to 29 d. At 14 days of age, birds were redistributed into 35 battery cages with 5 birds per cage for all corn particle size diets and 8 birds per cage for the protein-free (PF) diet. From days 29-30 birds transitioned to one of the five treatment diets (600µm, 900 µm, 1200µm, 1500µm, or PF). The PF diet contained only dextrose monohydrate as the sole energy source. At 35 d birds were killed and intestine harvested for apparent digestibility determination.

Day old Hy-Line W-36 chicks (325) were placed 25 birds per cage and fed standard treatment diets with 600µm, 900µm, and 150µm corn. At 5 and 10 weeks of age, birds were weighed and feed intake and feed conversion were calculated.

All data for both studies were analyzed using a one-way ANOVA with the mixed procedure of SAS 9.4 and Tukey’s range test for means comparison.

### Metabolism & Nutrition II

#### M89 Effect of oil source and peroxidation status on broiler performance and oxidative stress

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Oil source has been shown to affect broiler performance and oxidative status. Lipid peroxidation may also affect animal performance and oxidative status through the generation and degradation of peroxidation compounds which differ according to oil source and temperature and length of heating. The objective of the study was to evaluate the effect of oil source and peroxidation status on broiler performance and measures of oxidative stress. Broilers (initial BW 85.1 ± 7.8 g) were allotted to 40 battery cages in a completely randomized 4 × 2 factorial arrangement of treatments. Treatments consisted of oil source (palm oil, soybean oil, flaxseed oil, and fish oil) in combination with lipid quality (fresh or peroxidized oil). Peroxidation was achieved by thermally processing each oil at 90°C for 72 h with a constant air flow of 3 L/min. Oils were analyzed for peroxide value, anisidine value, hexanal, 2,4-decadienal, and total polymers as measures of oil peroxidation. Each treatment was replicated 5 times with 5 birds/cage (200 birds), with birds fed their respective diets for 20 d to measure performance criteria. On d 21, plasma was harvested from 2 birds from each cage for analysis of oxidative status, which included thiobarbituric acid reactive species (TBARS), protein carbonyls (PC), 8-hydroxy-2'-deoxyguanosine (8-OH-2dG), and glutathione peroxidase activity (GPx). An interaction between oil source and peroxidation status was noted for ADFI, ADG, and F:G (P = 0.01), where birds fed the peroxidized oil reduced ADFI, ADG, and F:G in all oil sources except for birds fed the fish oil. There were no interactions noted between oil source and peroxidation status for TBARS, PC, 8-OH-2dG, or GPx (P > 0.10). Oil source increased plasma TBARS and 8-OH-2dG (P = 0.01), and tended to increase plasma PC (P = 0.09), but did not affect plasma GPx (P > 0.44). Although lipid peroxidation had no effect on plasma TBARS or PC (P > 0.15), plasma 8-OH-2dG and GPx were affected by lipid peroxidation (P < 0.01). In conclusion, oil source and peroxidation status differentially affected growth performance, oil source increased plasma TBARS, PC, and 8-OH-2dG, and lipid peroxidation increased plasma 8-OH-2dG and decreased plasma GPx.

**Key Words:** lipid peroxidation, oxidative stress, broilers, oil source

#### M90 Effect of fat oxidation on male broiler performance, yield, and muscle quality

Cody Flores, Hunter Walters, Danny Portillo, Rob Shirley, M. Briens, Christine Alvarado, Jason Lee, Department of Poultry Science, Texas A&M AgriLife Research; Adisseo USA; Adisseo France SAS (CERN)

