

142 Carcass scratches and growth rate of microwave toe-treated broiler chickens. B. Wang^{*1}, J. L. MacIsaac², and B. M. Rathgeber¹, ¹*Nova Scotia Agricultural College, Nova Scotia, Canada*, ²*Atlantic Poultry Research Institute, Truro, Nova Scotia, Canada*.

Lighting programs that provide longer daylength as a broiler ages reduce the incidence of ascites and sudden death syndrome. Birds given this type of program often have an increased incidence of carcass scratches due to increased bird activity. The turkey industry uses microwave technology to restrict claw growth and reduce carcass scratches. One concern is that the treatment may reduce bird growth rate. The objective of this study was to determine if microwave toe-treatment would reduce growth rate of chickens if used to reduce carcass scratches for broilers on an increasing photoperiod program. Two replicate trials were conducted with 728 female and 728 male broilers in each trial. Half of each sex was toe-treated using microwave energy upon delivery from the hatchery. The birds in each trial were randomly assigned to four rooms with 8 pens per room. Two rooms were given 23 h of light per day from start to finish and the other two rooms were on a lighting program with short daylength after the first three days, which increased to 23 h by day 31. Light intensity was the same for each lighting program. For half the pens, the bird's growth rate was measured by catching and weighing each bird in the pen on day 7, 14, 24, 31. On day 38, the birds from all the pens were removed and weighed. For six pens per room, computerized bird scales were installed to continually monitor bird weight. Five birds per pen were shipped for slaughter and carcass scratches monitored. Toe-treatment reduced carcass scratches for both lighting programs of which increasing photoperiod had the higher incidence ($p < 0.05$). Based on the traditional weighing method, toe-treatment reduced bird weight on day 14 and 31 ($p < 0.05$). The computerized scales indicated that the toe-treated birds were lighter on day 14 and 24. For both sources of bird weight, the birds given an increasing photoperiod were lighter than those with continuous light on day 7, 14, 24 and 31 ($p < 0.05$). On day 38, there were no lighting and toe-treatment effects ($p > 0.05$). Collectively, the present results demonstrated that microwave toe-treatment and the increasing lighting program didn't influence body weight of broiler chickens at market age.

Key Words: Microwave Toe-Treatment, Lighting Program, Scratches

143 Effect of lighting and handling technique on breast fillet dimensions and meat quality. N. A. McKee^{*1}, R. J. Lien², J. B. Hess², S. F. Bilgili², and S. R. McKee^{*2}, ¹*Auburn University*, ²*Auburn University*.

This study was designed to determine the effect of lighting and handling on growth and meat quality factors. Male Ross 508 broilers (total $n=1050$) were housed in light-tight rooms and subjected to step-up lighting of either, bright (15.0 foot-candles) or dim (0.1 foot-candles). Within these lighting treatments, birds were further divided into 3 handling groups by the legs (L), wings (W), or no handling (NoH) at days 37 and 44 (20 sec. at each age) to determine the effect of handling on the incidence of deep thigh bruises and deep pectoral myopathy (DPM). Birds were reared to 51 d of age. After birds were processed and chilled, a sample of 288 birds were further divided into 2 groups based on deboning time post-mortem (PM). Breast fillets were deboned at 2 h and 4 h PM and fillet weights, fillet dimensions (length, width, and height), cook-loss, and tenderness were evaluated. Shear values were measured using a (TA.XT2i) Texture Analyzer (Texture Technologies Corp., Scarsdale, NY/ UK). Birds subjected to dim lighting had greater live weights ($P < 0.05$), post-chill weights, and fillet weights compared to birds reared in bright light. The increase in fillet weights observed for the dim light treatment was likely due to an observed increase in fillet length, as all other fillet dimensions were similar regardless of lighting or handling. The incidence of DPM and other carcass defects did not vary among the handling or lighting treatments. Cook-loss was affected by a light by handling interaction with the greatest percentage cook-loss observed in the fillets from the bright light NoH, dim light L, and dim light W ($P < 0.05$) compared to other groups. Fillets deboned at 2 h PM had higher shear values than those deboned at 4 h PM, regardless of lighting or handling. Within the 2 h PM deboning period, dim lighting resulted in an increase in shear values compared to bright light treatments. This trend was not observed in the fillets deboned at 4 h PM.

