The effect of perches in cages during pullet rearing and egg laying on hen performance, foot health, and plumage


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ABSTRACT Enrichment of pullet cages with perches has not been studied. Our objective was to determine if access to metal perches during all or part of the life cycle of caged White Leghorns affected egg traits, foot health, and feather condition. Treatment 1 represented control chickens that never had access to perches during their life cycle. Treatment 2 hens had perches only during the egg laying phase of the life cycle (17 to 71 wk of age), whereas treatment 3 chickens had perches during the pullet phase (0 to 16.9 wk of age). Treatment 4 chickens always had access to perches (0 to 71 wk of age). Comparisons between chickens that always had perches with controls that never had perches showed similar performance relative to egg production, cracked eggs, egg weight, shell weight, % shell, and shell thickness. More dirty eggs occurred in laying cages with perches. Feed usage increased resulting in poorer feed efficiency in hens with perch exposure during the pullet phase with no effect during egg laying. Perches did not affect hyperkeratosis of toes and feet. The back claw at 71 wk of age broke less if hens had prior experience with perches during the pullet phase. In contrast, during egg laying, the back claw at 71 wk of age broke more due to the presence of perches in laying cages. Perches in laying cages resulted in shorter trimmed claws and improved back feather scores, but caused poorer breast and tail feather scores. In conclusion, enriching conventional cages with perches during the entire life cycle resulted in similar hen performance compared with controls. Fewer broken back claws but poorer feed efficiency occurred because of prior experience with perches as pullets. Perch presence during egg laying improved back feather scores with more trimmed nails but caused more dirty eggs, broken back claws, and poorer breast and tail feather scores. Although perches allow chickens to express their natural perching instinct, it was not without causing welfare problems.

Key words: perch, pullet, laying hen, White Leghorn, egg production

INTRODUCTION

With an increased interest by the egg industry for housing laying hens in enriched colony housing units, consideration should also be given to enriching the cage environment of pullets. Current egg industry practice in the United States does not include access to perches or other enrichments in pullet cages.

Although the effects of perch access during the laying phase in furnished cages on hen performance and welfare have been reported (see the reviews of Tauson, 1998; Sandilands et al., 2009; Struelens and Tuyttens, 2009; Holt et al., 2011; Lay et al., 2011), little attention has been given to evaluating the use of enrichments in the pullet cage, in particular the ability to roost. Using pullets of the current study, Enneking et al. (2012b) demonstrated that perches stimulated chicken activity, promoting exercise and leading to improved musculo-skeletal health (Enneking et al., 2012a). In addition, early exposure to perches during the pullet phase may encourage adult perching behavior; Faure and Jones (1982) showed that pullets on littered floors increased perching behavior with repeated exposure to perches.

There are few studies on the effects of perch access in pullet cages on behavior and welfare parameters. Using the pullets of the current study, Enneking et al. (2012b) reported that caged pullets given access to front and back perches immediately following hatch began using roosts as early as 2 wk of age, though perching was...
rare at this age. Perch use increased with age, peaking at 12 wk of age, and this level of perching activity was maintained until the end of the observations at 16 wk of age (Enneking et al., 2012b). Using the pullets of the current study, there were no keel bone deviations up to 12 wk of age in the perch and control treatment groups (Enneking et al., 2012a). In addition, hyperkeratosis of the foot-pad and toes was practically nonexistent and were not affected by perch access up to 12 wk of age compared with pullets in cages without perches (Enneking et al., 2012a).

Early use of perches has also been reported for pullets reared in noncage systems. For example, a total of 21 of 23 pullets given access to roosts at 4 wk of age in a littered floor pen began perching within a week, whereas older pullets exposed later in life to perches (8, 12, 16, and 20 wk of age) did not show similar rates of perching until 37 wk of age (Appleby and Duncan, 1989). A benefit of early exposure to perches in noncage systems was reduced cloacal cannibalism during egg laying in beak intact hens (Gunnarsson et al., 1999).

We are not aware of any studies that have been conducted on perch availability in pullet cages and their subsequent effect on laying hen performance and welfare. Therefore, the objective of the current study was to determine if perch availability during all or part of the life cycle of caged White Leghorns affected hen performance and welfare. Our hypothesis was that early exposure to perches in cages during the pullet phase with continued exposure during egg laying would enhance hen performance and welfare of caged White Leghorn hens. Hen performance was evaluated by measuring egg production, egg weight, shell quality traits, and feed efficiency. Well-being traits included hen BW, mortality, foot health, and feather condition. Foot health was evaluated for hyperkeratosis (hypertrophy of the corneus layer of the skin) and measuring claw length as well as the incidence of broken claws.

