The purpose of this study is to investigate the influence of dietary genistein supplementation on the reproductive performance and bone status of laying broiler breeders during the late egg-laying period. A total of 960 Ross 308 layering broiler breeders at age of 55 weeks were randomly allocated into 4 groups and fed with corn-soybean meal (CSM) diet (control), corn-soybean meal-cottonseed meal (CSCM) diet, CSCM diet + 40mg/kg of genistein and CSCM diet + 400 mg/kg of genistein, respectively. The trial lasted for 8 weeks. Compared with the control, hens fed with CSCM diet had lower egg production (P < 0.05), egg weight (P < 0.05), eggshell strength (P < 0.05) and tibia strength (P < 0.05) as well as higher percentage of albumen (P < 0.05). However, CSCM diet supplemented with genistein significantly increased the egg production (P < 0.05). Also, we found dietary genistein increased the eggshell strength (P < 0.05) as well as the level of genistein in yolk and VTG in the serum (P < 0.05). Compared with CSCM diet, dietary genistein addition elevated the level of progesterone and follicle-stimulating hormone in the serum (P < 0.05). Furthermore, genistein supplementation upregulated the mRNA expression of insulin-like growth factor-binding protein 1 (P = 0.089) and estrogen receptor α (P < 0.05) in the fallopian tube. The vitellogenin (VTG-II) mRNA expression in the liver was significantly upregulated, while amphiregulin mRNA expression in the fallopian tube was downregulated by dietary genistein addition (P < 0.05). Additionally, dietary genistein supplementation at 400 mg/kg increased tibia calcium and phosphorus deposition (P < 0.05) as well as the tibia strength of hens compared with CSCM diet (P < 0.05). In the 400 mg/kg genistein-treated group, the level of calcitonin and alkaline phosphatase in the serum increased (P < 0.05), while 25-hydroxy Vitamin D3 level tended to decrease (P = 0.075). In conclusion, dietary genistein supplementation into CSCM improved the production and quality of eggs as well as bone status of laying broiler breeders during the late egg-laying period.

Key Words: genistein, reproductive performance, tibia, laying broiler breeder

345 Effects of a commercial β-mannanase product on body and bone composition in Pekin ducks. Jungwoo Park*, Micky Clary, John Padgett, Hector Leyva-Jimenez, and John Carey, Texas A&M University, College Station, TX.

Two studies were conducted to verify the effect of β-mannanase (CTCzyme, CTCBio Inc., Seoul, Republic of Korea) on d 25 ducklings. Five different treatments (0% (CON), 0.01% (T01), 0.05% (T05), 0.1% (T10), and 0.2% (T20) of β-mannanase) were used to investigate effect of β-mannanase on duck body and bone composition. Ducklings were randomly housed in battery cage pens containing one bird, replicated 8 times (8 birds treatment). All birds were euthanized via CO2 asphyxiation on d 25 and immediately transferred to the Applied Exercise Science Laboratory at Texas A&M University for Dual-energy x-ray Absorptiometry (DEXA) scanning. To determine body composition, ducks were placed dorsal on the DEXA scanner bed and scanned twice through the DEXA (6 randomly selected ducks per scan). Both left and right tibiae were collected immediately after body composition scanning to determine bone composition. Left tibiae were used to determine bone ash. The bone length and weight were determined after bones were defatted with petroleum ether. Dried bones were ashed at 600°C for 16 h to determine bone ash. Right tibiae were used to determine bone strength. Bones were sheared midshaft using a crosshead speed of 5.0 mm/min. Data from both experiments were analyzed for linear and quadratic effects. The quadratic effects were not significant thus the data were analyzed as a completely randomized block design using the Standard Least Squares procedure of JMP including. Means were deemed significantly different at P ≤ 0.05 and separated using the Least Square Means Differences Student’s t-test. No significant differences were observed in bone weight, length, and percentage of ash results. No significant differences were observed in bone mineral density (BMD) and bone mineral contents (BMC) among the treatments. Significantly stronger bone strength was observed in T05 compared with CON and T20 (P ≤ 0.0291). No significant differences were observed in total fat and lean tissue amount. Treatment T10 had significantly less percentage of body fat than CON and T20 (P ≤ 0.0397). These results indicate that β-mannanase affected bone strength and percentage of body fat of the ducklings. Higher levels of β-mannanase (T20) were not significantly different from CON for duck body and bone composition. β-mannanase appears to affect body and bone composition of Pekin ducks.

