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Wageningen Livestock Research

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Summary
In the Netherlands, the production of broiler chickens experienced a significant change between 2014 and 2016 due to alternative production concepts being introduced, i.e. the slower-growing concept. Currently, around 35-40% of broiler chickens is produced in the Netherlands according to this slower-growing concept. However, because the slower growing breeds have only recently been introduced, we lack knowledge with regard to the environmental enrichments that are needed to meet their behavioural needs. This pilot study was performed within the PPP Slower growing broiler chickens (SloGro/SloBro) and aimed to identify the preference of slower-growing broilers for different types of rest (round metal perch, mushroom plastic perch, flat-shape plastic perch, round wooden perch and platform) and activity enrichment (firmly pressed straw bale (control, current standard), loosely pressed straw bale and lucerne bale). The number of birds sitting on the platforms was 8 times higher as compared to the perch types combined. When looking at the number of birds sitting under the different types of rest enrichments, birds seemed to have a slight preference to sit under the round metal perch, while the round wooden perch was least preferred. The number of birds sitting on the loosely pressed straw bales was higher compared to the number of birds on the firmly pressed straw and lucerne bales. This might be related to less birds sitting around the loosely pressed straw bales and therefore less disturbance compared to the firmly pressed straw and lucerne bales. To conclude, slower-growing broilers preferred platforms over perches. With regard to activity enrichments, slower-growing broilers seemed to prefer to sit on loosely pressed straw bales, while they seemed to prefer to sit around firmly pressed straw and lucerne bales.

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Public Wageningen Livestock Research Report 1292

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Foreword

The project '*Trager groeiende vleeskuikens: Op weg naar integraal duurzaam dierenwelzijn'* (SloGro/ SloBro) is a public-private partnership between the Ministry of Agriculture, Nature and Food Quality, a consortium, of various commercial partners and organizations within the slow growing chain and Wageningen Livestock Research. The PPP SloGro/SloBro aims to contribute to a broader sustainable and healthy slow growing chain in the Netherlands.

This report contains the results of a pilot study, aimed to identify the preference of slower-growing broilers for different types of rest areas and activity enrichment. Scientists of Wageningen Livestock Research worked together with a commercial poultry farmer. We are grateful to him for providing one of his broiler houses for the experiment. Besides we thank the different representatives from the consortium for their worthwhile input.

Dr. R.A. (Rick) van Emous, project leader.

Summary

In the Netherlands, the production of broiler chickens experienced a significant change between 2014 and 2016 due to alternative production concepts being introduced, i.e. concepts with slower-growing broiler breeds. Currently, around 35-40% of broiler chickens is produced in the Netherlands according to these slower-growing concepts. However, because the slower growing breeds have only recently been introduced, we lack knowledge with regard to the environmental enrichments that are needed to meet their behavioural needs. This pilot study was performed within the PPP Slower growing broiler chickens (SloGro/SloBro) and aimed to identify the preference of slower-growing broilers for different types of rest (platforms/perches) and activity enrichment (bales). In one commercial broiler house, with about 11,000 Hubbard JA 757 broilers, five different types of rest enrichment (round metal perch, mushroom plastic perch, flat-shape plastic perch, round wooden perch and platform) and three different types of activity enrichment (firmly pressed straw bale (control, current standard), loosely pressed straw bale and lucerne bale) were provided. Each type of enrichment was placed in each quadrant of the house. The use of the enrichments was studied between 1 and 6 weeks of age as indication of the possible preference of the birds for a specific type of rest and activity enrichment.

