

in SL display marked decreases in calcium intensity with time during illumination compared to CSF-contacting neurons in other circumventricular organs. This is strong physiological evidence that some VIP-expressing

CSF-contacting neurons in SL act as photoreceptors in the classical avian photo-neuroendocrine system.

Key Words: EPR, CSF-contacting neuron, VIP, Calcium, Chick

Environment and Management - Layers & Gamebirds

190 Early brooding temperature considerations for bobwhite quail. J. P. Blake*, J. B. Hess, W. D. Berry, and N. W. Thornhill, *Auburn University, AL.*

Over 20 million bobwhite quail are produced commercially to meet annual sporting needs. Limited information exists concerning their requirements for chick brooding to maintain livability and health. Three short-term (2-wks) studies evaluated brooding temperature requirements and effects of a feed supplement on early livability. In all experiments, birds were fed a 26% corn-soybean meal diet containing 2,811 kcal/kg ME. In Exp. 1, bobwhite quail were brooded at 90, 95, or 100 F (32.2, 35.0, or 37.8 C) for two weeks (c.a. 62 birds/pen with 2 reps/temp). For week 1, birds maintained at 95 F gained 9.65 g/bird compared to 90 and 100 F, which gained 9.11 and 9.10 g./bird, respectively ($P > .05$). During week 2, birds maintained at 90 F gained 18.1 g/bird ($P < .05$) compared to 95 and 100 F which gained 15.80 and 15.31 g/bird, respectively. Feed consumption for week 1 was greater ($P < .10$) in birds brooded at 95 F (16.38 g/bird) versus 90 and 100 F being 13.82 and 14.38 g/bird, respectively. Feed consumption for week 2 was greater ($P < .05$) in the 90 F versus the 100 F group (31.28 vs. 26.96 g/bird), as the 95 F group remained intermediate (29.15 g/bird). It was concluded that bobwhite quail require a brooding temperature of 95 F during the first week and a brooding temperature of 90 F during the second week post hatch. In experiments 2 and 3, birds were brooded at either 85 or 95 F (29.4 or 35.0 C) and offered top-dressed feed supplements "Oasis" or "GroGel Plus" for three days post-hatch. Bird numbers were c.a. 115 birds/pen with 4 reps/temp in Exp. 2 and 85 birds/pen with 4 reps/temp in Exp. 3. The feed supplements failed to provide a significant improvement in growth, feed efficiency, or mortality during the first two weeks post hatch under conditions of this trial. Birds subjected to the 85 vs. 95 F brooding temperature exhibited decreased body weight gain (15.7%) and feed consumption (4.7%) during week 1 and a slight reduction in body weight gain (5.1%) during week 2. Results confirm that a brooding temperature of 85 F is below that required for the first two weeks post hatch.

Key Words: Bobwhite, Quail, Brooding

191 Changes in protein level for bobwhite quail. J. P. Blake*, J. B. Hess, and B. D. Bowers, *Auburn University, AL.*

Limited information exists concerning dietary protein requirements of bobwhite quail when reared for sporting purposes and producers could benefit from such information. In this experiment, 576 two-week-old Bobwhite quail were divided among 6 treatment groups and randomized into 8 replications with 12 birds/rep. A 26, 24 or 22% protein mash diet (2810 kcal ME/kg) was fed to 4 or 6 weeks of age followed by the introduction of a 20% protein mash diet (2810 kcal ME/kg) fed through 8 weeks of age. Birds and feed were weighed biweekly. Results indicate that there were no differences in bodyweight of birds subjected to the 22% protein regimes as compared to the 26 and 24% protein regimes. Period bodyweight gains exhibited no distinct patterns based on protein level. However, during the 2-4 week period, bodyweight gains were slightly greater (3.8%) in the 26 and 24% protein fed birds as compared to the 22% protein level. During the 4-6 week period, bodyweight gain was significantly ($P < .05$) lower in the group that received 22% protein from 2-4 weeks with a subsequent change to the 20% protein diet. This group consumed the lowest level of protein, but during the 6-8 week period exhibited the greatest bodyweight gain and feed consumption coinciding with compensatory growth. Feed efficiency appeared to be unaffected by feeding regime. Mortality was negligible during the course of this experiment, averaging less than 1% among treatments for the six-week experimental period. Results indicate that bobwhite quail exhibit compensatory gain as a response to a decrease in protein intake. Bobwhite quail appeared to be unaffected by major dietary changes in protein level under the conditions of this study and when maintained in a healthy environment.