The current study evaluated the impact of oxidized fat on broiler growth performance, processing yield, and meat quality. Canola oil was the source of fat in the current study. Fat oxidation procedure included heating fat to 95°C for 60 hours, with air percolating thru at approximately 12 L/min in order to achieve a target peroxide value of 129 meq/kg fat. On day-of-hatch, 2752 Cobb 500 male broilers were placed in floor pens with 43 birds/replicate pen and 32 replicate pens/treatment. The two treatments fed throughout the duration of the trial were corn/SBM/DDGS/MBM-based with the inclusion of either oxidized or non-oxidized (NO) fat. The feeding program consisted of a starter (d 0-14: crumble), grower (d 15-28: pellets), and finisher (d 29-42: pellet) diets. Body weight (BW) and feed consumption (g/bird/d) measurements were taken at each feed changeover for determination of body weight gain and feed conversion ratio. Following an 8 hour feed withdrawal on d 42, 8 birds/replicate pen were selected for processing yield (+/- 300 g of the mean pen weight). Furthermore, tissues from 6 birds/replicate pen were then used for meat quality measurements, which consisted of muscle pH, drip loss, and color. Inclusion of oxidized fat significantly reduced feed consumption compared to NO fat during the grower phase, as well as cumulatively through d 28 (0.7% and 1.8%, respectively). On d 14 and 28, inclusion of oxidized fat significantly reduced average BW compared to NO fat (2.3% and 2.1%, respectively). No significant differences in FCR were observed throughout the trial. A correction factor of 27g of BW per kg of BW was applied to the cumulative d 41 FCR in an effort to standardize treatment means. A significant impact on cumulative d 41 BW-corrected FCR was observed when oxidized fat was fed, resulting in a higher FCR when compared to the inclusion of NO fat. No significant impacts were observed on carcass or parts yield; however, color of the breast filet was unexpectedly impacted, as oxidation increased the redness (a*) of the tissue. In conclusion, feed manufactured with an oxidized fat source can negatively impact broiler growth performance and alter breast tissue color.

**Key Words:** Meat quality, Oxidized fat, Broiler, Canola oil, Performance
yielded no significant treatment effects. Carcass composition showed a significant increase in fat pad weight in dietary treatments, where 8% YG was higher than both 6% YG and control (P<0.01). Fat pad weight also significantly increased in tons fed 8% YG for 14 days compared to those fed for 10 days (P<0.028). No significant treatment interactions were observed in fat pad weight. Livability in the present study was approximately 70% across all treatments. Although fat pad weight was greater in high fat diets, the level of mortality inhibits definite interpretation of the results and repetition of the study would be beneficial.

Key Words: Turkey, Yellow Grease

M92 Effect of different feed form and function on the performance of turkey poults to 3 weeks using Alphastart (AS) mini pellet and standard crumbled diets. Karlinton Flores<sup>GSO</sup>, Jesse Grimes<sup>1</sup>, Steven Clark<sup>2</sup>, Adam Fahrenholz<sup>1</sup> North Carolina State University; <sup>2</sup>Devenish nutrition

The first feed can have an impact on poult health and performance. Feed form and nutrition can influence consumption, wastage, and early development of the intestine and immune systems. A study was conducted to observe and measure the performance and small intestine development of turkey poult with different diet forms (FRM) and/or function (FCT).

Aviagen male poult (336) were randomly assigned to 48 battery cages with 7 birds/cage. Four treatments were evaluated: an NCSU control crumble diet, AS crumble (FCT), AS mini-pellet (FCT + FRM), and a 3-way medicated diet (3W).

The treatments were fed from placement to 14 d. A control crumble starter (NCSU) was fed for all pens from 14 to 21 d. All crumble diets had a ratio of 70% crucibles and 30% fines. The parameters observed, measured, and analyzed were mean body weight (BW), mean body weight gain (BWG), feed intake (FI), and feed conversion ratio (FCR) adjusted for mortalities. Histo-morphological observations and measurements were analyzed for 13 and 21 d. The JMP program of SAS was used to determine if the parameters between the treatments were significantly different (P<0.05).

