**Metabolism and Nutrition: Nutrition**

**P391 Hematology, growth and performance of duck fed rations supplemented with Mexican sunflower leaf (MSL).** A. H. Ekeocha,* University of Ibadan, Ibadan, Oyo, Nigeria.

A 84 – day feeding trial was conducted to evaluate mexican sunflower leaf (MSL; *Tithonia diversifolia*) as dietary fiber source in duck diets. Five straight diets were formulated to contain the MSL at dietary levels of 0%, 2.5%, 5.0%, 7.5% and 10.0% as a replacement for wheat bran. Ninety (90), day - old duckling and wing-banded for individual identification were randomly allotted to the 5 diets containing 3 replicates per treatment with 6 Ducklings per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and routine medications and vaccinations administered. Data were analyzed using descriptive statistics and ANOVA. The study investigated the performance characteristics of duck. Ninety day-old ducklings and wing-banded for individual identification were randomly allotted to the 5 diets containing 3 replicates per treatment with 6 Ducklings per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and routine medications and vaccinations administered. Data were analyzed using descriptive statistics and ANOVA. The study investigated the performance characteristics of Duck. Ninety day-old ducklings and wing-banded for individual identification were randomly assigned to 5 treatments, A, B, C, D and E. Treatment A served as control while birds in treatments B, C, D and E received MSL at 2.5, 5.0, 7.5 and 10.0% respectively. Feeds and water were provided ad libitum and the routine vaccination/medication followed the standard procedures. The results shows a decrease in most of the parameters measured for carcass characteristics (shank, head, thigh, crop, drumstick, wings, breast, back, abdominal fat, spleen, heart, lung, liver, intestine and proventriculus) where cut parts of birds on the control diet were relatively higher than the MSL inclusion diets except for the neck weight (270.13g) where birds on treatment B (2.5% MSL) obtained the highest neck weight and the gizzard with highest weight (6.05g) obtained in treatment C (5.0% MSL) and both measures were significant ($P < 0.05$). The liver and spleen weights significantly increased ($P < 0.05$) across the dietary treatments while other organs observed did not differ significantly ($P > 0.05$) in weight across the treatments. However, the carcass quality shows no significant ($P > 0.05$) difference in Head weight, Drumstick weight, thigh and breast muscle weight. The results of this study show that inclusion of MSL at 2.5, 5.0, 7.5 and 10.0% had almost no effect on the carcass characteristics whereas there was more impact on the carcass quality of the ducks under study.

**Key Words:** lesser known sunflower, hematology, performance, duck

**P392 Utilization of Mexican sunflower leaf (*Tithonia diversifolia Hemsley A Gray*) on average production cost and returns of duck.** A. H. Ekeocha,* University of Ibadan, Ibadan, Oyo, Nigeria.

A 84-day feeding trial was conducted to evaluate the utilization of Mexican sunflower leaf (MSL; *Tithonia diversifolia*) as dietary fiber source and economic of gain in duck diets. Five straight diets were formulated to contain the MSL at dietary levels of 0%, 2.5%, 5.0%, 7.5% and 10.0% as a replacement for wheat bran. Ninety (90), day-old duckling and wing-banded for individual identification were randomly allotted to the 5 diets containing 3 replicates per treatment with 6 Ducklings per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and routine medications and vaccinations administered. Data were analyzed using descriptive statistics and ANOVA. The study investigated the performance and economic of gain. The results shows a decrease in most of the parameters measured for carcass characteristics. The final body weight, daily weight, daily feed intake and daily protein intake were generally higher in the birds fed control diet (0%MSL). There were significant ($P < 0.05$) differences in daily feed intake and daily protein intake between the control diet and the other groups, while daily weight gain, feed conversion ratio and protein efficiency ratio were statistically the same ($P > 0.05$) across board except at 10% level where there was a fall in weight gain. Digestible crude fiber values significantly ($P < 0.05$) decreased with increasing levels of MSL in the diets while the other digestibility percentages were comparable ($P > 0.05$) in all dietary treatments. Cost per kg feed decreased as the level of MSL inclusion in the diets increased while the cost per kg weight gain showed that birds fed on diet C (5.0% MSL) were the most economical to produce. Based on the results of this experiment and due to substantial decreases in intake, performance and profit margin, the decision to use Mexican sunflower leaf at above 7.5% inclusion level as a dietary fiber source in feeding programs for duck should rest on economics.

**Key Words:** Mexican sunflower leaf, economics of gain, duck

**P393 Effect of feeding Mexican sunflower leaf (*Tithonia diversifolia Hemsley A Gray*) on carcass characteristics of duck (*Anas platyrhynchos*).** A. H. Ekeocha,* University of Ibadan, Ibadan, Oyo, Nigeria.

A study was conducted for 12 weeks to investigate the effect of feeding Mexican Sunflower leaf (MSL; *Tithonia diversifolia*) on carcass characteristics of Duck. Ninety day-old ducklings and wing-banded for individual identification were used. The ducklings were randomly assigned to 5 treatments, A, B, C, D and E. Treatment A served as control while birds in treatments B, C, D and E received MSL at 2.5, 5.0, 7.5 and 10.0% respectively. Feeds and water were provided ad libitum and the routine vaccination/medication followed the standard procedures. The results shows a decrease in most of the parameters measured for carcass characteristics (shank, head, thigh, crop, drumstick, wings, breast, back, abdominal fat, spleen, heart, lung, liver, intestine and proventriculus) where cut parts of birds on the control diet were relatively higher than the MSL inclusion diets except for the neck weight (270.13g) where birds on treatment B (2.5% MSL) obtained the highest neck weight and the gizzard with highest weight (6.05g) obtained in treatment C (5.0% MSL) and both measures were significant ($P < 0.05$). The liver and spleen weights significantly increased ($P < 0.05$) across the dietary treatments while other organs observed did not differ significantly ($P > 0.05$) in weight across the treatments. However, the carcass quality shows no significant ($P > 0.05$) difference in Head weight, Drumstick weight, thigh and breast muscle weight. The results of this study show that inclusion of MSL at 2.5, 5.0, 7.5 and 10.0% had almost no effect on the carcass characteristics whereas there was more impact on the carcass quality of the ducks under study.

**Key Words:** carcass characteristics, *Tithonia diversifolia*, duck

**P394 Hematology, growth and performance of goose fed rations supplemented with Mexican sunflower leaf (MSL).** A. H. Ekeocha,* University of Ibadan, Ibadan, Oyo, Nigeria.

A 112-day feeding trial was conducted to evaluate Mexican sunflower leaf (MSL; *Tithonia diversifolia*) as dietary fiber source in goose diets. Five straight diets were formulated to contain the MSL at dietary levels of 0%, 2.5%, 5.0%, 7.5% and 10.0% as a replacement for wheat bran. Seventy-five (75), day-old goslings and wing-banded for individual identification were randomly allotted to the 5 diets containing 3 replicates...
per treatment with 5 goslings per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and routine medications and vaccinations administered. Data were analyzed using descriptive statistics and ANOVA. The study investigated the performance and hematological responses of the birds to the diets. The results show a progressive reduction in all the parameters measured for performance characteristics up to 5.0% MSL and a significant ($P < 0.05$) decrease at levels above 5.0% MSL. The final body weight, daily weight, daily feed intake and daily protein intake were generally higher in the birds fed diet A (0% MSL). There were significant ($P < 0.05$) differences in daily feed intake and daily protein intake between the control, diets B and C and the other groups, while daily weight gain, feed conversion ratio and protein efficiency ratio were statistically the same ($P > 0.05$) across board. The results in this study for feed conversion ratio though better for birds in diets B (2.5% MSL) and diets C (5.0% MSL) did not differ statistically as was reported above. The feed conversion trends observed in this study suggested that geese gained weight in relation to their feed intake. Digestible crude fiber values significantly ($P < 0.05$) decreased with increasing levels of MSL in the diets while the other digestibility percentages were comparable ($P > 0.05$) in all dietary treatments. Values for the hematological parameters and blood serum chemistry did not deviate ($P > 0.05$) statistically from established normal values for geese. The results suggest that MSL could replace wheat bran in geese diets up to 7.5% as a dietary fiber source.

