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The use of perches and platforms by broiler chickens

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ABSTRACT

Perching is considered an integral part of chicken behaviour, and is suggested to alleviate leg problems and enhance mobility in broilers, as it stimulates diversification of locomotion. The use of perches is, however, low in broilers. There is a need for investigation of elevated structures that are better accepted by meat type chickens.

We compared elevated plastic platforms with wooden perches on a commercial farm. The data comprises 4 flocks with perches and 6 flocks with platforms, as well as control flocks for both. The use of these structures and the activity of broilers were recorded from video. Activity was measured as bouts of movements in an area with no platforms. The behaviour of the birds was analysed at 3 ages, during both day and night.

The use of platforms exceeded the use of perches. Broilers used low perches (10 cm) more than high perches (30 cm) at the age of 32 days ($P = 0.001$). Platforms were used more during day time than during nights especially in younger broilers ($P = 0.046$). Broilers became more inactive as they got older and were less active during the nights. The presence of platforms had no effect on general activity. Because the perches were mostly unused their effect on bird activity was not analysed.

The frequent use of platforms indicates they are better suited for broilers than perches. However, platforms did not appear to stimulate general activity. The fact that the broilers used platforms to a high degree indicate that broilers are motivated to use elevated structures or driven by high animal densities. It might be that the low perch use is due to physical challenges and not to a lack of motivation to use elevated structures.

1. Introduction

Broilers are normally kept in very stable environments which provide minimal stimulation. This lack of environmental enrichment was identified as a concern for animal welfare in broiler production in the Report on the welfare of broilers by the European Commission (2000). Perches, defined as elevated structures which birds can grasp with their feet and use to survey their environment from (EFSA, 2015), have been shown to be very important recourses for chicken (Olsson and Keeling, 2000). Their use is motivated by multiple needs: night-time roosting is part of the natural anti-predator behaviour in chicken (Newberry et al., 2001).

In layer chicks the day time use of perches begins at about 2 weeks of age, while perching at night starts to develop at an age of 3 weeks (Heikkilä et al., 2006). In broilers, the use of perches has been shown to be highest at the age of 4–5 weeks and declines thereafter (Bizeray et al., 2002; Ventura et al., 2012; Bailie and O'Connell 2015). However, most experimental studies on perch use by broilers indicate that these are used only to a modest degree (Pettit-Riley and Estevez 2001; Su et al., 2000; Rodriguez-Aurrekoetxea et al., 2015), while published reports on other types of elevated structures, such as platforms, are very few (Oester and Wiedmer, 2005).

Providing greater environmental complexity with a possibility to perch is suggested to encourage increased physical activity of birds, which potentially leads to better leg health and animal welfare (Bizeray et al., 2002; Ventura et al., 2012; Bailie et al., 2013; Ohara et al., 2015; Bailie and O'Connell 2015). The use of perches by layer pullets has been shown to promote their skeletal development (Yan et al., 2014) and might also develop their spatial skills (Gunnarsson et al., 2000). Furthermore, a change in exercise patterns brought upon by barrier perches affected the development of musculature in broilers (Sandusky and Heath, 1988). A further potential benefit of promoting perching and roosting behavior in broilers in commercial farming environments is that these may decrease the contact between foot pads and the litter, as well as increase the use of available space (Bizeray et al. 2002; Ventura et al. 2012).

As perch use has been reported to be very low in broilers, the benefits of perches for these animals might be only minor. However, other types of structures, which are easier for broilers to access and

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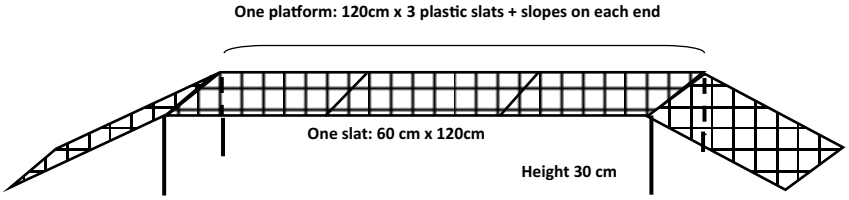

Fig. 1. Illustration of the platform structure. The ramps extend all the way to floor with 15 ◦ angle.