Birds fed the AS mini-pellet exhibited improved BW and BWG at 7, 14, and 21 d (184g, 405g, 870g ± SEM 2, 6.6, 8 respectively for BW) (125g, 406g, 811g ± SEM 1.6, 6.6, 8.6 respectively for BWG). A higher FI was observed for birds fed the AS mini-pellet at 14 and 21 d (489g, 1087g ± SEM 6.5, 15.7). FCR was not significantly different between treatments with an overall mean at 21 d of 1.257 (g:g). No consistent differences were found for the histo-morphometric observations. In conclusion, a mini-pellet with both form + function factor fed to male poult resulted in an increase in body weight, body weight gain, and feed intake at 14 and 21 d. This effect persisted to 21 d of age despite poult being fed a control diet after 14 d. Further investigation is needed to better understand the relationship between feed form and function on turkey poult performance and small intestine development.

Key Words: starter, turkey poult, small intestine histology, feed form

M93 Effect of potassium and available phosphorus in broiler breeder diets on fecal and egg characteristics at the onset of lay. Dinabandhu Jourdan<sup>GSO</sup>, Coltin Caraway, John Brake North Carolina State University

Wet feces have been frequently observed at the onset of lay in broiler breeders. Hydrogen (H) ions produced during egg shell calcification that are not buffered by the phosphate system in the kidney are excreted in the form of water utilizing the bicarbonate buffer system. Excess dietary calcium (Ca) combines with available phosphorus (AvP) to reduce phosphate buffering capacity, which may be causally related to wet litter. Although potassium (K) is a primary intracellular cation, it has an overall dietary alkalogenic effect and was thought to affect wet litter. There were 64 Ross 708 broiler breeder pullets reared on diets containing 0.9% Ca and either 0.3% or 0.5% AvP. Half of the pullets on each rearing diet remained on their AvP while the other half were changed to the other AvP level as Ca was increased to 0.5% AvP layer diet amended with 0.2% K to the 0.3% AvP layer diet reduced (P<0.05) LP at 25, 26, and 27 wk and FM at 23, 25, 26, and 28 wk as compared to the 0.5% AvP layer diet amended with 0.2% K. The non-amended 0.3% and 0.5% AvP layer diets were intermediate. Further, the LP and FM were generally reduced as the breeders achieved peak egg production. The 0.3% AvP grower diet increased (P<0.05) the weights of the second egg and its albumen. It was concluded that while supplementing 0.2% K to the 0.5% AvP layer diet increased LP and FM the opposite was true with the 0.3% AvP layer diet. These findings could be beneficial in controlling excess litter moisture during onset of lay in broiler breeders.

Key Words: Broiler Breeders, fecal moisture, fecal liquid portion, potassium buffer

M94 Effects of dietary copper removal on Ross 708 male broiler growth performance K. Brown<sup>GSO</sup>, C. Eagleson<sup>1</sup>, T. Parr<sup>2</sup>, J. Lee<sup>1</sup> Texas A&M University; <sup>2</sup>Micronutrients USA LLC

A 48 day experiment was conducted to evaluate the effects of removing dietary copper (Cu) at specific time points during growthout. The experimental design consisted of 5 treatment groups with 10 replicates per treatment and 35 chicks/replicate. Treatments included a control which contained no supplemental Cu, and then 4 treatment diets that contained dietary Cu at a concentration of 125 ppm added as copper chloride. The Cu in these 4 treatments was removed at either 28 d (trt 2 and 3), 41 d (trt 4), or left in for the entire 48 d (trt 5). Treatment 2 contained bacitracin methylene disalicylate (BMD) for 28d while it was not included in any other treatments. On day of placement, all birds were vaccinated with a commercially available coccidiosis vaccine in a commercial spray cabinet and allowed to preen 1 hr prior to randomization and placement. Four dietary phases were fed throughout the duration of the trial: starter (d 0-14), grower (d 14-28, pellet), finisher (d 28-41, pellet), and withdrawal (d 41-48, pel-let). Body weight (BW) and feed consumption (FC) measurements were taken at the conclusion of each dietary phase and were used to calculate body weight gain (BWG), feed conversion ratio (FCR), and mortality-corrected feed conversion ratio (FCR). The advantage of copper inclusion was immediately observed resulting in heavier (P<0.001) BW as soon as 14 d of age. Additionally, FC was increased (P<0.005) and FCR was improved (P<0.002) following the starter phase with Cu inclusion. Similar effects were observed on d 28, with Cu inclusion increasing (P<0.001) BW and reducing (P=0.001) FCR compared to the control diet. A further improvement in performance was not observed (P>0.582) due to the addition of BMD through 28 d of age. Body weight at d 41 and 48 was not impacted by treatment; however, treatments with Cu inclusion exhibited improved FCR compared to the control diet through the finisher phase (P=0.030) and continuous through d 48(P=0.031). These data indicated Cu inclusion is beneficial to growth performance, and the inclusion of BMD in combination with Cu did not result in any further improvement.

