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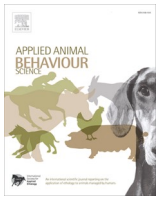

Commercial broiler breeder pullet hens use perches but show no preference for perch type or height

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ABSTRACT

An important behavioral need for laying hens is perching, but few studies have investigated perching behavior in commercial broiler breeder pullets. The aim of this study was to investigate perching behavior throughout the pullet period and preferences for different perch types and heights. We also investigated the effect of hybrid on perching and the potential effect of perches on keel bone damage (KBD) and footpad dermatitis (FPD). We followed four commercial broiler breeder pullet hen flocks (Ross 308, n = 2 and Hubbard JA 757, n = 2), each with three groups of birds (n = 2 500 hens); *A-group*; four A frames consisting of four perch types (plastic, steel square, steel round and wood) placed on different heights (35 cm and 95 cm); *S-group*; Siesta perches (a plastic perch 15 cm high) and *C-group;* control group without perches. Perch use was recorded by counting number of birds on the perches during the last hour before the light went off, at week 2, 5, 6, 7, 10, 12 and 15. At week 16, footpad dermatitis, keel bone deformations and keel bone fractures were scored in 30 random birds in each group (n = 90 birds/flock). Hubbard birds perched significantly more than Ross birds ($P < 0.0001$), and more birds perched on the Siesta perches than on the A frames ($P = 0.046$). Perching increased with age for Hubbard birds ($P < 0.05$), but not for the Ross birds. There were no effects of perch height or perch types on number of birds observed on the perches. There were no observed cases of bumblefoot, breast blisters, keel bone deformations or keel bone fractures. The incidence of FPD was low, with 73.6% of assessed birds receiving a score of 0, with no significant differences between hybrids or perch groups. In conclusion, Hubbard birds perched more than Ross 308 birds, and all birds perched more with age. None of the hybrids showed any preferences for perch type or height and increased perching had no negative effects on important health parameters. Broiler breeder pullets should therefore be given access to perches from day 1 to promote training and perch use.

1. Introduction

A sustainable poultry production must encompass acceptable welfare for the birds throughout the value chain, including the breeding stock. Animal welfare is a broad concept, but acceptable welfare for farm animals includes at a minimum good health, accommodation of behavioral needs and facilitation of positive emotions (Fraser and Duncan, 1998). One important behavioral need for laying hens is perching (e.g. Newberry et al., 2001), which is an anti-predator behavior still strongly embedded in the birds. Laying hens perch for three main reasons; to roost at night, to reach resources and to escape unwanted attention from other birds (Gunnarson et al., 2000). Several studies have shown that laying hens are strongly motivated to perch, and will work harder for access to an elevated perch compared to an elevated platform (Olsson and Keeling, 2002). Consistent with the anti-predator strategy, laying hens prefer a high perch (60 cm above the ground) over a lower perch (15 cm) (Schrader and Müller, 2009). Regarding materials, laying hens do not show much preference for particular features such as material or width (Liu et al., 2018), but have in some studies shown a preference for flat and wide perches (<4 cm) (Struelens and Tuyttens, 2009; Pickel et al., 2010; Skånberg et al., 2021). Perches of hard materials such as steel or hard plastic are durable and hygienic, and could be a good option if the birds do not show preferences between materials.

Knowledge about the importance of perches has resulted in perches being included as a requirement in European regulation, stating that all laying hens must have access to minimum 15 cm perch per hen (Council Directive 199/74/EC). However, apart from Switzerland, there is currently no national requirement for perches for broilers or broiler

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breeders in Europe. Perches are seldom used in broiler production, as broilers generally prefer platforms over perches (Norring et al., 2016; Bailie et al., 2018). Only a few studies have investigated perching behavior in commercial broiler breeders, and fewer yet in commercial broiler breeder pullets.

Brandes et al. (2020) investigated perch use by broiler breeders in commercial flocks of Ross 308, Ross 708 and the slower growing Ross Ranger. The birds were given perches of different materials, heights and locations (littered area and elevated slats) depending on the farm. The flocks used all the perches with a higher intensity during the dark period (2.07 birds/m perch versus 0.73 birds/m in the light period) and seemed to prefer perches with a height of at least 5.5 cm. The Ranger birds perched more than Ross 308/708 during day time, but perching was similar between the hybrids during the dark period. A study by Gebhardt-Henrich et al. (2018) suggests that broiler breeders of both Sasso strain and Ross 308 are motivated to perch; nighttime perching increased from only a few birds at 10 WOA, reaching a maximum after 20 weeks of age (WOA) where almost all birds perched at night and declining after 35 WOA. Perching behavior in broiler breeders may also be linked to perch space. Gebhardt-Henrich et al. (2017) compared groups of Ross 308 broiler breeders with 5, 10, 14 and 20 cm perch space. More birds perched at night when provided with 14 cm perch length per bird, but there was no difference between 14 and 20 cm per bird. Perch use in this study was relatively low (50–20%) and declined with age. With decreasing perch length per bird, more birds were found sitting on the slats and the elevated hen feeder lines at night, suggesting those structures were less preferred.