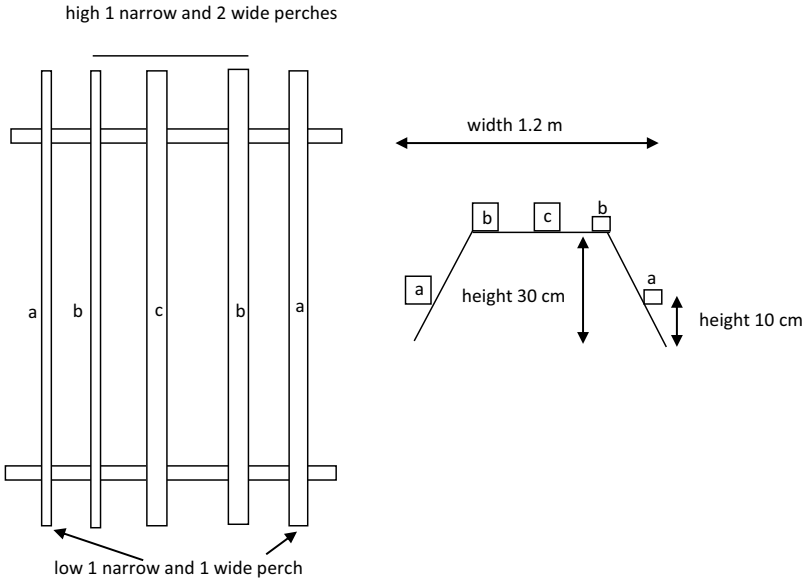

Fig. 2. Illustration of the perch structure showing a: low perches, b: high perches and c: high in the middle perch. Broilers used the low perches more than the other types at 32 days of age ($P = 0.018$). The median number of birds observed per one perch at the age of 32 days are a: low 0.2, b: high 0.0 and c: high in the middle 0.0 (range 0.3, 0.0, 0.0 respectively) birds/perch. Perch use was observed in 4 flocks.

more comfortable to use, might be more appropriate. There is a clear demand for further research on optimal design for enrichment stimuli for modern broilers (Bailie and O'Connell, 2015).

We aimed to compare the use of platforms and perches by broiler chickens in commercial flocks. In addition, we wanted to establish if the activity of broilers could be increased by these elevated structures.

2. Materials and methods

The study was approved by the University of Helsinki Viikki Campus Research Ethics Committee and submit to the European Directive 2010/63 on the protection of animals used for scientific purposes. The birds were managed according to normal farm practices, under commercial conditions and no additional harm was expected by the perches or platforms, or of the filming.

2.1. Birds and housing

Ross 508 birds obtained from a commercial hatchery and raised on one broiler farm in Western Finland were studied. Birds were fed ad libitum with pan feeders, beginning with commercial starter feed, then transitioning to a grower diet combined with whole wheat. Water was offered in nipple drinkers with drip cups. The house had no windows and was continuously lit at the beginning. After day 6 the birds had 2 dark periods at 0:00–4:00 and 12:00–14:00. Birds were housed in rooms of 797 m^2 on deep peat litter. In the beginning of the rearing period there were on average 12945 (SD 558) birds in the flocks and the peak animal density was 40 (SD 2.4) kg/m^2 which was reached prior to slaughter. There was no thinning of the flock and all the birds were slaughtered at the age of 37 or 38 days.

2.2. Platforms and perches

The building had four similar rooms. In each replicate, there was one room with perches, one room with platforms, and 2 control rooms without perches or platforms. Six replicates included a platform room and its control. The platform treatment and the control treatment without platforms alternated between these two rooms. The four first replicates also included a perch room and its control. The perch treatment and the control treatment without perches alternated between these two rooms. Treatment and control flocks were observed simultaneously. Platforms (20) were evenly dispersed between drinker and feeder lines in platform rooms. Perch structures (21) were evenly dispersed between drinker and feeder lines in perch rooms. It was calculated that the platforms and perches could occupy approximately 10% of the birds in a flock simultaneously.

The plastic mesh (with holes of 20 × 25 mm) platforms were built of a total of 5 parts, each part being 120 cm long and 60 cm wide. They were elevated using metal feet to 30 cm from the floor. In both ends an elevated platform formed a ramp continuing all the way to the floor (Fig. 1).

