176 Body weight control in laying hens using feed restriction and phase feeding of energy and protein. E. N. Fischer*,1, H. L. Classen1, C. D. Bennett2, and K. V. Schwean1,
1 University of Saskatchewan, Saskatoon, SK, Canada, 2 Manitoba Agriculture, Winnipeg, MB, Canada.

Laying hens often gain weight in excess of primary breeder recommendations during the latter portion of the laying cycle. The increased body weight can decrease productivity and efficiency of egg production while leading to egg size larger than the market requirement. Three experiments were conducted to investigate the use of feed restriction and dietary nutrient content to control hen body weight to standards set out by primary breeder companies. Each experiment used a total of either 360 or 720 hens of each of the Dekalb Delta and Hyline W-36 strains. In Exp. 1 the birds were fed one of four dietary treatments: 1) high nutrient density (HAL), 2) high nutrient density restricted to maintain body weight (HFR), 3) phase feeding energy and protein (PAL), and 4) phase feeding energy and protein with feed restriction to maintain body weight (PFR). In Exp. 2 and 3, PAL and PFR treatments were compared. Feed allocations in feed restricted treatments and changes in phase feeding diets were based on body weight. In Exp. 1, PAL fed birds gained less weight (p<0.05) than those on the HAL treatment, however, birds on both feed restriction programs gained less weight and consumed less feed than their ad libitum counterparts. Egg production was not affected by dietary treatment and eggs were approximately 1g lighter for restricted birds from 25 to 48 weeks of production (end of the experiment). The feed restricted hens were also more efficient and had a lower incidence of mortality than ad libitum fed birds. These results were repeated in Experiments 2 and 3 with restricted birds being (p<0.05) lighter and more efficient egg producers with equivalent productivity and reduced egg size after 25 weeks of production than hens in the PAL treatment. These data indicate that feed intake control based on body weight can improve feed efficiency, reduce mortality and decrease late cycle egg size while maintaining equivalent egg production.

Key Words: Feed restriction, Egg size, Laying hens, Phase feeding

177 Molecular cloning and functional expression of a chicken intestinal peptide transporter (cPepT1) in Xenopus Oocytes and CHO Cells. H. Chen*,1, Y. Pan1, E. A. Wong1, J. R. Bloomquist2, and K. E. Webb, Jr.3, 1 Department of Animal and Poultry Sciences, 2 Department of Entomology, Virginia Tech.

In order to study peptide absorption in chickens, a chicken cDNA library was screened using a probe derived from our ovine peptide transporter mRNA. Steady state mRNA levels for the chicks fed the high protein diet at both 6 and 24 hours when compared to the level in chicks fed the control or low protein diet. Malic enzyme mRNA levels were higher (P<0.001) in the chicks fed the low protein diet when compared to the levels detected in chicks fed the other two diets. In Experiment 2 the levels of the mRNA for malic enzyme were examined at 1.5 and 3 hours after the introduction of the experimental diets. At 3 hours the steady state levels of malic enzyme mRNA for the chicks fed the 3 diets were all significantly (P<.05) different from one another with the amount of malic enzyme mRNA decreased as dietary protein increased. There were no differences, however, in the expression of malic enzyme mRNA among the chicks fed the three diets at the 1.5 hour time point. The results suggest that previously observed alterations in the activity of malic enzyme which were correlated with dietary protein intake were due to changes in mRNA expression of this enzyme.

Key Words: chicken, protein, malic enzyme, hepatic

178 Dietary protein level regulates the mRNA expression of chicken hepatic malic enzyme. Adams K. A.* and Davis A. J., University of Georgia.

