stand compared to other abattoirs. A particularly attractive feature of the bacterial score and rating systems is that the scoring is entirely based on sample data and that subjective scoring is eliminated. With such systems and assistance at hand, the present surveillance system can only benefit the whole meat industry for many years to come.

Key Words: Base line study, Microbiological safety, Meat

1071 Fermentation of whey permeate to lactic acid by *Lactobacillus helveticus* in a spiral-sheet bioreactor. M.M. Salameh*, A. Shahbazi, S.A. Ibrahim, M. Mims, and V. Shirley, *North Carolina Agricultural and Technical State University*.

The United States generates nearly 325 billion gallons of wastes and by-products during the processing of foods. Whey is a by-product produced in cheese industry and it is estimated that as much as 40-50% of the whey produced is disposed of as sewage or applied to agricultural lands. The remaining 50-60% is being used primarily for animal feed or for human food. Whey contains high quantity of lactose and other nutrients, which can be easily utilized by lactic acid bacteria to produce organic acids and value added products. The objectives of this work were to determine the ability of spiral-sheet to immobilize *Lactobacillus helveticus* (*L. helveticus*) and to determine the performance membrane for the continuous production of lactic acids using cheese whey as by-product. Active culture of *L. helveticus* (ATCC15009) was weekly transferred into fresh MRS and maintained at 4C. This culture was inoculated into 9 liters of MRS and incubated at 37 C for 16-18 hours. Fermented broth was transferred into the spiral-sheet bioreactor and was allowed to immobilize for 24 hours. After successful immobilization, MRS broth was withdrawn and replaced by fresh 4.8% lactose-MRS broth under aseptic conditions. Bioreactor was connected to Bioflo III (2-liter fermentor which has a control loop for temperature and pH) with continuous medium circulation at 37 C and agitation rate at 100rpm. Samples were withdrawn every 6 hours for lactose and lactic acid analysis using HPLC. Changes in pH were monitored during fermentation process. During fermentation the pH value was dropped from 6.2 to 3.8, which inhibited the bacterial activity. During the following experiments, we adjusted the pH to 6.50 by neutralizing the acid with 5-N ammonium hydroxide. Under the controlled pH condition, lactose conversion rate was 59.00%. These results showed that immobilization of *L. helveticus* on spiral-sheet reactor was a successful operation for the continuous production of lactic acid.

Key Words: spiral-sheet bioreactor, *Lactobacillus helveticus*, immobilization

1072 Molecular certification in chicken meat channel. V. Haezebroeck[1], R. Renaville*[1], I. Parmentier[1], S. Fontaine[1], S. Hetzel[1], and D. Portetelle[1], [1]*Animal and microbial biology Unit, Gembloux Agricultural University, Gembloux, Belgium*.

Adulteration of meat products is prohibited for fair trading, consumer protection, religious reasons or public health. As DNA can be extract from many different sources (blood, raw or cooked meat, milk,), DNA fingerprinting methods find an interesting applicability in species identification and meat traceability. Microsatellites markers are very polymorphic loci constituted by a variable number of a tandemly repeated motif of 1 to 6 base pairs, more commonly (CA)n/(TG)n. There are abundant, multi-allelic, codominant and uniformly distributed throughout the genome of numerous species. The aim of this study was to find specific chicken microsatellites markers and to verify their ability to authentify chicken products from other major meats. Nine microsatellites markers (MCW180, MCW135, MCW68, LEI161, MCW239, MCW264, LEI162, HUJ2, LEI78) were selected in the chicken genome and were combined in three triplex reactions. No cross-amplification were observed with bovine and pig DNA. All the nine microsatellites were also tested for cross-species amplification with other avian genomes. We observed that the microsatellite LEI161 give amplification product only for chicken. LEI161 is associated in a triplex PCR reaction with the markers MCW239 and MCW264. These three markers were revealed to easily distinguish chicken or turkey meat products. In conclusion, this triplex could be used to authentify chicken or turkey in food and to detect falsification. Such a mean of analysis give new and alternative approaches of animal and species characterisation in meat products (Grant S-5876, Belgian Ministry of Small Enterprises, Traders and Agriculture DG4 and DG6 / and Belgian Public Health Ministry).

Key Words: Certification, Chicken, Meat

1073 Nutritional evaluation of Bt-corn in pigs . Tim Reuter, Karen Aulrich*, Andreas Berk, and Gerhard Flachowsky, *Institute of Animal Nutrition, Federal Agricultural Research Centre* .

The increasing cultivation of genetically modified plants opens new questions to animal nutritionists. One of them is to compare the nutritional value from parental and transgenic plants, another one is consumer safety. Analytical investigations to check the nutritional value are in progress at our institute, also investigations on the fate of "foreign"-DNA. The present project deals with a balance study to check the substantial equivalence, a grower-finisher trial to measure the pig performances and the fate of foreign-DNA in different tissues of pigs. The pigs were supplied with a 70% corn of the parental or the Bt-line containing diet. In a three collection period containing trial with twelve pigs we compared the feeding value of the Bt and the parental corn. All measured parameters were similar for both corn lines as shown in Table 1 ($p > 0.05$). The pig performances were measured with 48 pigs in a second trial. 12 pigs were fed a diet containing the parental corn, 36 pigs a diet containing the Bt corn. There were no significant differences (parental vs. Bt) in daily weight gain g/d (81593 vs. 80464), feed consumption kg/d (2.060.10 vs. 2.040.16) and Feed:gain kg/kg (2.550.27 vs. 2.590.18) between both groups ($p > 0.05$). The calculated results base on a growing period of 91 days. To investigate the fate of foreign DNA pigs were divided into different groups of six pigs each and slaughtered on different times after feeding. Samples were taken after slaughtering from different tissues.

