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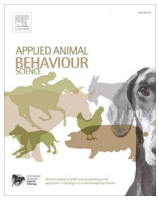

Broiler breeders roosted more on slats than on perches during the laying period

Annemarie J.W. Mens *, Rick A. van Emous

Wageningen Livestock Research, De Elst 1, NL-6708 WD Wageningen, the Netherlands

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ABSTRACT

Roosting on elevated areas is part of natural chicken behaviour, and therefore perches are required for broiler breeders in some countries. However, elevated slats may also meet the behavioural requirements. To date, hardly any research has been done on broiler breeder preferences for roosting on slats or perches. An experiment was conducted between 40 and 60 weeks of age (WOA) to observe the relative preference for elevated roosting places (slats and perches) in female Ross 308 broiler breeders, housed in 24 floor pens with each 26 females and 3 males at start. The birds could choose to roost on elevated wooden slats (30% floor surface) and on 2 plastic rectangle perches with rounded edges (total 4 m). Pens were further equipped with littered floor area, a drinking line above the slats and a nest box. Due to practical limitations, the litter, drinking lines and nest boxes could not be excluded as roosting areas. The number of birds per roosting place (slats, perches, drinking line, inside nest box and litter) were counted weekly, half an hour after lights went off. Three random birds per pen were marked to measure individual preference for roosting place over time. Breast blisters and feather cover of marked birds were scored at 45, 50, 55 and 60 WOA. The majority of the birds roosted on the slats (51.5 ± 1.4%), followed by the perches (23.9 ± 1.2%), drinking line (11.2 ± 0.7%), nest box (9.2 ± 0.7%), and litter (4.2 ± 0.8%). Generally, the preference for a certain roosting place was constant during the laying period and almost 80% of the birds were observed on the same roosting place at 15 of the 20 observations. More and severe breast blisters were found in birds roosting on the drinking line and perches, respectively, compared to the slats. Feather cover of birds roosting on slats was worse compared to the birds on the perches. The results of this study indicate that broiler breeders roosted more on slats rather than on perches, which is also more beneficial for their health. Furthermore, the broiler breeders roost consistently on their preferred place.

1. Introduction

Since chickens are prey animals, anti-predator behaviour is an important incentive to seek protection on an elevated place during the night (Wood-Gush et al., 1978; Newberry et al., 2001; Schrader and Müller, 2009). An elevated roosting place reduces the risk of getting caught by a ground predator (Wood-Gush and Duncan, 1976; Newberry et al., 2001). Therefore, the ancestors of modern commercial chicken breeds roost during the night in trees where they use branches as roosting places (Wood-Gush et al., 1978; Blokhuis, 1984). Moreover, roosting as high as possible from the ground may give the greatest feeling of safety (Brake et al., 1994; Keeling, 1997; Newberry et al., 2001; Brendler et al., 2014). This is underlined in an experiment where layers on high perches react less fearful towards a stuffed predator than layers on low perches (Keeling, 1997). For layers, height of elevated roosting places is more important than the material or layout of the roosting places (i.e., perches or platforms) (Schrader and Müller, 2009).

Layers and breeders, however, are different types of chickens and it is not clear if outcomes from research from layers is also applicable in breeders. Especially differences in mature BW, and thus mobility, between laying hens (1.6–2.0 kg) and broiler breeders (3.8–4.2 kg) could affect prevalence for material and or height. In the study of Gebhardt-Henrich et al. (2018) perch use of relatively heavy Ross 308 breeders (approx. 4 kg) was compared to relatively light Sasso breeders (approx. 2.5 kg). They observed a lower use of perches during the night (approx. 40% vs. 70%) for the Ross 308 compared to the Sasso breeders, which implies that BW affects perching behaviour. Moreover, the body conformation of laying hens and breeders is different due to the large breast muscles (Zuidhof et al., 2014), which means that the centre of gravity of breeders is different compared to layers, which might affect

* Corresponding author.
E-mail address: annemarie.mens@wur.nl (A.J.W. Mens).

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stability and reduces accessibility on elevated perches (Gebhardt-Henrich et al., 2018).

According to one study, 7.2% and 3.4% of breeder pullets roosted on perches (5 cm per bird available) during the day and night respectively (van Middelkoop and van Harn, 2003). More recent observations showed a higher use of elevated roosting places by broiler breeders. In a study with broiler breeder pullets under commercial conditions, 10% of the pullets were roosting on elevated perches during the day and 24% during the night at the end of the rearing period (von Wachenfelt and Berndtson, 2014). Gebhardt-Henrich et al., (2017, 2018) observed a higher use (between 35% and 70%) of elevated areas (perches, A-frames or aviaries) by fast- and slow-growing breeders. Research at commercial broiler breeder farms with different types of perches (plastic, metal or wood), showed that 23% (slow growing) to 27% (fast growing) of the birds used a perch at night, and that the use increased for both breeds while aging (Brandes et al., 2017).

