The scarcity of conventional feed resources and their high price has necessitated exploring cost effective non-conventional ingredients to be utilized to replace the conventional ones like hatchery waste (HW). The chemical composition of HW has revealed its nutrient composition especially higher level of fat (18–21%), which poses threat to spoil the quality of product through rancidity. Hatchery waste was processed by simple cooking, autoclaving, and extrusion cooking. Four different levels of antioxidant (Oxygen) at 0, 100, 200 and 300 mg/kg were added to all the processed and raw hatchery waste. The samples were stored for 50 d and analyzed for peroxide value (PV), thiobarbituric acid value (TBA) and free fatty acids (FFA) contents with the interval of 10 d to evaluate the fat storage stability of HW. There was a linear increase in PV, FFA and TBA values of all the treatments throughout the storage period. Comparison within the raw hatchery waste and processed HW revealed that extrusion cooking was the most effective processing technique to check fat oxidation followed by autoclaving and simple cooking, whereas unprocessed (raw) hatchery waste showed maximum fat deterioration. PV, FFA and TBA decreased with all the levels of antioxidant addition when compared with samples without antioxidant fortification. At the end of storage period the significantly highest (P ≤ 0.05) levels of PV, FFA and TBA were observed in unprocessed samples without antioxidant addition, while the least degradation of fat was observed in extruded samples with 300 mg/kg of antioxidant addition. In general, all the processing techniques as well as antioxidant addition checked the fat rancidity throughout the storage period as compared with raw samples without antioxidant addition; however synergistic effect of extrusion cooking and 300 mg/kg of antioxidant addition was found to be most appropriate to keep the samples highly acceptable for 50 d of storage period.

**Key Words:** hatchery waste, antioxidant, processing, oxidative stability

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An experiment was carried out to evaluate the effects of physical form of corn and soybean meal based diet on performance of broiler chickens. One thousand 2 hundred and 60 d-old Cobb 500 broiler male chicks were used during the 42 d of trial, following a completely randomized design of 3 treatments with 6 replicates of 70 birds each: 3 physical forms of rations (mash, pellet, and expanded-pellet). Broilers fed expanded-pellet diet grew faster than broilers fed pelleted diet, but these birds performed better as compared with birds fed with unprocessed diet. The body weights, weight gain and feed conversion improved with processed rations as compared with mash diet. The results of body weight, weight gain and feed conversion of birds fed expanded-pellet, pellet and mash were, respectively, 180.6, 171.1 and 168.4 g of BW; 132.9, 123.6 and 120.81 g of WG; 1.075, 1.154 and 1.141 kg/kg of FC (1 to 7 d); 1.069, 1.052 and 0.960 kg BW; 1.024, 1.003 and 0.913 kg WG; 1.254, 1.271 and 1.305 kg/kg FC (1 to 21 d); 2.488, 2.455 and 2.252 kg of BW; 2.994, 2.950 and 2.714 kg of WG; 1.192, 1.222 and 1.242 kg/kg of FC (1 to 35 d); 3.076, 3.052 and 2.834 kg of BW; 3.031, 3.003 and 2.788 kg of WG; 1.498, 1.528 and 1.598 kg/kg of FC (1 to 42 d). Broiler fed expanded-pellet and pelleted diets had higher feed intake than those fed mash diet but among them was no differences. Feed intake (1 to 42 d) were 4.542, 4.587 and 4.457 kg for expanded-pellet, pellet and mash rations, respectively. The viability was the same among the expanded-pellet and pelleted rations, but were lower as compared with mash ration (93.1, 92.8 and 95.2%). The carcass, breast, thigh and drumstick weights were 2.529, 2.550 and 2.384 kg; 916, 893 and 794 g; 289, 299 and 271 g; 386, 396 and 350 g of bird fed expanded-pellet, pellet and mash respectively. The feed costs per kilogram of live weight were USD 0.76, 0.77 and 0.80 of bird fed expanded-pellet, pellet and mash, respectively. It is concluded that heat-treatment of corn and soybean meal based diet improves performance and reduces the cost of feeding broiler.

**Key Words:** broiler, physical form, pellet, mash, expanded-pellet

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**327 Impact of feeder and water placement on broiler meat yield.** R. K. Gilcrease*, G. Casco, T. Yalamanchili, C. Ruiz, and C. Z. Alvarado, Texas A&M University, College Station.