The purpose of the present study was to investigate the dietary protein regulation of chicken hepatic malic enzyme. Arbor Acre Highline 7-8 day-old broiler chicks were fed a semipurified soy protein based basal diet (22% protein) for 4 days and at the end of this period the chicks were split into three groups each consisting of 6 pens of 2 birds each. One group was maintained on the basal diet while the other two groups were fed the experimental diets. In Experiment 1 total RNA was isolated from liver samples 6 and 24 hours after introduction to the experimental diets. Northern analysis was performed using 32P-labeled duck malic enzyme and chicken GAPDH (control) cDNA probes. Steady state mRNA levels for malic enzyme were significantly (P<0.001) lower in chicks fed the high protein diet at both 6 and 24 hours when compared to the level in chicks fed the control or low protein diet. Malic enzyme mRNA levels were higher (P<0.001) in the chicks fed the low protein diet when compared to the levels detected in chicks fed the other two diets. In Experiment 2 the levels of the mRNA for malic enzyme were examined at 1.5 and 3 hours after the introduction of the experimental diets. At 3 hours the steady state levels of malic enzyme mRNA for the chicks fed the 3 diets were all significantly (P<0.05) different from one another with the amount of malic enzyme mRNA decreased as dietary protein increased. There were no differences, however, in the expression of malic enzyme mRNA among the chicks fed the three diets at the 1.5 hour time point. The results suggest that previously observed alterations in the activity of malic enzyme which were correlated with dietary protein intake were due to changes in mRNA expression of this enzyme.

Key Words: chicken, protein, malic enzyme, hepatic

Saturday, PM, NUTRITION B
with PHS in cold-stressed broiler chickens, and improved feed conversion. This can probably be explained by the protective effects of antioxidants and a resulting better cellular membrane integrity.

**Key Words:** Broiler, Se-yeast, Se-selenite, Ascortes, Vitamin E

### 180 Effect of heat stress and age of increasing dietary Ca on reproductive performance of broiler breeder hens. A. Petruk1, 2, D. R. Korver1, 2, and M. J. Zuiderduin2, 1University of Alberta, Edmonton, AB, 2AAFRD, Edmonton, AB.

An experiment was conducted to determine the effect of temperature and age of increasing dietary Ca level on egg shell weight, specific gravity, egg production, weekly feed intake, blood pCO2, pO2, Na, pH levels and hen weight. Ross 508 broiler breeder chickens were housed at 17 wk under either hot conditions (28 C; n=126) or normal conditions (20 C; n=127). The hens were maintained on a 1% Ca grower diet until either 18 wks, 20 wks, 22 wks, 24 wks, or 26 wks when they were fed a 3.25% Ca layer diet. Individual body weights were collected weekly; feed allocation based on the weights was calculated separately for the hot and normal treatment groups. Eggs were collected and weighed daily with egg traits measured on eggs twice per week. Blood samples were taken weekly and analysed for pCO2, pO2, Na, and pH. The hens were killed at 31 wks of age and carcass traits measured. The high temperature significantly increased pCO2 and Na levels in the blood. High temperature caused a decrease in specific gravity; the 22 wk treatment showing the highest specific gravity and shell weight. Shell weight was decreased by high temperature. Hen body weight showed no differences due to diet, however at 21 and 24 wks the birds housed under higher temperature conditions were heavier. At 29, 30, and 31 wks the birds housed under normal conditions were significantly heavier. Feed intake of the birds began to diverge at 26 wks and was significantly different at 29 and 30 weeks with the high temp birds consuming less. No difference in feed consumption was found between dietary treatments. The fatpad, ovary, stroma, and liver weights of the birds in the normal temperature were significantly greater than those in the hot temperature with the breast weight also approaching significance. Total egg production was not affected by diet or environmental temperature.

**Key Words:** broiler breeder, calcium, heat stress, eggshell quality

### 181 Nutritional and Toxicological Evaluation of ital-cizeAspergillus Niger Fermentation Product on Taiwan Country Chicken. Hsiao-Mei Liang* and Peter Chiuo, National Chung-Hsing University, Taichung, Taiwan.