Besides the use for natural behaviour, providing elevated roosting places during the rearing period helps to reduce the number of floor eggs during the laying period. In two consecutive studies, Brake (1987) found, on average, a 40% decrease in number of floor eggs during the laying period when breeder pullets had access to perches. By reaching elevated places (perches or platforms), the female pullets are trained to move vertically, which promotes the movement towards the nest boxes during lay (Aviagen, 2018; Hubbard, 2017). It is recommended by Aviagen (2018) to provide at least 1 m^2 elevated platforms (with slats) per 500 pullets around 50 cm above the floor from about 6 WOA onwards. To further stimulate the pullets to move in a vertical direction, a drinking water system is often installed above the elevated platforms (de Jong and van Emous, 2017; Riber et al., 2017).

However, perches could also increase physical injuries in broiler breeders. Observations have shown that perches can cause more breast blisters (von Wachenfelt and Berndtson, 2014) and keel bone fractures (Gebhardt-Henrich et al., 2018). The combination of increased BW and decreased mobility of breeders, resulting in longer periods of intensive point load on the sternum while aging, are suggested to cause these injuries (von Wachenfelt and Berndtson, 2014; Gebhardt-Henrich et al., 2018).

In general, legislation on perches for broiler breeders is very limited and varies between individual countries. In the Netherlands, 7 cm perch per bird is obligatory during the rearing and laying whereas, for example, 14 cm per bird is used in Switzerland (Gebhardt-Henrich et al., 2017). These standards are based on small-scale research and/or an extrapolation of results from layer experiments which may not reflect the needs for an elevated resting area in broiler breeders.

Until now, information on the preferences for elevated roosting places (slats or perches) of broiler breeders is limited. Studies on roosting places often lack a proper comparison, since the places do not have similar available space for the birds and/or are not positioned at the same height. Therefore, we carried out an experiment to observe the relative preference for roosting on slats or perches during the laying period in broiler breeders.

2. Materials and methods

The study was approved by the Dutch Central Authority for Scientific Procedures on Animals (CCD) and is registered under application number AVD4010020185007.

2.1. Animals, housing, and management

A total of 624 female and 72 male Ross 308 broiler breeders were randomly distributed over 24 floor pens (2.5 × 2.0 m). The breeders were part of another study until 40 WOA in which diet density and feeding frequency was studied (van Emous et al., 2021). The experiment started at 40 WOA with 26 females and 3 males per pen and stocking density was 5.8 birds (females and males) per m^2. Due to mortality and grading (smallest birds), this number was reduced to 24 females and 2 males at 50 WOA (stocking density: 5.2 birds/m^2). Each pen contained 2 feeding troughs for females (3.7 m total length) with a male exclusion system and a separate feeding trough (60 cm length) for males at a height of 50 cm to prevent females from accessing to the feed. The pens contained a drinking line (22 mm diameter, 80 cm long) with 7 nipple drinkers with drip cups 45 cm above the slats and 1 nest box (88 × 36 cm divided in 2 nests) adjacent to the slats outside the pens. Females and males received commercial female (11.93 MJ/kg AME_n; 14.8% CP; 0.58% dig. Lys; 0.56% dig. M+C; 3.0% Ca; 0.32% aP) and male diets (10.89 MJ/kg AME_n; 13.0% CP; 0.45% dig. Lys; 0.50% dig. M+C; 1.0% Ca; 0.30% aP). Males and females were fed simultaneously. Photoperiod was 14 L:10D (40 lx) with lights on between 02:45 and 16:45 h and room temperature was maintained at 20 °C.

