

685 Extended supplementation of limiting amino acids to increase effective dietary protein and improve production of heat stressed broilers. A. J. Zarate*¹, E. T. Moran, Jr.¹, and D. J. Burnham², ¹*Poultry Science Department, Auburn University, Auburn, AL 36849*, ²*Heartland Lysine Inc. Chicago, IL 60631*.

Broilers in a hot environment decrease their feed intake and growth. Uric acid formation from amino acids in excess of optimal balance generates heat. Presumably, adding limiting essential amino acids (EAA) beyond requirement levels but proportioned for total balance enables an increase in effective protein which could compensate for reduced feed intake while decreasing heat generation. A total of 400 male and 400 female broilers Ross x Avian 24K was reared sex separate to 7 weeks of age in 32 floor pens. A commercial type feeding regimen was fed either "as is" or supplemented with limiting EAA to assure at least 110% of the requirements that approximated an ideal pattern. Environmental conditions existing from May-June were sufficiently hot to depress performance but not cause related deaths. Increasing the levels of EAA and balance within existing crude protein and ME did alter live performance throughout experimentation. Measurement of abdominal fat after birds were processed indicated a significant increase with the carcasses of both sexes when the 110% level of EAA was employed. Carcass yield without abdominal fat, incidence of grade defects, and recovery of deboned breast meat were similar between treatments, respective of sex. Improved amount and balance of effective protein together with reduced excretion of N likely increased dietary productive energy with its conversion to depot fat, but no advantage to live performance was perceived.

Key Words: Broilers, Carcass Characteristics, Heat Stress, Limiting Essential Amino Acids.

686 Reduced lysine and threonine levels in a phase-feeding regimen can support maximum growth performance during the grower phase. J.A. Townsend*, H.R. Pope, and J.L. Emmert, *University of Arkansas*.

Phase-feeding (PF) has been explored as a means of reducing feed costs without reducing growth performance. Predicted amino acid requirements for PF are generated using linear regression equations derived from estimates of lysine (Lys), sulfur amino acid (SAA) and threonine (Thr) requirements. The objective of this study was to determine if growth performance would be impacted by reduced levels of lysine and threonine in a PF regimen relative to birds fed NRC recommendations. In addition to NRC (Treatment 1) and unmodified PF (Treatment 2) regimens, four modified PF treatments were tested. In two modified PF treatments, predicted Lys (Treatment 3) and Thr (Treatment 5) requirements were reduced by 10%, whereas in the remaining modified PF treatments the slopes of the linear regression equations used to predict Lys (Treatment 4) and Thr (Treatment 6) requirements were increased by 15%. The six dietary treatments were administered from 3-6 weeks of age. The NRC diet was fed throughout the entire experiment, whereas treatments 2, 3, 4, 5 and 6 were tested in a series of 3 diets (21-28, 28-35, and 35-42 d). Despite a reduction in Lys and Thr levels in treatments 3, 4, 5 and 6, no differences ($P > 0.05$) in weight gain, feed intake and feed efficiency were detected among treatments at 42 d. Relative to treatments 1 and 2, digestible Lys intake was reduced ($P < 0.05$) by treatment 3 and digestible Thr intake was reduced ($P < 0.05$) by treatments 5 and 6. Breast yield was not reduced ($P > 0.05$) in treatments 3, 4, 5 and 6 relative to treatments 1 or 2, however abdominal fat percentage was increased ($P < 0.05$) by treatment 3. These data indicate that despite a substantial reduction in Lys and Thr levels, growth performance of birds fed these PF regimens was not different than birds fed NRC recommendations. Because dietary Lys, SAA, and Thr levels are decreased under PF systems, substantial dietary cost savings may be available.

Key Words: Broiler, Phase-feeding, Amino Acids

687 Evaluation of Amino Acid Dose-Response Data and Implications for Commercial Formulation of Broiler Diets. D. Hoehler*, S. Mack, and M. Pack, *Degussa-Huels Corporation, Kennesaw, GA*.