Birds were observed to make use of all rest enrichments provided, although there were clear differences in the extent to which the different types of rest enrichments were used. The number of birds sitting on the platforms was 8 times higher as compared to the different perch types combined. A possible explanation for the relatively low use of the perches could be the material and shape. The plastic and metal perches might have been too slippery and the mushroom and flat-shape perches might have been too big. When looking at the number of birds sitting under the different types of rest enrichments, birds seemed to have a slight preference to sit under the round metal perch, while the round wooden perch was least preferred at all ages. Although we did not look at activity levels, birds made use of all activity enrichments provided. The number of birds sitting on the loosely pressed straw bales was higher compared to the number of birds on the firmly pressed straw and lucerne bales. This might be related to less birds sitting around the loosely pressed straw bales and therefore less disturbance compared to the firmly pressed straw and lucerne bales. Loosely pressed straw bales had to be replaced once and lucerne bales 2.5 times during the production cycle, while firmly pressed straw bales did not have to be replaced at all. This might indicate that especially lucerne and loosely pressed straw bales were used as explorative pecking objects, thereby disintegrating bales and causing the need for replacement.

To conclude, slower-growing broilers preferred platforms over perches. Platforms might be better used by broilers as they have fewer problems with finding their balance when resting on platforms in comparison to perches. Especially when considering their relatively high body weight, weak bones and body confirmation with heavy breast muscles. With regard to activity enrichments, slower-growing broilers seemed to prefer to sit on loosely pressed straw bales, while they seemed to prefer to sit around firmly pressed straw and lucerne bales. Loosely pressed straw bales might be suitable as both rest and activity enrichment. While lucerne bales seem to mostly be used for explorative pecking and might even be consumed by birds.

1 Introduction

In the Netherlands, the production of broiler chickens experienced a significant change between 2014 and 2016. This was due to the rapid introduction of all Dutch supermarkets' 'Kip van Morgen' (Chicken of tomorrow) concepts (Saatkamp et al., 2019) in addition to the already existing 'Beter Leven keurmerk' (Better life label) concept that was introduced by the Dutch Society for the Protection of Animals (SPA) in 2007. These alternative production concepts are aimed at improving broiler welfare. As a result, currently around 35-40% of broiler chickens produced in the Netherlands are kept according to a slower-growing concept (Avined, 2019). Slower-growing broilers are defined as broiler chickens produced by slower-growing female parent stock that are crossed with a regular or slower-growing male. These broiler breeds are either accredited by the Dutch SPA with the 'Beter Leven' quality label (maximum average daily growth of 45 grams) or fall within the standards of the original 'Kip van Morgen' concepts (maximum average daily growth of 50 grams) (Ellen et al., 2012; Saatkamp et al., 2019).

With regard to animal welfare, it is important that farm animals are kept in an environment that meets their behavioural needs. The possibilities to perform natural behaviour are an essential part of animal welfare and contribute to the animal's experiencing positive emotions (Fraser, 1995; Boissy et al., 2007; Quality, 2009). Chickens are day-active animals that spend a large part of the light period gathering food and being active (Dawkins, 1989). Also, chickens are intelligent animals that need cognitive challenges and actively collect information from their environment (Marino, 2017). Furthermore, resting and sleeping on elevated structures, such as on trees or perches, are essential behaviours (Duncan et al., 1998). Therefore, providing a variety of environmental enrichments (i.e. including both rest (platforms/perches) and activity enrichment (bales)), instead of the currently applied enrichment in commercial broiler houses (i.e. bales), is expected to better meet the behavioural needs of broiler chickens.

Effective environmental enrichment stimulates natural behaviour, can reduce negative feelings such as anxiety, and contributes to experiencing positive emotions (Riber et al., 2018) and thus potentially contributes to broiler chickens' welfare. Although much research is currently being done on effective environmental enrichment for broiler chickens, the majority of previous and current research focused on regular, fast-growing breeds. With regard to rest enrichment, fast-growing broilers prefer platforms over perches (Norring et al., 2016; Kaukonen et al., 2017; Bailie et al., 2018; Berghout et al., 2018; Malchow et al., 2019a) and platforms either improved (Kaukonen et al., 2017) or did not affect leg health (Bailie et al., 2018). With regard to activity enrichment, lucerne and wood shaving bales were evenly used by fast-growing broilers (Berghout et al., 2018).