2.2. Experimental design

The relative preference for roosting on slats or perches was determined in 24 pens with Ross 308 breeders per pen between 40 and 60 WOA. The layout of all pens was identical and due to practical limitations, the litter area, nest boxes and drinking lines could be used as roosting areas as well. For resting, breeders had access to a wooden slatted floor (150 × 100 cm; 30% floor surface) and two plastic rectangle plastic perches with rounded edges (37 × 32 mm, each 200 cm long) which were positioned opposite to each other (Fig. 1). In order to test the relative preference for layout and not the height of the elevated resting areas, both the slats and perches were placed at 50 cm height. In rearing, pullets had access to both a plastic slatted floor (150 × 60 cm) and the same plastic perches from 6 WOA onwards to prevent the development of a preference for a particular element at young ages. Calculations were made to compare the bird capacity of the slats and perches. The equation as published by Baxter (1992) was used to determine the required area for a roosting bird (cm^2) = 0.035 * W ^ 0.67 * 10,000 (W = animal weight in kg; ^ = power). The slats were 150 cm long and 100 cm wide (surface: 15,000 cm^2). However, because the birds often roost on the edges of the slats parts of the chickens were above the litter floor, resulting in a larger actual available surface. It was estimated that the animals could use approx. 10 cm extra space on all sides, making the available surface area 20,400 cm^2 (170 ×140 cm). Average width of the birds (20 cm) was measured (data not shown) for the needed space per sitting bird on the perches. For the roosting capacity of the perches, it was assumed that this width of the breeders did not change between 40 and 60 WOA. During the entire experiment the two different elevated roosting places could each accommodate almost at least 69% of all birds (Table 1).

2.3. Observations

2.3.1. Roosting place

Each week, the number of females roosting on or in different pen elements (slats, perches, drinking line, inside nest box, and litter) were counted by scan sampling half an hour after lights were turned off. Observations were performed using a small blue headlight which minimised reaction of the birds. In the rare occasion of a female moving to another place due to the light, the first roosting place was used.

2.3.2. Individual roosting preference

At 40 WOA, 3 random females per pen were marked with a blue livestock marker to measure individual preference for roosting place. Birds were marked on the left wing only, right wing only or both wings, respectively.

2.3.3. Breast blisters

Prevalence of breast blisters of the 3 marked females per pen was scored at 46, 50, 55 and 60 WOA. Breast blisters were scored from 0 (no breast blister), 1 (less than 1 cm, no swelling, pale skin), 2 (between 1

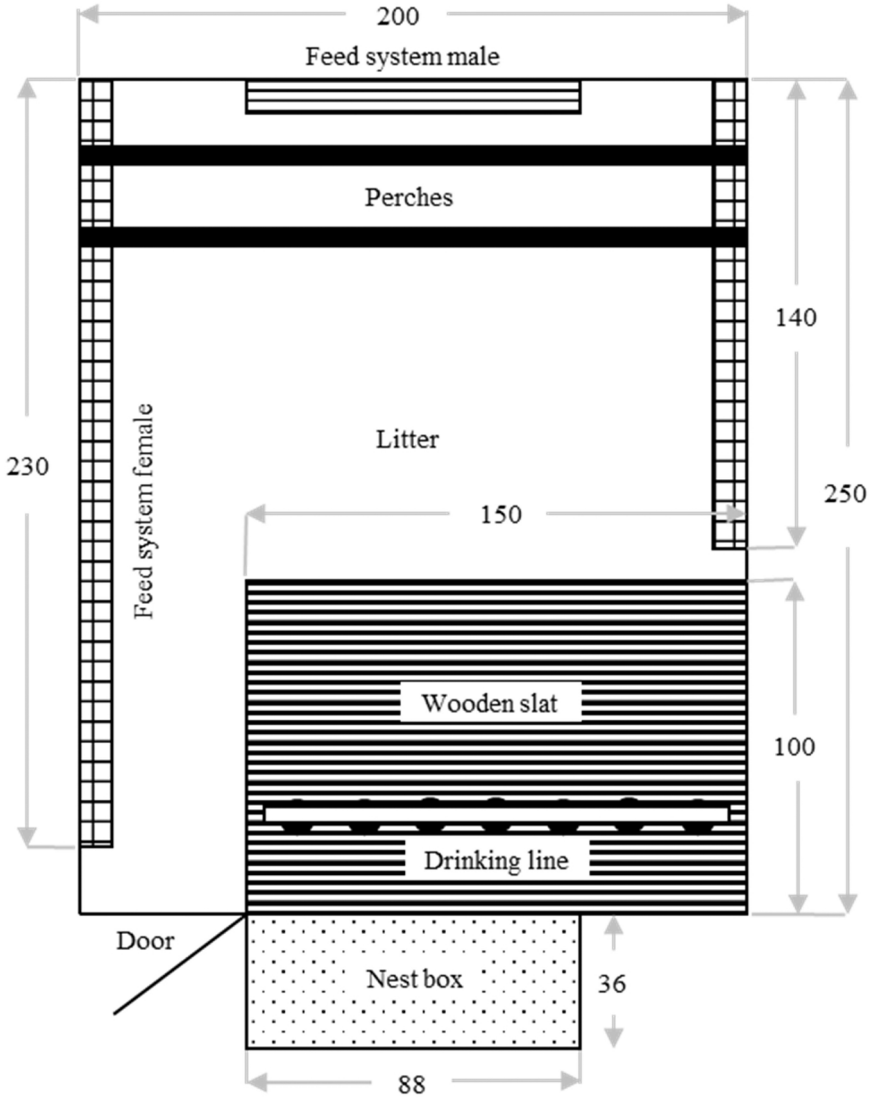

Fig. 1. Layout of one pen. All sizes in cm.

