

Production, Management and the Environment: Poultry

M308 Tibial dyschondroplasia in four crosses of male commercial broilers and its relationship to gait score. P. Y. Hester*¹, P. N. Talaty¹, and M. N. Katanbaf², ¹Purdue University, W. Lafayette, IN, ²Cobb-Vantress, Inc., Monticello, KY.

The objective of the following study was to determine the incidence of tibial dyschondroplasia (TD) among 4 crosses (crosses A, B, C, and D) of male meat-type commercial broilers and its relationship to gait score at 6 wk of age. At 38 and 39 d of age, 360 birds were evaluated individually for gait score. Three male chickens/pen with good walking ability (gait score of 0 or 1) and 3 male chickens/pen with poorer walking ability (gait score of 3) were killed and individual BW determined at 6 wk of age. Both drumsticks were retrieved and the distal and proximal tibia were scored for TD lesion (0 = no lesion; 1 = mild lesion; 2 = moderate lesion; and 3 = severe lesion). Data were analyzed via ANOVA using the mixed model procedure of SAS. Very few birds showed TD lesions. The TD scores were similar among crosses even though gait scores differed among genotypes with cross C having better gait scores than crosses A and B but did not differ from cross D. The TD lesion scores did not differ between male broilers with a gait score of 0 or 1 (mean TD lesion score of 0.03 ± 0.03) as compared with those with a poorer walking ability and a gait score of 3 (mean TD lesion score of 0.08 ± 0.03). The proximal end of the right and left tibia had similar TD lesion scores. The TD lesions scores were higher for the right proximal tibia when compared with the distal ends of the right and left tibia. These results suggest the poorer walking ability of male broilers in this study was not due to TD lesions.

Key Words: tibial dyschondroplasia, male broiler, gait score

M309 Impact of egg storage on blastodermal cell viability and embryonic metabolism in broiler breeders. J. A. Hamidu*¹, Z. Uddin¹, G. M. Fassenko², and D. R. Barreda¹, ¹University of Alberta, Edmonton, Alberta, Canada, ²University of New Mexico, Albuquerque.

The objective of the current study was to investigate the impact of short-term (4 d) and long-term (14 d) egg storage on blastodermal cell viability and embryonic metabolism. Two separated experiments were conducted using Ross 308 broiler strains after egg storage (4 d vs. 14 d) at 18°C and 80% RH. Study-1 involved separation of individual blastoderms into individual cells. The cells were pooled together in each treatment and stained with Annexin V-FITC and propidium iodide. A flow cytometer (BD FACScan) was used to analyze the cell suspensions and separated into percentages of live cells (Annexin V-/PI-), early apoptotic cells (Annexin V+/PI-), necrotic cells (Annexin V-/PI+) and late apoptotic/necrotic cells (Annexin V+/PI+). In study-2, eggs from each treatment were placed in metabolic chambers inside an incubator. Measurements of O₂ consumption and CO₂ production were used to calculate embryonic heat production. Daily dry embryo weights (4 to 21 d of incubation) were measured and used to determine heat production/g embryo weight. All data were analyzed by the proc mixed model procedure of SAS ($P \leq 0.05$). The PDIFF procedure in SAS was applied to separate LSmeans between storage treatments. The percentage of live cells decreased significantly as egg storage duration increased (4 d = $81.17 \pm 2.13\%$ vs. 14 d = $68.18 \pm 2.15\%$). The percentage of early apoptotic cells increased in 14 d ($17.88 \pm 1.87\%$) vs. 4 d ($4.32 \pm 1.89\%$). While daily embryo weight and heat production decreased with egg storage, the heat production/g embryo weight increased. Though embryos from 14 d stored eggs were metabolizing at a higher rate than 4 d storage

group, they had reduced embryonic metabolism. The study indicates that reduction in blastodermal cell numbers following egg storage for 14 d is primarily due to events of apoptosis. Examining genes that induce apoptosis in broiler breeders could be used to slow down the events of apoptosis and increase cell viability, improve embryonic metabolism and embryo survival during incubation.

Key Words: egg storage, viable and apoptotic cells, embryonic metabolism

M310 Influence of hen's age and phenotypic correlation between external and internal traits of eggs. O. T. F. Abanikannda* and A. O. Leigh, Lagos State University, Ojo - Lagos, Nigeria.