Access to perches from a young age will increase the use of perches in laying hens (e.g. Newberry et al., 2001). In the wild, feral fowl start nighttime perching around six WOA depending on the flight feathers, predation and the mother hens' behavior (McBride et al., 1969; Duncan et al., 1978). Similar development of perching has been observed in laying hens, where perching behavior increases from 5 WOA, after which most birds consistently perch at night (Heikkilä et al., 2006; Kozak et al., 2016). In Ross 308 and Sasso broiler breeder pullets, one study showed that the birds began perching in low numbers between 5 and 10 WOA (Gebhardt-Henrich et al., 2018). Several studies have found a difference in perching behavior between hybrids (Gebhardt-Henrich et al., 2018; Brandes et al., 2020), which may partly be explained by differences in body mass, as lighter birds generally perch more than heavier birds (Kozak et al., 2016). However, the observed differences between hybrids in broiler breeders may also be due to different motivations to perch, forage, or escape unwanted copulations. Varying body mass and motivation to perch may require specialized perch adaptions for different hybrids, and more knowledge on this is needed.

Environmental enrichments such as perches should improve animal welfare by accommodating important behavioral needs. Furthermore, access to perches has positive effects on the hens' development of leg muscle, bone minerals, spatial cognition, and reduces fearfulness (Gunnarson et al., 2000; Enneking et al., 2012). However, some studies suggest that perches may have negative effects on bird health, including increased prevalence of keel bone deformations (KBD) which may affect more than 80% of the laying hens in a flock (Sandilans et al., 2009; Pickel et al., 2010; Rufener and Makagon, 2020). A negative effect of perches was also found by Gebhardt-Henrich et al. (2018) with more KBD in Sasso breeders (40%) compared to Ross 308 breeders (15%). The large breast muscle in broiler breeders might protect the keel bone as it is less exposed compared to laying hens, or it might be due to less perching behavior in broiler breeders. However, we do not know at what age KBD start to develop in broiler breeder pullets, or if early access to perches increases their prevalence. In addition, foot pad dermatitis (FPD) and bumble foot are well known welfare issues in broiler breeders, and we need to investigate if early access to perches has any positive or negative effects on these important health indicators.

The aim of this study was to investigate (1) overall use of perches at different ages throughout the rearing period (2) preferences for different perch types and heights (3) effect of hybrid on perching and preferences (4) effect of perches on prevalence of KBD, FPD and bumble feet in commercial broiler breeder pullets.

2. Material and methods

2.1. Study design

A total of four commercial rearers, with one flock per farm, were included in the study. The four hen pullet flocks (Ross 308, n = 2 and Hubbard JA 757, n = 2) were observed throughout the pullet period (0–18 week of age (WOA)) in the eastern and middle part of Norway from March to August 2021. Each flock (n = 7 500 hens) had three separate groups of birds (n = 2 500 hens), randomly allocated by the farmer to one of the following treatments; *A-group*; four different A frames consisting of four types of perches made from thee different materials placed in different heights (plastic, steel square, steel round and wood; Figs. 1a and 1b), *S-group*; Siesta perches (Fig. 2) and *C-group;* control group without perches for the comparison of the welfare indicators. A-group and S-group had access to perches from day 1. Because the study did not involve any adverse animal handling, experimental manipulations or invasive procedures, it was exempt from approval of animal use by the Norwegian Food Safety Authority (Norwegian Regulations on Use of Animals in Research, 2015).

2.2. Animals and housing

All birds in a flock were kept in the same house, and the three groups of hens in the flock were separated by netting walls. Males were reared in a separate group in the same house and were not part of the study. All houses were fully insulated with mechanical ventilation and concrete floor with wood shavings. Management during rearing followed the recommendations of the breeding companies and Norwegian regulations. All flocks were managed according to standardized practices with regards to feed, water, ventilation, litter and lighting (Norwegian quality standard: KSL, 2020). The flocks had a short dusk period, where the light gradually decreased over 5 min. All flocks were fed pelleted feed using a spin-feeder once per day. The pullets arrived at the farm as day-old chicks, and were randomly allocated by the farmer to one of the three perch groups. There were no other perches available in the animal room. The pullets remained in the same group during the pullet period, and were sent to the broiler breeder farms at around 18 WOA. Average live weight of Hubbard hens at 18 WOA was 1 680 g, while the corresponding number for Ross 308 hens was 1 950 g.