Table 1
Calculated roosting capacity of the different elevated roosting places.

Age (wk)	Birds/ pen (#)[a]	BW (kg)[b]	Required surface/bird (cm^2)[c]	Calculated capacity slats (# birds)	Calculated capacity perches (# birds)
40	29	3.98	883	23	20
45	29	4.07	896	23	20
50	29	4.16	908	22	20
55	26	4.18	913	22	20
60	26	4.21	916	22	20

[a] Males and females.
[b] Weighted average from BW of females and males.
[c] Based on Baxter (1992): required area for a roosting bird (cm^2) = 0.035 * W ^ 0.67 * 10,000 (W = bird weight in kg; ^ = power).

and 2 cm, small swelling, pink skin), 3 (between 2 and 3 cm, moderate swelling, pink skin), 4 (between 3 and 5 cm, moderate swelling, red skin), and 5 (more than 5 cm, big swelling, red skin).

2.3.4. Feather cover

At 45, 50, 55 and 60 WOA, feather cover of the 3 marked females per pen was scored according to the method described by Bilcik and Keeling (1999). Scores, varying from 0 (intact feathers) to 5 (completely denuded area), were given for each of seven body parts (neck, breast, belly, back, wings, tail, and legs). The average of these seven scores was also used for analysis.

2.4. Calculations and Statistical analysis

The data were analysed using Genstat statistical software (Genstat, 2018). Statistical significance difference was declared at $P < 0.05$, with $0.05 \leq P < 0.10$ considered as a tendency. Parameters were tested for normal distribution before analysis. The experimental unit for roosting place and preference was pen and for breast blisters and feather cover were the individual birds.

The roosting place preference was determined by the weekly counts of the number of birds at the different roosting places, converted to the percentage of birds. The average was determined at pen level of the total number of observations (20 weeks). The mean data per pen was analyzed by with linear mixed models (REML) with the main effects of age and roosting place (slats, perches, drinking line, nest box and litter) and pen as a random effect. Analyses were not corrected for multiple analyses. Multiple comparisons of the means were done by the Fisher's protected Least Significant Difference test.

Breast blisters and feather cover were analyzed with linear mixed

models (REML) with roosting place and age as main effect and pen as random effect. Due to the design of the study and the small number of observed birds per pen, pen was not included in the model. Analyses were not corrected for multiple analyses. Multiple comparisons of the means were done by the Fisher's protected Least Significant Difference test. At 45, 50, 55 and 60 WOA, individual marked birds were included in the analyses which were found consistently at least 75% of the weeks on the same roosting place. This means that birds were used found 4 out of 5 weeks (between 41 and 45 WOA), 8 out of 10 weeks (between 41 and 50 WOA), 11 out of 15 weeks (between 41 and 55 WOA) and 15 out of 20 weeks (between 41 and 60 WOA) on the same roosting place. Due to the lack of consistent observations of birds roosting on the litter and in the nest boxes, litter and nest boxes were excluded from analysis. The mean of the prevalence of breast blisters and the breast blister score were determined per observation day and per roosting place. Prevalence and score of breast blisters and feather cover score were analyzed with linear mixed models (REML) with age and roosting place as main effect and pen as random effect.

3. Results

3.1. Relative preference for roosting places

The majority of the birds roosted on the slats (51.5 ± 1.4%), followed by the perches (23.9 ± 1.2%), drinking line (11.2 ± 0.7%), nest box (9.2 ± 0.7%), and litter (4.2 ± 0.8%) ($P < 0.001$). The development of the relative preference over time is represented in Fig. 2. A significant interaction between roosting place and age was found ($P = 0.001$). Percentage of birds on the slats was relatively constant between 50% and 53% between 41 and 60 WOA. Use of the perches increased between 41 and 43 WOA from 23% to 27%, however, this decreased to 20% at the end of the laying period. The percentage of birds using the drinking line as a roosting place increased from 10% to 13% at 58 WOA where after it decreased to 11%. At 41 WOA the percentage of birds using the nest box as roosting place was 7.5%, which increased until 11.5% at 60 WOA. On average, only 4% of the breeders rested on the litter area.

