Animal Behavior and Well-Being: Poultry 2: Broilers

581 The effect of lighting regimen on broiler behavior and health. R. A. Blatchford*, G. S. Archer, and J. A. Mench, *University of California*, *Davis*.

Although long dim photoperiods are commonly used in commercial broiler production, evidence suggests that moderate-length photoperiods with brighter light intensities could be beneficial for broiler welfare. We evaluated the effects of long (20L:4D) and moderate (16L:8D) photoperiods at dim (1 lx day, 0.5 lx night) and bright (200 lx day, 0.5 lx night) light intensities on the behavior and health of broilers (n = 1004; 6 replicate pens/treatment). General activity was measured using passive infrared detection, and feeding activity measured by the amount of feed consumed per hour during one 24-h period per pen each week. Broilers were gait scored using a 0–5 scoring system, weighed, and killed at 6 weeks of age. Eyes were dissected from 30 birds/treatment and measured for size and weight. Behaviors and performance were analyzed using a general linear model, gait score using a Kruskal-Wallis test, and eye measures using a MANOVA. There were no differences in feed conversion ratio (mean = 1.63 ± 0.01 kg feed/kg body weight), however 1 lx broilers (2.79 ± 0.01kg) were slightly heavier ($P = 0.02$) than 200 lx broilers (2.72 ± 0.01 kg). The 200 lx broilers were more active during the day ($P = 0.03$), but less active at night ($P = 0.02$), than those reared with 1 lx. They also fed more ($P = 0.001$) during the day but less at night ($P = 0.0001$) than those reared with 1 lx. Similarly, broilers reared with 16L:8D fed more ($P = 0.007$) at night than those reared with 20L:4D. The 200 lx broilers had the best ($P = 0.0002$) gait scores, although treatment differences were small. The 1 lx broilers had greater side-to-side (18.86 ± 0.11 mm vs. 17.63 ± 0.11 mm, $P < 0.0001$) and back-to-front (13.39 ± 0.09 mm vs. 12.89 ± 0.09 mm, $P = 0.0002$) eye diameters, as well as heavier eyes (2.42 ± 0.03 g vs. 1.99 ± 0.03 g, $P < 0.0001$) than those reared with 200 lx. These results show that light intensity, rather than photoperiod, is the major factor affecting broiler behavior and eye health. Light intensity of 1 lx dampens behavioral rhythms, with possible physiological effects such as the observed differences in eye health.

Key Words: broiler, lighting, behavior

582 Effect of daylength on physiological and behavioral rhythms in broilers. K. Schwean-Lardner*[1], B. I. Fancher[2], and H. L. Classen[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Aviagen*, *Huntsville, AL*.

The impact of day length (14, 17, 20 and 23 h) on melatonin and behavioral rhythms was studied in Ross × Ross 308 male broilers. Blood samples were collected 6 times (n = 6) over 24 h at 21 d of age to provide serum for RIA melatonin analysis. Behavior was recorded with infrared cameras for 24 h per replicate (2 per trial) in trial 1 (27–28 d of age (d 27)) and 2 (42–43 d (d 42)) in one pen of 53 male broilers (30 kg/m^2). The recordings were observed using scan sampling (10 min intervals) for the full 24 h. Data were analyzed with Proc Reg and RSReg of SAS to determine if relationships existed between the variable and time of day. Serum melatonin in birds raised on 14, 17 and 20 h day length showed quadratic (Q) relationships with time of d, with high and low values during the scotophase and photophase respectively, suggesting flock synchrony. No relationship was found for birds raised under 23 h, suggesting unsynchronized free-running rhythms. No scotoperiod activity occurred except in birds raised under 14 h day length, where stretching and feeding occurred before the photophase. Regression analyses revealed quadratic (or linear (ln) where noted) relationships ($P < 0.05$) between behavior and time within the photoperiod for percent inactive resting (27 d - 14, 17L; 42 d - 14, 20L),where the lowest values occurred at the start and just before the end of photophase; walking (27 d - 14, 17L), standing (27 and 42 d - 14, 17L, ln 20L), feeding (27 d - 14, 17L), and drinking (27 d - 14, 17, 20 L), with peaks at start and end of photophase; and finally preening (27 d - 14, 17L), and dustbathing (27 d - 14, 17, 20L), with the peak toward the center of the photophase. No relationships between behavior and time were noted for birds under 23 h day length. The melatonin and behavioral data in this work strongly suggest that flocks raised under 23 h do not develop synchronized circadian rhythms. Sleep fragmentation, a form of sleep deprivation, may result from the unsynchronized behavioral activity.