2.3. Perches

2.3.1. A frames group (A-group)

The four A frames were placed in different areas of the litter area. Each of the four A frames (A-rack metal, Big Dutchman, Vechta, Germany) were 150 cm long with a steel frame, and had perches in two different heights: 35 cm and 95 cm. Each frame had four different perches (each 150 cm long); steel round (Ø 33 mm, Big Dutchman), steel square (40 mm, Big Dutchman), plastic (Ø 38 mm, APL/NAT, Big Dutchman) and wood (Ø 35 mm, NAT, Big Dutchman) (Fig. 1a). The four different perches were placed in the different positions on each A frame (Fig. 1b), labeled P1, P2, P3 and P4 (Fig. 1a). Total length of each perch type in the group was 4×150 cm = 600 cm. Based on the average shoulder width of the Ross 308 (Aviagen, 2018), each perch type in A-group (600 cm total) should theoretically accommodate a maximum of 120 (WOA 5 with 5 cm shoulder width), 66 (WOA 10 with 9 cm shoulder width) and 42 (WOA 15 with 14 cm shoulder width) birds respectively, if the birds perched shoulder to shoulder along the entire perch length. Information on the average shoulder width on Hubbard hens at different ages are not available, but they are smaller than the

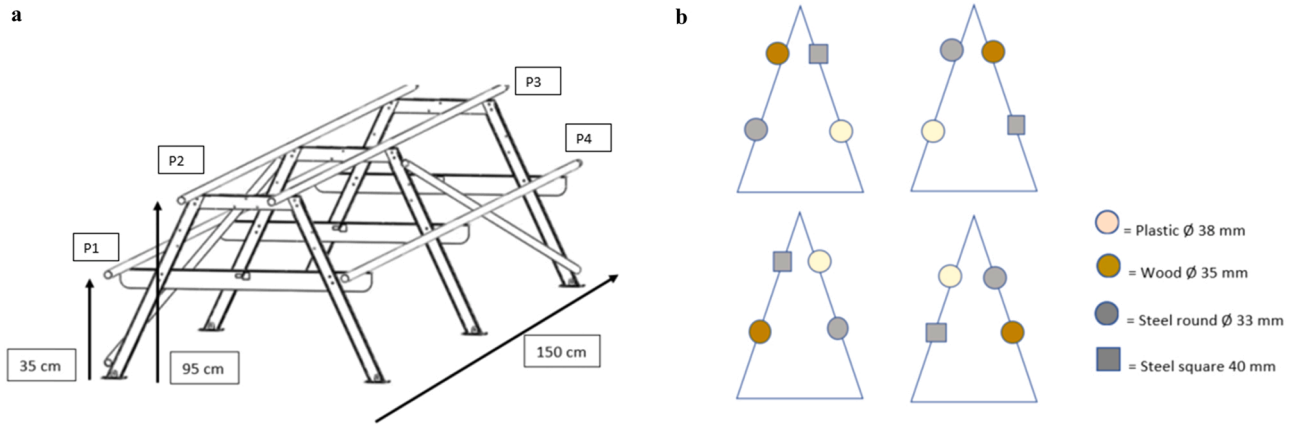

Fig. 1a. Schematic figure of the A frame (figure: Big Dutchman, Vechta, Germany).