**Key Words:** lesser known sunflower, hematology, performance, goose

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**P395** Utilization of Mexican sunflower leaf (*Tithonia diversifolia* Hemsley A Gray) on economic indices of goose. A. H. Ekeocha,*

*University of Ibadan, Ibadan, Oyo, Nigeria.

A 112-day feeding trial was conducted to evaluate the utilization of Mexican sunflower leaf (MSL; *Tithonia diversifolia*) as dietary fiber source and economic of gain in geese diets. Five straight diets were formulated to contain the MSL at dietary levels of 0%, 2.5%, 5.0%, 7.5% and 10.0% as a replacement for wheat bran. Seventy-five (75), day-old goslings were wing-banded for individual identification were randomly allotted to the 5 diets containing 3 replicates per treatment with 5 Goslings per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and routine medications and vaccinations administered. Data were analyzed using descriptive statistics and ANOVA. The study investigated the performance and economic of gain. The result shows a progressive reduction in all the parameters measured for performance characteristics up to 5.0% MSL and a significant ($P < 0.05$) decrease at levels above 5.0% MSL. The final body weight, daily weight, daily feed intake and daily protein intake were generally higher in the birds fed control diet (0% MSL), diets B (2.5% MSL) and diets C (5.0% MSL) while daily weight gain, feed conversion ratio and protein efficiency ratio were statistically the same ($P > 0.05$) across board except at 10% level where there was a fall in weight gain. Final live weights and growth rates decreased linearly as MSL increases in the diets but there was no effect of diet on feed conversion. Digestible crude fiber values significantly ($P < 0.05$) decreased with increasing levels of MSL in the diets while the other digestibility percentages were comparable ($P > 0.05$) in all dietary treatments. Cost per kg feed decreased as the level of MSL inclusion in the diets increased. Control diet (0% MSL) had the highest profit margin followed by diets B, C, D and E respectively. Cost to produce 1kg live weight and cost per unit gain was more economical in control diet followed by diets B, C, D and E respectively. The results suggest that MSL could replace wheat bran in geese diets up to 10.0% as a dietary fiber source before envisaging deleterious effect.

**Key Words:** Mexican sunflower leaf, economic indices, goose

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**P396** Effect of feeding Mexican sunflower leaf (*Tithonia diversifolia* Hemsley A Gray) on carcass traits of goose. 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 (MSL) on carcass traits of goose. Seventy-five day-old goslings and wing-banded for individual identification were used. The goslings were randomly assigned to 5 treatments, A, B, C, D and E. Treatment A served as control while birds in treatments B, C, D and E received MSL at 2.5, 5.0, 7.5 and 10.0% as graded replacement w/w for wheat bran (WB). Feed/ water were provided ad libitum and routine vaccination/medication followed the standard procedures. Data were analyzed using descriptive statistics and ANOVA. The results show a significant ($P < 0.05$) decrease in all the parameters measured for carcass traits except for the thigh and breast muscle. The reduced weight gain associated with increasing level of MSL corresponds mainly to a reduction in carcass fat and that the weight of the thigh and breast muscle decreased very slightly. Control diet had a higher body weight at slaughter. There were no differences in feed conversion rates of the geese but liver weights significantly ($P < 0.05$) increased. The comparison for carcass index showed that there were differences and similarities observed among the 5 diets. However, the carcass traits shows no significant ($P > 0.05$) difference in head weight, drumstick weight, thigh and breast muscle weight. There were no differences between mean carcass percentages among the 5 treatments. There were no differences for mean breast weight between diets B, C, D and control; however diets E breast weight was significantly ($P < 0.05$) lower than the other 4 diets. The mean leg and thigh weight, and fat weight followed identical trends. These results suggests that WB fed restriction levels of 2.5%, 5.0% and 7.5% below control diet do not have any significant effect on carcass traits, however, at 10.0% MSL replacement for WB, carcass traits were significantly ($P < 0.05$) lower than the control diet with the exception in the carcass percentages (%) and this suggests that carcass % index are relatively constant in the breed of geese regardless of feeding regimens and body weight differences.

**Key Words:** carcass traits, *Tithonia diversifolia*, goose

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**P397** Cost analysis of poultry feed formulated with fly larvae. R. A. Holser and D. Samuel,*

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Fly larvae were evaluated as an alternative protein source for use in poultry feeds. Larvae contain approximately 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 larva also contain numerous trace elements and vitamins. An economic analysis was performed to examine the cost benefit of replacing soybean meal with fly larvae in a starter feed ration. The cost of a standard poultry feed was estimated from component costs and compared with feed that replaced the soybean meal component with fly larvae. A value of 285 USD/T soybean meal was used as the basis in a starter feed containing 24% protein. This formulation would require 120 kg soybean meal/T feed. Commercial bulk starter crumble cost ranges from 300 – 400
USD/T (FOB). The results of our cost analysis indicated that a savings of 8.5% – 11.4% per kg feed could be obtained by replacing soybean meal with fly larvae as the protein source. This analysis assumed that larvae were available on-site as a by-product of a litter treatment system. The additional benefits of the litter treatment system were not considered in the analysis. These results demonstrated the economic advantage of insect larvae as an alternative protein source to replace commodity feed ingredients such as soybean meal. This approach supports sustainable agricultural practices and is currently under development at commercial scale in South Africa.

Key Words: soy meal, insect larvae, protein, formulation, costing

P398 Changes in cecal digesta pH, short chain volatile fatty acids, tissue lipid components and muscle oxidative stability in broilers as affected by dietary plant or marine fats. A. E. Aziza, N. Quezada, and G. Cherian,* Oregon State University, Corvallis.

The effects of qualitative modulation of dietary fat on gastrointestinal tract health in poultry remain largely unexplored. Use of plant or marine fats in broiler diet on changes in cecal digesta pH, short chain volatile fatty acids (SCVFA), and tissue lipid components are investigated. One hundred and twenty 8 one-day-old Cobb chicks were randomly assigned to one of 4 treatments with 4 replications of 8 birds in each replicate. The experimental diets were: corn-soybean meal based with 3.2% corn oil (Control) or 3.2% fish oil (FO), corn oil +10% Camelina meal (CAM), or FO +10% Camelina meal (FO+CAM). Corn oil and CAM are used as sources of linoleic (18:2 n-6), and linolenic (18:3 n-3) acids and FO is used as a source of eicosapentaenoic (20:5 n-3) and docosahexaenoic acids (22:6 n-3). The diets were formulated to contain 22% CP and 3,200 kcal of ME/kg. Body weight, weight gain, feed consumption, and fatty acids (SCVFA), and tissue lipid components are investigated. One

Key Words: soy meal, insect larvae, protein, formulation, costing


Application of high temperatures during pelleting improves the physical quality of pellets, but may lower nutrient availability which may counterbalance the benefits of pelleting. A 2 × 2 factorial arrangement of treatments was used to evaluate the effect of pellet diameter (3 and 4.76 mm) and pellet length (3 and 6 mm) on pellet quality and, performance and nutrient utilization in broilers. From 0 to 9 d of age, the birds were offered a common starter diet. Broiler grower (d 10 to 21) and finisher (d 22 to 42) diets, based on corn, were formulated to meet Ross 308 strain recommendations and then subjected to the 4 treatments. The diets were steam-conditioned at 60°C before pelleting. In grower diets, increasing pellet diameter and pellet length reduced (P < 0.001) gelatinized starch content of the diets. In finisher diets, gelatinized starch content of pellets was not influenced (P > 0.05) by neither main effects nor the interaction. In grower and finisher diets, increments in pellet durability index and pellet hardness with increasing pellet length were greater in pellets with 3-mm diameter than those with 4.76-mm diameter. During the grower period, birds fed 3-mm diameter pellets had lower feed per gain (P < 0.01, 1.383 vs. 1.403) than those fed pellets with 4.76-mm diameter. During the finisher and whole trial (d 10 to 42) periods, neither main...
effects nor the interaction were significant ($P > 0.05$) for weight gain, feed intake and feed per gain. Increasing the pellet diameter from 3 to 4.76 mm decreased ($P < 0.001$) the AME (13.98 vs. 13.70 MJ/kg DM). Neither main effects nor the interaction were significant ($P > 0.05$) for the ileal digestibility of nitrogen. Numerical reductions were observed in the ileal digestibility of starch in birds fed 3-mm diameter pellets with increasing the pellet length, while the reverse was observed in birds fed 4.76-mm diameter pellets. Overall, small diameter die holes and longer pellet lengths can favor the manufacture of high physical quality pellets under low conditioning temperatures.