Many of the performance indicators of a modern integrated broiler enterprise, such as feed cost per ton, serve to de-link the operation into

discrete business units. This disintegrative management does not necessarily lead to the best overall profit. In the present study, case scenarios are drafted for two different production goals minimum feed cost per kg live weight gain or minimum feed cost per kg breast meat, which comprise the whole production chain. The amino acids lysine and Met+Cys are used as variable factors, because their dietary concentration has a large effect on several efficiency measures of an integrated operation. Actual performance data of 9 dose-response experiments for Met+Cys and another 5 with lysine were combined with cost figures for feed and supplemented amino acids. Data covered the grower/finisher period of commercial broiler strains. The relative response in performance between the lowest and highest levels of lysine or Met+Cys was similar, which offered the opportunity to pool all dose-response data after transforming them to a relative scale. Data were then subjected to exponential regression analysis. The best performance as described by the maximum of the regression curve was set at 100%. Subsequently, relative performance data were transformed back to absolute values by setting the desired optimum performance at 100%. Under the given conditions, feed cost per kg live weight gain reached a minimum at dietary concentrations of 0.90% Met+Cys and 1.03% lysine. The response in feed cost per kg breast meat to rising amino acid levels is not only affected by the feed to gain ratio, but also by the increasing breast meat yield as percentage of live weight. This extra benefit shifted the optimum dietary Met+Cys and lysine concentration to 0.98% and 1.16%, respectively. Price changes for raw materials or amino acids only slightly shifted the economic optimum level for the respective amino acid. This approach may well be extended to other nutrients and can serve as a general tool to determine dietary specifications in a meaningful way.

Key Words: Broiler, Dose-Response, Economics

688 Growth and carcass response of male broilers to two commercial sources of supplemental L-lysine. ME Jackson*¹, A Lemme¹, JL Emmert², and HR Pope², ¹*Degussa Huls Corporation, Kennesaw GA*, ²*University of Arkansas, Fayetteville, AR*.

Biolys[®] 60 is a new form of lysine containing 47.3% L-lysine (46.8% free plus 0.5% protein-bound L-lysine) plus additional energy and nutrients from the biomass, including 0.2% phosphorus, 0.3% Met+Cys, 0.5% Thr, and 0.15% Trp. Biolys[®] 60 is produced by microbial fermentation of *Corynebacterium glutamicum*, and the lysine substitution value is calculated as 60% of the value of L-lysine-HCl. A 49-d floor pen trial with 1890 male Ross X Cobb broilers, 54 floor pens, and 35 birds/pen was conducted to determine responses to 2 forms of supplemental lysine. Starter and grower series of corn/soybean meal/corn gluten meal-based diets were provided from 0-21 and 22-49d. Nine isonitrogenous dietary treatments (x 6 replicates) included a non-supplemented control and 4 levels of added lysine from the 2 sources. Starter and grower basal diets contained 20.72 and 17.56% CP and 0.83 and 0.62% Lys, respectively. L-lysine was added at 0.08, 0.16, 0.24% and (0.42% starter, 0.30% grower) from each source. Birds responded to both lysine sources with 0-49 d gain ranging from 1466 g (no supplementation) to 2811 g (highest supplementations) ($P < 0.01$), feed:gain ratio (FCR) decreasing from 3.10 to 2.10 ($P < 0.01$), and breast yield increasing from 17 to 27% of carcass weight ($P < 0.01$). Experimental data were subjected to non-linear exponential regression analysis. This permits the evaluation of the complete response curve to graded levels of a limiting amino acid. The data fitted well to predicted values with r-square values ranging from 0.90 to 0.99 for the measured criteria. The calculated relative effectiveness of Biolys[®] 60 compared to L-lysine-HCl was 110 and 104% for weight gain and breast yield, respectively. Both values were not significantly different from 100%. It is concluded that Biolys[®] 60 is at least equal to L-lysine-HCl in eliciting performance responses in broiler chickens.

Key Words: Lysine Sources, Broilers, Breast Yield

689 Interaction of methionine and lysine in broiler diets changed at NRC or industry time intervals. M. B. Cafe*, C. A. Fritts, and P. W. Waldroup, *University of Arkansas*.

The broiler industry changes feed at intervals that differ from those on which NRC requirements are based. A study was conducted to examine the response of broilers to diets formulated to contain different levels of Lys and Met when diets were changed at intervals on which NRC recommendations are made (0 to 21 d for starter; 21 to 42 d for