In conclusion, dim lighting treatment resulted in greater bird and fillet weights but slightly tougher meat when fillets were deboned at 2 h PM.

Key Words: Lighting, Handling, Meat Quality

144 Meat quality evaluation of minimally aged broiler breast fillets from five commercial genetic strains. J. M. Mehaffey^{*1}, J. L. Emmert¹, J.-F. C. Meullenet¹, S. R. McKee², and C. M. Owens¹, ¹*Department of Poultry Science, University of Arkansas, Fayetteville*, ²*Department of Poultry Science, Auburn University, Auburn, AL*.

A total of 1040 birds from 5 common commercial genetic broiler strains were raised and processed in order to analyze the effect of strain and deboning time on meat quality. The birds were processed at either 6 or 7 weeks of age in two replications each. Replications consisted of 26 birds of each strain deboned at 2 h postmortem (PM) and 4 h PM. Carcass and breast weights were measured on each bird in order to calculate breast yield. Fillets deboned at 4 h PM were then measured for length, width, and height at 3 points along the fillet to evaluate footprint analysis. At time of deboning, the caudal tip was taken from one fillet per bird for muscle pH determination using the iodoacetate method. Fillets were individually bagged and stored at 4 C overnight. At 24 h PM, fillets were weighed in order to calculate drip loss, and color ($L^*a^*b^*$) was also measured. The fillets were then cooked to 76 C and cook loss was calculated. One fillet per bird was then subjected to shear analysis using the razor blade shear method where shear energy (N.mm) was calculated in order to evaluate tenderness. The strains in this study were chosen for differences in growth rate and yield; therefore, as expected, breast yield was significantly different among strains. Higher yielding birds exhibited higher shear energy (more tough), higher drip and cook loss, and higher muscle pH when deboned at 2 h PM compared to lower yielding birds. However, at 4 h PM, fewer differences among strains existed in meat quality characteristics (tenderness, water holding capacity, and pH). At 6 and 7 wks, deboning at 2 h PM resulted in higher shear energy, muscle pH, and lower L^* value compared to deboning at 4 h PM in all but one strain. However, water holding capacity was not affected by deboning time at either age interval. Footprint analysis showed that most differences among strains were apparent in heights measured at the fillet midpoint and caudal end. These results suggest that early deboning may impact meat quality of broiler strains differently resulting in greater variation within the industry.

Key Words: Tenderness, Strain, Aging

145 Comparison of Sensory Qualities of Poultry Meat from Alternative Slow-Growing Breeds and a Commercial Breed Grown with or without Outdoor Access. A. C. Fanatico^{*}, P. B. Pillai, L. C. Cavitt, J. F. Meullenet, J. L. Emmert, and C. M. Owens, *University of Arkansas, Fayetteville*.

An experiment was conducted to assess the impact of breed and outdoor access on meat quality of broilers. One slow-growing breed (S), two medium-growing breeds (M1 and M2) and a commercial fast-growing breed (F) were raised for 12, 10, or 8 weeks, respectively, in an attempt to achieve similar body weights. The birds were straight-run, and the placement date was staggered such that all breeds were processed on the same day. Each breed was assigned to three pens of 24 birds each and raised in indoor floor pens; the S and F breeds were also assigned to two floor pens with outdoor access (during daylight hours) containing 36 birds each. All birds were provided with the same starter (0 to 4 weeks for S and M; 0 to 3 weeks for F), grower (4 to 8 weeks S and M; 3 to 6 weeks for F) and finisher (8 to 12 weeks for S; 8 to 10 weeks for M; 6 to 8 weeks for F) feeds. Birds were commercially processed; Pectoralis samples were collected at 6 h postmortem. Thighs were vacuum packed and frozen for 5 months. Consumer panels evaluated breast meat pieces and ground thigh meat patties. There was little difference in texture in breast meat samples among genotypes, although the breast meat from medium-growing broilers was perceived as more tender than breast meat from the fast-growing broilers (indoors) ($P < 0.05$). The thigh meat of the medium-growing broiler (M2) was more intense in flavor than that of the slow-growing broiler (indoor) ($P < 0.05$). The flavor of thigh meat from the medium-growing broilers and the fast-growing broilers was more liked than the slow-growing broilers (indoors) ($P < 0.05$). These data indicate that meat quality differences

may exist among breeds with different growth rates and reared with or without outdoor access.