**Key Words:** pellet diameter, pellet length, pellet quality, performance, broilers

### P401 Raw full-fat soybean or toasted in the feeding of broilers.

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The soybean has a high concentration of protein and energy, however, has antinutritional factors (e.g., trypsin inhibitor, lectin, phytate) which limits its use in poultry feed when not subjected to processing. This research evaluated the influence of the use of raw full-fat soybean, toasted full-fat soybean and over processing full-fat soybean on the small intestinal morphology, sialic acid concentration, and pancreatic weight of broilers from 1 to 21 d of age. Twenty-four male broilers were distributed in a completely randomized experimental design containing 4 treatments and 6 replicates. The experimental diets consisted of addition of 15% of toasted full-fat soybean (TFS), 10%TFS+5% of raw full-fat soybean (RFS), 15% RFS and 10%TFS+5% over processing full-fat soybean (PFS). The over processing full-fat soybean was obtained by dry heat at 180°C for a period of 4 h. Birds fed diets containing RFS produced higher amounts ($P < 0.01$) of sialic acid in the ileal content than birds fed with diets containing TFS and PFS. The number of goblet cells in the ileum was increased ($P < 0.01$) by adding 15% of RFS in the diet. The height of the villus in the ileum of birds fed 15% RFS was lower ($P < 0.05$) in relation to treatment 10%TFS+5%RFS. The crypt depth in the ileum was not affected by the treatments ($P > 0.05$). The pancreas of birds fed diets containing 15% RFS was significantly heavier ($P < 0.05$) than birds fed diets containing TFS and PFS. It was conclude that the under processing of full-fat soybean affect the intestinal homeostasis and pancreatic weight of broiler chickens.

**Key Words:** Glycine max, sialic acid, intestinal health, processing

### P402 Nutrient digestibility in air-classified pulse protein concentrates and wet-fractionated soy protein concentrate for 15-d-old broiler chicks.

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Nutrient and energy digestibility in commercially-available, air-classified field pea (PPC) and zero-tannin fava bean (FPC) protein concentrates (Partheim Foods; Saskatoon, SK) were compared with that of wet-fractionated soy protein (SPC) concentrate (ADM Company; Decatur, IL) in 15 d-old broiler chicks. On the day of hatch, male broiler chicks (Ross 308; n = 225) were distributed among 18 battery cages and fed a commercial starter ration until 8 d of age. Cages were then assigned to 1 of 3 test diets for 7 d in a RCB design with 8 replicate cages per treatment. Test diets consisted of 80% of a basal concentrate, which included 2% celite, and 20% of 1 of 3 test ingredients (PPC, FPC or SPC). On d 15, birds were euthanized and ileal digesta collected. Excreta was collected for the 48-h period before digesta collection and both digesta and excreta were pooled to produce a single specimen of each per test cage. Nutrient digestibility in the basal concentrate had previously been measured permitting nutrient digestibility in the test ingredients to be calculated by the difference method. Nutrient digestibility coefficients were compared using PROC MIXED of SAS 9.1. Models included test ingredient (PPC, FPC or SPC) as a fixed effect and block as the random term. Total tract digestibility of GE and DM were similar among test ingredients ($P < 0.10$), however ileal CP digestibility was greater for PPC compared with FPC or SPC ($P < 0.05$). Apparent ileal digestibility (AID) of ARG, HIS, LYS and THR did not differ among test ingredients ($P > 0.25$). As expected for pulses, AID of MET and MET+CYS was lower for PPC and FPC compared with SPC ($P < 0.01$). Due to lower AID of sulfur AA, replacing soy-based protein in broiler diets with FPC or PPC would require additional supplementation with MET to achieve an optimal digestible AA profile for chicks.

**Key Words:** broilers, digestibility, protein concentrates, pulses

### P403 Nutritional evaluation of alternative soy processing techniques for poultry.

K. J. Bolek, R. Lemoine, T. Wang, S. Jung, and M. E. Persia, Iowa State University, Ames.

A method of soybean fractionation has been developed using enzymes and water to extract soybean oil. This process allows for oil extraction without using industrial chemicals such as hexanes, yielding byproducts including soluble protein (soy skim) and soy fiber portions. The objective of this experiment was to test the suitability of these byproducts for use in poultry diets. Soy skim contained 52.5% crude protein (CP), 1.04% methionine, 3.53% lysine, 2.02% threonine, 0.14% Ca, 0.92% P while soy fiber contained 14.1% CP, 0.30% methionine, 0.89% lysine, 0.52% threonine, 0.37% Ca, and 0.72% P. Amino acid digestibility was determined using cecectomized roosters and was found to be 72.9, 79.5, and 73.4% for skim and 69, 52, and 72.3% for fiber for methionine, lysine, and threonine digestibility, respectively. A chick experiment was conducted to determine the protein efficiency ratio (PER) and net protein ratio (NPR) for soy skim compared with commercial soybean meal (SBM). Both PER and NPR at 4% and 8% CP were lower for the soy skim compared with SBM. In a second chick experiment, soy skim and soy fiber were incorporated into corn-SBM diets at 4% and 8% to determine safe, efficient feeding concentrations. There were no differences in body weight gain or feed intake among any of the soy skim, soy fiber, or corn-SBM meal diets ($P > 0.05$). Feed efficiency (FE) was similar among all treatments except that the 4% soy fiber diet increased feed efficiency by 8.4% compared with the corn-SBM control diet ($P > 0.05$). This increase in FE is unexpected due to the low nutrient content and poor utilization of fiber by chickens, but may be due to prebiotic effects of the fiber. The soy skim was found to contain appreciable amount of nutrients, but reduced amino acid quality compared with commercial soybean meal. The soy fiber was found to contain low nutrient concentrations, but possible prebiotic effects. Both fractions can be fed in poultry diets up to 8% of the diet.

**Key Words:** soluble soy protein, soy fiber, poultry, amino acid digestibility
P404 Screw-pressed Camelina sativa meal as feedstuff for broilers: Effects of graded dietary inclusion on organ weights and post-mortem signs of toxicity. M. Oryschak*1, C. Annett1, and E. Beltranena1,2, Albertia Agriculture and Rural Development, Edmonton, AB, Canada, 2University of Alberta, Edmonton, AB, Canada.

The effect of increasing dietary inclusion of screw-pressed Camelina sativa meal (CAM; 17% residual oil, 34% CP) on clinical signs of toxicity and wt of selected organs was evaluated in broilers (Ross 308; n = 725). Birds housed in battery cages were fed diets containing 0, 8, 16 or 24% CAM for 42-d in a RCB design with 6 replicate cages per treatment. Diets consisted of 76% of a concentrate and cornstarch in reciprocal amounts to CAM to comprise the remaining 24%. Six birds from each cage were removed on d 14, 28 and 42 of the experiment. Three of these birds were euthanized by injectable barbiturate to preserve the integrity of the thyroid and were sent intact for post-mortem examination by a veterinary pathologist (blind to treatment). The other 3 birds removed on each day were euthanized by cervical dislocation and dissected to remove selected organs, which were weighed. Results of post-mortem examinations were analyzed using appropriate non-parametric tests. Organ weights were analyzed using PROC MIXED in SAS 9.1, with CAM inclusion as fixed effect, block as the random term, and BW as a covariate. There was no relationship between dietary CAM inclusion level and post-mortem findings of any key organs or tissues. Increasing dietary CAM inclusion linearly reduced liver wt, but only at 14 d of age (P < 0.01). Heart wt increased by 4% for each 8% increase in dietary CAM inclusion, but only at 28 d of age (linear; P < 0.02). Dietary CAM inclusion level did not affect spleen wt at any age (P > 0.31). For each 8% incremental increase in dietary CAM inclusion, pancreas wt increased by 27 and 21% at 28 and 42-d of age, respectively (linear; P < 0.01). Changes in organ wt were likely induced by differences in digestible protein and fat content among test diets, rather than CAM toxicity. In conclusion, dietary inclusion of up to 24% CAM did not cause any gross morphological changes in organs that would indicate toxicity.