Table 1. Digestibility of crude protein (dP), N-free extracts (dX) and metabolizable energy (ME) of diets

	1.period control	(grower) Bt	2.period control	(finisher) Bt	3.period control	(finisher) Bt
dP %	83.33.1	86.21.8	85.62.4	85.02.0	85.71.5	87.01.6
dX %	91.60.8	92.40.7	93.20.4	93.30.5	93.40.5	93.70.6
MJ ME/ kg DM	15.40.3	15.70.2	15.80.2	15.60.2	15.90.1	15.90.2

Key Words: Bt-corn, Genetically modified plants, pig

PSA Environment and Management

1074 The Effect of Lighting Program and Light Intensity on the Performance and the Incidence of Leg Abnormalities of Broiler Chickens . A. Kamyab*[1], S. Raja-Abadi[2], K. Yousefi[3], and A. Taghipour Farshi[4], [1]*University of Tehran, Animal Sci. Dept.,* [2]*University of Mazandaran,* [3]*Mobark Andish, Co.,* [4]*Telavang, Co.*.

This experiment was conducted in a 2x2x2 factorial arrangement, using two different lighting regimens, continuous (23L:lD) vs. intermittent (1L: 3D), two light intensities, high (30 Lx) vs. low (8 Lx) and two sexes. Some 864-day old chicks were randomly distributed by sex among 24 pens of 36 chicks each. In the first 2 days, all birds received 23 hours of light per day with 20 Lx intensity. After that chicks were subjected to an intermittent or continuous lighting program, combined with two different intensities. At the end of study, day 42, body weight gain was affected by lighting treatments ($P<0.05$), but feed intake was not affected by lighting programs and intensities, and the only difference was found among males and females which had reflected the sex effect ($P<0.05$). Cumulative feed conversion among lighting programs, intensities and genders was significant ($P<0.05$). Comparison of feed conversions revealed the superiority of the intermittent lighting program relative to continuous one, low intensity compared to that of high intensity and males in comparison with females ($P<0.05$). The interactions of lighting programXintensity, lighting program x sex and intensity x sex were significant in some cases ($P<0.05$). Abdominal fat was affected by lighting treatment and was much lower in broilers reared under the intermittent lighting regimen than that of the broilers reared under the continuous one. Also males deposited less fat than that of the fe-

males (P<0.05). Comparison the effects of high and low intensity on abdominal fat showed no discrepancy (P>0.05). The lighting programs, intensities and sexes interactions, in most cases, had a significant effect on abdominal fat (P<0.05). When comparing the effects of treatments on mortality, no significant differences were found. Meanwhile, the difference of bone ash percentage was not statistically significant among the different treatments.

Key Words: Light, Intensity, Leg abnormality

1075 Effect of a subtherapeutic level of virginiamycin on the clearance of *E. coli* 0157:H7 from an anaerobic continuous-flow culture of chicken microflora. Toni Poole*, Kenneth Bischoff, Todd Callaway, and David Nisbet, *USDA,ARS, College Station, TX 77845.*

Antibiotics are used in food animal production for growth promotion; these drugs typically target Gram-positive microorganisms. An anaerobic continuous-flow fermentation culture of chicken gastrointestinal microorganisms has been used as a model of the chicken ceca to study interactions between normal avian gut microflora and enteropathogens. Previous studies have shown that such a culture clears *E. coli* O157:H7 at a rate of one log/CFU/day. The purpose of this study was to determine if virginiamycin, an antibiotic used for growth promotion that targets Gram-positive microorganisms and anaerobes, would provide a selective growth advantage for *E. coli* O157:H7; thus preventing clearance from the continuous-flow culture. Two of three identical chicken continuous-flow cultures were treated with 1.0 μg/ml virginiamycin, a concentration considered to be subtherapeutic. After one week of virginiamycin treatment, 1.0 x 10^7 CFU/ml *E. coli* O157:H7 was added to all three cultures. For the duration of the experiment the endogenous bacteroides, veillonella, lactic acid bacteria and enterococci in the virginiamycin treated cultures remained at the same concentration as those in the untreated control culture. The *E. coli* O157:H7 population dropped at a rate of one log/CFU/day until it reached a concentration of approximately 10^3 CFU/ml in all three cultures. The *E. coli* O157:H7 population remained at approximately 10^2-10^3 CFU/ml in the two virginiamycin treated cultures and at 10^1-10^2 CFU/ml in the untreated control. The results of this study suggest that a subtherapeutic level of 1.0 μg/ml virginiamycin was not sufficient to perturb the microbial ecology of the culture such that E. coli O157:H7 was provided with a competitive advantage.

Key Words: Growth promotion, Competitive exclusion, E. coli O157:H7

1076 Effect of Organic Acids and Formaldehyde on Pellet Quality and Pellet Process Efficiencies. S. Moore, M. Neill, P. Bentley, R. Odgaard, and P. A. Welch*, *Kemin Americas, Inc.*.

An organic acid containing compound (K-One $_{brand}$ Feed Treatment) and a 30% formaldehyde based compound were evaluated for their effects on pellet quality and pelleting efficiencies. Control elements, i.e., mash temperature, run time (min), pellet mill volts, and production rate per hour (2.9 MT/hr.) in the pelleting process were maintained constant. Percent pellets, Pellet Durability Index (PDI), amperage, motor load, horsepower, and relative electrical energy per ton (kWh/MT) were measured. A commercial broiler grower ration containing 65% corn, 27% soybean meal, and 3% meat and bone meal was used as a basal diet, to which the various chemical treatments were applied. Treatment inclusion rates of organic acids was 0.4%, and the 30% formaldehyde based compound was added at a rate of 0.3% (0.09% formaldehyde). No significant differences were observed in percent pellets or PDI values between the control and organic acid treatment; however, incorporating formaldehyde into the basal diet resulted in a significant decrease in percent pellets (3.14%) and PDI (4.87%). Motor load was similar for the control and the organic acid treatment, but increased significantly with the inclusion of formaldehyde into the basal diet. Organic acid treatment resulted in lower amperage and horsepower requirement as compared to the control and the formaldehyde treatment. Although relative electrical energy per ton values appeared to be numerically higher for formaldehyde treated feed, statistically all treatments were similar. In conclusion, it appears that the use of organic acids improve pellet quality when compared to formaldehyde, and organic acids reduced amperage, and horsepower requirements for pelleting broiler feed. Formaldehyde in this study appears to have had a negative impact on pelleting process dynamics.

