Laser enrichment increased activity and pen-wide locomotion in Ross 708 broilers

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Summary and Implications

Fast growth rate and genetically driven breast muscle yield in modern broilers have had unintended effects on animal welfare resulting in increased inactivity and leg disorders. Thus, the current research objectives were to implement a laser enrichment device designed to stimulate bird activity. 600 Ross 708 broilers were assigned to enrichment (LASER; laser enrichment), or CON; (no laser enrichment) for 6 weeks. Forty focal birds were randomly assigned to 8 video-recorded pens for weekly behavioral analysis and were gait scored on-farm weekly. Time spent active was increased in LASER-enriched birds compared to the CON on week 4 (408% increase), percent of time at the feeder was increased in LASER-enriched birds on weeks 2 and 4, and time spent at the drinker was increased on week 3. Inactive behaviors were significantly reduced in LASER-enriched broilers on week 2-4 by up to 35% (week 4). Distance walked was increased due to laser enrichment on week 4-5 (149% increase on week 5). Percent of birds moving (laser-following or not) was increased on week 4 and 5 in LASER-enriched pens, with a percent increase of 79% observed on week 4 ($P<0.05$). No differences were observed in gait scores due to treatment. These data indicate that laser enrichment stimulated broiler movement through week 5 of life without negatively impacting broiler walking ability.

Introduction

Primary among broiler welfare issues are leg disorders affecting nearly one-third of commercial birds, who display reduced walking ability that can negatively impact access to feed and water. Culls due to lameness are estimated to cause 2% loss in a $30 billion industry. Leg disorders are exacerbated by characteristic broiler inactivity and in general, stimulating active behavior in broilers has proven challenging. A laser enrichment device was implemented by the authors in a previous study using Ross 308 broilers with the hypothesis that particle-sized, red lasers would visually motivate broiler exercise when moving across the pen floor. The device proved capable of increasing broiler locomotion through week 5. Therefore, the current research objectives were to confirm the ability of the laser enrichment device to motivate broiler activity and to measure effects on pen-wide movement and gait score.

Materials and Methods

All bird procedures were approved by the Iowa State University Institutional Animal Care and Use Committee.

Animals

600 straight-run Ross 708 broiler chicks were transported from Welp Hatchery (Bancroft, IA, U.S.) on day of hatch to the Poultry Research and Teaching Unit at Iowa State University for a 6-week experiment. Environmental conditions and management were the same between rooms. High and low temperatures and humidity were monitored daily. Birds were gradually adjusted from 24h light on d0, defined as day of placement, (30-40 lux) to 20h light (20-30 lux) from d8-42. Diets were formulated according to Ross 708 broiler guidelines for starter, grower, and finisher 1 performance periods. Birds were fed a*d libitum* out of a hanging feeder and water was provided from a hanging nipple water line.

Treatments

Thirty birds were randomly assigned to 20 pens (1.22 by 2.44 m/pen). Forty birds were randomly selected as focal birds (n=5 birds/pen in 8 video-recorded pens; 4 pens/treatment. Focal birds were identified with wing-bands and marked with animal-safe food coloring (red, blue, green, purple, and black). One room in the barn contained 10 enriched pens (LASER), and another room contained 10 control (defined as no laser; CON) pens.

Lasers

Five laser enrichment devices were placed over 10 pens; each device was calibrated to cover two neighboring pens. The laser enrichment device consisted of two independent red 650 nm lasers held within a cm metal box with a glass bottom mounted on a 2.3m tall wooden structure. The lasers projected onto the pen floor and moved in a random pattern for 4-min “laser periods” daily at: 05:30, 11:30, 17:30, and 23:30. Barn and research staff did not enter the LASER or CON rooms during the hours containing the four laser-periods each day.

Behaviors and postures

Cameras were affixed above video-recorded pens using brackets adjusted to capture the entire pen. Filming occurred one day weekly during the 6-week trial. All laser periods (4 periods per day of analysis) were analyzed for the entirety of the 4-min period in LASER and CON pens. Video observers were trained by one researcher with 4 years of animal behavior analysis experience to 90% agreeability using randomly selected 4-min training clips. Trained observers watched the red-colored focal bird (n=8) during laser periods and categorized bird behavior continuously as active, inactive, at feeder, at drinker, or other using a pre-determined ethogram.