grower; 42 to 49 d for finisher) as compared to intervals used by the poultry industry (0 to 16 d for starter; 16 to 35 d for grower; 35 to 49 d for finisher). Diets were formulated to provide a minimum of 110% of essential amino acids (NRC) other than Met or Lys; these were formulated to be at 100% of NRC recommendations. Aliquots of a common basal diet were fortified with DL-methionine and lysine HCl to provide a factorial arrangement with three Met levels (100, 115, 130% of NRC) and four Lys levels (100, 110, 120, 130% of NRC). These were fed at either NRC feed change intervals or at industry feed change intervals for a total of 24 treatments. Each treatment was fed to four pens of 60 male broilers in litter floor pens. At 35, 42, and 49 d samples of birds were processed to determine dressing percentage (DP) and breast meat yield (BY). Changing at NRC intervals resulted in significantly higher BW and better FCR at 21 and 42 d but not at 35 or 49 d. Birds fed diets changed at NRC intervals had significantly greater BY at 42 and 49 d. However there were no interactions between time of change and either Met or Lys levels for any factor. Birds fed diets with 110% of Lys were significantly superior to those fed 100% Lys in virtually every category. Increasing levels of Met also improved performance in nearly every category. However, there were few interactions between Lys and Met levels. Results of the study suggest that more attention be paid to needs of these amino acids when dietary feeding programs are altered.

Key Words: Broilers, Diet Change, Amino acids

690 Ileal true digestibility of protein does not increase with age in broiler chicks. E.L. Miller*, Y.X. Huang, O.C. Fabb, B. Rayner, and S. Kasinathan, *Department of Clinical Veterinary Medicine, University of Cambridge.*

Endogenous N (EN) loss and ileal true digestibility of fish meal (FM) and soybean meal (SBM) were determined at 4, 7, 11 and 14 days of age. Six diets contained 144, 185 and 226 g crude protein (CP)/kg supplied by FM or SBM as the sole protein. A further diet (EHC) contained 211g CP/kg from enzyme-hydrolysed casein supplemented with amino acids to determine EN. Chromic oxide was used as marker. From 350 day old male broiler chicks (Ross) 96 chicks weighing (SD) 492.4g were randomised to 24 cages each with 4 chicks. The FM and SBM diets were each randomised to 3 replicate cages while EHC was randomised to 6 cages. The remaining chicks were reared on commercial chick starter crumb until 4, 7 or 11 days of age when 72 chicks of average weight 80.5, 154.14, 18315.3g were allocated at 3 birds per cage to 3 replicates of each test diet and 6 replicates of EHC. Test diets were offered for 3 or 4 days ad libitum, fasted overnight and then killed by intra-peritoneal injection with sodium pentobarbitone 4 h after the re-introduction of food. Ileal digesta was washed from the ileum (vitelline junction to 1 cm from the ileo-caecal junction) freeze-dried, pooled per cage and analysed for N and Cr. Ileal digesta from EHC was centrifuged over a 10,000 dalton membrane before drying. EN (mg N/g diet) determined with EHC and by regression to zero FM or SBM (including EHC as zero FM or SBM) did not change with age (meanSEM, EHC 1.350.146, 1.030.085, 0.960.166, 1.140.103; regression with FM 1.380.255, 1.030.230, 1.050.248, 1.160.178; regression with SBM 1.290.175, 0.94.0.154, 0.970.289, 1.120.160 at 4, 7, 11, 14 d). Ileal true digestibility, calculated from the regression of ileal N/g diet on diet N/g diet including EHC as zero test N, did not differ with age with FM (0.910.011, 0.890.010, 0.900.011, 0.910.008 at 4, 7, 11, 14 d) but with SBM d 4 (0.950.008) was greater than d 7 (0.920.007) or d 11 (0.910.013) ($P < 0.05$) but not d 14 (0.930.007). EN and ileal true digestibility of FM or SBM N did not increase with age.

Key Words: Ileal Digestibility, Endogenous , Age

691 Effects of supplemental antibiotics in a diet containing sub-optimal protein, methionine and lysine on the performance, carcass characteristics and organ measurements of finishing broilers reared under hot-humid climate. A. A. Onifade*¹, A. A. Odunsi², S.G. Ademola^{1,2}, and B.R. Olorede³, ¹Department of Animal Science, University of Ibadan, ²Department of Animal Production and Health, Ladoke Akintola University of Technology, Ogbomoso, ³Department of Animal Production and Health, Usmanu Danfodiyo University, Sokoto, Nigeria.

Protein and amino acid requirements of broilers decrease with age; therefore, finishing broilers may be economically and environmentally friendly raised on lower protein and critical amino acid concentrations. However, maximization of performance and reduction of carcass fat in broiler fed

