

the use of CM in laying hen diets. The objective of this research was to determine the effect of graded levels of low glucosinolate CM, up to complete replacement of soybean meal, on the performance of laying hens. Wheat-based diets were formulated on a digestible amino acid basis with 4 levels of CM (0 to 16.7%) and fed to 3 commercial laying hen strains, Lohmann Brown (LOH), ISA Brown (ISA), and Lohmann LSL (LSL). Rations were fed from 19 to 59 wks of age, with egg weight, specific gravity and feed intake measured at 4 wk intervals. Overall, level of CM inclusion had no effect on hen body weight gain, feed intake, feed to egg mass ratio, egg weight or egg specific gravity. Hen-day egg production was also not affected by CM but hens fed all diets including CM laid numerically more eggs than those fed the wheat-soybean meal control diet ($P=0.0512$). Although not statistically significant, hens fed the highest level of CM had the highest mortality ($P=0.0933$). Hen-day production and mortality were similar for all strains, but there were significant differences amongst genotypes for egg shell quality traits. There were no interactions between level of CM inclusion and bird strain. In conclusion, complete replacement of soybean meal in laying hen rations with CM did not affect hen performance but the effect of high levels of CM on mortality requires further investigation.

Key Words: brown-shelled layers, canola meal, egg production

101 Effects of the addition of whole sorghum on the productive and digestive responses of broiler chickens. S. Gómez*, M. L. Angeles, M. A. Islas, and V. Mondragón, *CENIDFyMA - INIFAP, Colón, Querétaro, México.*

An experiment was carried out to evaluate the productivity, breast yield, ileal digestibility of nutrients, organ weights, mucine production and the activity of malatase and sacarase on the mucosa of the small intestine of broiler fed diets in which 20% whole sorghum was included. Birds were allocated individually and were kept on the experiment during 28 days, from 20 to 48 days of age. There were four treatments given by the combination of 2 diets based either on ground sorghum or corn (GS or GC) and the inclusion of 20% ground or whole sorghum (20GS or 20WS). The average daily weight gain, feed intake, feed conversion ratio and breast yield were similar among treatments. However, the ileal digestibility of dry matter ($P < 0.05$) and energy ($P < 0.10$) were lower for 20WS. The weight of the proventriculus and gizzard were greater for 20WS ($P < 0.05$). The amount of total acid mucines (ug of Alcian blue), the acid mucines present per square centimeter per g of the mucosa and the acid mucines per g protein were greater for WS. The total maltase activity was higher for GS-20GS than for GS-20WS

(diet and form interaction, $P < 0.05$). In summary, the results indicate that the ileal digestibility of dry matter and energy were lower and the concentration of acids mucines was greater on the small intestinal mucosa of broiler chickens when 20% whole sorghum was included, however there was not any negative effect on growth performance and breast yield. The results suggest that is feasible to include up to 20% whole sorghum in the ration of finisher broiler chickens as a mean to reduce the cost of feed processing.

Key Words: broiler chickens, whole sorghum, growth performance, nutrient ileal digestibility, mucosal enzymes

102 Chemical composition and energy metabolizable values of the cassava (*Manihot esculenta* Crantz) products for Japanese quails. F. S. de A. Cunha¹, C. B-V. Rabello*¹, S. B. P. de Lima¹, T. S. de Lima¹, E. M. F. de Arruda¹, and F. G. P. Costa², ¹Universidade Federal Rural de Pernambuco, Recife, PE, Brazil, ²Universidade Federal da Paraíba, Areia, PB, Brazil.