Walking distance

Distance walked by the blue-colored focal bird (n=8) was measured over the 4-min laser periods one day/week through use of the custom ruler tool on Adobe Photoshop. Methods followed previous published methods for broiler walking distance.

Laser-following

All birds in each video-recorded pen (n= 30 birds/pen, 4 pens/treatment) were categorized into two pen-wide behavior categories during laser periods including: percent of birds following the laser (in laser-enriched pens only) and total percent of birds physically moving, both calculated using the total number of birds in each pen.

Gait score

Focal birds (n=40) were removed from their pens weekly and gait scored. Birds were placed on a plywood runway and either walked 1.5m independently or were gently encouraged to walk by one researcher. Scores were assigned using a 0-2 scale adapted from National Chicken Council guidelines where 0 indicated the ability to walk 1.5m with no lameness, 1 indicated the ability to walk 1.5m but showed unevenness in steps or sat down, and 2 indicated a bird unable to walk 1.5m.

Statistical analysis

Broiler behavior was analyzed one day/week (every Thursday). The statistical model for all behaviors analyzed included the random effect of pen within treatment, as birds were randomly assigned to pens. All data were analyzed using SAS software version 9.4 with the main effect of enrichment. PROC UNIVARIATE was used to assess the distribution of data prior to analysis. Home pen behavior, pen-wide movement, and walking distance data were abnormally distributed (Poisson distribution), hence were analyzed using PROC GLIMMIX with the fixed effect of enrichment (LASER vs. CON), week, and the enrichment x week interaction. Laser-following behavior was analyzed with the main effect of week only. Gait scores were unable to be analyzed statistically, as scores other than 0 rarely occurred. For all measures, a value of $P \leq 0.05$ was considered significant.

Results and Discussion

Behaviors and postures

Results are presented as percent of time spent on each behavior per 4-min period. The enrichment x week interaction was significant for active, inactive, at feeder, and at drinker ($P<0.001$) behaviors. "Other" behaviors could not be statistically analyzed (convergence criteria attempted to 10-4). Increased time active was observed in LASER-enriched birds on week 4 (408% increase) compared to CON birds ($P<0.05$). Percent of time inactive increased in CON birds on weeks 2, 3, and 4 by 32, 30, and 35%, respectively ($P<0.05$). Percent of time at feeder was increased in LASER-enriched birds on weeks 2 (692% increase) and 4 (851% increase). Time at the drinker was increased in LASER-enriched birds on week 3 by 326% ($P<0.05$; Figure 1A-D).

Walking distance

During laser periods, total walking distance was increased in LASER-enriched focal birds by 36cm on week 4 (227% increase) and by 26cm on week 5 (149% increase; $P<0.05$, Figure 2). The effect of week was significant on laser-following behavior ($P<0.0001$), with peak laser-following occurring on week 1 (3.28% of birds; Figure 3).

Laser-following

Pen-wide, total percent of birds moving in LASER-enriched and CON pens was affected by enrichment, week, and the enrichment x week interaction ($P<0.0001$). Percent of birds moving (laser-following or not) was increased on weeks 4 and 5 in LASER-enriched pens, with an increase of 79% observed on week 4 and 19% in week 5 ($P<0.05$; Figure 4).

Gait score

Gait scores are presented by occurrence of score other than 0 (a normal bird able to walk 1.5m with no signs of lameness). A score of 1 was observed in a CON focal bird on week 3, a score of 1 was observed in a LASER-enriched focal bird on week 4, and one CON bird and one LASER bird each received a score of 1 on week 6. No scores of 2 were observed in either treatment.