The perch structures with 5 perches each were altogether 200 cm long and 120 cm wide. The perches were at the heights: 30 cm and at 10 cm from the floor (Fig. 2). The perches were of 2 thicknesses: 22 × 22 mm and 50 × 50 mm. All the perches were

wooden and horizontal and had rounded edges. There was a total of 5 × 200 cm perch space per each perch structure.

2.3. Behaviours

2.3.1. Filming and observation periods

Infrared cameras were attached to the ceiling in the middle of the rooms. One perch and half of a platform structure was filmed with one camera in each treatment room. In addition, one camera in each treatment and control room was positioned to film birds on the floor in an area with no elevated structures. During each day a light and dark period observation was included. Daytime observations started at 9a.m. (5 h after lights on) and night time observations at 1a.m. (1 h after lights off). Observations were performed on approximately days 11 (10–14), 19 (17–21), and 32 (31–34) after the birds arrived at the farm.

2.3.2. Use of perches and platforms

To quantify the use of platforms and perches the number of birds on these was counted at 6 occasions, 10 min apart during each observation period. The number of birds sitting on one perch structure was counted and half of a platform structure was recorded in similar manner. For analysis the number of birds on half of the platform was multiplied with 2 to get an estimate number of birds on an entire platform structure.

2.3.3. Difference of bird counts as measure of activity on floor

Due to a very low usage level of the perches (see Results) the relevance of these for the floor activity of birds was considered to be minimal, and we only looked at the effect of platforms on the activity of the birds. To evaluate the activity of birds a 200 × 120 cm area was defined by temporarily adding a frame on the floor in between feeder and drinker lines during the first video recording. When analysing the videos, this was replicated by adding a frame on the video monitor screen, resulting in a test area of the same size. Within this frame the birds were calculated at 6 occasions 10 min apart. The difference in highest and lowest bird counts within the frame during 6 consecutive counts was further used as an estimate of flock activity 'Difference of bird counts'.

2.3.4. Focal bird observations

Due to a very low usage level of the perches also focal bird activity was only observed in platforms and control flocks. The activity of birds was quantified also by selecting a focal bird within a frame and following its activity pattern for 2 min. The first and second focal bird is selected in middle of the frame, the third focal bird was selected from the upper left quarter, fourth from the upper right quarter, fifth from the lower right quarter and the last bird in the lower left quarter. The activity was recorded as number of bouts, and included the following activity types: 'Stationary activity', the bird was active without movement forward, such as moving wings or stepping; and 'Locomotion', the bird moved forward either walking or running. If a bird stopped for 3 s the bout was considered to have ended. Total number of 'Stationary activity' and 'Locomotion' were recorded per 2 min per focal bird. After 2 min had elapsed a new focal animal was selected within the same frame. After the first 6 focal animals were recorded, another 6 animals were recorded beginning an hour later (10a.m. and 2a.m.). The total length of focal bird observation was 24 min. If a focal bird left the observation frame during the 2 min period, the observation of this bird was discarded, and a new focal bird was selected for a full 2 min focal period. These observations were used as a separate variable defined as 'Runaways', and measured the frequency of birds moving out of the frame during the observation period needed to obtain a full set of 6 times 2 min focal bird observations for the activity patterns, as described above.

Table 1
Median (interquartile range) number of birds on perch structure or on platform by the age of broilers.

	N	Day 11	Day 19	Day 32	*P*
Perch	4	0 (0.4)	1.0 (1.4)	0.3 (0.6)	ns
Platform	4	54 (22)	56 (18)*	30 (8)*	0.039

* Pairwise comparison $P < 0.05$.

2.4. Statistical analysis

2.4.1. Platforms and perches

The use of platforms and perches was analysed using non-parametric tests as the sample size was rather limited, and the data on use of platforms and perches was not normally distributed. The mean number of birds on perches and platforms across the 6 observations was used as the outcome variable. The development in the use of elevated structures (data pooled across day and night) by age was analysed with related samples Friedman tests separately for platform and perch use. The significance levels of pairwise post hoc test were adjusted with the Bonferroni correction. The difference in the use of platforms during day and night was analysed separately for each observation ages with Friedman tests. The similar analysis was performed with use of perches.

The difference in the use of low and high perches, and thinner and thicker perches was analysed with related samples Friedman tests. The mean number of birds on perches of different height and thickness, and at different age, was analysed with separate tests. The mean number of birds per one perch was used in the analyses.

