

hatch as a % of initial egg weight demonstrated an interaction of storage treatment and rate of warm up. This difference appears to be the result of the significant differences in the low amount of residual yolk at hatch in the slow fresh chicks. The slow had significantly elevated heart rates. Relative heart weight was significantly greater for fresh versus stored and slow versus fast warm up although grams of glycogen per heart was reversed. Relative liver weights were significantly greater for fresh versus the stored eggs and the slow versus the fast warm up

and the grams of glycogen per liver were reversed. Body weights at 6 weeks were significantly greater in females if they came from eggs which were stored and increased slowly compared to the other treatments. Male broilers were significantly higher when warmed up fast compared to slowly.

Key Words: warm-up, incubation, glycogen, egg storage

Nutrition I

M16 Effect of feeding NuPro® at different time intervals on the performance of commercial broilers. M. C. Shivakumar¹, H. N. Narasimhamurthy¹, and H. V. L. N. Swamy*², ¹*KVAFSU, Bangalore, India*, ²*Alltech Inc., Guelph, ON, Canada*.

NuPro® (Alltech Inc.) is a yeast derived protein extracted from a specific strain, *Saccharomyces cerevisiae*¹⁰²⁶. The objective of the current trial was to determine the effects of feeding NuPro at different time intervals on the performance and economic returns of commercial broilers. The trial lasted from 0 to 42 days, tested 880 birds on deep litter, conducting 4 treatments, 10 replications per treatment and 22 birds per replication. Four diets used in the trial are: a control (corn-soybean meal), 2% NuPro for 7 days, 2% NuPro for 14 days and 2% NuPro for 42 days. Body weight gain, feed intake, feed efficiency, mortality, European Production Efficiency Factor (EPEF) and return on investment (ROI) were evaluated. Data were subjected to ANCOVA and means were compared using Tukey's multiple comparison test (SAS, P<0.05). Feeding NuPro for 14 days statistically increased feed intake as compared to Control birds. At the end of the trial, however, birds fed NuPro for 7 and 14 days consumed less feed than the Control. Weight gain was better in all the NuPro diets both on day 7 and 42 as compared to Control (P<0.05). Birds fed NuPro had lower FCR than the control birds on day 7 and 42 (P<0.05). This may be related to the role of the product in improving gut development and in turn the nutrient absorption. At the end of the trial, birds fed NuPro diets showed significantly less mortality as compared to control birds. Birds fed NuPro showed 37 to 68 better EPEF points has compared to control birds (P<0.05). Maximum profit (0.2 USD per bird) was obtained when NuPro was fed for 14 days, but maximum ROI (1:7.9) was obtained when fed for 7 days. To conclude, feeding NuPro enhanced broiler performance and economic returns. Though the best ROI was noticed when NuPro was fed for 7 days, it can be fed up to 14 days with significant economic benefits.

Key Words: broilers, yeast derived protein, functional nutrient, poultry, NuPro

M17 Effect of feeding NuPro® at different time intervals on immunity and meat quality of commercial broilers. M. C. Shivakumar¹, H. N. Narasimhamurthy¹, and H. V. L. N. Swamy*², ¹*KVAFSU, Bangalore, India*, ²*Alltech Inc., Guelph, ON, Canada*.

NuPro® (Alltech Inc.) is a yeast derived protein extracted from a specific strain, *Saccharomyces cerevisiae*¹⁰²⁶. The objective of the current trial was to determine the effects of feeding NuPro at different time intervals on the immunity and meat quality of commercial broilers. The trial lasted from 0 to 42 days, tested 880 birds on deep litter, conducting 4

treatments, 10 replications per treatment and 22 birds per replication. Four diets used in the trial are: a control (corn-soybean meal), 2% NuPro for 7, 14 and 42 days. One bird per pen was randomly allocated for studying the immune and meat quality parameters. Weights of heart, liver, spleen, bursa, thymus, gizzard, proventriculus and intestine were measured on day 7, 14 and 42 and expressed as % body weight. On day 42 weights of total dressed meat, breast, thighs, wings, drumstick and abdominal fat was measured and expressed as % body weight. Birds were vaccinated for Newcastle disease (ND) and antibody titers were measured on a weekly interval. Data were subjected to ANOVA and means were compared using Tukey's multiple comparison test (GLM of SAS, P<0.05). On day 7 birds fed NuPro had significantly higher bursa and spleen weight than Control birds. This effect carried on till the end of the experiment. Only on day 14 birds fed NuPro had higher intestinal weight than Control birds (P<0.05). There was no significant effect of treatments on total dressing % and weights of thigh, drumstick and wings at the end of the trial. However, feeding NuPro for 7 days significantly reduced abdominal fat content of birds as compared to birds on Control diet. Breast weight was significantly higher in birds fed NuPro for 14 days as compared to birds on Control diet. Birds fed NuPro for 14 and 42 days had higher antibody titers to ND as compared to birds on Control diet (P<0.05). To conclude feeding NuPro has the potential to improve immunity of birds and can also assist in the production of leaner meat. Further research is needed to evaluate the effect of NuPro on cell mediated immunity.