Key Words: Pellet Quality, Pelleting Efficiencies, Broiler Ration

1077 Phylogenetic analysis of cecum mucosal bacteria in broiler chickens. J. Gong[1], J.R. Chambers*[1], R.J. Forster[2], H. Yu[1], P. Sabour[1], R. Wheatcroft[1], and S. Chen[3], [1]*Food Research Program, Agriculture & Agri-Food Canada,* [2]*Lethbridge Research Center, Agriculture & Agri-Food Canada,* [3]*Laboratory Service, University of Guelph, Guelph.*

The community structures of bacterial populations associated with cecal surface of broiler chickens were investigated by comparative DNA sequence analysis of 16S rRNA genes. Total DNA was extracted from bacteria collected from the cecal surface of ten 6-week-old chickens that were fed with standard commercial diets containing no antibiotics. One hundred and fifteen random clones of 16S rRNA genes were isolated for sequence analysis after PCR amplification with eubacterial primers. Phylogenetic analysis indicated that all cloned sequences were similar to low G + C Gram-positive bacteria. The cloned sequences showed large phylogenetic diversity within this group, with many sequences being related to cloned sequences from the human gut or from the rumen. There were 11 groups of sequences comprised of 4 or more closely related clones, and the largest group of sequences (34) were closely or distantly related to *Fusobacterium prausnitzii*. Of all the clones, at lease 29% were related to butyrate-producing bacteria. The ecological/physiological significance of the predominant bacteria remains to be determined.

Key Words: Chicken, Bacteria, 16S rRNA

1078 Bioprocessing of poultry feather wastes using three feather-degrading microorganisms: fermentation characteristics, keratinases activities and biochemical properties. A. A. Onifade*[1] and N.A. Al-Sane[1], [1]*Department of Biological Sciences, Kuwait University, P.O. Box 5969, Safat 13060, Kuwait.*

Poultry feather accumulates as waste after slaughtering of the chicken; however, there exists the potential for its bioprocessing prior to recycling as animal feedstuff using feather-degrading microorganisms. Bioprocessing is environmentally friendly, low-energy consuming and an alternative to hydro-thermal processing, which appears not completely satisfactory. Three feather-degrading microorganisms: *C. zonatum*, *C. pannicola* and the *Streptomyces* (K) were used for bioprocessing of feather. *In vitro* biodegradation of poultry feather obtained from slaughtered 7-week old white-feathered broilers was carried out by inoculating the spore suspension of feather-degrading microbes in Keratin Salt Medium containing g l^{-1}: 20 partially milled feather; 0.5 $MgSO_4.7H_20$; 0.46 KH_2PO_4 and 1.0 K_2HPO_4 followed by incubation at 28 ^oC for 9 days at 200 rpm until the feather was completely degraded. The extracellular keratinases were separately recovered from a cell-free extract of the growth media of the three microbes by 80% $(NH4)_2SO_4$ saturation and further subjected to biochemical assays. Results showed that the three fermentation media became alkaline terminally and highest substrate consumption of 75.6% was by *Streptomyces* (K) achieved because of its highest proteolytic activity. The three microbes synthesized *de novo* and export considerably active keratinases into the culture media, which were recoverable. Production of keratinase by *Streptomyces* (K) tended to decrease with time, whereas both *Chrysosporium* species demonstrated increasing production, but *C. zonatum* produced greater amount of keratinase than *C. pannicola*. The data obtained suggest that the major keratinases produced by *C. zonatum* and *Streptomyces* (K) are metalloproteases while a mixture of serine and metalloprotease are produced by *C. pannicola*. The optimal pH and temperature were: 8.0; 9.0; 8; 50 ^oC; 65 ^oC and 40 ^oC for *C. zonatum*, *Streptomyces* (K) and *C. pannicola*, respectively. The biochemical adjuncts added to the keratinase assay milieu elicited improved activities especially organic detergents, sulfurhydryl group protectors and reducing agents and the keratinase tolerated some common organic solvents. In conclusion, poultry feather wastes were bioprocessed and microbially digested, multicomponent, relatively thermostable keratinases were produced and both products are amenable to animal feeding operations.

Key Words: Bioprocessing of poultry feather, Feather-degrading microorganisms, Fermentation and keratinases characteristics

1079 Effect of timing of hypobaric exposure on the incidence of ascites syndrome in broilers. J. M. Balog*[1], N. B. Anthony[2], M. A. Cooper[2], B. D. Kidd[1,2], G. R. Huff[1], W. E. Huff[1], N. C. Rath[1], and Y. K. Kirby[1], [1]*PP&PSR/ARS/USDA, Fayetteville, AR,* [2]*University of Arkansas, Fayetteville, AR.*

Ascites is a metabolic disease of fast growing meat-type birds, that can be induced by rearing birds in a hypobaric chamber. The hypobaric chamber simulates high altitude by operating under a partial vacuum, leaving the birds with less available oxygen. A study was conducted to determine if birds exposed to simulated altitude for varying amounts of time would, when moved to local altitude, still develop ascites and if the reverse was true for birds moved from local altitude to high altitude. Three replicate trials were conducted utilizing 480 male broilers for each trial. Half the birds were assigned to the hypobaric chamber and the other 240 were placed in an environmentally matched local altitude chamber. Within each chamber, birds were randomly assigned to one of four treatments. The control birds remained at their initial altitude for the entire 6 wk trial. Birds in Treatment 2 remained at their initial altitude for 2 wk, and were then moved to the other chamber. Treatment 3 birds remained for 3 wk, and Treatment 4 birds remained for 4 wk at their initial altitude before being moved. All birds and feed were weighed weekly. Necropsies were conducted daily to determine cause of death. At the end of 6 wks, blood samples and organ weights were collected and all birds were examined for signs of ascites. In all three trials, time spent at simulated high altitude significantly affected ascites mortality and body weight. Birds that remained at high altitude for the duration experienced the highest ascites mortality while birds that were never placed at high altitude had the least ascites. As the amount of time that a group spent at high altitude increased, so did their ascites mortality. Body weights were negatively correlated with the amount of time spent at high altitude. In general, when birds were moved to high altitude, it took 2 wks of exposure before a significant increase in ascites incidence was noted. Conversely, when birds were moved from high altitude to low, it took 2 wks before ascites mortality significantly declined.

