361 Microwave toe trimming Leghorn pullets and its effect on rearing performance. P.H. Patterson*, E.S. Lorenz, and R.M. Hulet, *Penn State University, University Park, PA*.

Previous research toe clipping day old Leghorn pullets reduced bird hysteria with no impact on feed consumption or BW to 16wk (Ruszler, 1974). Egg production was greater and mortality was reduced compared to control birds. Recently, toe trimming turkeys and broilers with a microwave technology has demonstrated reduced carcass tears and downgrading. Therefore, three Leghorn strains at 1d of age were banded and half the chicks/strain (n=75) were treated for 0.6 s with 2.45 ghz of microwave energy (NovaTech Engineering, Wilmer, MN) at the toenail cuticle of three toes/foot. The chicks were caged at 142 cm^2/bird to 6wk of age. At 7d all birds were beak trimmed. At 6wk half the birds/cage were moved to a new cage increasing space to 284 cm^2/bird to 18wk of age. Feed intake, BW, and mortality were recorded during the study. Within 24h after microwave treatment the chicks toenails turned white, and by 3d had sloughed off. BW at 1d, 6 and 18wk was significantly influenced by pullet strain. Microwave toe-trimmed pullets (TT) at 6 and 18wk weighed significantly less than control birds (437 vs 454g, and 1289 vs 1332g, respectively). Both strain, and treatment significantly influenced feed intake from 1d to 3wk of age. Control birds consumed 17.1^a g/bd/d compared to 14.8^bg for the TT during the same period. No significant strain, or treatment effect was observed for feed intake from 3 to 6wk of age. Initial mortality was high due to brooding challenges, but not significantly influenced by treatment or strain. Total mortality averaged 3.8% from 3 to 18wk. Body scratching was scored at 18wk of age with no scratching = 0 to severe = 4. Strain scores were significant, but low, ranging from 0.07 to 0.56. TT pullets had significantly more body scratches (0.39^a) than controls (0.24^b) although scores were low. Overall, microwave toe trimming of Leghorn pullets was associated with reduced feed intake, reduced body weight and greater body scratches than control birds. The impact on hen house performance is yet to be determined.

Key Words: Microwave, Toe, Trim

362 Drinking water treatment and dietary treatment effects on *Salmonella enteritidis* in Leghorn hens during forced molt. L.F. Kubena*[1], Y.M. Kwon[1], J.A. Byrd[1], C.L. Woodward[2], R.W. Moore[1], R.L. Ziprin[1], R.C. Anderson[1], D.J. Nisbet[1], and S.C. Ricke[2], [1]*USDA-ARS,SPARC, College Station, Texas/USA,* [2]*Texas A&M University, College Station, Texas/USA*.

The layer industry uses feed deprivation to induce molting and stimulate multiple egg-laying cycles in laying hens. Unfortunately, the stress involved with this method of molting causes an increased susceptibility to *Salmonella enteritidis* (SE) under laboratory conditions and increases the risk of SE positive eggs and internal organs. There is the need for methods to stimulate multiple egg-laying cycles without the increased risk of SE. Studies were conducted utilizing Leghorn hens over 50 wk of age. The hens were divided into treatment groups of 12 hens each and placed in individual laying hen cages. One wk before water and feed changes, hens were exposed to an 8-h light and 16 h-dark photoperiod that was continued throughout the 9-day experiment. Individual hens in all treatments were challenged orally with 10^4 cfu of SE on the fourth day. Treatments consisted of full-fed hens (non-molted, NM), non-fed hens (molted, M), M hens administered 0.25% lactic acid (LA) in the water, or hens fed a diet containing 10,000 mg zinc/kg (HZ). When compared with the NM treatment, weight losses were higher in the M, M + LA, and HZ treatments and water consumption was reduced. Crop pH and ovary weights were lower in the NM and HZ treatments, when compared to the M treatment. Cecal propionic acid and total volatile fatty acids were decreased in the M treatment when compared to the NM and HZ treatments. The number of crop and ceca culture positive hens and the numbers of SE per crop and per gram of cecal contents were higher in the M treatment, when compared to the NM and HZ treatments. This regimen or other dietary regimens may prove to be useful tools for reducing the incidence of SE in eggs and internal organs during and following molting of laying hens.