**MATERIALS AND METHODS**

**Birds and Management**

A total of 1,064 Hy-Line W36 hatchlings were placed in 28 pullet cages at the Purdue University Poultry Research Farm in West Lafayette, Indiana. Half of the pullet cages had perches, whereas the remaining 14 pullet cages did not have perches. Standard management and vaccination practices were used. The protocol was approved by the Purdue University Animal Care and Use Committee. Infrared beak trimming was performed at the hatchery. Metal cage specifications, perch placement, the number of pullets per cage, and floor, perch, and feeder space per chicken during the pullet phase were described in Enneking et al. (2012a). With the exception of the perch, pullets were reared similar to industry standards. At 17 wk of age, 324 pullets were transferred to 36 metal laying cages housed in 1 room of the Layer Research Unit at Purdue University. Similar to the pullet phase, half of the laying cages were retrofitted with 2 perches, whereas the other 18 cages did not have perches (controls). Metal round perches with a smooth surface, 32 mm in diameter, were used during the laying phase. With the exception of length, they were identical to the perches used in the pullet cages. Cage dimensions and perch placement within the conventional laying cage are depicted in Figure 1. Floor space allocation, perch space/hen, and feeder space/hen from 17 wk of age to the end of the study at 71 wk of age were 439 cm², 16.9 cm, and 8.4 cm per hen, respectively. Because 16.9 cm of perch space/hen was provided, all hens could perch simultaneously if desired. Two nipple drinkers were assigned to each laying cage.

A prelay diet (CP = 18.40%, Ca = 2.50%, and nonphytate P = 0.35%) was fed for 5 d beginning when pullets were 17.3 wk of age (121 d of age). Prior to 17.3 wk of age, pullets were on a grower diet (Enneking et al., 2012a). At 18 wk of age, chickens were switched to a laying hen diet (CP = 18.3%, Ca = 4.20%, and nonphytate P = 0.30%), and they remained on this diet to the end of the study. Diets were formulated using the recommendations for nutrients by the Hy-Line Variety W-36 Commercial Management Guide (2009–2011, Hy-Line International, West Des Moines, IA) or the NRC (1994). Feed and water were provided for ad libitum consumption.

A step-down lighting regimen was used during the pullet phase where light hours were gradually decreased from 22L:2D at 1 d of age to 12L:12D by 9 wk of age. Beginning at 18 wk of age, light hours were gradually stepped up, achieving a photoperiod of 16L:8D by 30 wk of age, where it remained until termination of the study. Light intensities were set at 32, 2, and 11 lx at 1 d, 1 wk, and 18 wk of age, respectively.

**Treatments**

A 2 × 2 factorial arrangement was employed during the egg laying phase of the study (17 to 71 wk of age).
The factors were the pullet vs. the laying phase and the presence or absence of the perch. The controls (treatment 1) never had access to perches at any point during their life cycle, which is typical of current egg industry practices. Treatment 2 chickens had access to perches only during the during the egg laying phase of the life cycle (17 to 71 wk of age), whereas treatment 3 chickens had access to perches only during the pullet phase (0 to 16.9 wk of age). Treatment 4 chickens always had access to perches (0 to 71 wk of age). Treatments were assigned randomly to cages. There were 9 cages with 9 hens/cage for each of the 4 treatments for a total of 36 cages.

**Measured Parameters**

Eggs were collected manually on a daily basis, and each egg was examined as to whether it was cracked or dirty. Any mortality that occurred during egg laying was recorded daily with a necropsy performed by Purdue University’s Avian Disease Diagnostic Laboratory. Mortalities were not replaced with spare hens. The amount of feed used during a 7-d period was determined on a per cage basis every 5 wk during the egg production cycle beginning at 18 wk of age. Feed efficiency (kg of feed used/dozen eggs) was determined on a per cage basis every 5 wk beginning at 23 wk of age. Ten intact hard-shelled eggs were collected from each cage over a 2-d period every 5 wk during egg laying beginning at 23 wk of age. Egg weight and shell quality measurements were made as described by Klingensmith and Hester (1985).