Key Words: Ascites, Hypobaric, Broilers

1080 Campylobacter jejuni Isolation Trends of Broilers Reared on Different Bedding Materials. W Willis*, C Murray, and W Willis, *North Carolina A&T State University.*

An experiment was conducted to evaluate different bedding materials on *Campylobacter jejuni* isolation with broiler chickens. Five bedding types were utilized in floor pens: (1) pine wood shaving; (2) sand; (3) corn-cob; (4) red cedar shaving and (5) wheatstraw. Each treatment was replicated three times with five birds placed on day 0, 3, and 6-d in each pen. Samples were taken 3, 6, 9, 12 and 15-d post placement in each treatment. All litter treatments had been previous utilized by a *Campylobacter jejuni* experimental infected flock. No chicks tested positive in any of the treatments at 0, 3 and 6-d placement for 3-d cloaca sampling. The longest time that chicks tested negative was 12-d at the 0, 3, and 6-d placements. Chicks placed on the pine and corn-cob bedding generally were the first to test positive, whereas, the cedar and sand were the last to test positive for C. *jejuni* at all placement times. All chicks crop tested for C. *jejuni* at 49-d of age were 100% positive for all treatments. Carcass yields varied for each treatment with 71.6, 75.1, 73.9, 73.8 and 71.2, respectively. The results from this study indicates that bedding materials can influence or delay the isolation of C. *jejuni* but not totally inhibit it.

Key Words: *Campylobacter jejuni*, Broilers, Bedding

1081 Multi-Phase Versus Single-Phase Feeding During the Broiler Starter Period; Effects on Performance and Nitrogen Excretion. N. Nasril*, C. Zhang, A.U. Haq, J. Carey, and C.A. Bailey, *Texas Agricultural Experiment Station.*

Two experiments were conducted to evaluate the effects of a multi-phase feeding program in which the nutrient content of the diet was changed every 24 hours versus a single-phase feeding program in which a single diet was fed over a 21-day growing period. In Experiment 1, 144 day-old straight run broiler chicks were randomly placed in 24 separate battery brooder pens and fed either a broiler starter diet containing 22% protein (3146 kcal ME/kg) or a linear blend of two diets so that birds received a diet containing 24% protein (3124 kcal ME/kg) on Day 1 and 20% protein (3168 kcal ME/kg) by Day 21. Experiment 2 was similar to Experiment 1 with the exception that 24 day-old straight run broilers were individually caged and the control diet contained 23% protein while the blended diet ranged from 26 to 20% protein. Poultry metabolizable energy was maintained at 3200 kcal ME/kg. Multi-phase feeding had no significant influence on feed consumption, daily gain, feed conversion or net fecal nitrogen in either experiment.

Key Words: Multi-phase feeding, Broilers, Nitrogen excretion

1082 Limitation of *Salmonella enteritidis* colonization by diets containing low calcium and low zinc. S.C. Ricke*[1], Y.M. Kwon[2], C.L. Woodward[1], J.A. Byrd[2], D.J. Nisbet[2], and L.F. Kubena[2], [1]*Texas A&M University, College Station, Texas/USA,* [2]*USDA-ARS, SPARC, College Station, Texas/USA.*

The use of feed deprivation to induce molting and stimulate multiple egg-laying cycles in laying hens is a common practice in commercial egg production. An increased susceptibility to *Salmonella enteritidis* (SE) and an increased risk of SE positive eggs and internal organs has been observed under laboratory conditions, probably due to the stress involved in feed deprivation. There is the need to test other methods that stimulate multiple egg-laying cycles without the increased risk of SE. Leghorn hens over 50 wk of age were divided into treatment groups of 12 hens each and placed in individual laying hen cages. One wk prior to dietary 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-molt, NM), non-fed hens (molt, M), hens fed a low calcium diet (LC), and hens fed the low LC diet supplemented with 110 mg zinc/kg of diet (LC-ZN). When compared with the NM treatment, weight losses were higher and water consumption was increased in hens fed the LC and LC-ZN diets. The number of crop and ceca culture positive hens and the numbers of SE per crop and per gram of cecal contents were lower in the LC and LC-ZN treatments than in the M treatment, and were comparable to the NM treatment. Invasion of the liver, spleen, and ovary by SE was similar to the NM treatment, which was significantly lower ($P < 0.05$) than the M treatment. These dietary regimens may prove to be useful 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-calcium

1083 *Salmonella* Typhimurium Virulence Response to Poultry House Water as Measured by *hilA:lacZY* Fusion. J. D. Nutt*, K. L. Medvedev, C. L. Woodward, S. D. Pillai, and S. C. Ricke, *Texas A&M University, College Station, TX, USA.*

Salmonella is regarded as a primary foodborne pathogen commonly found in the gastrointestinal tract and internal organs of poultry. Recent studies have shown *Salmonella* to be capable of surviving in several types of aquatic habitats. Depending on environmental factors of the aquatic habitat, the bacteria cells may be induced to express virulence genes. Our objective in this study was to determine virulence expression in a strain of *Salmonella* Typhimurium when exposed to fresh versus standing water samples taken from the drinking containers of commercial laying hens. The caging facility contained two rows of 30 cages placed back to back for a total of 60 cages housing 58 hens. Water was supplied to each cage by a U-shaped pipe with individual outlets to each cage. The 60 cages were divided into four quadrants. Quadrant one was the closest to the initial water source while quadrant four was the greatest distance from the origin of the water source. Water from the containers were sampled, refilled and sampled again. Each water sample (1.5ml) was inoculated with 0.120ml of a *hilA:lacZY* fusion strain of *S.* Typhimurium inoculum and incubated for two hours. After incubation, β-galactosidase assays were performed on the samples to determine virulence expression with brain heart infusion (BHI) broth serving as a control. BHI values ranged from 40-45 Miller units while water samples displayed Miller units in the range of 300-500. Results showed that there was a significant difference ($p<0.05$) in virulence expression between the four quadrants in the fresh water samples. However, no significant difference was observed between quadrants for the standing water samples. Both standing and fresh water samples gave a 5-10 fold increase of virulence expression as compared to BHI.