Key Words: Salmonella enteritidis, Laying hens-molting, Diets-zinc

363 Effect of dietary chitosan on production characteristics and egg proportions and quality from commercial white egg laying strains. K. E. Anderson*, G. S. Davis, and S. Hudson, *North Carolina State University*.

Chitin is considered the second most abundant organic resource on the earth next to cellulose, and it is derived from harvesting the waste of shellfish. Chitosan, a component of chitin, has been shown to exhibit hypocholesterolemic action and reduce cholesterol levels in rats, humans, and broiler chickens. A study was conducted to determine the effects of feeding Chitosan to egg laying hens on the egg production characteristics, quality, and proportions. The study was a randomized complete block design consisting of 4 dietary regimens. The regimens consist of the brood/grow (BG) and Layer phase (L): (1) no Chitosan fed during the BG and L (C); (2) 0.5% Chitosan fed during the BG but not in the L (TC); (3) no Chitosan fed during the BG but fed 0.5% in L (CT); (4) 0.5% Chitosan fed in BG and L (TT). The hens were placed in a layer house which contained 4 banks of tri-deck stair-step cages. Each bank of cages was designated as a block for a total of 4 blocks with 9 replicates per treatment, for a total of 882 hens per treatment. In the initial production period TT reduced yolk proportions and egg weight in contrast to the C by .89 and 3.2 g, respectively. The yolk cholesterol content was not different between any of the treatment groups. However, the cholesterol content (mg/g) of the yolk decreased from 15.2 to 12.3 mg/g as the hens aged. Feed consumption was lower ($P<.05$) by 0.4 kg in the birds fed Chitosan during the laying cycle. Production parameters were not effected by the feeding of 0.5% Chitosan in the diet. Egg size was shifted ($P<.05$) from X-Large to mediums. It was concluded that dietary Chitosan does not reduce cholesterol content on an equivalent basis but, can result in altered egg proportions and size distribution.

Key Words: Layers, Chitosan, Cholesterol

364 Effect of Termin-8® anti-microbial preservative on the growth of commercial white and brown egg type pullets and environmental microbial population. K. E. Anderson*[1], B. W. Sheldon[1], and K. E. Richardson[2], [1]*North Carolina State University,* [2]*Anitox Corp., Lawrenceville, GA 30043*.

Farm to Table HACCP programs recommend that feed supplied to the layer industry must be free of microbial pathogens. Microbial pathogens in feed have the potential to be passed to the pullets resulting in the pullets becoming carriers of these organisms and subsequently passing the organisms onto their eggs during the production cycle. The objective of this experiment was to evaluate the feed treatment, Termin-8® to eliminate or reduce the microbial contamination of feed. This could benefit the layer by reducing competition in the digestive tract between indigenous and feed borne microorganisms attempting to colonize the small intestine, lowering the microbiological populations in the environment, and enhancing the pullet growth performance. The study utilized 14,976 pullets during the brood/grow period from 0 to 16 wks of age. Pullets were housed in a brood/grow facility with quad-deck cages divided into 4 rooms containing 72 replicates containing 52 birds each at a density of 310 cm2 per pullet. Pullets in 2 rooms received rearing diets formulated with 2.72 kg/ton of Termin-8®. The pullets in the remaining 2 rooms received the same diets without Termin-8®. Each load of feed delivered to the farm was sampled and assayed for mold, total aerobic bacteria, enterobacteriaceae, coliform, Salmonella and Termin-8® concentration. Body weights and feed consumption data were collected from each replicate on a bi-weekly basis through 16 wks of age and environmental microbial sampling conducted every 4 wks. Treatment of the feed with Termin-8® resulted in a reduction ($P<.05$) of pullet body weight and lower overall feed consumption compared to the control. Mortality was also lower in the brown egg pullets receiving Termin-8®. Bacterial counts in the control and treated feeds averaged 3261 cfu/g and 413 cfu./g respectively over the course of the trial. The environmental microbial counts were altered in the rooms containing pullets on the Termin-8® supplemented feed. These results suggest that treating the feed with Termin-8® reduced microbial contaminants, which was associated with a subsequent positive impact on the pullets growth and feed consumption.

