371 *Salmonella* recovery following air chilling for matched neck-skin and whole carcass sampling methodologies. R. J. Buhr*, N. A. Cox, J. A. Cason, L. L. Rigsby, and D. V. Bourassa, *USDA-ARS Russell Research Center*, *Athens, GA*.

The prevalence and serogroups of *Salmonella* recovered following air chilling were determined for both enriched neck skin and matching enriched whole carcass samples. Commercially processed and eviscerated carcasses were air chilled to 4°C before removing the neck skin (8.3 g) and stomaching in 83 mL buffered peptone water. The remaining carcass was subjected to whole carcass enrichment in 500 mL buffered peptone water. Both neck skins and whole carcasses were incubated at 37°C for 24 h before aliquots were transferred to selective enrichment broths (RV and TT) and incubated at 37°C for 24 h. Following incubation, BGS and MLIA plates were streaked and incubated at 37°C for 24 h. Three typical colonies were individually stabbed into TSI and LIA slants and incubated at 37°C for 24 h. For neck skin samples, 14/18 were Salmonella-positive with 5 identified as serogroup C1, 8 serogroup C3, and 2 serogroup E. For whole carcasses 16/18 carcasses were Salmonella-positive with 1 identified as serogroup B, 6 serogroup C1, 9 serogroup C3, and 2 serogroup E. Two *Salmonella* serogroups were detected from one neck skin (C3/E) sample and 2 *Salmonella* serogroups were detected from 2 non-matched carcasses (C1/C3 and C3/E). All 4 of the Salmonella-negative neck skin samples had Salmonella-positive matching whole carcasses and the 2 Salmonella-negative whole carcasses had Salmonella-positive matching neck skin samples. Selecting 3 individual colonies, versus only one, from BGS and MLIA plates resulted in 2 additional Salmonella-positive neck skin samples (C1) and 2 additional Salmonella-positive carcasses (C1 and C3). In this study, individual neck skin enrichment (78%) and whole carcass enrichment (89%) sampling methodologies were comparable in the prevalence detection of *Salmonella* from matched air-chilled carcasses.

Key Words: *Salmonella* serogroups, whole carcass enrichment, neck skin enrichment

372 Effect of ultrasonication and phosphate level during marination on numbers of *Salmonella* and *Escherichia coli* on broiler breast meat. D. P. Smith*, *Poultry Science Dept., North Carolina State University*, *Raleigh*.

Four trials were conducted to determine the effect of ultrasonic treatment and phosphate level during marination on numbers of *Salmonella* and *Escherichia (E.) coli*. In each trial 2 whole boneless, skinless chicken breasts were obtained from a retail store and split into paired fillets. One fillet from each pair was assigned to marination either with or without ultrasonication for 20 min. Trials 1 and 2 marination solution contained 91% water, 6% NaCl, and 3% sodium tripolyphosphate (STP); for Trials 3 and 4 the solution consisted of 91% water, 6% STP, and 3% NaCl. Ten min before marination fillets were inoculated with 1.0 mL of a culture containing nalidixic acid-resistant strains of *Salmonella* Typhimurium, Enteritidis, *heidelberg*, and *montevideo* (mean count of 7.1 $\log_{10}$), and an *E. coli* strain (mean count of 6.1 $\log_{10}$). After marination fillets were shaken for 1 min in a 50 mL rinse of 1% BPW. Serial dilutions were plated onto BGA with sulfapyridine with 200 ppm nalidixic acid and incubated at 37°C for 24 h, and onto *E. coli*/coliform Petrifilm and incubated at 35°C for 24 h. Post-treatment marination solutions were sampled and average *Salmonella* counts of 1.7 $\log_{10}$ were recovered; no *E. coli* were recovered. Bacterial counts were transformed to $\log_{10}$ CFU/ml, data main effects analyzed by ANOVA, and mean differences due to treatment analyzed by *t* test. There were no significant ($P < 0.05$) differences due to ultrasonication for either *Salmonella* (mean count 4.6 $\log_{10}$ CFU) or *E. coli* (mean count of 2.8 $\log_{10}$ CFU). Higher STP significantly reduced *Salmonella* numbers (from 4.7 to 4.5 $\log_{10}$ CFU) but had no effect on *E. coli*. The reduction of *Salmonella* numbers was small and would have limited usefulness in practical application. Ultrasonic treatment during marination was not effective for reducing numbers of *Salmonella* and *E. coli* on broiler breast meat.