Table egg remains the cheapest source of animal protein, however competing demands for nutrients by the hen for its maintenance and production at different stages of lay impact on the quantity and quality of eggs produced. This study investigates the influence of hen's age on quality of egg's external and internal traits. A total of 300 eggs derived from Harco Black layers from 5 ordinal groups based on age [A (22–32), B (33–43), C (44–54), D (55–65) and E (66–76) weeks] consisting of 60 eggs from each group were sampled and measured. Data were analyzed using JMP (7.0.1) statistical software for basic descriptives, correlation, regression and ANOVA. The overall mean \pm SE for egg weight (EGGWT), egg length (EGGLT), egg width (EGGWD), shape index (SHPINDEX), vertical circumference (VTCIRC) and horizontal circumference (HTCIRC) are 55.65 ± 0.28 g, 56.09 ± 0.15 mm, 42.40 ± 0.08 mm, $75.69 \pm 0.19\%$, 15.67 ± 0.03 cm and 13.41 ± 0.03 cm, respectively. The effect of hen's age was highly significant ($P < 0.01$) on all external traits, and accounted for 0.26, 0.22, 0.16, 0.07, 0.27, and 0.33, respectively, of the total variation. Age Group A consistently had the least mean values for all external traits except shape index, while group D recorded the highest. The internal traits exhibited similar trend as the external traits across different age groups, with overall mean values of 15.66 ± 0.12 g, 33.53 ± 0.21 g, 6.46 ± 0.04 g, $28.15 \pm 0.17\%$, $60.93 \pm 0.22\%$, $11.64 \pm 0.06\%$, $46.56 \pm 0.41\%$ and 0.36 ± 0.01 mm respectively for yolk weight (YLKWT), albumen weight (ALBWT), shell weight (SHLLWT), yolk ratio (YLKCRAT), albumen ratio (ALBRAT), shell ratio (SHLRAT), yolk:albumen ratio (YKALBRT) and shell thickness (SHLLTKN). Largest correlation was recorded between Albumen weight and all external traits ($P < 0.05$) except for shape index which was low and not significant. Yolk ratio, albumen ratio and yolk:albumen ratio had very low correlation against all external traits and were not significant ($P > 0.05$). The study revealed that hen's age significantly ($P < 0.05$) affect both external and internal traits of eggs and that some of the internal traits had moderate to high correlation with most of the external traits studied.

Table 1. Phenotypic correlations between external and internal traits of egg

	YLKWT	ALBWT	SHLLWT	YLKCRAT	ALBRAT	SHLRAT	YKALBRT	SHLLTKN
EGGWT	0.591*	0.877*	0.603*	-0.071	0.017	-0.260*	0.052	0.138*
EGGLT	0.444*	0.621*	0.488*	-0.030	0.071	-0.128*	0.040	0.013
EGGWD	0.476*	0.701*	0.505*	-0.060	0.052	-0.190*	0.062	0.119*
VTCIRC	0.518*	0.763*	0.546*	-0.058	0.109	-0.202*	-0.076	0.020
HTCIRC	0.499*	0.682*	0.436*	-0.017	0.015	-0.252*	-0.009	0.130*
SHPINDEX	-0.100	-0.109	-0.133*	-0.016	-0.027	-0.024	-0.010	0.064

*= Statistical Significance ($P < 0.05$).

Key Words: egg, hen age, phenotypic correlation

M311 Effects of heat stress on egg production and quality in two strains of layers. L. A. Mack^{*1}, J. N. Felver-Gant¹, R. L. Dennis², and H. W. Cheng², ¹Purdue University, West Lafayette, IN, ²LBRU, USDA-ARS, West Lafayette, IN.

Heat stress is a problem for both egg production and bird well-being. Given a stressor, genetic differences can alter the type and degree of birds' responses and their adaptation. This study examined heat stress responses of 2 strains of White Leghorns: DeKalb XL (DXL), an individually-selected, commercial strain and a strain of kind, gentle birds (KGB) genetically-selected on high group productivity and survivability. Ninety 28wk-old birds (48 DXL, 42 KGB) were randomly paired, housed by strain, and assigned to hot (H) or control (C) treatments for 14 d (mean: H = 32.6°C, C = 24.3°C). Birds' egg production (egg number, EN; egg weight, EW; shell thickness, ST; and percentage of broken eggs, PB), behavior, and physical variables (BW; ovary weight, OW; number of mature follicles, FN; and crop feed weight, CF) were measured. Data were analyzed in SAS using the mixed models procedures. Compared with C birds, EN, EW, and ST were lower in H birds across both strains ($P < 0.05$). In H birds but not in C birds, both EN and EW increased over time while ST decreased. The PB tended to be greatest in the H-DXL, intermediate in the C birds, and lowest in the H-KGB birds, but a significant difference was found between H-DXL and H-KGB only ($P < 0.5$). Behaviorally, comparing treatments, H birds spent more time drinking and resting, and less time sitting ($P < 0.05$) than C birds. Comparing strains, DXL birds rested more on d 1 ($P < 0.05$) and tended to drink more on d 13 than KGB birds ($P < 0.1$). C-KGB birds ate more frequently than C-DXL birds on d 6 and 11 ($P < 0.05$) but no strain difference was evident in responding to heat stress ($P > 0.05$). H-KGB birds tended to have lower CF than C-KGB birds at both wk 1 and 2, while H-DXL birds tended to have higher CF than C-DXL birds at wk 1 only ($P < 0.1$). Body weight, d 14 OW and FN were all reduced in the H birds compared with relative controls ($P < 0.05$). Although heat stress reduced production variables in both strains of birds, genetic background shaped both the nature and intensity of the response.