low-protein diet critically deserve research attention, and we hypothesized that supplemental dietary antibiotics might be useful. 5-week old broilers were fed for 4 weeks on diets containing 16% crude protein (CP) and 80% of the recommended methionine and lysine without or with penicillin, streptomycin, tylosin, and zinc bacitracin added separately at 75 mg kg⁻¹ or control diets containing 18% or 20% CP and adequate amino acids. Antibiotic-fed broilers enhanced ($P < 0.05$) their feed intakes; feed conversion correlated with dietary CP and was similar in all broilers fed 16% CP. The body weights, carcass and breast yields of antibiotic-fed broilers were heavier ($P < 0.05$) than those fed unsupplemented diet, compared with those fed 18% CP, but lower than those fed the 20% CP. Abdominal fat of antibiotic-fed broilers was smaller ($P < 0.05$) than those fed unsupplemented 16 and 20% CP, which were inexplicably similar. Antibiotic-fed broilers had bigger ($P < 0.05$) lymphoid organs: spleen and bursa of fabricious; lengthier ($P < 0.05$) intestines and smaller ($P < 0.05$) gizzards than broilers fed unsupplemented 16% CP though gizzard weights were generally heavier on all the 16% groups irrespective of the supplements. The implication of the comparable productive indices obtained on low-protein antibiotic-fed broilers suggests improved, economical and environmentally friendly feeding program with feasible adoption in finishing broiler nutrition barring no restrictions to antibiotic use in animal feeds.

Key Words: Supplemental Antibiotics, Sub-optimal Dietary Protein and Amino Acids, Finishing Broilers

692 Influence of heat processing of corn and barley and enzyme supplementation on nutrient digestibility of broiler chicks. M. I. Gracia*, M. J. Aranibar, and G. G. Mateos, *Universidad Politecnica de Madrid. Spain.*

A trial was conducted to study the influence of heat processing (HP) of cereals, and enzyme supplementation (ES) on digestibility of nutrients of broilers from 0 to 21d. There were 8 treatments arranged factorially, with two basal cereals (corn vs barley), two processing treatments (raw vs cooked for 1h at 103°C and 19% moisture), and two levels of ES (0 vs 500ppm). The enzyme complex contained 20,000 TLXU of xylanases, 90 BAU of α -amylases, and 19,000 PU of proteases per kg. Each treatment was replicated 5 times (16 Cobb chicks per cage). The apparent fecal digestibility (AFD) of organic matter (OM), crude protein (CP), ether extract (EE), and neutral detergent fiber (NDF) was measured at 4, 8, 15, and 21d of age. Digestibility of nutrients varied with time for all treatments ($P < 0.05$). Heat processing improved AFD of OM, CP, and NDF until 8d of age (58.6 vs 62.1 %, 45.5 vs 47.6 %, and 22.6 vs 27.5 %, respectively; $P < 0.05$), but not thereafter. However, HP increased AFD of EE throughout the trial (58.4 vs 64.3 %; $P < 0.05$). Also, HP increased AFD of NDF in barley but not in corn diets ($P < 0.01$), while the opposite occurred for EE ($P < 0.01$). Birds fed barley had lower digestibility coefficient of OM at 8 and 15d ($P < 0.05$) than broilers fed corn diets, but the differences disappeared thereafter. On the other hand, AFD of EE was greater for barley than for corn diets throughout the trial ($P < 0.01$). Enzyme supplementation improved AFD of OM, CP and EE for all diets throughout the trial (61.3 vs 64.0 %, 46.7 vs 51.1 %, and 58.9 vs 63.7 %, respectively; $P < 0.05$) but the effect was greater for barley than for corn diets ($P < 0.05$). Enzyme supplementation improved AFD of EE more for HP than for raw cereal diets ($P = 0.05$). It is concluded that nutrient digestibility of broiler chicks was modified by both HP and ES though the beneficial effects of HP were only noticed during the first week of age, and the effect of ES was greater for barley than for corn diets.

Key Words: Heat Processing, Digestibility, Broilers

693 Age and dietary influences on size and fermentation patterns in the gastrointestinal tract (GIT) of broilers fed wheat and corn diets. E. N. Fischer*¹, H. L. Classen¹, and M. Choct², ¹University of Saskatchewan, Saskatoon, SK Canada, ²University of New England, Armidale, NSW, Australia.

An experiment was conducted to identify changes in size and bacterial fermentation patterns in broilers (840) fed diets containing corn (C), wheat (W) or wheat supplemented with endoxylanase (E, Avizyme 1300, 0.1%). Birds were sampled for GIT measures and contents were collected weekly for viscosity and volatile fatty acid (VFA) determination. Jejunal viscosity was highest ($p \leq 0.05$) for the W treatment (trt) at all ages except 7d. Ileal viscosity was highest in this diet at all ages. Empty jejunal and ileal weights and ileal length were higher ($p \leq 0.05$) for W and E trts relative to the C trt at most ages. Jejunal content

