

**823 Efficacy of vitamin D source and level on performance and bone mineralization of broilers fed dietary treatments for six weeks.** D. R. Ledoux\*<sup>1</sup>, J. N. Broomhead<sup>1</sup>, D. R. Campbell<sup>2</sup>, J. W. Wilson<sup>2</sup>, and N. E. Ward<sup>2</sup>, <sup>1</sup>University of Missouri, Columbia, <sup>2</sup>DSM Nutritional Products, Inc., Parsippany, NJ.

A floor pen study was conducted to determine the efficacy of vitamin D source and level on performance and bone mineralization of broilers fed dietary treatments for six weeks. Dietary treatments included: 1) Basal diet supplemented with NRC recommended levels of vitamin D<sub>3</sub> (200,000 ICU/ton); 2) Basal plus 2.5 million ICU (MICU) D<sub>3</sub> /ton; 3) basal plus 2.5 MICU D<sub>3</sub>/ton plus 62.5 mg Hy-D/ton; 4) basal diet plus 5 MICU D<sub>3</sub> /ton diet; and 5) basal plus 62.5 mg Hy-D/ton diet. Diets were fed from day 1 to 42, and nutrient concentrations were adjusted at the end of week 3 according to NRC recommendations. Four replicate pens of 20 chicks were fed each treatment from day 1 to 21. On day 21, 6 chicks from each pen were removed for sampling, leaving 4 replicate pens of 14 chicks from day 21 to 42. Compared with chicks fed diet 1, chicks fed all other treatments consumed more feed and gained more weight ( $P < 0.05$ ) at both weeks 3 and 6. Feed intake and body weight gain were similar ( $P > 0.05$ ) for chicks fed treatments 2 - 4 at both weeks 3 and 6. Feed conversion was not affected ( $P > 0.05$ ) by dietary treatments at either week 3 or 6. Compared with chicks fed diet 1, chicks fed all other treatments had a higher ( $P < 0.05$ ) percent tibia ash at week 3, whereas at week 6, chicks fed diets 1 and 5 had a lower ( $P < 0.05$ ) percent tibia ash compared with other dietary treatments. However, on an absolute bone ash weight basis (mg bone ash), bone ash was not affected ( $P > 0.05$ ) by dietary treatments at either week 3 or 6. Bone breaking strength was also not affected ( $P > 0.05$ ) by dietary treatments at either week 3 or 6. Results indicate that supplemental vitamin D<sub>3</sub> above NRC recommendations was effective in improving chick performance and bone mineralization, and 62.5 mg Hy-D/ton feed was as effective as industry vitamin D<sub>3</sub> levels in improving chick performance.

**Key Words:** Vitamin D, Bone Ash, Broilers

**824 Influence of large doses of vitamin C on performance, plasma and bone calcium and phosphorus, bone characteristics and egg quality of local Dandarawi hens exposed to cold stress.** M. M. Metwally\*, Department of Animal and Poultry Production, Assiut University, Assiut, Egypt.

An experiment was conducted to investigate the effect of large doses of dietary vitamin C (0 to 2,000 ppm) on performance, plasma calcium and phosphorus, bone characteristics and egg quality of Local Dandarawi Hens exposed to low environmental temperatures in Winter season (December, January and February) of upper Egypt. A total of 192 local Dandarawi hens (32 wks of age) were fed diets containing vitamin C (ranging from 0 to 2,000 ppm) for 4 months. Body weight changes, egg production, weight, egg quality and bone characteristics were determined. Plasma and tibiae were analyzed for total calcium and phosphorus. Results indicated that body weight loss and mortality rate (%) were significantly ( $P < 0.05$ ) lower in groups fed high doses of vitamin C. Egg laying rate (%) was significantly ( $P < 0.05$ ) higher by 20% during the period of cold stress in birds fed the highest level of vit. C than control birds. Egg weight increased up to 6% and egg specific gravity was improved in hens fed 2000 ppm of vitamin C which also had increased calcium and phosphorus in the bone and blood plasma. Egg quality criteria was enhanced by high dose of vitamin C. Improved in both feed consumption and feed conversion with groups fed the highest level of vitamin C. Results recommend that large doses of vitamin C in the diets of laying hens influence calcium metabolism, affecting bone and shell mineralization and improved egg production and quality of laying hens under cold stress.

**Key Words:** Laying Hens, Performance, Vitamin C

**825 Litter quality and feet dermatitis with broilers in response to corn-soybean vegetarian feeds.** G. Eichner, S. L. Vieira\*, R. P. Ott, E. S. Viola, and J. G. Almeida, UFRGS, Porto Alegre, RS, Brazil.