Key Words: heat stress, egg quality, behavior

M312 Effect of litter type and wetness on foot pad dermatitis in broiler chickens. O. Cengiz^{*1}, J. B. Hess², and S. F. Bilgili², ¹Adnan Menderes University, Aydin, Turkey, ²Auburn University, Auburn, AL.

An experiment was conducted to determine if wetting fresh or used litter for a short period of time during the latter part of the grow-out could influence the incidence and severity of foot pad dermatitis (FPD) in broiler chickens with and without existing lesions. A total of 2 hundred male broiler chickens with and without existing FPD lesions were selected from a 52-d old (Ross 708) flock and reared to 67 d of age in a design consisting of 2 × 2 arrangement of litter type (fresh or used) and added moisture (with or without added water). Broilers (8 treatments; 5 birds per pen; 40 pens total) were reared in floor pens (3 × 4 ft) prepared with used or fresh pine shavings bedding (8 cm deep). One half of the pens were wetted with a gallon of water daily for 5 d starting on Day 52. Litter samples were collected, pooled and analyzed for moisture at 56 and 67 d of age. FPD incidence and severity were assessed at the end of the study by using a 3-point scale. A common withdrawal feed and water were freely available; lighting was continuous throughout the study. Data were analyzed as a factorial design by the GLM procedure of SAS, Inc. Moisture level was higher with used than fresh litter on Day 56 ($P < 0.05$) but not on Day 67 of the trial. Wetting increased the moisture level from an average of 24 to 54% on Day 56. Litter moisture remained high in fresh wetted pens, but was equalized between the

two litter types by Day 67. Placing the birds with FPD lesions on fresh bedding significantly reduced the incidence at 67 days of age (78 and 50% for used and fresh litter, respectively). Similarly, FPD severity was also reduced from 42 to 14% with fresh, as compared to used litter. Wetting treatment did not affect FPD incidence, but reduced mild ($P < 0.06$) and severe ($P < 0.07$) lesions at 67 days of age. Neither litter type nor litter wetting influenced FPD incidence or severity in adult birds without existing FPD lesions. These findings indicate that FPD may be occurring early in the grow-out and that improvements in litter quality can reverse the severity of lesions in market age broilers. In addition, in older broiler chickens, exposure to wet litter conditions for short periods prior to marketing is not sufficient to induce FPD.

Key Words: broiler, foot pad dermatitis, litter moisture

M313 Eggshell quality of Japanese quail (*Coturnix japonica*) after long-term selection for egg production. M. M. Fathi^{*1}, A. E. El-Dlebhshany², and M. Bahie El-Deen², ¹Al-Qassim University, Buridah, Al-Qassim, Saudi Arabia, ²Alexandria University, El-Shatby, Alex., Egypt.

An experiment was conducted to evaluate egg quality and ultrastructural measurements of eggshell using scanning electron microscopy (SEM) in 2 lines (selected and control) of Japanese quails. Selection program was applied over 22 consecutive generations for higher egg production and lower broken egg percentage. The results revealed that the females of selected line significantly ($P < 0.01$) produced higher egg mass compared with that of control line. Also, selection procedure resulted in significantly improvement in feed conversion ratio. The eggshell of selected line had a higher breaking strength compared with that of control line, although there was no difference between them in shell thickness. Significantly higher wet ($P < 0.01$) and dry ($P < 0.05$) eggshell percentages were found in selected line. In general, the eggshells of selected line had a lower total score (good) of ultrastructural evaluation compared with control line. According to scanning electron microscopy data, the incidence of certain structural variants is more common in eggshell of control line suggesting poor shell strength. Alignment appearance was more prevalent in control eggshells compared with selected ones, suggesting lower resistance to breakage. Late fusion and large interstitial spaces of palisade layer indicating decrease resistance to fracture were observed in control eggshells. It could be concluded that long-term selection for egg production over 22 generations improved mammillary layer measurements and in turn breaking strength.