weight also trended higher for W and E trts at most ages ($p \leq 0.001$, 35d). Ileal content weights were highest ($p \leq 0.05$, 7d) from birds on the W trt to 21d, after which both W and E trts yielded higher content weights than C ($p \leq 0.05$, 35d). Empty caecal weights were highest ($p \leq 0.05$, 14, 21, 35d; $p \leq 0.10$, 42d) from birds on the E trt, while content weights from this trt trended highest to 21d only. Ileal VFAs were not affected by trt and levels peaked at 14d and declined thereafter. Caecal VFAs from all trts increased steadily to 28d, then declined. Acetate and butyrate accounted for the greatest proportion of total VFAs and were both highest ($p \leq 0.05$) in birds from the W and E trts at 21d, when ileal viscosity peaked. Caecal propionate ($p \leq 0.05$) and isovalerate ($p \leq 0.10$) levels were highest in birds from the C trt at all ages except 7d. The higher NSP content of the wheat diets likely caused the increased GIT size of the W and E trts. While the NSP in W and E trts are broken down by the caecal bacteria to acetate and butyrate, the C trt resulted in the production of propionate and isovalerate. The latter finding suggests that undigested starch and protein from corn enter the caeca and are being fermented by bacteria in this location.

Key Words: Non-starch polysaccharides, Volatile fatty acids, Bacterial fermentation

694 Live performance, caloric efficiency, carcass characteristics, and cost/gain of broiler chickens fed corn-soy-poultry byproduct diets with or without the enzyme Rovabio Excel™. M.D. Sims^{*1}, M. Blair², and D. M. Hooge³, ¹Virginia Scientific Research, Inc., Harrisonburg, VA, ²Aventis Animal Nutrition, Alpharetta, GA, ³Hooge Consulting Service, Inc., Eagle Mountain, UT.

Two floor pen trials were conducted to evaluate and compare the performance, caloric efficiency and carcass characteristics of broilers fed diets with or without Rovabio Excel™ enzyme (RX). Custom starter, grower and finisher corn-soy based diets containing a level of 4% poultry by-product meal were used in each trial. The studies were similar except for dates the tests were conducted and broiler strain crosses used. In trial 1, 2,880 Ross x Ross 308 and in trial 2, 2,880 Ross x Arbor Acres broilers were used. Two series of basal diets, differing by 66 kcal ME/kg within each trial and identified as regular energy (RegME) and lower energy (LowME) diets, were used. Calculated ME levels of RegME feeds ranged from 3030 to 3251 kcal/kg, and LowME feeds ranged from 2964 to 3185 kcal/kg. Crude protein levels were adjusted proportionally with energy. The liquid form of RX was used in these trials and was sprayed on RegME and LowME pelleted feeds at 200 ml/metric ton. Live weights, feed conversion, caloric efficiency, mortality and carcass characteristic data were pooled after no significant treatments x experiment interactions were found. Pooled wk 3 live weight of the LowME + RX group tended to be heavier ($p=0.11$) than the LowME group. Combined wk 7 live weight of the RegME + RX group was significantly heavier ($p=0.02$) than the RegME group. Pooled wk 3 feed conversion ratio was significantly lower ($p=0.03$) for the LowME + RX group than the LowME group. Caloric efficiency (adjusted to a common weight) of the LowME + RX group was significantly better ($p < 0.001$) than its LowME control (6,184 kcal/kg vs. 6,425 kcal/kg, respectively). Deboned breast of the RegME + RX and LowME + RX groups were heavier ($p < 0.01$ and $p=0.06$, respectively) than those of their respective control groups. Feed expense per kg gained was lower ($p \leq 0.05$) for the LowME + RX group than for the LowME group (0.2899 dollars vs. 0.2961 dollars, respectively) but similar ($p \geq 0.05$) between the two RegME groups (0.2961 dollars vs. 0.2959 dollars). Broilers benefited from the addition of RX to diets with either RegME or LowME but most prominently when applied to LowME diets with calculated ME in the range of 2964 to 3185 kcal/kg.

Key Words: Broilers, Rovabio Excel™, Caloric efficiency

695 The effect of barley concentration, Natugrain blend 66%L and Natugrain 33%L on performance of broilers fed wheat-based diets. M.B. Coelho¹, B.W. Cousins¹, W.F. McKnight^{*1}, P. Blanchard¹, A. Knox², and J. McNab², ¹BASF, ²Roslin Nutrition Ltd.

