significant, the Tukey test was used to separate treatment means. From 0 to 5 wk of age, no interactions between beak trimming and OH inclusion were detected for any trait, and therefore, only main effects are presented. Water intake and water to feed intake ratio were greater for the non-treated than for the beak- trimmed pullets ($P < 0.001$). The preference for coarse particles was greater for the intact beak birds than for the beak-trimmed birds ($P < 0.001$). Diet did not affect any of the GIT traits studied ($P > 0.05$). An interaction between beak trimming and age was observed for water intake and water to feed intake ratio. Non-treated pullets drank morewater and had higher water to feed intake ratio than beak-trimmed pullets from 0 to 4 wk of age. However, no differences were detected thereafter. In summary, infrared beak trimming at hatch reduced water intake and water to feed intake ratio but did not affect GIT development. Non-trimmed pullets showed a clear preference for coarse particles compared with treated pullets as indicated by the higher percentage of fine particles (< 315 µm) in the residual feeds. The inclusion of OH in the diet did not affect water intake or GIT development but increased the preference of the pullets for coarse particles ($P < 0.001$).

Key Words: beak trimming, oat hulls, preference behaviour, pullets, water intake

210 Feed processing technologies on *Camelina sativa* and its effect on performance in laying hens. Kiana A. Rieger* [GS], Rex Newkirk; *Animal and Poultry Science, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.*

Incorporating Camelina sativa (camelina) meal into poultry feed provides an alternative ingredient to flax in order to produce an omega-3 egg. However, anti-nutritional factors limit the inclusion level to 10% in laying hen formulations, reducing its efficacy for use in omega-3 egg production. It was hypothesized that heat treating camelina would reduce anti-nutritional factors and increase feed efficiency and egg production, and that cold-pressed camelina meal would result in similar egg production and feed efficiency to flax meal. A total of 1,080 Lohmann LSL Lite laying hens were fed one of ten experimental treatments ad libitum in a 112-day trial consisting of a 5x2 factorial design including five experimental meals (extruded camelina, pelleted camelina, cold-pressed camelina, hot-pressed camelina, flax) by two inclusion levels (10% and 20%). Each treatment was replicated 9 times, with 12 birds per replication. Experimental diets were formulated to reach the omega-3 polyunsaturated fatty acid composition required to produce an omega-3 claim (>300 mg/egg). Hen performance was measured through feed consumption, egg production, and visual assessment of the eggs. Egg production was assessed 5 days a week and analysed as percentlay, visual assessment was recorded during daily egg collections, and feed was weighed back every 28 days. The data was analysed as a 2-way ANOVA in a completely randomized block design as a 5x2 factorial with statistical significance being declared at $P < 0.05$. The 20% flax meal treatment was terminated after 4 weeks of the study due to excessive reductions in body weight and egg production. At 10% inclusion, flax meal and cold-pressed camelina meal resulted in the lowest average percent lay for the overall period (84.4% and 83.3%, respectively). Hot pressing and pelleting camelina meal numerically increased production over both flax and cold-pressed camelina meal (91.4% and 90.7%, respectively). Flax meal resulted in the highest feed intake but the lowest egg production. However, pelleting and hot pressing tended to increase feed intake suggesting that reductions in anti-nutritional factors may have improved palatability. At the 20% level, egg production decreased in all treatments. Extrusion and pelleting numerically increased production over hot and cold-pressed camelina meal (83.9%, 80.4%, 72.6% and 76.4%, respectively). There were no significant differences in feed intake at the 20% level. In conclusion, heat processing camelina improved the performance of laying hens through an increased egg production. However, at the 20% inclusion level, performance was decreased across all feed groups.

Key Words: camelina, flax, feed processing, fatty acids, omega-3

211 Influence of the inclusion of *Aspergillus oryzae* on productive performance and egg quality of brown hens from 15 to 43 weeks of age. A.F. de Juan* [GS 1], Ignacio R. Ipharraguerre[2], J. Ben Mabrouk[1], C. Ocasio-Vega[3], L. Aguirre[1], Gonzalo Mateos[1]; *[1]UPM, Madrid, Madrid, Spain, [2]Institute of Human Nutrition and Food Science, University of Kiel, Kiel, Germany, [3]BioZyme Incorporated, St. Joseph, Missouri, United States.*

The object of this study was to determine the effects of the dietary inclusion of either a prebiotic (PRE)or a postbiotic (PTO) both of them obtained from Aspergillus oryzae (AO) on performance and egg quality traits of Lohmann Brown Classic hens from 15 to 43 wk of age. The experimental design was completely randomized with 3 treatments that consisted in a control diet with 2,750 kcal AMEn/kg and16.9% of CP and the same diet supplementedwith 50 ppm of PTO or 500 ppm of PRE. Each treatment was replicated 24 times and the experimental unit was the cage with an individual hen. The experiment lasted 28 wk (7 periods of 4 wk each). Egg production, egg weight, shell-less, broken, and dirty eggs, and mortality were controlled daily, and feed disappearance was measured weekly. The proportion of albumen, yolk, and shell of the eggs, shell quality traits (weight, strength, and thickness), and Haugh units were measured in all the eggs produced for the last 2 d of each of the 7 experimental periods. BW of the hens was measured at the start of the trial and at the end of each of the 7 experimental periods. In addition, the quality of the excreta (moisture content and visual score by two independent observers) and the AME of the feeds were determined at 35 wk of age. Also, Escherichia coli, Clostridium perfringens, total coliforms, Enterobacteriaceae, and Lactobacillus spp. colonies were

measured in representative excreta samples. Data were analyzed as a completely randomized design with type of diet as main effect by using the GLM procedure of SAS. In addition, the effect of AO supplementation was also studied by using orthogonal contrast (AO containing diets vs. control diet). Contrast of AO containing diets against the control diet was done by using a Dunnett's test. From 15 to 43 wk of age, AO supplementation reduced ($P < 0.05$) the incidence of shell-less eggs. In addition, from 15 to 21 wk of age, the feedingof PTO increased egg production by 9% and improved FCR by 8% but the differences were not significant. No significant effect was observed for any of the bacteria colonies studied. The inclusion of AO in the diet might increase hen performance and eggshell quality. A second study to measure hen production and egg quality during the first stages of the egg cycle using a larger number of hens to reduce the variability among replicates is granted.