Europe and Saudi Arabia require that broiler grown for their market are not fed animal by products. The so called vegetarian feeds are largely formulated with an increased inclusion of soybean meal, which usually

leads to increased excreta viscosity. An experiment was designed with 8 treatments: four ingredient formulation varying in ingredient inclusion and optimizing or not the dietary electrolyte balance (DEB) to 250 meq/kg of feed. Feed treatments were: corn and soybean meal, corn and soybean meal plus a commercial pectinase + beta glucanase, inclusion of poultry by-product, inclusion of corn gluten meal. Feeds did not have any growth promotant. Birds were fed ad libitum to 42 days of age in floor pens having bell drinkers. At the end of the study birds receiving the feed with corn gluten meal had a significantly reduced body weight, but feed conversion was not affected by any treatment. Optimization of DEB did not affect any live performance response. Birds showing feet dermatitis at 21 days were tagged and lesion scores for feet dermatitis were weekly performed afterwards. These lesions were clearly intensified through the end of the study with birds fed diets with corn gluten meal demonstrating a significant reduction. Increasing diet DEB led to higher lesion scores at 21 days of age with no difference between the treatments afterwards. Lesion scores were positively correlated with the moisture of litter.

**Key Words:** Vegetarian Feeds, Broiler Litter, Feet Dermatites

**826 Effects of salmonella typhimurium lipopolysaccharide challenge on the performance and zinc metabolism in laying hens supplemented with zinc from different sources.** T. Cheng\*, Y. Guo, and J. Yuan, College of Animal Science and Technology, China Agricultural University, Beijing, P.R. China.

The study was conducted to determine the effects of *Salmonella Typhimurium* lipopolysaccharide (LPS) challenge on egg-laying performance, inflammatory response, and zinc metabolism in layers fed diets supplemented with organic or inorganic zinc since 3-week-old. The three dietary treatments were corn-soybean meal basal diet without supplemental zinc or with zinc at 60 mg/kg from ZnSO<sub>4</sub> or zinc amino acid complex (ZnAA). At the age of 58-week-old, twelve hens from each treatment were allotted into two sub-groups. On day 1, 3, 5, 7 of the 58th week of age, six birds of one sub-group were injected intraperitoneally with LPS or sterile saline. Neither effect of zinc source/LPS challenge interaction nor zinc source on egg production performance was observed. LPS-challenge decreased egg production ( $p < 0.04$ ) and increased percentage of cracked eggs ( $p < 0.01$ ). With LPS challenge, the fever response of hens fed ZnAA tended to peak and subside also earlier than fed ZnSO<sub>4</sub> or basal diet, serum IL-1 level at 3-h was higher ( $p < 0.01$ ), but lower at 12 h post-challenge ( $p < 0.001$ ) in hens fed ZnAA than ZnSO<sub>4</sub>. In saline-injected groups, serum IL-1 was higher in hens fed ZnAA than the basal diet at 3-h post-injection ( $p < 0.01$ ). LPS-challenged birds had lower serum zinc and higher zinc sequester in liver and spleen ( $p < 0.001$ ). Supplementation of 60mg/kg zinc from either ZnAA or ZnSO<sub>4</sub> significantly ( $p < 0.05$ ) elevated metallothionein (MT) concentrations in liver and spleen. MT concentration in liver of birds fed ZnAA was higher than fed ZnSO<sub>4</sub> ( $p < 0.05$ ). The magnitude of increase of hepatic and splenic MT due to LPS challenge were higher by supplementation of ZnAA than ZnSO<sub>4</sub>. The results suggest that zinc amino acid complex enhances MT synthesis and zinc sequester in hepatic and splenic tissues, and increases the sensitivity of immune response due to LPS challenge.

**Key Words:** Laying Hens, Lipopolysaccharide, Zinc Metabolism

**827 Effects of broiler strain on nonphytate phosphorus requirement.** M. E. Persia\* and W. W. Saylor, University of Delaware, Newark.

With yearly improvements in genetic stock and recent pressure to reduce safety margins of nonphytate phosphorus (nPP) in poultry feed, it is important to revisit strain differences in the nPP requirement of broiler chicks. Experiments were conducted to determine if broiler strain affects the nPP requirements of growing chicks. One-day-old Ross 308 and 708 chicks were obtained from a local commercial hatchery. Chicks utilized in both experiments were from breeder flocks of similar age that received the same level of dietary nPP. Chicks were maintained on a standard starter diet until 8 days of age, when chicks were sorted, wing-banded and randomly assigned to experimental treatments. Chick weight gain and feed intake were measured from 8 to 22 d of age. Chicks were then euthanized by cervical dislocation and the right tibia was harvested to determine fat-free tibia ash. Treatments were arranged utilizing a six by two factorial design. Experimental diets formulated to contain one

of six levels of nPP (0.13, 0.21, 0.29, 0.37, 0.45 or 0.53%) were fed to the two strains of broiler chicks. One hundred forty-four chicks of each strain were randomly assigned to six replicate groups of four chicks for each experimental treatment. Both dietary nPP level and broiler strain significantly affected weight gain and feed intake, but no interaction between the two factors was observed. Broken-line regression analysis resulted in requirement estimates of 0.33 and 0.30% for weight gain and 0.33 and 0.33% for feed intake for Ross 308 and TP7 chicks, respectively. There appears to be little difference in the NPP requirements of the two broiler strains utilized in this experiments.