Key Words: broilers, yeast derived protein, functional protein, NuPro, poultry

M18 The effect of dietary N,N-dimethyl glycine (DMG) on technical performance, plasma metabolites and broiler ascites syndrome: A challenge study. I. D. Kalmar¹, J. Buyse², and G. P. J. Janssens*¹, ¹*Ghent University, Belgium*, ²*Catholic University of Leuven, Belgium*.

Introduction DMG is reputed to enhance oxygen supply at cellular level. The primary condition of ascites, being hypoxemia, constitutes a possible application of DMG as a feed additive in broiler rations in order to abate losses due to broiler ascites syndrome and to improve technical performance. The current study intended to investigate these potential benefits of dietary DMG.

Materials In total sixty four 14-day-old broiler hens (Ross-308) were reared in 16 pens of 4 birds each until 40 days of age. The birds were challenged with a low environmental temperature (15 °C) and a diet enriched with poly unsaturated fatty acids in form of corn oil in order to provoke ascites. To each pen, one of two test diets was randomly assigned for the whole trial period: a control diet or the same diet added

with 167 ppm DMG. Mortality, feed conversion ratio (FCR) and apparent metabolizability were recorded at pen level. Further, individual blood samples were taken at the end of the trial, on which hematocrit level (HCT), thiobarbituric acid reactive substances (TBARS) and selected plasma metabolites were analysed. Next, all birds were euthanized and manually dissected, which included assessment of ascites heart index (AHI), carcass and meat%.

Results Mortality, clinical ascites and overall FCR were numerically lower in the DMG supplemented groups compared to the controls. Moreover, FCR between 30d and 40d improved with a statistical trend (control:2.33; DMG:2.17; $0.1 < P\text{-value} < 0.05$). Next, in contrast to similar HCT, AHI was significantly lower in the treatment groups (-18%, $P < 0.5$). Whereas, meat and carcass% were similar between both feeding groups. Further, apparent dry matter metabolizability was significantly higher when fed the DMG supplemented diet (+3.7%, $P < 0.05$). Finally, TBARS, as a measure of oxidative stress, numerically declined through provision of DMG.

Conclusion Dietary DMG benefits broiler production by improving apparent metabolizability and FCR and by diminishing progression towards ascites. The latter effect is probably at least partly due to an anti-oxidant effect.

Key Words: nutrition, broiler, feed additive, dimethyl glycine, ascites

M19 Effect of aflatoxin culture on intestinal function and nutrient loss in laying hens. T. J. Applegate^{*1}, G. Schatzmayr², K. Prickel¹, C. Troche¹, and Z. Jiang¹, ¹Purdue University, West Lafayette, IN, ²Biomim Research Center, Tulln, Austria.

The negative effects of aflatoxins (AFLA) on hepatic necrosis and total tract digestibility of energy, nitrogen (N), and amino acids have been well documented. However, the question remains as to if this is an effect on nutrient metabolizability alone and/or an effect on the intestine resulting in increased endogenous nutrient loss and/or reduced nutrient digestibility. Therefore, a 2 wk feeding study with a crude AFLA culture was conducted with laying hens to measure endogenous losses and digestive functionality of the intestine. Hyline W36 hens were fed 1 of 4 experimental diets containing a crude AFLA culture from 20 to 22 wk of age. Diets were analyzed to contain 0, 0.6, 1.2, or 2.5 ppm AFLA B1. Dietary AFLA concentration had no effect on BW, egg production, or feed intake. Intestinal crypt depth (but not villus length) increased linearly with increasing AFLA concentration. Similarly, specific activity of the intestinal disaccharidase, maltase, increased quadratically by feeding up to 1.2 ppm AFLA and declined at 2.5 ppm AFLA. Although there was no impact of AFLA on goblet cell number, density, or crude mucin excretion, sialic acid excretion increased quadratically such that it was increased 12% when 0.6 and 1.2 ppm AFLA was fed versus the control. Digestibility of DM and N were unaffected by AFLA. Feeding of 0.6 and 1.2 ppm reduced the apparent digestible and AMEn of the hen by 10 and 4%, respectively. As intestinal characteristics (intestinal morphology, sialic acid production, and apparent digestible energy) were altered by AFLA feeding, it can be surmised that AFLA can have a direct and/or indirect effect on functionality of the gastro-intestinal tract.