Key Words: copper, broiler, performance

M95 Effects of manganese and zinc sources and increasing late supplementation on egg production and quality in corn-soy diets fed to White Leghorn hens Austin Jasek<sup>GSO</sup>, Kyle Smith<sup>1</sup>, Terri Parr<sup>2</sup>, Jason Lee<sup>1</sup> Texas A&M; <sup>2</sup>Micronutrients USA LLC

The objective of the current study was to evaluate the impact of manganese (Mn) and zinc (Zn) sources (oxides and chlorides) on production rate and egg quality in White Leghorn (W-36) hens and determine if a targeted increase in Mn and Zn level (wk 48-52) would improve production or egg quality. A total of 330 11-wk old pullets were randomly assigned to 5 dietary treatments consisting of 22 replicates of 3 hens / rep. The first two treatments, which served as the basal trace mineral diets, were an oxide control (OC) and a chloride control (CC) that were fed from 11-62 wk of age, and which included Mn at 80 ppm and Zn at 60 ppm. Three additional
treatments were generated by supplementing an additional 40 ppm of Zn and Mn either as an amino acid complex form to the OC (OC+OR) and CC (CC+OR) diets and the additional 40 ppm added as additional chlo-
ride in the CC (CC+CC) diet during the period of 48 to 52 weeks of age.
The feeding program included a pre-lay (wk11-18), production (wk19-47),
pre-finisher (wk48-52), and finisher (wk53-62). Lay rate (%), egg weight,
egg mass, feed consumption (FC), and egg feed conversion ratio (FCR) were
determined every two weeks, and egg quality parameters were evalu-
ated based on dietary changes. Lay rate, egg mass and FCR were improved
(p<0.05) in the overall experiment for the CC-fed hens compared to the
OC-fed hens. No significant differences were observed in egg quality
between any of the treatments. The OC+OR-fed hens had a significantly
(p=0.011) higher lay rate than any of the other treatments, however, similar
results in lay rate were reported between the OC+OR and CC-fed hens. Egg
weights were similar between OC and CC-fed hens, however, inclusion of
either the organic minerals (OC+OR) or the additional chloride minerals
(CC+CC) from wk 48 to 52 significantly (p<0.001) increased egg wt. The
OC-fed birds had significantly (p<0.001) poorer egg FCR compared to any
other treatment. Egg force (kg) improved during the phase of additional
chloride supplementation for the hens fed the CC+CC diet though not to a
level of significance (p=0.12). These data suggest that mineral source does
influence laying hen performance and that a targeted increase in mineral
level during the later stages of production is beneficial to egg production.