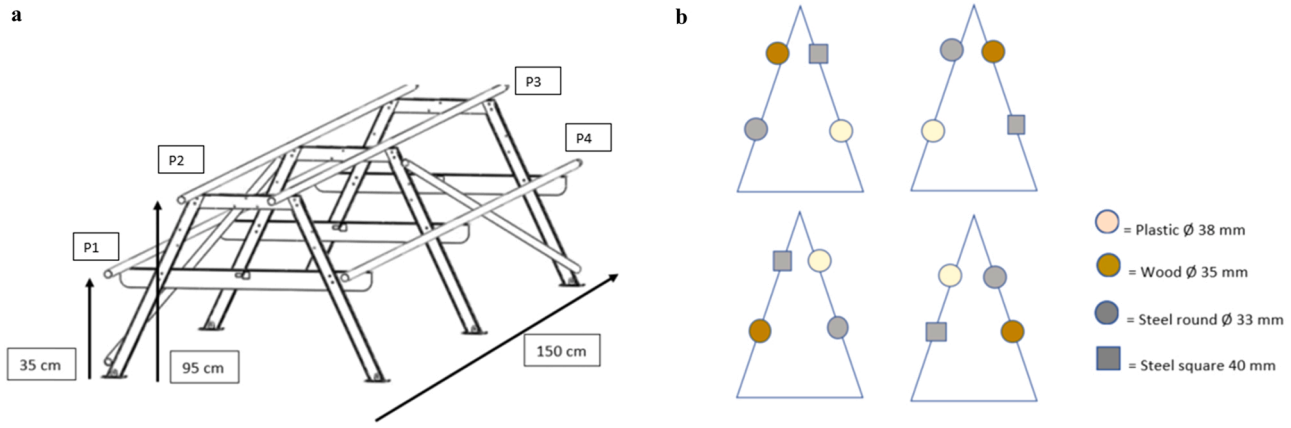

Fig. 1b. The different combinations of heights and perch types in the four A frames.

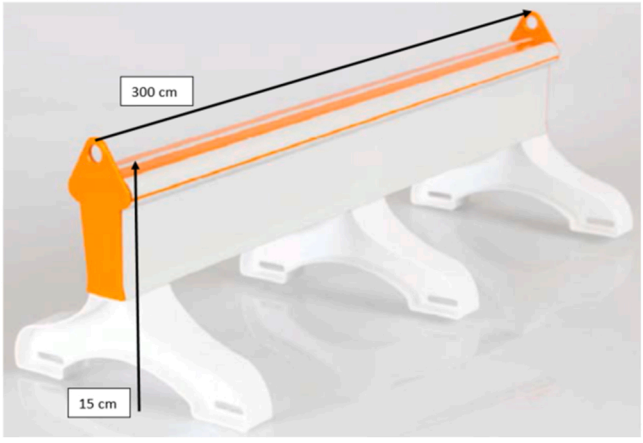

Fig. 2. The plastic Siesta perch (figure: Big Dutchman, Vechta, Germany).

Ross birds. The estimates based on the width of the Ross hens will therefore likely be a small underestimate for the Hubbard hens. The Ross shoulder widths corresponds to 20, 11 and 7 birds/m perch at 5, 10 and 15 WOA, respectively.

2.3.2. *Siesta group (S-group)*

In the S-group on each of the four farms, three Siesta perches (Siesta L3000, Big Dutchman, Vechta, Germany, Fig. 2) were placed in the litter area. The Siesta perches are specifically designed for broiler breeders, and are made of hard plastic, with a mushroom shaped top with an even surface. Each Siesta perch was 15 cm high, 80 mm wide, and 300 cm long, resulting in 900 cm Siesta perch length per group. Based on the average shoulder width of the Ross 308 hens (Aviagen, 2018), the perches in S-group (900 cm total) should theoretically accommodate a maximum of 180 (WOA 5 with 5 cm shoulder width), 100 (WOA 10 with 9 cm shoulder width) and 64 (WOA 15 with 14 cm shoulder width) birds respectively, if the birds perched shoulder to shoulder along the entire perch length. This corresponds to 20, 11 and 7 birds/m perch at 5, 10 and 15 WOA, respectively.

2.4. *Observation of perch use*

Pictures of the four A frames and the three Siesta perches were taken by the farmers using their mobile phones at week 2, 5, 7, 10 and 15, during the last minutes before lights were turned off. Perch use in A-group was then recorded from the pictures by one scientist by counting the number of birds on each A frame, including perch type and height, and in S-group by counting number of birds on the three Siesta perches. In addition, week 6 and 12, each farm was visited once by an observer (GV), and perch use in A-group and S-group were recorded through video recordings. The video cameras (Sony Handycam HDR-CX 405, Zaventem, Belgium) placed on tripods (Velbon EX-330, Yamanashi, Japan) were placed around 3 m away from each A frame two hours before the light went off to allow the birds to get used to the presence of the cameras. Then, perching behavior was recorded during the last hour before lights were turned off. In the video analyses, number of birds on each perch and height (A-group) and on the Siesta perches (S-group)

every 5 min were counted and summed per group per hour (n = 30 scans/group/age).

2.5. Health recordings

At 16 WOA, one observer recorded FPD on a categorical scale (scale 0–4, Welfare Quality®) in 30 random birds in each perch group (n = 90 birds/flock). Randomization was performed by walking though the flock, allowing the gaze to land on a random bird, and then selecting the bird next to the original bird. Keel bone deformations (scale 0–2, Welfare Quality®) and keel bone fractures (scale 0, 2, Welfare Quality®) were scored by palpation in 30 random birds in each group (n = 90 birds/flock). In addition, prevalence of toe lesions, bumblefoot and breast blisters were recorded on a 0/1 scale. Litter quality was scored at the same day, using a categorical scale (scale 0–4, Welfare Quality®).