However, a one-to-one translation of effects of environmental enrichment on behaviour and other welfare indicators of fast-growing to slower-growing breeds is not possible, because the behavioural needs of slower-growing breeds may differ since they are usually much more active and have a different time budget than fast-growing breeds (Bokkers and Koene, 2003; Torrey et al., 2019). Slower-growing broilers are less affected by their body weight, body shape and locomotion problems than fast-growing broilers when conducting behaviour, especially in the last weeks prior to slaughter (EFSA, 2010). Thus, the need for specific environmental enrichment may differ between fast and slower-growing broilers. Indeed, slower-growing broiler breeders used perches twice as often as fast-growing broiler breeders during the light period, but no difference was found during the dark period and both breeds used all perch types (material: plastic, wood, or metal and shape: round, mushroom oval or rectangular) (Brandes et al., 2020). Only two studies to date have identified rest enrichment use in slower-growing broilers, where they seem to prefer platforms over perches (de Jong and Van Wijhe-Kiezebrink, 2014; Malchow et al., 2019a).

The aim of this pilot study was to increase our knowledge on the preferences of slower-growing broilers for different types of rest and activity enrichment. In one commercial broiler house with Hubbard JA757 broilers, five different types of rest enrichment (round metal perch, mushroom plastic perch, flat-shape plastic perch, round wooden perch and platform) and three different types of activity enrichment (firmly pressed straw bale (control, current standard), loosely pressed straw bale and lucerne bale) were provided in each quadrant of the house. The use of these enrichments at different ages was studied as an indication of the possible preference of the birds for a specific type of rest and activity enrichment. The study comprised one production cycle.

This pilot study was performed within the project 'PPS Trager groeiende vleeskuikens: Op weg naar integraal duurzaam dierenwelzijn' (PPP Slow growing broiler chickens: steps forward to an integral sustainable animal welfare) with the final aim being: to offer an environment to slower-growing broilers which meets their behavioural needs, e.g. for exploration, free-range use, dustbathing, foraging behaviour, resting behaviour, and promotes positive experiences, and, thus, limits the risk for negative emotions such as fearfulness. This is to optimise their welfare in commercial systems, while at the same time being practically applicable and economically efficient.

2 Materials and Methods

2.1 Animals and housing

For this pilot study one house at a commercial farm was available during one production cycle (lasting 51 days). In the cycle (start 17-08-2020) 10,800 day-old chicks (Hubbard JA757, as hatched) were placed in the house. House dimensions were 14.3 x 63.5 metres. Peat was provided as litter. Three feeder lines (pan feeders) and six drinking lines (nipple drinkers) were present in the house (see Figure 1 for an overview of the house and Appendix 1 for more overview pictures). Daylight could enter the house via windows in the roof (3% of floor area). Management was according to standard farm management. The standard farm management with regard to enrichment was 1 firmly pressed straw bale of 20kg per 1000 chickens.

Figure 1 *Overview of the broiler house at 2 (left) and at 6 weeks of age (right).*

2.2 Enrichments

Five types of rest enrichment and three types of activity enrichment were installed in each quarter of the house (see Figure 2 for the approximate location of the different enrichments). Enrichments were grouped for rest and activity enrichment separately. Order of the enrichments within each group/location was randomly assigned.