Key Words: Aspergillus oryzae, egg quality, hen performance, laying hen, postbiotic

212 Allometric coeffient and energy for maintenance in pullets and laying hens. Freddy Horna* [GS], Matheus D. Reis, Rony Riveros Lizana, Raully L. Silva, Carolina Cardoso Nagib Nascimento, Bruno Balbino Leme, Nilva Sakomura; *Animal Science, Sao Paulo State University, Jaboticabal, Sao Paulo, Brazil.*

In the net energy system, the relationship between basal metabolic rate (or fasting heat production, FHP) and body mass (BW) is an important issue in energy requirements estimation. FHP is typically scaled with BW according to the equation $FHP=aBW^b$, where a is the constant and b is the allometric exponent. The allometric coefficient of 0.75 suggested by Kleiber is commonly accepted for many species; however, different allometric coefficient was suggested for growing pigs (0.60), growing calves (0.85), and growing turkeys (0.70). These differences in allometric coefficient can lead to under or overestimations of energy required for maintenance. The purpose of this study is to reassess FHP in modern pullets and laying hens and determine a specific exponent for expressing the metabolic BW. A total of forty-eight observations of FHP were obtained in different groups of white lohmann birds with body weight ranging between 0.08 and 1.60 kg. Birds were fed ad libitum before fasting. Heat production was measured using indirect calorimetry in two calorimetry chambers (0.9m x 0.9m X 0.85m). Following bird chamber placement, birds were fed for three days (adaptation period), then, the feed was removed at the beginning of the fasting period. All birds had continuous access to water during the fasting period. In each run, the number of birds was reduced according to chamber size. Concentrations of O_2 and CO_2 entering and exiting the calorimetry chambers were recorded two times per hour. Oxygen consumption (vO_2) and carbon dioxide production (vCO_2) were estimated as the difference between incoming and outgoing chamber gases, multiplied by the chamber airflow rates. Brouwer's equation (1965) was subsequently used to estimate FHP from the vO_2 and vCO_2 values. FHP was standardized as the plateau or asymptotic heat production following a fast of at least 8 hour. Recorded data of FHP and BW were logarithmically transformed to fit linear regression of the form log(FHP)=log(a)+b*log(BW), where a is the constant term and represents FHP ($kcal/BW^b$), and b is the allometric coefficient. The allometric coefficient estimated was b=0.67 (95% confidence limits: 0.648-0.696), while the estimated FHP was a=90.1 $kcal/BW^{0.67}$ (95% confidence limits: 88.2-91.9). The confidence limits of allometric exponent include 0.67 and excluded 0.75 exponent. In conclusion, the value of 0.67 was found to be appropriate to describe the ratio of metabolic body weight and 90.1 $kcal/BW^{0.67}$ was estimated to be the amount of energy to meet the maintenance needs for pullets and laying hens.

Key Words: fasting heat production, indirect calorimetry method, net energy

213 Withdrawn.

214 Metabolomics biomarkers of sexual development in broiler breeders. Mohammad Afrouziyeh* [GS 1], Nicole Zukiwsky[2], Douglas R. Korver[2], Martin J. Zuidhof[2]; *[1]University of Alberta, Edmonton, Alberta, Canada, [2]University of Alberta, Edmonton, Alberta, Canada.*

Profiling the plasma metabolome provides a new perspective for studying the metabolic aspects of sexual maturity in broiler breeder hens, a better understanding of its biological mechanisms, and provides potential biomarkers for predicting sexual development. The objectives of the current study were to evaluate the effect of maturity (pullet vs. hen) and onset of lay (early vs. late) on plasma metabolome dynamics to identify potential biomarkers that predict sexual development. A total of 36 pullets were used, 30 of which were randomly assigned to one of 10 unique growth trajectories, and 6 were not feed restricted. The growth trajectories were designed using a 3-phase Gompertz growth model with 10 levels of BW gain in the prepubertal and pubertal growth phases ranging from the breeder-recommended target BW to 22.5% higher, in 2.5% increments. The BW trajectories were applied using a precision feeding system, which collected BW and feed intake data for each individual bird. Birds were classified post hoc based on age at first egg (AFE), and 12 pullets were chosen from the lower and upper AFE extremes (early and late onset of lay) for repeated plasma metabolomic assays (collected at 18, 20, 22, 24, and 26 wk of age) using a direct-injection liquid chromatography-tandem mass spectrometry and steroid assays. Univariate analysis identified 87 differential metabolites between the early and late onset of lay groups at 24 wk of age and 104 differential metabolites between the pullet and hen groups. We identified 15 potential biomarkers to predict pullet to hen transition by analyzing receiver operating characteristic curve, mainly consisting of carnitine and choline metabolites. Differential