2.6. Statistical analysis

Statistical analyses were performed using the software SAS 9.4 (SAS Institute Inc., Cary, NC, USA). The data collected from the pictures and from the videos of perch use were analyzed separately. From the videos, the number of birds per perch in each scan (n = 12) was summed and averaged for the hour of observation. The number of birds observed perching per meter of perch available (i.e., 24 m of A frame perches and 9 m of Siesta perches) per flock per week of age was calculated. The use of perches was analyzed using the mixed procedure, with perch group (A-group vs S-group), week of age, hybrid and their interactions as fixed factors and flock as a random factor. The data fit the model assumptions, e.g. normal distribution of the residuals. Insignificant interactions were removed from the model in a backward inclusion method until the final model contained only the individual fixed factors.

For the analysis of preference for A frame perch height and perch type, the number of birds observed in each combination of perch height and perch type was counted per flock per week of age. This number was analyzed using the mixed procedure, with the fixed factors perch height, perch type, hybrid, and week of age, as well as their interactions. Flock was included in the model as a random factor. As before, the non-significant interactions were removed from the model in a backward inclusion method.

The effect of perch use on footpad dermatitis on a categorical scale was tested using the GLIMMIX procedure, with a multinomial ordered distribution, with perch group and hybrid as fixed factors and flock and litter quality as random factors. The model including the interaction between perch group and hybrid did not meet the conversion criteria and, therefore, this interaction was not included in the final model. The other health issues (keel bone deformations, keel bone fractures, toe lesions, bumblefoot and breast blisters) did not appear or were present in too low numbers to be statistically analyzed.

3. Results

3.1. Effect of age and hybrid on perch use

The observations at week 2, 5, 7, 10 and 15 showed no interaction effect between the fixed factors (hybrid, perch group, week of age (P > 0.05)). There was an effect of hybrid, with more Hubbard birds/m perch compared to Ross 308 at all ages ($F_{1,32}$ = 30.70; P < 0.0001) (Table 1, Fig. 3). There was also an effect of perch group, with more birds/m perch observed on the Siesta perch compared to the A frames ($F_{1,32}$ = 4.31; P = 0.046) (Table 1). In general, perching increased with age ($F_{4,32}$ = 2.92; P = 0.04), with more birds/m perch observed at week 10 of age compared to week 2 (P = 0.04) (Table 1, Fig. 3).

The video observations at week 6 and 12 show that Hubbard birds perched significantly more than Ross birds at both ages ($F_{1,10}$ = 17.15; P = 0.002) (Table 1, Fig. 4). There was a tendency for both hybrids to perch more at week 12 compared to 6 weeks of age ($F_{1,10}$ = 3.33; P = 0.1) (Fig. 4).

Table 1
The effect of age, perch group and hybrid on perching by broiler breeder pullets, based on pictures at week 2, 5, 7, 10 and 15, and video observation at week 6 and 12.

Photos	Variable level	LS Means	Standard Error
Perch group	A Frame	1.41[a]	0.27
	Siesta	2.21[b]	0.28
Week of age	2	0.61a	0.42
	5	1.65[ab]	0.42
	7	2.32[ab]	0.42
	10	2.40[b]	0.42
	15	2.06[ab]	0.46
Hybrid	Hubbard	2.88[a]	0.27
	Ross 308	0.74[b]	0.23
Videos			
Perch Group	A Frame	1.67	0.40
	Siesta	1.26	0.40
Week of age	6	0.94	0.44
	12	1.99	0.37
Hybrid	Hubbard	2.65[a]	0.44
	Ross 308	0.28[b]	0.37

[a,b] Different letters within photos or videos and variable indicate significant differences (P < 0.05).

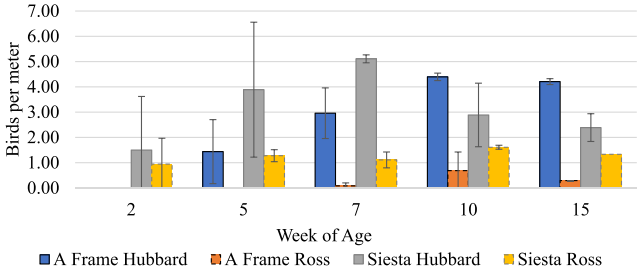

Fig. 3. Broiler breeder pullets/m perch (mean ± Standard deviation) observed perching in one picture per perch/age taken at 2, 5, 7, 10 and 15 weeks of age.