Key Words: broiler breast meat, ultrasonic marination, *Salmonella*

373 The enrichment of breast and thigh meat in broilers for DHA using supplemental DHA. M. K. Manangi*, B. Wuelling, J. Hux, S. Carter, and M. Vazquez-Anon, *Novus International, Inc.*, *St. Charles, MO*.

A 44-d experiment was conducted to evaluate the enrichment levels of DHA (docosahexaenoic acid) in broiler breast and thigh meat along with various other tissues using supplemental source of DHA (DHA GOLD) in a corn-SBM based diet. A total of 540 Ross-708 male broiler chicks were raised in floor pens up to d 23 of age using starter and grower diets. On d 23, 432 birds were assigned to 3 treatments with 12 pens/treatment and 12 birds/pen under completely randomized block design. The 3 treatments were: 1) 0% DHA GOLD; 2) 1% DHA GOLD; 3) 1.5% DHA GOLD supplementation. DHA GOLD was supplemented as 'on-top' addition from d 23 to 44. DHA was quantified in various tissues at d 37 and only for breast meat at d 44. D 37 data indicates significant ($P < 0.05$) increase in DHA content due to supplemental DHA for breast and thigh meat and skin, liver, and fat pad. D 44 breast meat data also indicates a significant ($P < 0.05$) increase in DHA content. Supplementing broilers diets with 0, 1, and 1.5% DHA GOLD on top for 14 d (d 23 - 37) resulted in 17, 26 and 34 mg of DHA/100g of breast muscle; 17, 32, and 43 mg of DHA/100 g of thigh muscle; 20, 160, and 274 mg of DHA/100g of breast skin; 27, 119, and 253 mg of DHA/100 g of thigh skin; 4, 80, and 160 mg of DHA/100 g of liver; and 13, 179, and 289 mg of DHA/100 g of fat pad, respectively. Supplementing broilers with diets containing 0, 1, and 1.5% DHA GOLD on top for the last 21 d (d 23 - 44) resulted in 13, 35, and 54mg of DHA/100g of breast muscle, respectively. Data also indicates that supplementing up to 1.5% of DHA GOLD on top in the broiler diets does not affect ($P > 0.05$) weight gain and F:G. In summary, supplemental DHA GOLD can be used to enrich broiler meat with levels of DHA to satisfy recommended daily allowance. Further increase in enrichment was possible by extended period of dietary DHA inclusion. DHA GOLD is a dried whole cell algae product, derived from *Schizochytrium sp*, contains a minimum of 18% DHA by weight.
DHA GOLD is a registered trademark of Martek Biosciences Corporation, USA.

Key Words: broiler, DHA

374 Effect of feeding hatchery waste meal processed by different techniques on egg quality and productive performance of laying hens. A. Mahmud*[1], Saima[1], M. A. Jabbar[1], A. W. Sahoota[1], Z. Ali[2], and M. Z. U. Khan[1], [1]*University of Veterinary & Animal Sciences*, *Lahore, Pakistan*, [2]*Big Feeds (Pvt) Ltd.*, *Lahore, Pakistan*.