**Abstract** This study was to investigate the effects of Aspergillus Niger fermentation product (ANFP) that produced from the fermentation byproduct of food processing plant, as partial substitute for soybean meal in the diet on performance, blood constituent, visceral weight and carcass characteristics of Taiwan country chicken. No pathologically and serologically abnormality found in the chickens. Nutritional, toxicological and finisher (21 to 42d) diet. The apparent digestibility of organic matter (OMD), crude protein (CPD), fat (FD) and AMEn was measured for all the nutrients in the diet did not negative impact on performance, carcass characteristics and meat quality. **Keywords:** Aspergillus Niger fermentation product, chicken, nutritional, toxicological **Introduction** The purpose was to investitigate ANFP that produced from the fermentation by-product of food processing plant, as partial substitute for soybean meal. **Materials and Methods** 400 chickens were selected to the different dietary treatments: 0, 15, 30, 45 and 60% ANFP replacing soybean meal as protein source for 16 weeks experiment feeding period to evaluate the effects on performance, blood constituent, visceral weight, carcass characteristics and meat quality of Taiwan country chickens. **Results and Discussion** The weight gain of the chickens decreased (P<0.05) as the level of ANFP increased in the diet. Beside 60% ANFP group, no significantly effects on feed intake and feed conversion in other treatment groups (P>0.05). It showed that no significant on dressing percentage, breast meat percentage and abdominal fat percentage (P>0.05). Inclusion of ANFP did not significantly affect the meat quality of breast and leg on cohesion, elastic and chemise (P>0.05). Chickens fed the 30% ANFP diet significantly (P<0.05) other than others from the sensory panel test for leg meat. **Conclusion** showed that ANFP did not significantly affect on blood urea nitrogen and creatinine (P>0.05). Total serum protein and albumin significantly decreased as the dietary level of ANFP increased (P<0.05). No significantly effects in relative weight of liver, spleen, small intestine and colon-rectum of chicken in the ANFP dietary groups, no pathologically and serologically abnormality found in the chickens. **Reference** Shiomai, P., P. Margalith, and S. Mokady.


**Key Words:** Aspergillus niger fermentation product, Chicken, Nutritional, Toxicological

### 182 Replacement of a commercial diet by cereal based diet in post-hatching: effects on immune system development, and on serum fatty acid profile. S. Salado1, J. Piquer2, J. Mendez3, and G. G. Mateos1, 1U. P. Madrid, 2Premix Iberica, S.L., 3Cooperativas Orensanas, S.C.L.

A trial was conducted to compare the effects of feeding a cereal based diet, with 94% of wheat (1.03 Mcal/kg, AMEn: 10.3%, CP; 9.35%, starch) or a commercial diet (CD) consisting on 60% wheat and 33% soybean meal (2.9 Mcal/kg, AMEn: 21.9%, CP; 35.5%, starch) on the development of the immune system, and on serum fatty acid profile of broiler chickens. The two experimental diets were fed from 0 to 6d of age and then all the chickens received a common grower (6 to 21d) and finisher (22 to 49d) diet. Each treatment was replicated 6 times (15 chicks per cage). Data were analyzed by GLM of SAS with age, and treatment as main effects, and their interaction in the statistical model. As expected, the relative weight respect to BW (RW) of immune organs (spleen and bursa of Fabricius), the antibody titers against vaccinal viruses for bur-sal disease and infectious bronchitis and serum fatty acid profile changed significantly (P<0.05). Inclusion of ANFP did not showed that no significant on dressing percentage, breast meat percent-age (OMD), crude protein (CPD), and AMEn was measured at 7 and 10d postfeeding. At the time of placement control chicks were heavier (P<0.03) than those fed WD. At 30 h postfeeding, chicks with a PHT of 36 h showed in-crease in OMD, CPD, and AMEn of (1.21, 1.16 and 1.12 g/g, respectively; P<0.01) but daily gains were not different between the two groups. After revaccination against infectious bronchitis at 21d of age, chickens fed CD produced more antibodies than those fed WD and the effect increased with age (P<0.01). A similar effect was observed for bursal disease but the difference was not significant probably because re-vaccination took place later. In summary, feeding WD from 0 to 6d of life retarded the development of spleen and bursa of fabricius, reduced antibody production after revaccination at 21d, and modified serum mitotic, linolenic, and DHA profile as compared with feeding a CD.