Key Words: aflatoxin, energy, intestine, laying hen

M20 Effects of oregano essential oil on performance and livability of large broilers in a commercial setting. M. A. Mellencamp^{*1}, P. A. Stayer², R. Smith¹, R. Dvorak¹, and T. S. Cummings³, ¹Ralco Nutrition, Inc., Marshall, MN, ²Sanderson Farms, Inc., Laurel, MN, ³Mississippi State University, Mississippi State.

Coccidiosis is an economically devastating disease in broilers. It impacts growth, mortality and susceptibility to other pathogens. With public pressure to reduce the use of antibiotics and anti-coccidials, the industry is investigating natural compounds to improve broiler performance. Oregano essential oil (OEO) is a natural feed flavorant that has been shown to improve broiler performance on farms with enteric challenges. This study investigated the effects of OEO on performance of large broilers on a commercial farm in south central US. Two of 4 tunnel-ventilated houses received OEO (Regano[®], Ralco Nutrition). Two control houses received the current anti-coccidial program (24,400 birds/house). OEO was delivered in feed from d1-49 (d1-14: 0.88 lb/ton; d15-28: 0.75 lb/ton; d29-48: 0.6 lb/ton) and in water on d1-5 and 23-27 (3 oz Regano/gal at 1:128). Control birds received Nicarb/BMD (d1-14), Robenz/BMD (d15-28), Bicox/BMD (d29-48). All birds received Stafac on d49-59, followed by plain feed from d60-63. Necropsies were performed (10/house) on d21, 28 and 37 to assess intestinal health. Performance results showed that OEO birds were within 1.5% of control birds for final weight (8.569 lb v. 8.649 lb), average daily gain (0.134 lb v. 0.135 lb), and feed conversion (2.106 v. 2.080). Livability was similar in both groups (97.08% v. 96.85%). Clinical coccidiosis was not observed in OEO or control houses. However, mild (1+) to moderate (2+) intestinal lesions were seen in OEO-fed birds at d21 and d28 (100% and 65% of birds, respectively). No lesions were seen on d37. Control birds showed little coccidiosis at necropsy (10%, 15%, 0%, respectively). These results show that in the face of severe coccidia challenge, OEO birds remained healthy and performed well compared to birds fed an aggressive anti-coccidial program.

Key Words: oregano essential oil, broilers, coccidiosis, natural, performance

M21 Effects of ractopamine-HCl on finishing tom turkey performance. D. J. Ivers, C. T. Herr, D. H. Mowrey, and E. A. Heskett^{*}, *Elanco Animal Health, A Division of Eli Lilly and Company, Greenfield, IN.*

A six site study across the United States and Canada was conducted and pooled to evaluate the effects of feeding ractopamine-HCl (RAC) for the final 7 days (d) or 14 d on tom average daily gain (ADG) and feed efficiency measured by gain:feed ratio (G:F). A randomized complete block design with location as a blocking factor was conducted at each site. Treatment design consisted of two factors: duration (7 d and 14 d) and RAC (0, 5, 9, and 13 ppm). At four of the six sites, eight blocks of eight pens were used (64 pens/site), and at two sites, six blocks of eight pens each were used for a total of 352 pens or 3,904 toms. Diets were formulated to contain industry average levels of lysine (total) and metabolizable energy for the finishing phase (as fed); 0.99% lysine and 1,567 kcal/pound of feed. Following completion of the treatment phase, feed was withdrawn for about 4 hours (hrs) and then toms were transported for at least 4 hrs. Toms were either 20 wk of age (39.93 lbs +/- 2.20; 14 d duration) or 21 wk of age (41.90 lbs +/- 2.10; 7 d duration) at the start of the treatment. ADG was higher and G:F was improved

($P < 0.05$) in toms fed RAC for 14 d compared to control. This resulted in toms fed RAC for 14 days gaining 0.37 to 0.52 pounds more than controls. However, no RAC differences in ADG or G:F ($P > 0.086$) were observed in the 7 d duration. No RAC effects were observed in feed intake ($P > 0.141$). Feeding 5 to 13 ppm RAC for 14 d improved the ADG and GF compared to controls in finishing toms.