This study was conducted to evaluate the chemical composition and determine the values of apparent metabolizable energy (AME) and apparent metabolizable energy corrected by nitrogen balance (AMEn) of cassava root, leaf of the cassava plant and the branch of the cassava plant. Initially considered was the composition of ingredients and their contents of dry matter (DM), crude protein (CP), mineral matter (MM), ether extract (EE), crude fiber (CF) neutral detergent fiber (NDF) and acid detergent fiber (ADF). After, one metabolism assay was conducted with Japanese quail (*Coturnix japonica*) with twenty days of age, using the method of total excreta collection. 160 birds were allocate in cage system and distributed in a completely randomized design with four replicates and ten birds per experimental unit. The experimental treatments consisted of a reference diet and three other diets composed of 70% of reference diet and 30% of each food test. The assay lasted for 8 days, 4 days of adaptation and 4 days for excreta collection. The chemical composition of the cassava products were: 86.40, 1.82, 2.36, 1.00, 6.99, 4.23 and 3.10% for cassava root; 83.99, 22.48, 3.31, 55.63, 41.63 and 18.39% leaf of the cassava plant and 85.11, 19.52, 5.90; 2.46, 61.81, 42.49 and 24.35% for the hay stems of the cassava plant, for DM, CP, MM, EE, NDF, ADF and FB, respectively. The values of AME and AMEn were: 3,306 and 3,058 kcal/kg for cassava root; 1,626 and 1,373 kcal/kg for leaf of the cassava plant; and 1,524 and 1,448 kcal/kg for branch of the cassava plant, respectively.

Key Words: alternative feeds, chemical composition, digestibility, quail, metabolizable energy

Processing, Products, and Food Safety I

103 Penetration of *Salmonella enteritidis* through the yolk membrane in eggs from six genetically distinct commercial lines of laying hens. R. K. Gast*¹, D. R. Jones¹, K. E. Anderson², R. Guraya¹, J. Guard-Bouldin¹, and P. S. Holt¹, ¹USDA-ARS, Egg Safety and Quality Research Unit, Athens, GA, ²North Carolina State University, Raleigh.

Infected laying hens can deposit *Salmonella enteritidis* inside developing eggs and thereby transmit disease to humans. Although deposition of *S. enteritidis* inside yolks is less common than deposition in the albumen or on the yolk (vitelline) membrane in naturally contaminated eggs, migration across the membrane to reach the nutrient-rich yolk contents

could lead to extensive bacterial multiplication. Previous studies using *in vitro* egg contamination models determined that penetration into yolks to produce significant growth can occur during storage at warm temperatures, but not when eggs are refrigerated. The present study used an *in vitro* egg contamination model to assess the ability of small numbers of *S. enteritidis* to penetrate the vitelline membrane and multiply inside yolks of eggs laid by six genetically distinct commercial lines of hens during 24 hours of storage at 30° C. Eggs from each line were tested at four different hen ages by inoculation of approximately 100 cfu of *S. enteritidis* onto the outside of the vitelline membranes of intact yolks in plastic centrifuge tubes and then adding back the albumen into each tube

before incubation. Overall, the frequency of penetration of *S. enteritidis* into the yolk contents of eggs from individual lines of hens ranged from 30% to 58% and the mean concentration of *S. enteritidis* in yolk contents after incubation ranged from 0.8 to 2.0 log₁₀ cfu/ml. For both of these parameters, values for one hen line were significantly higher than for two other lines, but no other differences were observed. Hen age did not have a significant effect on egg yolk penetration by *S. enteritidis*. These results indicate that opportunities for the migration and growth of small initial numbers of *S. enteritidis* to attain more dangerous levels inside contaminated eggs during storage at warm temperatures can vary with different lines of laying hens.

Key Words: *Salmonella enteritidis*, eggs, penetration, yolk membrane, hen lines

104 Occurrence of white striping in chicken breast fillets in relation to broiler size. L. J. Bauermeister*¹, A. U. Morey¹, E. T. Moran¹, M. Singh¹, C. M. Owens², and S. R. McKee¹, ¹Auburn University, Auburn, AL, ²University of Arkansas, Fayetteville.

A phenomenon referred to as white striping has become a concern to some poultry producers in regards to the visual quality of chicken breast fillets. This study was designed to determine if there was any relationship between the severity of the white striping, the growth of the broiler and the meat quality characteristics. Broilers, Ross 708 straight run, (n=1280) were randomly placed in a completely randomized block design on the day of hatch. Chicks were fed basal diets (2 x 2 x 2 factorial arrangement) consisting of a Corn Soy Diet or a Corn Soy diet with meat and feather meal. Broilers were grown out under normal rearing conditions and were conventionally processed using a hard scald (62.7°C for 45 s) at 6 wks (n=640) and 8 wks (n=640). Of the birds processed, only the males (n=320 at 6 wks, n= 320 at 8 wks) were used to determine the occurrence of white striping. Live weight and fillet weight were recorded and fillets were ranked visually (1 = normal fillets, 2 = mild white striping, 3 = moderate white striping and 4 = severe occurrence of white striping) based on severity of white striping for each breast fillet. To determine if the quality of the breast fillets were affected by the white striping, tenderness, cook-loss and Hunter L*a*b* color of the breast fillets were measured using fillets from each ranking (1-4). Diet treatments had no effect on severity ranking. However, severity of white striping increased with increasing live weight and fillet weights. In addition, the severity of the white striping increased between the 6 wk processing period and the 8 wk processing period. There were no differences observed in tenderness, cook-loss or color based on the ranking of severity of white striping. This study suggests that there is a relationship between the size of the bird and the severity of the white striping of the breast fillets, but the severity of white striping has no impact on meat quality.