Three thousand eight hundred and forty, day old broilers were utilized in a 4X3 factorial design (8 reps/treatment) to determine the effect of barley concentration (0, 10, 20 and 30%), and enzyme (0, Natugrain® Blend 66%L at 150 ppm, and Natugrain® 33%L at 300 ppm) on the performance of broilers fed wheat-based diets. The starter phase diets were

fed in crumble form and growing-finishing phase diets were fed in pellet form. Eighteen-day performance of 0% barley diets for enzyme treatments 0 enzyme, Natugrain Blend and Natugrain were: weight gain, g (624^d, 587^{abc} and 585^{abc}), FCR (1.412^{ab}, 1.422^{ab}, 1.456^{ab}), viscosity, cps (2.912^a, 5.242^c, 7.009^d). Eighteen-day performance of 20% barley diets for enzyme treatments 0 enzyme, Natugrain Blend and Natugrain were: weight gain, g (603^{cd}, 592^{abc} and 580^{abc}), FCR (1.454^{ab}, 1.428^{ab}, 1.479^{ab}), viscosity, cps (3.981^b, 6.297^d, 6.584^d). Increasing levels of barley decreased performance. However, NSP enzyme addition compensated for the negative performance effect of barley.

Key Words: Broilers, NSP enzymes, Diet composition

696 Improved utilization of wheat screening by enzyme supplementation. B.A. Slominski^{*1}, D. Boros¹, W. Guenter¹, L.D. Campbell¹, and O. Jones², ¹University of Manitoba, Winnipeg, MB, Canada, ²Canadian Bio-Systems Inc., Calgary, AB, Canada.

Research conducted in our laboratory has shown positive attributes associated with wheat screenings. In comparison to wheat, wheat screenings were found to contain less starch (44.8 vs 56%, as fed basis), similar amounts of sugars (1.4 vs 1.2%) and NSP (9.9 vs 9.1%) and significantly more protein (15.0 vs 12.6) and fat (6.4 vs 1.2%). The latter two components contributed to good performance of broiler chickens (2 week growth trial) fed wheat-based diets substituted with wheat screenings. A significant improvement in animal performance was also noted with enzyme supplementation. To further substantiate the importance of enzyme supplementation, a long-term production trial with broiler chickens was conducted. Five replicate pens of 60 birds per treatment were used in starter (21 days) and grower (16 days) phases of the experiment consisting of three treatments: positive control (PC)(wheat/soybean meal/fish meal), negative control (NC)(wheat/wheat screenings/barley/soybean/canola meal) and NC+Enzyme. In comparison to PC, the NC diet contained 10% less metabolizable energy, crude protein, amino acids and calcium and 25% less available phosphorus. The enzyme supplement included xylanase, glucanase, cellulase, phytase and a broad spectrum of other enzyme activities. Body weight gain and feed conversion ratio averaged 2.14, 2.10, 2.17 kg/bird and 1.68, 1.76, 1.66 for PC, NC and NC+Enzyme, respectively. A significant ($P < 0.05$) improvement in broiler chicken performance with enzyme supplementation was further substantiated by the same magnitude of difference in dry matter (71.2, 68.7, 75.1%), energy (AME)(2956, 2827, 3066 kcal/kg), starch (92.5, 90.3, 95.6%), NSP (4.8, 15.0, 36.1%) and phytate (44.3, 37.5, 69.5%) digestibilities. It is evident from this study that the use of wheat screenings in concert with an effective enzyme supplement will allow for cost effective formulation of poultry diets.

Key Words: Wheat screenings, Nutritive value, Broiler chicken, Enzyme

697 Apparent metabolizable energy of drought tolerant barley cultivars as affected by enzyme supplementation. G. W. Barbour^{*1}, A. H. Darwish¹, M. T. Farran², N.N. Usayan³, M. M. Beck⁴, H. H. Machlab¹, M. G. Uwayjan², and V. M. Ashkarian², ¹Agriculture Research Institute, Tel Amara, Beqa'a, Lebanon, ²American University of Beirut, Beirut, Lebanon, ³Lebanese University, Beirut, Lebanon, ⁴University of Nebraska, Lincoln, Nebraska.