Key Words: circadian rhythm, melatonin, behavior

583 The effect of providing lighting during incubation on stress responses of broiler chickens post-hatch. G. S. Archer* and J. A. Mench, *University of California, Davis*.

Lighting conditions during incubation affect brain development and hormone regulation in chickens, thus potentially affecting the stress response. We examined the effects of 4 lighting conditions during incubation on stress responses of broilers post hatch. Throughout incubation, Cobb broiler eggs were provided with either 0, 1, 6, or 12 h of 550 lx full-spectrum fluorescent light daily. Each treatment was divided over 3 incubators and was replicated once in time. Broilers were housed in pens with others from their own incubator. Post-hatch, broilers were subjected to an adrenocorticotropic hormone (ACTH) challenge (n = 12 per treatment) and a stress test (1 h of crating, n = 24 per treatment, treatments were equally distributed across crates) at 4 weeks of age. Half of the crated broilers had blood collected via brachial vein (1.5 to 2 mL) pre- and post-crating to determine the effect of crating on corticosterone levels, while the other half were challenged with keyhole limpet hemocyanin (KLH). Bilateral traits (middle toe length, metatarsal width and length) were also measured in 60 broilers per treatment to assess developmental asymmetry at 6 weeks of age. There was no difference ($P > 0.05$) between treatments in the corticosterone response to ACTH challenge (18.1 ng/mL). However, 12L broilers had lower ($P < 0.05$) corticosterone concentrations after crating (0.31 ng/mL) than 0L (0.64 ng/mL) broilers. The 12L broilers also had higher ($P < 0.05$) anti-KLH IgG titers (93295 U/mL) and lower ($P < 0.05$) composite asymmetry scores (0.92) than the 0L broilers (62239 U/mL, 1.21). Broilers provided with 12 h of light during incubation were thus less affected by stressors post-hatch, as indicated by corticosterone and IgG concentrations and composite asymmetry score.

Key Words: incubation, light, stress

584 The effect of providing light during incubation on fear responses of broiler chickens post-hatch. G. S. Archer* and J. A. Mench, *University of California, Davis*.

Lighting conditions during incubation affect brain development and hormone regulation in chickens, thus potentially affecting post-hatch behavior, including fear-related behavior. We examined the effects of 4 incubation lighting conditions on the fear responses of broilers post-hatch. Throughout incubation, Cobb broiler eggs were provided with either 0, 1, 6, or 12 h of 550 lx full-spectrum fluorescent light daily. Post-hatch, the broilers (n = 60 per treatment) were subjected to the following fear tests: chute/emergence test (3 weeks of age), approach/

isolation test (3 weeks of age), tonic immobility test (5 weeks of age), and inversion after catching test (6 weeks of age). All data were analyzed using GLMs differences were considered when $P > 0.05$. During all tests, the responses of the 12L broilers indicated that they were less fearful than broilers in other treatment groups. During the chute test, 12L broilers emerged faster from the darkened start box (28.9 ± 3.3 s, $P < 0.05$) than broilers from all other treatments. During the approach test, 12L broilers vocalized less (179 ± 9 times), were less active (28 ± 2% of the time), and spent more time in the area closest to the observer (63 ± 3% of the time) than the 0L broilers (211 ± 10 times, 35 ± 3% of the time, 51 ± 4% of the time, $P < 0.05$). During the tonic immobility test, 12L broilers had shorter ($P < 0.05$) latencies to first head movement (26 ± 3 s) and to right (120 ± 17 s) than 0L (57 ± 14 s, 201 ± 25 s) and 1L (51 ± 9 s, 213 ± 22 s) broilers. During the inversion test, 0L broilers wing-flapped more intensely (5.5 ± 0.1 flaps/sec, $P < 0.05$) than broilers in all other treatment (5.9 ± 0.1 flaps/sec). These results indicate that providing 12 h of light during incubation reduced the fear response of the broilers when compared with the broilers incubated in complete darkness.

Key Words: fear, incubation, lighting

585 Impact of light intensity on broiler biological rhythms and welfare. A. Deep*[1], K. Schwean-Lardner[1], T. G. Crowe[1], B. I. Fancher[2], and H. L. Classen[1], [1]*University of Saskatchewan*, *Saskatoon, Canada*, [2]*Aviagen*, *Huntsville, AL*.