Key Words: white striping, breast fillet, meat quality, quality defects, broiler size

105 Acid solubilization process of mechanically separated turkey meat (MSTM) with the aid of citric acid and calcium ions: Effect on the polar and neutral lipid classes. Y. V. Hrynets*, J. Chan, Y. Xu, and M. Betti, *University of Alberta, Edmonton, AB, Canada.*

Lipid oxidation is one of the major factors limiting the use of MSTM proteins for the production of further processed poultry meat products.

Polar lipids (PL) membranes being rich in polyunsaturated fatty acids (PUFAs) are considered to be the primary substrates for lipid oxidation as compared to neutral lipids (triacylglycerol; TAG). Thus, if polar lipid membranes are removed from MSTM, the stability of the isolated proteins could be increased dramatically. The experiment was conducted to determine the combined effect of citric acid and calcium ions on polar and neutral lipids removal from MSTM. Mechanically separated turkey meat was homogenized and treated with different concentrations of citric acid (0, 2, 4, 6, 8 and 10 mmol/L) and calcium ions (0 and 8 mmol/L) at pH 2.5. After homogenization, myofibrillar proteins were recovered by centrifugation and precipitation at the isoelectric point (pH 5.2). The entire experiment was replicated 3 times resulting in 36 extractions (3 x 6 x 2). Total fat, PL and TAG content were determined in the extracted proteins. Data were analyzed as 6 x 2 factorial analysis of variance. Means were separated by using HSD Tukey's adjustment. Strong interactions (P < 0.0001) were found for total lipid content. In general, all the combinations removed an average of 90.3% of the total fat from MSTM, ranging from 83.4 to 94.7%. The lowest amount (1.14%) was found by using 4 mmol/L citric acid with no calcium added. No significant effect of calcium was observed in either PL or TAG. In contrast, citric acid significantly (P = 0.011) affected polar lipid content of protein extracts. The highest removal was observed with addition of 2 mmol/L (95.1%). No significant effect of citric acid was observed for neutral lipids. The results indicated that addition of citric acid may improve the oxidative stability of proteins isolated from MSTM.

Key Words: calcium chloride, citric acid, lipid oxidation, mechanically separated turkey meat (MSTM), myofibrillar proteins

106 Water usage in Alabama broiler processing plants. J. C. Butler*, P. A. Curtis, S. F. Bilgili, and L. K. Kerth, *Auburn University, Auburn, AL.*

Due to an increase in food safety regulations, water usage in the poultry industry, specifically during broiler processing, has been relaxed. In addition to the increase in water usage per bird, the amount of waste-water pollutants (i.e., suspended solids, fats, oils and grease and nitrogen), have increased as well. Regional water shortages, tightening environmental discharge regulations, and changing municipal policies on water availability and cost make water conservation and reduction of waste load discharge more important now than ever before. A written survey was recently conducted on water use and waste handling patterns in broiler processing plants in the State, which was then followed up by water audits at selected plants. The written survey indicated that water use in broiler processing plants was 6.17 gallons per bird. One common problem observed during the audits was that water continued to run through processing equipment during breaks and lunch periods. The most common recommendations based on the water audits were (1) to add cut-offs on the gooseneck faucets used in the inspection area, (2) turn off water to equipment (pickers, bird washers, evisceration equipment, etc.) and (3) to use dry clean-up rather than washing solid products down the drain.