Key Words: turkey, tom, ractopamine-HCl, growth, finishing

M22 Effects of ractopamine-HCl on finishing hen turkey performance. D. J. Ivers, C. T. Herr, D. H. Mowrey, and E. A. Heskett*, *Elanco Animal Health, A Division of Eli Lilly and Company, Greenfield, IN.*

A six site study across the United States and Canada was conducted and pooled to evaluate the effects of feeding ractopamine-HCl (RAC) in the final 7 days (d) or 14 d on hen average daily gain (ADG) and feed efficiency measured by gain:feed (G:F). A randomized complete block design with location as a blocking factor was conducted at each site. Treatment design consisted of two factors: duration (7 and 14 d) and RAC (0, 5, 9, and 13 ppm). At each site there were a total of forty-eight pens (6 blocks and 8 pens per block) for a total of 288 pens or 5,280 hens. Diets were formulated to contain industry average lysine (total) and metabolizable energy for the finishing phase (as fed); 0.96% lysine and 1,572 kcal/pound of feed. Following completion of the treatment phase, feed was withdrawn for about 4 hours and then hens were loaded and transported for at least 4 hours. Hens were either 15 wks of age (19.06 lb +/- 0.745; 14 d duration) or 16 wks of age (20.73 lb +/- 0.591; 7 d duration) at the start of the treatment phase. Hens fed RAC for either 7 d or 14 d had higher ADG and improved G:F than controls ($P < 0.001$). This resulted in hens fed RAC for 7 days gaining 0.23 to 0.32 pounds more than controls or birds fed RAC for 14 days gaining 0.34 to 0.71 pounds more than controls. No RAC effects were observed in feed intake for either duration ($P > 0.10$). Feeding 5 to 13 ppm RAC for 7 to 14 d improved ADG and G:F as compared to controls in finishing hens.

Key Words: turkey, hen, ractopamine-HCl, growth, duration

M23 Bioplex Zn prevents from Zn-Fe interaction in broiler chickens. Y. M. Bao*^{1,3} and M. Choct^{1,2}, ¹University of New England, Armidale, NSW, Australia, ²Australian Poultry CRC, Armidale, NSW, Australia, ³Alltech Asia-Pacific Bioscience Centre, Bangkok, Thailand.

It is believed that mineral ions complexed with organic molecules are protected from interactions that interfere with their bioavailability. However, there is no direct evidence to demonstrate that organic trace minerals could prevent from this interaction.

In an experiment, 8 replicates of groups of 6 birds were set into 3 treatments: 1) Bioplex Zn (Org-Zn): the control diet plus 30 mg organic Fe and organic Zn/kg diet; 2) Inorganic Zn(Ino-Zn): the control diet plus 30 mg inorganic Fe and inorganic Zn/diet; 3) Normal Zn: the same as treatment 1 but maintained till the end of the experiment. All birds were fed the organic or inorganic Zn deficient control diet at first week of age and then treated with experimental diets for two weeks. From three weeks of age, birds in treatments 1 and 2 were fed organic Zn or inorganic Zn deficient control diets until 42 days of age.

Total tibia bone trace mineral contents and bone characteristics were analyzed statistically using one-way ANOVA with STATGRAPHICS

software and the significance of difference between means was determined by Duncan's multiple range test (Table 1).

Table 1. Effects of depletion of Zn on tibia trace mineral contents and bone characteristics

Cu (\hat{A} μ g)	Fe (\hat{A} μ g)	Mn (\hat{A} μ g)	Zn (\hat{A} μ g)	Strength (kg)	Length (mm)	Width (mm)		
Organic Zn	7.1	225.9a	11.4	161.9b	21.5	53.4b	11.1a	
Inorganic Zn	7.2	178.5b	10.0	191.2b	26.1	56.3b	9.9b	
Normal Zn	8.0	234.6a	10.6	350.8a	19.8	62.3a	9.5b	
Pooled SEM	1.12	15.50	1.15	32.30	1.89	1.89	0.25	
P-value	NS	<0.05	NS	<0.01	NS	<0.01	<0.01	

Thus, it confirmed that there was no Zn-Fe interaction when broiler diets were supplemented with Bioplex Zn and Fe. However, the deficiency of inorganic Zn significantly depressed inorganic Fe uptake in tibia bones.