Key Words: Layers, Microorganisms, Termin-8®

365 Effect of a feed additive or manure treatment application on the mass generation rate of ammonia produced from laying hen manure. K.W. Koelkebeck*, P.C. Harrison, and G.L. Riskowski, *University of Illinois, Urbana, IL USA.*

An experiment compared the ammonia generation rate from laying hen manure that received an ammonia production inhibitor which worked systemically (through the feed) to a topically applied compound. Eighty-one mature laying hens (56 wk of age) housed in a cage layer facility were divided into three treatments with three replicates each. The treatments were: 1) control, 2) systemic (Micro-Aid® in the feed), and 3) topical (Al^+ Clear® sprayed on the manure daily). The application rate of the topical ammonia inhibiting compound was evenly applied as a liquid spray (161.3 g/m^2) daily. Hens in the systemic treatment had received the feed treatment for three months prior to the start of the experiment. These treatments were applied for two weeks and ammonia generation rate was measured at Day 1, 7, and 14 following the start of the experiment. The mean overall mass generation rate of ammonia for the two week period of manure collection was 67, 60, and 36 mg NH_3/hr/kg manure for the control, systemic, and topical treatments, respectively. Ammonia generation rate from manure on Day 1, 7, and 14 was the lowest for the topical treatment. Treatments had no effect on manure weight or moisture; however, when ammonia generation rate was compared on a dry weight basis for the 14-d evaluation, the systemic and topical treatments were 17 and 26% lower, respectively, than the control. Thus, these data indicate that the mass generation rate of ammonia production from laying hen manure may be depressed by using a topical manure treatment.

Key Words: Ammonia Generation Rate, Manure Treatment Application, Ammonia Production Inhibitor

366 Interaction of increased Ca and P regimens on commercial strains of layers housed at various densities. M.H. Fosnaught* and K.E. Anderson, *North Carolina State University.*

It is established that nutrient recommendations of layers vary with strain. As layers are being housed at lower density due to animal welfare concerns, nutrient requirements will also vary. Hens housed at lower density generally consume more feed and have greater egg production. Ca and P levels, critical for optimal layer health and production, should be considered in light of not only strain but stocking density. Therefore, two strains of hens were fed two levels of Ca and P while kept at two densities from 18-66 wks of age and evaluated for performance. This 2X2X2 factorial utilized 5,824 hens (14 reps/trt) which were housed in environmentally controlled, stair step cages. The two strains (Hy-Line W-36 (H) and Babcock 300 (B)) were fed two levels of Ca and P (constant Ca and P or control (C) and increasing Ca and P (CaP+))while housed at two densities (low density (LD or 413 cm^2/hen) and high density (HD or 310 cm^2/hen) both at 4 birds/cage). Feed cons was measured every 4 wks and egg production daily. Strain and density affected ($p<.05$) most production parameters measured. The H strain compared to B had lower feed cons/100 hens (9.7 vs. 10.3 kg, $p<.01$) and lower hen day production (80.1 vs. 81.3 %, $p<.01$). The LD vs. HD showed lower feed cons/100 hens (10.4 vs. 9.5 kg, $p<.0001$) and higher hen day production (82.9 vs. 78.5 %, $p<.0001$). The finding of particular interest was a significant three-way interaction between strain, Ca and P, and density ($p<.05$). Hens responded similarly to the CaP+ regimen when kept at HD regardless of strain. However, if these hens were housed at LD then the H strain responded favorably to the CaP+ regimen while the reverse response was observed for the B strain. At LD, the H vs. B strain when fed CaP+ consumed less feed/100 hens (9.98 vs. 10.91 kg, $p=.05$), improved FE (.47 vs. .45 g egg/ g feed, $p=.05$), elevated eggs/hen housed (272 vs. 265 eggs, $p=.02$) and increased egg income ($16.10 vs. $15.64, $p=.04$). Reevaluating the need of layers for Ca and P when housed at lower stocking densities may be more strain dependent than previously realized. Therefore, as shifts are being made to lower density such as in many European production systems, further research may be necessary to determine optimal nutritional requirements of different strains.