Key Words: audit, poultry, processing, survey, water

107 Removed

villi (0.151 mm²) than in Non-efficient birds (0.108 mm²) (P=0.03). Gut length did not affect change in n-3 PUFA, although eggs from short-gut birds had more n-3 PUFA than for longer-gut birds (P=0.03) at 14d. Birds with lower feed intake had a lower concentration of n-3 PUFA in the egg (P=0.07). Increased feed intake led to increased liver weight ($r=0.51$, P=0.015) and also occurred in smaller birds ($r=-0.47$; P=0.029); Likely reflecting the demands of egg production. Increased metabolic efficiency was associated with increased n-3 PUFA concentrations in the egg.

Key Words: laying hen, metabolic efficiency, omega-3 PUFA, gut histology, enrichment

109 Validation of a simple screening procedure to estimate contaminant concentration in processed poultry. I. Reyes-Herrera*¹, J. H. Metcalf¹, P. J. Blore¹, M. J. Schneider², and D. J. Donoghue¹, ¹University of Arkansas, Fayetteville, ²USDA-ARS-ERRC, Wyndmoor, PA.

The Federal Government monitors food products, including poultry, to detect and prevent unsafe residues (e.g. drugs and pesticides) in the food supply. Monitoring procedures often require analysis of specific marketable tissues (e.g. muscle). A potential alternative is to evaluate residue concentrations in blood samples, which are often easier and less expensive to obtain and analyze. Also, collecting blood at the processing plant does not require carcass destruction and would characterize the presence of residues in the entire flock as opposed to individual samples. Data from our laboratory show that quantitation of residues in blood is a reliable predictor of concentrations in muscle tissues for another antibiotic (enrofloxacin). To determine if this relationship is consistent for other antibiotics, the pharmacokinetic relationship between blood and muscle was evaluated for oxytetracycline (OTC). In this study, 5-wk-old broiler chickens (n= 144) were divided in 2 treatment groups and dosed with either a low or high dose of OTC (800 or 8,000 mg). Blood and breast muscle samples were collected from 6 birds/group at 0, 1, 3, 6, 12, or 24 h during the dosing period and then every 12 h during the withdrawal period for up to 60 h post-withdrawal. Using a quantitative bioassay, OTC was detectable within 1 h of dosing, reaching its plateau phase at 12 h for both groups (low dose 50 and 141 ppm; high dose 504 and 526 ppm, muscle and blood respectively) and had a higher persistence in muscle than serum during the withdrawal period. Levels in blood were consistently lower than those in muscle and maintained an approximately 1:5 blood:muscle relation. Thus, determination of antibiotic residues in blood is a simple and effective means to predict whether residue concentrations in muscle exceed the FDA's imposed tolerance level for OTC in poultry muscle tissue.

Key Words: oxytetracycline, residues, muscle, pharmacokinetic, poultry

110 Effects of feeding distillers dried grains with solubles (DDGS) to commercial laying hens: I. Egg characteristics and consumer acceptability. R. E. Loar II*¹, M. W. Schilling¹, C. D. McDaniel¹, C. D. Coufal¹, S. R. Rogers², K. Karges³, and A. Corzo¹, ¹Mississippi State University, Mississippi State, ²Cal-Maine Foods, Jackson, MS, ³Poet Nutrition, Sioux Falls, SD.

This study evaluated the effects of feeding incremental levels of DDGS on egg characteristics. Five different levels of DDGS (0-32%) were fed to second cycle Bovans White laying hens for a period of 15 weeks. On two separate occasions, eggs were collected and analyzed for Haugh units and CIE L*a*b* (instrumental color). Sensory panelists (n=100)

108 Role of hen efficiency in the transfer of omega-3 PUFA to table eggs. S. Nain* and R. A. Renema, University of Alberta, Edmonton, AB, Canada.

This study explored potential linkages between metabolic efficiency, intestinal length and morphology, and transfer of omega-3 polyunsaturated fatty acids (n-3 PUFA) to the egg. Core temperature telemetry devices were surgically implanted into 20, 56 week old Lohman White Leghorn laying hens. 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. This was used to score hens as Efficient and Non-efficient. Birds were then provided an n-3 PUFA enriched diet containing 17% Linpro (extruded flax product). Egg traits were determined and yolks collected at 0d and 14d, and egg lipid profile determined by GC analysis. At 14d, birds were sacrificed to collect gut length and histomorphometric indices.