All hens in the study were euthanized using sodium pentobarbital followed by cervical dislocation at 71 wk of age for purposes of tissue collection. Results on blood and bone parameters are currently undergoing analysis. After death, all 71-wk-old hens were weighed and assessed for foot health and feather condition. Both foot-pads and all toes were examined for hyperkeratosis and scored. Severity of hyperkeratosis for the foot-pad and toes was evaluated using a scoring system of values ranging from 1 to 4 points (Tauson et al., 2004). A score of 1 represented severe hyperkeratosis with deep and large epithelial lesions of the foot-pad and toes. A score of 2 represented moderate hyperkeratosis of the foot-pad and toes with deep epithelial lesions. A score of 3 represented mild hyperkeratosis with superficial lesions of the epithelium. A score of 4 represented healthy feet and toes with no lesions. The scores of both feet were averaged for each hen. Claw length on 4 toes as well as the dew claw of each foot was determined using a flexible measuring tape. The 10 claw length measurements per hen were averaged. All 10 claws of both feet for each hen were examined for breakage, and % claw breakage per hen was calculated. Feather condition was scored for the neck, breast, back, wings, vent, and tail and averaged for an overall feather score. Scores ranged from 1 to 4, with 4 signifying no damage to the featherers and 1 signifying severe damage (Tauson et al., 1984, 2004). A score of 1 represented severe damage of feathers with mostly bare regions. Hens with a score of 2 had explicit damage of feathers and could include bare areas. A score of 3 represented hens that were completely or almost completely feathered, but had some damaged feathers. A score of 4 represented very good plumage condition with little to no damaged feathers. Photographs of feather scores for different regions of the hen’s body were reported by Tauson et al. (2004).

**Statistical Analysis**

Data from the completely randomized design was subjected to an ANOVA (Steel et al., 1997) using the MIXED model procedure of SAS Institute (2008). A 2 x 2 factorial arrangement was used in which the presence or absence of the perches within the pullet or laying cages were the main plots. An ANOVA with repeated measures over the age of the hen was used for egg production, cracked eggs, dirty eggs, egg weight, shell weight, % shell, shell thickness, feed utilization, and feed efficiency. For the feather scores, a split plot with respect to feather tract location was included in the statistical model. Treatment (factors of pullet vs. the laying phase and the presence or absence of the perch), age, and feather tracts were considered fixed effects. The variability of least squares means was reported as the SEM. If data lacked homogenous variances, transformations of arcsine square root were used and the data reanalyzed. Because statistical trends were similar for both transformed and untransformed data, the untransformed results will be presented. The Tukey-Kramer test was used to partition differences among means (Oehlert, 2000) with the exception of the 3-way interaction for egg production and the 2-way interaction for feather score where the SLICE option was used (Winer, 1971).

**RESULTS**

For egg traits, only egg weight was affected by previous exposure to perches as pullets; specifically, chickens with access to perches during the pullet phase laid heavier eggs than controls without access to perches \((P = 0.03, \text{Table 1})\). Perch access during egg laying resulted in hens laying eggs with lower egg \((P < 0.0001)\) and shell \((P = 0.006)\) weights and a greater percentage of dirty eggs \((P < 0.0001)\) compared with control hens without perches (Table 1).

The interaction (pullet × laying phases) was significant for the following egg traits: egg weight \((P = 0.009)\), shell weight \((P < 0.0001)\), % shell \((P = 0.002)\), and shell thickness \((P < 0.0001, \text{Table 1})\). Egg and shell weight as well as % shell were not affected by placing control pullets into laying cages with or without perches. In contrast, hens with prior perch experience as pullets, when placed in laying cages with perches, showed
Table 1. The effect of perch access in conventional cages on egg traits of White Leghorns