Key Words: Japanese quail, ultrastructural measurements, eggshell quality

M314 Effects of ambient temperature on body weight, cloacal temperature and blood traits in Pekin ducks. J. F. Huang^{*1}, C. H. Su¹, C. C. Lin², J. H. Lin¹, and S. R. Lee¹, ¹Ilan Branch, Livestock Research Institute, Ilan, Taiwan, ²National Ilan University, Ilan, Taiwan.

This study aimed to investigate the effects of ambient temperature on body weight, cloacal temperature, and blood traits in Pekin ducks. A total of 36 Pekin ducks at 10–11 weeks of age were randomly assigned into 3 temperature groups: (1) 25 ± 1°C (LT), (2) 30 ± 1°C (MT), and (3) 35 ± 1°C (HT) and raised in an individual cage in a climate chamber. The relative humidity was 80–85% for all groups. This study lasted for 3 weeks. Body weight, feed intake, cloacal temperature and blood traits were determined once a week. The data was analyzed by the General Linear Model procedure of the Statistical Analysis System. The most dramatic decrease in body weight was observed in the HT group, followed by MT and then LT groups. Although there was a trend

of lower feed intake in the MT and HT groups, no significant differences among treatments were observed. After one week of treatment, significant differences in cloacal temperature were observed between the LT and HT groups. However, this significance disappeared after 2 weeks of treatment, probably due to adaptation of ducks to high ambient temperature. The cloacal temperatures in the MT and HT groups after 2 weeks of treatment were lower compared with those measured after one week of treatment. The blood traits showed that levels of calcium, sodium, magnesium, chloride ions, glucose, and total cholesterol were decreased in the MT and HT groups after one week of treatment, but were increased thereafter. However, the levels of the blood traits were relatively stable in the LT group throughout this study. The high ambient temperature caused the most remarkable decrease in body weight and blood traits and the most remarkable increase in cloacal temperature in the first week.

Key Words: ambient temperature, blood trait, Pekin duck

M315 The study on correlation between the liver enzyme activity and dioxin contents in the eggs of laying Brown Tsaiya ducks. C. C. Lin^{*1}, T. H. Ueng², Y. H. Lin¹, J. F. Huang³, and S. R. Lee³, ¹National Ilan University, Ilan, Taiwan, ²National Taiwan University, Taipei, Taiwan, ³Ilan Branch, Livestock Research Institute, Ilan, Taiwan.

The objective of this study was to study the correlation between the liver enzyme activity and dioxin contents in the eggs of laying Brown Tsaiya ducks. One hundred Brown Tsaiya ducks (119 d old) were raised in the Hsiangsi township (dioxin-contaminated area) and Wuchieh township (not dioxin-contaminated area), respectively. In each township, 50 ducks were raised on the ground and 50 ducks were raised in the cage. This study lasted for 7 mo. In each month, we collected duck liver microsomes to detect 7-ethoxy resorufin O-deethylase (EROD), 7-pentoxoresorufin O-dealkylase (PROD), and 7-ethoxycoumarin O-deethylase (ECOD) activity and also collected the egg samples for analysis and calculation of dioxin toxic equivalency (TEQ_{DF}) by high-resolution gas chromatography/mass spectrometry (HRGC/HRMS). Then, the correlation coefficient was calculated between liver enzyme activity and HRGC/HRMS results. An average correlation coefficient of 0.95 was observed between duck liver EROD and duck egg dioxin TEQ_{DF}. In contrast, a very low correlation coefficient was observed between liver PROD or ECOD activity and dioxin TEQ_{DF} in duck eggs. Furthermore, we used real-time PCR to determine CYP1A4 mRNA expression in duck liver. It showed the highest value of CYP1A4 expression was observed in the liver of ducks raised on the ground of dioxin-contaminated area compared with those in other treatments. The high correlation coefficient between liver EROD activity and dioxin TEQ_{DF} in duck eggs suggests that EROD is a valuable bio-marker of dioxin contamination in Brown Tsaiya ducks.