Efficient hens had a 92.2% rate of lay compared to 88.4% in Non-efficient hens. The n-3 PUFA enriched ration resulted in yolk size declining from 31.5% of the egg at 0d to 29.3% at 14d. By 14 d, concentration of n-3 PUFA (particularly C18:3 n3) had risen while both n-6 PUFA and *de novo* synthesized fatty acids were reduced (P<0.0001). Hen efficiency did not affect changes in n-3 PUFA content between 0d and 14d. However, Efficient birds had more C18:3 n3 than the Non-efficient birds at 14d (0.278 vs. 0.225 g/egg). Efficient hens had wider (P=0.04) and longer (P=0.08) villi and therefore a greater absorptive surface area/

were asked to rate eggs from 0, 16, or 32% DDGS diets on a nine point hedonic scale for texture, flavor, and overall acceptability. Once during the study, eggs (n=241) were analyzed for shell strength via instron. Treatments were replicated 6 times with each replicate consisting of 5 cages (2 birds/cage; 10 birds/replicate). The study was a randomized complete block design, and Fisher's protected LSD test was used to separate treatment means. There were no interactions observed between egg collection week and treatments, therefore data were pooled. Color evaluation of eggs showed that increasing DDGS levels in the diet led to a darker (L*) yolk (P<0.003) that was also more red (a*) (P<0.0001). Egg shell strength data was not different (P>0.05) among treatments. Eggs from hens fed the 8% DDGS treatment exhibited a lower Haugh unit score when compared to eggs from the 24% and 32% DDGS treatments, with the 0% and 16% DDGS treatments intermediate (P<0.05). Sensory evaluation results indicated no difference (P>0.05) in texture, but eggs from DDGS fed hens received slightly higher ratings from panelists for flavor and overall acceptability (P<0.05). However, eggs from all treatments received mean scores between like-slightly and like-moderately on the hedonic scale and would be acceptable to most consumers. Panelists were also able to detect a difference (P<0.10) between eggs derived from the 0% and the 32% DDGS treatment, with eggs from the 16% DDGS treatment being intermediate. Data suggest no negative effects in egg characteristics with increasing DDGS dietary levels. In fact, sensory evaluation results suggest that there may be slight improvement in consumer acceptability of eggs derived from hens fed DDGS in the diet.

Key Words: DDGS, Leghorns, eggs, flavor, texture

111 Evaluation of recombinant *Salmonella* expressing the flagellar protein FliC for enhanced immune responses in commercial turkeys. C. J. Kremer*¹, K. M. O'Meara¹, S. L. Layton², B. M. Hargis², and K. Cole¹, ¹The Ohio State University, Columbus, ²University of Arkansas, Fayetteville.

Salmonella enteritidis is one of the most common sources of human food-borne illness. This organism is often transmitted to humans from poultry products that may have been contaminated pre- or post-harvest. Previous research indicates that oral vaccination of poultry with live attenuated *Salmonella* can confer a high degree of protection to poultry flocks, thus decreasing the risk of infection in humans. The flagellar protein FliC has shown promise in creating an increased immune response and the ability to protect against challenge of wild-type *S. enteritidis*. Several novel attenuated strains of *S. enteritidis* were developed that expressed the FliC protein on the outer membrane protein lamB using the Red recombinase system in combination with overlapping extension PCR. Commercial turkey poults were orally immunized with saline (Negative Control) or one of the following recombinant *Salmonella* strains (immunization dose: 10⁶-10⁸ cfu/poult): Δ aroA/ Δ htrA SE, fliC(loop 4), M2e (loop 9) or Δ aroA/ Δ htrA SE, M2e (loop 9) on day-of-hatch and 21 days post-hatch. Liver, spleen, and cecal tonsil were aseptically removed on days 1, 3, 5, 7, 14, 21, 35 and 42 post-hatch to determine colonization and organ invasion. Blood samples were collected on days 7, 14, 21, 35 and 42 post-hatch to determine M2e-specific antibody responses. On day 3 post-inoculation the M2e only group exhibited 100% invasion of the liver and spleen compared to the FliC-M2e group, which exhibited only 50% invasion in the birds sampled. No marked difference in colonization of the cecal tonsils was noted at this time point. There were no significant differences observed between groups in M2e-specific antibody responses. Overall, both candidate strains were cleared from the liver, spleen, and cecal tonsils by day 35 post-inoculation. In summary, the vaccine candidate strains

appear to be effective in stimulating host immune responses and may provide lasting protection against challenge when compared to the wild-type parent strain.