Key Words: β-mannanase, Pekin duck, DEXA, bone and body composition, CTCzyme

346 Influence of dietary carotenoids on serum carotenoids levels and live and post-slaughter skin pigmentation of meat-type chicken. Oluwafumilayo Adeleye* and Esther Oginni, University of Ibadan, Ibadan, Oyo, Nigeria.

Carotenoids, bioactive molecules synthesized in plants, are important in the development of hues in the skin and muscles of chickens. In this study, the degree of variation in absorption and assimilation of carotenoids from different plant materials was assessed in serum carotenoid levels as well as live and post-slaughter pigmentation of meat-type chicken. One hundred twenty-eight 1-d-old meat-type chicks were allotted to 4 treatments, 4 replicates of 8 chicks each. Chicks were fed a starter diet for 21 d and thereafter diets containing one of moringa (Moringa oleifera) and baobab (Adansonia digita) leaves, roselle (Hibiscus sabdariffa) calyces and orange (Citrus × sinensis) rind- at 4% of grower/finisher diets for 35 d. Pigmentation of the apterylum and shanks of live chicken were monitored weekly, while shank, breast, vent, back and abdominal fat pigmentation were measured post-slaughter. Skin pigmentation was scored using a DSM broiler fan and serum carotenoids measured as red and yellow pigments by a spectrophotometric method on a weekly basis. Means were compared and separated within time using ANOVA and LSD (P < 0.05). Overall, pigmentation was higher in the shank > vent > breast. Higher live and post-slaughter skin pigmentation was observed in chicken on moringa diet and lower pigmentation in those on roselle diet. Shank pigmentation peaked at 21d for chicken on baobab (102.32 ± 0.10) and roselle (101.32 ± 0.48) diets, and 35d for chicken on the moringa and orange rind (103.75 ± 0.14 and 102.06 ± 0.06, respectively) diets. Apterylum pigmentation peaked at 21d for chicken on baobab (101.54 ± 0.1) and orange (101.40 ± 0.10) diets and 28d for chicken on the moringa (102.40 ± 0.10) diet. Dietary sources of carotenoids did not significantly influence yellow pigment deposition in the serum between 21 and 28d of exposure while red pigment...
deposition in the serum was unaffected by the dietary treatments after 28d of exposure. Yellow pigment composition of serum was significantly lower ($P < 0.05$) in chicken on moringa diet at 14 and 21d (19.84 ± 0.15 and 18.54 ± 0.14 ppm). A similar trend was observed for red pigment composition of serum on chicken diet at 28 and 35d (19.60 ± 0.13 and 18.36 ± 0.19 ppm). Absorption and assimilation of carotenoids varied for the different carotenoid sources assessed. Moringa oleifera leaves significantly improved live and post-slaughter pigmentation of meat-type chicken.

**Key Words:** skin pigmentation, meat-type chicken, carotenoids, yellow and red pigments

### 347 The effects of TYPREX chelate on broiler growth performance, litter coccidial oocysts and cecal microbial profile.

Farina Khattak*, 1 Simon Williams2, Jafar Mahdavi3, and Jos Houdijk1, 1SRUC, Edinburgh, United Kingdom, 2Akeso Biomedical Inc., Waltham, MA, 3University of Nottingham, Nottingham, United Kingdom.