Key Words: Minerals, Chloride, FCR, Hen-day production

M96 Effects of combination of phytase and Multi-Carbohydrase
enzymes on growth performance and bone mineralization in broilers
Jinquan Wang*, Rob Patterson1, Woo Kyun Kim1 'University of Georgia; 'Canadian Bio-Systems
Phytic acid and non-starch polysaccharides (NSP) are two primary anti-
nutrient factors in poultry feed. An experiment was conducted to evaluate
the effect of phytase and Multi-Carbohydrase enzymes (Canadian Bio-
Systems, Calgary, Canada) supplementation on growth performance and
bone mineralization in broilers. A total of 640 Cobb 500 male broilers were
randomly allocated as 20 birds per pen to eight experimental diets with
four replicates from day 0 to 35. Treatments consisted of a positive control
diet (PC) with 0.9% Ca and 0.44% of aP, 0.88% Ca and 0.42% aP, and
0.81% Ca and 0.38% aP for starter, grower and finisher diet, respectively.
The negative control (NC) diet had 0.15% lower Ca and aP levels, and
the same NC diet with or without Multi-Carbohydrase enzymes supple-
mentation (500 grams per ton) for three phytase levels (500, 1000, and
1500 FTU/kg). Feed intake, body weight, and feed conversion ratio were
measured at day 7, 21 and 35. At day 35, 3 birds per pen were euthanized
and body composition was measured by dual energy X-ray absorptiometry
(DXA) and right femurs were collected for bone ash. Body weight gain was
significantly improved (p<0.05) from day 0 to 21 with the supplementation
of 1500 FTU/kg phytase, or 500, 1000, 1500 FTU/kg phytase plus Multi-
Carbohydrase enzymes. There was no difference of body weight gain, feed
intake and feed conversion ratio during the 35 day period. The reduction of
Ca and aP significantly reduced the body mineral density, bone ash per-
centage, and bone density at day 35. However, the combination of phytase
and Multi-Carbohydrase enzymes supplementation significantly improved
the body mineral density (p<0.05) and bone ash percentage (p<0.001) to
the PC level. There was no difference on body fat percentage and bone
mineral content.

Key Words: phytase, Multi-Carbohydrase, broiler, mineralization, growth
performance

M97 Effect of poult hatch weight on their subsequent growth response
to dietary energy, phosphorus, calcium and Azomite *, Samantha
Black*, Marissa Herchler*, Vinicius Schramm*, Rafael Crivellari*,
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1Universidade Federal do Parana

Poult quality and size at time of placement is a concern in the turkey indus-
try because it affects animal welfare, production efficiency, and final prod-
uct quality. Pouls of substandard weight often have an undeveloped diges-
tive capacity, a perturbed gastrointestinal ecosystem, and persistent enteric
health problems. Consequently, they may be more sensitive to changes in
diet nutrient density and bioavailability or enteric conditioning supple-
ments than standard pouls. Azomite® (Az, Azomite Mineral Products, Inc.,
Nephi, UT), a full spectrum trace mineral feed additive of volcanic origin is
typically used as a pellet processing aid, but may also act as an enteric con-
ditioner. In this randomized complete block split-plot design experiment,
684 turkey hen poult were randomly assigned to 24 pens, each with 25
standards and 11 smalls. The whole plots factors were six dietary treatments
in a factorial arrangement with three levels of Az (0, 2.5, and 5.0 g/kg, Az0,
Az2.5, Az5 respectively) and two dietary treatments differing by .145% aP,
.125% Ca, and 100 kcal ME/kg (Hi and Lo). The sub-plot poult size factor
was based on placement body weight (BW) (58 g standard vs 51 g small,
P<0.001)). BW and feed intake (FI) were recorded at 0, 3, 5, 8, and 10, 12
and 14 wks of age to calculate feed:gain, but identification of individual
pouls could only be tracked until 10 wks. Among hens fed the Hi diet,
Az2.5 and Az5 supplementation increased BW, but for those fed the Lo
diet, Az5 supplementation decreased BW. These interaction effects were
lost after wk 10. Significant size effects were observed until wk 10, where
the small birds had significantly lower 5 wk BW than the standard birds
(5.34 kg vs. 5.56 kg, p<0.001). The small birds also had lower 14 wk BW
(9.00 vs. 9.46 kg, p<0.004) and nominally lower breast muscle yield (23.8
vs. 24.6% BW, p<0.07) than the standard birds. There were no significant
treatment effects on feed:gain or mortality rate. Poult size and quality has
a lasting effect on body weight gain and breast muscle yield and cannot be
recovered by modifying dietary nutrient density or feed additives, such as
Azomite®.