Environmental enrichment was introduced with the aim to motivate broiler locomotion and to ultimately improve walking ability. Our data indicate that the size, color, and speed of lasers were effective in visually stimulating the broilers. The increased activity observed here agrees with results from the proof-of-concept study testing the laser devices, where broiler activity was also increased. Two new measures were included in this study (a) laser-following behavior and (b) pen-wide activity. These results showed that while a relatively small percent of all broilers in the pen

were observed actively following the laser dots during recorded laser periods through week 6, this behavior was maintained, indicating that laser habituation did not occur. Additionally, pen-wide movement was increased during weeks 4 and 5, indicating a larger stimulatory effect including birds not actively engaged with the lasers. One of the study aims was to measure walking ability. Under our research conditions, lameness in general was not observed. Most gait scores were recorded as 0, or birds showing no signs of lameness. The highest score identified was 1 (mild lameness); hence, we did not see a change in gait score due to laser enrichment which could be considered a positive outcome.

In summary, these data show significant laser device-induced locomotion in a different genetic line of broilers than tested previously in our group through week 5 of life. The laser device may hence provide a means to increase pen-wide locomotion without altering barn management or hindering performance. Increased activity throughout the pen appears to have been achieved through engagement of a small proportion of birds. Walking ability of focal birds was not impacted by laser enrichment, and the birds overall maintained good leg health.

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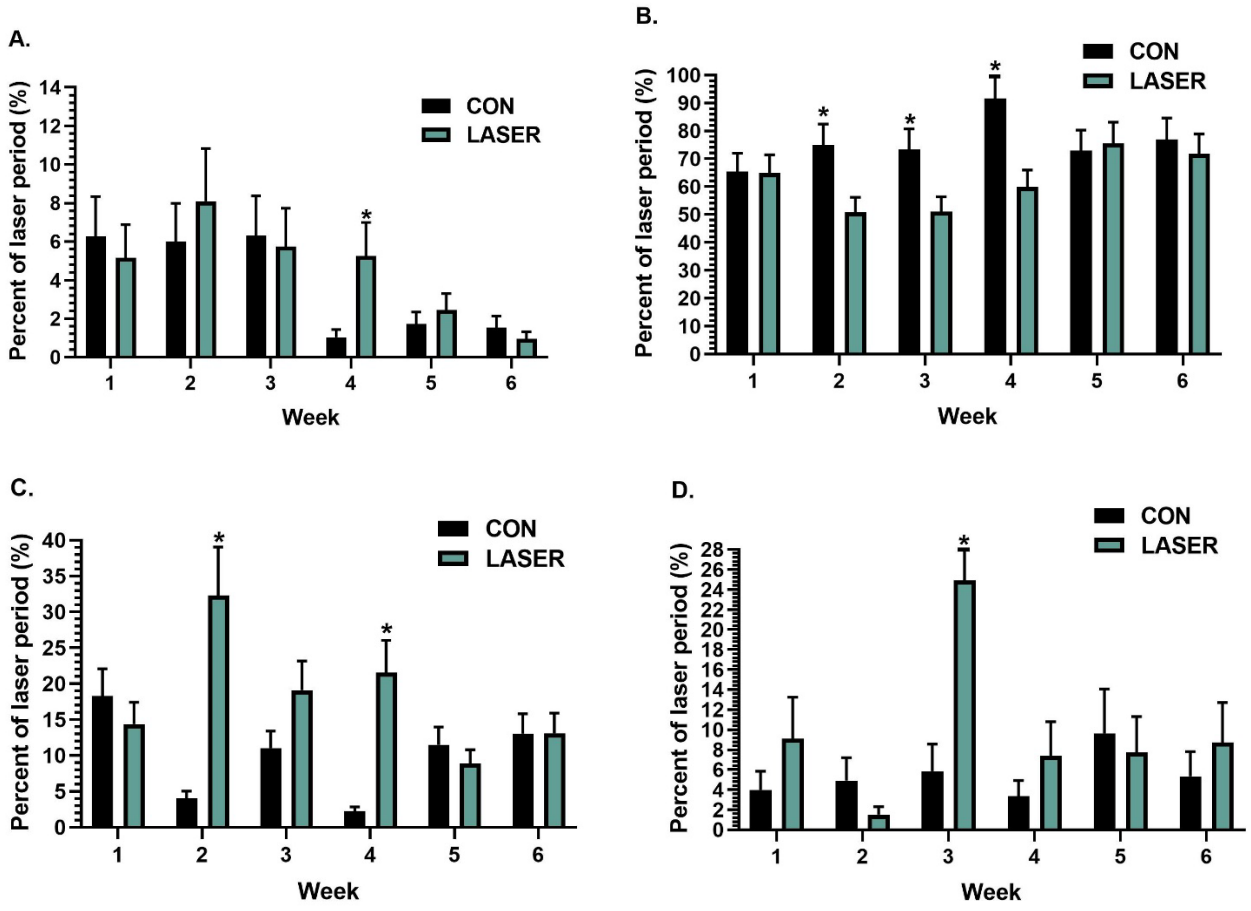

