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Perch-shape preference and perching behaviors of young laying hens

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ABSTRACT

Provision of perches in enriched colony or cage-free hen housing facilitates birds' ability to express natural behaviors, thus enhancing animal welfare. Although considerable research has been conducted on poultry perches, further investigation is needed of perching behavior and preference of laying hens to perch exposure and perch types. This study aimed to assess preference of young laying hens for round *vs.* hexagon perches and to characterize temporal perching behaviors of the young hens brought to an enriched colony setting from a cage pullet-rearing environment. A total of 42 Lohmann white hens in six equal groups, 17 weeks of age at the onset of the experiment, were used in the study. Each group of hens was housed in a wire-mesh floor pen equipped with two 120 cm long perches (one round perch at 3.2 cm dia. and one hexagon perch at 3.1 cm circumscribed dia., placed 40 cm apart and 30 cm above the floor). Each group was monitored continuously for 9 weeks. Perching behaviors during the monitoring period, including perching time, perch visit, and perching bird number, were recorded and analyzed daily using an automated perching monitoring system. Results revealed that the laying hens showed no preference between the round and hexagon perches ($P = 0.59–0.98$). Young laying hens without prior perching experience showed increasing use of perches over time ($P < 0.01$). It took up to five to seven weeks of perch exposure for young hens to show consistent perching behaviors in the enriched colony setting. This study also found that laying hens spent about 10% of daytime on the perches and over 75% of hens perched at night after approaching consistent perching behaviors. In general, the results supplemented to the existing knowledge base for the quantitative behavior study on laying hens' temporal perch use.

1. Introduction

Laying hens are highly motivated to perch, thus provision of perches in hen housing can accommodate hen's natural behavior needs, enhancing animal welfare (Olsson and Keeling, 2002; Cooper and Albentosa, 2003; Weeks and Nicol, 2006). To improve laying hen welfare, the EU Directive banned conventional cages from 2012 and set forth the minimum standards that perches must have no sharp edges and perch space must be at least 15 cm per hen in alternative hen housing systems (Council Directive, 1999). Because of the EU's ban on conventional cages, enriched colony housing (**ECH**) became a popular alternative hen housing system. In 2014, 58% of the laying hens in the EU were housed in ECH systems (Windhorst, Personal Communication). Although laying hens are mostly housed in conventional cages in the United States (approximately 85%) and many other major egg-producing countries (e.g., China, Mexico, Japan, Indian, Brazil), ECH systems have been adopted by some egg producers in these countries. In the ECH systems, the perch is one of the most essential enrichments for the hens.

Many studies have investigated the effects of perch provision on production performance, health, and well-being of laying hens over the past four decades (Struelens and Tuyttens, 2009; Hester, 2014). Benefits of providing perches to laying hens include stimulating leg muscle development and bone mineral deposition (Enneking et al., 2012; Hester et al., 2013a), increasing volume and strength of certain bones (Hughes et al., 1993; Appleby and Hughes, 1990; Barnett et al., 2009), reducing abdominal fat deposition (Jiang et al., 2014), and reducing fearfulness and aggression (Donaldson and O'Connell, 2012). On the contrary, detrimental effects associated with perches include keel bone deformities, foot disorders, and bone fractures (Appleby et al., 1993; Tauson and Abrahamsson, 1994; Donaldson et al., 2012). Studies have also shown inconsistent results related to the impact of perches on feather condition or mortality of laying hens. For example, Duncan et al. (1992), Glatz and Barnett (1996), and Wechsler and Huber-Eicher (1998) reported beneficial impacts, whereas Tauson (1984), Moinard et al. (1998), and Hester et al. (2013b) reported detrimental impacts. These inconsistent results, to a large extent, could be attributed to differences in perch design, spatial arrangement of perches, or timing of

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birds' introduction to perches in the studies (Struelens and Tuyttens, 2009; Hester, 2014).

The EU Directive has required that perches must have no sharp edges (Council Directive, 1999). Pickel et al. (2011) found that peak force on the footpads of hens was greater when standing on the perches with sharp edges (square perch) as compared to round perches. This finding provided certain scientific evidence for the requirement of no sharp edges because the extra force on the footpads may lead to severe foot disorders such as bumble foot and toe pad hyperkeratosis. Consequently, round perches are most commonly used in alternative housing systems. However, the peak force on the keel bone of hens was much greater when resting on round *vs.* square perches (Pickel et al., 2011), which could contribute to development of more keel bone deformity. It should be noted that the pressure peaks on the keel bone were approximately 5 times higher compared with the pressure peaks on a single footpad (Pickel et al., 2011). In addition, round perches might be less adequate in terms of providing the stability necessary to accommodate the hen's landing or long-term roosting. For instance, Duncan et al. (1992) found that hens' feet slipped back and forth on round perches but not on square perches. Therefore, a hexagon perch, combining the shape features and advantages of both square and round perches, might prove to be more attractive to hens because of its potential to improve hens' ability to grasp the perch and reduce the chance of peak pressure on the keel bone and footpads. A review of literature did not reveal research information regarding hen's comparative use of round *vs.* hexagon perches.