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hen-day egg production1 (%)</th>
<th>Hen-house egg production1 (%)</th>
<th>Cracked eggs1 (%)</th>
<th>Dirty eggs1 (%)</th>
<th>Egg weight2 (g)</th>
<th>Shell weight2 (g)</th>
<th>% Shell2</th>
<th>Shell thickness2 (mm)</th>
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<tr>
<td>During pullet phase</td>
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<td></td>
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<tr>
<td>Control</td>
<td>83.4</td>
<td>83.8</td>
<td>0.8</td>
<td>2.9</td>
<td>61.2b</td>
<td>5.220</td>
<td>8.54</td>
<td>0.356</td>
</tr>
<tr>
<td>Perch</td>
<td>84.0</td>
<td>83.0</td>
<td>0.8</td>
<td>3.2</td>
<td>61.8a</td>
<td>5.235</td>
<td>8.50</td>
<td>0.354</td>
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<td>0.6</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
<td>0.025</td>
<td>0.028</td>
<td>0.001</td>
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<td>228</td>
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<td>228</td>
<td>228</td>
<td>1,786</td>
<td>1,788</td>
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<td>1,788</td>
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<td>P-value</td>
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<td>0.39</td>
<td>0.84</td>
<td>0.32</td>
<td>0.008</td>
<td>0.65</td>
<td>0.32</td>
<td>0.30</td>
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<tr>
<td>Control</td>
<td>83.6</td>
<td>82.8</td>
<td>0.7</td>
<td>2.5b</td>
<td>62.1a</td>
<td>5.275a</td>
<td>8.54</td>
<td>0.354</td>
</tr>
<tr>
<td>Perch</td>
<td>83.8</td>
<td>84.0</td>
<td>0.8</td>
<td>3.6a</td>
<td>61.0b</td>
<td>5.180b</td>
<td>8.49</td>
<td>0.356</td>
</tr>
<tr>
<td>SEM</td>
<td>0.6</td>
<td>0.6</td>
<td>0.1</td>
<td>0.2</td>
<td>0.2</td>
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<td>P-value</td>
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<td>&lt;0.0001</td>
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<td>Interaction (pullet-laying)</td>
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</tr>
<tr>
<td>Control-Control</td>
<td>82.6</td>
<td>82.8</td>
<td>0.7</td>
<td>2.2</td>
<td>61.4b</td>
<td>5.185bc</td>
<td>8.50b</td>
<td>0.351b</td>
</tr>
<tr>
<td>Control-Perch</td>
<td>84.2</td>
<td>84.7</td>
<td>0.9</td>
<td>3.6</td>
<td>61.9b</td>
<td>5.255b</td>
<td>8.58a</td>
<td>0.361b</td>
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<tr>
<td>Perch-Control</td>
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<td>82.7</td>
<td>0.8</td>
<td>2.8</td>
<td>62.7a</td>
<td>5.366a</td>
<td>8.59a</td>
<td>0.358a</td>
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<tr>
<td>Perch-Perch</td>
<td>83.4</td>
<td>83.3</td>
<td>0.7</td>
<td>3.5</td>
<td>60.9b</td>
<td>5.105c</td>
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<tr>
<td>SEM</td>
<td>0.8</td>
<td>0.9</td>
<td>0.2</td>
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<td>0.034</td>
<td>0.04</td>
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<tr>
<td>P-value</td>
<td>0.10</td>
<td>0.49</td>
<td>0.39</td>
<td>0.17</td>
<td>0.009</td>
<td>&lt;0.0001</td>
<td>0.002</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

1Values within a column represent the least squares means averaged over 13 mo of egg production.
2Values within a column represent the least squares means of 10 eggs from each of the 4 treatment groups averaged over 10 ages from 23 to 68 wk of age at 5-wk intervals.
3Average number of observations per least squares means during the pullet phase, laying phase, or the interaction for pullet with laying phases.

4Control-Control chickens never had access to perches during their life cycle; Control-Perch chickens had access to perches only during the egg laying phase of the life cycle (17 to 71 wk of age); Perch-Control chickens had access to perches only during the pullet phase (0 to 16.9 wk of age); and Perch-Perch chickens always had access to perches (0 to 71 wk of age).
a decrease in egg and shell weight as well as % shell compared with those placed in laying cages without perches. The shell of eggs increased in thickness when control pullets with no prior perching experience were placed into laying cages with perches. In contrast, hens with prior experience with perches as pullets, when placed in laying cages with perches, showed a decrease in shell thickness compared with those placed in control laying cages without perches (Table 1).

Hen-day egg production in response to the presence or absence of perches was inconsistent with age, resulting in a 3-way interaction (age of the hen × pullet with or without perches × hen with or without perches, \( P = 0.006 \), Figure 2). For 9 out of the 13 mo of production, there were no significant differences among the 4 treatments (3, 4, and 7 to 13 mo). However, hens that did not have perches during egg laying but had access to perches as pullets had better hen-day egg production at 1, 2, and 5 mo of production than hens with perches throughout their life cycle. Interestingly, the control pullets placed in laying cages with perches responded to the perch positively with greater hen-day egg production at 1 and 6 mo of production compared with controls that never experienced perches.

Similar to hen-day egg production, hen-house egg production response to the presence or absence of perches was inconsistent with age, resulting in a 3-way interaction (age of the hen × pullet with or without perches × hen with or without perches, \( P = 0.0002 \), Figure 3). For 7 mo of production, there were no differences among the 4 treatments (3, 4, 5, 7, 8, 9, and 13 mo). During mo 1 and 6, control pullets placed in laying cages with perches laid more eggs on a per hen house basis than chickens that never had access to perches. Chickens with access to perches during their entire life laid fewer eggs on a hen-house basis during mo 1, 2, and 6, but laid more eggs during mo 10, 11, and 12 compared with control hens (no perch in the laying cage), but with access to perches during the pullet phase.

Cumulative hen mortality from 17 to 71 wk of age was unaffected by the presence of perches in the laying cage or with prior experience with perches as pullets (Table 2). A total of 8 hens, all from control laying cages (1 dead hen/cage), died throughout the study. Causes of death included cannibalism (\( n = 2 \)), hepatitis (\( n = 1 \)), uterine prolapse, internal layer, or egg retention (\( n = 3 \)), physical injury while trying to escape from the cage (\( n = 1 \)), and unknown (\( n = 1 \)).