Key Words: Layers, Calcium, Density

367 The effects of dietary protein and available phosphorus on production measures and nutrient excretion by egg-type hens from 21 to 36 weeks of age. R Reed*, J. Nixon, and M. Lilburn, *The Ohio State University/OARDC.*

From 21 to 36 weeks of age, commercial egg-type hens (Hyline W-36) were fed diets containing two levels of calculated available phosphorus (AvP; .25%, .42%) and two levels of dietary crude protein (CP; 14.9%, 16.5%). There were also two combinations of phytase supplementation (0, 300) for a total of 6 possible dietary treatment combinations. The experiment was broken down into four, 28-day production periods and all data was analyzed within each period. During the last week of each production period, feed intake was determined and excreta was collected for nutrient analysis. Egg production was recorded daily and all eggs were collected and weighed during the last week of each production period. These eggs were used for shell weight determination. There were no consistent treatment main effects (AvP, CP, Phytase) on feed intake but the low AvP treatment did result in significant increases in BW over the last 3 experimental periods. The low AvP level resulted in increased egg production over all 4 experimental periods whereas the high CP diets resulted in consistent increases in egg wt over all production periods. There were no other consistent main effects or significant two-way interactions. There were no consistent main effects on shell weight although supplemental phytase did significantly reduce shell wt during periods 2 and 3. Excreta P was significantly increased in all production periods with increased dietary AvP and there were no significant effects due to phytase supplementation. During the last production period, there was an AvP by phytase interaction resulting from less excreta P in the low AvP treatment supplemented with phytase. The high CP diets resulted in increased excreta N but there were no other main effects or interactions. It is important to note that while not significant ($P\leq .063$ - .192), there was a consistent increase in excreta P associated with the high CP diets, most likely due to the increased soybean meal necessary to achieve the higher levels of CP.

Key Words: Phytase, Phosphorus, Manure

368 The effect of claw and beak reduction on growth parameters and fearfulness of two Leghorn strains. C. N. Ferst*[1] and P. L. Ruszler[1], [1]*Virginia Tech.*

Commercial equipment being used by the turkey industry reduces claw growth and trims the beak without physical invasion of body tissue. To test the effects of this technique on chickens, one-half of two strains of 1250 Leghorn chicks each were subjected to the claw reduction technique (CR) using microwave energy that kills the germinal cells at hatch. The other half retained normal claws (NC). The beaks of 1/3 of the chicks were reduced at hatch using an infra-red energy technique; one-third were precision beak trimmed at 7 days and one-third were not trimmed. Body weight, feed intake, mortality and fearfulness were measured weekly and biweekly until housing at 20 weeks in laying cages. Rearing followed standard commercial feeding and husbandry procedures using 10-20 lumens of light and fed *ad libitum* a 20% starter with 2926 kcal; 17% grower, and 15% developer with 2860 kcal/kg.
Body weights were equal to or greater than breeder standards throughout the trial, being 2 weeks advanced at 16 weeks of age. There were no statistically significant differences between treatments in body weight. However, the chicks with beak reduction at 1 day of age experienced consistently lower body weight numerically from 3 to 14 weeks of age and also ate less total feed at the 0.08 level of significance by 14 weeks of age and thereafter. Mortality was less than 1.3% throughout the trial. Fearfulness was being expressed in the NC treatment by 5 days of age, continuing to a peak of 8-10 points at 6-8 weeks of age on a subjective scale of 1 (calm) to 10 (total fear). The CR treatment expressed a fearfulness level of only 3-4 points at 6-8 weeks. Expressed fearfulness later subsided to levels of 2-3 for CR and 6-8 for NC birds by 16-18 weeks. The larger body size of older birds filling the cage space appears to reduce the expression of fear. Reducing the claw growth and beak development during the growing period showed that pullets can be raised on less total feed and without the usual level of fearfulness by improving the environmental climate in the cage.

