Coccidiosis is among the major disease challenges facing the worlds poultry industries. Though a variety of diet-delivered drugs are available to minimize coccidiosis incidence and severity, birds will normally develop immunity during the production cycle. Immunity development is critical as drugs are usually not fed continuously to process. Vaccination at hatch speeds immunity. Timing of immunity development can be critical to performance as late growth curve challenges may have extreme costs for birds lacking immunity. To examine the caloric cost of immunity development 2 groups of birds were reared in cocci free environments with one vaccinated at hatch (Coccivac-B) and the other maintained as naive to cocci. Previous work with such groups indicated that unless ration energy is lowered, vaccinated birds trend higher in body lipid content suggesting energy sparing as body protein was similar. In this experiment finisher rations were fed as formulated, or reduced by 70 kcal to test the hypothesis that energy sparing may occur for Coccivac-B vaccinated chicks. Birds were selected from the 2 backgrounds at 35 d of age and placed on finisher rations plus/minus 70 kcal metabolizable energy per kg ration. Though coccidiosis immunity development occurring early in the production cycle, had small energy costs (3 points FCR at 28 d), this impact was eliminated by 42 d. Further, chicks consuming finisher rations with reduced energy had similar body composition to non vaccinated chicks while vaccinated consuming normal energy trended higher in body lipid content. The concept of Coccivac-B vaccinated chicks sparing energy late in the growth curve requires additional consideration. Strategies to optimize metabolizable energy utilization, and lower feed cost, at constant broiler growth curve can be critical to performance as late growth curve challenges may have extreme costs for birds lacking immunity. Vaccines protecting against coccidiosis impact energy utilization differentially with Coccivac-B52 having less impact than Coccivac-B early in the growth curve.

Key Words: broiler, vaccine, energy, nutrition, coccidiosis

Coccidiosis is among the major disease challenges facing the poultry industries. Though a variety of diet-delivered drugs are available to minimize coccidiosis incidence and severity, birds will normally develop immunity during the production cycle. Research documents that immunity developed early in the growth curve has less performance consequence than that occurring late in the growth curve. Cocci challenge in non-immune chickens has greater impact on performance as the bird approaches processing age. Early immunity development is critical as anti-coccidial drugs must be withdrawn before processing. Vaccination at hatch with live vaccines speeds immunity development, but may have a measurable short-term impact on bird metabolic parameters and performance. Coccivac-B is the first and most widely used coccidiosis vaccine in the US. To better address the need for early onset of immunity, particularly for E. maxima, a short life-cycle priming strain has been added to the new vaccine formulation Coccivac-B52. Calorimetry principles have been applied to birds housed in metabolic chambers to quantify the impact of live vaccine types (Coccivac-B; Coccivac-B52) upon metabolic costs to 28 d. In this study, chicks vaccinated with Coccivac-B exhibited lower (P < 0.05) live weight on d 21 while Coccivac-B52 had a similar live weight to the nonvaccinated controls at 21 and 28 d. Heat Production per metabolizable energy consumed was elevated (P = 0.06) for Coccivac-B birds versus controls on d 21. The lowest net energy (P = 0.06) was exhibited by Coccivac-B birds on 21 d of age with Coccivac-B52 similar to controls. This impact, however, diminished on d 28 due to apparent compensatory gain by Coccivac-B vaccinated chicks. Optimization of metabolizable energy utilization requires approaches that minimize energy wastage. Vaccines protecting against coccidiosis impact energy utilization differentially with Coccivac-B52 having less impact than Coccivac-B early in the growth curve.

Key Words: broiler, vaccine, energy, nutrition, coccidiosis

### Table 1. Quality parameter variability between Argentine SBM and US SBM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Argentine SBM</th>
<th>US SBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI mg/g</td>
<td>1.50-3.45</td>
<td>1.74-2.30</td>
</tr>
<tr>
<td>KOHPS, %</td>
<td>77-81</td>
<td>80-87</td>
</tr>
</tbody>
</table>

Key Words: soybean meal, trypsin inhibitors, protein solubility, amino acid digestibility