Key Words: Bobwhite, Quail, Protein

192 The effects of feeding different dietary formulations on growth criteria in ring necked pheasants. G. S. Davis*¹, K. E. Anderson¹, C. R. Parkhurst¹, and L. R. Minear², ¹*North Carolina State University, Raleigh, NC/USA*, ²*Southern States Cooperative, Richmond, VA/USA.*

Ring necked pheasants exhibit aggressive and cannibalistic behavior resulting in mortality or poor feather quality thereby reducing their desirability to hunting preserve operators and hunters. Producers proclaim that high dietary protein levels and vegetative cover in flight pens reduce cannibalism, mortality, and enhance feather development. One hundred ninety two one-day-old pheasants were divided equally into sixteen 9.3 sq. m floor pens. Four dietary treatments consisted of: (1) 28% protein starter, 24% developer, 20% conditioner; (2) 26% starter, 23% developer, 19% conditioner; (3) Combination of diets 1 and 2; (4) one diet at 22.5% protein fed 1 d to 17 wk. The starter diet was fed until 5 wk of age, the developer until 10 wk, and conditioner until 17 wk. There were 4 replications per treatment and each replicate pen housed one of two different hiding barriers, bales of straw or a PVC framed-barrier covered with burlap cloth. Mortality was measured daily, and BW and feed consumption were measured weekly. Feather quality was measured at 5, 10, and 17 wk of age. In addition, at 18 wk of age, flight ability was measured at 2 different hunting preserves. To study aggressive and cannibalistic behavior, the pens were periodically time-lapsed video taped. There were no differences among the treatments in mortality. Pheasants in treatments 1 and 3 had significantly ($p < 0.05$) heavier BW, pheasants in treatment 4 exhibited lower BW with BW of treatment 2 being intermediate to the others until 15 wk of age. BW among all treatments was similar from 15 to 17 wk of age. Feather quality of pheasants in treatments 1 and 3 was significantly ($p < 0.05$) better than treatments 2 and 4 at 5 wk of age. However, feather quality of all treatments was similar at 10 and 17 wk of age. Flight ability was not different among the treatments, however, hens tended to fly better than cocks. Minimal aggressive and cannibalistic behavior was observed throughout the entire study. Pheasants in pens with bales of straw tended to exhibit less aggression and appeared to cope with personal space invasion by flock mates. It was concluded that pheasants can exhibit compensatory growth and feather development when fed lower levels of protein; and providing barriers in pens can reduce cannibalism and aggression.

Key Words: Ring necked pheasants, Dietary protein, Feather quality

193 The second cycle behavioral response and fearfulness of commercial laying hen strains to alternative molting programs. K. E. Anderson*¹ and D. Joyce², ¹*North Carolina State University, Raleigh, NC*, ²*North Carolina Department of Agriculture and Consumer Services, Salisbury, NC.*

Animal rights groups are pressuring government and the food service industry to force an end to the husbandry practice of molting, which they deem as cruel. Molt initiators that are known stressors, that trigger the weight loss and cessation of egg production, are the targets. Therefore, a behavioral study was conducted to examine four alternative molt programs impact on 2nd cycle behavior patterns; Not molted (NM); Non-Fasted Molt (NF); 5 d Fast Feed Restricted Molt (SF); 13 d Fast Molt (FR). This represents factorial design of 3 strains x 4 programs; a total of 24 replicates containing 24 hens per replicate at a density of 413 cm²/hen. Hens were observed using a modified scanning technique at lights on, mid-day, and just prior to lights off on two consecutive days every 8 weeks. Behavioral observations were conducted throughout the second cycle. The hens from each strain developed different ($P < 0.05$) behavioral patterns, as they progressed through the different production phases. The frequency of the independent act (those involving a single hen) of standing, which did not change. The frequency of social behaviors (behaviors that require the interaction of two hens) responded to molting in a similar manner. Aggression, and feather pecking frequencies were different ($P < 0.05$) between the strains, however, the pattern of change was similar for each strain. The FR hens Aggression and Avoid and Escape frequencies increased ($P < 0.05$) post-fast and returned to pre-molt levels