Key Words: Broiler, Slow-Growing, Free-Range

146 The effect of blood removal, oxidation and shelf-life in broiler meat. C. Z. Alvarado*¹, S. F. O'Keefe², and M. P. Richards³, ¹Texas Tech University, Lubbock, ²Virginia Polytechnic and State University, Blacksburg, ³University of Wisconsin, Madison.

Blood components, especially hemoglobin, are powerful catalysts of lipid oxidation and may cause a decrease in shelf-life of the product. Therefore, this study examined the effect of different slaughter techniques (CO₂ kill and non-bled, no stun and bled, electrical stun and bled, CO₂ stun and bled, and no stun and decapitation) to determine their effect on pH (24 hr), L*a*b* value (24 hr), oxidation, residual hemoglobin concentration (24 hr), and sensory evaluation (day 1 and day 4 postmortem) in the broiler breast fillets. The birds were conventionally processed and analyses were performed at 24 hr PM except residual hemoglobin where the samples were frozen (-80 °C) until analyses (< 2 months). There were no significant differences in pH or b* values at 24 hr postmortem among any of the treatments. L* values were significantly higher indicating lighter fillets in the electrically stunned (56.99) and decapitated birds (56.29) compared to the darker fillets from the CO₂ stunned and bled birds (53.88). The CO₂ kill and non-bled birds (4.18) had significantly higher a* values, indicating more red color, when compared to the electrically stunned and bled (3.09) and decapitated birds (2.80). There were no significant differences in the residual hemoglobin content in the broiler breast muscle when comparing all of the treatments except CO₂ kill non-bled which was significantly higher (10.04). Overall TBARS (raw, cooked 24hr and cooked 72hr PM) indicate that ES and bled had the lowest TBARS when compared to the remaining treatments. Consumer panels detected a difference in both aroma (chicken meaty and warmed-over) and flavor (chicken meaty and warmed-over) at 24 hr PM. However, by 72 hr PM, there were no significant differences in either aroma or flavor. Therefore, different slaughter and bleeding methods may affect color and sensory properties of the broiler breast fillets.

Key Words: Oxidation, Blood Removal, Shelf-Life

147 Dietary supplementation of functional ingredients improves quality of irradiated raw turkey breast. H. Yan*, K. Nam, E. J. Lee, B. Min, K. S. Park, H. Ismail, and D. U. Ahn, Iowa State University, Ames.

The effect of dietary functional ingredients - vitamin E, selenium (Se), conjugated linoleic acid (CLA) - alone or combination on the quality of irradiated turkey breast meat was evaluated. Four hundred eighty male turkeys (12-week-old, raised on a corn-soybean basal diet) were randomly allotted to 32 pens (4 pens/treatment) and fed 8 experimental diets (A, B, C, D, E, F, G, H) supplemented with none (Control, Diet A), 200 IU/kg diet vitamin E (Diet B), 0.3 ppm Se (Diet C), 2.5 % CLA (Diet D), combination of Vitamin E and Se (Diet E), combination of Vitamin E and CLA (Diet F), combination of CLA and Se (Diet G), combination of vitamin E, Se, and CLA (Diet H). At 15-week age, all birds were slaughtered and breast muscle from 8 birds per each pen was separated and grounded. Raw meat patties were either aerobically or vacuum packaged and irradiated using a Linear Accelerator to a dose of 0 or 1.5 kGy absorbed dose. Lipid oxidation, color, and volatile changes of meat were measured after 0 and 7 days of storage at 4 °C. Vitamin E, Se, and fatty acids composition were also determined. Dietary supplementation of vitamin E and CLA increased their deposit in turkey breast. Dietary supplementation of CLA increased monosaturated fatty acids in meat. Irradiation increased ($p < 0.05$) lipid oxidation and hunter color a value, produced specific volatiles such as dimethyl disulfide and hexanal involved in off-odor. Dietary Vitamin E, Se, CLA alone and their combination decreased ($p < 0.05$) lipid oxidation caused by both irradiation and storage. Off-odor volatiles from irradiation were significantly ($p < 0.05$) decreased by dietary functional ingredients. It was concluded that dietary supplementation of functional ingredients improved the quality of irradiated turkey breast meat, lipid oxidation and off-odor caused by irradiation and storage.