Key Words: broiler, Camelina, organ weights, toxicity


Acidulated soap stock (ASS) and lecithin (LEC) are by-products from the soybean oil industry whereas glycerol (GLY) is separated from the soybean oil (SO) through transesterification in the production of biodiesel. An experiment was conducted using 1,750 one-day-old Cobb × Cobb 500 slow feathering male broilers to evaluate the effects of the soybean oil industry by-products: ASS, LEC, GLY as well as for their mixture (MIX – 85% ASS, 5% LEC and 10% GLY) to mimic the composition of these compounds in the triglyceride molecule in crude soybean oil. Live performance and carcass yields were evaluated. A 4 phases feeding program was used. Control diets (Control) formulated with degummed soybean oil (DSO) were used in a feeding program of 4 diets: 1 to 7, 8 to 21, 22 to 35 and 36 to 40 d of age. Five dietary treatments were formulated with DSO, ASS, LEC, GLY and MIX in fixed inclusions of 2% (1 to 7 and 8 to 21 d) and 4% (22 to 35 and 36 to 40 d) whereas 4 treatments had inclusion of ASS, LEC, GLY, MIX in diets having DSO to reach apparent metabolizable energy (AME) levels of the Control. The 10 treatments with 7 replicates of 25 birds as the experimental unit were distributed in a completely randomized block design. Animals fed diets with DSO, ASS, LEC and MIX with fixed energy level showed, reduced body weight gain from 7 to 21 d (P ≤ 0.05), improved feed intake, and had similar feed conversion ratio (P ≤ 0.05), from 21 to 39 d when compared with the Control, however, GLY had the worst values for these variables. Blends of DSO+by-products and their mixture showed similar performance than Control treatment from 1 to 39 d. Dietary energy source affected carcass yield, however no significant differences were reported for abdominal fat and commercial cuts.

Key Words: acidulated soap stock, lecithin, glycerol, metabolizable energy, carcass yield

P406 The effect of dietary glycerol in the starter phase on turkey hen production. E. Y. Opoku,* H. L. Classen, and T. A. Scott, University of Saskatchewan, Saskatoon, Canada.

Glycerol, a co-product from bio-diesel production, has the potential to be an energy source for turkey production. Presently, it is not recognized as a feed ingredient by the Canadian Food Inspection Agency; and therefore this research was undertaken to build a scientific basis for the acceptability of glycerol in turkey feeding. In the present study, a total of 96 Hybrid Converter female turkey poults were fed a wheat and soybean meal basal diet containing different levels of glycerol (0, 2.5, 5.0 and 7.5%) from 7 to 21 d of age. Diets in mash form were balanced with different levels of canola oil, to maintain a similar energy content for all diets. The 4 diets were each randomly assigned to 6 cages (4 poults per cage). Feed and water were available on an ad libitum basis. There were no adverse effects of glycerol inclusion on growth performance. There was no mortality in the study. Data was analyzed by linear regression. There was no significant difference in 21 d body weight (g) or feed intake (g/b/d). However, there was a significant linear effect (P < 0.05) of glycerol level on 7–21 d feed conversion ratio (y = 1.54–0.0114*glycerol level; R² = 0.31). There were no significant effects of glycerol level on AME (kcal/kg diet). There was a linear effect of glycerol on nitrogen retention (y = 53.9+0.88*glycerol level; R² = 0.15). Relative to 21 d body weight gut measurements (i.e., empty gizzard and proventriculus weight, and duodenal, jejunal, ileal and ceca length) were not affected (P > 0.05) by the level of glycerol. In conclusion, the data suggest that glycerol can be incorporated in the diet of hen turkeys as high as 7.5% without detrimental effect on growth performance.

Key Words: glycerol, turkey poults, growth, feed conversion efficiency, gut measurements

P407 Effects of increasing levels of biodiesel glycerin in broiler diets on carcass characteristics and breast meat composition. K. C. Zavarize*1,2, J. F. M. Menten2, L. W. Freitas2, G. R. Goretti2, R. Pereira2, Y. K. Carvalho1, and S. R. A. Rosa1, 1State University of Goias, Sao Luis de Montes Belos, Goias, Brazil, 2University of Sao Paulo, Piracicaba, Sao Paulo, Brazil, 3Federal University of Acre, Rio Branco, Acre, Brazil, 4Montes Belos College, Sao Luis de Montes Belos, Goias, Brazil.

Glycerin obtained from biodiesel production has been shown to be a highly available energy source for animals. It can potentially be used as a
The soybean oil is an important energy source to poultry diet, but currently alternatives lipids or energy sources have attracted the attention of poultry industry. This experiment evaluated performance of laying hens fed diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol. The soybean oil is an important energy source to poultry diet, but currently alternatives lipids or energy sources have attracted the attention of poultry industry. This experiment evaluated performance of laying hens fed diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol.


The soybean oil is an important energy source to poultry diet, but currently alternatives lipids or energy sources have attracted the attention of poultry industry. This experiment evaluated performance of laying hens fed diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol. Three hundred sixty Dekalb White hens (63 weeks of age) were randomly placed and fed 5 diet with different lipids sources and glycerol.

P409  Algae biomass as an energy source for animal feeds. A. M. Evans*a, K. D. Baldock2, D. L. Smith3, and J. S. Moritz4, 1West Virginia University, Morgantown, 2Eastern New Mexico University, Portales.

Algae is a top alternative fuel source to crude oil for several reasons: 1) algae has a short growing cycle; 2) algae production does not require arable land or potable water; 3) algae is an efficient photosynthetic plant that requires no energy for making roots, stems, seeds, or flowers. In general, the algae are harvested from ponds and the cell walls are broken to extract the oil; after extraction, the remaining biomass is composed of a mixture of proteins, carbohydrates, and residual oil. The algae biomass is a co-product that has the potential to be used in various animal feeds including: poultry, swine, and cattle; however, several variables are associated with production, thus necessitating research that compares method of production and feeding value. Variables for consideration include the extraction, drying, and storage of the co-product. The objective of the current study was to conduct an initial screening of 2 algae co-products for nitrogen corrected true metabolizable energy (TME) content. A total of 10 intact Single Comb White Leghorn Roosters were precision fed algae co-products (A and B), with 5 replications per treatment. Excreta was collected for 48 h, dried, and analyzed for gross energy and nitrogen content; these values were used to calculate TMEc. Fat and protein content varied; 6.9%, 34.8%, and 1.8%, 43.2% for co-products A and B, respectively. All roosters fed co-product A died within 48 h after feeding. The cause of death is unknown but may be associated with fat-soluble toxins or toxin residue due to method of production. The mean TMEc for co-product B was determined to be 1,305 ± 230.01 calories per gram. These data show a potentially significant draw-back to algae biomass use as well as high variability in energy metabolism necessitating more extensive and rigorous research before algae biomass is considered for use in animal feeds.

Key Words: algae biomass, true metabolizable energy, co-product, rooster, crude oil alternative

P410  Nutrient and energy digestibility in air-classified faba bean and field pea protein and starch concentrates in 21-day-old broilers. M. Oryschak*a and E. Beltranena;t, 'Alberta Agriculture and Rural Development, Edmonton, AB, Canada, 2University of Alberta, Edmonton, AB, Canada.