3.2. Prevalence of breast blisters

Both the prevalence and severity of breast blisters was affected by the preference for roosting place (Table 2). Percentage of birds roosting on the slats, perches, and drinking line that has developed breast blisters was 11.3%, 45.0%, and 81.6%, respectively ($P < 0.001$). Breast blister score showed a positive correlation with prevalence of breast blisters: 0.2, 0.9, and 1.5 for the slats, perches and drinking line, respectively (Table 2 and Fig. 3). Furthermore, the average breast blisters severity increased over time with the different roosting places ($P < 0.001$).

Table 2
Prevalence (% birds with breast blister scored between 1 and 5) and score of breast blisters in broiler breeders affected by roosting place and age.

Source	Prevalence (%)	Score[1]
Roosting place		
Slats	11.3[c]	0.2[c]
Perches	45.0[b]	0.9[b]
Drinking line	81.6[a]	1.5[a]
SEM	6.04	0.11
Age (wk)		
45	31.2	0.4[bc]
50	48.5	0.8[b]
55	55.0	1.5[a]
60	50.0	0.8[b]
SEM	7.79	0.14
P-value		
Roosting place	< 0.001	< 0.001
Age	0.285	< 0.001
Roosting place*Age	0.998	0.066

[a,b,c] Means within a column and treatment without a common superscript differ significantly ($P < 0.05$).
[1] Scored from 0 (no breast blister) to 5 (breast blister with big swelling of approx. 5 cm).

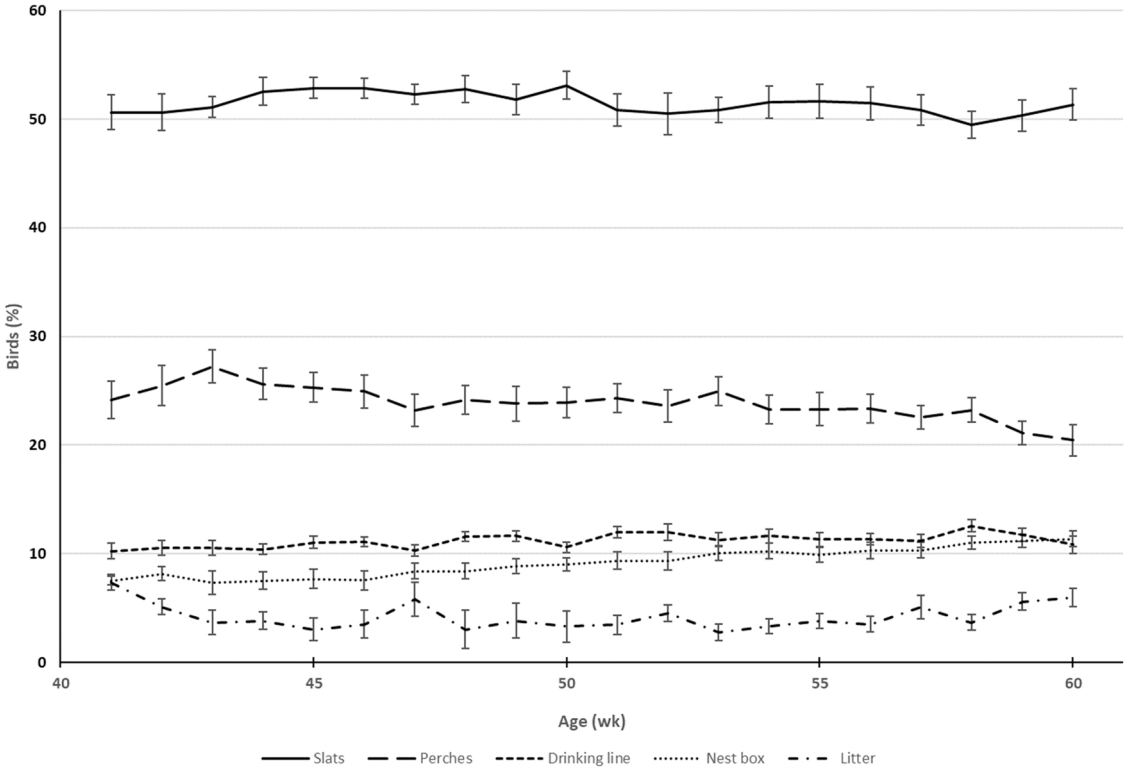

Fig. 2. The percentage of birds that roosted on the slats, perches, drinking line, nest box and litter according to age. Error bars depict the standard error.