Key Words: Dietary Functional Ingredients, Irradiation, Meat Quality

148 Na⁺ migration and quality parameters in turkey fillets using different marination techniques. C. Z. Alvarado*¹ and H. Wang^{2, 1}, ¹Texas Tech University, Lubbock, ²Virginia Polytechnic and State University, Blacksburg.

Marination with salt and phosphate is used as a method of improving quality and extracting salt soluble proteins in turkey meat. However, there are several marination methods available that can affect penetration of marinade and therefore affect meat quality. The objectives of this research were to determine the quality parameters (pH, L* value, marinade pick up (%), marinade retention (%), protein solubility, shear value, cook loss (%), and Na⁺ migration) of the turkey fillet when marinated by several commercial methods. A total of 160 fillets were marinated (20% wt/wt, 94% water, 3.6% NaCl, and 2.4% STP) by multi-needle injection at 4°C, vacuum tumbling (25 mmHg, 4°C, 14 RPM for 1 hour), injection + tumbling or were left as non-marinated controls. There were no significant differences in pH or L* value among the fillets prior to marination. However, by 24 hr post-marination, the pH and L* value of injected + tumbled (6.14, 51.12) and injected (6.13, 50.97) fillets were significantly higher than the control fillets (6.04, 48.91). Injected + tumbled (24.30%) and injected (24.25%) fillets had higher pickup than the tumbled (18.15%) fillets while the tumbled (98.93%) and injected + tumbled (98.23%) had higher retention than injected (95.58%) fillets. There were no significant differences in tenderness, protein solubility or cook loss among any of the treatments. The injected treatment had no differences in sodium ion content throughout the fillets while the injected + tumbled and tumbled treatments had varying levels of Na⁺ migration throughout the fillet. Overall, the injected + tumbled and injected fillets had the highest concentrations of total Na⁺ followed by tumbled and control which were significantly different. Therefore, marination method may affect Na⁺ migration throughout the turkey fillet but this difference may not cause a negative effect on quality.

Key Words: Marination, Sodium, Turkey Fillets

149 Utilizing marination and vacuum tumbling techniques to optimize tenderness of breast fillets deboned early post-mortem. L. J. Bauermeister* and S. R. McKee, Department of Poultry Science, Auburn University, Auburn, AL.

This study was designed to determine the effectiveness of marination, injection marination and/or vacuum tumbling as a means of alleviating the toughness associated with early deboning of breast. Broilers (n=480) 48-60 days of age were conventionally processed. Experimentally, a 2 X 2 X 8 factorial arrangement was used, in which replicates were considered different processing days. Fillets deboned at 2 and 4 h post mortem (PM) were subjected to the following treatments (n=15/treatment): 1. control, 2. tumble (T), 3. marination (M), 4. marination, tumbling (MT), 5. dry injection (I), 6. injection marination, tumbling (IMT), 7. dry injection, tumbling (IT), 8. injection marination (IM). When marinade was applied either by injection or brine-soaked, the marinade pick-up was 10% of the fillet weight to give a final concentration of 0.7% sodium chloride and 0.45% sodium tripolyphosphate per fillet. Biochemical parameters measured (n=80) included pH, sarcomere length, R-value. In addition, cook-loss and shear values were evaluated. Shear values were measured using the (TA.XT2i) Texture Analyzer (Texture Technologies Corp., Scarsdale, NY/Stable MicroSystems, Godalming, Surrey, UK). In the fillets deboned at 2 h PM, injection marination treatments (IMT and IM) decreased cook-loss. In the fillets deboned at 4 h PM, all marination treatments (M, MT, IMT and IM) lowered the cook-loss compared to other treatment groups. At 2 h PM, the injection marination treatments (IMT and IM) lowered shear values compared to shear values of other treatments and the 4 h PM control. Also, in fillets deboned at 4 h PM, the marination treatments (M, MT, IMT and IM) lowered shear values below the 4 h PM control. This study suggests that the use of marination and injection marination could be an effective means of alleviating toughness associated with deboning fillets as early as 2 h PM.