Key Words: Claw & Beak, Fearfulness, Body weight

369 Growth Response of a *Salmonella typhimurium* Poultry Isolate to Zinc Addition. S. Y. Park*[1], C. L. Woodward[1], S. G. Birkhold[1], L. F. Kubena[2], D. J. Nisbet[2], and S. C. Ricke[1], [1] *Texas A & M University, College Station, Texas, USA,* [2] *USDA-ARS, Food and Food Safety Research Unit, College Station, Texas, USA.*

It has been shown that induced molting by complete feed withdrawal increases *Salmonella* horizontal transfer in laying hens and contamination in eggs. Zinc-containing diets have been used as an alternative means to induce molt in laying as a management while avoiding feed withdrawal. It is not known if the zinc in these molt diets would inhibit *Salmonella* spp. growth and therefore potentially minimize the *Salmonella* spp. infection in individual hens. The objective of this study was to examine the effects of zinc concentration on a primary poultry isolate of *Salmonella typhimurium* growth from either nutrient rich or minimal media after inoculation. zinc sulfate ($ZnSO_4$) concentrations (0.67%, 2.01%, 3.35%, 4.69%, and 6.03%) were added to either 5ml of tryptic soy broth (TSB) or M9 broth after inoculation of overnight fresh culture. The growth of *S. typhimurium* poultry isolate in individual tubes at 37 °C was measured by as optical density (A_{600}) on a spectronic 20D spectrometer. Growth rate was determined by linear regression of change in natural logarithm of A_{600} during exponential growth. Growth rate of *S. typhimurium* poultry isolate was significantly ($P<0.05$) decreased by the presence of zinc sulfate in M9 at concentrations greater than 2.01%. Zinc added to M9 broth at the same concentrations was much less inhibitory to *S. typhimurium* poultry isolate growth rates. The results indicate that the higher concentrations of zinc addition may be effective by inhibiting *Salmonella* spp. growth.

Key Words: *S. typhimurium*, Molting, Zinc

370 Use of an alfalfa diet for molting in Leghorn hens to reduce *Salmonella enteritidis* colonization and invasion. Y.M. Kwon*[1], L.F. Kubena[1], C.L. Woodward[2], J.A. Byrd[1], R.W. Moore[1], D.J. Nisbet[1], and S.C. Ricke[2], [1] *USDA-ARS, SPARC, College Station, Texas/USA,* [2] *Texas A&M University, College Station, Texas/USA.*

The standard method for molting to stimulate multiple egg-laying cycles in laying hens is feed deprivation. However, the environmental changes within hens caused by feed deprivation are known to increase susceptibility of the hens to *Salmonella enteritidis* (SE) infection. In an effort to develop an alternative method to induce molting without increasing susceptibility to SE, an alfalfa diet was compared with the standard molting method for the level of molting and SE colonization. Hens over 50 wk of age were divided into three treatment groups (12 hens/group); non-molting by normal feeding (NM), molting by feed deprivation (MO), and molting by alfalfa diet (AD). The individual hens in all treatments were challenged orally with 10^4 cfu of SE on the fourth day after feed changes, and analyzed for ovary weight and SE colonization or invasion in crop contents, cecal contents, liver, spleen, and ovary on the ninth day. In ovary weight, AD (4.8 g) was not different from MO (6.9 g) but was significantly lower ($P = < 0.05$) than NM (27.5 g), indicating the molting was possibly as successfully induced in AD as in MO. However, the total number of SE positive organs for all of the organs determined by enrichment technique was decreased in AD (10/60) as compared to MO (46/60), while no colonization was detected in NM (0/60). The trends of SE reduction in AD as compared to MO were consistent with all of the organs analyzed. Therefore, the results of this study suggest that an alfalfa diet has the potential to be used as an alternative method for forced molting, without increasing the incidence of SE in eggs and internal organs.