**Key Words:** Nonphytate Phosphorus Requirement, Broiler, Strain

**828 Plasma and tissue selenium and plasma glutathione peroxidase concentrations of broilers fed a selenium-deficient diet following a selenium-loading period.** R. L. Payne\* and L. L. Southern, *Agricultural Center, Louisiana State University, Baton Rouge.*

An experiment was conducted to compare plasma glutathione peroxidase (pGPX3) and plasma and tissue Se concentrations in broilers fed a Se-deficient diet after having been fed diets supplemented with either sodium selenite (SS) or Se-enriched yeast (SY). Female broilers were assigned to three treatments on d 0, and the trial lasted 22 d. The treatments were: 1) a corn-soybean meal diet without Se supplementation (C-SBM), 2) C-SBM + 0.30 ppm Se from SS, and 3) C-SBM + 0.30 ppm Se from SY. Each treatment was replicated eight times with 15 broilers per replicate, and these treatments were fed from d 0 to 10 posthatching. On d 10, all broilers were fed a Se-deficient diet, which consisted of cornstarch (25%), dextrose (25%), SBM (31%), and torula yeast (10%). Baseline concentrations of plasma and tissue Se and pGPX3 were established using 10 broilers on d 0. On d 10, 13, 16, 19, and 22, three broilers per replicate were randomly selected for plasma and tissue collection. Any significant effects listed are significant at  $P < 0.05$ . Diet did not affect growth performance during the Se-loading period (d 0 to 10) or overall (d 0 to 22). Broilers fed either SS or SY had similar pGPX3 concentrations on d 10 and 13, but the broilers fed SY had higher pGPX3 activities than those fed SS on d 16, 19, and 22. Both sources of Se resulted in higher pGPX3 and plasma Se concentrations than broilers fed the C-SBM without Se supplementation. Broilers fed SY had higher plasma Se than those fed SS except for d 10 and 22. Liver Se concentration was higher in broilers fed SY on d 10, 13, and 16 compared with those fed SS, but it was similar on d 19 and 22. Similarly, breast Se concentration was higher in broilers fed SY on d 10, 13, 16, and 19 compared with those fed SS, but it was similar on d 22. These results indicate that organic sources of Se are deposited at a greater rate in tissues, and then better utilized for maintaining pGPX3 concentrations over time than inorganic forms of Se.

**Key Words:** Broiler, Glutathione Peroxidase, Selenium

**829 Validation of a selenium-deficient diet for broilers.** R. L. Payne\* and L. L. Southern, *Agricultural Center, Louisiana State University, Baton Rouge.*

Two experiments (EXP) were conducted to develop a Se-deficient diet that could be used for selenium-dependent plasma glutathione peroxidase (pGPX3) assays in broilers. For each EXP, 288 female broilers were weighed, wingbanded, and allotted to dietary treatment on d 0, and the EXP lasted 21 or 20 d, respectively. All diets were formulated to provide 1.26% total Lys, 1.0% Ca, 0.45% available P, and 3,200 kcal/kg ME. Four basal diets were used in EXP 1 and they were a corn-soybean meal diet (C-SBM), a C-torula yeast diet (C-TY), a cornstarch-dextrose-TY diet (CS-D-TY), and a CS-D-SBM + 20% TY diet (20TY). Each basal diet was supplemented with 0 or 0.30 ppm sodium selenite (SS), and each treatment was replicated six times with six broilers per replicate. The broilers fed C-SBM, regardless of Se level, had higher daily gain (ADG) and gain:feed ( $P < 0.05$ ) than broilers fed any other diet. However, the broilers fed 20TY had similar daily feed intake (ADFI;  $P > 0.05$ ) to those fed the C-SBM. Data from EXP 1 indicated that the best diet of these was the 20TY diet. In EXP 2, two levels of TY were used in the CS-D-SBM + TY diet. Three basal diets were used: 1) C-SBM diet; 2) CS-D-SBM + 10% TY (10TY); and 3) CS-D-SBM + 15% TY diet (15TY). Each basal diet was supplemented with 0 or 0.30 ppm SS, and each treatment was replicated eight times with six broilers per replicate. The broilers fed 10TY, regardless of Se level, had similar ADG ( $P > 0.05$ ) as those fed C-SBM, and those fed 15TY had lower

ADG ( $P < 0.05$ ) compared with those fed C-SBM. All broilers fed diets containing TY had decreased ADFI ( $P < 0.05$ ) and lower gain:feed ( $P < 0.05$ ) compared to those fed C-SBM. However, pGPX3 concentrations in the broilers were lowest in the TY diets without Se supplementation ( $P < 0.05$ ), but they returned to levels comparable to those fed C-SBM when SS was supplemented. Therefore, a semi-purified diet containing 10% TY provides similar ADG while lowering pGPX3 activity in order to properly examine Se activity in the broiler.