A chick assay was conducted to study the effect of enzyme supplementation on AME and AME_n of three drought tolerant barley cultivars 'Litani' (L), 'Pamir-35' (P), and 'Rihane-03' (R). A reference diet containing 55% glucose was prepared. Corn, L, P, and R replaced 50% glucose in the experimental diets with 0 or 0.1% Avizyme 1100®. Each diet was fed to 4-d-old Arbor Acres male broiler chicks in four replicates with four birds per replicate. Total fecal collection was made 48 and 96 h post 7-d adaptation period. Soluble non-starch polysaccharide concentration in L, P, R, and corn grains was 5.83, 2.56, 4.86, and 1.36%, while total β -glucan content was 3.91, 4.32, 3.56, and 0.04% DM, respectively. The AME and AME_n of corn were 4034 and 3944 kcal/kg DM, respectively. There was no significant interaction between barley cultivar and enzyme level. Also no significant cultivar effect was detected and the overall means across enzyme levels of AME were 3226, 3164, and 3191 kcal/kg DM, while those of AME_n were 3094, 3083, and 3088 kcal/kg DM for L, P, and R, respectively. Enzyme addition, however, increased ($P < 0.05$) AME and AME_n means across barley cultivars by

283 and 304 kcal/kg DM, respectively. In conclusion L, P, and R barley cultivars had similar ME values which were improved through enzyme supplementation.

Key Words: Barley cultivars, Enzyme, Apparent metabolizable energy

698 ME-equivalent value of feed enzymes varies with dietary nutrient concentrations for broilers. Keying Zhang*, Shaoqun Zuo, Zhiyong Ni, and Daiwen Chen, *Institute of Animal Nutrition, Sichuan Agricultural University, Yaan, Sichuan 625014, PR. China.*

ME-equivalent value (MEV) of feed enzymes is important for the formulation of diets supplemented with enzymes. Whether MEV of an enzyme product is constant or varies with dietary nutrient concentrations (DNC) is not yet known. In this study, a two-factor D-saturated optimization regression design with six treatments was used to measure MEV of a complex feed enzyme product (CFE) in the diets of various DNC for broilers. CFE consisted of amylase (2400U/g), beta-amylase (20000U/g), beta-glucanase (5800U/g), protease (3800U/g), cellulase (1700U/g), xylanase (4600U/g) and pectinase (55000U/g). Basal diet

PSA Nutrition: Early Nutrition, Immunology, and G. I. Function

699 Effect of fasting versus feeding Oasis[®] after hatching on nutrient utilization in chicks. A.B. Batal* and C.M. Parsons, *University of Illinois, Urbana, IL USA.*

Two experiments were conducted to determine the effects of fasting, feeding OasisTM, or feeding a corn-soybean meal (SBM) diet immediately after hatching on growth performance, and energy and amino acid utilization of chicks. In each experiment, six pens of eight chicks were assigned to four treatments which were feeding a corn-SBM diet for 21 d immediately after hatching, fasting for 48 h (no feed or water) after hatching, or feeding OasisTM for 24 or 48 h after hatching. The fasting and feeding OasisTM treatments were followed by feeding the corn-SBM diet for 21 d. Excreta were collected at 0-2, 3-4, 7, 14, and 21 d on feed for determination of MEn and amino acid digestibility. Fasting chicks for 48 h posthatching significantly depressed weight gains compared to all other treatments at 21 d of age. Although weight gains were not significantly different at 48 h posthatching, chicks fed OasisTM for 48 h had significantly ($P < 0.05$) higher weight gains at 1, 2, and 3 wk of age than did chicks fasted for 48 h. As days on feed increased from three to 21, energy utilization (ME_n) increased for all the experimental treatments. In addition, the ME_n of the corn-SBM diet for chicks fed OasisTM for 24 and 48 h was significantly ($P < 0.05$) higher than for chicks fasted for 48 h at most ages. There were generally no large differences in ME_n values among other dietary treatments within ages. Digestibility of most amino acids increased with increasing age for all experimental treatments, and the digestibility values were similar among treatments. Our results indicated that feeding OasisTM (compared to fasting) had a beneficial effect on subsequent energy utilization of a corn-SBM diet and that OasisTM may be stimulating early gut development even though early growth (0-48 h) is not affected.

Key Words: OasisTM, Age, Chicks

700 The effect of mannanoligosaccharides, bambarmycins, and virginiamycin on the physical and microbial characteristics of the gastrointestinal tract of large white male turkeys. C. W. Parks*, J. L. Grimes, and P. R. Ferket, *NC State University, Raleigh, NC USA.*