The present experiment was conducted in 2 phases. In the first phase, hatchery waste (HW) was subjected to the following processing techniques; cooking, autoclaving and extrusion to prepare hatchery waste

meal (HWM). Prepared HWM was chemically analyzed. In the second phase, an optimum inclusion level for each type of processed HWM was determined in layer diets. For this purpose, 3 hundred White Leghorn hens were randomly distributed to 10 dietary treatments. A negative control diet was prepared without HWM, while 9 experimental diets contained 4, 8 or 12% of cooked, autoclaved or extruded HWM, respectively. Completely randomized design was used and statistical analyses were carried out with SAS version 9.1 using Duncan multiple range test for mean comparisons at 5% probability. Results showed that maximum egg production was achieved with 4% HWM processed by autoclaving. Processing of HW with extrusion significantly reduced egg production and a more pronounced decrease was found with 12% of extruded HWM. Egg mass and feed conversion followed the same trend observed for egg production. Average egg weight due to different treatments fell within a very narrow range and showed no difference ($P > 0.05$) among treatments. Shell, yolk and albumen weights, as a percentage of egg weight, were not significantly affected with the use of different levels and processing of HWM. Maximum values for albumen height as well as Haugh units were obtained by feeding the 4% autoclaved HWM. Other egg quality parameters like shell thickness, yolk index and color were independent of the dietary treatments. The findings of this study suggest that autoclaving of hatchery waste is better than extrusion or cooking techniques and 4% of autoclaved HWM may be included in layer rations to get more production than diets without HWM. Nevertheless, layer diets up to 8% HWM could be used to feed the laying hens to maintain reasonably good production without detrimental effects on egg quality.

Key Words: hatchery wastes, processing, layers

375 Effect of feeding flaxseed and two types of antioxidants on quality parameters of omega-3 enriched eggs during storage. Z. Hayat*[1,2], G. Cherian[3], T. N. Pasha[2], F. M. Khattak[2], and M. A. Jabbar[2], [1]*University College of Agriculture, University of Sargodha, Sargodha-40100, Pakistan*, [2]*University of Veterinary and Animal Sciences, Lahore-54000, Pakistan*, [3]*Department of Animal Sciences, Oregon State University, Corvallis*.

Inclusion of flaxseed to enhance omega-3 content of eggs is well documented. However, increasing omega-3 fatty acids perpetuates the extent of fatty acid unsaturation, leading to oxidative damage of yolk lipids and reduction in egg quality. This phenomenon is aggravated during storage, and needs suitable strategies to combat deterioration of egg quality. Currently, a limited number of antioxidants are available that poses major challenge for the feed industry to use them efficiently. Therefore, the aim of present study was to examine the effect of 2 types of antioxidants and storage on quality parameters of eggs enriched with omega-3 fatty acids. ISA brown layer pullets were fed corn-soybean meal-based diet with no added antioxidants (Control) or 10% flax seed and 2 types of antioxidants (α-tocopherols, butylated hydroxytoluene, [BHT] at 0, 50, 100, 150 IU or mg/kg). A total of 384 eggs (48/diet) were collected and stored at 4°C for 60 d. On d 0, 20, 40, and 60 of storage, 2 eggs from each replicate (totaling 12 eggs per treatment) were selected randomly. Egg quality parameters such as egg weight, yolk weight, yolk color, albumen weight, albumen height, shell weight, shell thickness and Haugh unit were measured. Storage over 20 d affected all the parameters except egg weight, shell weight and shell thickness ($P < 0.05$). Supplementation of antioxidants at higher levels (150 IU or mg/kg) was found to be effective in reducing the drop in egg quality. This may be at the expense of antioxidants as storage led to over 50% reduction in egg tocopherols content ($P < 0.05$). The interaction of storage with diet was not significant on all egg quality parameters tested ($P > 0.05$). Egg weight, shell thickness and shell weight as percentage of total egg weight were not affected by diet or storage ($P > 0.05$). These data demonstrate that added antioxidant supplementation may be needed in improving the quality parameters during storage in eggs from hens fed flaxseed.

Key Words: flaxseed, antioxidants, egg quality

376 Quality of shell eggs stored under modified atmosphere packaging. T Yalamanchili*, C. Z. Alvarado, L. D. Thompson, and C. J. Brooks, *Texas Tech University*, *Lubbock*.