**Key Words:** Broiler, Selenium, Torula Yeast

**830 Growth performance and spontaneous bone fracture incidence of toms fed various levels of calcium and non-phytate phosphorus to heavy market weight.** K. D. Roberson\*, J. L. Kalbfleisch, R. A. Charbeneau, and W. Pan, *Michigan State University, East Lansing.*

This trial evaluated various dietary calcium and non-phytate phosphorus (nPP) levels fed to Nicholas 700 toms from 2 to 19 wk of age. After a two-wk brooding period, 24-25 poult/pen were allocated to 8 pens/treatment. Crumbles were fed from 2 to 5 wk of age and pellets were then fed to 19 wk of age. Treatment diets were fed in three-wk phases except for the finisher II diet which was fed for 2 wk. Diet 1 (LOW) was formulated to provide 0.50% nPP from 2-5 wk of age and matched NRC (1994) recommendations for each phase change ending with 0.25% nPP from 17-19 wk of age. Dietary calcium was kept at a 2:1 ratio with nPP for all diets. Diet 2 (MED) had formulated nPP levels that averaged 0.06 percentage units higher than the LOW diet. Diet 3 (HIGH) averaged 0.10 percentage units higher nPP than the MED diet. Diet 4 (VHIGH) was formulated according to breeder recommendations and was about 0.10 percentage units higher than the HIGH diet for dietary nPP. Body weight was reduced by the LOW diet at 5 wk of age ( $p=0.009$ ). At 8 wk of age, BW was lower when the MED diet was fed compared to the HIGH and VHIGH diets ( $p<0.001$ ). The LOW diet resulted in lower BW compared to the MED diet at 8 wk. Similar responses were observed the rest of the trial. Cumulative feed intake was reduced by the LOW diet at 14 wk ( $p=0.001$ ) compared to the other diets and was lower than the HIGH and VHIGH diets at 17 and 19 wk ( $p=0.001, 0.004$ ). Feed:gain was higher for the LOW diet compared to HIGH and VHIGH diets the whole trial. Within phase, BW gain was not significantly increased by feeding higher calcium and nPP than the MED diet in the 11-14 wk phase and the LOW diet in the 17-19 wk phase. Incidence of leg problems and spontaneous bone fractures (femur and tibia) were increased ( $p=0.001$ ) when the LOW diet was fed compared to other diets. The HIGH and VHIGH diets resulted in the best growth performance and skeletal integrity. The HIGH diet resulted in about 3 g less nPP consumed per tom compared to the VHIGH diet with an average daily gain of 171 g/d for the trial.

**Key Words:** Phosphorus, Bone Fractures, Tom

**831 The impact of dietary copper source and level on hen performance, egg quality and egg yolk cholesterol.** P. H. Patterson<sup>1</sup>, T. L. Cravener<sup>1</sup>, and D. M. Hooge\*<sup>2</sup>, <sup>1</sup>*The Pennsylvania State University, University Park,* <sup>2</sup>*Hooge Consulting Service, Inc., Eagle Mountain, UT.*

A first-cycle layer feeding trial was conducted for twelve 28d periods (October 2001 to October 2002; 18 to 66wk) using 504 Hy-Line W-36 hens in cages at 387cm<sup>2</sup>/bd initially. Three dietary treatments were: control (CON), 18.4ppm Cu; copper sulfate (CuSO<sub>4</sub>), +125ppm Cu; tribasic copper chloride (TBCC), +125ppm Cu. There were 18 replicates of CON, 12 of each CuSO<sub>4</sub>, and TBCC treatments all with 12 hens/replicate. Pullets were grown on corn-soy based CON, CuSO<sub>4</sub>, or TBCC diets to 18wk, and as layers fed every pullet/hen diet combination e.g. CON/CON, CON/ CuSO<sub>4</sub>, CON/TBCC etc. Laying hen results are reported as main effects. Egg quality measurements were taken in Periods 3, 6, 7, 9, and 12, and eggs were sampled for egg yolk cholesterol in Period 7. Better mixing was observed with the TBCC, which was non-hygroscopic, with small uniform particle size compared to CuSO<sub>4</sub>, which had to be ground with mortar and pestle to break up large particles. For CON, CuSO<sub>4</sub>, and TBCC fed hens, respectively, results were: final BW 1.692, 1.672, and 1.672 kg ( $P = 0.34$ ); 12-period average hen-day egg production 74.9, 77.5, and 76.0% ( $P = 0.19$ ); feed intake 95.6, 95.1, and 95.6 g/hen/d ( $P = 0.88$ ); kg feed/dozen eggs 1.627, 1.555, and 1.590 ( $P = 0.14$ ); kg feed/kg eggs 2.066, 2.049, and 2.088 ( $P = 0.84$ ); egg weight 58.3, 58.2, and 57.9 g ( $P = 0.47$ ); Haugh units 71.7,

78.2, and 72.2 ( $P = 0.87$ ); and egg yolk cholesterol 1.237, 1.248, and 1.252 g/100g ( $P = 0.91$ ). Shell weight, thickness, % shell, and albumen height means were either equal or very close by treatment. It was concluded that addition of 125ppm Cu from  $\text{CuSO}_4$  or TBCC to the diets of first-cycle laying hens containing 18.4ppm Cu did not significantly affect hen performance or egg quality although this does not preclude the possibility that higher levels may be beneficial as shown recently by other researchers.