Key Words: bioplex trace minerals, trace mineral interactions, zinc, iron, broiler chickens

M24 Impact of broiler breeder nutrition on progeny performance and carcass characteristics. L. Araujo*, C. Araujo, C. D. Zumwalt, C. D. McDaniel, H. M. Parker, and M. T. Kidd, *Mississippi State University, Mississippi State.*

Two progeny grow-out experiments were conducted to evaluate growth and carcass parameters of progeny from broiler breeders fed diets supplemented different vitamins and minerals. Two hundred forty Ross 708 hens received a control diet (containing a vitamin and mineral premix devoid of Se) or the control diet supplemental vitamin B (vitamin B12, 60 μ g/kg; d-biotin, 500 μ g/kg; folic acid, 4 mg/kg; niacin, 80 mg/kg; d-pantothenic acid, 25 mg/kg; vitamin B6, 10 mg/kg; riboflavin, 25 mg/kg), vitamin D (1 kg of HyD/ton), and vitamin E (120 IU/kg), the combination of the three vitamins, Se (0.3 mg/kg), Zn (30 mg/kg), Mn (40 mg/kg) from organic sources, the combination of the three minerals, and an additional diet containing the combination of all vitamins and minerals (10 treatments; 8 replications; 3 hens per replicate). A total of 450 eggs (45 eggs/treatment) and 1200 eggs (120 eggs/treatment) were obtained and set when breeders were 31 (experiment 1) and 34 (experiment 2) wk of age, respectively. At d 1, chicks were separated, weighed, and wing-banded by breeder treatment. In experiment 1, chicks were placed in a facility and separated only by wing-band. In experiment 2, chicks were placed into 80 pens (12 birds/ pen) of an open-sided, floor pen facility. Chicks were placed as straight-run. Chicks were allowed access to common mash feed and water ad libitum from 0 to 41 d in both experiments. BW gain and feed conversion ratio were measured from 1 to 41 in both experiments. On d 42, all birds in experiment 1 and 6 birds per pen (3 male and 3 female) in experiment 2 were selected randomly and processed. The progeny experiment was a randomized complete block design. Breeder pen was the experimental unit for the progeny design. Significant improvements in progeny from hens fed Mn were noted in experiment 1 (d 7 BW gain, carcass and tender yields) and in experiment 2 (BW gain, feed conversion, and total breast and tender yields). Future research should further address the impact of breeder Mn level, source, and level to source ratio on progeny live performance and carcass characteristics.

Key Words: broiler breeder, manganese, progeny

M25 Observations on the comparative stability of five commercial pigmenter products. R. V. Snyder*, B. Hajar, and A. G. Yersin, *Kemin Industries, Des Moines, IA.*

Purified xanthophyll products used to pigment egg yolks share a common susceptibility to oxidation and thus loss of their pigmenting ability. Changes in the production processes of pigmenters can reduce their susceptibility to degradation. Objectively demonstrating slower degradation rates of one pigmenter compared to competing products would be an advantage in the market place. The results from a series of kinetic experiments have allowed the ranking of five commercially available pigmenting products. Employing a pseudo first-order kinetic model, the rate constants for the loss of total xanthophylls and trans-lutein contents were estimated for five neat pigmenting products and for the products when mixed with a vitamin and mineral feed premix. The results indicated that pigment losses were accelerated when mixed with the premix product and that there were statistically significant differences in the rates of degradation of color and lutein content. The advantage of using a kinetic description of the degradation process is that direct comparisons of time to lose a set proportion of the initial activity or the activity lost in a given time can be calculated and compared from separate experimental determinations.