Key Words: *Salmonella*, poultry water, virulence

1084 Differential response in fertility of broiler breeder males selected for the sperm quality index prior to heat exposure. A. G. Karaca*, H. M. Parker, J. B. Yeatman, and C. D. McDaniel, *Mississippi State University, Mississippi State, MS*.

Heat stress (H) is deleterious to broiler breeder reproductive performance. The present study was undertaken to determine if fertility of males with a higher sperm quality index (SQI), prior to exposure to H, is more susceptible to high ambient temperatures than that of males with a lower SQI. Cobb males (108) were individually caged in six temperature controlled rooms. Males were tested twice for the SQI and then placed into four SQI treatment groups as follows: best (B), good (G), fair (F), and poor (P). The SQI groups represented the four SQI population quartiles. Four or five males from each SQI group were placed in every room. After a 29 wk acclimation period, three rooms were heated to 35°C, and the other three rooms were maintained at a constant 22°C as controls (C). For each SQI group in each room, 15 Leghorn hens were artificially inseminated (50 million sperm/hen) once a week for 8 wk for fertility observations. Sperm concentration, sperm viability, and the SQI were evaluated for each male on a weekly basis. Linear contrasts were used to compare males in the top 75% of the SQI population (B+G+F) to males in the lowest 25% of the SQI population (P). Body weight, sperm concentration, SQI, and fertility of the P males was lower than that of the other three SQI groups. Body temperature of the top three SQI groups was increased by exposure to heat stress, but body temperature was not altered by H in the P group. Also, mortality was elevated and feed consumption was decreased by exposure of males to high ambient temperature. Fertility, sperm viability, and SQI of the top three SQI groups was decreased by exposure to high ambient temperature; however, the same characteristics of the P males were not affected by heat exposure. In conclusion, high ambient temperatures had a more dramatic impact on the semen quality and fertility of males with a higher SQI as compared to those with a lower SQI prior to heat exposure.

Key Words: fertility, sperm quality index, heat stress

1085 Employing Ultrasound Technology to Measure Testicular Development in Broiler Breeder Roosters. L. J. Richardson*[1], A. B. Caudle[1], and J. L. Wilson[1], [1] *The University of Georgia*.

An ultrasound (Aloka SSD-500V) fitted with a linear prostate probe (UST-660 7.5MhG-16mm) was used to access testicular development in broiler breeder males. The objective was to characterize the size of the testes without killing or harming the birds. In order to obtain diagnostic images, bird position, probe placement, lubricant mixture, and feeding schedule had to be determined. The birds were fed one hour prior to the ultrasound procedure to reduce intestinal fragility and the presence of lower gastrointestinal feces. A lubricant (J-Lube) was used to ease probe insertion, decrease the possibility of intestinal tract damage, while increasing ultrasound image quality.
The trial was completed with twelve, 65 wk old broiler breeder males. Five ultrasound images were attempted of each rooster over a four wk period. Several problems were identified to interfere with probe placement and image quality: limited abdominal cavity space to maneuver probe, close proximity of abdominal air sacs and abdominal aorta to testes, and narrowing of large intestine at the branch of the ceca. Roosters were held in a dorsal position by an assistant to reduce bird stress and allow for easy probe insertion through the cloaca to a depth of 12 cm. The longitudinal scanning face of the probe was inserted parallel with the spinal column and came to rest between the testes. In this position, the scanning face of the probe was rotated 30-40 degrees in either direction to obtain an ultrasound image of each testis. Semen collection was attempted from the roosters before ultrasound images were obtained (semen collected from 8 of the 12 roosters). A similar number of males ejaculated semen 3-7 days after the ultrasound procedures indicating no long term detrimental effect of probe insertion.

Key Words: Ultrasound , Testes, Broiler breeder males

1086 The Effects of Chlorine and Hydrogen Peroxide at Various Concentrations on Total Bacteria and Coliform Counts in Poultry Drinking Water. J Zhang*, D McGhee, and S VanBoekel, *Cold Springs Farm Ltd. Thamesford, Ontario, Canada*.

Water samples were collected from the drinkers in the poultry barns on four farms and were cultured on petrifilm plates for the total aerobic bacteria and coliform counts. Water in the poultry barns on all farms was treated either with chlorine (Cl_2) or with hydrogen peroxide (H_2O_2). The Cl_2 levels in the water were about 3-4 ppm and the H_2O_2 levels were about 40-50 ppm. All the levels were measured at the beginning points of water lines, however, both Cl_2 and H_2O_2 concentrations were much lower in the water samples collected from the drinkers (below 0.5 ppm for Cl_2 and below 30 ppm for H_2O_2). After 24 hour incubation at 37 °C, the total aerobic bacteria counts were too numerous to count (TNTC) for all samples and coliforms were recovered for these samples in which H_2O_2 levels were below 30 ppm and Cl_2 level was not detected. However, there was no coliform count from the samples in which Cl_2 levels were discovered (> 0 ppm). To continue this investigation, water sample contaminated with bacteria was used. One sample was untreated as control and some samples were treated either with Cl_2 at 0.5, 1, 1.5, 2, 2.5, 4, and 6 ppm or with H_2O_2 at 20, 40, and 60 ppm as in final solutions in the laboratory. From the control sample, the total aerobic bacteria count was TNTC and coliform count was 69/mL. From the samples treated with Cl_2, the aerobic bacteria counts were 2400, 3, and 2/mL when Cl_2 concentrations were at 0.5, 1 and 1.5 ppm, respectively. There was no bacteria count in all samples when Cl_2 concentrations were at 2 ppm and higher levels. While, the coliform count was zero in each sample treated with Cl_2 at all concentrations. From the samples treated with H_2O_2, the total aerobic bacteria were TNTC and there were countable numbers of coliforms in all samples. However, the coliform counts were decreased when the H_2O_2 concentrations were increased from 20 to 60 ppm. From these investigations, the results indicate that when Cl_2 is used as a disinfectant in the poultry drinking water, it plays a better role in the deductions for total bacteria counts, especially for coliform counts over H_2O_2. Further study may be required to investigate H_2O_2 effect on bacteria deduction in poultry drinking water at higher concentration.