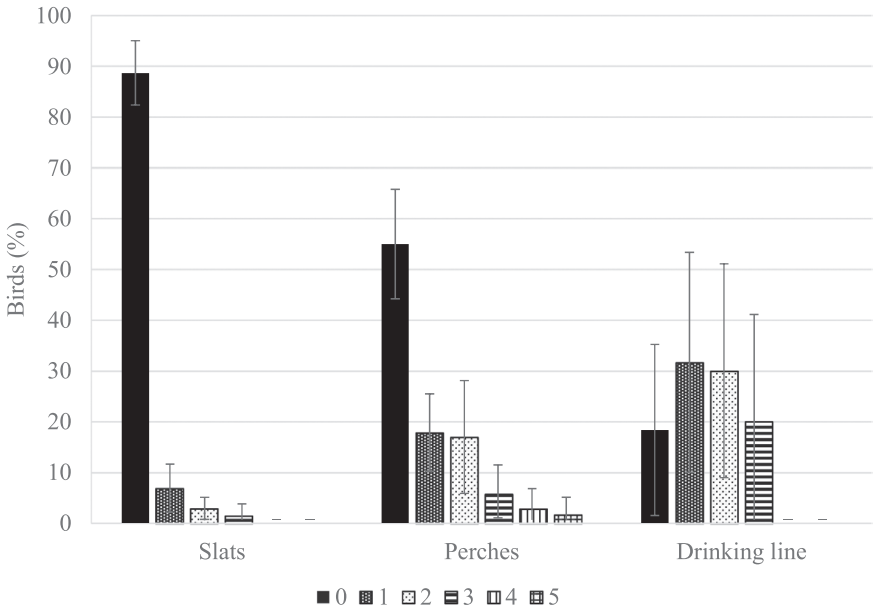

Fig. 3. Breast blisters score in marked birds consistent using the slats, perches or drinking line as roosting place. Error bars depict the standard error.

3.3. Feather cover

The birds on the slats showed a higher average feather cover score (2.65 vs. 2.47; $P = 0.003$) compared to the birds on the perches, meaning a worse plumage condition (Table 3). The feather cover score of birds roosting on the drinking line did not differ from the other roosting places. More in detail, the birds on the slats had a higher (worse) score for the back compared to the birds roosting on the perches. The belly (1.84 vs. 1.46; $P = 0.022$) and tail (2.96 vs. 2.64; $P < 0.001$) of the birds on the slats had a worse feather cover compared to the birds on the drinking line.

4. Discussion

There could be a potential confounding effect of the location of the perches and slats, since in all pens the slats were located in the front of the pen, and the perches were at the rear side of the pen. However, due to practical reasons such as floor eggs prevention and the aim to test the relative preference in a setting which is closer to commercial conditions, it was decided to equip the pens in this way. This means, however, that the preference of the roosting place could be influenced by the location within the pen. To the authors' knowledge, preference for a location within a pen or breeder houses to roost has not been studied yet and could add valuable information to the results described in the current study. Furthermore, within this study certain materials were used: wooden slats and a particular perch. Although there are many perch materials possibilities, as is known from studies in laying hens (e.g. Scott and MacAngus, 2004; Pickel et al., 2010), the aim of the current study was to compare between roosting possibilities, not to test different materials. Moreover, testing multiple perches and slats would require larger testing facilities which were not available. Lastly, studies focussing on perches, preferred materials and effects of different materials are very scarce in breeders and do not compare effectively (von Wachenfelt and Berndtson, 2014; Gebhardt-Henrich et al., 2017, 2018; Brandes et al., 2017). For those reasons, the materials were assorted in consultation with the Animal Welfare Body, with a reliable comparison to materials mostly used in practice. However, there is a possibility the results found in the current study could diverge when other materials are used.

This study shows clearly that broiler breeders roosted more on slats than on perches (51.5% vs. 23.9%) during the laying phase. To our knowledge, no preference studies on roosting place with broiler breeders are available on this topic. Both fast- and slower-growing broilers, however, showed a comparable preference of slats over perches (Oester

Table 3
Feather cover score in broiler breeders affected by roosting place and age.[1]