250 Soybean meal quality: Parameters beyond crude protein content in commercial Argentine SBM versus US SBM. N. Ruiz,*

A study was conducted to analyze the quality control parameters used by the animal agriculture industry to evaluate the nutritional quality of soybean meal in poultry. Samples were collected from 6 commercial vessels containing several thousand metric tons of each Argentine origin and US origin commodity soybean meal (SBM). Besides proximate analysis, protein solubility in KOH (KOHPS) and trypsin inhibitors (TI) were measured in 3 samples per vessel, for a total of 36 samples. The ranges for TI and KOHPS values are presented in the Table. Protein solubility values of commercial Argentine SBM are consistently lower than KOHPS values of commercial US SBM. Giving the in vitro/in vivo correlation between KOHPS and digestible amino acids, the lower KOHPS values of Argentine SBM explain their lower digestibility of amino acids. Conversely, as KOHPS values of Argentine SBM are higher than 80%, TI values start to increase beyond acceptable values for high inclusion levels of the meal in feed formulation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Argentine SBM</th>
<th>US SBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI mg/g</td>
<td>1.50-3.45</td>
<td>1.74-2.30</td>
</tr>
<tr>
<td>KOHPS, %</td>
<td>77-81</td>
<td>80-87</td>
</tr>
</tbody>
</table>

Key Words: soybean meal, trypsin inhibitors, protein solubility, amino acid digestibility

251 Effect of increasing dietary inclusion of solvent-extracted *B. juncea* versus *B. napus* canola meal on broiler growth performance, carcass traits and yield of carcass components. M. Oryschak*, B. Slominski, and E. Beltranena*

Table 1. Quality parameter variability between Argentine SBM and US SBM.
The effect of increasing dietary inclusion of novel, yellow-seeded B. juncea (JUN) or conventional dark-seeded B. napus (NAP) canola meal was evaluated in mixed-sex broilers (Ross 308; n = 1900) raised in bedded floor pens to 35-d of age. Dietary regimens, consisting of 10, 20 or 30% dietary inclusions of solvent-extracted JUN or NAP or a 0% control, were fed to 6 replicate pens per treatment in a completely randomized design. Diets within growth phase were formulated to contain similar levels of AME and digestible AA (fixed ratios to AME). Broilers were weighed as pen groups on d 0, 11, 22 and 35 and pen feed consumption was determined on d 11, 22 and 35 to calculate ADG, ADFI and G:F in each phase. On d 35, 15 males and 15 females per dietary treatment were processed under commercial conditions to obtain carcass measurements, including wt and yield of carcass components. Growth performance data were analyzed as repeated measures using PROC MIXED of SAS 9.1. Models included inclusion level (0, 10, 20 or 30%), canola species (NAP or JUN) and the 2-way interaction as fixed effects; block as the random term and phase the repeated term. Carcass data were analyzed similarly, but as single measures. Overall ADG, ADFI and G:F were not affected by inclusion level or canola species (P > 0.25). Carcass traits were not affected by canola species (P > 0.31), but eviscerated carcass wt linearly declined (P < 0.01) 6 g for each 10% increase in canola meal inclusion. Weight of breast muscles and drumsticks, and yield of breast muscles and total saleable components linearly increased (P < 0.01) with increasing canola meal inclusion. The results of this study indicate that diets formulated on a digestible nutrient basis to include up to 30% of JUN or NAP canola meal did not adversely affect broiler growth performance, carcass traits, or yield of carcass components.

Key Words: broilers, canola, performance, carcass

Biofortified maize (Zea mays L.) provides more bioavailable iron than standard maize: Studies in poultry (Gallus gallus) and an in vitro digestion/Caco-2 model. E. Tako*, O. A. Hockenga, L. V. Kochian, and R. P. Glahn, USDA-ARS, Robert W. Holley Center for Agriculture and Health, Ithaca, NY.

Iron biofortification is a strategy that alleviates Fe deficiency by improving staple crops, such as maize. Previously, we demonstrated that by using a Caco2 cell model, 2 maize varieties were developed for high and low Fe bioavailability, yet with similar Fe concentrations. In vitro and in vivo assessments of Fe bioavailability in these lines showed an advantage to the high Fe variety. In the current study, we tested bioavailable Fe in the consecutive growth cycles of these maize lines, in addition we compared the Fe bioavailability between cooked and raw maize +/- added Fe in the maize based diets. Diets were made with 75% w/w maize of either the low (“Low”) or high (“High”) Fe bioavailability maize. Broiler chicks (n = 10) were fed the maize diets for 7 weeks. Hemoglobin (Hb), body weight, feed consumption, liver ferritin and gene expression of Fe related intestinal transporters were measured. Duodenal DMT1, Dcytb and ferroportin were higher (P ≤ 0.05) in the Low groups vs. the High groups, indicating adaptation to the Low diets. Hb concentrations, Hb-maintenance efficiency, Hb-Fe and liver ferritin were higher in the High groups vs. the Low groups (P ≤ 0.05), indicating greater Fe absorption from the diet and improved the Fe status of the broiler chickens. We conclude that the High variety contains more bioavailable Fe than the Low and that maize shows promise for Fe biofortification. Also, the increased Fe bioavailability quality is kept in the biofortified maize daughter lines.