Key Words: Chlorine, Hydrogen Peroxide , Bacteria

1087 Prevalence of *Campylobacter* in a Turkey Production Facility. A. S. Kiess* and P. B. Kenney, *West Virginia University*.

Campylobacter ingestion may cause campylobacteriosis in humans with most cases being linked to poultry products. In order to reduce *Campylobacter* in turkey products, frequency of *Campylobacter* colonization in live turkeys must be reduced. One turkey flock, with two genetic lines, was sampled for *Campylobacter*. Gastrointestinal tracts and box liners were collected when poults were placed, and water and fecal samples were taken at specified times throughout a 20-week production cycle. Each GI tract and box liner sample, a 5.2-cm square, was removed and placed in a sterile stomacher bag containing 100 or 25-mL nutrient broth (#2), respectively. A 100-mL water sample was transferred from each drinker to a sterile 250-mL bottle, and fecal droppings were placed in sterile plastic bags. All samples were packed on ice and transported to the microbiology lab for *Campylobacter* isolation. Following mixture of feces with nutrient broth, a sample was directly plated onto a Campy-Cefex agar plate. Water samples were filtered through a 0.4-micron filter; the filter was then placed face down onto a Campy-Cefex agar plate. Twelve plates were placed in a gallon, ziplock bag, flushed (85% N_2, 10% CO_2 and 5% O_2) sealed, and incubated at 40 to 42 °C for 36h. Presumptive positives were confirmed by latex agglutination. *Campylobacter* was present in 59.7% of all samples by week three of production, and it remained at this level throughout production. Frequency of detection was higher in females (63.1%) than males (56.3%). The higher frequency in females may be the influence of the males on female behavior in adjacent pens. The high prevalence of *Campylobacter* in this flock supports the need for implementation of preharvest practices to reduce this food borne pathogen in turkeys at harvest.

Key Words: Turkeys, *Campylobacter*, Preharvest

1088 Does genetic selection for contrasting adrenocortical responsiveness influence underlying sociality in Japanese quail? R. H. Marin*[1], R. B. Jones[2], D. G. Satterlee[1], and G. G. Cadd[1], [1]*Dept. of Poultry Science, Louisiana State University Agricultural Center, Baton Rouge, LA 70803, US,* [2]*Roslin Institute (Edinburgh), Midlothian EH25 9PS, Scotland.*

Inappropriate levels of sociality (motivation to be near conspecifics) may engender fear and distress, high levels of which can seriously damage poultry productivity and well-being. Thus, low sociality birds may be ill-suited to housing in very large groups. Genetic selection of Japanese quail for a dampened (LS, low stress) rather than exaggerated (HS, high stress) adrenocortical response to brief restraint is associated with decreased fearfulness and a non-specific reduction in stress responsiveness. Because sociality and fear may be linked in certain circumstances, the present study compared underlying sociality in chicks of the LS and HS lines in two test situations. In Experiment 1, social proximity was evaluated by filming undisturbed same-line groups of LS and HS chicks in their home cages; during subsequent analysis of the videotapes we then measured clumping and the distance between the two furthest birds at regular intervals. In Experiment 2, the responses of individually-tested chicks were measured in a runway when the goal box at the opposite end contained two other chicks (1 LS, 1 HS). Social proximity was greater ($P < 0.03$) in LS than HS quail and the LS birds tended to segregate more ($P < 0.10$). Similarly, once the quail had reached the runway zone nearest the goal box, LS birds spent a greater proportion of the remaining time in close proximity to the stimulus birds ($P = 0.04$) than did HS ones. Social proximity in the home cage and affiliation responses in a runway are widely considered to be positively related to underlying sociality. Therefore, the present findings clearly suggest that underlying sociality is greater in quail selected for low rather than high adrenocortical stress responsiveness

Key Words: Adrenocortical responsiveness, Japanese quail, Genetic selection, Sociality

1089 Early T-maze behavior, puberty and egg production in Japanese quail selected for contrasting adrenocortical responsiveness. R. H. Marin*[1], D. G. Satterlee[1], G. G. Cadd[1], and R. B. Jones[2], [1]*Dept. of Poultry Science, Louisiana State University Agricultural Center, Baton Rouge, LA 70803,* [2]*Roslin Institute (Edinburgh), Midlothian EH25 9PS, Scotland.*

Broiler chicks that traversed a T-maze quickly to reinstate contact with their companions (HP, high performance) then grew faster, showed greater sociality and lower plasma corticosterone (C) responses to an acute stressor than did slower (LP, low performance) chicks. Genetic lines differing in adrenocortical responsiveness are powerful tools for studying the relationships between behavior, stress and performance. Herein we asked if early T-maze behavior is related to the attainment of puberty and to egg production in Japanese quail selected for low (LS) or high (HS) plasma C response to restraint. At 3 d of age, 196 HS and 189 LS quails were tested in a T-maze and categorized as HP or LP if running times were < 25 s or >100 s, respectively. They were housed in mixed-category, mixed-line groups in brooder batteries until 4 weeks when they were caged in same-line, same-category pairs of 1 male and 1 female until 14 weeks. Thus, there were 4 treatment combinations, i.e., 19 HP-LS, 21 HP-HS, 23 LP-LS and 24 LP-HS pairs. Egg records were kept from the first oviposition for the next 8 weeks. HP birds reached puberty sooner than LP ones as shown by reductions in age at first egg and at 25% egg production (ANOVA, $P<0.02$). Post-hoc tests showed that age at first egg and at 25% egg production were lower ($P<0.05$) in HP-LS than LP-HS pairs. Overall hen-day egg production (HDEP) was greater (repeated measures ANOVA, $P<0.04$) in HP than LP quail. A numerical trend towards greater overall HDEP (+5%) in LS than HS quail failed to reach significance ($P<0.34$). Our results suggest that rapid negotiation of the T-maze was associated with accelerated puberty and an associated increase in HDEP in quail of two genetically diverse lines. These findings strengthen our proposal that this simple, non-invasive test could be a useful selection criterion for breeding programs to improve productivity

Key Words: Japanese quail, T-maze behavior, puberty

1090 Effect of age, body weight, and sex ratio on fertility and hatchability in the Japanese quail *(Coturnix coturnix japonica)* under subtropical conditions. Gehan Ragheb*, H. El-Hammady, and M. Abdelnabi, *Assiut University, Assiut, Egypt.*