2.4.2. Activity on floor

The effect of platform treatment, age and time of day on the activity of birds was analysed with linear mixed models. The numbers of 'Locomotion', 'Stationary activity', 'Runaways' and the difference of bird counts on floor were analysed as a measure of activity. Replicate (6) was inserted as random variable. Treatment (platform or no platform), age (3), time (night or day) and two way interactions were inserted as fixed factors. Only significant interactions were left in the final models. Statistical analyses were performed with SPSS 23.

3. Results

The number of birds using platforms massively exceeded the number of birds seen perching. However, the shape of the perch and platform structures is different. There was a mean of 0.4 (SD 0.5) birds sitting on a perch structure with a perch length of 10 m in total versus a mean of 48 birds (SD 18) observed on a platform structure of a total of 3.6 m^2.

3.1. Age effect on platform and perch use

The use of platforms was lower on the last observation day than during the earlier observation days (Table 1).

3.2. Time of day effect on platform and perch use

The birds used the platforms more during day time than nights during the observation day 11 and 19 (Table 2). Time of day had no effect on perch use ($P > 0.05$).

3.3. The effect of perch position and thickness on perch use

The perch height affected its usage at the age of 32 days, when birds used the low perches more frequently than other perches,

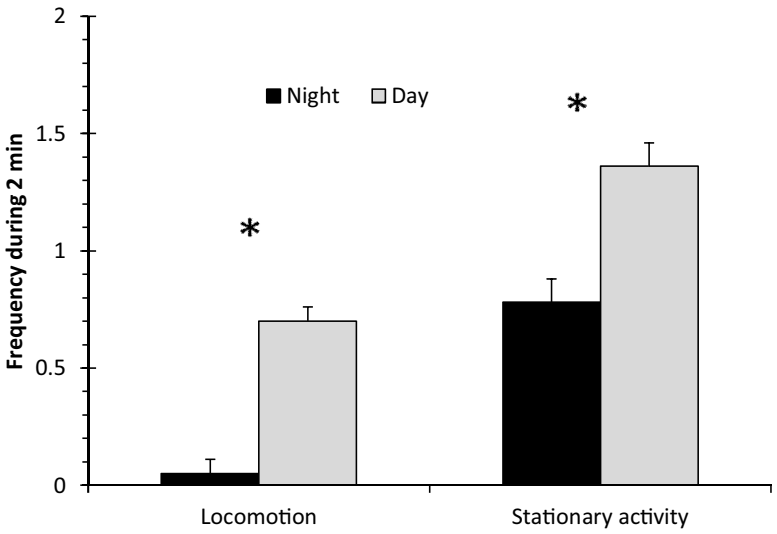

Fig. 3. Mean (SE) number of 'Stationary activity' and 'Locomotion' on floor during 2 min period night and day. Birds were more active during day than during night (*$P = 0.001$). The data is based on observations of 12 flocks.

Table 2
Median (interquartile range) number of birds on platform by time of day (N = 4).

	Day	Night	*P*
Day 11	62 (22)	20 (22)	0.046
Day 19	66 (20)	56 (18)	0.046
Day 32	34 (18)	30 (8)	ns

with no difference on the other observation days (Fig. 2). The thickness of the perches had no effect on perch use ($P > 0.05$).

3.4. Activity on floor

The day time activity exceeded the activity during nights (Fig. 3). The difference of bird counts on floor was affected by age ($P = 0.001$), time of day ($P = 0.003$) and their interaction (Fig. 4). The number of 'Runaways' was affected by the interaction of age and time (Fig. 5) and it was greatest at the youngest observation age ($P = 0.001$) and during the day ($P = 0.001$). Bird age had no effect on frequency of 'Locomotion' or 'Stationary activity'. The presence of platforms had no effect on any measure of activity compared with control treatment (Locomotion, Stationary activity, Runaways or Difference in bird counts, $P > 0.05$ for all). Due to a very low usage of the perches, activity on floor was only observed on platform and control flocks.

4. Discussion

Our results show that the use of platforms clearly exceeded the use of perches. There are many studies on the effects of perches on broiler behaviour (Bizeray et al., 2002; Rodriguez-Aurrekoetxea et al., 2015; Ohara et al., 2015), however the knowledge about the use of platform-type elevated structures on farms is insufficient. The current study provides novel information about broiler behaviour on large commercial flocks. However, the number of observed flocks is low, thus limiting to the generalizability of the results.