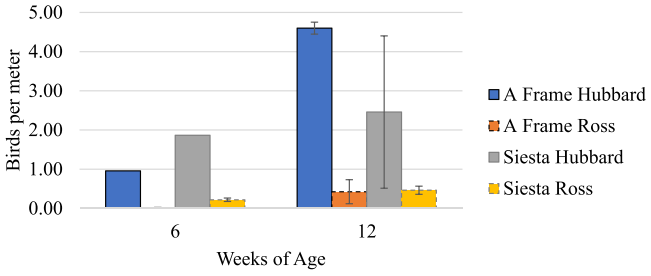

Fig. 4. Broiler breeder pullets/m perch (mean ± Standard deviation) observed perching in the videos taken during the last hour before the lights went out at 6 and 12 weeks of age.

3.2. Preferences for perch types and heights in the A-group

The observations at week 2, 5, 7, 10 and 15 within the A-group show no effect of perch height or perch type on number of birds/m perch (F_{1114} = 0.86; P = 0.35 and F_{3144} = 0.63; P = 0.6, respectively) (Fig. 5). There was, however, a significant interaction between hybrid and week of age (F_{4144} = 14.26; P < 0.0001). As can been seen from Fig. 5, the use of perches on the A frame increased with age for the Hubbard birds (P < 0.05), but not for the Ross birds (P > 0.05).

3.3. Health assessment

The health recordings at 16 weeks showed no observed cases of

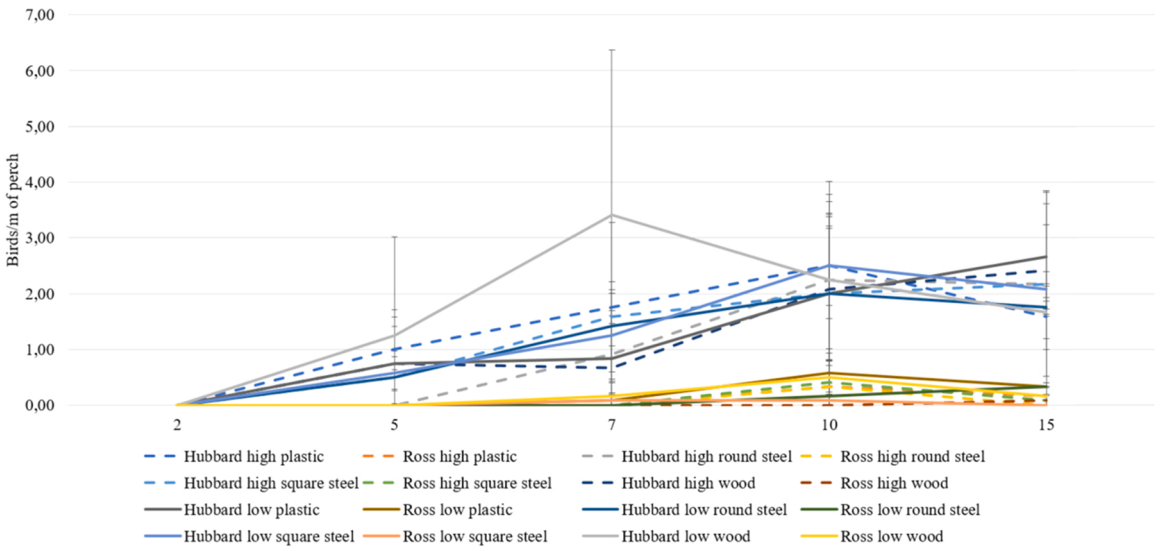

Fig. 5. Broiler breeder pullets m/perch material and height (35 cm/ 95 cm) in the A group (mean ± Standard deviation) observed perching.

bumblefoot, breast blisters, keel bone deformations or keel bone fractures in any of the flocks. Furthermore, only two cases of toe lesions were observed in the 360 birds assessed (0.56%); one in a Ross bird, the other in a Hubbard bird; both with access to Siesta perches. Overall, the incidence of footpad dermatitis was low, with no observed cases of score 4% and 73.6% of assessed birds receiving a score of 0 (Fig. 6). Despite the numerical differences that can be seen in Fig. 6, particularly between hybrids, the statistical analysis did not detect a significant effect of either perch type or hybrid ($F_{2352} = 0.82$; $P = 0.44$; and $F_{1352} = 1{,}58$; $P = 0.21$, respectively).