Key Words: xanthophylls, pigmenter, stability, degradation, kinetics

M26 Comparison of commercial adsorbent products Using an in vitro binding assay. D. Sanders* and A. G. Yersin, *Kemin Industries, Des Moines, IA.*

Six commercial adsorbent products were tested for their ability to bind a series of mycotoxins using a two-step binding model. Each product was tested for binding efficiency at three dosages, 1, 3 and 5 mg/ml. The mycotoxins tested included aflatoxin (B1, B2, G1 and G2), zearalenone, deoxynivalenol, ochratoxin and fumonisin B1 at concentrations of 5 ppb each, 300 ppb, 1 ppm, 200 and 300 ppb, respectively. The in vitro assay includes an adsorption step, which is conducted at pH 3.0 and

measures a reduction in mycotoxin solution concentration. The second step measures the degree to which the toxin can be desorbed and is determined by re-suspending the test material, with adsorbed mycotoxins, in a clean pH 6.8 buffer. Efficiency is determined by comparing the initial challenge toxin concentration to the final desorbed solution toxin levels. Several products showed binding efficiency (greater than 50%) for aflatoxins, zearalenone and fumonisin B1. However most products tested showed little (less than 10%) binding efficacy for deoxynivalenol or ochratoxin, with limited absorption seen in the former and complete desorption in the latter.

Key Words: zeolite, mycotoxin, desorption, adsorption, clinoptilolite

M27 The effect of shrimp waste meal as dietary replacement for fish meal in diet of broilers. B. O. Iyamu*¹ and E. O. Uwagboe², ¹*Ministry of Agriculture and Natural Resources, Benin, Edo State, Nigeria.*, ²*Cocoa Research Institute of Nigeria, Ibadan, Oyo State, Nigeria.*

Shrimp waste meal is of high nutritional value, palatable and of pleasant aroma which is considered as a potential substitute for fish meal. This study was carried out to ascertain the effect of shrimp waste as a replacement for fish meal in broiler diet. One hundred and fifty day old chicks were allotted to five experimental diets with three replicates of 10 birds each for a period of 5 weeks in completely randomized design. Diets 1-5 contained 100% FM (Fish Meal) at 0% SWM (Shrimp Waste Meal), 75% FM at 25% SWM, 50% FM at 50% SWM, 25% FM at 75% SWM, and 0% FM at 100% SWM accordingly. Diets were Iso-Nitrogenous. Diets were subjected to ANOVA (Steel and Torrie, 1980).

At the end of the 5th week there were no significant difference ($P \leq 0.05$) between the treatment mean for average weight gain, average dry matter intake, feed-gain ratio and protein efficiency. This suggest that SWM could replace FM for protein in diet of broilers.

Key Words: shrimp waste meal, replacement, fish meal, diet, broilers

Nutrition II

M28 Effect of protease enzyme on performance and ileal digestibility of broilers grown to 42 days of age in floor pens. A. Favero*^{1SC}, A. Maiorka¹, C. Rocha¹, M. D. Appelt¹, and J. O. B. Sorbara², ¹*Universidade Federal do Paraná, Curitiba, PR, Brazil.*, ²*DSM Nutritional Products, São Paulo, SP, Brazil.*

This experiment investigated the effects of supplementing diets with different levels of crude protein (CP) and apparent metabolizable energy (AME) with or without a protease (RONOZYME[®] ProAct declared 75000 PROT/g, analyzed 78067 PROT/g) on the performance, digestible energy (DE) and the ileal digestibility of nitrogen and fat of broilers. The diets were formulated to be similar to commercial diets with corn, soybean meal and meat-bone-meal. The experimental design was a 2 x 2 x 2 factorial arrangement of treatments to evaluate 2 CP and amino acid levels, 2 AME levels and 2 protease levels (0 and 200 ppm: 15000

PROT/kg feed). The difference between the two levels of CP was 7.5% while digestible Lys, TSAA and Thr differed by 15% from the control, and the difference between the two levels of AME was 3%. Each diet was fed to 11 pens of 22 male broilers raised in floor pens from d 1 to d 42. At d 42, five birds/pen were euthanized, for ileal collection and energy, nitrogen and fat digestibility was determined (1% of Celite was added to the withdraw feed as indigestible marker). No interaction (CP x AME x Enzyme) was observed in any performance parameters analyzed. Broiler performance was superior ($P \leq 0.01$) in birds fed the higher levels of CP and AME. Protease supplementation significantly ($P \leq 0.01$) improved feed conversion ratio compared to the non-supplemented groups. A lower daily feed intake ($P \leq 0.05$) was observed during the grower period (21 to 42 d of age) on the treatments with the higher level of AME compared with the low level. Birds fed high CP levels improved ($P \leq 0.05$) ileal nitrogen, fat and DE while high AME levels increased ($P \leq 0.01$)