Key Words: *Salmonella*, FliC, colonization, immune, response

112 Big bird programs: Impact of strain, gender, and debone time on meat quality of broilers. V. B. Brewer*, V. A. Kuttappan, J-F. C. Meullenet, J. L. Emmert, and C. M. Owens, University of Arkansas, Fayetteville.

The industry trend towards early deboning has led to the need to explore the impact on meat quality including interactions of strain and gender. An experiment was conducted using broilers of four different high yielding commercial strains chosen because of their common use in big-bird production. Of each strain, 360 birds were commercially processed at d 59, 61, and 63d of age in two replicates per day. Breast fillets were harvested at 2, 4, and 6 h postmortem (PM). Muscle pH and color (L*a*b*) were measured at time of deboning and at 24 h PM. Fillets were cooked to 76 C and cook loss was calculated, followed by Meullenet-Owens Razor shear (MORS) analysis. Muscle pH significantly decreased over time as aging prior to deboning increased. L* values significantly increased as aging time increased; the fillets deboned at 6h PM had the highest L* value, followed by 4 h, and then 2 h PM. At 24 h, the fillets deboned at 6 h still had the highest L* compared to those deboned at 2 or 4 h PM. Color a* values significantly increased as deboning time increased, and b* values significantly decreased with aging time when measured at 24 h PM. There was variation in color due to strain. Strain 2 had the highest L* values and low a* and b* values. Fillets deboned at 2 h PM had significantly higher cook loss than fillets deboned at 4 or 6 h PM, but there was no difference in cook loss due to strain at any deboning time. Fillets deboned at 2 h had higher MORS energy (indicating tougher fillets) than fillets deboned at 4 h or 6 h PM. Fillets deboned at 4 h PM also had higher MORS energy than fillets deboned at 6 h PM. At 2 h PM, there were no differences in tenderness due to strain, but differences due to strain were observed at 4 and 6 h PM. There was no difference in L*, a*, b* (24 h PM), or cook loss due to gender. Fillets of males had significantly higher MORS energy (tougher) when deboned at 2, 4, and 6 h PM than those of females; however, there was no difference in pH pertaining to the different genders. The results of this study suggest that deboning time, gender and strain can have impacts on meat quality.

Key Words: strain, debone hour, pH, color, tenderness

113 Big bird programs: Impact of phase-feeding strain and debone hour on yield, fillet dimensions of broilers. V. B. Brewer*, V. A. Kuttappan, J. L. Emmert, and C. M. Owens, University of Arkansas, Fayetteville.

Phase-feeding (PF) has been effective at maintaining broiler growth while reducing production cost in small bird production scenarios with various strains. To explore the impact of PF strain and debone hour on fillet dimensions in a big bird production scenario an experiment was conducted using 4 high yielding commercial strains typically used in big bird programs. PF is a feeding regimen which utilizes shortened feeding periods in order to more accurately target nutrient requirements of broilers. At d 17; birds were fed one of two dietary treatments: diets with average industry nutrient levels, or diets with phased levels of AA. For PF a low nutrient diet matched nutrient requirements at d 17, and a high nutrient diet matched requirements at d 60. High and low nutrient diets were blended to produce rations that matched projected requirements

over two-day intervals. At 59, 61, and 63 d 180 birds per treatment were commercially processed and breast fillets were harvested at 2, 4, and 6 h postmortem (PM). Parts weights were taken at time of debone and fillet dimensions were measured at 24h PM. Dietary treatment had little impact on fillet yield with the exception of one strain at each 2 and 4 h PM deboning time. There was no difference in yield due to debone hour, but strain did have an impact. Strains 2 and 4 had higher fillet yield than strains 1 and 3. Strain had little impact on fillet length and width. At 4 and 6h PM debone times, strain 4 had longer fillets, and at 2h PM, strain 2 had wider fillets. Strain had more impact on fillet thickness; in general, strains 2 and 4 had thicker fillets than strains 1 and 3. There was little difference in fillet dimensions due to PF regimen with the exception of one dimension of one strain at each 2, 4, and 6 h PM debone time. The greatest effect of PF on fillet dimensions was observed in the uniformity where SDs and CVs indicate that uniformity was either maintained or improved the incorporation of PF regimen. In conclusion, PF has little impact on yield and fillet dimensions, and most differences observed in both can be attributed to strain.