**Key Words:** Broilers, Post-hatching, Fatty acid profile, Immune system


The effect of post hatch holding time (PHT) and diet composition on digestibility of nutrients and productive performance was studied in broil-ers using a completely randomized design with 18 treatments. There were two PHT (12 vs 36 h), three energy levels (2,820, 3,000, and 3,180 kcal AMEn/kg), and three protein levels (21.6, 23.0, and 24.4% corre-sponding to 1.24, 1.34, and 1.43% of total Lys, respectively). There were 5 replicates (10 birds/cage) per treatment. The experimental diets were fed for 10d, and then all the birds received a common starter (10 to 21d) and finisher (21 to 42d) diet. The apparent digestibility of organic matter (OMD), crude protein (CPD), fat (FD) and AMEn was measured at 7 and 10d postfeeding. At the time of placement control chicks were heavier (44.5 vs 39.6 g, P<0.01) than chicks held without feed for 36 h. At 10d postfeeding, the chicks with a PHT of 36 h had better feed intake (20.6 vs 21.9 g/d; P<0.01) and grew more (17.8 vs 18.9 g/d; P<0.01) than the control birds, but not differences were detected for feed effi-ciency. Increasing the energy content of the diet improved feed efficiency (1.21, 1.16 and 1.12 g/g, respectively; P<0.01) but daily gains were not affected. Increasing the crude protein content of the diet also improved feed efficiency (P<0.01) but not daily gains. At 7d postfeeding, chicks held without feed for 36 h showed increased OMD, CPD, and AMEn of the diet (P<0.01) with respect to control chicks, but FD was not modifi ed (P>0.05). As dietary energy content was increased the OMD, CPD, FD, and AMEn was improved (P<0.01). Protein level affected FD at 7d postfeeding (P<0.03) only. The digestibility coefficients for all the nut-rients studied were higher at 10 than at 7d postfeeding. No differences among treatments for BW and feed efficiency were observed at 42d. In conclusion, a PHT of 36 h did not affect broiler performance at 42d and increased nutrient digestibility at 7 and 10d postfeeding whit respect to control non fasted birds.

**Key Words:** post hatch time, metabolizable energy, protein, digestibility
184 Comparison of some factors influencing ascites syndrome in broiler chickens in high altitudes in Iran. Majid Bouzari*1, 1 Isfahan University.

Ascites syndrome causes death and condemnation of broiler chickens in Iran. The multifactorial nature of it, necessitates determination of ethological and predisposing factors in each region. Factors such as ventilation, lighting programs, the rate of protein in the diet, the rate of salt in food and water, heating systems, season and breed of 20-40 days old broiler chickens were compared in four seasons in 24 flocks at altitude of 2000-3500 meters above sea level. Analysis of variance (ANOVA) was used for statistical analysis. Mortality in Ross breed was significantly lower than other breeds (Aryan and Hybro). The highest mortality was observed in winter and then autumn and spring. The lowest mortality was observed in the summer. In winter poultry houses with defective heating systems (using inside air for burning of gasoline) had the highest mortality. Significant correlation was observed between the rate of ventilation and mortality. No significant correlation was observed between the rate of salt and protein with mortality. No significant correlation was observed in mortality and 1000 meter difference of altitude. Use of Ross breed and improvement of ventilation and heating systems was suggested.

Key Words: Broiler, Ascites, Nutrition, Ventilation, Breed

185 Chick Growth and Immunity as Affected by Dietary Arginine. M. T. Kidd1*, 1 E. D. Peebles1, S. K. Whitmarsh1, J. B. Yeatman1, and R. F. Wideman, Jr. 1 Mississippi State University, Mississippi State, MS 39762, 2University of Arkansas, Fayetteville, AR 72701.

Broilers fed diets deficient in arginine may have suppressed immune system functions. Also, broiler diets containing excess lysine may result in growth depression through antagonism with arginine. This study was conducted to evaluate growth responses and immunity in broiler chicks fed arginine and lysine levels near NRC (1994) specifications and near levels typically observed in the U.S. poultry industry. Dietary treatments in Experiment 1 consisted of the combination of two arginine levels (100 and 120% of 1994 NRC) and two lysine levels (100 and 120% of 1994 NRC) replicated six times. Experiment 2 consisted of three treatments (6 replications/treatment): L-lysine HCl (0.16% of diet) and L-arginine (0.20% of diet) added to the control diet analyzed to contain 1.21 and 1.59% dietary lysine and arginine, respectively. Both experiments were conducted from Day 1 to 18 in Ross male broilers reared in battery chambers. No interactions occurred between lysine and arginine in Experiment 1. Additional lysine did not affect (P ≤ 0.05) growth responses. However, increasing dietary arginine from 100 to 120% of the NRC (1994) specifications improved (P ≤ 0.05) Day 18 BW and average daily gain. Differences (P ≤ 0.05) in cellular immunity as measured by a cutaneous basophil hypersensitivity test did not occur. In Experiment 2, additional lysine or arginine to the control diet did not affect (P ≤ 0.05) growth responses, primary antibody response to sheep red blood cells, and thymus, spleen, or bursa of Fabricius weights. Lysine and arginine do not interact to affect chick performance when fed at levels between 100 and 120% of NRC (1994) specifications. However, increasing arginine above NRC (1994) specifications may improve chick weight.