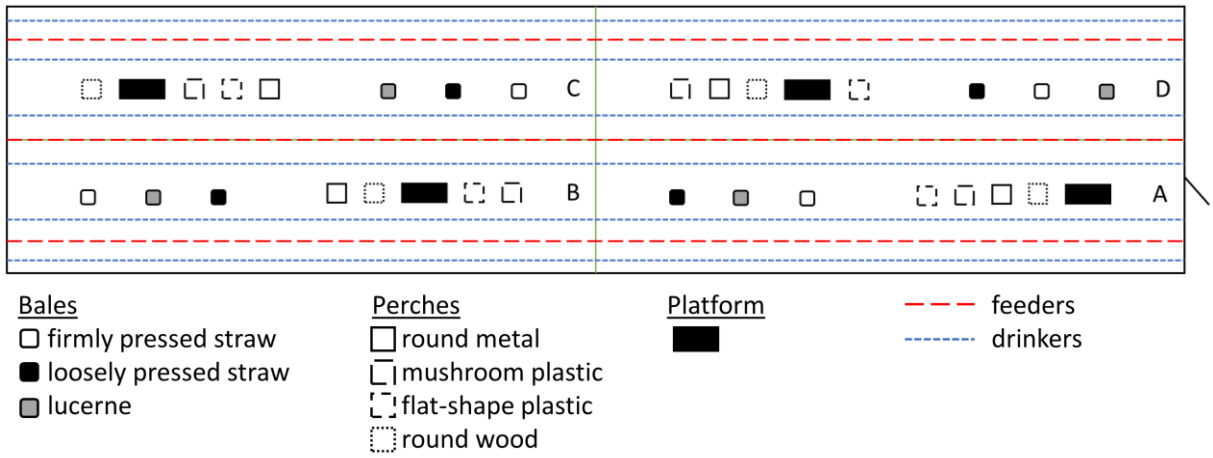


Figure 2 *Schematic diagram of the broiler house, indicating the approximate position of feeder and drinker lines and the enrichments. Quarters of the house (indicated by green lines) where marked A-D. The entrance door was positioned on the right side in section A.*

Rest enrichments

Five different types of rest enrichment were provided in each quarter of the house: 1) round metal perch, 2) mushroom plastic perch, 3) flat-shape plastic perch, 4) round wooden perch and 5) platform (see Figure 3 for overview of the rest enrichments). Each of the perches measured 1 m in length, with total perch length being 6 m per unit. Each perch unit had two levels, the first level at approximately 20 cm above the floor with 4 perches, and the second level at approximately 40 cm with 2 perches. The floor area occupied by each perch unit was approximately 1 x 1 m. Each platform unit had two levels, the first level at approximately 40 cm above the floor and the second level at approximately 60 cm. The first level measured 1.4 x 1 m and the second level measured 1 x 1 m, with a total platform area of 2.4 m^2 per unit. The floor area occupied by each platform unit was approximately 2.5 x 1 m (see Table 1 for exact measurement of the different rest enrichments). Perch and platform levels differed in height because birds could pile underneath the platforms. If we would have provided platforms at 20 and 40cm height the farmer could not check the birds underneath the platforms and there would be a risk of too high CO_2 levels and piling behaviour where birds could not escape easily. There was ca. 1 m of free area between rest enrichment units.

Figure 3 *Overview of the rest enrichments used in the experiment: (from left to right, top to bottom) round metal perch (control), mushroom plastic perch, flat-shape plastic perch, round wooden perch and platform.*

Table 1 *Measurements (in cm) of different types of rest enrichment used.*

Enrichment	Length[1]	Width[1]	Length[2]	Width[2]	Height[1]	Height[2]	Shape	Diameter/width of perch
Round metal	100	92	100	31	23	44		3 cm
Mushroom plastic	100	100	100	33	21	43		4 cm (top)
Flat-shape plastic	97	100	97	33	22	41		3.5 cm
Round wood	114	115	114	60	18	39		1.5 cm
Platform[a]	140	100	100	100	37	62	n.a.	n.a.

[1] Length, width or height of first level and [2] Length, width or height of second level; [a] Measurements are for grids only, total area covered by platforms was 2.5 m^2; n.a. = not applicable

Since rest enrichments differed in measurements, especially when comparing the perches to the platforms, we calculated the number of chickens that could make use of the rest enrichments (i.e. their capacity) at different ages (see Table 2). These calculations were based on the surface area (platform) and length (perches) needed for a sitting chicken. The surface area (cm^2) needed for a sitting chicken was calculated based on the formula from Baxter (1992): $0.035 * BW^{0.67} * 10.000$ (BW = bodyweight in kg). The body weight (kg) and width (cm) needed for a sitting chicken was based on previous measurements from fast-growing broilers (Ross 308) at different ages. Especially, at 1-2 weeks of age there is a difference between the available space on perches vs. platforms. However, at older ages the available space is comparable for perches vs. platforms.