Some studies showed that early access to perches had positive effects on musculoskeletal health of pullets as well as subsequent long-term health of hens (Hester et al., 2013a; Yan et al., 2014; Habinski et al., 2016). Similarly, research found that rearing pullets without early access to perches could impair the spatial cognitive skills of hens (Gunnarsson et al., 2000), thus may be detrimental to their subsequent perching ability and long-term welfare. However, raising pullets in conventional cages without perches is the most typical management practice in current commercial ECH systems. Thus there is still a need to further investigate and characterize perching behaviors of young laying hens (without perch exposure) introduced to ECH systems.

The objectives of this study were a) to assess hens' preference for perch shape between round and hexagon perches, and b) to quantify and characterize temporal perching behaviors of young laying hens after transfer from pullet-rearing cages into an enriched colony setting. The results contribute to scientific information on laying hen perch design and responses of novice birds to perch introduction.

2. Materials and methods

The study was conducted in an environment-controlled animal research laboratory located at Iowa State University, Ames, Iowa, USA. Before the onset of the experiment, the experimental protocol was approved by the Iowa State University Institutional Animal Care and Use Committee (Log # 5-12-7364-G).

2.1. Experimental birds and management

A total of 42 Lohmann white laying hens in two successive batches (21 hens per batch) were used in the study. The birds were reared in a commercial pullet-rearing cage house (six pullets per cage) until the commencement of the experiment when they were at 17 weeks of age (**WOA**). All the birds had similar physical conditions, including body weight (1200–1250 g), feather coverage (no damage/loss), feet and keel bone conditions (no abnormal sign), and no prior perching experience at the onset of the experiment. For each batch, the birds were randomly assigned to three groups, with seven birds per group.

Three identical enriched experimental pens (P1, P2, and P3) were used in the study. These experimental pens (Fig. 1), each measuring 120 × 120 × 120 cm (L × W × H), had a wire-mesh floor (2.5 × 2.5 cm wire-mesh, 2057 cm^2/bird space allowance), a 120 × 30 × 40 cm elevated nest box (45 cm above floor, 514 cm^2/bird), two 60 × 15 × 10 cm rectangular feeders (installed outside of the left and right sidewalls), two nipple drinkers (on the rear wall at 40 cm above floor), and two parallel 120 cm long metal perches (a 3.2 cm dia. round perch and a 3.1 cm circumscribed circle dia. hexagon perch, each giving a minimum of 17 cm perch space per bird). Both perches were installed on adjustable brackets, 30 cm above the floor and 40 cm away from each respective sidewall, with a horizontal space of 40 cm between the two perches. The adjustable brackets allowed for quick relocation and placement of perches. The hexagon perches were oriented to present a flat surface on the top (Fig. 2a). All resource allowances, including perch, floor, feeder, nest, and nipple drinkers met or exceeded those in the legislation or recommendations for the hens. The experimental room was equipped with mechanical ventilation and heating/cooling to maintain the desired temperature of 21 °C and relative humidity of 40–60% throughout the experiment.

The lighting scheme applied in the study followed the commercial management guidelines (Table 1), including light, dim (dawn and dusk), and dark periods. Artificial light was the only light source throughout the experiment, and light was provided with compact fluorescent lamps for the daytime (20 lx) and light-emitting diode lights for the dim period (1–2 lx). Light intensity was measured and adjusted using a light meter (Model EA31, FLIR Systems Inc., Wilsonville, OR, USA[1]), and lighting was maintained at comparable levels at the same spot of the respective perch.

All birds underwent a 9-week test period (17–25 WOA). During this test period, the round and hexagon perches were continuously provided, and the birds had free access to both. The locations of the two perches were swapped once a week (at the end of each week) to avoid potential location effects (Table 2). The nest box door was blocked to restrict hen access during the dark period, i.e., the door was closed and reopened an hour before the onset of dusk and dawn periods, respectively. Feed (commercial corn and soy diets) and water were available *ad-libitum* for the hens throughout the test. Feeders were replenished and eggs were collected once a day at 17:00 h. The experimental pens were cleaned each week right after relocation of the perches. Wood shavings were placed under the wire-mesh floor to absorb the manure moisture and for easier cleaning.

2.2. Automated perching monitoring system

A real-time, sensor-based perching monitoring system was built by incorporating six pairs of load-cell sensors (Model 642C, Revere Transducers Inc., Tustin, CA, USA) supporting six metal perches (two perches per pen, Fig. 2a), coupled with a LabVIEW-based data acquisition system (version 7.1, National Instrument Corporation, Austin, TX, USA). This monitoring system consisted of a compact FieldPoint controller (NI cFP-2020, National Instrument Corporation) and two 8-channel thermocouple input modules (NI cFP-TC-120, National Instrument Corporation), collecting data at 1 Hz sampling rate. Each pair of load-cell sensors was fitted with the adjustable brackets and coupled to a metal perch, forming the weighing perch (Fig. 2a). For each weighing perch, an equation was developed by establishing relationship between a series of standard load weights (i.e., 0, 1500, 3000, 4500, 6000, and 9000 g) and the corresponding analog voltage outputs (Fig. 2b). The data acquisition system automatically read analog voltage outputs of the weighing perches and converted the electronic signals to load weight using the pre-defined equations, thereby providing real-time measurement of load weight on the perches (Fig. 2c). The load weight of perching birds on each perch was then converted to

[1] Mention of product or company name is for presentation clarity and does not imply endorsement by the authors or Iowa State University, nor exclusion of other suitable products.