Figures 2. Monthly hen-day egg production of White Leghorns was subjected to the following 4 treatments: 1) Control-Control chickens never had access to perches during their life cycle; 2) Control-Perch chickens had access to perches only during the egg laying phase of the life cycle (17 to 71 wk of age); 3) Perch-Control chickens had access to perches only during the pullet phase (0 to 16.9 wk of age); and 4) Perch-Perch chickens always had access to perches (0 to 71 wk of age). Values represent the least squares means. SEM = 1.6. The 3-way interaction of age of the hen × pullet with or without perches × hen with or without perches was significant (\( P = 0.006 \)). Color version available in the online PDF.
not the pullet phase \((P = 0.09, \text{Table 3})\). The incidence of broken claws was higher for hens with access to perches compared with hens with no access to perches during the laying phase \((P < 0.0001)\), whereas the opposite trend occurred for the pullet phase. Specifically, hens with no access to perches as pullets had a greater incidence of broken claws than those with perches \((P = 0.006, \text{Table 3})\). Of a total of 606 feet examined, it was the back claw of the right \((n = 56/303 \text{ or } 18.5\%)\) and left \((n = 60/303 \text{ or } 19.8\%)\) feet that experienced breakage. The front 3 claws and the dew claw of hens were not broken at 71 wk of age.

For hens which were raised with perches as pullets and had perches in their laying cage, 71-wk-old feather score, when averaged for all feather tracts, was poorer compared with controls \((\text{Table 3, pullet phase main effect, } P = 0.002 \text{ and laying phase main effect, } P = 0.049)\). Feather conditions of the breast and tail were improved when the perch was absent from the laying hen cage, with the opposite effect occurring for the back region, where hens with perches had improved feather scores over controls. Other feather tracts (neck, vent, and wing) were not affected by the perch treatment in laying cages \((2\text{-way interaction of hen perch treatment } \times \text{ feather tract location; } P < 0.0001, \text{Figure 4})\).

**DISCUSSION**

The current study is the first to report the effect of early exposure of caged pullets to perches and its subsequent effects on hen performance and efficiency. With the exception of dirty eggs, comparisons between chickens that always had access to perches with those that were caged conventionally with no perches showed similar performance relative to egg production, cracked eggs, egg weight, shell weight, \% shell, and shell thickness \((\text{see pullet } \times \text{ laying phases interaction means, Table 1})\). Perch availability during either the pullet or laying phases offered benefits relative to hens laying eggs with thicker shells, but the effect did not persist in the hens that always had perches; their egg shells were thinner and similar to controls. Egg weight and BW are positively correlated \((\text{Siegel, 1962; Festing and Nordskog, 1967})\). Thus, because BW were lower \((\text{Table 2})\), it was no surprise that egg weights were also lower for hens with access to perches during the laying phase as compared with controls \((\text{main effect of laying phase, Table 1})\). Other studies have also reported lower hen BW \((\text{Tauson, 1984; Glatz and Barnett, 1996})\) and egg weights \((\text{Tauson, 1984})\) with perch availability in conventional laying cages compared with control cages.
without perches. Other studies, however, reported that egg weight (Braastad, 1990) and BW of laying hens were not affected by perches in laying cages (Appleby et al., 1992).

Our conclusion that egg production was not affected by perches was based on the fact that the main effects and the 2-way interaction (pullet by laying phase) were not significant (Table 1). Furthermore, the lack of consistency in response to perches at different ages of production (the 3-way interaction of age of the hen × pullet with or without perches × hen with or without perches) adds credence to our interpretation that perches had little effect on hen performance. During some months of production, perches lowered egg production, and in other months, perches increased egg production, but for the majority of the time (>50%), there was no effect due to perches (Figures 2 and 3).

White Leghorns and Brown hybrids with access to perches in laying cages also had similar egg production as hens in conventional cages without perches (Tauson, 1984; Braastad, 1990; Appleby et al., 1992; Duncan et al., 1992; Abrahamsson and Tauson, 1993; Tauson and Abrahamsson, 1994; Wall and Tauson, 2007). Only Glatz and Barnett (1996) reported a decrease in egg production as a result of a wooden perch installed in a conventional cage. Glatz and Barnett (1996) attributed the lowered egg production to the placement of the perch 24 cm from the feed trough, preventing hens from eating from the perch, which is a perplexing explanation for the observed reduction in feed intake. In the current study, egg production was not affected by perch placement 18 cm from the feed trough (Figure 1), and these hens were also not able to eat from the front perch because of their inability to reach the feed (P. Y. Hester, unpublished data).