Bone weakness can constitute issues with animal welfare and uniformity due to inability to eat or drink. Bone strength in broilers can be improved through physical activity. However, there is little research on the effect of physical activity on meat yield. The objective of this study was to determine the effect of increased physical activity on yield of broilers. A total of 432 birds (216 males and 216 females) were raised for either 42 or 52 d of age and conventionally processed by stunning, slaughter, bleeding, scalding, defeathering, eviscerating, chilling, and deboning. Yield analyses included percentages for the following: WOG, chilled carcass, wing, breast, skinless boneless breast, tender, thigh, and drum. Data was analyzed using the GLM procedure of SAS and the means were separated using Duncan’s Linear Model with a P-value of <0.05 to determine significance. Males and females were reported separately. No significant differences were observed in male or female yield data slaughtered at 42d. However, by 52d of age, females had significantly higher breast meat yield (bone-in, skin-on and boneless skinless breast) in the controls (30.18) and T6 (30.09) compared with T10 (28.68). T10 females at 52 d had significantly higher drum yield (12.65) when compared with the other treatments (12.50). In the data collected from males at 52d, the WOG yield was significantly higher in the control (74.24) and T6 (73.80) treatments compared with the T10 (72.75). Therefore, it can be concluded that the different distances between feeders made no difference in either male or female birds at 42d, but by 52d, significant differences were observed.

**Key Words:** animal welfare, broilers, yield, physical activity, exercise

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The antioxidant effect of natural and synthetic compounds on cooked chicken meat was assessed. The lipid oxidation stability of refrigerated cooked breast meat was estimated using dietary supplemented antioxidants: vitamin E (VE 10 and 100 mg) and oregano essential oil (OR 100 mg) per kg of feed, and meat-added antioxidants: honey (3%) and BHT (0.02%). Broilers were fed with a basal corn-soybean meal diet during 6 weeks of feeding period. Honey and BHT were added to the meat from the VE10 treatment. The meat was cooked on an electric grill up to an internal temperature of 74°C, cooled at room temperature, placed on trays and covered with packaging film, and refrigerator stored (4°C) during 0, 3, 6, and 9 d. TBARS (2-thiobarbituric reactant substances analysis) was conducted at each storage day to quantify the malondialdehyde (MDA) values. Data were analyzed using a completely randomized design; each treatment had 12 repetitions and the least squares means were compared using orthogonal contrasts. The results showed that the VE10 treatment had higher MDA values than the other ones (P < 0.001). No differences (P > 0.05) in MDA values were detected between the dietary supplemented (VE100 and OR100) and the meat-added antioxidants (honey and BHT). Addition of honey to the meat resulted in lower MDA values than the BHT treatment (P < 0.05). The VE100 treatment showed lower MDA values than the OR100 one (P < 0.05). In conclusion, the supplementation of 10 mg/kg of vitamin E resulted in a higher lipid oxidation development of the meat. The use of dietary supplemented or meat-added antioxidants has a similar effect on the lipid oxidation stability of the meat. Dietary supplementation of vitamin E exerts a higher antioxidant effect of the meat than oregano essential oil, at the same level of inclusion. Finally, the addition of honey to the meat is more effective at inhibiting the lipid oxidation development than the synthetic BHT antioxidant.

Key Words: meat lipid oxidation stability, natural antioxidants, synthetic antioxidants

329 Meat quality evaluation of a commercial and a heritage broiler strain. D. P. Smith*, 1, J. K. Northcutt2, and E. L. Steinberg2, 1Department of Poultry Science, Raleigh, NC, 2Department of Food, Nutrition, and Packaging Science, Clemson, SC.