Figure 1. Ross 708 focal broiler home pen behavior week 1-6 during 4-min laser periods: enrichment *week LSMeans (±SEM)[1]. Percent of time spent: (A) active; (B) inactive; (C) at feeder; and (D) at drinker.
[1]Bars denoted * indicate means that are significantly different within the same week ($P \leq 0.05$)

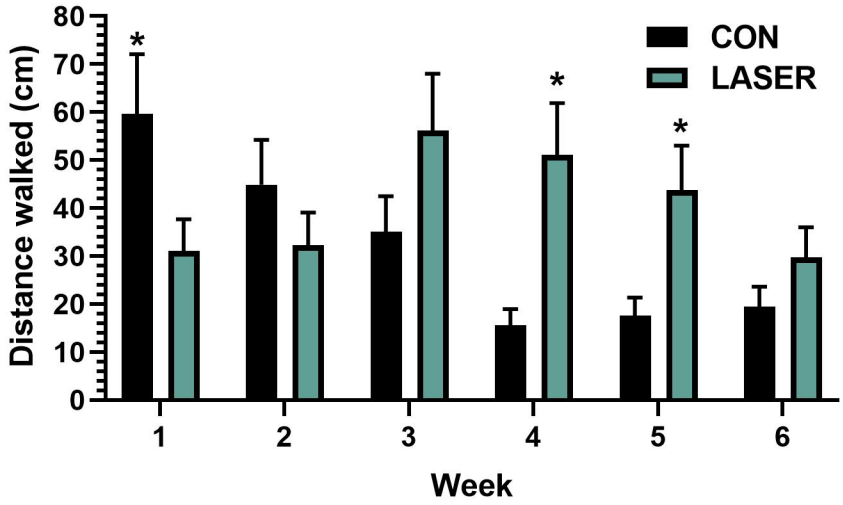

Figure 2. Mean walking distance[1] (cm) of focal birds during 4-min laser periods week 1-6 (enrichment *week LSMeans ± SEM)[1]
[1]Bars denoted * indicate means that are significantly different within the same week (P ≤ 0.05)

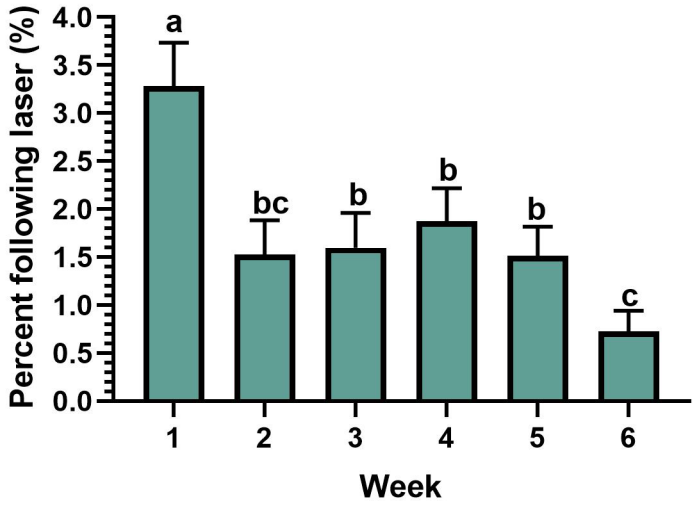

Figure 3. Laser-following behavior week 1-6 (week LSMeans ± SEM) in LASER-enriched pens only[1]
[1]Bars lacking common letters indicate means that are significantly different (P ≤ 0.05)