05) than those fed BCM (5350 g bird−1) and the Control (5430 g bird−1). Weights for turkeys fed BCC (5548 g bird−1) and YCS (5549 g bird−1) were heavier (P ≤ 0.05) than those fed BCM. Feeding canola, either as full-fat seeds or meal supplemented with canola oil increased (P ≤ 0.05) the α-linolenic (LNA) and total omega-3 contents of the skin tissue, breast tissue (skinless) and wings (skin on and bone in). The eicosapentaenoic acid (EPA) (0.04, 0.08, 0.07, 0.09, 0.08 mg g−1; Control, BCM, YCS, YCM, YCS, respectively) and docosahexaenoic acid (DHA) (0.07, 0.14, 0.12, 0.15, 0.13 mg g−1; Control, BCM, BCS, YCS, YCS, respectively) contents of the wings from all of the canola treatment birds were higher (P ≤ 0.05) than the Control. Wings from the YCM birds had a higher (P ≤ 0.05) EPA content than the BCM, BCS, and YCS birds. The DHA in the wings from the YCM birds was higher (P ≤ 0.05) than the BCS birds. Feeding canola-based diets significantly increased the total omega-3 content, EPA, DHA and LNA content of the turkey skin and breast tissues.

Key Words: canola, turkeys, omega 3, eicosapentaenoic acid, docosahexaenoic acid


The aim of this study was to include shrimp meal (SM) and red crab meal (RCM) in laying hen diets and to know their effect on lipid composition and oxidation of egg storage at 0, 15 and 30 d 4°C and 20°C. 135 laying hens were distributed into 3 treatments: control, 20% SM and 4% RCM. At the end of the 4th week, 100 eggs per treatment were taken to quantify total lipids, fatty acid profile, cholesterol, fat soluble vitamins, astaxanthin, peroxide and TBAR’S in eggs stored at different times (0, 15, 30 d) and temperatures (4°C and 20°C). Data were analyzed using a 3 × 3 × 2 factorial design and a multiple range test of Duncan for comparison of the means (P < 0.05). The treatment with SM showed highest total lipids, n-6, n-3, and cholesterol content in eggs. In the treatment with RCM, the eggs showed highest astaxanthin content (P < 0.05). In regard to storage times and temperatures, the content of total lipids, LA, EPA, DHA and astaxanthin in eggs were
lowest at 30 d/20°C, in all treatments. On the other hand, AA, ALA, cholesterol, and fat soluble vitamins were no affected at 30 d/4° and 20°C. Oxidation was not detected in any treatments at 15 and 30d/4° and 20°C. Under the conditions of this study, it is conclude that SM is a good source of n-3 and RCM of astaxanthin, and that these lipid components are not affected by storage at 15d/4° and 20°C.

**Key Words:** crustacean meals, eggs, lipid fraction, storage, laying hens

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<th>Growth response and economic benefits of male turkey on Mexican sunflower leaf meal (MSLM) based diets.</th>
<th>A. H. Ekeocha*1 and A. A. Mako2, 1University of Ibadan, Ibadan, Oyo, Nigeria, 2Tai Solarin University of Education, Ijagun Ijebu-Ode, Ogun, Nigeria.</th>
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This study determined the growth and economic benefits of 150 male poults turkeys on Mexican sunflower leaf meal (MSLM) based diets from day old. The poults were randomly allotted to 5 experimental rations A, B, C, D and E of 30 birds per treatment such that each treatment had 3 replicates of 10 poults. Treatment A served as the control and treatments B, C, D and E received Mexican sunflower leaf meal (MSLM) at 3.5, 7.0, 10.5 and 14.0% levels replacing maize and soymeal respectively. Feed and water were provided ad-libitum and routine medications and vaccinations administered. Performance characteristics measured were feed intake, weight gain and net profit. The results of the experiment showed that there were significant differences \((P < 0.05)\) in the live weight and feed intake. However, birds on treatment A performed best by attaining a live weight of 9670.46g in 16 (16) weeks with feed intake of 16,093.16g per bird. The same birds yielded the highest net profit of N880.04k or $5.87 per bird on dressed weight unlike a deficit of N5.28k or $0.04 per bird on birds in treatment E (14% MSLM) and N 1399.81k or $9.33 profit per bird on live weight and a profit of N308.30k or $2.06 per bird in treatment E (14% MSLM). The study indicated that MSLM based diets enhanced performance of male turkey and could serve as alternative replacement for maize and soymeal at 3.5 to 10.5% level with good returns on investment.

**Key Words:** growth response, economic benefits, male turkey

| Increasing feeding meals influences the reproductive performance of broiler breeder females during laying period. | S. Moradi1, M. Zaghari1, M. Shivazad*1, R. Osfori2, and M. Mardi2, 1University of Tehran, Karaj, Iran, 2Agriculture Biotechnology Research Institute of Iran (ABRII), Karaj, Iran. |

Broiler breeder hens are commonly fed restricted during the laying period to prevent or reduce health and reproductive disorders associated with obesity. Feed restriction performed as once-a-day feeding regimens during laying period, this feed is completely consumed in about 4 h, and as a result they will fast for a long time of each day which has a negative impact on their welfare. The aim of this research was to evaluate the effects of increasing feeding meals to 2 or 3 times per day on performance and welfare of female broiler breeder hens from 24 to 38 wk of ages. Seventy-two Cobb 500 breeder pullets were assigned to 3 feeding regimens with 4 replicates per each treatment. Feeding treatments included a control group was once-a-day feeding schedule, which all birds were received their total restricted feed at 0615 h; twice-a-day feeding schedule, which 50% of restricted feed was fed at 0615 h and the other 50% at 1230 h; and thrice-a-day feeding, in which daily restricted feed allowance was divided to 3 parts and were fed at 0615 h, 1230 h and 1815 h. Total daily feed intake was the same in all treatments. Egg production and egg weight were measured on daily basis. Blood samples were collected and birds were killed at peak of production (wk 32) and the end of trial (wk 38). During the early phase of production cycle, feeding schedules significantly affect egg production rate and egg weight. Broiler breeder hens fed 2 and 3 meals per day produced more eggs than once-a-day fed birds from wk 26 to 38 \((P < 0.01)\). Increasing feeding meals significantly elevated mean egg weight throughout the experimental period \((P < 0.01)\), but did not influence yolk weight at 26, 31 and 38 wk of age. The plasma level of NEFA and corticosterone did not differ consistently among experimental treatments. We concluded that feeding twice and thrice-a-day did not significantly improve broiler breeder welfare as indicators of hunger and stress have not changed. Elevated feeding frequency to 2 or 3 times per day can improve the productivity of broiler breeder hens during the early lay cycle.

**Key Words:** broiler breeder, feeding meals, performance