during the 2nd cycle. Pecking neighbor and being pecked by a neighbor increased ($P < 0.05$) during the 66-68 wk (fast phase) and returned to pre-molt levels after the hens had been returned to feed. Feather pecking increased ($P < 0.05$) during the fast and after the hens were returned to feed feather pecking was at or below pre-molt incidence. The molt treatment had no impact on the Hansen's Test scores, and only resulted in a lower feather score in the SF molted hens. As hens age they become more fearful, which may be a function of feather score since this is negatively correlated. The changes in behavior patterns and fearfulness noted here do not appear to indicate conditions that compromise welfare. Hens constantly go through adaptive phases in their life, regardless housing or management, that do not negatively impact their welfare.

Key Words: Chicken, Laying hen, Molt, Fasting, Behavior

194 Second cycle production and mortality response of commercial laying hen strains to alternative molting programs. K. E. Anderson^{*1}, L. R. Minear², and D. Joyce³, ¹North Carolina State University, Raleigh, NC, ²Southern States Cooperative, Richmond, VA, ³North Carolina Department of Agriculture and Consumer Services, Salisbury, NC.

Animal rights groups are pressuring government and the food service industry to force an end to the husbandry practice of molting, which they deem as cruel. Molt initiators (stressors) that trigger the weight loss and cessation of egg production, are their targets. Therefore, a production study was conducted to examine four alternative molt programs impact on 2nd cycle production parameters; Not molted (NM); Non-Fasted Molt (NF); 5 d Fast Feed Restricted Molt (SF); 13 d Fast Molt (FR). This represents factorial design of 13 strains x 4 programs x 2 densities (310 cm² and 413 cm²); representing 468 replicates for a total of 13,070 hens. The hens were housed in 2 environmentally controlled laying houses containing either a quad-deck cage system or a combination tri/quad-deck cage system. The NM hens were housed so the light program could be controlled independently from the NF, SF, and FR groups, which were randomly allocated to the remaining replicates such that all strains and densities were equally represented in rows and levels. The 2nd cycle was initiated at 70 wk of age and performance parameters were monitored throughout the second cycle every 28 d. The strains responded to the molt programs differently, indicating that the molting method should be tailored to the laying hen strain. The NM hens had the lowest production during the 2nd cycle. The NF, SF, and FR molted hens had improved ($P < 0.05$) feed efficiency and approximately 26 more eggs per hen housed, and reduced ($P < 0.05$) mortality by approximately 6%. Feed costs were increased ($P < 0.05$) in the hens that were molted. However, net incomes for the white egg hens in the NM, NF, SF, and FR molt treatments were 11.64, 12.23, 12.17, and 11.91 dollars, respectively. Molted brown egg strains also had improved feed conversion, eggs per hen housed, and lower mortality. Alternative molt programs, which minimize the fasting period or eliminate it entirely, are feasible and may in fact be less expensive to implement than what is currently practiced in the egg industry. This study also showed that different strains respond to the molt induction method differently, indicating that the molting method used should be tailored to the strain of laying hen being used.

Key Words: Chicken, Laying hen, Molt, Egg Production

195 Strain and vitamin D source effects on egg production and bone mineral density of laying hens. K. L. Nadeau^{*1}, D. R. Korver¹, M. J. Zuidhof², F. E. Robinson¹, and R. A. Renema¹, ¹University of Alberta, Edmonton, AB, Canada, ²Alberta Agriculture, Food and Rural Development, Edmonton, AB, Canada.