**Key Words:** Dietary Copper, Hens Eggs, Cholesterol

**832 Use of 2-hydroxy-4(methylthio) butanoic acid (HMTBA) as a ligand for organic trace minerals.** J. J. Dibner\*, M. Trehy, C. S. Schasteen, and J. A. Hume, *Novus International, Inc., St. Louis, MO.*

Organic trace minerals (OTM) are used in animal feed to provide enhanced mineral availability compared to inorganic salts. Mineral absorption from inorganic salts is limited by their tendency to form complexes with dietary constituents like phytic acid, and by their tendency to interfere with each other when multiple salts are included in the diet. The most common OTM forms are mineral amino acid complexes (such as zinc methionine) or mineral proteinates. The latter consist of hydrolyzed protein; thus, the ligand consists of multiple amino acids, each with its own binding characteristics. HMTBA is an organic acid with a structure identical to methionine except that it bears a hydroxyl group on the alpha carbon instead of an amino group. Its mineral binding is also similar to that of methionine except that the hydroxyl group replaces the amino group in formation of the complex. Mintrex™ Zn mineral supplement is the name of the zinc complex using HMTBA as ligand. It is a 2:1 ligand to mineral complex. In the study reported here, birds were vaccinated with ADVENT® Coccidiosis Control on day of hatch and fed a zinc deficient diet ( $\text{Zn} < 30$  ppm) for eight days followed by application of treatment diets consisting of the basal and four supplemented diets: zinc sulfate, Zinpro 100 and Mintrex Zn, all at a final concentration of 70 ppm supplemental zinc. Pre-challenge performance and gut morphometry were affected by vaccination ( $P < .01$ ) and zinc source ( $P < .05$ ). Birds were given a coccidiosis challenge by oral gavage on day 23. Performance and lesion scores following challenge were improved by zinc supplementation ( $P < .05$ ). Post-challenge tibia zinc was affected by vaccination and zinc source with the highest tibia zinc observed in the birds that were fed Mintrex. All zinc supplemented birds had greater tibia zinc than the unsupplemented basal ( $P < .01$ ). ADVENT is a trademark of Novus International, Inc., and is registered in the United States and other countries

**Key Words:** Mintrex, Zinc, Hydroxy-4(methylthio)butanoic Acid

**833 Reduction of ascites mortality in broilers by dietary coenzyme Q<sub>10</sub> supplementation.** A. Geng\*, Y. Guo, and Y. Yang, *College of Animal Science and Technology, China Agricultural University, Beijing, P.R. China.*

One experiment was conducted to study the effects of dietary coenzyme Q<sub>10</sub> ( $\text{CoQ}_{10}$ ) supplementation on growth performance and ascites in broilers. One hundred and eighty one-day-old Arbor Acre male broiler chicks were randomly allocated into 3 groups with 6 replicates each. From day 8, the diets were supplemented with  $\text{CoQ}_{10}$  at levels of 0, 20, and 40 mg/kg, respectively. During day 15 to day 21, all the chicks were exposed to low ambient temperature (15-18 °C) to induce ascites. Feed intake, weight gain, and feed conversion ratio of the broilers during 0-6 wk were measured, mortality was recorded, and ascites was diagnosed. On day 15, 22, 29, 36, 43 and 47, blood was sampled to measure blood packed cell volume (PCV) and erythrocyte osmotic fragility (EOF) immediately. On day 22, 36, and 43, a method of right cardiac catheter was adopted to determine right ventricular pressure (RVP), pulmonary arterial pressure (PAP) and the maximum change ratio of right intraventricular pressure, and then the right ventricle and total ventricle of heart were weighed to calculate ascites heart index (AHI). The results showed that there were no significant influences observed on broilers growth performance, but the mortality due to ascites was significantly reduced by  $\text{CoQ}_{10}$  supplementation ( $P < 0.01$ ). 40 mg/kg  $\text{CoQ}_{10}$  decreased EOF significantly compared with the control, but no significant changes were observed in PCV between the  $\text{CoQ}_{10}$  supplemented birds and the control. Pulmonary arterial diastolic pressure was significantly lowered at age of 36 days, but no significant changes were observed in RVP, pulmonary arterial systolic pressure, and the maximum change

ratio of right intraventricular pressure. AHI was significantly decreased by dietary 40 mg/kg  $\text{CoQ}_{10}$  supplementation ( $P < 0.05$ ). The results of this study suggest that dietary supplementation of  $\text{CoQ}_{10}$  has beneficial effect on reducing ascites mortality in broilers.