The processing of shell eggs involves collecting of eggs and transporting them to a packaging plant where they are cleaned, sorted and packaged. However, the cooling capacity at the farm, storage, and the transportation trucks as well as time to the retail outlet can decrease egg quality. The objective of this experiment was to determine the effect of a modified atmosphere packaging (MAP) on the quality of USDA Quality grade AA shell eggs placed in a Master bag (Cryovac 33cm × 55.88cm) and stored at 4°C. Shell eggs were subjected to one of the 2 packaging treatments: (1) control–air; (2) 20% CO_2 and 80% N_2. Packaged eggs were stored for 28 d in the master bag at 4 ± 1°C. A total of 5760 eggs were used in 2 experiments, with 2 trials and 5 replications each. Five master bags were used for analyses on 1, 7, 14, 21, and 30d. In Experiment 2, and the packages were allowed to sit at 4 ± 1°C for 24h before testing for quality attributes. Analyses included albumen pH, Haugh units, yolk index, color (hard cooked and raw), foam ability, foam stability and TBARS. The data were analyzed by ANOVA in a 2 (packaging treatment) × 5 (time points) × 2 (trial) factorial design. In both the experiments, pH of the albumen of the eggs stored in MAP was lower than the eggs stored in air. The albumen of the raw eggs stored in MAP was lighter than those stored in air. However, in both the experiments, the albumen of the raw eggs stored in MAP were more yellow than the eggs stored in air. The hard cooked albumen of the eggs stored in MAP showed increased brightness and intensity in color. The yolk of the eggs stored in MAP maintained a more vivid and lighter yellow color. The carbon dioxide present in the MAP lowered the pH of the egg and thus may have prevented the green ring formation. Thus, packaging eggs in a MAP master bag was effective in reducing egg deterioration and loss of some functional quality during storage at refrigerated temperatures.

Key Words: shell eggs, packaging, quality

377 Evaluation of fatty acids and proteins in eggs from cage and range laying hens. L. K. Kerth*[1], P. A. Curtis[1], K. R. Willian[2], C. R. Kerth[1], and K. E. Anderson[3], [1]*Auburn University, Auburn, AL,* [2]*Tuskegee University, Tuskegee, AL,* [3]*North Carolina State University, Raleigh*.

Consumer trends and new legislation have furthered the transition of caged layers to range. However, little research has evaluated the impact that these environmental rearing changes will cause to the egg itself. This study was designed to compare what changes occur in the egg when layers are raised on a range system versus traditional cage system. In the 37th North Carolina Layer Performance and Management Test Hy-Line Brown hens were used in both the range environment and the cage. This strain was selected because it is the current brown egg strain used in the US. Hens were reared according to what environment they were going into and all other rearing husbandry was identical. On a quarterly basis, eggs were gathered from layers at 17 to 82 wk of age. Once collected eggs were pooled into 2 replicates and functional and proximate analyses were conducted in duplicate on each pooled set. Remaining egg samples were stored for further testing. Initial findings found that angel food cake volume was significantly higher ($P < 0.05$)

for caged eggs when compared with range. However, that difference could not be attributed to the ph and percent fat of the albumen as neither was different ($P > 0.05$). Upon further investigation it was discovered that the percentage of solids and protein were higher ($P < 0.05$) in range eggs. When the functional properties of the yolk were evaluated range eggs had a stronger ($P < 0.05$) emulsion in both fresh and stored mayonnaise. Conversely, there were no differences ($P > 0.05$) in pH, percentage of solids, fat or protein in the yolk from cage or range eggs. The frozen samples were tested for fatty acid methyl ester profiles on the yolk samples and SDS-PAGE on the albumen samples to identify and quantify fatty acids and proteins. The amount of saturated and omega-3 fatty acids present in the yolk, were highest ($P < 0.05$) in the last sampling period. Saturated fatty acids were also found to be higher ($P < 0.05$) in eggs from caged birds as opposed to a range birds.

Key Words: eggs, fatty acids, proteins