We hypothesized that the incidence of cracked eggs would increase for hens housed in laying cages with perches compared with hens in cages without perches, similar to the results of previous studies (Tauson, 1984; Duncan et al., 1992; Glatz and Barnett, 1996). Because there was no nest, some hens may have laid their eggs from the perch rather than from a standing position on the cage floor. However, for the current study, the greater distance for the egg to travel from the perched hen before landing on the cage floor was not enough to compromise the integrity of the shell, which was similar to the results of Appleby et al. (1992), who reported no effect of perches in laying cages on % cracked eggs. Perch height in the study by Appleby et al. (1992) was 7.5 cm from the cage floor when measured from the center of the perch, which is less than what was used in the current study (8.9 cm, Figure 1).

During the design phase, the height of the perch (8.9 cm) within the cage was placed in such a manner that

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cumulative hen mortality (%)</th>
<th>Feed utilization1 (g/hen/d)</th>
<th>Feed efficiency2 (kg of feed/dozen eggs)</th>
<th>Hen BW (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>During pullet phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>1.1</td>
<td>98.4b</td>
<td>1.404b</td>
<td>1.724b</td>
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<tr>
<td>Perch</td>
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<td>0.26</td>
<td>0.99</td>
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</table>

a,bLeast squares means within a column for the pullet or laying phase lacking a common superscript differ (P < 0.05).

1Values within a column represent the least squares means averaged over 11 ages from 18 to 68 wk of age at 5-wk intervals.

2Values within a column represent the least squares means averaged over 10 ages from 23 to 68 wk of age at 5-wk intervals.

3Average number of observations per least squares means during the pullet phase, laying phase, or the interaction for pullet with laying phases.

4Control-Control chickens never had access to perches during their life cycle; Control-Perch chickens had access to perches only during the egg laying phase of the life cycle (17 to 71 wk of age); Perch-Control chickens had access to perches only during the pullet phase (0 to 16.9 wk of age); and Perch-Perch chickens always had access to perches (0 to 71 wk of age).
allowed the hen to stand on the perch without the top of its head touching the roof of the cage and to also prevent perches from interfering with the egg rolling down the sloped cage floor to the collection area. Although time for the egg to reach the collection area following oviposition was not measured, eggs may have become trapped in cages with perches, perhaps because of less hen movement on the cage floor compared with control cages. Hens that perch may spend less time walking on the cage floor, and this could possibly lead to lower cage floor vibrations. Because eggs may not have arrived at the collecting area as fast as in the control cages, greater fecal contamination occurred, leading to a higher incidence of dirty eggs. Another possibility is that because of less hen traffic under the perches, manure may have not fallen through the wired cage floor to the dropping boards as effectively as in conventional cages without perches. Because eggs are washed and sanitized in the United States, dirty eggs from laying cages with perches may be cleaned of debris, preventing downgrades and resulting in minimal economic impact for the egg producer. Our result was similar to Abrahamsson and Tauson (1993) and Glatz and Barnett (1996), but differed from those of Tauson (1984) and Appleby et al. (1992) who reported no effect of perches in conventional laying cages on % dirty eggs. Differences in hen perching activity and the height of

Table 3. The effect of perch access in conventional cages on hyperkeratosis, claw length, and broken claws of White Leghorns at 71 wk of age

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Hyperkeratosis score</th>
<th>Mean claw length (cm)</th>
<th>Broken claws (%)</th>
<th>Mean feather score</th>
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<td>During pullet phase</td>
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<td>2.9&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
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<td>3.922</td>
<td>1.35&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
</tr>
<tr>
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<td>1.39</td>
<td>1.8</td>
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<td>0.24</td>
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</table>

<sup>a,b</sup>Least squares means within a column for the pullet phase or laying phase lacking a common superscript differ (P < 0.05).

<sup>1</sup>Score for hyperkeratosis ranged from 1 to 4. A score of 1 represented severe hyperkeratosis, and a score of 4 represented healthy, normal feet.

<sup>2</sup>Scores for feather condition ranged from 1 to 4, with 4 signifying no damage to the feathers and 1 signifying severe damage.

<sup>3</sup>Average number of observations per least squares means during the pullet phase, laying phase, or the interaction for pullet with laying phases.

<sup>4</sup>Control-Control chickens never had access to perches during their life cycle; Control-Perch chickens had access to perches only during the egg laying phase of the life cycle (17 to 71 wk of age); Perch-Control chickens had access to perches only during the pullet phase (0 to 16.9 wk of age); and Perch-Perch chickens always had access to perches (0 to 71 wk of age).
the perch from the cage floor may have contributed to
the dissimilarities in % dirty eggs among studies.