Some consumers have reported that meat from heritage broiler strains (HS) is preferred to commercial broiler strains (CS) in regard to meat quality attributes, but relatively few objective measurements have been conducted on most heritage strains. To directly compare meat quality from a heritage and a commercial broiler strain, 5 ready-to-cook carcasses from each strain were obtained from the processing plant or retail store on each of 5 d. Boneless skinless breast fillets and boneless thighs were taken from each carcass, weighed, and assigned to different testing lots for cooking to determine yield, objective texture (razor blade shear), or sensory panel evaluation (experienced untrained), or, raw parts pooled for proximate composition analysis (percent protein, moisture, fat, and ash). The CS breast fillets were significantly (P < 0.05) heavier than HS fillets (168 vs. 103 g) but there was no difference for thigh weight (82 vs. 77 g, respectively). HS breast cook yield was higher than CS breast (82 vs. 76%), but there was no difference in strains for thigh meat. Objective texture results showed no significant differences for breast or thigh meat due to strain. No significant differences were observed for breast meat by sensory panel due to strain; HS strain thigh meat had lower values than CS for appearance (5.2 vs. 7.6), juiciness (8.3 vs. 9.4) and tenderness (8.7 vs. 10.5). There were no significant differences due to strain for percent protein, moisture, fat, and ash, for either breast or thigh meat. Few differences between strains were observed for breast meat quality attributes, while sensory panel attributes for thigh meat ranked higher for the commercial strain than the heritage strain.

Key Words: broiler, heritage strain, meat quality, sensory analysis, proximate composition

330 Quality of chicken meat as influenced by heat stress and post slaughter chilling. G. A. Veluz*, 1, C. M. Owens2, and C. Z. Alvarado1, 1Poultry Science Department, Texas A&M University, College Station, 2Poultry Science Department, University of Arkansas, Fayetteville.

Poor meat quality is a growing problem in poultry and can be attributed to heat stress as well as improper chilling of the carcass. This study was conducted to determine the relationship between prechilling and chilling in control and heat-stressed birds. A total of 300 broilers in 2 trials were raised in control or heat-stressed environments. At 49 d of age, heat stressed and control broilers were conventionally processed, and either prechilled at 55°F for 15 min and chilled at 34°F for 60 min or chilled only (34°F for 60 min). Analyses of quality attributes included pH (0.25 h, 1.25 h, 3 h and 24 h PM), color (L*, a*, and b*), tenderness (allo-kramer shear), cook loss, and cooked meat moisture. Data was analyzed by GLM in SAS and means were separated using Duncan’s Multiple Range test (P < 0.05). Data was analyzed by control and heat stressed birds with chilling as the treatment. Results indicated that the meat quality from the control and heat stressed birds subjected to prechilling and chilling was the same as those birds that were only chilled. There were no significant differences in meat quality (moisture content, cook loss, color, pH and tenderness) from either the heat-stressed (chilled/pre-chilled) and control birds (chilled/prechilled). In the control birds, the development of rigor mortis as indicated by pH decline (0.25 h to 24 h) was 6.61 to 5.82 for the chilled birds which was not significantly different from the prechilled/chilled birds (6.62 and 5.78). Likewise, similar pH decline values from heat-stressed birds chilled (6.67 to 5.81) and heat stressed birds treated with prechill/chill (6.69 to 5.82) were noted. Although cook loss was slightly lower for the chilled birds as compare with prechilled/chilled treatment for both control and heat-stressed birds, there was no significant difference (P > 0.05). Therefore, prechilling for 15 min (55°F) does not negatively affect meat quality in control or heat stressed birds.

Key Words: prechilling, chilling, heat stress, broilers, tenderness

331 Postmortem aging can significantly enhance water-holding capacity of broiler pectoralis major muscle measured by the salt-induced swelling/centrifugation method. H. Zhuang* and E. Savage, USDA-ARS, Athens, GA.