The purpose of this experiment was to study the effect of age, body weight and sex ratio on fertility and hatchability in the Japanese quail raised under subtropical conditions. Three hundred, newly hatched chicks were raised in brooders under standard temperature, humidity and photoperiod regimen until puberty. Birds from both sexes were divided according to their weights into high (HBW; 160-180 gr.) and low (LBW, 120-150 gr.) body weight. Each body weight group was divided into two subgroups; the male/ female ratios were 1:1 and 1:2, respectively. A total of 400 eggs (100/subgroup) were collected over the course of 13 time periods, each consisted of 28 days. These eggs were incubated and then measurements of fertility and hatchability were determined. The results from this experiment showed highly significant differences ($P<0.01$) in fertility and hatchability in all subgroups with respect to age. No significant differences were found in both traits between groups (HBW and LBW) and between sex ratio (1:1 and 1:2) in all periods. The highest fertility was 95.0; 95.7% and 95.8; 95.9% while the highest hatchability was 82.1; 85.7% and 90.7; 87.8 % in HBW and LBW at sex ratio of 1:1 and 1:2, respectively. Therefore, HBW and 1: 2 sex ratio is considered economically cost-efficient for quail breeders under subtropical conditions.

Key Words: Quail, Sex ratio, Fertility and hatchability

1091 Optimum Timing of Amino Acid Injections in Broiler Breeder Eggs. Y. Ohta*[1], T. Yoshida[2], and M. T. Kidd[1], [1]*Department of Poultry Science, Mississippi State University, Mississippi State, MS 39762,* [2]*Nippon Veterinary and Animal Science University, Tokyo, Japan 180-8602.*

Amino acid (AA) injection *in ovo* in broiler breeder eggs results in heightened BW at hatch. However, recent research has indicated that *in ovo* AA injections into the yolk and extra-embryonic coelom, but not the amniotic cavity, result in optimal responses to AA. Because egg constituents and cavities change over time, we conducted this study to determine the optimal injection time for AA *in ovo*. An AA solution, identical to the AA pattern of the egg, was injected over time in three experiments and subsequent BW and hatchability of chicks were measured. In Experiment 1, the AA solution was injected into eggs on Days 1, 3, 5, 7, 9, 11, and 14 of incubation. In Experiment 2, the AA solution was injected into eggs on Days 7, 8, 9, 10, 11, 12, 13, and 14 of incubation. In Experiment 3, the AA solution was injected into eggs on Days 14, 15, 16, 17, 18, and 19 of incubation. *In ovo* AA injections at Days 1 and 7 reduced ($P < 0.05$) hatchability. Injection of AA *in ovo* at Days 9 and 14 in Experiment 1, Days 9, 11, and 14 in Experiment 2, and all levels in Experiment 3 increased ($P < 0.05$) relative chick BW to egg weight over that of chicks from eggs not injected with an AA solution. The optimal time to inject AA solution *in ovo* in broiler breeder eggs may be Day 14 of incubation.

Key Words: Amino Acid, *In ovo*, Chick Weight

1092 Effect of number of birds per cage on the reproductive performance of Japanese quail breeders. J.F. Obregon[1], G. Contreras[1], A. Montoya[1], M.E. Gamez[1], and R. Barajas[1], [1]*FMVZ-Universidad Autonoma de Sinaloa (Mexico).*

To determinate the effect of the number of birds per cage on the reproductive performance of Japanese quail breeders, a complete randomized experiment was conducted with one hundred sixty Japanese quail (40 males and 120 females;16 weeks old). Treatments consisted of: 1) Six females and two males allocated in a 0.25 x 0.3 m wire cage (2-M; and 2) Three females and one male allocated in a 0.25 x 0.15 m wire cage (1-M). Birds were fed a diet containing 21% CP and 2.9 Mcal DE/kg. After an adaptation period of seven days, eggs were collected during six weeks. Dead animals were replaced with birds of the same age and sex. Number of eggs hatched, was 10% higher ($P<0.02$) with the 1-M treatment (46 vs. 51 egg). Percent hatching was increased ($P<0.01$) by 22% as result of one male and three females (62.8 vs. 76.8%). Hatchability as a mean value was 54.2% and was not affected ($P>0.02$) by treatments. The number of hatched quails per day, was improved ($P<0.03$) by 24%

for 1-M treatment (25 vs. 20 quails).It is concluded, that allocation of one male and three females per cage, is a better management system than placing two males and six females in the cage.

Key Words: Japanese quail breeders, population size

1093 Multiple-objective programming to reduce ration cost and nutrient excretion. P.R. Tozer* and J.R. Stokes, *The Pennsylvania State University, University Park, PA.*.

Typical dairy rations are formulated to meet the nutrient requirements of the cow at the least cost. This approach is single objective oriented, and that is to minimize cost. In this paper we examine the use of multiple objective programming to formulate rations that minimize cost, and minimize phosphorus and nitrogen excretion. A ration formulation model was developed using the National Research Council's recommendations for nutrient requirements, and functions for protein intake and digestion, a phosphorus excretion function, and a set of prices of representative feeds for the northeastern United States. A "standard" cow was used in the model, this cow weighed 600kg, produced 30 kg of milk per day with a fat content of 3.5 per cent and was gaining 300 g per day. The cost of the minimum cost ration was $2.81 per day and consisted principally of alfalfa hay, straw, dry distillers grain, bakery product and dry shelled corn. The ration contained less than 100g of mineral supplements. The "standard" cow excreted 279 g/day of nitrogen and 32.1 g/day of phosphorus. Rations were also formulated to minimize nitrogen and phosphorus. The results of the three single objective models were combined into a multiple-objective programming model to minimize the maximum deviation from the goals generated in the single objective models. The multiple objective models resulted in marginal reductions in nitrogen and phosphorus excretion. The most marked change in ration formulations occurred when the efficiency of phosphorus utilization was increased. The base ration contained an unacceptably large proportion of straw and no corn silage, hence other multiple objective rations were formulated to reduce the straw and increase the corn silage contents. These rations increased the costs of the ration by 0.05 - 0.35 per day and marginally increased the level of nitrogen and phosphorus excreted. Another result of this ration formulation research is that all rations formulated contained less than 100 g/day of mineral supplements, indicating that the use of these supplements is a costly expense and any amount of supplement fed over those formulated leads to excretion of excess nutrients.