Although the presence of perches had little effect on
egg traits, feed usage and efficiency were greater when
access to perches was provided during the pullet phase.

Pullets with access to perches at 12 wk of age weighed
more than control pullets without perches and had per-
haps a larger skeletal frame because of larger bones
(Enneking et al., 2012a). The BW of pullets at 17 wk
of age was not measured when birds were transferred
to laying cages, but because of the increase in 12-wk-
old BW, it is suspected that the chickens with perches
during the pullet phase began egg laying as larger birds
compared with controls. This ultimately led to heavier
71-wk-old hens (Table 2) with prior access to perches
that laid heavier weight eggs (Table 1, pullet phase
main effect). In contrast to the pullet phase, the pre-

ence of perches in laying cages resulted in lower BW (P
< 0.0001) and less feed usage (approached significance,

P = 0.06) compared with hens in conventional laying
cages (laying phase main effect, Table 2), similar to
other studies (Tauson, 1984; Braastad, 1990; Tauson
and Abrahamsson, 1994) that used perches during egg
laying. Perching hens insulate one another (Lill, 1968),
especially at night when roosting is more popular
(Duncan et al., 1992), and hens rest more on perches,
which may explain the lower food usage (Tauson and
Abrahamsson, 1994; Tauson, 1998). In addition to the
lower maintenance needs, our results on lower BW of
perched hens during egg laying (Table 2) could also
be due to greater competition at the feeder. Though
mortality was not affected by perches (Table 2), 8 hens
died at different times during the study, 1 for each of 8
control laying hen cages out of a total of 18 (44% of the
control cages). Greater feeder and floor space on a per
nen basis in the 8 control laying cages with mortality
most likely contributed in part to their greater BW and
greater feed usage (approached significance, P = 0.06,
Table 2) during the laying phase.

Whereas beak-trimmed White Leghorns with perches
during egg laying of the current study had no mort-
ality, non-beak-trimmed ISA Browns in laying cages
with wooden perches installed 6 cm from the cage floor
(perch height was 8.9 cm in the current study, Figure 1)
experienced increased mortality because of cloacal can-
nibalism. Hens expelling eggs while perching exposed
their cloaca to other hens in the cage, leading to vent
cannibalism (Moinard et al., 1998). Cloacal canni-
balism did not occur among hens with perches in the current
study. Breed and beak trimming differences between
studies are the likely explanations for the opposing re-

results. Perch height should not have played a role in the
difference in cannibalism incidence between the current
study and the one of Moinard et al. (1998) because the
perches were not elevated high enough to prevent hens
from viewing and pecking the vents of other caged hens
(Sandilands et al., 2009). Similar to our results, Braas-
tad (1990) and Glatz and Barnett (1996) reported no
differences in mortality between hens housed in conven-
tional laying cages with (7.5 cm height from the cage
floor) and without a wooden perch.

The smooth round metal perches used during the
pullet and laying phases of the current study did not
result in hyperkeratosis of the feet and toes; scores for
all treatment groups at 71 wk of age were identical and
near 4, which is representative of healthy, normal feet.
Likewise, evaluation of feet and toes of pullets at 3, 6,
and 12 wk of age used in the current study also resulted
in identical hyperkeratosis score of 3.99 for both the
control and perch treatments (Enneking et al., 2012a).
Tauson (1984) also reported similar foot health (les-
ions of the pad and toes) between White Leghorns in
conventional laying cages with and without perches. In
contrast, Abrahamsson and Tauson (1997) thought that
the constant standing and walking on the wired floor of a
conventional cage floor without opportunity to perch
caused a poorer toe-pad hyperkeratosis score in 55-wk-
old hens of conventional cages (score of 3.97) compared
with those in furnished cages, which had a round flat-
tened upper surface wooden perch, nest box, and sand
box (score of 4.00, P = 0.001). The current study used
the same scoring system as Abrahamsson and Tauson
(1997), and even though they reported significant dif-
fERENCE between conventional and furnished cages with
regard to hyperkeratosis, a score of 3.97 for the hens
of the conventional cage does not reflect a serious foot
health problem. Similar to Abrahamsson and Tauson
(1997), Appleby et al. (1992) reported greater foot-pad
damage in caged hens without perches (score of 1.1)
compared with those with perches (score <0.6); the
more time hens spent perching, the less foot-pad dam-
age. The median score of 1.1 for hens in conventional
cages was not a serious foot health problem because a
score of 4 was needed to warrant a severe rating with 0
indicating foot pads with no damage. Unlike all other
studies, Glatz and Barnett (1996) surprisingly reported
greater foot damage for caged hens with a wooden rect-
angular perch compared with no perch; these hens were
heat stressed during the summer months and food con-
sumption was lower for the perched hens, which could
have contributed to poor foot health. Too narrow of a
perch and its placement within the cage were also of-
fered as explanations for the poorer foot health (Glatz
and Barnett, 1996).