Key Words: Turkey Hens, Poult Size, Growth and Breast Muscle,
Dietary Energy, P and Ca, Azomite®

M98 The effects of Hostazyme® and Optiphos® super dosing in combi-
nation with Azomite® on growth performance in market turkey
hens Marissa Herchler*, Samantha Black1, Vinicius Schramm1, Rafael
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Supplementation of xylanase and phytase are commonly used to minimize
formula costs, formulation risks and animal performance variation, and im-
prove nutrient utilization. A market turkey hen growth trial was conducted
to evaluate the dietary supplementation of Azomite® (Az; Azomite Mineral
Products, Inc., Nephi, UT), a full-spectrum mineral dietary supplement of
volcanic origin, the xylanase Hostazyme® (Xyl; Huvpharma, Inc., So-
phia, Bulgaria), and the phytase Optiphos® (Phy; Huvpharma, Inc., So-
pahia, Bulgaria). Nicholas Select turkey hen poult were randomly assigned
among 48 litter floor pens containing 36 pouls each according to a ran-
domized complete block design. The 12 dietary treatments consisted of a 3
X 4 factorial arrangement of 3 dietary levels of Az (0, 2.5, or 5 g/kg) and
4 enzyme diets: a positive control (PC; 0 EPU Xyl/kg, 0 FTU Phy/kg), a
negative control (NC; 0 EPU Xyl/kg, 0 FTU Phy kg), a NC with standard
enzyme levels (NC250; 1500 EPU Xyl/kg, 250 FTU Phy/kg), and a NC
with Xyl and elevated Phy levels (NC1500; 1500 EPU Xyl/kg, 1500 FTU
Phy/kg). The PC and NC diets differed by 0.145%aP, 0.125%Ca, and 100
calcium ME/kg. Body weights (BW) and feed intake (FI) were measured
to calculate the feed conversion ratio (FCR) during the brooding phase (0 – 5
wk) and overall production phase (0 - 14 wk). Breast muscle yield (BMY)
as a percent of total body weight was measured on a random sample of 4
hens per pen at wk 14. A significant Az X Diet effect was only observed
M99 The effect of Original XPC on egg production, component yield and composition in laying hens *Rachel Blount1, Don McIntyre2, Hilary Pavlidis2, John Carey1, Don McIntyre1, Juan Suarez1, Rachel Blount1, Hilary Pavlidis2, John Carey1 University; 2Diamond V University

An experiment was designed to evaluate the effects of the functional metabolites of Diamond V Original XPC™ on egg production, quality, component yield, and composition in commercial laying hens. Birds in this experiment were fed a standard layer diet (CON) or a diet containing Original XPC at either 0.625 kg/MT (FM-L) or 1.25 kg/MT (FM-H). Overall, no significant treatment effect (P > 0.05) was observed for egg production during the entirety of the study (20-53 weeks of age). Hens from the FM-H group had significantly higher feed consumption compared to the CON group. Feed consumption of the FM-L group was not significantly different from the other treatments. Hens from the FM-L and FM-H groups had significantly improved feed conversion (P < 0.0009) compared to the CON group. FM-L hens had lower hen-day egg mass (P < 0.0013) compared to those of CON or FM-H. Compared to CON and FM-H, FM-L hens had significantly (P < 0.0183) greater percentage of jumbo-sized eggs. Egg characteristics were evaluated weekly 30-53 weeks of age. Yolk weight from FM-H hens was significantly (P < 0.0001) heavier at 16.3g compared to CON and FM-L hens at 16.0g and 16.1g, respectively. Percent yolk yield from FM-H hens was also significantly (P < 0.0001) increased to 26.3% compared to 25.9% and 26.1% for the CON and FM-L hens, respectively. Compared to CON, eggs from FM-H hens exhibited a significant (P < 0.0001) increase in yolk solids of 0.10% and a decrease in yolk nitrogen of 0.09% with FM-L hens being intermediate in yolk yield. Each treatment was significantly different (P < 0.0004) from the others for percent albumen yield (64.4%, 64.0% and 63.8% for CON, FM-L and FM-H, respectively). Albumen nitrogen in the FM-H group was 14.08%, which was significantly (P < 0.0004) greater than the CON and FM-L groups at 14.01% and 14.02%, respectively. Egg weight, albumen weight, shell weight, shell yield and albumen solids were not significantly impacted by the treatments. This research demonstrates that feeding Original XPC had a positive impact on egg production parameters as well as egg component yield and composition.