Key Words: Ration formulation, nutrient management, mathematical programming

ASAS/ADSA Production, Management, and Environment

1094 Feeding neonatal calves high levels of milk replacers (MR) with different protein and fat levels. T. M. Hill*, J. M. Aldrich, A. J. Proeschel, and R. L. Schlotterbeck, *Akey, Inc., Lewisburg, OH.*

Recent research with neonatal calves not receiving starters has suggested that feeding MR at high levels (over .6 kg daily) and with a high crude protein (CP) content (26 # 30%) will result in more efficient and faster gains. However, trials with a 20% CP MR fed at .57 vs. .45 kg daily observed no differences in gains because of reductions in starter feed intake with increased MR fed. We conducted a series of trials to examine how feeding rate and level of CP and fat in MR affect calf performance. In all trials, bull calves were randomly assigned to MR treatments and fed fixed amounts of MR (all milk CP plus synthetic lysine and methionine) with free-choice starter for 6 weeks. Calves were fed starter alone after 6 weeks. Calves were weighed initially and weekly. Starter intake was measured and fecal scores and medical treatments recorded daily. In all trials, a 20% CP, 20% fat MR fed at .45 kg daily served as a control treatment. Average initial body weights were 40 to 42 kg. Feeding a 28% CP, 20% fat MR stepped-up to 1.13 or 1.36 kg daily resulted in no increase in gains, increased ($P < .1$) fecal scores and medical treatments, and reduced ($P < .1$) starter feed intake by 7 weeks of age compared to the control. Feeding a 28% CP, 20% fat MR at .68 kg daily increased gains, medical treatments, and fecal scores, but decreased starter intake vs. the control ($P < .1$). When .68 kg daily of a 13% fat MR was fed with CP levels from 20 to 28%, gains increased ($P < .1$) in a quadratic manner (optimum of 26%) and starter intake was no different from the control. When .68 kg daily of a 24% CP MR was fed with fat levels between 11 and 17%, gains increased ($P < .1$) linearly and starter intake was no different from the control. These results indicate that MR fed should be limited (to near .68 kg daily) so not to depress starter intake and that the CP (optimum near 26%) and fat (optimum near 17%) levels critically impact performance.

Key Words: Protein, Fat, Calves

1095 Feeding neonatal calves milk replacers (MR) containing egg proteins. T. M. Hill*, J. M. Aldrich, A. J. Proeschel, and R. L. Schlotterbeck, *Akey, Inc., Lewisburg, OH.*

Alternative crude protein (CP) to milk CP interest the calf raising industry because of the high price of milk CP. Soy CP sources are popular because of their low cost relative to milk CP sources but, depending upon the type and level included in a milk replacer, performance can be compromised. Our objectives were to 1) evaluate how calf performance is affected by the level of milk CP replacement with egg CP, 2) compare two whole egg sources, and 3) combine egg, soy protein concentrate (SPC), and milk proteins in MR. In each trial, 50 bull calves were randomly assigned to MR treatments and .45 kg of MR was fed with free-choice starter for 6 weeks. Calves were fed starter alone after 6 weeks. Calves were weighed initially and weekly. Starter intake was measured daily. Fecal scores and medical treatments were recorded daily. In all trials, a 20% CP (from milk protein) and 20% fat MR served as a control treatment. The egg CP source was used to replace a percentage of the total protein in the MR. Average initial body weights were 41 to 43 kg. In two trials, 10, 20, and 30% egg CP from source A and 20% egg CP from source B replaced whey CP. Increasing egg CP from source A resulted in a quadratic response ($P < .1$) of gain and starter intake with 30% being inferior to other lower levels of egg and the control. The 20% egg CP from source B supported lower ($P < .1$) gains and starter intakes than the control. Additionally, three trials were conducted to compared 15% egg CP from source A, 15% SPC CP, and 70% milk CP in a MR to the control MR. There were no differences in gains and starter intake. Fecal scores and medical treatments were not different from the control when egg CP from source A was used alone or combined with SPC. Egg CP can be used successfully as a partial replacement for whey CP in calf MR, but source of egg CP differs.

Key Words: Protein, Egg, Calves

1096 Protein levels for neonatal calf starters. T. M. Hill*, J. M. Aldrich, A. J. Proeschel, and R. L. Schlotterbeck, *Akey, Inc., Lewisburg, OH.*

Previous research has suggested that approximately 18% crude protein (CP; as-fed basis) is adequate for neonatal calf starters, however, some feed companies and universities have suggested that higher levels of CP may be required. To investigate CP requirements for calf starters we fed calves starters that contained graded levels of CP along with either a 20% CP (all milk CP plus synthetic lysine and methionine), 20% fat milk replacer at .45 kg daily (trial 1) or a 26% CP (all milk CP plus synthetic lysine and methionine), 17% fat milk replacer at .68 kg daily (trial 2). In each trial, 50 bull calves were randomly assigned to starter protein levels of 18, 20, 22, 24, and 26% as-fed basis (88% DM) and fed milk replacers and free-choice starter for 6 weeks. Calves were fed starter alone after 6 weeks. The starters were a corn-based pellet with 15% wheat midds and a fixed protein blend replacing corn with elevated levels of CP. The protein blend consisted of 75% soybean meal (48% CP), distiller#s grains, blood meal, corn gluten meal, and fish meal. Mineral and vitamins levels were equal among starters. Calves were weighed initially and weekly. Starter intake was measured daily. Fecal scores and medical treatments were recorded daily. Hip widths and body condition scores was measured initially and every two weeks. Data were analyzed as a completely randomized design with linear, quadratic, and cubic contrasts relative to level of protein in the starters. Average initial body weights were 40 and 41 kg. In both trials, there were no differences ($P > .1$) in any measurement taken. These results indicate that neonatal calves fed 20% CP, 20% fat milk replacers at .45 kg daily and