Our result support earlier studies showing a low use of perches by broilers (LeVan et al., 2000; Martrenchar et al., 2000; Su et al., 2000; Pettit-Riley and Estevez 2001; Hongchao et al., 2014), although broilers have also been reported to perch as much as 10–25% of their time (Bizeray et al., 2002; Ventura et al., 2012). One possible reason for a variation on perch use is the breed. In the present study we used fast growing meat chicken (Ross 508) with a high breast muscle yield. However, even in slow growing broilers, perching behaviour has been shown to be highly variable (Nielsen, 2004; Lee and Chen, 2007; Rodriguez-Aurrekoetxea et al., 2015), suggesting other reasons for the variation between the studies.

The fact that the current study was conducted on a commercial broiler farm might have contributed to the low use of perches compared with earlier studies in experimental conditions (Pettit-Riley and Estevez 2001; Ventura et al., 2012; Hongchao et al., 2014). The remarkable difference in the use of perches compared to platforms observed in the current study indicates that offering traditional perches to broilers in commercial farms might be suboptimal use of farmer's resources. Although it is important to increase the environmental complexity of broilers, the value of traditional perches, at least of the type used in this study, for broiler welfare, might need critical evaluation.

Broiler chicken seem to have difficulties reaching higher perches as they were mostly using the lowest ones only requiring a leap of 10 cm. In addition to being the lowest perch the 10 cm perches were also at the outside of the structure, allowing bird to jump on them directly from ground whereas the higher perches were probably only reachable from another perch. Perches in earlier studies were of comparable height (15 cm), and still frequently used (Bizeray et al., 2002; Ventura et al., 2012), yet perches in the current study were left almost unused. Another possible reason for the low perch use could be unsuitable perch thickness. However, in previous studies perches of comparable thickness have been used by broilers (Bizeray et al., 2002; Bailie and O'Connell, 2015).

Further, the fact that the broilers used platforms to a high degree, indicates that they did have a motivation to use elevated structures if given the possibility. Thus, it seems probable that the low use of perches is not due to a lack of motivation as such. One reason for the low perch use might instead be that broilers find it physically challenging to use these. Compared to layer chicken, broilers are much heavier and are bred for muscle size (Shim et al., 2012), which might make it difficult for them to reach, or stay on, the perches.

One possible explanation for the high use of platforms is that the perching behaviour is motivated by an urge to decrease the animal density. Martrenchar et al. (2000) observed more perching with high densities. However, studies have contradictory results as Ventura et al. (2012) observed an opposite trend. All our flocks were housed at similar densities, thus we are not able to elucidate

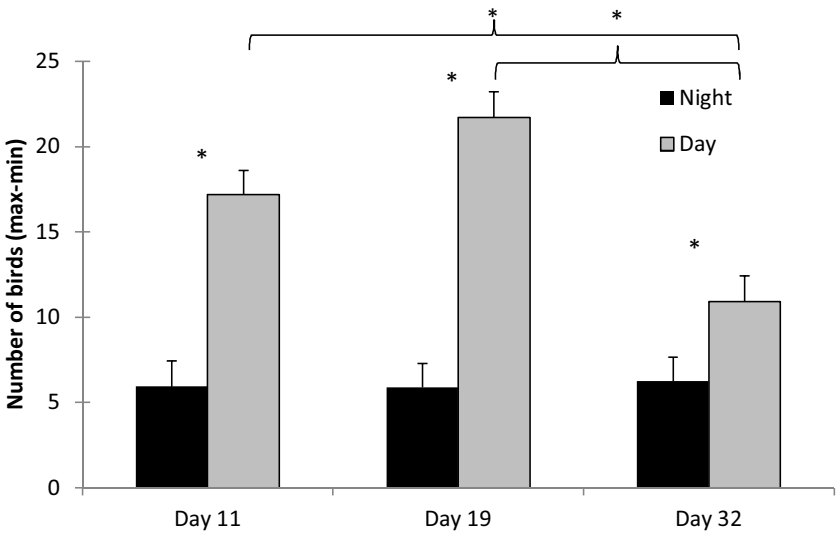

Fig. 4. Broiler activity by age and time of day. Activity is described as mean (SE) 'Difference of bird counts' counted on floor during 6 consecutive observations 10 min apart. The figure demonstrates an interaction of age and time ($P = 0.001$). The data is based on observations of 12 flocks. (* $P < 0.05$).