Nutrient and energy digestibility in air-classified starch (ST) and protein (PR) fractions of zero-tannin ‘Snowbird’ fava bean (FB) and ‘Cooper’ field pea (PEA) were measured in 21-d-old broilers. On the day of hatch, male broiler chicks (Ross 308; n = 300) were distributed among 24 test cages and fed a commercial starter diet until 14 d of age. On d 14, cages were then fed 1 of 4 test diets for 7 d in a RCB design with 6 replicate cages per treatment. Test diets consisted of 70% of a wheat-based basal diet, containing 0.5% chromic oxide as an indigestible marker, and 30% of 1 of 4 test ingredients (ST or PR fractions of FB or PEA). On d 21, birds were euthanized for collection of ileal digesta. Excreta was collected for 48-h before digesta collection. Digesta or...
excreta were pooled to produce a single specimen of each per test cage. Nutrient digestibility in the basal diet had previously been measured, thus permitting nutrient digestibility in the test ingredients to be calculated by the difference method. Nutrient digestibility coefficients were analyzed using the MIXED procedure of SAS 9.1. Statistical models included the fixed effects of pulse crop (FB or PEA), fraction type (ST or PR), and the 2-way interaction; block was the random term. Total tract digestibility coefficients for both GE and DM were greater for PR compared with ST ($P < 0.01$), but were similar between FB and PEA ($P > 0.24$). Pulse crop interacted with fraction type to affect AID coefficients for ARG, MET, ILE, TRP and VAL ($P < 0.02$). Coefficients for LYS, TSAA and PHE were higher in PR compared with ST ($P < 0.02$). In conclusion, low digestibility of sulfur AA indicates that diets including any of the 4 fractions studied would require supplemental MET to achieve an optimal digestible AA profile for growing broilers.

Key Words: broiler, digestibility, faba bean, field pea, fractions

P411 Effects of dietary fiber source and crude protein content on plasma and liver lipids in broiler breeder hens fed restricted or ad libitum. M. Mohiti-Asli1, M. Shivaazad1*, M. Zaghari2, and S. Aminzadeh2, 1University of Tehran, College of Agriculture and Natural Resources, Animal Science Department, Karaj, Iran, 2Department of Veterinary Science, University of Tehran, Tehran, Iran, 3National Institute of Genetic Engineering and Biotechnology, Tehran, Iran.

This study investigated the effects of dietary fiber source, cellulose or inulin, as well as CP content of diet, 14.5% or 17.4%, on hepatic lipids and plasma metabolites in broiler breeder hens fed either restricted (R) or ad libitum (AL). Hens were assigned into 60 floor pens with 6 hens in each, and 12 dietary treatments were applied from 43 to 55 wk of age. The treatments arranged factorially with 2 levels of CP (14.5 vs. 17.4%), 3 fiber sources (0 vs. 3% inulin vs. 3% cellulose), and 2 levels of feed intake (160 vs. 208 g/d) that corresponded to R or AL feeding regimens. The experimental diets contained 2,800 kcal ME with either 14.5% or 17.4% CP. The ratios of amino acids to CP were kept constant in the both diet. AL feeding of broiler breeder hens increased the liver weight (106.8 vs. 86.1 g; $P < 0.001$) and hepatic lipid deposition (51.4 vs. 38.6%; $P < 0.001$), which was associated with enhances ($P < 0.05$) in plasma glucose, triglyceride (TG), total cholesterol, and low density lipoprotein cholesterol. Fat deposition in abdomen was also increased ($P < 0.001$) in AL fed hens which led to excessive body weight (BW). Increasing dietary CP from 14.5% to 17.4% decreased hepatic fat content (42.1 vs. 46.5%; $P < 0.05$) and it was associated with lower ($P < 0.05$) liver weight, hepatic lipid accumulation and cholesterol. Plasma TG concentration and abdominal fat pad weight were also reduced ($P < 0.05$) by higher dietary CP content. Inclusion of inulin to the diet suppressed ($P < 0.05$) liver weight and abdominal fat weight. Cellulose inclusion to the diet decreased ($P < 0.05$) feed intake, BW, abdominal fat and liver weight. Cellulose was more effective than inulin in decreasing feed intake and BW of hens but both were similar in suppression of abdominal fat and liver weight. No interaction was found between dietary CP content and the fiber source of diet. It is concluded that an increase in CP content of the diet alleviates hepatic lipid content in broiler breeder hens but inclusion of inulin or cellulose in the diet did not suppress liver and plasma lipids.

Key Words: broiler breeder hen, crude protein, dietary fiber, plasma metabolites

P412 Evaluation of pressed, dehulled cottonseed meal on growth performance when included broiler diets. J. Pieniazek*, R. Stipanovic2, L. Puckhaber2, M. B. Farnell1, and J. T. Lee1, 1Poultry Science Department, Texas AgriLife Research and Extension, Texas A&M System, College Station, 2USDA-ARS, College Station, TX.

An experiment was conducted to evaluate the effect of pressed, dehulled cottonseed meal on broiler growth performance and residual tissue gossypol. Cottonseed meal was included at 2 inclusion rates (5 and 10%) either for the first 21 d or for the entire 41 d trial and compared with an industry type corn soybean meal diet yielding a total of 5 dietary treatment groups. Each treatment contained 6 replicate pens with each pen containing 30 straight-run broilers for a total placement of 900 broilers. A starter diet was fed through 21 d of age, a grower diet through 35 d of age and a finisher diet through 41 d of age. Body weight and feed consumptions were determined on d 10, 21, 35, and 41. Muscle and liver samples were collected from one broiler per replicate pen to determine the presence of gossypol. No differences were observed in growth performance at 10 d of age. Body weight was reduced ($P < 0.05$) with the inclusion of 10% pressed, dehulled cottonseed meal at 21 d of age, however, no growth depression was observed following 21 d of age within any of the treatment groups. Feed conversion ratio was decreased ($P < 0.05$) through 35 d of age in the 5 and 10% continuous inclusion treatment groups. At the conclusion of the trial, no differences were observed ($P > 0.05$) in body weight or feed conversion ratio. These data indicate that pressed, dehulled cottonseed meal can be included at up to 10% inclusion without negatively affecting growth performance, however further research needs to be conducted to determine the exact nutrient value of pressed, dehulled cottonseed meal and to identify the maximum level of inclusion in broiler diets.

Key Words: broiler, cottonseed meal, performance

P413 Comparison of fresh and stored egg in laying hen fed cottonseed meal supplemented with lysine and enzyme. K. Pournia*, A. A. Saki, and P. Zamani, Department of Animal Science, Bu-Ali Sina University of Hamadan, Hamadan, Iran.

Cottonseed meal (CSM) could be a favorable alternative protein source for layers diets, but in regarding to presence of the potentially toxic agent, gossypol, has limited its uses. Eighty White Leghorn hens (80 weeks old) were used in this study for 12th weeks. Hens were randomly divided into 4 treatments and 5 replicates with 4 birds in each. The experiment was conducted in 2 × 2 factorial experiment in completely random design (CRD). The hens were fed by mash basal diet supplemented with 1% lysine + 0% enzyme (Treatment 1), 1% lysine+0.025% enzyme (Treatment 2), 2% lysine+0% enzyme (Treatment 3), 2% lysine+0.025% enzyme (Treatment 4). Water and feed were offered ad libitum. The light program was 16 h per day. House's temperature and humidity were recorded during the experiment. Average ambient relative humidity house inside and daily temperature were 65 ± 5% and 18 ± 1°C, respectively. Body weights were recorded at the beginning and at the end of study. Feed intake was measured weekly. Egg production and egg weight from all birds were tested daily through the experiment. Egg mass was calculated. Net feed conversion ratio (NFCR) was analyzed. The result have indicated that protein content in magnum was not significantly affected by different levels of lysine and enzyme ($P > 0.50$). Although magnum Protein: RNA ratio increased with 2% of lysine as compared with 1% ($P < 0.50$). Moreover, result have shown that jejunum DNA concentration was not significantly affected by...
lysine ($P > 0.50$). Also jejunum RNA: DNA ratio increased with 2% of lysine ($P < 0.50$). Performance specificity significantly improved by 2% of lysine and 0.025% of enzyme ($P < 0.50$). The results of current study have shown that diets supplemented with 2% lysine and 0.025% enzyme could improve performance, some egg characteristics and increased magnum protein synthesis and jejunum cell efficiency. It was concluded that laying hen performance improved by cottonseed meal supplemented by 2% lysine and 0.025%enzyme.