Key Words: iron, intestine, absorption, bioavailability, broiler

253 Biofortified red mottled beans (Phaseolus vulgaris L.) in a maize and bean diet provide more bioavailable iron than standard red mottled beans: Studies in poultry (Gallus gallus) and an in vitro digestion/Caco 2 model. E. Tako*, M. W. Blair2, and R. P. Glahn1, USDA-ARS, Robert W. Holley Center for Agriculture and Health, Ithaca, NY; Cornell University, Ithaca, NY.

Our objective was to compare the capacities of biofortified and standard colored beans to deliver Fe for hemoglobin (Hb) synthesis. Two isolines of red mottled Andean beans (Phaseolus vulgaris L.), standard (“Low Fe”, 49μg Fe/g) and biofortified (“High Fe”, 71μg Fe/g) in Fe were used. Bean based diets were formulated to meet the nutrient requirements for broiler except for Fe (42 ± 1 and 54 ± 0.9 mg/kg). Chicks (Gallus gallus) were allocated to the experimental diets (n = 12). For 4 weeks, Hb, diet consumption and body weights were measured. Hemoglobin maintenance efficiency differed between groups on d 14 and 21 of the experiment (P ≤ 0.05). Hb-Fe contents differed between standard (12 ± 1mg) and high Fe (15 ± 0.6mg) bean groups (P ≤ 0.05). Duodenal DMT1, DcytB and ferroportin expressions were higher and liver ferritin was lower in the standard group vs. the biofortified group. In vitro analysis showed lower Fe bioavailability in cells exposed to standard (“Low Fe”) bean diet. We conclude that this 22μg/g increase in bean Fe concentration delivered more absorbable Fe as indicated by our in vitro and in vivo models. This justifies further work on the Andean beans which are the staple of regions where Fe deficiency anemia is a primary cause of infant death and poor health status. Moreover, application of this screening approach should be effective in planning human efficacy trials.

Key Words: iron, bioavailability, broiler, intestine, bean

254 Omega-3 fatty acids in the feed improve broiler chick health. S. Bhalerao, M. Hegde, Y. Badhe, and S. Kadam, Bharati Vidyapeeth Deemed University, Pune, Maharashtra, India.

Omega-3 fatty acids (n-3FA) are known for their versatile health benefits world over. The objective of the study was to evaluate the impact of n-3FA in the chick feed on broiler bird health. One hundred and 20 broiler birds of commercially used Vencobb-400 variety were randomly divided into control and experimental groups, with 6 replicates and 10 birds in each replicate. Control group was given regular diet. We replaced 5% finisher feed of experimental group by specially designed Enriched Feed Mix (EFM) derived from linseed, linseed oil and linseed cake in pellet form. Various health parameters such as growth performance, morbidity, mortality, immunity were checked. Cardiac health was evaluated using Power lab system. Also brain health was examined by giving trauma and recovery was examined histopathologically. In experimental group more gain in weight was recorded in 4th, 5th and 6th week than the control group. Average final weight on 42nd day was 2634g significantly higher and feed conversion ratio for experimental group was 2.06 also significantly higher than control with P = 0.0334. The mortality in n-3 FA fed group was reduced from 3% to 0.3%. Improved morbidity of n-3 FA fed group was also evidenced by better immunity status as significant reduction in lymphoid depletion on
histopathological examination of bursa, thymus and spleen tissues. With a concomitant increase in n-3 FA, decrease in abdominal fat was observed on carcass evaluation in experimental group. Better cardiac health of the n-3 FA fed birds was evident from the lower heart beats with increased n-3 FA in heart tissue. So also with higher levels of n-3FA in the brain, the birds in the experimental group showed better capacity to withstand brain trauma. It can be concluded that while higher levels of omega 3 in edible tissues is healthier for the consumer, incidental increase in n-3 FA in other tissues like heart and brain is beneficial to the health of the broiler chicks also.