Table 2 *Available space expressed in number of chickens for different types of rest enrichment at different ages (note: we did not include length of side bars for perches).*

Age in weeks	Chick width (cm)	Round metal	Mushroom plastic	Flat-shape plastic	Round wood	Chick body weight (kg)	Chick surface area (cm^2)	Platform	Perch / platform ratio*
1-2	7.3	84	84	81	95	0.23	127	209	0.44
3-4	10.8	56	56	54	64	0.80	298	82	0.71
5-6	14	43	43	42	49	1.55	468	52	0.86

* Calculated by averaging available space for the four perch types combined and dividing by the available space for the platform

Activity enrichments

Three different types of activity enrichment were provided in each quarter of the house: 1) firmly pressed straw bales (control, current standard), 2) loosely pressed straw bales and 3) lucerne bales (see Figure 4 for overview of activity enrichments). Measurements of the bales differed (see Table 3 for exact measurements of the different bales). There was ca. 3 m of free area in between bales. Bales

were replaced when completely consumed; in total 4 firmly pressed straw, 8 loosely pressed straw and 14 lucerne bales were used during the production cycle.

Figure 4 *Overview of the activity enrichments used in the experiment: (from left to right) firmly pressed straw, loosely pressed straw and lucerne bales.*

Table 3 *Measurements (in cm) of different types of activity enrichment used.*

Enrichment	Length	Width	Height	Weight
Firmly pressed straw	55	30	42	20 kg
Loosely pressed straw	105	38	48	24 kg
Lucerne	50	30	28	20 kg

2.3 Observations

Observations were carried out in two ways: 1) live and 2) from pictures. Both live and picture observations consisted of counting the number of birds on and under the rest enrichments; and on and within 0.5 m around the activity enrichments.

Live observations
Live observations were carried out three times within the production cycle at 2, 4 and 6 weeks of age. Live observations were performed on one day per age and between approximately 09.00 and 17.00 h. Per observation day, four similar blocks of observations were carried out, equally distributed over the day: block 1 starting at 09.00 h; block 2 at 11.00 h; block 3 at 13.00 h and block 4 at 15.00 h; observations were finished at approximately 17.00 h. At 6 weeks of age only two blocks of observations were carried out because of practical limitations, block 1 and block 3. Per block, all enrichments were observed once.

Picture observations
Pictures of each enrichment were made by the farmer at 1, 3 and 5 weeks of age during daily inspection rounds. Pictures were taken on two days per age, once during the morning and once during the afternoon inspection. At 6 weeks of age, an additional set of pictures from a morning inspection was counted to adjust for the two missing live observation blocks.

We summed counts for live and picture observations over two subsequent weeks (age 1-2, 3-4, 5-6) and calculated the average number of birds counted per unit and per observation.

2.4 Light measurements

After the live observations, light measurements were performed using the HATO ONE meter. After each observation block, the light meter was placed on the top of the enrichment that was in the centre of the rest or activity enrichment group for each quarter of the house. Light aspects measured by the meter include light intensity (LUX: perceived by humans, Gallilux: perceived by chickens and foot candle), colour temperature (Correlated Colour Temperature, CCT), comparison to sunlight (Colour Rendering Index, CRI) and light flicker (percentage flicker and flicker index).

Light measurements were averaged per rest and activity enrichment groups over all measurements made throughout the day and production cycle.