A study was conducted to investigate the effect of TYPREX chelate (ferric tyrosine, Akeso Biomedical Inc., Waltham, MA) on growth performance, litter condition, litter coccidial oocysts and gut microbiota. Five hundred seventy-six male day-old Ross 708 male broilers were allocated to 1 of 4 dietary treatments where ferric tyrosine was added at 0 (T1), 0.02 (T2), 0.05 (T3) and 0.20 (T4) g/kg to wheat/soya-based diets without coccidiostats. Each treatment was replicated 12 times with 12 birds/pen in a randomized complete block design. The experimental diets were fed in mash form for 42 d and stocking density was maintained at 38 kg/m² to mimic commercial conditions of environmental pressure. Both feed and water were available ad libitum. Mean feed intakes and mean body weights were recorded/pen at d 0, 21 and 42 to calculate mean weight gain and mortality-adjusted feed conversion ratios. Litter moisture was determined at d 0 and 35; cecal microbiota composition was assessed at d 35 through percent Guanine + Cytosine profiling of the total chromosomal deoxyribonucleic acid, and litter coccidial oocysts were enumerated at d 42. Data were analyzed by ANOVA using Genstat 16. Compared with T1, T4 birds were 5.5% heavier ($P < 0.05$) at d 42 and weight gain was increased ($P < 0.05$) by 5.6% from d 0 to 42. The feed conversion ratios for the T2, T3 and T4 birds combined improved ($P = 0.061$) by 2.2% compared with T1 birds (1.531 vs. 1.566). Dietary treatments did not affect ($P > 0.05$) feed intakes and litter moisture content. Litter coccidial oocysts were consistently reduced ($−27.9\%$) for all birds fed ferric tyrosine compared with unsupplemented T1, but the differences were only significant ($P = 0.033$) when T4 was compared with T1 ($−42.4\%$; 1.826 vs. 3.173 log10 oocysts/g). In comparison with T1, T4 showed a significant elevation ($P < 0.05$) of microbial dominance at 52–54% Guanine + Cytosine, which is indicative of high-performing healthy birds. In conclusion, addition of ferric tyrosine to broiler diets improved growth, reduced litter coccidial oocyst counts and improved gut health by encouraging the development of a beneficial microbial community.

**Key Words:** ferric tyrosine, growth, litter coccidia, gut microbiota

### 348 Effects of a novel antioxidant blend, Selko POMix, as partial replacement of vitamin E on broiler chicken growth performance, antioxidant status and meat quality.

Gregory Page*, 1 Zahid Nasir1, and Theo van Kempen2, 1Trouw Nutrition Agresearch, Guelph, ON, Canada, 2Trouw Nutrition R&D, Boxmeer, the Netherlands.

Among the numerous antioxidative defense mechanisms, vitamin E is known as a very potent antioxidant that prevents tissue free radical damage. However, there is an over-reliance on vitamin E, with supplementation levels well above NRC 1994 requirements, and which has a relatively narrow affinity for free radical scavenging and limited tissue distribution. In contrast, the antioxidant properties of phenolic compounds are well established and involve radical scavenging, hydrogen or electron donating, and metal chelating activity, in addition to solubility in both lipid and aqueous cell fractions. The present study was aimed at validating the potential of a novel polyphenol blend (Selko POMix; containing *Citrus paradisi*, *Capsicum anuum*, *Thymus vulgaris*, *Curcuma longa*) to replace the supplemental vitamin E above the 10 IU/kg NRC 1994 requirement. A study was performed at Trouw Nutrition Agresearch, Burford, Ontario Canada. A total of 2,250 Ross 708 male coccidiosis-vaccinated chicks were randomly and equally assigned to one of 3 treatments in 45 floor pens. Broilers were fed a 2-phase pelleted corn-soybean meal feed program with BMD (55 ppm), and supplemented with either 50/35 IU/kg vitamin E (starter vs– grower-finisher, respectively), 10 IU/kg Vitamin E (NRC 1994 recommendations), or 10 IU/kg Vitamin E plus 40/25 IU/kg (starter vs– grower-finisher, respectively) vitamin E equivalents of Selko POMix. Feed intake, body weights, and mortality were recorded on d7, 13, 30, 27 and 34, while plasma superoxide dismutase and malondialdehyde levels were measured on d34. Breast meat pH, drip loss, and Hunter L* a* b* scores were measured post-slaughter. Data were analyzed by ANOVA using Minitab 16, with pair-wise comparison of means by Tukeys. Results demonstrated no significant differences in final body weight, average daily weight gain, average daily feed intake, or feed conversion ratio ($P > 0.05$). No significant treatment effects were observed on plasma MDA or SOD concentrations, or on meat (pectoralis major) quality parameters including drip loss, pH, or color up to 10 d of refrigerated storage ($P > 0.05$). High doses of vitamin E performed the same as NRC 1994 requirement of vitamin E plus a vitamin E equivalent antioxidant dose of Selko POMix, making POMix more cost-effective.