**Key Words:** cottonseed meal, egg, laying hen


Corn is the most commonly used cereal grain in poultry diets worldwide and brings most of the energy required by birds. The objective of this study was to compare different approaches for the determination of the apparent metabolizable energy corrected for nitrogen balance (AME$_c$) of 2 corn samples using 23-d-old growing broilers. Experiments were designed to determine AME$_c$ with ad libitum feeding and total excreta collection using the European Reference Method. A basal diet containing corn (58.9%), soybean meal (31.3%), minerals and vitamins was used. Evaluation of 2 corn batches (corn 1 and corn 2) was done by substituting various levels of the basal diet (25, 50% and 15, 30, 50% for corn 1 and 2, respectively). In addition, 12 diets were prepared from 12 ingredients (wheat, barley, wheat bran, corn 1 and 2, soybean meal, vegetable oil), the inclusion levels of these ingredients being independent of each other. The apparent metabolizable energy values were first calculated by difference based on diet including 50% corn, and second by regression based on the control/corn ratios and third by the iterative Marquardt method. No effect of the methodology was observed either on animal feed consumption or animal variability within experimental treatment. Results showed that AME$_c$ values obtained for the evaluation of the corn 1 were 3,802; 3,805 and 3,689 kcal/kg DM for the methods by difference, by simple regression and by multiple regression, respectively. The methods by difference and by simple regression gave very close results while the multiple regression gave lower AMEn value (-115 kcal/kg). Performance specificity significantly improved by simple regression and by multiple regression, respectively. The apparent metabolizable energy values were first determined by iterative method that combines NEm and energy retention, and the NE values of corn and soybean meal was estimated using the difference method. When considering the effect of light and fasting time on HP and respiratory quotient (RQ), the data were analyzed by 2-way ANOVA with SPSS 17.0. Results showed that hens fed basal diet had a 0.06 Mcal/kg greater heat increment and 3.43% lower NE/ME ratio ($P < 0.05$) than giving corn diet. Hens had a pronounced diurnal rhythm in HP in during both feeding and fasting state, the HP during fasting period was increased by 0.72 kcal/kg BW$^{0.75}$ per h in the light than that during dark period ($P < 0.01$). Hens had lower HP and RQ on the 3rd day of fasting than that on the 2nd day ($P < 0.01$). It was suggested that the HP associated with feeding had not been eliminated until by 52 h of fast. The NEm of hens was estimated to be 63.47 kcal/kg BW$^{0.75}$ per d at 20 ± 1°C. The estimated AME$_c$, NE values and NE/AME$_c$ ratio were 3.42, 2.59 Mkal/kg and 75.62% for corn, 2.86, 1.78 Mkal/kg and 62.08% for soybean meal, respectively. In conclusion, compared with corn, the energy value of protein-rich soybean meal for hens was overestimated when expressed on AME basis. Duration of adaptation of hens to diet and fasting time as well as difference method should be considered when using indirect calorimetry method to estimate diet NE content, NEm and NE values of feedstuffs.

**Key Words:** net energy, laying hens, corn, soybean meal, heat production

### P415 The net energy values of corn and soybean meal for dwarf laying hens using indirect calorimetry method. D. Ning,* Y. M. Guo, Y. W. Wang, and Y. Z. Peng, China Agricultural University, Beijing, China.

The study was conducted to estimate the net energy (NE) values of corn and soybean meal for laying hens based on indirect calorimetry method and nitrogen balance measurements. A total of 288 28-wk-old Nongda 3 dwarf laying hens were randomly assigned to 2 groups with 4 replicates each fed with corn-soybean-meal diet (basal diet) and corn diet, respectively. After a 10 d adaptation period, each replicate of 36 hens from the 2 groups were simultaneously arranged into 2 respiration chambers to measure the heat production (HP) for 3 d in hens fed the 2 diets, including HP following a 72 h of fast after feeding basal diet. The equilibrium fasting HP (FHP) may provide an estimate of NE requirements for maintenance (NEm). The NE intake from diets was determined by factorial method that combines NEm and energy retention, and the NE values of corn and soybean meal was estimated using the difference method. When considering the effect of light and fasting time on HP and respiratory quotient (RQ), the data were analyzed by 2-way ANOVA with SPSS 17.0. Results showed that hens fed basal diet had a 0.06 Mcal/kg greater heat increment and 3.43% lower NE/ME ratio ($P < 0.05$) than giving corn diet. Hens had a pronounced diurnal rhythm in HP in during both feeding and fasting state, the HP during fasting period was increased by 0.72 kcal/kg BW$^{0.75}$ per h in the light than that during dark period ($P < 0.01$). Hens had lower HP and RQ on the 3rd day of fasting than that on the 2nd day ($P < 0.01$). It was suggested that the HP associated with feeding had not been eliminated until by 52 h of fast. The NEm of hens was estimated to be 63.47 kcal/kg BW$^{0.75}$ per d at 20 ± 1°C. The estimated AME$_c$, NE values and NE/AME$_c$ ratio were 3.42, 2.59 Mkal/kg and 75.62% for corn, 2.86, 1.78 Mkal/kg and 62.08% for soybean meal, respectively. In conclusion, compared with corn, the energy value of protein-rich soybean meal for hens was overestimated when expressed on AME basis. Duration of adaptation of hens to diet and fasting time as well as difference method should be considered when using indirect calorimetry method to estimate diet NE content, NEm and NE values of feedstuffs.

**Key Words:** corn, energy, broilers, methodology

### P416 Dietary energy and performance of broiler chickens from 8 to 28 days of age. M. A. Silva*1, T. M. Filho1, A. V. C. Souza2, and R. V. Nunes3, 1Aviagen Inc., Huntsville, AL, 2Poli-Nutri Animal Nutrition, Sao Paulo, SP, Brazil, 3Unioste, M. C. Rondon, PR, Brazil.

The aim of this trial was to evaluate the effects of different energy levels during Grower (8-to-21 d) and Finisher (22-to-28 d) phases on performance of 2160 female broiler chicks (RossxRoss308). Basal practical mash diets (lower and higher energy) based on corn (3,360 kcal/kg), soybean meal (2,430 kcal/kg), and refined soy oil (8,880 kcal/kg) were produced and blended to achieve calculated apparent metabolizable energy (AME) values of 2,926, 2,980, 3,113, 3,245, and 3,300 kcal/kg for Grower diets and 2,951, 3,016, 3,175, 3,334, and 3,400 kcal/kg for Finisher diets. At d-8, all birds were weighed and distributed equally according to a 2$ ^{2}$ full-factorial arrangement in central composite design with 12 runs (8 treatments+4 center points) with 4 replicates per run. Six birds were randomly taken from each pen at d-29 for processing. The statistical analyses were performed and significant effects considered in the prediction equations based on the code matrix ($-1.41,-1.0,+1)$. There was a linear effect (L) of dietary energy ($P < 0.01$) on body weight gain (BWG = 1,162.91+26.79*G $R^2 = 0.76$) in Grower phase. Quadratic effect (Q) on feed intake was observed in Grower phase ($P < 0.01$) followed by L ($P < 0.01$) and Q ($P < 0.10$) of Finisher (FI = 1,793.49+14.23*G-18.78*G$^2$-28.31*F-8.99*F$^2$ $R^2 = 0.89$). There was L of Grower ($P < 0.05$) and Finisher ($P < 0.015$) energy levels on feed conversion ratio (FCR = 1.527-0.023*G-0.0350*F $R^2 = 0.88$). A significant interaction ($P < 0.01$) between Grower and Finisher energy levels on carcass yield was observed (CY = 69.19+0.105*G-0.39*F+0.22*G$^2$)
P417  Effect of dietary energy level on feed intake of modern broilers at different ages. A. H. Ataei,* A. Golian, and H. Kermanshahi, Ferdowsi University of Mashhad, Mashhad, Iran.