Key Words: Brown Tsaiya duck, dioxin, EROD

M316 Safety of industrial hemp as feed ingredient in the diets of laying hens and its impact on their performance. N. Gakhar^{*}, E. Goldberg, and J. D. House, *University of Manitoba, Winnipeg, MB, Canada.*

Despite the utility of industrial hemp (*Cannabis sativa* L.) as a source of fiber and seed, its cultivation in N. America in the past was deemed illegal, due to concerns over the presence of the psychoactive compound tetrahydrocannabinol (THC) in the plant components. Regulatory changes undertaken by the Canadian government in 1998 permitted the use of cannabis cultivars containing lower concentrations (<0.3%) of THC. These changes present an opportunity to exploit the immense

untapped potential of industrial hemp. Keeping this in perspective, a total of sixteen 19-wk-old individually housed Bovan White laying hens were fed one of the 2 diets containing 10 and 20% of hemp seed (HS). Concurrently, a total of twenty-four 19-wk-old individually housed Bovan White laying hens were fed one of the 3 diets containing 4, 8 and 12% of hemp oil (HO). Eight birds fed wheat, soy and corn oil based diets served as control. The diets were fed over a period of 12 weeks. All the diets were formulated to be isonitrogenous and isoenergetic. Daily egg weights, egg production, average daily feed intake (ADFI), feed efficiency (FE) and weekly body weights were recorded for the entire 12 weeks. Shell thickness and Haugh units (HU) were recorded from the eggs collected in wk 4, 8 and 12. Data were subjected to statistical analysis using Proc Mixed procedure of SAS. Daily egg weights (55.13 vs. 51.49 ± 1.2 g), FE (1.74 vs. 1.88 ± 0.04) and body weights (1.47 vs. 1.43 ± 0.02 kg) were higher ($P < 0.05$) for the birds fed 20% HS in comparison to the control. ADFI was lower ($P < 0.05$) in all HO treatments as compared with the control. Hen day egg production (91.12 vs. 96.84 ± 0.07%) and HU (83.8 vs. 86.8 ± 1.53 HU) were lower ($P < 0.05$) in 4% HO group whereas HU increased ($P < 0.05$) in 8% HO group as compared with the control. FE was higher ($P < 0.05$) in 12% HO group (1.70 vs. 1.85 ± 0.04) as compared with the control. In conclusion, this study allays concerns over the safety of feeding industrial hemp to the laying hens and demonstrates the positive impact of feeding HS on their performance.

Key Words: laying hens, hemp seed, hemp oil

M317 Duckweed as a feed ingredient in laying hen diet and its effect on egg production and composition. K. E. Anderson^{*}, Z. Lowman, A. Stomp, and J. Chang, *North Carolina State University, Raleigh.*

Duckweed is a native North Carolina aquatic plant that can be used for bio-fuels (ethanol) and animal feeds. Researchers at North Carolina State University have worked for a decade and have developed a system to produce high-protein duckweed biomass utilizing the nutrient-rich effluent from anaerobic digestion of swine wastewater. This aspect of the project was to evaluate data generated in a feeding trial utilizing the duckweed biomass as a protein source in laying hen feed. First, the nutrient and energy composition of the Duckweed grown in these conditions was determined, and found to contain 29.05% CP, 25.08% C Fiber, and 695 kcal/kg AMEn based on a feeding trial with marker. Then a completely randomized design study to evaluate the impact of duckweed on the performance of a commercial layer egg production and feed conversion was conducted. Two layer diets were formulated to be iso-nitrogenous (18.1% crude protein) and Iso-caloric (2930 kcal/kg). The Control (C) no Duckweed and Duckweed (D), using the analysis to formulate the diet containing 12.6% duckweed. The study, utilized 60, 76 wk old Hy-Line, W-36 hens that were individually caged such that 30 hens received the C diet and the remaining 30 hens received the D diet. During the 12 wk study performance criteria were monitored daily and each week USDA grades, Haugh unit, shell strength, vitelline membrane strength, and yolk color data was collected on 1 d production. The data was analyzed using the Proc T-Test procedure, with significant differences of ($P < 0.05$) determined by *t*-test. On wk 3, 7, and 11 whole 6 egg pooled samples were collected and sent in for nutrient composition laboratory analysis. Diet had no impact on the hen-day production. There was a significant increase ($P < 0.05$) in the percent grade B eggs in the hens fed the D by 2% over the C hens. Surprisingly, there was no difference in the nutrient composition of the eggs except for omega-3 fatty acids concentration which were 0.06% higher ($P < 0.0001$) than in the C hens. The results indicate that duckweed can be fed at a 12.6%

inclusion rate and not impact the performance of laying hens and may be a means of enhancing omega-3 fatty acid concentration in eggs.

Key Words: laying hen, duckweed, egg nutrient composition

M318 Blood lipid concentration and performance parameters of broiler was fed by tomato pomace and turmeric powder under heat stress condition. S. J. Hosseini-Vashan^{1,2}, A. Golian*¹, A. Yag-hobfar², H. Lotfolahian², and P. Esmailinasab³, ¹Ferdowsi University of Mashhad, Mashhad, Khorasan Razavi, IR Iran, ²Animal Science Research Institute, Karaj, Tehran, IR Iran, ³Birjand University, Birjand, Khorasan Jonobi, IR Iran.