Key Words: Arginine, Broiler, Immunity, Lysine

186 Effect of amino acid supplementation of low protein diets on broiler growth and processing yields. A. H. Cantor1*, 1 A. J. Pescatore1, R. S. Gates1, D. J. Burnham2, M. J. Ford1, and N. D. Paton1, 1University of Kentucky, Lexington, KY, 2Heartland Lysine, Inc., Chicago, IL.

The effect of using low CP, amino acid fortified, corn-soybean meal meat grower and finisher diets in place of conventional diets on growth performance and processing yields of broilers was studied. Twelve replicate groups of 24 male chicks, housed in floor pens (102 X 152 cm) were assigned to each of four treatments. All chicks were fed the same broiler starter diet during Days 1 through 17. The experimental grower and finisher diets were fed during Days 18 through 35 and Days 36 through 42, respectively. Vocational CP levels used in the grower and finisher diets were as follows: Treatment A - 23.0 and 22.5%; Treatment B - 20.8 and 20.0%; Treatment C - 18.5 and 17.5%; and Treatment D - 16.3 and 15.0%. The lowest CP diets were supplemented with lysine, arginine, methionine, threonine, tryptophan, isolucine, and valine to meet NRC (1994) requirements. The diets with the intermediate levels of CP were prepared by mixing the highest and lowest CP diets in a ratio of 1:2 or 2:1. At 6 wk of age, three birds per pen were selected for processing. Gain to feed ratio, BW gain and final BW, but not feed intake, were significantly (P ≤ 0.05) reduced by feeding the low protein diets with values for Treatments D < C < B = A. Decreasing dietary protein significantly increased percent abdominal fat pad. Significant differences in the absolute or relative weights of the carcass (with or without giblets), breast, leg quarters, giblets and necks were not detected. Reducing dietary CP from either Treatments A or B to Treatments C and D decreased gain to feed ratio and final BW by 4 and 8%, respectively, with little effect on processing yields.

Key Words: Low protein, Amino acids, Growth performance, Processing yields, Broilers

187 Comparisons of Male and Female Broiler Responses to Dietary Threonine from 42 to 56 Days of Age. W.A. Dozier, III1*, 1 E.T. Moran, Jr.1, and M.T. Kidd1, 1Auburn University, Auburn, AL, 2Nutri-Quest, Inc. Chesterfield, MO.

Threonine needs for females are known to be less than males during the first few weeks of production; however, information is limited on any differences thereafter. This study examined responses of male and female feather-sexable broilers to three concentrations of dietary threonine from 42 to 56 days of age. Day-old male and female Ross × Ross 508 broilers were placed into floor pens (15 pens/sex; 25 birds/pen) of an open-sided house. Birds were given a common feeding regimen from placement until six weeks of age, then experimental diets were fed that contained three concentrations of threonine (0.52, 0.6, and 0.74% total). Male broilers optimized growth rate and feed/gain (89, 95, 100 g/d; 2.39, 2.24, 2.18) when threonine approximated 0.74% of the diet, whereas 0.63% dietary threonine (72, 73, 70 g/d; 2.59, 2.54, 2.60) was more appropriate for females (dietary threonine × sex interactions, P ≤ 0.001 and P ≤ 0.05, respectively). Dietary threonine concentration did not influence chilled carcass yield, abdominal fat percentage, nor the proportion of A Grades. In agreement with live performance, males required 0.74% dietary threonine for maximum fillet weight (545, 565, 582 g), and females needed 0.63% dietary threonine (469, 489, 457 g) (dietary threonine × sex interaction, P ≤ 0.001). The need for dietary threonine to optimize live performance and recovery of the breast fillets is less for females than males during 42 to 56 days of age.

Key Words: Amino Acid, Breast Fillet, Broiler, Threonine

188 Amino acid profile for two strains of broilers from 22 to 42 days of age. Otto Mack Junqueira 1*, Lucio Francelino Arajo 1, Cristiane Soares Silva Arajo 2, Marcelo Oliveira Andreotti 3, Luciana Cardoso Cancherini 1, Silvia Kazue Sakumura 1, 1Faculdade de Ciências Agrárias e Veterinárias - Jaboticabal - UNESP.