4. Discussion

The aim of this study was to investigate overall use of perches by broiler breeder pullet hens at different ages during the rearing period as well as preferences for different perch types and heights. Furthermore, we wanted to investigate the effect of hybrid on perching behavior and if access to perches affected prevalence of KBD, FPD and bumble feet. Our results show that the birds perched increasingly more with age, and that they started using the Siesta perch early on. At week 2, we observed on average 2 and 1 birds/m perch for Hubbard and Ross 308, respectively. In week 5, this number increased to around 5 and 1.5 birds/m perch for Hubbard and Ross, respectively. Based on the average shoulder width of Ross hens, approximately 5 cm wide at 5 weeks old (Aviagen, 2018), the perches could theoretically fit 20 birds/m perch if the birds perched shoulder to shoulder. For the slightly smaller Hubbard hens, this estimate may be a small underestimate. This means that the perch utilization at 5 weeks were 25% and 7.5% for Hubbard and Ross, respectively. Few studies have reported broiler breeder perch use in detail during the pullet period, but one study reports that the birds began perching in low numbers between 5 and 10 WOA (Gebhardt-Henrich et al., 2018). Our results are similar to studies in laying hens where perching starts during the first week of age (Heikkilä et al., 2006). From week 2 until week 10, the Siesta perch was most used by both hybrids in the present study. An important point however, is that there was more total perch meter provided for the Siesta perch compared to the four different perch types on the A frames (9 m vs. 6 m). As broiler breeders are prey animals, synchrony of behavior is important, and the amount of perch space available could have affected the outcome. Future studies should provide equal amount of perch length for all perch types. Furthermore, the Siesta perch is lower (15 cm) and wider (8 cm) than the lowest perches on the A frame (35 cm high, 3–4 cm wide), likely making them more accessible and easier to land on for the young pullets. On average, we observed 3.9 and 1.3 birds/m on the Siesta perch at week 5 (Hubbard and Ross, respectively), while corresponding numbers for the lowest perches on the A frames were 1.4 and 0 birds/m perch. Skånberg et al. (2021) found that laying hen pullets preferred a wide and flat perch over narrow and round perches, they had fewer problematic landings on the wide and flat perches and preferred these for resting and preening. This could be part of the explanation for the higher use of Siesta perches at an early age in our study. Early access to wide and flat perches such as the Siesta perch may promote perch use and training for the breeder pullets.

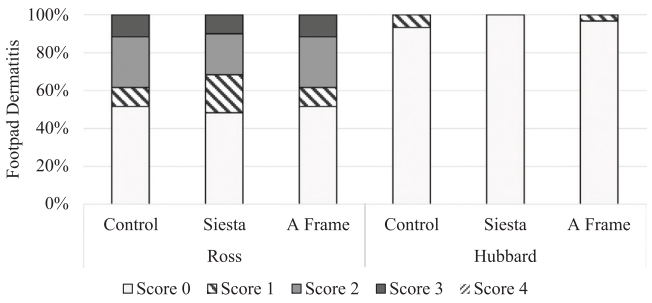

Fig. 6. Percentage distribution of footpad dermatitis scores across the two hybrids and three groups during the health visit at 16 weeks of age.

In the present study, Hubbard birds perched more than Ross 308 birds at all ages. This is similar to results reported by Gebhardt-Henrich et al. (2018), where the lighter Sasso birds perched more than the heavier Ross 308 birds. On the other hand, Brandes et al. (2020) compared perch use by broiler breeders in the slower growing Ross Ranger and the fast growing hybrids Ross 308 and Ross 708, and found similar perch use in all hybrids during the dark period. The birds used the perches three times more in the dark period (2.07 birds/m perch) compared to the light period (0.73 birds/m perch). The Ranger, however, perched more than Ross 308/708 during the light period. In the present study, we only observed perching during the light period, albeit in the hours preceding dusk, and further studies should include observations of perch use by pullets during the dark period as well.

Within the A-groups, the birds showed no preference for the lower (35 cm) or higher (95 cm) perches. Ross 308 hens are 5 cm wide from shoulder to shoulder at 5 WOA, increasing to 9 cm shoulder width at 10 WOA and to 14 cm at 15 WOA (Aviagen, 2018). The high perches (150 cm×8 = 12 m) should therefore be able to fit at least 240, 133 and 85 birds at 5, 10 and 15 WOA, respectively, if they perched shoulder to shoulder. The largest number of birds observed at the high perches were

66 birds, in one of the Hubbard flocks at 5 WOA. Thus, the perches in our study were not used to maximum capacity, and if the birds had strong preferences for one perch type or height, there would be available room on the perches. Adult broiler breeders in Brandes et al. (2020) clearly preferred the perches higher than 5 cm, and the highest perch use was by birds with wooden perches installed 15 cm above the slatted area. The motivation for selecting the higher perches is expected, as perching is partly an anti-predator strategy, and several studies have found that laying hens prefer a high perch (60 cm above the ground) over a lower perch (15 cm) (Schrader and Müller, 2009). In the A frame groups in the present study however, both the 35 cm and the 95 cm height appear to be equally attractive for the birds, and likely accommodate the birds' motivation for an elevated resting area.