White Leghorn pullets (Hy-Line W36 or W98) were individually caged at 12 wk of age ($n=32$ /strain, 12 wk of age) and fed diets containing either cholecalciferol or 25-OH cholecalciferol (Hy-D) as the sole source of supplemental vitamin D activity. Feed intake of each bird was recorded on a weekly basis and egg production was recorded daily to 68 wk of age. Bone mineral density (BMD) was measured by Quantitative Computed Tomography at 12, 16, 17, 18, 19, 20, 21, 22, 23, 24, 32, 40, 48, 60 and 68 wk of age. Feed intake and egg production records were summed for each time period between consecutive BMD analyses. Pearson correlation coefficients were calculated for BMD, BW, feed intake, egg production and eggshell traits. Across all treatments, BW of the birds was correlated with total, trabecular and cortical BMD ($r=0.13$ to 0.26 ; $P < 0.0001$). Trabecular BMD of the birds at 68 wk was negatively correlated with the total number of soft-shelled eggs ($r=-0.26$,

$P < 0.05$). Cumulative (from 12 weeks of age) and period (since the previous BMD analysis) feed consumption were correlated with trabecular BMD ($r=0.45$ to 0.46 ; $P < 0.0001$), but not with cortical BMD. In W98 hens, trabecular BMD was negatively correlated with prime sequence length ($r=-0.43$, $P < 0.02$) and positively correlated with the number of shell-less eggs ($r=0.41$, $P < 0.03$); no significant correlations existed with trabecular BMD of W36 hens. Trabecular BMD was correlated with period feed intake and cumulative feed intake in the Hy-D birds ($r=0.38$, $P < 0.0001$), but only with period feed intake in cholecalciferol-fed birds ($r=0.53$, $P < 0.0001$). Trabecular BMD was the measurement most often correlated with production traits, and thus may be the most appropriate BMD trait to assess in laying hen bone quality research. Cortical BMD was the measure least often correlated with production traits.

Key Words: Laying hen, Bone mineral density, Quantitative Computed Tomography, Egg production, 25-OH cholecalciferol

196 Feeding high levels of whole wheat in combination with mash or pelleted diets to laying hens. K. Schwan-Lardner^{*1}, H. L. Classen¹, and C. D. Bennett², ¹University of Saskatchewan, ²Manitoba Agriculture and Food.

Using whole grain can reduce milling and transportation costs associated with feeding laying hens. An experiment was designed to compare feeding hens a mash diet based primarily on wheat and soybean meal (WC) to three diets where whole wheat replaced 53% of the ground wheat. The non-whole grain portion of the latter treatments was fed in mash (WWM) or pellet (WWP) form with an additional mash diet where two thirds of the diet calcium was in the form of oyster shell (WWO). Two strains of White Leghorn hens were fed the above diets from 19 to 62 weeks of age with 6 replications of 15 hens each per strain x dietary treatment subclass. Dietary treatment did not affect hen-day egg production or egg weight. However hens fed whole grain ate more feed (approx. 6 to 7 g/d) and as a consequence had poorer feed efficiency on both an egg mass and per dozen basis. An interaction between diet and strain showed that one strain had higher hen housed egg production with whole grain feeding while the production for the other was slightly reduced for the same treatments. This effect was primarily related to a similar interaction for mortality. The WWP treatment resulted in higher mortality due to FLHS than the WWM treatment with the other treatments having intermediate values. The WC hens had higher levels of mortality due to impacted oviduct than birds fed the other treatments. The WC and WWO treatments produced eggs with the highest specific gravity while the WWM eggs were lowest, and the WWP eggs intermediate in value. Hens from all whole grain treatments gained more weight during the experiment than the WC birds (80 grams). Strain of hen affected most parameters measured. In conclusion, feeding high levels of whole wheat reduced feed efficiency as a result of increased feed intake and hen body weight. Feeding the non-whole grain portion of the diet as mash or pellet did not have a major impact on performance and feeding oyster shell improved shell quality.

Key Words: Laying hens, Whole wheat, Pelleting

197 Feeding high levels of whole wheat in combination with mash or pelleted diets to laying hens II. K. Schwan-Lardner^{*1}, H. L. Classen¹, and C. D. Bennett², ¹University of Saskatchewan, ²Manitoba Agriculture and Food.