The purpose of this experiment was to study the performance and carcass yield of two strains of broilers fed different amino acid profile from 22 to 42 days of age. It was used 1600 broilers chickens in a experimental design in factorial arrangement 2x4 (two strains - Hubbard and HI-Yield and four amino acids recommendations - NRC (1994), Rostagno et al. (1992), Degussa (1997) and AEC (1993), with 4 replications of 50 birds each. In all diets the levels of lysine was constant, by using NRC (1994) as reference. It was not observed any interactions between treatments. Also the performance was not affected by studied treatments. The Hubbard broilers showed lower weight gain and better feed intake, but feed conversion was not affected. Carcass yield and parts were not affected by treatments. The results in here suggest that amino acid profile from NRC (1994) should be enough for broilers from 22 to 42 days of age. Acknowledgements: FAPESP Proc. 98/06355-3 for financial and technical support.

Key Words: Amino acid, Broiler, Carcass yield, Performance, Strains

189 Improved stabilities of vitamins A, D3, E, and riboflavin with tribasic copper chloride (TBCC) compared to copper sulfate pentahydrate in crumbled broiler starter feed. D. M. Hooge1*, F. A. Steward2, and J. L. McNaughton3, 1Hooge Consulting Service, Inc., Eagle Mountain, UT, 2Micronutrients, Indianapolis, IN, 3PARC Institute, Inc., Easton, MD.

In Experiment 1, control mash or crumbled starters with 10 mg Cu/kg from premix Cu sulfate were compared to feeds with an extra 250 mg Cu/kg from TBCC. Diets were fed for 21 d to mixed-sex Ross x
Hubbard HiY chicks in battery brooders (6 pens of 10 chicks each per treatment). Blood and liver samples from all birds per pen were each pooled for vitamin E assays. Levels of vitamins A, D$_3$, E, and riboflavin were lower in control crumbled diets than in mash feeds by 8.5, 1.0, 11.8, and 6.1%, respectively, showing effects of steam pelleting, whereas in TBCC$_{150}$ crumbled vs mash feeds, levels were lower by only 3.0, 0.8, 3.3, and 1.8%. Higher vitamin E levels were found in serum (5.02 vs 4.15 mcg/ml; P<0.05) and liver (4.68 vs 3.02 mcg/g wet wt; P<0.05) of chicks fed crumbled TBCC$_{150}$ diets vs control diets. In 21-d Experiment 2, either 0, 125, 187.5, or 250 mg Cu/kg from TBCC$_{150}$ or Cu sulfate was added to mash or crumbled diets (10 mg Cu/kg from premix Cu sulfate). There were 8 pens of 10 male Ross x Cobb chicks per treatment in battery brooders. Vitamin E levels in mash diets were not different but in crumbled diets were higher (P<0.05) at 187.5 or 250 mg Cu/kg from TBCC$_{150}$ minus from Cu sulfate. In crumbled diets, vitamin E levels were higher (P<0.05) at 187.5 or 250 mg Cu/kg from either TBCC$_{150}$ or Cu sulfate than in the control diet. Chicks fed crumbled diets with 187.5 or 250 mg Cu/kg from TBCC$_{150}$ or 250 mg Cu/kg from Cu sulfate had increased (P<0.05) serum vitamin E compared to control. Using mash or crumbled diets, liver vitamin E increased (P<0.05) at the two highest Cu levels from each source and at the 187.5 and 250 mg Cu/kg levels in TBCC$_{150}$ diets vs Cu sulfate diets. Steam pelleting of feed appeared to improve vitamin losses, and TBCC$_{150}$ was clearly more effective than Cu sulfate for reducing these losses. Cu sources probably reduced microbial (bacterial, mold, or both) oxidation to conserve vitamins. In Experiment 3, a small in vitro test, slightly acid solutions of either 0 or 250 mg Cu/kg from each source were incubated with a DelMarVa strain of either E. coli, Salmonella, or Campylobacter and plated onto MacConkey and Blood Agar. Control solutions gave >500, >500, and >100 colonies, respectively. Cu sulfate reduced counts to 200 to 300, 400 to 500, and 60 mg Cu/kg from TBCC$_{150}$ or Cu sulfate at 50 to 100, 200 to 300, and 50 to 100 colonies whereas TBCC$_{150}$ yielded 50 to 100, 200 to 300, and 50 to 80 colonies.