Key Words: Salmonella enteritidis, Laying hens-molting, Alfalfa diet

PSA Nutrition: Feed Regimens

371 Minimal available phosphorus requirement of molted laying hens. J.L. Snow*, M.W. Douglas, A.B. Batal, M.E. Persia, P.E. Biggs, and C.M. Parsons, *University of Illinois, Urbana, IL USA.*

In an effort to diminish excessive feeding of phosphorus, our objective was to determine the minimal available phosphorus (AP) requirement for hens being molted and kept for two egg production cycles. Six replications of Dekalb Delta hens were fed diets (17% CP, 3.8% Ca) containing 0.10, 0.12, 0.14, 0.16, 0.18, 0.20 or 0.45% AP starting at 21 wk of age. Diets containing 0.10, 0.12, and 0.14% AP were terminated at 35, 39, and 50 wk, respectively, due to low egg production and increased mortality. The remaining hens were then induced molted at 64 wk of age by 10 d feed removal. Following feed removal, three replications from each previous AP level were fed either a 100% corn (C) diet or a nutritionally complete (NC) molt diet (16% CP) for 16 d. The hens were then returned to the same AP layer diet they had been fed from 21 to 64 wk. Egg production performance will be measured from 68 to 110 wk of age, with data for only the 68 to 87 wk period being reported here. During the molt period, mean body weight loss at the end of the 10 d feed removal was 22%. As expected, hens fed the NC molt diet returned to egg production faster and had significantly higher body weight gains than birds fed the C molt diet. For the 68 to 87 wk postmolt period, hens fed the 0.16% AP (163 mg/d) diet had significantly lower egg production and egg mass yield compared to hens fed 0.45% AP ($P<.05$). Although there were no significant ($P>.05$) differences in egg production among the other treatments, egg production and egg mass yield were numerically lower ($P\leq.1$) and mortality was higher for hens fed 0.18% AP (185 mg/d) versus those fed 0.45% AP. There were no significant differences in body weight or egg weight among any treatments. Our results suggest that molted hens in their second lay cycle require approximately 0.20% AP or 210 mg AP/d. This requirement is higher than what we determined in several previous experiments for first cycle, nonmolted hens.

Key Words: Available Phosphrous, Requirement, Molting

372 The effect of various levels of vitamin E supplementation in the diets of laying hens on egg yolk alpha-tocopherol content and hen performance. R. C. Johnson*[1], J. C. Hermes[1], R. Kampen[2], and A. M. Craig[1], [1] *Oregon State University, Corvallis, OR,* [2] *BASF, Abbotsfort, BC, Canada.*

Two experiments were conducted to determine the effect of high levels of vitamin E in the diet of laying hens on egg yolk alpha-tocopherol content and hen performance. In experiment 1, 192, 50+ week old hens were fed one of 12 experimental diets formulated to contain 5, 10, 15, 20, 25, 100, 200, 250, 350, 400, 550, or 700 IU/kg of alpha-tocopherol for 4 weeks. Hens were selected at random, housed in individual cages and separated into four replicate treatment groups with four hens per treatment ($n = 16$). Daily egg production was determined along with weekly analysis of body weight, egg weight, albumen height, yolk color and yolk alpha-tocopherol content. Only egg weight and yolk alpha-tocopherol showed significant differences between dietary treatments. In experiment 2, 96 laying hens, 33 wks of age, were allocated into groups and housed as in experiment 1. The diets were formulated to contain either 15, 250, 1000, 2000, or 3000 IU/kg of vitamin E. Data collected was similar to experiment 1. After consuming the diets during the four weeks of the trial, the hens produced average egg yolk alpha-tocopherol levels of 153, 356, 607, 684, 1549, and 1394 μg/g, respectively. Results with significant differences include egg weight ($P<.002$), albumen height ($P<.002$), yolk color ($P<.0001$), yolk weight ($P<.01$), and the number of eggs produced per diet ($P<.021$). In both experiments, the vitamin E level in the feed significantly increased the alpha-tocopherol content in the yolk ($P<.05$). No signs of alpha-tocopherol toxicity were noticed at necropsy following the experiment.

Key Words: Vitamin E, Egg vitamin content, Layers

373 Nutrient requirements of Hy Line W-36, Bovans White and a new strain of Bovans White hens for optimum profits during phase I. A. Bateman*[1], M. Bryant, and D. A. Roland, Sr., [1] *Auburn University.*

A study was conducted to compare performance and nutrient requirements of a new strain of Bovans White hen with the previous strain of Bovans White hen as well as Hy Line W-36 hens (weeks 21-36). Three