Adding whole grain to laying hen diets on farm may improve farm economics due to reduced milling and transportation costs. However, the acceptable level of whole grain inclusion and how whole grain feeding is affected by diet form is not clear. An experiment was conducted using 6 dietary treatments fed to 2 strains of laying hens from 19 to 66 wks of age with 6 replicates of 15 hens per strain x diet subclass. Diets containing 0 (WW0), 30 (WW30) and 50% (WW50) wheat as whole grain were fed with the non-whole grain fraction of the diet in a mash (M) or pellet (P) form. All data were analyzed as a 2 (form) x 3 (whole wheat level) x 2 (strain) factorial analysis. The addition of whole wheat had no effect on egg production, damaged eggs, egg weight, body weight at 43 wks of age, or mortality. Feather score at 66 wks of age was the poorest in the WW0 fed birds, and best in the WW30 fed hens. An interaction was noted between whole wheat feeding and feed form in body weight at 66 wks, feed intake and feather score. Feeding the balancer portion of the ration in a pellet form increased feed intake and reduced feed efficiency (egg mass and dozen egg basis). Feeding a pellet improved shell quality and increased body weight at 66 wks, but reduced feather score. Hen housed

egg production was lower in pellet fed birds primarily due to mortality in one subclass. Strains reacted differently to feed form in body weight (43 and 66 wks), feed intake and feed per egg mass. Strain differences were significant in hen day egg production, egg weight, specific gravity, body weight, feed intake, feed efficiency on a dozen egg basis, feather score and mortality. In conclusion, feeding whole wheat in laying hen diets is not detrimental to egg production, and balancer portions of the ration should preferably be fed in a mash rather than pellet form.

Key Words: Laying hens, Whole wheat, Pelleting

198 Development of successful alternative induced molting programs for commercial layers. J. Brake*, *North Carolina State University, Raleigh, NC USA.*

Much work was carried out from 1930 to 1990 to develop commercially viable induced molting techniques for commercial layers but animal welfare concerns curtailed this work in recent years. Fasting was found to be the method of choice and gained widespread acceptance in the laying hen industry. Under commercial conditions the key aspect of fasting methods is a BW loss of 30-35% over a period of time that generally exceeds 12 days. A mixture of fasting and restricted feeding has been successfully employed to deal with molting during cold weather when BW loss would otherwise be too rapid. Recent concern over the shedding of *Salmonella enteritidis* (SE) during a fasting-induced molt of commercial layers has renewed interest in alternative molting techniques. Commercial acceptance of alternative techniques will depend upon ease of implementation and achievement of performance equal to fasting methodology on both a reproductive and economic basis. Given the fact that SE shedding appears to be associated with the absence of feed in the gastrointestinal tract a successful alternative molting method must presumably maintain a reasonable intake of compound feed of a composition similar to what is normally consumed in order to not significantly impact the gut microflora nor create a feed milling or delivery problem. One such approach would be to utilize the known anti-gonadal effects of excess dietary zinc and anti-gonadotropic effects of low dietary calcium in concert. In research and commercial studies using such an approach for 14 days laying hens appear to consume about 60% as much compound feed as normal but go through the normal metabolic changes previously identified as being essential to a successful induced molt.

Key Words: Induced molt, Fasting, Body weight loss, Zinc, Calcium

199 Globalizing a senior level poultry production course. J. D. Firman*, *University of Missouri.*

Poultry Production at the University of Missouri is taught as a senior level elective following background courses prior to the senior year. Each

of the senior level production courses are taught as writing intensive as well as capstone experiences. Globalization of capstone courses is encouraged for those faculty that have significant international experience. Globalization of the course has been accomplished through routine use of examples from other countries as well as the capstone project. The project revolves around the evaluation of individual countries as potential locations for a new integrated broiler complex. Groups of students are expected to select a country and research the potential for such a complex. Areas that are covered include population, per capita income, road systems, local economic conditions, customs that may affect poultry meat consumption and penetration of markets by local firms. At various stages during the work they will have board meetings to check progress and develop sound evaluation strategies. They will then provide a written and oral presentation on their country with a go-no go decision. Those countries that appear to be favorable environments are then evaluated further in a discussion setting and a single country is selected. Utilization of this and similar teaching strategies has resulted in increased student satisfaction as well as dramatic increases in enrollment in an elective poultry course.