Water-holding capacity (WHC) is one of the most important functional properties of fresh meat and can be significantly affected by postmortem muscle changes. Two experiments were carried out to evaluate the effects of postmortem aging on WHC of broiler pectoralis (p.) major muscle indicated with % salt-induced water gain (swelling/centrifugation method). The first experiment was to determine the effect of postmortem aging on WHC of broiler p. major with different color lightness. The p major muscle was deboned 6–8 h postmortem and categorized based on CIELAB L* value. The muscle WHC was measured either after deboning or after being aged at refrigerated tempera-
ture for 24 h. Regardless of muscle color lightness, the salt-induced water gain by the broiler p. major aged 24 h post-deboning was at least 50% higher than the samples without post-deboning aging, indicating that post-deboning aging could enhance WHC of broiler breast meat. The second experiment was to determine effects of deboning time and post-deboning aging time on the WHC. The p. major muscle was deboned at either 2 h or 24 h postmortem, and the 2-h deboned p. major was aged for either 22 h or 7 d at refrigerated temperature before WHC were measured. Regardless of aging methods (on or off the carcass) and aging time (22 h or 7 d), the salt-induced water gain by the aged p. major was more than 80% higher than that by the 2-h deboned samples. There was no difference in the WHC between the muscle deboned 24 h postmortem and the muscle deboned 2 h and aged 22 h post-deboning. There was no difference between the 22-h postmortem aging and 7-d post-deboning aging. These results suggest that the first 24 h postmortem aging after slaughtering could enhance WHC of broiler p. major muscle.

Key Words: postmortem aging, water-holding capacity, pectoralis major muscle, broiler, deboning time

332 Quality and sensory attributes of shell eggs sanitized with a combination of hydrogen peroxide and ultraviolet light. K. Woodring*, S. M. Gottselig, C. Alvarado, L. Hirschler, J. T. Lee, and C. D. Couf al, Texas A&M University, College Station.

An experiment was conducted to evaluate the combination of hydrogen peroxide and UV light (UV) as an alternative eggshell sanitization procedure for shell egg processing. Two cases of eggs (720 total) were collected at a commercial inline egg production facility. To assure egg uniformity, only eggs between 57 and 62 g were collected from a single hen house. Half of the eggs (360) were commercially processed (washer and sanitizing rinse) following normal procedures outlined by the USDA for shell egg processing. These eggs were designated as the control group. The other half of the eggs (360) were washed as normal but without the sanitizing rinse. These eggs were then treated with the hydrogen peroxide and UV treatment (treated group). The treatment consisted of spraying the eggs with 3% hydrogen peroxide over the entire shell surface followed immediately by exposure to UV for 5 s in an enclosed chamber equipped with germicidal lamps (UV-C). This treatment was performed twice. Following washing and treatment, all eggs were packaged in clean styrofoam cartons and transported to the lab and stored in a refrigerator at 5 C. Eggshell aerobic plate counts (APC), breaking strength, and thickness, albumen height and pH, haugh units, and yolk color were measured on d 1 and 15 of storage. On d 15, sensory evaluation of scrambled egg samples was conducted to determine if consumers could detect a difference between treatment groups using a triangle test. Results indicate that treated APC were significantly lower than the control eggs for d 1 and 15. On each day, only 25% of treated eggs were positive for APC by rinse and plate method. No differences were found for all other egg quality parameters measured. In the sensory evaluation, only 28% of the participants correctly differentiated between the control and treated eggs. Data from this experiment suggests that hydrogen peroxide and UV can be used as an alternative eggshell sanitizing procedure without impacting eggshell or internal egg quality.

Key Words: eggs, sanitization, ultraviolet, hydrogen peroxide, sensory

333 The impact of marination on the quality of frozen broiler breast fillets. A. G. Sanchez Pena* and C. Z. Alvarado, Texas A&M University, College Station.

Eighty-three percent of consumers purchase fresh poultry and freeze it for future use. The objective of this study was to evaluate the effects of marination (M) on the quality of chicken breast fillets after 2 wk storage in a home freezer (~18°C). A total of 240 fillets (24 hr PM) in 2 reps were used in the following treatments: non-marinated fresh non-frozen (NM-NF), non-marinated frozen (NM-F), marinated fresh not frozen (M-NF), and marinated frozen (M-F). The M fillets were vacuum-tumbled (25 mm Hg, 14 RPM, 30 min, 4°C) with a 10% solution (0.45% STP and 1.25% salt). Samples subjected to frozen storage were randomly placed in freezer bags and frozen for 2 wk in a home freezer. The frozen samples were compared with the non-frozen fresh (24 h PM) fillets to determine ability to withstand freshness in a home freezer. Raw samples were analyzed for color (L*, hue, chroma), TBARS, and freezing loss. Cook loss, texture, moisture and sensory attributes (color, juiciness, tenderness, overall flavor and preference) were analyzed in the cooked samples at wk 2. Data was analyzed using the GLM procedure of SAS and the means were separated using Duncan’s Linear Model (P value of <0.05). M-F had a significantly lower freezing loss compared with NM-F (1.75, 9.44). The NM samples (fresh and frozen) had significantly higher TBARS values when compared with the M samples indicating that marination resulted in antioxidative properties. All M samples had significantly lower cook loss, shear value, and higher moisture, preference, overall flavor and tenderness (sensory) than the NM ones. The M-F fillets samples had the lowest cook loss, shear force, and highest moisture of the 4 treatments. In addition, the M-F and the M-NF samples had the highest sensory ratings for color, juiciness, tenderness, overall flavor and preference. Therefore, consumers preferred the marinated samples more than the non-marinated samples. In addition, freezing in a home freezer for 2 wk did not negatively impact the quality in the marinated fillets but did decrease quality in the non-marinated fillets.