**Key Words:** Broilers, Ascites, Coenzyme Q<sub>10</sub>

**834 Comparison of growth potential and carcass components of a new strain of tom turkeys with other commercial strains.** K. D. Roberson\*<sup>1</sup>, J. L. Kalbfleisch<sup>1</sup>, and D. Dransfield<sup>2</sup>, <sup>1</sup>Michigan State University, East Lansing, <sup>2</sup>British United Turkeys of America.

A 19-wk trial was conducted to evaluate the growth potential and carcass component yield of a newly developed tom strain with two other major strains of commercial toms grown in the U.S. turkey industry. Hybrid Converter (HYB) poulters were smaller ( $p=0.005$ ) at hatch than Nicholas 700 (NIC) or B.U.T.A. T2 (T2) poulters (56.7 vs. 59.8 or 59.0 g). Breeder hen wk of lay was 21 wk (HYB), 19 wk (NIC) or 6 wk (T2). Poults were brooded at 50 toms/pen for two wk with 4 pens of HYB and NIC toms and 8 pens of T2 toms. After two wk, each pen of poults was split to provide 32 total pens of 25 toms each. Body weight was measured at 2, 5, 11, 17 and 19 wk of age. T2 toms weighed less than other strains at 2 and 5 wk ( $p < 0.001$ ), but were heavier at 17 and 19 wk ( $p < 0.001$ ). T2 toms were lighter than NIC toms at 11 wk, but heavier than HYB toms ( $p < 0.001$ ). Net cumulative feed conversion was higher for T2 toms than HYB toms at 2 wk ( $p < 0.001$ ) and both HYB and NIC toms at 5 wk of age ( $p=0.033$ ). There were no significant cumulative feed conversion effects in the remainder of the trial. Livability was higher ( $p=0.002$ ) for HYB toms compared to the other strains. Mortality due to cardiovascular problems was higher ( $p=0.007$ ) for NIC toms than the other strains. Three toms per pen were selected based upon similar BW (17.8 kg) at 17 wk and average BW in the pen at 19 wk. There was a significant ( $p < 0.001$ ) difference in BW of toms slaughtered at 19 wk (19.3, 20.5 or 21.2 kg for HYB, NIC, or T2, respectively). Breast yield was higher ( $p < 0.001$ ) for T2 toms than other strains at both market ages. Thigh and drumstick yield were consistently lower ( $p < 0.019$ ) for T2 toms compared to HYB and NIC. HYB toms had lower wing yield ( $p < 0.001$ ) and higher percent breast skin ( $p < 0.001$ ) than other strains. There was no significant effect on lightness of breast meat. The results show that T2 toms will reach heavy (18 kg) market weight sooner with a higher proportion of meat produced as breast tissue than common commercial tom strains from other breeder companies.

**Key Words:** Carcass Components, Growth Potential, Tom Strain

**835 Effects of cereal, heat processing, and fiber on productive performance and digestive traits of broilers.** J. M. González-Alvarado<sup>1</sup>, E. J. Moreno<sup>2</sup>, D. G. Valencia<sup>2</sup>, R. Lázaro<sup>2</sup>, and G. G. Mateos\*<sup>2</sup>, <sup>1</sup>Universidad Autónoma de Tlaxcala, México, <sup>2</sup>Universidad Politécnica de Madrid, Spain.

A battery trial was conducted to study the influence of type of cereal (60% corn or 60% rice), heat processing of the cereal (HP) (raw or cooked at 90 °C for 50 min and then rolled), and sources of fiber (none, 3% oat hulls, and 3% soybean hulls) on productivity and digestive traits of broilers from 1 to 21 d of age. Each of the twelve treatments were replicated 6 times (a cage with 14 birds). The two control diets were based on soybean protein concentrate and fish meal, and had either 2.45% (corn diets) or 1.54% (rice diets) crude fiber. In the high fiber diets, the hull source was included at expenses of an inert material. Birds and feed intake were weighed at 0, 4, 8, 13, and 21 D. Ileal viscosity and digestive organ size were measured at 21 d. From 0 to 21 d broilers fed rice had better feed conversion (FC) (1.34 vs 1.38,  $P < 0.001$ ) than broiler fed corn. Heat processing of the cereal did not affect broiler performance at 21 d of age, but a cereal x HP interaction was detected; HP improved FC in broilers fed rice but not in broilers fed corn. Broilers fed the hull-containing diets had better FC (1.34 vs 1.39,  $P < 0.01$ ), higher ADG (32.5 vs 30.7 g/d,  $P < 0.05$ ), larger gizzards ( $P < 0.001$ ), and heavier gastrointestinal tracts ( $P < 0.01$ ) than chicks fed diets without hulls. Also, a cereal x fiber interaction was observed at 21 d; the inclusion of hulls improved FC in broilers fed rice but not in broilers fed corn. Soybean hulls but not oat hulls increased ileal viscosity at 21 d ( $P < 0.05$ ). Rice can be used successfully in prestarter diets for chicks but no benefits are obtained from HP of corn. The inclusion of additional fiber in the diet improved chick performance, specially when low-fiber

rice diets are used, which indicates the need of a minimum of fiber in broiler diets.