We found no preference in any of the hybrids between perches of wood, steel or plastic in the present study. Gebhardt-Henrich et al. (2017) found that more birds perched when more space was available, and we do not know if number of perching pullets would increase if there were more perches, or other perch materials available. To the authors' knowledge, there are no systematic studies of perch material preference in broiler breeders. In laying hens, studies show divergent results; some studies report no preference for perch materials (Liu et al., 2018), while laying hen pullets in Skånberg et al. (2021) showed a clear preference of the wide rope perches over wood perches. Caged laying hens in Chen et al. (2014) preferred wood perches over steel and plastic, while Pickel et al. (2010) found that rubber perches decreased balance movements in adult layers. Mens and van Emous (2022) observed perching in broiler breeders and found that a majority of birds perched on the wooden slats, followed by the plastic perches (both were placed 50 cm above the litter). A preference for slats over perches has also been found in both fast-growing and slow-growing broiler chickens (Norring et al., 2016; Malchow et al., 2019). The lack of preference for perch material or heights in our study could imply that both steel, plastic and wooden perches are equally attractive for broiler breeder pullets.

Access to perches has in some studies been reported to increase the prevalence of keel bone fractures in adult broiler breeders (Gebhardt-Henrich et al., 2018) but not in all studies (Gebhardt-Henrich et al., 2017). We did not find any keel bone deformations, keel bone fractures or breast blisters in the 360 birds assessed by palpation. The full etiology behind keel bone damage is still being debated, but the onset of egg production and high egg production is likely involved (Toscano et al., 2020). In laying hens, palpation as an evaluation method for KBF is not as accurate as post-mortem examination or x-ray diagnostics (Tracy et al., 2019; Kittelsen et al., 2021). In addition, the accuracy of different methods for detecting KBF in broiler breeders have not been evaluated previously, neither in pullets nor in grown birds. Therefore, the prevalence of KBF in broiler breeder pullets should be investigated further. However, comparable results from laying hens show that KBF are not common prior to egg production and the pullets in the present study are too young to have started egg production.

Footpad dermatitis (FPD) is a serious welfare issue for broiler breeders with as much as 64% of the birds showing severe lesions at slaughter (Kaukonen et al., 2016). FPD is an entry gate for pathogens and may lead to increased mortality in broiler breeders (Thøfner et al., 2019). Presence of perches are reported to reduce footpad dermatitis in broiler breeders (Gebhardt-Henrich et al., 2017), but this is the first paper examining effect of perches on FPD in broiler breeder pullets. The incidence of footpad dermatitis at 16 weeks was low, with no observed cases of severe lesions and a majority of the birds receiving score 0. There were no differences in FPD between birds with or without access to perches. Although not significant, there was a numerical difference between hybrids, with the slightly heavier Ross birds (1 875 g vs. 1 520 g at 16 WOA) showing more severe FPD (around 30% of the birds with score 2 and 3) compared to Hubbard (0% of the birds with score 2 and 3). FPD generally increases with increased live weight (Kjaer et al., 2006), which could explain our results. It is likely that, had the present study included more flocks, this numerical difference would have also been detected statistically. Poor litter quality is regarded as a risk factor for FPD in broilers, but studies in broiler breeders have shown that FPD can occur even when the litter quality throughout the production period is good (Kaukonen et al., 2016; Thøfner et al., 2019). The litter quality in the four pullet flocks in the present study was good, and was not likely the cause of the FPD observed.

There are some important limitations in this study that should be addressed in future studies. As this is a field study, we could only include a limited sample size. In future studies, a higher number of flocks included per hybrid would provide more robust results to confirm the present findings. Furthermore, due to travel restrictions related to the Covid-19 pandemic, the pictures were taken by the farmers, and each flock could only receive a limited number of visits from the scientists with video camera. To increase number of observations per flock and group, a higher frequency of standardized visits is recommended.

In conclusion, birds of both hybrids perched increasingly more with age, and they started using the perches already from week 2. The lower and wider Siesta perch was most used by the young pullets, likely due to their easy accessibility and stability. Hubbard birds perched more than Ross 308 birds at all ages. The birds showed no preference for different perch heights or perch types, and access to perches had no negative effects on keel bone or foot pads. Broiler breeder pullets should therefore be given access to perches from day 1 to promote training and perch use.

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions

Guro Vasdal: Conceptualizing, Data sampling, Writing. **Sabine Gebhardt-Henrich**: Analyses, Writing. **Kathe Kittelsen**: Data sampling, Writing. **Fernanda Tahamtani**: Data sampling, Analyses, Writing.

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