The general opinion is that chickens are able to adjust their feed intake according to the dietary energy level. But it seems, the modern broilers due to intense genetic selection for growth and increased appetite, feed is consumed regardless of energy up to gut physical capacity. Hence, 4 experiments were conducted. Trial 1 was conducted to determine the apparent metabolizable energy (AME) of experimental diets, by total excreta collection method. Briefly 72 mixed-sex of Ross broilers (15–21 d) were randomly allocated to 12 treatments with 3 replicates of 2 chicks each. Total energy intake and total energy excreted from each cage were measured and used to calculate the AME of each diet. The 12 diets had about 2700, 2800, 2900, 3000, 2800, 2900, 3000, 3100, 2900, 3000, 3100 and 3200 kcal/kg. Trial 2, 3 and 4 were conducted to study the effect of dietary energy level on feed intake of modern broilers in starter (<14 d), grower (15–28 d) and finisher (29–49 d) periods, respectively. Each trial was performed with 160 mixed-sex Ross broiler chicks in a completely randomized design with 4 treatments and 4 replicates of 10 chicks each. In the second trial chicks were fed with 4 starter diets of 2700, 2800, 2900 and 3000 kcal ME/kg, and a grower and a finisher diet according to Ross recommendation. In the third trial, chickens were fed with 4 grower diets of 2800, 2900, 3000 and 3100 kcal ME/kg, and a starter and a finisher diet according to Ross recommendation. In the fourth trial chicks were fed with 4 finisher diets of 2900, 3000, 3100 and 3200 kcal ME/kg, and a starter and a grower diet according to Ross recommendation. All diets were formulated with constant energy to nutrient ratios. There was no significant difference on final live weight due to dietary energy levels (<0.05). There was no significant difference on final live weight due to dietary energy levels (<0.05). But it seems, the modern broilers require more energy than the control birds (157 vs 143g, 398 vs 374g and 801 vs 759g, respectively, P < 0.05), but had no effect on M, L, WG, CFCR and PEI. Chicks that received the diet were not as impacted by the harmful effects of the starvation period between hatching and placement when compared with those that were not supplemented. Apparently, the post-hatch feed confers an energy boost allowing chicks to adapt faster to their new environment and perform better during the first weeks of life. However, more studies are needed to show other benefits that post-hatch feeding might have on intestinal health and broiler performance.

Key Words: early feeding, chick, diet, performance, hatchery

P418  Post-hatch nutrition of broiler chickens. A. A. Santos Jr*1, F. B. O. Santos2, R. C. Freitas1, and M. M. Antunes1, 1Federal University Uberlandia, Uberlandia, MG, Brazil, 2Brazilian Agricultural Research Corporation, Concordia, SC, Brazil, 3Marfrei Consultoria, Uberaba, MG, Brazil.

Conditions that day-old chicks are subjected after hatch can significantly influence their performance. Traditionally, chicks gain access to food and water only at the farm after placement even though their gastrointestinal tract is physically complete at hatch. Although not fully competent, post-hatched chicks do not have significant restrictions to utilize exogenous nutrients. For that reason feeding chicks immediately after hatch became a major interest in poultry production as a way to increase performance. In addition, it has been shown that post-hatch feeding stimulates bird adaptation to the new environment. Therefore, the objective of the present study was to evaluate post-hatch feeding on performance of under-weight chicks (<40g) originated from young broiler breeders (27–31 wk). The experiment was conducted in a commercial setting, which was possible by the involvement of broiler producers. Chicks were fed a balanced hydrated post-hatch nutritional formulation during transport from the hatchery to the farms. A total of 1,023,083 broilers were supplemented with the post-hatch feed diet, while a total of 1,052,845 birds served as control and did not receive any kind of diet before placement at the farm. Bird body weight (BW) was measured at 1, 7, 14, 21, 28, 35 and 45 d (d). Livability (h) and mortality (M) were recorded on the same days, except for d 1. At 45d, weight gain (WG), corrected feed conversion ratio (CFCR) and productivity efficiency index (PEI) were also measured. Supplementing chicks with the post-hatch feed diet improved BW at 7, 14 and 21 d compared with the control birds (157 vs 143g, 398 vs 374g and 801 vs 759g, respectively, P < 0.05), but had no effect on M, L, WG, CFCR and PEI. Chicks that received the diet were not as impacted by the harmful effects of the starvation period between hatching and placement when compared with those that were not supplemented. Apparently, the post-hatch feed confers an energy boost allowing chicks to adapt faster to their new environment and perform better during the first weeks of life. However, more studies are needed to show other benefits that post-hatch feeding might have on intestinal health and broiler performance.

Key Words: optimizing process, response surface method, energy requirement, feed conversion

P419  Effect of a guanidino acetic acid, CreAmino, on performance measures in broiler chicks. F. Foroudi,* A. Afsar, and M. Jediyatkhah, Varamin-Pishva Branch Islamic Azad University, Varamin, Tehran, Iran.

The current study was conducted to investigate the effect of CreAmino as a guanidino acetic acid supplement on performance measures, carcass quality and economics of broiler chicks in comparison to negative (pure vegetable diet) and positive (fish meal containing diet) controls. One hundred 80 commercial hybrid of Ross 308 were allocated in a complete randomized block design with 3 treatments and 4 replicates in 12 floor pens with 15 chicks in each pen at d 1. Treatments contained CreAmino at 0.05% of feed, negative control (pure vegetable diet), or positive control (fish meal containing diet). The experiment was carried out for 42 d. Diets were fed during starter (0–10 d), grower (11–24 d) and finisher (25–42 d) periods that were prepared from the same batch of ingredients. Birds were weighed and feed consumption was recorded at 1, 10, 24 and 42 d of age. Feed conversion was corrected for mortality by considering the weight of dead birds. Three birds per replicate (12 birds per treatment) with body weights close to the pen average were selected for carcass evaluation focusing especially on abdominal fat accumulation after a feed deprivation of approximately 8 h at d 42. Results showed that there were no significant differences among treatments in weight gain (2079, 2206 and 2077 g for negative control, 0.05% CreAmino or positive control, respectively) but the CreAmino showed significant increase in fat deposits (<0.05). Upon carcass quality analysis, CreAmino birds showed significant increase in fat deposits (<0.05). Feed cost of producing 1 kg of live weight varied across treatments with CreAmino group costing significantly more than negative and positive control birds.
the least and negative control group costing the highest. We conclude that inclusion of CreAmino in broiler diet at 0.05% (as fed) can improve the efficiency of energy utilization that may allow reducing the energy of diet and thus the cost of production.

Key Words: guanidine acetic acid, CreAmino, broiler performance, energy metabolism

P420   Nutritional evaluation of Palomys as a feed additive for poultry. P. Utterback*1, C. Parsons1, and T. Marsteller2, 1University of Illinois, Urbana, 2Elanco Animal Health, Greenfield, IN.

Two trials were conducted to evaluate the nutritional value of Palomys in poultry diets. Palomys is a plant-based feed ingredient rich in medium-chain fatty acids (MCFA). A precision-fed rooster assay was first conducted to determine the true metabolizable energy (Em) of Palomys compared with soy oil. Five dietary treatments were included. Treatent 1 consisted of 100% corn, and, thereafter, the treaents contained either 5% or 10% of Palomys or soy oil mixed with corn. Roosters were tube-fed 30g of a diet and excreta were collected for 48 h post-feeding. The mean Em of the diets increased linearly with the addition of either Palomys or soy oil. The mean Em of Palomys was calculated by difference to be 9.084 kcal/g of dry matter. This value is slightly, but not significantly (P > 0.05), lower than the Em of soy oil. A 19-d growth assay was then conducted using 3-d old Ross 308 commercial male broiler chicks to evaluate Palomys in chick diets. Diet 1 was a 22% CP corn-soybean meal diet containing 3.6% poultry fat as the fat source. Diet 2 contained soy oil in place of the poultry fat as the fat source. Diets 3 and 4 replaced 0.25% and 0.50% of the soy oil with 0.25% or 0.50% Palomys, respectively. When compared with the soy oil diet (Diet 2), weight gain was significantly increased (P < 0.05) by 0.50% Palomys and feed efficiency was significantly improved by both levels of Palomys. The results of this study indicate that Palomys is an excellent source of energy for poultry diets and that it also improves growth performance of young broiler chicks.