2.5 Data analysis

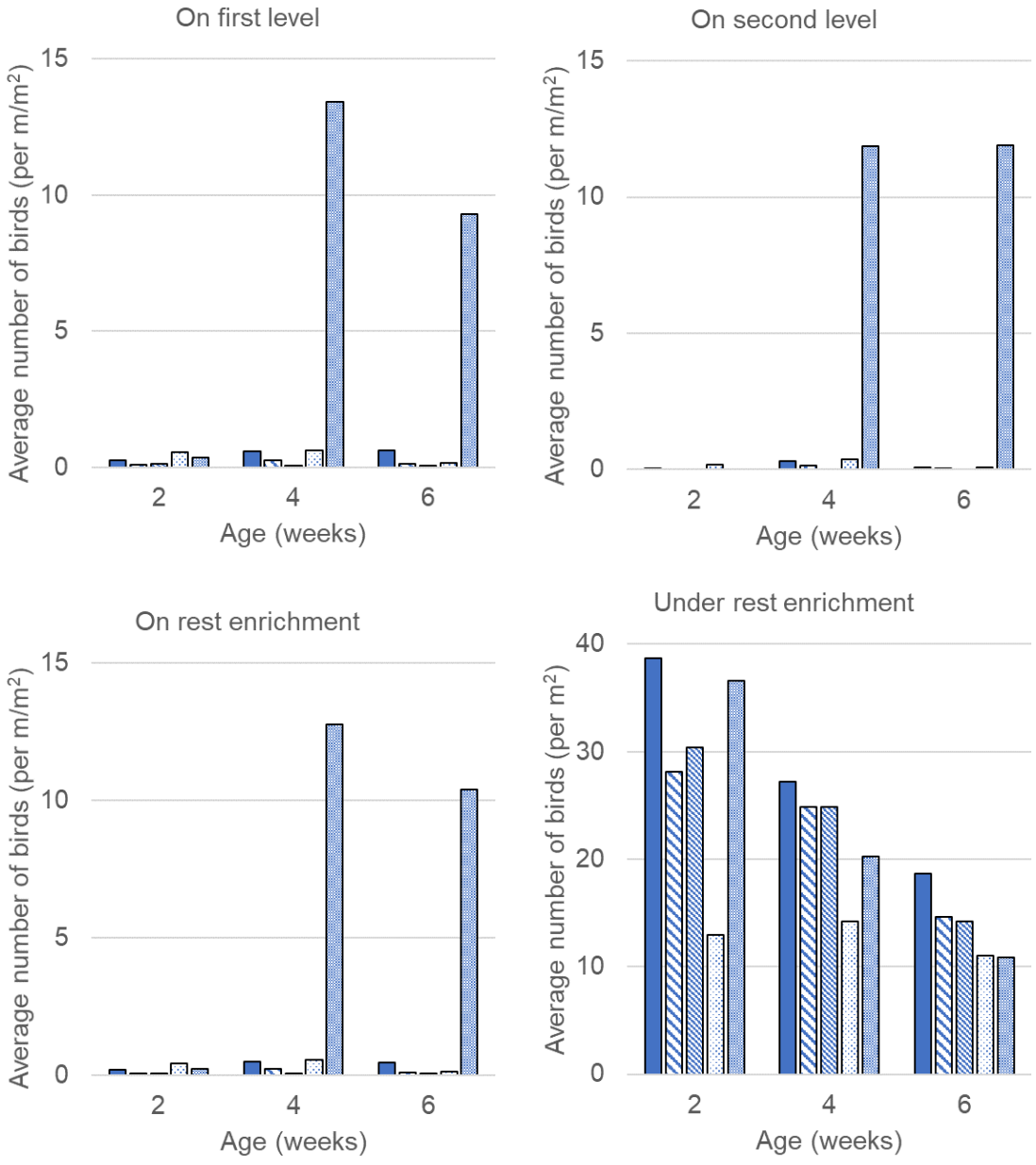
No statistical analysis was carried out because measures were only carried out in one production cycle in the same house. Data are presented as means.