Key Words: Original XPC, egg components, egg yield, egg solids, egg production

M101 The effect of refined functional carbohydrates (RFCs) from enzymatically hydrolyzed yeast on the transmission of Salmonella spp. between broilers and proliferation in broiler housing.

Grayson Walker1, Sangita Jalukar2, John Brake3 University; 2LignoTech

Enzymatic hydrolysis of yeast produces RFCs that have activities against gram negative bacteria. Specifically, Aviator SCP (Arm and Hammer Animal Nutrition, Princeton, NJ) possesses sugars that interfere with Salmonella attachment to the intestinal lumen. Hatching eggs were collected from four treatment groups of broiler breeder females that had been fed RFCs or control diets, with RFCs included at 0+0, 0+50, 50+0, or 50+50 g/MT during growing (0-21 wk) and laying (+22-48 wk), respectively. 576 male and female broiler progeny chicks were assigned to sex separate, new-litter pens by parent treatment and fed a 0 or 50 g/MT RFCs diet in a 4 x 2 factorial design within sex. Treatments were randomly assigned to replicate pens of 12 broilers per interaction for both sexes. BW and feed intake were determined at 14, 28, and 42 d. Litter was sampled by pen using sterile socks at 35 d and tested for Salmonella spp. using enzyme linked fluorescence assay methods. Salmonella spp. was isolated in 7 of 48 control-fed broiler pens but was not isolated in RFCs-fed pens. Thereafter, the 48 males and 48 females selected based on litter Salmonella presence and RFCs treatment had their cecas aseptically excised and tested for Salmonella spp. presence.

Three trials were conducted to investigate the effect of a lignosulfonate (LS) pellet binder on pellet durability under marginal pelleting conditions. Factors understood to affect pellet durability include, but are not limited to, conditioning temperature, mixer-added fat (MAF) inclusion, grain grind size, and crude protein (CP) level. The aforementioned factors are inevitably implemented to spare heat sensitive ingredients, supply adequate nutritional energy and protein, and stimulate gizzard function. The first trial investigated the interaction between conditioning temperature and LS inclusion. Pellets were pelleted over a range of temperatures from 70 to 82 °C with or without LS supplementation at 0.5% on top of the basal formulation. It was determined that LS improved pellet durability more at cooler conditions than at warmer conditioning temperatures. The second trial was a 2 x 2 factorial design utilizing 1.5 and 3.0% MAF, 0 and 13.5% coarse corn (CC), and 0 and 0.5% LS to determine if LS interacted to improve pellet durability more when increased MAF and CC inclusion were necessary parts of a formulation. It was determined that LS improved pellet durability to a greater extent when MAF inclusion was greater, but inclusion of CC did not affect pellet durability. The third trial investigated the effect of LS supplementation at 0.5% in diets ranging in CP from 16 to 24%. It was determined that pellet durability decreased as CP increased. The addition of LS did not result in an interaction, but rather improved pellet durability similarly across all ranges of CP. In conclusion, LS could be used as ingredient to improve pellet durability when marginal pelleting conditions, such as greater inclusions of MAF and cooler pelleting temperatures, were inevitable but maintenance of pellet durability was desired.

Key Words: lignosulfonate, pellet binder, pellet durability, conditioning temperature, mixer-added fat