The effects of including tomato pomace and turmeric powder in dietary broiler chickens, on performance and lipid concentration were evaluated. 440 one-day old Arian broiler were randomly allotted into 20 pens which were assigned to 5 dietary treatments containing 0 (control), 3 or 5% tomato pomace, or 0.4 or 0.8% turmeric powder. Each dietary treatment was replicated 4 times with 22 broilers per pen. Feed and water were offered ad libitum. The ambient temperature was increased from 22 to 32°C for 5 h (10–15 h) on study d 28 to 42 (simulating diurnal temperature during heat stress). Relative humidity ranged from 50% to 65%. On study d 42, one bird from each replicate was randomly selected, slaughtered and blood samples taken from the jugular vein. Data were pooled and analyzed using the general linear model of SAS, and means were separated by Tukey test when $P < 0.05$. Dietary treatments did not influence ($P > 0.05$) body weight gain and feed intake. Feed conversion (intake/gain) was not affected by dietary treatments until d 28, after which it decreased ($P < 0.05$) in birds fed diets with a high content of tomato pomace and turmeric powder. Total cholesterol and triglyceride content of serum did not differ ($P > 0.05$) among dietary treatments. Birds fed diets with high contents of tomato pomace had higher ($P < 0.05$) concentration of HDL cholesterol in serum and no differences were found among birds fed the control diet and diets containing turmeric powder. The lowest serum LDL cholesterol was observed when birds were fed the diet containing 5% tomato pomace. It is concluded that supplementation of 5% tomato pomace and 0.8% of turmeric powder could alleviate the effects of heat stress on feed conversion and they could modulate the serum concentration of LDL and HDL cholesterol.

Key Words: tomato pomace, turmeric powder, heat stress

M319 Reduction of *Clostridium perfringens* colonization in turkey poult by feeding Primalac. S. Rahimi¹, J. L. Grimes*², S. Kathariou², and R. Siletzky², ¹Tarbiat Modares University, Tehran, Islamic Republic of Iran, ²North Carolina State University, Raleigh.

Clostridium perfringens (CP) is recognized as an enteric pathogen in humans, domestic animals, and livestock. This organism is associated with necrotic enteritis, gangrenous dermatitis, clostridial dermatitis (turkeys) and gizzard erosion in poultry. This study was conducted to evaluate the effectiveness of a direct-fed microbial (DFM), Primalac (PM), as a preventative or mitigator of intestinal colonization by *C. perfringens* in turkey poults. One hundred and 20 8 d-old Large White Turkey poults were randomly divided into 4 treatments with 4 replicates (8 birds/pen) consisting of 1) basal diet (C); 2) basal diet supplemented with PM (1.5 kg/ton); 3) basal diet with poults gavaged with *C. perfringens* (C+CP); 4) basal diet supplemented with PM and poults gavaged with *C. perfringens* (PM+CP). Feed and distilled water were provided ad libitum throughout the trial. On d 3 and 7, each bird in CP groups were gavaged with 1 mL of *C. perfringens* (10^8 cfu/mL). On d 21, 2 birds per pen were killed. Spleen and bursa of Fabricius

(BF) were collected and weighed. On d 21, cecal contents were used for *C. perfringens* enumeration. Feed consumption (FC), BW and feed conversion ratio (FCR) were calculated weekly and cumulatively. Data were analyzed using GLM of SAS ($P < 0.05$). The *C. perfringens* in ceca were C–5.88^{bc}, C+CP–7.26^a, PM–5.35^c, PM+CP–6.19^b ± 0.36 log₁₀ cfu/g. No differences were observed for BW, FC, FCR, organ weights, or relative organ weights. Further studies are needed to fully ascertain the potential of using DFM (Primalac) to reduce the colonization of *C. perfringens* in the gastrointestinal tract of turkey poults.

Key Words: *Clostridium perfringens*, direct fed microbial, turkey

M320 Influence of *Bacillus subtilis* PB6 (CloSTAT) on the performance of Hyline W-98 layers from 68 to 102 weeks of age. M. Elliot¹, R. Myers², A. Lamptey², and A. G. Yersin*², ¹A&E Nutrition Services, LLC, Lititz, PA, ²Kemin AgriFoods, Des Moines, IA.