Key Words: broiler, phase-feeding, strain, yield, fillet dimensions

114 Ultrasonic bath marination of broiler breast meat. D. P. Smith*, North Carolina State University, Department of Poultry Science, Raleigh.

Two replicate trials were conducted to determine the effect of using an ultrasonic bath for marinating broiler breast meat. Twelve butterfly fillets per each trial (n=24) were collected from a commercial processing plant and trimmed of connective or fat tissue. One of the fillet pairs was marinated in a solution (91% water, 6% salt, and 3% polyphosphate) for 20 min in an ultrasonic bath (UB) while the other paired fillet was marinated by still soaking (SS) for 2 h. Fillets were held 18 h to determine drip loss and cooked to an internal temperature of 80^o C. Marination pickup, drip loss, cook yield, and Allo-Kramer (AK) shear were measured. Marination pickup was significantly ($P < 0.05$) higher for SS than UB (4.8 vs. 2.2%, respectively), but SS had higher drip loss than UB (2.2 vs. 1.1%). Higher cook yield was observed with SS (88.7%) than UB (84.2%). No difference in AK shear was found due to method, as SS averaged 3.7 and UB averaged 3.4 kg shear/g of sample. The UB method did not improve marination pickup, cook yield, or AK shear compared to the SS method.

Key Words: broiler breast meat, marination, ultrasonic bath, cook yield, shear

115 Effect of dietary balanced protein and metabolizable energy level, age and sex effects on broiler breast meat quality. B. L. Schneider*¹, M. Betti², M. J. Zuidhof², R. A. Renema², and V. L. Carney¹, ¹Alberta Agriculture and Rural Development, Edmonton, AB, Canada, ²University of Alberta, Edmonton, AB, Canada.

Fluctuation in dietary ingredient price or availability can result in changes to broiler diet formulations. To determine the effect of protein and energy level on breast meat functional properties, 432 Cobb x Avian 48 broilers were raised on one of 9 diets with one of 85, 100, 115% of breeder recommended protein and one of 94, 97 or 100% of breeder recommended energy levels. Color (CIE L*a*b*) and pH at 24 h post mortem, drip losses, cooking losses and Allo-Kramer shear (kg Force/g) at 72 h post-mortem were measured on 16 birds (8/sex) per dietary treatment at 3 processing ages (36, 52 and 56 d).

Lightness (L*) values ($p=0.0199$) of the 94% group were lower than the 100% ME treatment (54.05 vs 55.39, respectively); the 97% treatment was not different from either group (54.52). Yellowness (b*) values decreased ($p<.0001$) as ME level increased (6.53, 5.43 and 4.75, respectively). Increasing DBP level from 85 to 115% of recommended levels decreased b* values ($p<.0001$; 6.07, 5.63 and 5.02, respectively). Neither ME nor DBP level affected pH at 24 h post mortem, drip or cooking losses or Allo-Kramer shear.

Female broilers exhibited lighter breast meat ($p<.0001$) and higher drip loss ($p=0.0031$) than males (55.26 vs 54.05 and 3.5% vs 3.1 %, respectively). Lightness values at 36 d were lower ($p<.0001$) than those measured at 52 and 56 d (53.15 vs 55.16 and 55.64). Drip loss was lowest ($p=0.0145$) in the 56 d group compared to 36 and 52 d broilers (3.17 vs 3.34 and 3.36%, respectively). Allo-Kramer shear values were lowest ($p<.0001$) at 36 d compared to the 52 and 56 d broilers (3.80 kg Force/g vs 4.11 and 4.22 , respectively).

The breast meat functional properties tested in this project were unaffected by treatment. Despite similar pH at 24 h post- mortem, drip and cooking losses and Allo-Kramer shear values across treatments, muscle color was the factor most affected by altering DBP or ME levels. Ultimately both age at processing and sex of broiler had a greater influence on broiler breast meat quality than the dietary treatments.

Key Words: dietary balanced protein, metabolizable energy, broiler, meat quality, color

116 Effects of ractopamine-HCl on finishing tom and hen turkey meat quality. D. J. Ivers, D. H. Mowrey, C. T. Herr, and E. A. Heskett*, Elanco Animal Health, Greenfield, IN.