**Key Words:** Bacteria, Broiler, Copper sulfate, Tribasic copper chloride, Vitamin

### Abstract 191

**Use of a mixture of rapeseed and sunflower meal with or without hydrothermal processing in broiler diets.**


A trial was conducted to study the effects of a mixture of rapeseed and sunflower meal (70:30) raw or cooked and expanded on nutrient digestibility and performance of broilers at 42 d. A total of 385 one-day-old Cobb breeder male chicks were allotted at random into 7 treatments; a control diet based on extruded full fat soybean and soybean meal and 6 additional diets arranged factorially, with three levels of inclusion of the mixture (20, 15, and 10%) and two processing techniques (raw vs cooked and expanded). Each treatment was replicated 5 times (11 chicks per cage). All diets were formulated to be isonutritive and to exceed nutritional requirements of NRC (1994). At 42 d, broilers fed 10% of the cooked and expanded mixture had the same performance than control birds. Hydrothermal treatment of the mixture improved AMEn of the diet (3.170 vs 3.107 kcal/kg DM; P<0.005), fat digestibility (73.7 vs 69.9%; P<0.05), and daily gain from 1 to 21 d (23.3 vs 22.4 g/d; P=0.07). When the mixture was supplied at 20% of inclusion, hydrothermal processing improved performance from 22 to 42 d, but not from 1 to 21 d. At 42 d, feed efficiency of broilers fed the mixture at any level was similar to those fed the full fat soybean control diet, but BW was lower when the non-treated mixture was used at more than 10%. The mixture also decreased AMEn (3.138 vs 3.220 kcal/kg DM) and digestibility of DM (68.7 vs 71.4%), organic matter (70.4 vs 72.9%) and fat (71.8 vs 78.6%) with respect to the control diet (P<0.005). It is concluded that a mixture of rapeseed and sunflower meal can be used successfully in broiler diets from 1 to 21 d. Level of inclusion up to 20% can be used from 22 to 42 d, but not from 1 to 21 d. The inclusion of 10% of the cooked and expanded mixture produced similar results to those of the control diet from 1 to 21 d and at the end of the experiment.

**Key Words:** Broilers, Rapeseed, Hydrothermal processing, Digestibility, Performance

### Abstract 192

**Effects of poultry by-product meal based diets on juvenile Pacific white shrimp (Litopenaeus vannamei) biological performance.**

Z. J. Cheng$^1$, K. C. Behnke$^1$, and W. G. Dominy$^2$, *1 Kansas State University, Manhattan, Kansas, USA, 2 The Oceanic Institute, Waimanalo, Hawaii, USA.*

A 35% crude protein control experimental shrimp diet containing 24.5% fishmeal (FM) was modified by replacing FM with two types of poultry by-product meal (regular poultry by-product meal, PBM, and low ash petfood grade poultry by-product meal, PBMPG) at 33.3, 66.7 and 100% on a w/w basis. Additionally, the PBM and PBMPG were defatted and fish oil was added back so that the oil content was the same as the original. These modified meals were also used to replace FM at 33.3, 66.7 and 100% levels on a w/w basis. Thirteen diets (including FM control diet) were fed to 936 shrimp of average weight 0.17 ± 0.05 g according to a 2 x 2 x 3 factorial design. We used 3 tanks/diet and 24 shrimp/tank. After the 8-weeks growout period, final body weight (BW) of the shrimp ranged from 1.09 to 2.21 g, cumulative gain varied from 547.1 to 1207.6%, specific growth rate ranged from 3.33 to 4.59%, feed conversion ratio (FCR) varied from 3.61 to 5.26 g feed/g gain, and survival rate was in the range of 62.5 to 84.7%. Three-way ANOVA analyses revealed no BW differences between shrimp fed diets based on PBM and PBMPG (p = 0.188) and no BW differences between shrimp fed PBM with and without fish oil supplementation (p = 0.549). However, shrimp fed 33.3 or 66.7% FM replacement diets grew faster than those fed the 100% FM replacement diet (p = 0.018 and p = 0.048, respectively). No BW differences existed between shrimp fed 33.3 and 66.7% FM replacement diets (p = 0.108). Results demonstrated that up to 66.7% FM could be replaced by PBM without significantly reducing shrimp weight gain, FCR and survival (p > 0.05). However, completely replacing FM with PBMs significantly reduced shrimp weight gain and FCR (p < 0.05).

**Key Words:** poultry by-product meal, defatted poultry by-product meal, shrimp, fishmeal, fish oil