Key Words: Marination, Tenderness, Early Deboning

150 The correlation of razor blade shear, Allo-Kramer shear, Warner-Bratzler shear, and sensory tests to changes in tenderness of broiler breast fillets. L. C. Cavitt*¹, R. Xiong², J.-F. C. Meulenet², and C. M. Owens¹, ¹Department of Poultry Science, University of Arkansas, Fayetteville, ²Department of Food Science, University of Arkansas, Fayetteville.

This study was conducted in order to evaluate the efficacy of the razor blade shearing method and various other instrumental shearing methods (Allo-Kramer and Warner-Bratzler) as a means for developing models for predicting tenderness in broiler breast fillets. Breast fillets were deboned at various times postmortem (0.25 to 24 h) to yield a vast assortment of tenderness levels. Breast fillets were cooked to 76°C and subjected to either shear analysis or sensory analysis (trained or consumer). A trained descriptive panel was used to evaluate samples for attributes including initial hardness and chewdown hardness and a consumer panel for evaluation of attributes including overall acceptability and intensity of tenderness. Relationships between instrumental and descriptive sensory attributes exhibited correlations of $0.53 < R^2 < 0.73$ for initial hardness and chewdown hardness while correlations between instrumental and consumer sensory attributes of acceptability of tenderness and intensity of tenderness revealed coefficient of determination values ranging from $0.71 < R^2 < 0.97$. For both descriptive and consumer sensory analysis, razor blade, Warner-Bratzler, and Allo-Kramer shear tests performed similarly for predicting the tenderness of cooked broiler breast meat. When comparing all three instrumental shearing methods, the razor blade shear test is more advantageous in predicting tenderness as compared to the other instrumental methods due to the fact that no sample cutting or weighing is required in order to execute the test, nor is it excessively destructive as only a small incision (8.9 mm in width) is made in the sample. The razor blade shear test is also advantageous over the other testing methods in that results could be obtained two times as fast as opposed to the other testing methods with very similar or greater precision for predicting tenderness of cooked broiler breast meat.

Key Words: Tenderness, Razor Blade Shear, Sensory

Ruminant Nutrition: Beef - Energy and Nitrogen

152 Blood ketone levels of young postpartum range cows increased after supplementation ceased. R. L. Endecott*, C. M. Black, K. A. Notah, and M. K. Petersen, *New Mexico State University, Las Cruces.*

Young beef cows grazing dormant native range experience weight loss and nutrient imbalances postpartum. Due to high acetate production from ruminal fermentation and low metabolic glucose supply, ruminal acetate is cleared slowly and may be converted to β -hydroxybutyrate (β HB). As a chute-side measure of nutrient status, whole-blood β HB levels of two- and three-year-old postpartum range cows ($n = 45$) were measured with a handheld ketone sensor (MediSense/Abbott Laboratories, Abingdon, UK). Measurements were taken in May and July when cows were grazing dormant range. In May, cows were also receiving one of three 30% CP supplements containing increasing quantities of glucogenic precursors (57, 124, or 192 g/d glucogenic potential). For each ketone reading, β HB in the blood is oxidized to acetoacetate in the presence of hydroxybutyrate dehydrogenase with the concomitant reduction of NAD^+ to NADH. The NADH is reoxidized to NAD^+ by a redox mediator. The current generated is directly proportional to the β HB concentration. After 30 s, the β HB concentration (mmol/L) is displayed on the meter. Data were analyzed using physiological state, time of measurement and their interaction in the model. Cows had higher ($P < 0.01$) β HB in July than they did in May (0.34 vs 0.16 ± 0.02 mmol/L, respectively). Levels of β HB did not approach subclinical ketosis. However, the differences between the two measurements may suggest that the glucogenic precursors in the supplements may have improved utilization of acetate arising from ruminal fermentation. Cows were at an earlier stage of lactation (avg 53 d postpartum), presumably producing more milk, but gaining weight (0.11 ± 0.10 kg/d) in May, while in July were further along the lactation curve (avg 124 d postpartum) and producing less milk, but losing weight (-0.22 ± 0.10 kg/d). Protein sup-

151 Functional analysis of turkey breast muscle. M. S. Updike*¹, M. Lilburn², G. Kaletunc¹, H. Zerby¹, and M. Wick¹, ¹The Ohio State University, Columbus, ²The Ohio State University, Wooster.