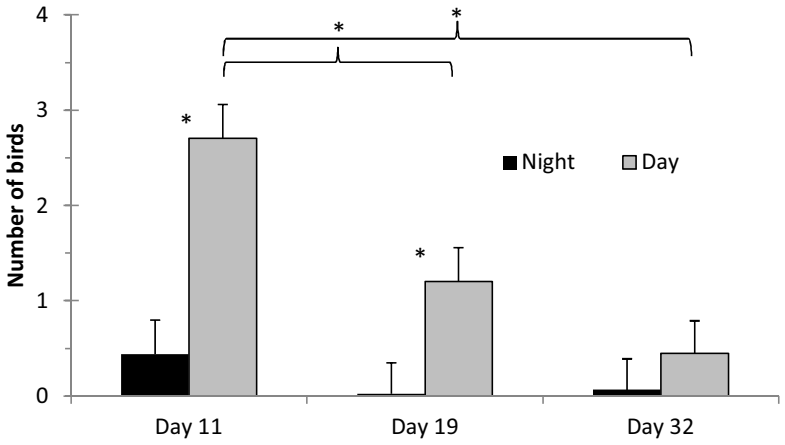

Fig. 5. Broiler activity by age and time of day. Activity is described as mean (SE) number of 'Runaways', broilers moving out of the frame during the focal bird observation period. The figure demonstrates an interaction of age and time ($P = 0.022$). The data is based on observations of 12 flocks. (* $P < 0.05$).

this question. Our results show that fewer birds used the platforms near slaughter age than at the younger observation age. This might be mainly due to the fact that the broilers were larger and there was not enough room for as many birds to use the platforms as in the beginning. Another possible factor contributing lower use of platforms of older broilers is their dwindling locomotor activity. Ohara et al. (2015) recorded a peak in perching rate at the age of 3 weeks in broilers and Ventura et al. (2012) and Bailie and O'Connell (2015) observed a peak in perching behaviour at age of 4–5 weeks.

However eagerly used, the platforms did not facilitate activity on the floor in an area with no platforms. Many studies suggest that perching, possibly also including perching on platforms, could stimulate a greater variety of locomotor activities, which in turn might be beneficial for welfare (Bizeray et al., 2002; Ventura et al., 2012; Bailie and O'Connell, 2015). Elevated structures can permit larger behavioural repertoire like jumping, flying attempts, grasping with digits, walking up hill and gazing. However, it is still not confirmed that this is the case, as several studies including our own, have failed to show increase in general locomotor activity (Bizeray et al., 2002; Rodriguez-Aurrekoetxea et al., 2015; Bailie and O'Connell, 2015).

Birds were more active during the day than during the night, and the day time activity decreased towards slaughter age. The decrease in broiler activity with age has been noted in many other studies (Bizeray et al., 2002; Ventura et al., 2012; Ohara et al., 2015) and has been suggested to be due to body weight impairing the movement, as lifting the body with a harness increased the activity (Rutten et al., 2002). In addition, older birds are more often lame and lameness is associated with reduced activity (Weeks et al., 2000). The passivity might also owe to pain, as giving birds pain medication improved their walking (Caplen et al., 2013).

Platforms were used more during the day than during the night. This implies that platforms were not primarily used for night-time perching, which, in adult chicken is a highly motivated behavioural pattern (Olsson and Keeling, 2000). Nielsen (2004) reported a clear diurnal pattern of more perching at night with one slow growing broiler strain at 5 weeks of age while no perching at all with another slow growing strain. However, also layer chicks have been reported to start using perches during the day at a much earlier age than during the night (Heikkilä et al., 2006). Still at the age of 6 weeks, layer chicks mostly rested under the heating lamps during the nights

instead of perching (Heikkilä et al., 2006). This suggest that also broilers may be too young for regular night-time roosting.

In conclusion, in commercial broiler houses the birds were using platforms with ramps eagerly but the use of perches was negligent. Nevertheless, the use of platforms did not appear to increase the general activity of the birds. The advantages of traditional perches for broilers should be re-evaluated as they remained largely unused. However, our prototype platforms show good potential as environmental stimuli for broilers.

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