**Key Words:** Rice, Fiber Source, Early Nutrition

## Ruminant Nutrition: Beef - Digestibility & Production

**836 Site and extent of digestion in beef cattle consuming restricted amounts of forage and supplemental ruminally undegradable protein.** E. J. Scholljegerdes\*, T. R. Weston, F. S. D'Angieri, P. A. Ludden, and B. W. Hess, *Department of Animal Science, University of Wyoming, Laramie.*

Twelve Angus-cross cattle (avg. initial BW = 594 kg  $\pm$  44.4 kg) fitted with ruminal and duodenal cannulae were used in a 4  $\times$  4 Latin square double cross-over designed experiment to determine site and extent of digestion in beef cattle consuming restricted amounts of forage plus a ruminally undegradable protein (RUP) supplement. Heifers were fed chopped (2.54 cm) bromegrass hay (11.4% CP, 57% NDF) at 30, 55, 80, or 105% of maintenance. Cattle fed below maintenance were given increasing amounts of RUP supplement (6.8% blood meal, 24.5% feather meal, and 68.7% menhaden fish meal; DM basis) in an effort to equalize duodenal essential AA flow to that of the 105% of maintenance diet. Experimental periods were 21 d in length with 17 d of adaptation followed by 4 d of intensive sample collection. Total OM intake and duodenal OM flow decreased ( $P < 0.001$ ) proportionally in cattle consuming 105 to 30% of the forage intake required for maintenance. Therefore, OM truly fermented (% of intake) did not differ ( $P = 0.43$ ) as intake declined. True ruminal N digestibility (% of intake) tended to decrease linearly ( $P = 0.07$ ); however true ruminal N digested (g/d) increased as intake decreased from 105 to 30%. Duodenal N flow was equal ( $P = 0.33$ ) across intake level, even though microbial N flow declined ( $P < 0.001$ ) as forage OM intake decreased. Due to the low ruminal degradability of the RUP supplement, non-ammonia non-microbial N flow increased ( $P < 0.001$ ) with RUP supplementation. Post-ruminal N digested tended to increase ( $P = 0.06$ ) with increasing levels of RUP in the diet. The increased ruminal N digested associated with supplemental RUP and restricted forage intake increased ruminal molar proportions of branched chain VFA ( $P \neq 8804.02$ ) and millimolar concentrations of ruminal  $\text{NH}_3$  ( $P < 0.001$ ). Therefore, when beef cattle consume restricted amounts of bromegrass hay, supplemental RUP can boost the supply of highly digestible N presented to the small intestine for absorption.

**Key Words:** Nutrient digestion, Restricted intake, Ruminal undegradable protein

**837 Digestion of barley-based high-grain diets supplemented with rumen degradable and undegradable protein in steers. - digestion trial.** B. W. Pamp\*, M. L. Bauer, G. P. Lardy, and S. A. Soto-Navarro, *Department of Animal and Range Sciences, North Dakota State University, Fargo.*

Fifteen Holstein steers (398.2  $\pm$  7.3 kg initial BW) were allotted by weight to one of four dietary treatments in a completely randomized design. Objectives of this trial were to determine effects of rumen degradable (RDP) and undegradable protein (RUP) on site and extent of digestion, microbial efficiency, and ruminal fermentation. Dietary treatments were arranged in a 2  $\times$  2 factorial. Factors were RDP (+/-) and RUP (+/-). RDP source was urea and RUP was a combination of hydrolyzed feather meal and blood meal (80:20 on N basis). The basal diet was formulated to contain (DM basis) 83% barley, 5% alfalfa hay, 5% corn silage, 5% de-sugared molasses, 27.5 mg/kg monensin, and 11.0 mg/kg tylosin. The control diet (without added RDP and RUP) was formulated to contain a minimum of 12.5% CP, 0.7% calcium, and 0.3% phosphorus. Diets were formulated such that +RDP added 1% CP from urea and +RUP added 1% CP from the feather meal/blood meal combination. Steers were adapted to the experimental diets for 29 d before collection. Average DMI during trial period was 11.5 kg/d. Apparent ruminal OM digestibility decreased ( $P = 0.05$ ) with RUP (41.4 vs. 35.1  $\pm$  2.2%). Digestibility of OM in the small intestine tended ( $P = 0.09$ ) to increase with the inclusion of RUP (2.8 vs. 9.8  $\pm$  2.3%). Intake and ruminal digestibility of NDF decreased ( $P = 0.01$ ) with the dietary addition of RUP (2.98 vs. 2.64  $\pm$  1.20 kg/d and 17.1 vs. 0.2  $\pm$  5.8%, respectively). The inclusion of RDP increased duodenal NDF flow ( $P = 0.08$ ; 2.45 vs. 2.87  $\pm$  2.06 kg/d) and decreased NDF ruminal digestion