Light intensity (LI) manipulation is an important management tool affecting broiler behavior and physiology but still there is debate regarding the optimum level to be used. Two trials were completed to study the impact of light intensity (LI) within the practical levels in confinement barns (1, 10, 20 and 40 lx) on biological rhythms and welfare of broilers raised to 35 d of age. In each trial, 950 Ross × Ross 308 chicks were housed per room with replication of individual LI treatments in 2 environmentally controlled rooms. Within each large room, a small pen with 25 male and 25 female chicks was used for recording behavior. Data were analyzed as a randomized complete block design with trial serving as a block. All chicks were provided with 40 lx intensity and 23 h light until shifting to treatment LI and 17 h day length at 7 d of age. For each replicate, behavior was recorded for a 24 h period, starting at 16 or 17 d of age. At 23 d of age, 3 birds per room were bled at the start, middle and end of light and dark periods for melatonin estimation using RIA. Skeletal and foot pad, and ocular health were monitored at 31 and 32 d of age, respectively. When summarized over the 24 h observation period, birds exposed to 1 lx rested more and had reduced expression of foraging, preening, dust-bathing ($P = 0.09$), stretching and wing-flapping ($P = 0.07$) behaviors in comparison to other light intensities. Diurnal rhythms of serum melatonin were unaffected by LI. Broilers exposed to 1 lx had heavier and bigger eyes as compared with other treatments. LI had no effect on skeletal health but deep ulcerative foot pad lesions decreased linearly with increasing LI. In conclusion, despite having prominent melatonin rhythms, broilers exposed to 1 lx demonstrated reduced welfare as indicated by altered behavioral expression, and increased foot pad lesions and eye size.

Key Words: broiler, light intensity, welfare

586 Broiler behavior under lighting programs with a sectioned dark period and its welfare considerations. C. Raginski*[1], K. V. Schwean-Lardner[1], H. W. Gonyou[1,2], and H. L. Classen[1], [1]*University of Saskatchewan*, *Saskatoon, SK, Canada*, [2]*Prairie Swine Centre*, *Saskatoon, SK, Canada*.

Light provision can influence broiler performance and also impact bird welfare. Therefore, understanding how much light, and in what pattern it is given, is required to provide guidance to organizations responsible for codes of practice. The objective of this research is to establish the impact of 9 h of darkness provided in one (9 h), trt 1, 2 (2 × 4.5 h), trt 2, and 3 (3 × 3 h), trt 3, periods on the welfare of broiler chickens as assessed by bird behavior. Each lighting treatment was replicated 3 times and behavior was recorded over a 24 h period in one room per treatment (12 pens per room each with 50 birds at housing) with a different room at each of 32, 33 and 34 d of age using infrared cameras. Behavior was quantified by instantaneous scan sampling at 10 min intervals over a 24 h period and compared between treatments over 24 h, overall photo- and scotoperiods, and within treatments between individual photo- and scotoperiods. Comparisons between the 3 treatment means by ANOVA indicate lighting treatment had little to no effect on feeding, drinking, resting, standing, walking, running, foraging, stretching, dust bathing, wing flapping and feather ruffling behaviors ($P > 0.10$). Preening (mean trt 1 = 4.74, trt 2 = 3.48, trt 3 = 3.33; $P = 0.03$) and comfort behaviors (meant trt 1 = 5.25, trt 2 = 3.86, trt 3 = 3.71; $P < 0.01$) show a reduction when the scotoperiod is increased from one to more. Behavioral expression over time was examined within major photoperiods using regression analyses to determine rhythms and patterns of activity. Quadratic patterns were seen for feeding ($P < 0.05$) and drinking ($P < 0.05$) with peaks at the initiation and end of the day. Dust bathing occurred consistently at mid-day for all treatments, indicating the presence of a biological rhythm. The reduced proportion of broilers partaking in comfort behaviors alone does not clearly indicate a reduction in welfare for broilers exposed to multiple scotoperiods in comparison to those given one longer period.

Key Words: broilers, lighting, behavior

587 Heat and moisture production in broilers during simulated winter transport. J. M. Watts*, L. J. Graff, M. L. Strawford, T. G. Crowe, N. A. Burlinguette, H. L. Classen, and P. J. Shand, *University of Saskatchewan*, *Saskatoon, Saskatchewan, Canada*.