Source	Neck	Breast	Belly	Back	Wings	Tail	Legs	Average
Roosting place								
Slats	2.37	2.97	1.84^{a}	3.15^{a}	2.43	2.96^{a}	2.87	2.65^{a}
Perches	2.12	3.00	1.60^{ab}	2.71^{b}	2.31	2.79^{ab}	2.75	2.47^{b}
Drinking line	2.11	3.29	1.46^{b}	3.13^{a}	2.46	2.64^{b}	2.74	2.56^{ab}
SEM	0.175	0.133	0.135	0.122	0.082	0.060	0.073	0.066
Age (wk)								
45	2.35^{ab}	2.96^{ab}	1.26^{b}	2.75^{b}	2.38^{b}	2.87	2.72^{bc}	2.47^{b}
50	2.03^{ab}	2.92^{b}	1.20^{b}	2.77^{b}	2.11^{c}	2.67	2.58^{c}	2.33^{b}
55	1.93^{b}	3.29^{a}	2.01^{a}	3.20^{a}	2.86^{a}	2.83	2.97^{a}	2.73^{a}
60	2.49^{a}	3.18^{ab}	2.06^{a}	3.26^{a}	2.26^{bc}	2.82	2.88^{ab}	2.71^{a}
SEM	0.182	0.138	0.145	0.127	0.087	0.066	0.077	0.069
P-value								
Roosting place	0.181	0.339	0.022	< 0.001	0.170	< 0.001	0.086	0.003
Age	0.020	< 0.001	< 0.001	< 0.001	< 0.001	0.291	< 0.001	< 0.001
Roosting place*Age	0.969	0.593	0.482	0.882	0.470	0.355	0.753	0.879

^{a,b,c} Means within a column and treatment without a common superscript differ significantly ($P < 0.05$).
[1] Feather cover score ranges from 0 (intact feathers) to 5 (completely denuded area).

et al., 2005; de Jong and van Wijhe-Kiezebrink, 2014; Norring et al., 2016; Malchow et al., 2019). The high use of the slats, compared to the perches, in the present study is likely due to higher stability and easier access for heavy birds on the slats than on the perches, as postulated by de Jong and van Wijhe-Kiezebrink (2014), Bailie and O'Connell (2015), Kaukonen et al. (2016), and Malchow et al. (2019). Moreover, the majority of the birds in the present experiment clustered together on the slats. Even despite the lack of natural circumstances, domestic chickens show flocking behaviour as a strategy for protection against predators (Appleby et al., 2004).

In the present experiment, percentage of birds roosting on the slats was twice as high (approx. 50% vs. 25%) compared to the experiment of Gebhardt-Henrich et al. (2017). Besides this, 24% of the breeders roosted on the perches which is somewhat lower than in previous experiments with breeders (Gebhardt-Henrich et al., 2017, 2018; Brandes et al., 2017), where 27–40% of the birds roosted on perches. The differences between the present and the previous studies might be explained by the differences in height of the roosting places. In the present study, the slats and perches were positioned on the same height whereas in the study of Gebhardt-Henrich et al., (2017, 2018) and Brandes et al. (2017) the perches were placed on top of the slats. Due to the anti-predator behaviour, domestic fowls prefer high compared to low perches during day- and night-time (Keeling, 1997; Newberry et al., 2001; Odén et al., 2002; Struelens et al., 2008; Wichman et al., 2007; Schrader and Müller, 2009). Birds choose, preferably, the highest roosting place from the ground floor because this may give the greatest feeling of safety (Brake et al., 1994; Keeling, 1997; Newberry et al., 2001). This might explain why in previous studies more breeders were observed on the perches. The high average number of birds on the short and non-easily accessible (45 cm height from the slats) drinking line in the present experiment may also suggest that height plays an important role in the choice for a roosting place. On average, 2.8 birds were observed while the maximum capacity was 4 birds (data not shown).

The drinking line was the third preferred (11%) roosting place for the breeders, however this element was not included in the preference test. It was expected that the use of the drinking line as roosting place would decrease with age, due to the increasing BW of the breeders in combination with the height of the small drinking line (45 cm above the slats). Despite the higher BW, it seems that height mattered (Schrader and Müller, 2009) more than possible instability problems (Gebhardt-Henrich, et al., 2018). Research with layers showed that more lower ranked birds used higher perches during the day, though no relation was found for the night (Cordiner and Savory, 2001). Breeders are much heavier than layers, thus it is hypothesised that more mobile, relative lighter and maybe subdominant birds in the present study might use the drinking line for roosting.

In contrast to the use of the drinking line over time, the use of the perches decreased from 43 to 60 WOA from approx. 27–20%. This is probably caused by the fact that BW increased from 3.9 to 4.1 kg in this period, which may have resulted in decreased mobilities and consequently, difficulty accessing the 50 cm high perches (Gebhardt-Henrich et al., 2017). BW development of breeders is especially concentrated on breast muscle (Zuidhof et al., 2014; van Emous et al., 2015) and it is suggested that breeders with a high BW might have some stability problems when using a perch (Riber et al., 2018), resulting in a lower use while aging.