Key Words: Teaching, Education, Poultry production course

200 Estimating the time of death of broiler DOA using breast muscle pH. C. W. Ritz*, D. L. Fletcher, and A. B. Webster, *The University of Georgia.*

Previous efforts to determine the time of death of processing plant dead on arrival (DOA) birds have been to estimate carcass temperature decline and subjective scoring of rigor development. Carcass temperature, however, is often a function of environmental conditions, and rigor development can not be accurately measured. Muscle pH was thought to be a more stable indicator for time of death determinations. Studies were conducted to compare carcass temperature and breast muscle pH to the length of time following death. Birds were stunned, killed, and held without scalding and picking (to simulate commercial DOA conditions). At 15, 30, and 45 minutes and at 1 through 8 hours postmortem, birds were evaluated for core body temperature and breast muscle pH using a meat-penetrating probe. All birds exhibited rigor within 15 minutes of slaughter and remained rigid during the entire 8 hour period. Body temperature decreased linearly (R-square 0.97) over the 8 hour period. The rate of temperature decline slowed as body temperature neared the ambient temperature. Breast muscle pH decreased from approximately 6.2 at 15 minutes postmortem to less than 5.9 at 4 to 5 hours postmortem. These results indicate that breast muscle pH may be a more sensitive method to determine the relative time of death of DOA arriving at processing plants than carcass temperature measurements or rigor scoring.

Key Words: Broiler, DOA, Breast muscle pH

Genetics II

201 Breast meat quality and composition in unique chicken populations. S. M. Lonergan, N. Deeb, C. A. Fedler, and S. J. Lamont*, *Iowa State University.*

The objective of this project was to examine the diversity of breast meat composition and quality traits among unique resource populations. Birds from five groups (inbred Leghorn (n=10), inbred Fayoumi (n=10), commercial broilers (n=6), F5 broiler-inbred Leghorn cross (n=10), and F5 broiler-inbred Fayoumi cross (n=10)) were utilized. Contemporary stocks (broilers, inbreds, and crosses) were grown in a single house but in separate pens. Birds were harvested at 8 weeks of age. Breast muscle weight, moisture content, lipid content, protein content, color, pH, and Kramer-Shear force values were determined on birds from each group. Breasts from broilers contained lower percentages of protein ($P < 0.05$) and greater percentages of lipid ($P < 0.05$) compared with all other groups. The five genetic stocks did not differ for Hunter L values or pH. The data indicate that the Leghorn inbred line had a more pure and more intense red color than its crossbred contemporary ($P < 0.05$). Kramer Shear force (kg/g sample) was higher ($P < 0.05$) in breasts from broilers than in breasts from the inbred lines. Our results demonstrate that the five genetic groups differed markedly in breast meat composition and quality characteristics. The described outbred by inbred advanced intercross lines will be useful in searches for genes affecting meat quality traits. Definition of the molecular factors that influence these traits will

enhance our ability to make improvements in composition and quality of poultry meats.

Key Words: Genetic lines, Meat quality, Composition, pH, Kramer Shear Force

202 Inheritance of the bioavailability of Phytate phosphorus and the genetic correlations with growth and feed utilization traits in random-bred poultry. W. Zhang*, S. Aggray, G. Pesti, H. Edwards, Jr., and R. Bakalli, *The University of Georgia.*

Several studies suggested that there was genetic variance for bioavailability of phytate P (PBA) in chickens. This paper focused on the estimation of the heritability of PBA and the genetic correlations between the character with growth rate, feed consumption, feed conversion efficiency and content of phytate P in excreta. The experimental birds sourced from Athens Canadian Randombred. A data set of the experimental records of 901 birds was used for this study. Chickens of 4-5 week of age were fed .35% P diet in metabolism individual cages. After an acclimatization period of 3 days, the excreta produced in next three days was collected and for measuring the phytate that was not hydrolyzed and calculating PBA in the experimental birds and the feed consumption was measured. PBA was calculated as the percent of phytate that