Although the presence of perches did not affect hy-
perkeratosis of the toes and feet of chickens during both
the pullet (Enneking et al., 2012a) and laying phases of
the current study, the % of broken claws at 71 wk
of age was increased by the presence of perches in lay-
ing cages. Hens jumping on and off the metal perches
in laying cages led to an increase in the incidence of
broken claws (back claw only) compared with hens in
cages without perches (Table 3). Hens at 71 wk of age
that had prior exposure to perches as pullets actually
experienced a reduced incidence of broken claws (2.9%)
compared with controls (4.7%, Table 3; P = 0.006) per-
haps because their claw lengths were slightly shorter
due to the presence of the metal perch during the pullet
The presence of the metal perch in laying cages kept nails trimmed as indicated by shorter claw lengths compared with control hens ($P < 0.0001$, laying phase main effect, Table 3). Excessive claw growth can occur if hens do not have access to abrasive materials for trimming nails. If claws grow too long, they can break off more easily, leading to open, bleeding wounds and greater susceptibility to infection (Lay et al., 2011). Hens with long claws in cages that are poorly designed can also lead to possible entrapment (Barnett et al., 1997). A sand bath in furnished cages served as an abrasive resulting in improved claw condition score in hens compared with those in conventional cages (Appleby et al., 1993; Abrahamsson and Tauson, 1997). Other researchers have reported no effect on claw length of hens in conventional laying cages with and without a perch (Tauson, 1984; Appleby et al., 1992). In contrast, access to wooden perches in laying cages resulted in hens with longer claws than those in standard cages, which might be due to increase perching time, less contact with the wired floor, and the less abrasive nature of wood (Glatz and Barnett, 1996; Barnett et al., 1997).

Feather scores of the breast and tail were poorer in hens with access to perches in laying cages and were likely due to the contact and rubbing of the breast and tail feathers on the metal roosts. In contrast, back feathers were in better condition for perched hens (Figure 4). Perhaps hens with perches resulted in less trampling or fewer cage mates walking over the backs of one another while sitting on the cage floor. Prior perch experience as pullets was detrimental to mean feather scores at 71 wk of age (Table 3); the longer the period of time that chickens were in contact with the metal perches, the poorer the mean feather score. Tauson (1984) also reported that hens in laying cages with a round wooden perch had poorer feather scores for the neck, breast, wings, and tail, but not the back, compared with hens of conventional cages without perches, perhaps due to more abrasion because of bird-to-bird contact during perching. The poorer feather score of the perching hens in the study of Tauson (1984) was not due to feather pecking; these hens showed a tendency toward performing less of this undesirable behavior than the control hens in conventional cages without perches. When a wide array of perching materials were used (Appleby et al., 1992), feather condition of hens was similar between laying cages with and without a perch (Appleby et al., 1992; Barnett et al., 1997). Unlike our results (Table 3), the presence of a wooden perch in a conventional cage improved the tail (Barnett et al., 1997) and vent (Glatz and Barnett, 1996) feather scores, but the total plumage score was not affected by the perch treatment.

A novel contribution of the current study was that the perch effect was evaluated without any confounding interacting factors both during the pullet and laying phases of production. Many studies comparing conventional cages with alternative housing are confounded with multiple enrichments, different stocking densities, cage heights, or feeder and drinker space allocations. Results from such studies are more difficult to interpret because it is never known if the noted treatment effects were due to one or a combination of confounding factors that differ between housing systems. By systematically evaluating enrichments to cages one factor at a time or in a factorial arrangement with other enrichments, studies such as this one, which only differed with respect to perch availability, can effectively delineate treatment effects.

Perches used in the current study are used in aviary systems and have been field tested extensively in Europe. Material cost for perches was estimated at $4.92/m ($1.50/ft) with estimated labor cost of the installation of metal perches at $2 to $3/cage (Enneking et al., 2012a).

In conclusion, there were few egg performance differences between chickens housed in cages with and without metal round perches. Fewer broken back claws but poorer feed efficiency occurred because of prior experience with perches as pullets. Perch presence during egg laying improved back feather scores with more trimmed nails but caused more dirty eggs, broken back claws, and poorer breast and tail feather scores. Whereas providing perches allowed caged chickens to express their natural roosting behavior (Enneking et al., 2012b) and improved nail length and back feather cover during egg laying, it was not without causing additional welfare problems of broken back claws and poorer feather cover for those areas of the hen’s body that rubbed against the perch.

ACKNOWLEDGMENTS

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REFERENCES