To ensure broiler welfare during winter transport it is necessary to manage heat and moisture accumulation within transport vehicles. Heat production (HP) and moisture production (MP) in broilers are affected by many factors, both intrinsic and environmental. Hence, it is necessary to determine HP and MP rates under representative conditions. A transport simulation chamber containing 1 or 2 standard transport drawers was used in 2 configurations. (Divided: 2 drawers were each partitioned into 15 small compartments, each containing 1 bird and stacked together in the chamber; Grouped: a single drawer contained 15 birds able to move and huddle together). Cold air was drawn into the system, at 0.35 m^3/s, from outside the building. A control system operated a heater to warm the air to the desired temperature before it passed through the drawer(s) and was exhausted from the building. Broilers were fasted for 7 h, placed into the chamber, and exposed to test conditions for 3 h. Air temperature and relative humidity (RH) were measured upstream and downstream of the insulated bird compartment at -min intervals. Differences in the paired temperature and RH values were a result of metabolic activity and were used to calculate a mean HP and MP value for the 3 h, per unit of bird weight, for n = 36 trials (12 Divided, 24 Grouped). The effects of temperature (−4, −5, −8, −10, −12, −15, −17, −18 or +20°C) and bird age (5 or 6 weeks) were studied. Drawers were balanced for numbers of male and female birds. At 20°C, HP was 6.1–8.1W/kg and MP was 3.6–5.7g/h-kg (n = 3). In both configurations HP and MP tended to increase with each colder temperature increment. Pooled observations between −4 and −18°C

were categorized by bird age and confinement type. Younger Grouped birds (n = 9 trials) had mean HP of 73.1W/kg (range 59.1–87.5) and MP of 20.5g/h-kg (range18.4–21.1), older Grouped birds (n = 11 trials) 41.4W/kg (range 35.5–46.8) and 12.8g/h-kg (range 5.5–14.1), younger Divided birds (n = 5 trials) 24.0W/kg (range 16.5–27.3) and 4.26g/h-kg (range 3.1–7.1) and older Divided birds (n = 5 trials) 19.5W/kg (range 15.8–22.2) and 3.54g/h-kg (range 2.9–4.5).

Key Words: broiler, heat production, cold weather transport

588 Humane slaughter methods for small- and mid-scale poultry operations. V. B. Brewer*[1], A. C. Fanatico[2], W. J. Kuenzel[1], C. M. Owens[1], V. A. Kuttappan[1], and A. M. Donoghue[2], [1]*University of Arkansas Department of Poultry Science*, *Fayetteville,* [2]*USDA Agricultural Research Service, Poultry Production and Product Safety Research*, *Fayetteville, AR*.

Interest is growing in humane handling of poultry and other livestock. Due to the cost of humane slaughter devices, small-scale poultry producers may cut birds necks without prior stunning. With the objective of determining low-cost humane slaughter methods, a trial was conducted to evaluate impact on blood loss, bird reactions, and carcass quality. Groups of slow-growing hybrid broilers (n = 20) were assigned to stun/kill treatments: no stun (NS; control); cervical dislocation (DIS); electrical knife at 40V/7s (LOW); electrical knife at 50V/7s (HIGH); and electrical head-only prong at 40V/7s (HEAD). There were 2 replications of treatments. Necks were cut immediately after all methods. Body movements were scored by 2 workers during bleeding with a 4-point scale (1 = mild; 4 = most severe), and measured in 3 phases (0–10, 10–60, and 60–120 s) post stun/kill. Carcasses were evaluated for hemorrhage and broken bones. When comparing the treatments to the control NS, blood loss was lower in DIS birds, probably due to internal tearing of vessels, and higher in LOW and HEAD birds, because low-voltage stuns help provide uniform heartbeat and facilitate bleeding ($P < 0.05$). Under Chi Square analysis, distributions of body movement scores differed significantly ($P < 0.05$). NS and DIS treatments displayed intense motor contractions early in the post stun/kill period: 44% and 95% of NS birds had Level 4 uncontrolled muscle contractions in phases 1 and 2, and 100% and 85% of DIS birds. Contractions in HIGH birds were Level 1 in phases 1 and 2, presumably due to immediate death. Muscle contractions of LOW birds were also minor at first and increased in phase 3 where 16% experienced Level 3 movements. Wing hemorrhage was higher in DIS birds and broken wings were higher in NS compared with other treatments ($P < 0.05$), probably due to increased wing flapping. Cervical dislocation, while a low-cost kill method for small numbers of birds, resulted in poor bleedout and wing hemorrhage. In conclusion, hand-held electrical stun devices can be effective methods used at low and high settings and warrant additional research for best welfare practices for small broiler operations.

Key Words: poultry, stun, welfare