Key Words: marination, quality, breast fillets, freezing

334 Yield Improvements in water and oil based marinades with a natural non-phosphate blend. G. Casco* and C. Z. Alvarado, Texas A&M University, College Station.

As consumer demand for natural marinades increases, the need to replace phosphate with a natural product that can produce equivalent or improved yield in products such as but not limited to rotisserie chickens is a challenge for processors. The objective of this research is to determine marination yield in water-based (W) and oil-based (O) marinades using a natural non-phosphate blend (SavorPhos-200). Two commercial phosphates used in water-based (PW) and oil-based (PO) injection brines for rotisserie chickens were compared with SavorPhos-200. The treatments included water control (water, 0.4% phosphate, 0.7% salt), WSF (water, 0.5% SavorPhos-200, 0.7% salt), oil control (water, 3% oil, 0.4% phosphate, 0.7% salt), and OSF (water, 3% oil, 0.5% SavorPhos-200, 0.7% salt). Whole birds were injected with a multi-needle injector to 20% (wt/wt) pick-up at a constant pressure (15-20 psi). The parameters measured were marinate pick-up %, marinate retention %, and cook loss %. Data (2 trials, n = 20) was analyzed using a single-way ANOVA using SigmaStat software. Means were separated using a t-test (P < 0.05). Data was analyzed within marination type (W and O). Results for the W marinated sam-

An experiment was conducted to measure the impact of water-fluming transport of broiler carcass feathers and viscera offal on poultry processing wastewater (PPW). Twenty-four 8-wk old male broilers were randomly assigned to 4 treatment groups (n = 6): SS (short-bleed/soft-scald), SH (short-bleed/hard-scald), LS (long-bleed/soft-scald), and LH (long-bleed/hard-scald). Short-bleed = 60 s, long-bleed = 120 s.

Soft-scald = 50°C, hard-scald = 60°C. Birds were electrically stunned, simultaneously decapitated and bled for either 60 s (S) or 120 s (L). Carcasses were then scalded for 2 min in individual scald tanks containing 16L of water heated to either 50°C or 60°C. Representative samples of 100g of feathers were removed from each carcass and agitated in 2L of potable water for 2 min. Feathers were coarse screened and rinse water was retained for analysis. Carcasses were eviscerated. Viscera were weighed and agitated in 4L of potable water for 1 min. 2L of coarse screened rinse water were retained for analysis. Viscera were agitated for an additional 2 min (3 min total) and remaining 2L of rinse water were retained for analysis. Samples of feather (24) and viscera (48) rinse water were analyzed for chemical oxygen demand (COD), total solids (TS), total suspended solids (TSS), total volatile solids (TVS), and total Kjeldahl nitrogen (TKN) concentration (mg/L).

A PPW load (g/carcass) was calculated for each concentration (mg/L) point data using the associated volume of rinse water and statistically analyzed. Results showed feather rinse water mean loadings (g/carcass) were COD 1.23, TS 0.86, TVS 0.69, TSS 0.40, and TKN 0.11, with no significant differences between treatments. Viscera rinse water mean loadings (g/carcass) at 1 min agitation were COD 1.12, TS 0.58, TVS 0.58, TSS 0.23, TKN 0.07, with no significant differences between treatments. Viscera rinse water mean loadings (g/carcass) at 3 min agitation were COD 1.88, TS 1.03, TVS 1.02, TSS 0.44, TKN 0.11, with no significant differences between treatments. The additional 2 min of viscera agitation resulted in increased mean loadings of COD 40%, TS 44%, TVS 45%, TSS 49%, and TKN 33% in PPW.