Key Words: omega-3 fatty acid, broiler health, brain trauma, cardiac health, growth performance


The present study was carried out with the objective of determining the effect of feeding different nutrient density diets on the production performance of Aseel (Indian native breed of chicken) during 25 to 40 weeks of age. At 24 weeks of age, 90 birds were randomly distributed into 3 groups. Each group had 30 birds distributed into 6 replicates with 5 birds in each. Maize-soybean meal based diets with 3 different nutrient densities [Low-2,400 kcal/kg Metabolizable Energy (ME), and 14% CP (Crude Protein); Medium - 2,600 kcal/kg ME, and 15% CP; and High-2,800 kcal/kg ME, and 16% CP] were fed to birds. The results revealed that there were no significant effect of variation in nutrient density on 40 weeks and 25–40 weeks egg production, feed conversion ratio (egg mass/ feed), egg weight, egg quality traits, liveability, immune competence traits (antibody response to sheep RBCs, and New Castle disease virus antigen and in vivo cell mediated immune response to Phytohaemagglutinin-P) and serum biochemical parameters (serum protein and total serum cholesterol) due to variation in the nutrient density of the diets. However, body weight gain (25–40 weeks) was significantly (P < 0.047) higher in high nutrient density diet compared with low nutrient density diet. Considering the overall performance, it was concluded that diet containing 2,400 kcal/kg ME, and 14% CP is adequate for Aseel breed to elicit optimum performance during 25–40 weeks of age.

Key Words: Aseel, nutrient density, production, early laying phase


The intent of the study was to determine the chemical profile and to explore the impact of replacing canola meal with Distillery Yeast Sludge (DYS) on hematology, histopathology, growth performance and economics of broiler chicks. Two hundred 40 (240) day-old broiler chicks were randomly divided into 20 experimental units in such a way that each diet was offered to 4 experimental units comprising 12 chicks under completely randomized design. Five isonitrogenous (CP, 21%) and isocaloric (ME, 3,000 Kcal/kg) broiler diets i.e., control, DYS5, DYS10, DYS15 and DYS20 were formulated having 0, 5, 10, 15 and 20% DYS replacing canola meal, respectively. The trial was 42 d long. Feed intake didn’t differ among the dietary treatments. Weight gain of chicks fed control diet was higher (P < 0.05) than those fed DYS20, however, there was non-significant difference in weight gain in birds fed C, DYS5, DYS10 and DYS15 diets. Feed conversion ratio was lower (P < 0.05) in chicks fed control diet than those fed DYS20, however, it was similar across other diets. Red blood cells, white blood cells, packed cell volume and hemoglobin values remained unchanged with increasing the inclusion level of DYS in the diet. No pathological lesions on heart, kidney and liver were observed across any diet. Feed cost per kg live weight gain decreased (P < 0.05) as the level of DYS was increased in the diet. Outcome of the study indicated that DYS is an economical protein source and can effectively replace canola meal up to 15% without any deleterious effect on performance of broiler chicks.

Key Words: distillery yeast sludge, canola meal, hematology, broilers performance

257 Investigation on effects of diet fat source on broiler chickens performance. A. R. Seidavi,* M. R. Poorghasemi, and A. A. Qotbi, Department of Animal Science, Rasht Branch, Islamic Azad University, Rasht, Guilan, Iran.

Aim of this experiment was investigation on effect of diet fat source on broiler performance. This study was conduct based on a completely randomized design using 5 treatments. Each treatment was included 4 replicate and experiment was conducted by means of 2 hindered broiler chickens Ross 308. Experimental treatments included (1) standard diet containing 4% tallow as animal fat; (2) standard diet containing 4% canola oil as plant fat; (3) standard diet containing 4% sunflower oil as plant fat; (4) standard diet containing 2% tallow as animal fat + 2% canola oil as plant fat; and (5) standard diet containing 2% tallow as animal fat + 2% sunflower oil as plant fat. The results showed that addition of vegetable and animal fats, had significant effect on consumed ME efficiency and total period consumed ME efficiency (P < 0.05). Fat sources had a significant effect on the weight gain during 5th week (P < 0.05) and also had no significant effect on weight gain during 1st, 2nd, 3rd, 4th, and 6th week, and starter, grower and finisher periods (P > 0.05). The addition of fat sources had a significant effect on the consumed metabolizable energy efficiency during total period (P < 0.05), however had no significant effect on the consumed metabolizable energy efficiency during 1st, 2nd, 3rd, 4th, 5th, and 6th week, and starter, grower and finisher periods (P > 0.05). The addition of fat sources had a significant effect on consumed protein efficiency during total period (P < 0.05) and had no significant effect on consumed protein efficiency during 1st, 2nd, 3rd, 4th, 5th, and 6th week, and starter, grower and finisher periods (P > 0.05). As conclusion, fat type in diets can change broiler performance economically.