**Key Words:** vitamin E, polyphenol, broiler chicken, meat quality, growth performance

### 349 Hydrolyzed yeast and Bacillus subtilis on the production of broiler breeder and incubation parameters.

Jeanna Wilson2, Melina Bonato*, 1 Liliana Borges1, and Ricardo Barbalho3, 1ICC Brazil, São Paulo, São Paulo, Brazil, 2University of Georgia, Athens, GA, 3ICC Brazil, São Paulo, São Paulo, Brazil.

A study was performed with the aim of evaluating the effect of the hydrolyzed yeast as a source of nucleotides, with or without *Bacillus subtilis*, in the production of broiler breeder and incubation parameters. Two thousand Cobb 500 broiler breeder pullet and 200 MX cockerel chicks were obtained from a primary breeder hatchery at 1 d of age. Chicks were randomly distributed to 8 pens and provided a common starter and growing diets through 25 weeks of age or 5% of egg production. At 21 weeks of age, approximately 1,800 pullets were transferred to 36 pens (45 hens and 5 roosters per pen) in a broiler breeder laying facility. Each treatment was represented by 9 replicate pens. The experimental diets started at the 21 weeks of age and the treatments were: hydrolyzed yeast (*Saccharomyces cerevisiae* product - Hilyse, ICC Brazil Company) at 1kg/MT (HY); *Bacillus subtilis* C–3102 (BS) at 3x10⁶ cfu/g; Mix of HY at 1kg/MT and BS at 3x10⁶ cfu/g; and Control diet (CD). The broiler breeders were fed with until 63 weeks of age. The eggs were collected 3 to 4 times daily and total egg production was calculated per week. The breeders were weighed every 4 weeks (all birds). Eggs were incubated 5 times to get incubation parameters (at 35, 40, 45, 50, 55
and 60 weeks of age). Chick number and quality were monitored and a residue breakout was completed on all eggs that did not hatch. Shell quality was measured by specific gravity at 32, 42, 52 and 62 weeks of age. The data were analyzed using the SAS LSD test ($P \leq 0.05$) to separate means when ANOVA F values are significant ($P \leq 0.05$). The hen’s body weight was not affected by the treatments ($P > 0.05$). The supplementation of breeder diets with hydrolyzed yeast improved ($P < 0.05$) egg production (CD 58.5b; HY 60.2a; HLY+BS 56.8c; BS 59.1b, %) and egg size (CD 66.9b; HY 67.2a; HLY+BS 66.7c; BS 66.7c, g), while Bacillus subtilis supplementation improved ($P < 0.05$) shell quality. The hatch of fertile eggs was positively ($P < 0.05$) influenced by HY+BS considering all incubation periods, when compared with control group (94 vs. 92.9). The supplementation of hydrolyzed yeast to broiler breeder diets improved egg production and egg weight, while Bacillus subtilis supplementation improved shell quality and the association of both additives improved the hatchability of fertile eggs.

**Key Words:** egg production, nucleotides, *Saccharomyces cerevisiae*, nutrition, poultry