The microbial population of the gastrointestinal tract is influenced by several factors, including pH, substrate availability, toxins, antibodies, and other bacteria. Birds possess an unstable microbial ecosystem and poorly digested nutrients and anti-nutritional factors can lead to undesirable microbial growth, often resulting in a negative impact on performance. Periods of stress can cause a shift in the microbial profile from positive to negative. Products, such as CloSTAT Dry Direct-Fed Microbial, a DFM based on a patented *Bacillus subtilis* PB6 organism, assist in maintaining intestinal microbial balance. A study was conducted at a commercial laying operation to evaluate the effect of CloSTAT on the performance of Hyline W-98 layers from 68 to 102 weeks of age. One house, utilizing a split feeding system, was utilized in the study. This arrangement allowed one group of 136,000 hens to be fed the control diet and another group of 136,000 hens to receive the DFM treatment under similar housing conditions. CloSTAT was added at 1 lb/ton (0.5 kg/tonne) to normal second cycle diets 2–3 weeks before induction of the molt and fed for an additional 34 weeks. Egg production, egg weight, body weight, feed intake and mortality were measured weekly. Egg production and mortality tended to be improved in the CloSTAT group throughout the trial, resulting in an increase of 1.9 eggs per hen-housed and 0.57 lb (0.25 kg) of egg per hen-housed and a 1.5% reduction in mortality in the CloSTAT group. Feed intake and body weight were slightly elevated in the CloSTAT group through approximately 83 weeks of age, after which there was no discernible difference between treatment groups. The results of this trial suggest that the use of CloSTAT will result in improved production, improved hen-housed eggs and decreased mortality in second cycle Hyline W-98 layers.

Key Words: *Bacillus subtilis*, layers, egg yield

M321 Do dietary protein:energy ratios modify growth and frame size of young broiler breeder females? E. Mba*, R. A. Renema, A. Pishnamazi, and M. J. Zuidhof, *University of Alberta, Edmonton, AB, Canada.*

Feeding practices to minimize muscling of broiler breeder pullets could improve maternal support for early egg production and long-term maintenance of lay. A total of 1,140 Ross 708 broiler breeder females were divided into 30 pens (38/pen) and fed a common starter ration until 3 wk of age, when experimental diets began. Pens were randomly assigned to a high energy (HE), standard energy (STD) or low energy (LE) treatment and a low protein (LP) or high protein (HP) treatment in a 3 × 2 factorial with 3 energy (2,600 kcal, 2,800 kcal and 2,950 kcal) and 2 crude protein levels (14% and 16%). Pen BW was determined 2×/wk to allow feed allocation changes to maintain a common BW target. Individual BW was recorded every 2 wk from 3 wk of age and frame size parameters

(shank length, keel length, and thoracic width) measured every 4 wk. Results were assessed with the proc MIXED procedure of SAS, with significance assessed at the $P < 0.05$ level. Feed intake varied widely to achieve BW targets, ranging from 47.9 (HP-HE) to 54.2 g/bird/day (LP-LE) by 9 wk of age. Differences in feeding level did not impact growth as measured by shank or keel length. On average, LE birds ate 9% more feed than HE or STD birds ($P=0.002$). Hence, the HE ration provided no growth benefit to the birds compared to the STD diet. Birds fed the LP diet consumed approximately 10% more feed than HP birds to maintain a similar rate of BW gain ($P=0.001$). Increased diet density had the potential to improve BW uniformity. The higher density HP/HE feed resulted in a BW CV of 13.7 compared to 15.1 for birds fed the lower density LP-LE diet. Impact of diets that elevated ME intake at the expense of CP were of interest. The HE-LP diet resulted in the highest overall ME intake/g feed (0.43/g) while providing average feed volume and measures of BW CV. However, when total intake of CP or ME per g of BW gain was measured, there were no differences among treatments. In this phase of growth, the degree of feed restriction limits lipid deposition, which may be masking the impact of unbalanced CP or ME intake.

Key Words: broiler breeders, CP, ME

M322 Population densities impact on feed intake and growth performance in Japanese quail. D. Cardoso-Jiménez¹, A. Z. M. Salem^{*1,2}, R. Rojo¹, S. R. Rebollar¹, and A. Perez-Chávez¹, ¹Universidad Autónoma del Estado de México, Centro Universitario UAEM-Temascaltepec, Estado de México, México, ²University of Alexandria, Department of Animal Production, Faculty of Agriculture (El-Shatby), Egypt.