( $P = 0.06$ ; 17.1 vs. 4.5  $\pm$  5.8%). The addition of RUP alone in the diet increased CP intake over control and RDP diets ( $P = 0.02$ ; 1.62 vs. 1.79  $\pm$  0.07 kg/d). Total tract OM, CP, ADF, and NDF digestibilities were unaffected by RDP and RUP supplementation. These results suggest protein supplementation decreased ruminal fiber digestion and did not improve digestion of other feed fractions.

**Key Words:** Barley, Digestion, Ruminal Fermentation

**838 Effect of choice-select spread on carcass value and profitability in early-weaned Simmental steers.** N. A. Pyatt\*<sup>1</sup>, L. L. Berger<sup>1</sup>, D. B. Faulkner<sup>1</sup>, and P. M. Walker<sup>2</sup>, <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, <sup>2</sup>Illinois State University, Normal.

Early-weaned steers (n = 192, <sup>3</sup>/<sub>4</sub> Simmental or greater) of known genetics were individually fed in a four-year study to determine the influence of Choice-Select (Ch-Se) spread (\$4, \$8, \$12 or \$16 per 45.4 kg) on performance and carcass factors explaining variation in carcass value and profitability. Steers were weaned at 88.0  $\pm$  1.1 d and fed a high concentrate diet for 334.2  $\pm$  0.7 d. Five-year price data were collected for feedstuffs, dressed beef, and grid premiums and discounts. Input costs included annual cow costs, veterinary, labor, feed markup, yardage and interest. Independent variables included growth and carcass EPDs, daily intake (DMI), daily gain (ADG), hot carcass weight (HCW), calculated yield grade (YG) and marbling score (MS). At \$4 Ch-Se spread, HCW (57%), YG (17%) and MS (4%) accounted for nearly 78% of the variation in carcass value among steers. ADG (27%), YG (19%), HCW (16%), MS (7%) and DMI (5%) accounted for nearly 74% of the variation in profit with a \$4 Ch-Se spread. At \$8 Ch-Se spread, HCW (55%), YG (13%) and MS (9%) accounted for over 77% of the variation in carcass value among steers. ADG (22%), MS (19%), YG (16%), HCW (11%) and DMI (4%) accounted for nearly 72% of the variation in profit with an \$8 Ch-Se spread. At \$12 Ch-Se spread, HCW (38%), MS (27%) and YG (11%) accounted for over 76% of the variation in carcass value among steers. Marbling score (26%), ADG (19%), YG (14%), HCW (8%) and DMI (4%) accounted for 71% of the variation in profit with a \$12 Ch-Se spread. At \$16 Ch-Se spread, MS (37%), ADG (16%), YG (12%) and HCW (7%) accounted for over 73% of the variation in carcass value among steers. Marbling score (33%), ADG (15%), YG (12%), HCW (6%) and DMI (4%) accounted for over 70% of the variation in profit with a \$16 Ch-Se spread. When estimating carcass value, the importance of marbling score increased while carcass weight decreased with rising Ch-Se spread. When assessing profitability, the importance of marbling score increased while ADG, carcass weight and YG diminished with increasing Ch-Se spread.

**Key Words:** Carcass Value, Profitability, Early-Weaning

**839 Effect of dressed price on carcass value and profitability in early-weaned Simmental steers.** N. A. Pyatt\*<sup>1</sup>, L. L. Berger<sup>1</sup>, D. B. Faulkner<sup>1</sup>, and P. M. Walker<sup>2</sup>, <sup>1</sup>University of Illinois at Urbana-Champaign, Urbana, <sup>2</sup>Illinois State University, Normal.

Early-weaned steers (n = 192, <sup>3</sup>/<sub>4</sub> Simmental or greater) of known genetics were individually fed in a four-year study to determine the influence of base price for dressed beef (\$96, \$108, \$120 or \$132 per 45.4 kg) on performance and carcass factors explaining variation in carcass value and profitability. Steers were weaned at 88.0  $\pm$  1.1 d and fed a high concentrate diet for 334.2  $\pm$  0.7 d. Five-year price data were collected for feedstuffs and grid premiums and discounts. Input costs included annual cow costs, veterinary, labor, feed markup, yardage and interest. Independent variables included growth and carcass EPDs, daily intake (DMI), daily gain (ADG), hot carcass weight (HCW), calculated yield grade (YG) and marbling score (MS). At \$96 per 45.4 kg, MS (25%), ADG (19%), YG (18%) and HCW (10%) accounted for nearly 72% of the variation in carcass value among steers. Marbling score (19%), YG