Key Words: fat, oil, broiler, performance, ME

258 Withdrawn.


The local Arabic Chickens were long been important to Kuwait’s society for both food and entertainment uses. The main objective of the current
study was to investigate whether or not increasing or decreasing protein levels in the diet of the local Arabi Chickens relative to the standard commercial, would affect their body weight gain, feed efficiency and mortality under Kuwait’s environmental conditions during the brooding period (0–3 weeks of age). A total of 175 one-day old Arabi chicks were randomly housed in 9 brooding pens, 19 chicks per pen (120×60 cm2 each). The 3 different levels of protein used in the diet were (18% lower than the standard level, 21% standard commercial level, and 22% higher than the standard level). Temperature, relative humidity and mortality were monitored and recorded on a daily basis. Body weight gain and feed efficiency were calculated on weekly basis. There was no significant difference of the 3 dietary treatments on the previously mentioned parameters ($P > 0.05$). Accordingly, using a dietary treatment with 18% protein is recommended to lower cost of brooding of Arabi Chickens under the environmental conditions of Kuwait.

**Key Words:** Arabi chickens, feed efficiency, mortality, brooding

**260 Blood parameters, growth and performance of turkey starters fed rations supplemented with Mexican sunflower leaf (MSL).** A. H. Ekeocha,* University of Ibadan, Ibadan, Oyo, Nigeria.

A 56-day feeding trial was conducted to evaluate Mexican Sunflower Leaf (MSL) *Tithonia diversifolia* as dietary fiber source in turkey diets. Five straight diets were as formulated to contain the MSL at dietary levels of 0, 3.5, 7.0, 10.5, and 14.0% as a replacement for maize, soyameal and GroundnutCake. One hundred fifty (150) day-old male poult were randomly allotted to the 5 diets containing 3 replicates per treatment with 10 poult per replicate in a completely randomized design (CRD). Feed and water were provided ad-libitum and the routine vaccinations / medications followed standard procedures. The study investigated the performance and hematological responses of the birds to the diets. The results shows a significant ($P < 0.05$) decrease in all the parameters measured for performance 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 group on diet 3 and the other groups, while daily weight gain, feed conversion ratio and protein efficiency ratio were statistically the same ($P > 0.05$) across board. 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 turkey. The results suggest that Mexican Sunflower Leaf (MSL) could replace maize, soymeal and groundnut cake in turkey diet up to 7.0% as a dietary fiber source without eliciting any adverse effect.

**Key Words:** Mexican sunflower leaf, performance, blood parameters, turkey

**261 Hematology, growth and performance of turkey finishers fed rations supplemented with Mexican sunflower leaf (MSL).** A. H. Ekeocha* and O. T. Bankole, University of Ibadan, Ibadan, Oyo, Nigeria.

A study was conducted for 8 weeks to investigate the effect of feeding Mexican Sunflower Leaf (*Tithonia diversifolia*) as a dietary fiber source in turkey diets. One hundred and 50 8 weeks old male poult were used. The 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 birds. The first ration was the standard finisher ration and served as control. The other rations contained 3.5%, 7.0%, 10.5% and 14.0% Mexican sunflower leaf (MSL) respectively as graded replacement (w/w) for maize, soyameal and GroundnutCake. Feeds and water were provided ad-libitum and the routine vaccinations / medications followed standard procedures. The study investigated the performance and hematological responses of the birds to the diets. Mexican Sunflower Leaf Meal supplementation did not improved performance characteristics over basal diets and significantly ($P < 0.05$) decreased feed intake, weight gain, except at 7.0% levels where birds were comparable to the control diet, but significantly ($P < 0.05$) enhanced feed conversion ratio while hematological parameters were largely unaffected except for an increase in the eosinophil and lymphocyte concentration of MSL meal fed turkey. 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. Mexican Sunflower Leaf meal supplementation was comparable to the control diets and could replace maize, soymeal and groundnut cake in turkey diet up to 7.0% as a dietary fiber source without any deleterious effect.

**Key Words:** Mexican sunflower leaf, performance, hematological parameters, turkey