Two-hundred seventy-six Japanese quail (*Coturnix coturnix japonica*) of 17 d of age were used to investigate the impact of population densities on quail feed intake and growth performance. A complete random design of 3 population densities (80 (PD80), 100 (PD100), and 120 (PD120) birds/m²) of 4 repetitions were used during 17 d of the experiment in floor housing system of 4 pens for each population densities type. Dry matter intake (DMI), average daily gain (ADG), Feed conversion (FC) and mortality were evaluated. DMI was improved ($P < 0.05$) at PD120 than PD100 or PD80 (380, 313 and 310g DM/bird, respectively). No significant differences were observed among treatments in ADG, whereas the FC was significantly ($P < 0.05$) improved at PD80 compared with PD100 and PD120 (3.7, 4, 5.6, respectively). A similar mortality of 1% was observed at the 3 experimental treatments. Population densities may be a very important factor that could affect on quails growth performance. Data suggested that, population sizes at 80 birds/m² was better than the other densities used

Key Words: Japanese quail, population density, growth performance

M323 Effects of dietary energy and broiler breeder hen energetic efficiency on egg production and fertility. T. G. V. Moraes*, M. J. Zuidhof, A. Pishnamazi, and R. A. Renema, University of Alberta, Edmonton, Alberta, Canada.

The effects of dietary energy and broiler breeder hen efficiency on production traits and duration of fertility were examined. At 21 wk, 192 Ross

708 pullets were individually caged in 1 of 6 environment chambers, and photostimulated at 23 wk. Birds were fed either a high energy (HE; 2900 kcal/kg) or low energy (LE; 2700 kcal/kg) diet. At 41 wk of age, individual energetic efficiency was determined through calculation of residual MEM (RME_M), which was the difference between observed and predicted maintenance requirements relative to ME intake. The highest and lowest efficiency hens ($n = 32$ /group) were inseminated on 2 consecutive days. Eggs were collected for 21 d to measure duration of fertility. Results were analyzed with the MIXED procedure of SAS. Efficient hens were 266 g heavier than inefficient hens ($P < 0.0001$), which did not affect egg size. Though egg numbers were similar, efficient hens produced 1.52 g/d more egg mass than inefficient hens ($P = 0.025$). At dissection (46 wk of age), inefficient hens had less breast muscle (19.8%) than efficient hens (20.8%), but neither % fatpad nor fertility were affected by hen efficiency. Egg weight in the LE treatment was 0.9 g more than HE eggs ($P = 0.056$), likely a result of 0.91 g/d higher CP intake with LE feed ($P = 0.13$). Duration of fertility of hens on the LE diet was 12.8 d compared to 11.8 d in HE treatment ($P = 0.034$). Hatch of fertile was similar among all treatment groups (mean=92.7 ± 1.5%). Breast muscle was larger in LE hens (20.7%) vs. HE hens (19.9%) and fatpad was 0.41% lower ($P = 0.0004$). These results suggest that the higher ME:CP ratio may reduce fertility due to lower CP intake.

Key Words: broiler breeder efficiency, metabolizable energy, fertility

M324 Growth performance of Pearl Grey guinea fowl subjected to varying floor densities from hatch to fourteen weeks of age. S. Nahashon*, J. Tyus, and D. Wright, Tennessee State University, Nashville.

Little is known of the required floor density for optimum performance of the Pearl Grey guinea fowl. The objective of this study was to assess the effect of varying floor densities on growth performance of the Pearl Grey guinea fowl. In 3 replicates, 786 1-d-old French guinea keets were weighed individually and randomly assigned to floor pens covered with pine wood shavings at 80, 69, 60 and 53 birds/pen, equivalent to densities of 18, 15.6, 13.6, and 12 birds/m², respectively. Birds in these floor densities were allowed feeder space of 2.3, 2.7, 3.1, and 3.5 cm/bird, respectively, and water space of 1.2, 1.4, 1.6, and 1.8 cm/bird, respectively. All birds received 23 h and 12 h lighting regimen at 0–8 and 9–14 weeks of age (WOA) and were fed diets comprising 3,000 and 3,100 kcal of ME/kg of diet at 0–5 and 6–8 WOA, respectively, and 24% CP. The birds were fed diets comprising 3,100 kcal ME/kg of diet and 18% CP at 9–14 WOA. Feed and water were provided for ad libitum consumption. Body weight and feed consumption (FC) were measured weekly. Overall body weight gains (BWG) were higher ($P < 0.05$) and feed conversion ratios (FCR) were significantly lower in birds reared on floor density of 18 birds/m² when compared with birds on floor densities of 12, 13.6 and 15.6 birds/m² at 0–8 WOA. However at 9–14 WOA, birds in floor densities of 12 birds/m² exhibited higher BWG and feed consumption and significantly lower FCR ($P < 0.05$) than those reared on 13.6, 15.6 and 18 birds/m². Therefore, pearl gray guinea fowl seem to exhibit superior performance when reared at floor densities of 18 birds/m² at 0–8 WOA and 12 birds/m² at 9–14 WOA.

Key Words: Pearl Grey guinea fowl, floor density, growth performance