A six site study across the United States and Canada was conducted and pooled to evaluate the effects of feeding ractopamine-HCl (RAC) for the final 7 days (d) or 14 d on tom and hen meat quality as measured by ultimate 24-hour pH, Minolta L* (star), and Kramer Shear Force. A randomized complete block design with location as a blocking factor was conducted at each site. Treatment design consisted of two factors: duration (7 d and 14 d) and RAC (0, 5, 9, and 13 ppm). Diets were formulated to contain industry average levels of lysine (total) and metabolizable energy for the finishing phase (as fed); 0.99% lysine and 1,567 kcal/pound of feed for toms; and 0.96% lysine and 1,572 kcal/pound of feed in hens. Selection of individual birds for meat quality analysis was performed via the following procedure: three replicates per site were randomly selected with two birds from each pen (8 pens per replicate) selected. This resulted in 48 birds per site over six sites totally 288 birds per gender undergoing meat quality analysis. Following completion of the treatment phase, feed was withdrawn for about 4 hours (hrs) and then toms were transported for at least 4 hrs. Toms were either 20 wks of age (14 d duration) or 21 wk of age (7 d duration) at the start of the treatment. Hens were either 15 wks of age (14 d duration) or 16 wks of age (7 d duration) at the start of the treatment.

Results of these studies demonstrated that feeding ractopamine-HCl (5-13 ppm) had no negative impact on meat quality as measured by ultimate 24-hour pH, Minolta L*, and Kramer Shear Force. Specific meat quality measured values will be presented for toms and hens, 7 day duration and 14 day durations and the following four doses: 0, 5, 9, and 13 ppm RAC. Additional studies are ongoing and will be reported as results are finalized.

Key Words: ractopamine-HCl, meat quality, Minolta L*, ultimate 24 hour pH, Kramer shear force

117 Improvement of muscle oxidative stability and processing yield in relation with dietary methionine sources. Y. Mercier*¹, C. Berri², E. Baeza², T. Bordeau², P. Chartrin², F. Mercierand², and P. A. Gereart¹, ¹*Adisseo France S.A.S., Commeny, France*, ²*INRA, Nouzilly France*.

The aim of this work was to compare the effect of dietary methionine sources (DLM/HMTBA) used separately or in combination, on technological traits of broiler Pectoralis muscle (PM). 672 male Ross broilers were distributed in three different treatments: DL-Methionine (DLM, Rhodimet NP99[®]), DL-methionine hydroxy-analogue (HMTBA; Rhodimet AT88[®]) and a 50% DL-Methionine + 50% DL-Methionine hydroxy-analogue (Met-Mix). Broilers were fed a wheat-corn-soybean meal based diet with soya oil as the unique lipid source.

42-d feed conversion ratio did not differ significantly between treatments. Meat quality parameters (pHu, color L*a*b*) and drip loss have been measured on Pectoralis major muscles. Moreover, Napole yield (curing-cooking yield) and lipid oxidation (TBA-RS) were determined at D3, D6 and D9 after slaughter.

No significant differences between treatments were observed on breast meat yield, thigh meat yield, fat pad and color parameters at D1. Conversely, a significantly higher pHu value ($p < 0.001$) was observed with Met-Mix treatment compared to respectively DLM or HMTBA treatment (6.03 vs 5.94 and 5.98). Moreover, Met-Mix treatment showed significantly lower drip loss ($p < 0.05$) than other treatments (0.75 vs 0.92 %). The Napole yield appeared also significantly higher ($p < 0.05$) in Met-Mix treatment (84.5%) compared to 82.9 and 82.8 % respectively for HMTBA and DLM fed birds. TBA-RS were significantly ($p < 0.05$) reduced with HMTBA and Met-Mix treatments suggesting a reduced lipid oxidation until 6 days after slaughter compared to DLM treatment.

The present results demonstrate that dietary methionine supplementation with either only hydroxy-analogue, for lipid oxidation, or combination methionine and hydroxy-analogue can significantly improve meat quality and technological properties of broiler Pectoralis muscle.

Key Words: DL-methionine, DL-HMTBA, meat quality, TBARS, napole yield