Key Words: Palomys, true metabolizable energy, broiler chicks


The effect of protein, energy intake, and age on protein turnover and its underlying mechanisms were investigated in broiler breeder hens. One hundred and 20 Cobb 700 broiler breeders were randomly assigned to one of 6 experimental diets in a 2x3 factorial fashion. Two levels of energy (390, 450 kcal/d) and 3 levels of protein (22.24, 26g CP/d), representing peak intakes, were utilized. Ten hens per treatment were given an intravenous flooding-dose of L-Phe (125 mM, 25% APE) at 10 mL/kg. After 10 min, birds were slaughtered and the breast muscle excised and frozen in liquid nitrogen. Excreta was also collected and frozen. The acid-soluble fraction (2% perchloric acid) containing free amino acids from muscle was separated from the protein precipitate. The ratio of 15N:14N of each fraction was determined via GCMS and GC-C-IRMS, respectively. Quantification of 3-methylhistidine in both muscle and excreta was determined via GCMS. Protein turnover was determined at wk 20, 26, 31, and 44. Relative expression of calpain 2, proteasome C2 subunit, and F box protein 32 were determined via RT-PCR using Taqman assay kits at wk 20, 26, and 44. Results indicated that there was an upregulation of protein degradation during periods of lower egg production. Fractional breakdown at wk 26 and 44 was higher than at wk 20 and 31 (P < 0.0001). There was also an overall rise in synthesis rates from wk 20 to peak production, before a continual drop thereafter (P < 0.0001). The ubiquitin-proteasome pathway appeared to be responsible for the observed changes in degradation. A significant drop in proteasome C2 subunit (P = 0.05) and F-box protein (P = 0.007) was seen between wk 26 and 44. However, no differences in calpain expression were observed. Furthermore, no differences were detected in the levels of fractional synthesis and degradation, or the expression of calpain, proteasome, and F box protein, due to protein or energy intake. In summary, fractional breakdown rates were upregulated coming into production but decreased with lower rates of egg production. The observed changes in degradation appeared to be mediated by the ubiquitin-proteasome pathway.

Key Words: broiler breeders, protein turnover

P422   Evaluation of feeding different levels of distillers dried grains with solubles (DDGS) and soybean hulls in non-feed-withdrawal molt programs for laying hens. K. A. Bland,* C. M. Parsons, and K. W. Koelkebeck, University of Illinois, Urbana.

An experiment was conducted using 504 Hy-Line W-36 hens (68 wk of age) to evaluate if laying hens can be successfully molted by ad-libitum feeding different levels of DDGS combined with corn and soybean hulls. The molt diet treatments consisted of a 47% corn (C):47% soy hulls (SH) diet, a 30% C: 44% SH: 20% DDGS diet, a 25% C: 49% SH: 20% DDGS diet, a 20% C: 54% SH: 20% DDGS diet, a 10% C: 37% SH: 47% DDGS diet, and a 47% C: 47% DDGS diet. All molt diets were fed for 28d. At the end of this molt period, all hens were fed a 16% CP corn-soybean meal layer diet. Body weight (BW) loss during the molt period was greatest (P < 0.05) for hens fed the 47% C: 47% SH diet (10%). Feed consumption during the molt period was lower (P < 0.05) for hens fed the 47% C: 47% SH control diet than for hens fed the diets containing DDGS. Hens fed the 47% C: 47% SH diet had the lowest (P < 0.05) egg production (below 5%) during the last 3 weeks of the molt period. During the first 8 wk of the post-molt period, egg production of hens that were fed the 47% C: 47% SH diet during the molt period was generally lower than that of hens fed the other molt diets. Egg specific gravity, egg mass, and egg weight measured Weeks 4 to 8 of the post-molt period did not differ significantly (P > 0.05) among treatments. This study showed that the molt diets containing 20 to 47% DDGS yielded inferior body weight, egg production, and feed consumption molt responses when compared with a 47% C: 47% SH diet even though most of the diets containing DDGS were calculated to contain ME levels that were lower than the 47% C: 47% SH diet.

Key Words: distillers dried grains with solubles, molting, laying hens
This study was conducted to assess the influence of dietary crude protein (CP) and metabolizable energy (ME) on growth parameters of Pearl Grey guinea fowl (PGGF) replacement pullets. In a $3 \times 3$ factorial arrangement, 180 1-d-old PGGF keets were randomly assigned to experimental diets comprising 2,900, 3,000 and 3,100 ME kcal/kg diet each containing 20, 22 and 24% CP, respectively, at 0–8 weeks of age (WOA), and 3,000, 3,100 and 3,200 kcal ME/kg, each containing 17, 19 and 21% CP, respectively, at 9–22 WOA. Each dietary treatment was replicated 4 times, and feed and water were provided at free choice. Body weight (BW) and feed consumption (FC) were measured weekly. Using BW and feed conversion data from hatch to 22 WOA, the Gompertz-Laird growth model was employed to estimate growth patterns of the PGGF replacement pullets. Mean differences in exponential growth rate, age of maximum growth and asymptotic BW among dietary ME levels were not significant. However, instantaneous growth rate, time of maximum growth, weight at inflection point and asymptotic BW were significantly higher ($P < 0.05$) in birds on 24% CP diet than those on 22 and 20% CP diets at 0–8 WOA. The Gompertz-Laird estimate of asymptotic BW of the PGGF on 24% CP and either 2,900, 3,000 or 3,100 Kcal ME/kg diet was not different from the observed maximum BW. Feed conversion ratios (FCR) were significantly lower ($P < 0.05$) in birds fed diets containing 24% CP and those containing 3,000 and 3,100 Kcal ME/kg diet at 0–8 WOA. Therefore, based on the Gompertz-Laird growth model estimates, feeding 24% CP and 2,900–3,100 Kcal ME/kg diet at 0–8 WOA, and 21% CP with 3,000–3,200 Kcal ME/kg diet at 9–22 WOA can be recommended as adequate for growth of the PGGF replacement pullets.

Key Words: Pearl Grey guinea fowl, crude protein, metabolizable energy, Gompertz-Laird model, replacement pullets

Coccidiosis is one of the challenges poultry producers face and many farmers vaccinate their chickens mostly using a live attenuated multispecies vaccine to prevent this disease. Two groups of birds (non-challenged, NCHA, and challenged, CHA, with coccidial vaccine $\sim12X$) were used in this study to determine the cost of coccidial vaccine challenge on DM, N, and energy utilization in 21- and 42-d-old broilers. Two hundred and 8 (208) broilers were obtained from a hatchery on the d of hatch and used in either a 21 or 42-d study. There were 8 replicate cages of 8 birds/cage (128 birds for d 21 sampling) and 8 replicate cages of 5 birds/cage (80 birds for d 42). Half of the broilers in each study were challenged with a mild (12 times recommended dosage) coccidial vaccine on d 15 and d 35, respectively. Both CHA and NCHA groups of birds were fed the same diet appropriate for their age and met or exceeded recommended nutrient and energy requirement. Titanium dioxide (0.5%) was used as the indigestible marker. Excreta were collected on d 21 and d 42, respectively, frozen and dried. Dried excreta and feeds were ground and analyzed for DM, gross energy, N, and titanium contents. Apparent DM retention for d 21 NCHA (74%) birds was higher ($P < 0.05$) than in CHA (56%) birds. Coccidial challenge did not result in differences in DM retention in 42-d-old birds (average 70.4%). Coccidial vaccine challenge resulted in lower ($P < 0.05$) N retention in 21-d-old CHA birds (32% vs. 62%). Apparent ME corrected for N was lower ($P < 0.05$) in CHA vs. NCHA birds (CHA vs. NCHA d 21; 3,076 vs. 1,889; d 42 2,914 vs. 2,746 kcal/kg). Results from this study showed the cost to N and energy utilization as a result of gut inflammation due to coccidial vaccine challenge.

Key Words: broiler, coccidiosis, nutrient utilization