Egg shells and cracked eggs of six pure lines compared to commercial white- and brown-egg layers. F. G. Silversides* and M. C. Robertson, Agriculture and Agri-Food Canada, Agassiz, British Columbia, Canada.

Egg production was measured over a 4-year period for 6 lines of layers kept at the Agassiz Research Centre along with that of Lohmann White (LW) and Brown (LB) hens. Egg and shell wt were measured on individual eggs at approximately 30, 40, and 60 wk of age and production of eggs and cracked eggs of the 3-hen cages was recorded in the 4-wk periods surrounding egg quality measurements. The LW and LB hens produced the most eggs and the Agassiz White Leghorns (BLK, BLU, BUR) and Rhode Island Reds (RIR) produced more than Barred Plymouth Rocks (BR) and Columbian Rocks (CR). The RIR had the heaviest eggs and LB hens had larger eggs than LW. Shells of eggs from LB and LW hens were heavier than those of eggs from other lines and those of LB eggs were greater than for LW eggs, but LW and LB eggs had similar % shell. Shell wt and % was lower for the Agassiz lines, suggesting not surprisingly that the breeding industry has paid significant attention to shell quality. The shell % of the Agassiz White Leghorn eggs was close to that of commercial lines and higher than for the BR, CR, and RIR lines, which could suggest that White Leghorns have inherently higher shell % than brown-egg layers. The number of cracked eggs from commercial lines was lower than that of other lines, and RIR had the most cracked eggs. Many observed correlations were because egg production decreases with age, while cracked eggs and egg and shell wt increase and shell % decreases. High producing lines had higher shell % leading to a positive association (0.28)
between production and % shell. The association between shell % and cracked eggs was surprisingly low (−0.19). The line appeared to be more important than the age for the correlation between eggshell and number of cracked eggs because those within the line over the 3 periods were lower than those within age for all lines. These data suggest that industrial breeders have been successful at reducing variation in cracked eggs that relate to eggshell wt, especially for white-egg layers. Breeders should look for other factors, such as eggshell structure, to further reduce cracked eggs.

**Key Words:** eggshell quality, layer lines, cracked eggs


Pastured hen egg producers must demand a premium for their eggs due to increased labor and cost of production. Consumers have justified spending more for these eggs because they perceive animal welfare, sustainability, and nutrition are enhanced compared with conventionally produced eggs. However, scientific data does not support these perceptions. This study implemented practical management strategies to increase eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) composition of eggs which may better justify egg premiums due to these fatty acids being associated with numerous health benefits. A randomized complete block design was utilized with 15 single-comb-white leghorn Hyline W-36 hens per experimental unit and 5 replications. Hens were reared in 5 different portable houses that were divided into 4 pens of equal size. Pens contained 2 doors for access to outdoor paddocks. Hens were allowed to forage during daylight hours and paddocks were rotated to assure fresh pasture access. Corn and soybean based basal diets were provided for ad libitum consumption and depending on treatment utilized a 1:1 replacement of soybean oil with either marine or flaxseed oil. Each house contained 4 different treatments 1) basal, 2) basal + 0.5% marine oil, 3) basal + 1% marine oil, and 4) basal + 1% flaxseed oil. The marine oil was analyzed to contain 18% EPA and 12% DHA and flaxseed oil primarily contained α-linolenic acid (>50%). Hens were on experiment from 20 to 24 wks, and eggs were collected for nutrient analysis at the end of this period. Hen performance among treatments was not different. Pastured hens fed the basal diet had the lowest EPA and DHA levels, followed by basal + 0.5% marine oil and basal +1% flaxseed oil ($P = 0.0001$). Hens fed the basal diet + 1% marine oil produced eggs with the greatest concentration of EPA and DHA (213 mg/egg total, $P = 0.0001$). This level could provide nearly all of the American Heart Association’s daily recommendation for EPA and DHA consumption (220mg/day). Aroma and flavor attributes determined by a taste panel were similar among eggs from all treatments.

**Key Words:** marine oil, EPA, DHA