Data from recent publications suggest that there is a decrease in turkey breast muscle functionality in further processing. This reduced functionality is hypothesized to be associated with changes in the salt soluble proteins extracted from the breast muscle prior to cooking. To test this hypothesis, salt soluble proteins were extracted from breast muscles obtained from three distinct turkey genotypes. These genetic lines were as follows: 1) the RBC2 line, representative of the 1960s era commercial turkeys; 2) F-line, a subline of RBC2 selected only for 16 week body weight; 3) C-line, representative of present day commercial turkeys selected for body weight and increased breast muscle yield. The rationale for using the three genotypes was to create an extremely variable genetic pool of muscle samples from which to correlate protein composition and functionality relationships. Myosin heavy chain concentrations in the salt soluble protein solutions, as determined by electrophoresis and image analysis, were not different among the genotypes ($P < 0.05$). Rheological analysis was conducted on thermally induced meat gels generated from all the breast muscles sampled ($n=5$ per line). There was a 50-fold difference in the storage modulus (G) between the highest and lowest values obtained from the final step of a programmed temperature ramp from 40°C to 80°C. Breast muscles from the RBC2 line had the highest gel strength at 131 Pa, followed by the F-line (89 Pa), and the C-line (54 Pa; $P=0.09$). A reverse stepwise linear regression analysis was used to associate staining intensities of bands obtained from a 1-D proteomic fingerprint of the salt soluble proteins with the rheological variability observed in the thermally induced meat gel strengths. This analysis showed that two bands were associated with the ultimate gel strength ($R^2 = 0.87$, $P < 0.01$). These findings are unique in showing that variations among the salt soluble proteins, other than myosin, affect the functionality of thermally induced meat gels. Further characterization of these bands will give further insight into the mechanisms underlying the functionality of turkey breast meat.

Key Words: Thermally Induced Meat Gel, Rheology, Proteomic Fingerprinting

plementation may have decreased β HB produced by improving acetate clearance due to a greater supply of glucogenic precursors.

Key Words: Beta-hydroxybutyrate, Acetate, Glucose

153 Effect of step-up program during grain adaptation on ruminal pH and fermentation in feedlot cattle. D. W. Bevens*^{1,2}, K. S. Schwartzkopf-Genswein¹, T. A. McAllister¹, K. A. Beauchemin¹, and J. J. McKinnon², ¹Agriculture and Agri-Food Canada Research Centre, Lethbridge, AB, Canada, ²University of Saskatchewan, Saskatoon, SK, Canada.

Effects on ruminal parameters of rapid vs. gradual adaptation to a high concentrate feedlot diet were compared in a completely randomized study ($n = 6$) using 12 ruminally cannulated heifers (384 ± 25 kg BW). The heifers were housed individually and feed was delivered once daily for ad libitum consumption. Dietary transition from 40 to 90% concentrate was accomplished in 3 d using one step-up diet (rapid adaptation, RA) or in 15 d with five step-up diets (gradual adaptation, GA). The initial diet comprised 35% dry-rolled barley, 45% barley silage, 15% grass hay and 5% supplement (DM basis). These ingredients were used to formulate diets containing (DM basis) 48.3, 56.7, 65.0, 73.3, 81.7, and 90% concentrate. For treatment GA, each diet was fed for 3 d; for RA, only the 65% and 90% concentrate diets were fed. Ruminal pH was monitored continuously for 20 d via indwelling electrodes, and ruminal fluid was sampled 8 h after feeding on days of diet change. On days of change to 65 or 90% concentrate, treatment effects on minimum, maximum, or mean pH, or on the area of $pH \times$ time curves falling below 5.6 or below 6.2, were not observed ($P > 0.10$). Over the 3 d following introduction of 65% concentrate diets, the area of $pH < 5.6$ was greater ($P = 0.08$) with RA than with GA. No other effects ($P > 0.10$) of treatment on pH variables were observed during the 3 d of feeding 65% or 90% concentrate diets. Treatment did not affect ($P > 0.10$) total VFA concentrations or ruminal fluid osmolality, but in some samples, acetic