The objectives of this experiment were to investigate the effects of a growth-promoting oligosaccharide and two traditional antibiotics on the physical and microbial attributes of the gastrointestinal tract of male turkeys. Day old Hybrid Large White male poult were assigned to four dietary treatments: Control, Bio-Mos[®] (MOS), Bambarmycins (BM), and Virginiamycin (VM). There were eight replicate floor pens per treatment with 20 birds per pen reared from 1 to 140 days of age. All data were analyzed using the GLM procedure of SAS (1994). At 12 wks of age, three birds per pen were randomly sampled to measure the following: intestinal section weights, length, density, and mucosal and muscularis weights. Jejunal and cecal digesta samples were taken for

was formulated with corn, soybean meal and extruded soybean to contain on as-fed basis (DM86.9%) ME 12.55 MJ/kg, CP 20%. Ground rice hull was used to dilute the basal diet to formulate diets with 5.0%, 8.0% and 11.5% lower in ME, CP and amino acid contents than basal diet. The doses of CFE in diets ranged from 0% up to 0.23%. 360 1-d-old Avian male broilers were randomly allotted into the 6 treatments with 4 replicates of 15 birds each, and were fed ad libitum until 42 days old. Then 8 birds per treatment were selected for a 4-d metabolism trial, during which excreta were completely collected for measuring nutrient utilizations. Bodyweight gain and feed efficiency were improved quadratically ($P < 0.01$) as DNC increased, and so did the utilizations of dietary energy, protein and dry matter. Performance and nutrient utilizations responded quadratically ($P < 0.01$) to the doses of CFE, and reached peak when CFE dose was 0.1%. ME-equivalent value (MEV) of CFE was calculated by the difference of measured ME of diets with vs. without CFE supplementation at the same DNC. When CFE was included in diets at 0.1%, its MEV was 173, 343, 451 and 586 MJ/kg respectively for the diets of control, and 5%, 8% and 11.5% lower in DNC compared to control. It is concluded that MEV of feed enzymes varies with dietary nutrient concentrations.

Key Words: ME-Equivalent Value, Feed Enzymes, Broilers

ammonia, pH, lactate, volatile fatty acids, and dietary AME_N measurement. Birds fed MOS exhibited no effects on physical parameters while BM resulted in significantly increased duodenal attributes compared to control ($P \leq 0.05$). In contrast, feeding VM resulted in significantly decreased duodenal, ileal, cecal, colon weights and decreased duodenal, jejunal, and ileal muscularis weights compared to control ($P \leq 0.05$). In comparison to controls, jejunal propionate and total VFA production was decreased in the MOS and BM treatments, respectively. Feeding VM resulted in a significantly increased jejunal pH level and significantly decreased propionate production as compared to control-fed birds ($P \leq 0.05$). Dietary AME_N was not significantly affected by treatment. Results suggest that MOS affects the enteric ecosystem by a different mode than antibiotic (BM and VM) growth promotants.

Key Words: Turkey, Mannanligosaccharide, Antibiotics

701 Effects of ratios of dietary linoleic to linolenic acid on hen performance, mitogenic response, and antibody production of White Leghorn hens against Newcastle disease vaccine. U. Puthongsiriporn*¹ and S. Scheideler¹, ¹*University of Nebraska-Lincoln.*

The objective of this study was to investigate the effects of ratio of dietary linoleic to linolenic acid on hen performance, mitogenic response, and antibody production against Newcastle disease (NDV) vaccination in the second phase of the laying cycle. A corn-soybean meal diet was supplemented with flaxseed to have ratios of dietary linoleic to linolenic acid (n:6/n:3) of 17:1 (control), 8:1, or 4:1. Each diet was randomly assigned to 6 replicate pens with 5 hens/pen. Hy-Line W-36 hens were fed the diets from 53 to 58 wks of age. At the age of 57 wks, hens were boosted with NDV vaccine (Merial Select[®]; 25-5,000 Pkg/dose). No differences on feed consumption, body weight, egg production, and egg quality were observed throughout the study. The n:6/n:3 ratio did affect mitogenic response and antibody production of hens only after vaccination. Mitogenic response to concanavalin A (Con A) was significantly greater ($P \leq 0.02$) in hens fed n:6/n:3 of 8:1 (0.742), or 4:1 (0.728) as compared to the control (0.577). Mitogenic response to Salmonella typhimurium lipopolysaccharide (LPS) was greater ($P \leq 0.008$) in hens fed n:6/n:3 of 8:1 (1.028), or 4:1 (0.991) as compared to the control (0.899). Dietary decrease in n:6/n:3 induced higher ($P \leq 0.0004$) antibody production against NDV vaccine measured by an ELISA test. Mortality rate of hens in each treatment was 0% during the study. These results indicate that a decrease in the ratios of dietary linoleic to linolenic acid (n:6/n:3) enhanced mitogenic response and antibody production against the Newcastle disease vaccine, but not performance of White leghorn hens in the second phase of the laying cycle.

Key Words: Ratios of Linoleic to Linolenic Acid, Mitogenic Response, Newcastle Disease Vaccine