In commercial breeder houses nest boxes are closed during the night, making them inaccessible for roosting to prevent soiling of the nest. In this experiment, due to practical reasons the nest could not be closed resulting in 9% of the birds using it as a roosting place. It is hypothesised that nest boxes are used more by subordinate birds during the day to avoid dominant birds (McLean et al., 1986; Gibson et al., 1988). In the contrary, Cordiner and Savory (2001), found some evidence of increased nest box use by higher ranking birds at night. However, in the present study the ranking order of the of birds was not observed, which means that the exact reason for using the nest box as roosting place is unknown.

The litter use as roosting place was relatively low (4%), which was expected due to the anti-predator hypothesis behaviour to roost as high as possible (Brake et al., 1994; Keeling, 1997; Newberry et al., 2001; Schrader and Müller, 2009). Although male roosting behaviour was not observed, it was noted that the majority (at least 50%) of the males roosted on the litter and less on slats and perches (data not shown). This phenomenon is also observed under commercial circumstances (personal observation, Dr. R.A. van Emous).

The observations of individual roosting behaviour showed the consistency of the birds in roosting place preference. Almost 80% of the marked birds were observed on the same roosting place at 15 of the 20 weeks of observation (data not shown). In the current study only three birds were marked to follow individual roosting behaviour. Perching is socially facilitated, and therefore the whole group and group hierarchy is important. In hindsight, observing all birds within the pen would have given more valuable information about individual perching. However, due to practical reasons (24 pens with each 26 and later 24 females), it was decided at the time not to mark all birds. Since the individuals are not independent of one another, the results might be biased by not accounting for pen effects within the model.

To our knowledge, no studies on consistency or individual roosting behaviour of breeders are available. However, a study with 3500 layers in two compartments with loose housing systems, birds were observed on roosting place consistency (Odén et al., 2004). Birds were marked at 25 WOA and at 35 WOA they found 22% roosting in the same or adjacent sections. At 65 WOA birds were marked again and roosting place consistency during two consecutive nights was 47% and 31%. The low roosting place consistency in that study compared to the present one is due to the larger house (220 m^2) and the identical equipment of the different sections without any markers to find their way (Collias et al., 1966). The discrepancy between the previous studies and the present study could be explained by the differences in pen and thus group size. The maximum number of other birds that can be recognised by an individual bird is not clear, however Nicol et al. (1999) suggested that this must be approx. one hundred individuals. Birds in large groups continually meet unfamiliar birds (Appleby et al., 1985), probably resulting in avoiding birds of higher rank and thus increasing use of the house surface. Moreover, research with layers showed that unfamiliar hens may be aversive to others resulting in more hierarchy pecking (Grigor et al., 1995; Freire et al., 1997). In a smaller group, as was used in the present study, birds presumably recognise each other. This recognition might result in less aggressive situations linked to hierarchy, probably resulting in a higher consistency in roosting place preference for individual birds.

Prevalence and severity of breast blisters were the lowest in birds roosting on the slats, followed by the birds on perches and the highest in birds on the drinking lines. Breast blisters (sternal bursitis) are caused by prolonged pressure on the bursa of the sternum which enlarges and fills with fluid (McCune and Dellmann, 1968). The higher prevalence and severity in birds on perches and drinking lines is most likely caused by the smaller surface where heavy birds roost on resulting in a more intensive point load on the sternum of the birds, during 10 h at night on these elements. Birds roosting on the slats distribute the weight on a bigger surface and thus experience less point load, resulting in fewer and less severe breast blisters. The findings in this study are in line with the study of von Wachenfelt and Berndtson (2014), whom recorded 90% and 30% breast blisters in 58 week old breeders roosting on perches and slats, respectively.

The worse feather cover of the birds on the slats compared to the birds on the perches is probably caused by the high occupation rate of the slats. During observations, it was noted that birds on the slats regularly showed social clumping behaviour and sometimes piling up each other. It is hypothesised that this increased contact between birds negatively affects feather cover as previous found in layers (Brantsæter et al., 2018). The abrasiveness of the wooden slats may also have affected the feather cover of the belly.

5. Conclusion

Broiler breeders in this study clearly roosted more on slats compared to perches, nest box or litter area. The drinking line was also well occupied, which may have been caused by the fact that this was the highest place to rest on. In addition, it appears that individual birds consistently use the same roosting place for a longer period of time. More and severe breast blisters were found in birds roosting on perches and drinking line compared to the slats, which suggests that slats are also better for physical health than perches.

Declaration of Competing Interest

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.

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