3 Results

3.1 Use of rest enrichments

Sitting on rest enrichments

When comparing the different types of rest enrichments, slower-growing broilers had a clear preference for the platforms at 4 and 6 weeks of age (see Figure 4 bottom left). Across all ages, the number of broilers sitting on the platforms was almost eight times higher compared to the number of broilers sitting on the four perch types combined. However, it should be noted that these figures do not represent a fair comparison between perches and platforms, due to averages being indicated per m and per m^2 respectively. Still they give an indication of the preference of the birds for the different types of rest enrichments. Furthermore, as indicated previously the number of birds that could sit on the different types of rest enrichments was similar, especially at 4 and 6 weeks of age. When comparing the different perch designs, slower-growing broilers seemed to have a slight preference for sitting on the round wooden perches at 2 weeks of age, which switched to the round metal perch at 6 weeks of age. The mushroom plastic and flat-shape plastic perches were least preferred. Furthermore, for the perches most birds were sitting on the first level, while for the platforms birds were sitting on both the first and second level (see Figure 4 top left and right).



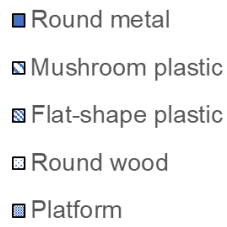


Figure 4 *Average number of birds per m/m² on the first (top left), second level (top right) of the rest enrichments and average number of birds per m/m² on (bottom left) and under (bottom right) the rest enrichments. Note that average number of birds on perches (round metal, mushroom plastic, flat-shape plastic and round wood) was calculated per m and average number of birds on platforms was calculated per m².*

Sitting under rest enrichments

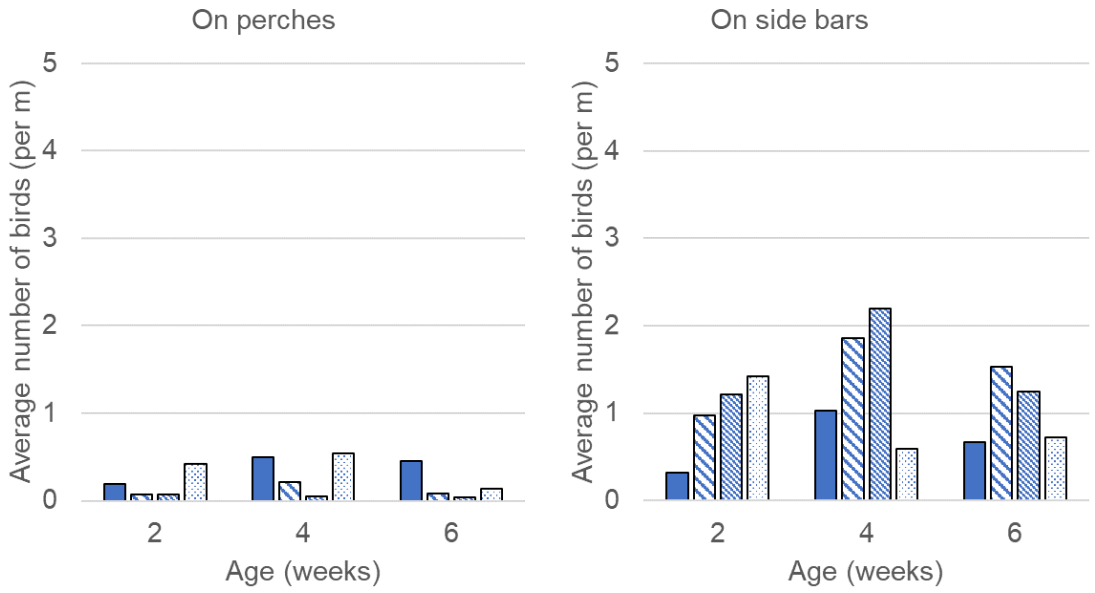
When comparing the different perch designs, slower-growing broilers seemed to have a preference for sitting under the round metal perches at 2 and 6 weeks of age and the mushroom plastic and flat-shape plastic were almost equally preferred. The round wooden perch was least preferred. When comparing the different types of rest enrichments, slower-growing broilers seemed to have a preference for the round metal perches and platforms at 2 weeks of age, but preference for sitting under the platform seemed to decrease with age (see Figure 4 bottom right).

Sitting on rest enrichments (side bars)

Interestingly, we noticed that a lot of broilers were sitting on the side bars of the perches (see Table 4 for overview of side bar designs). Across all ages, the number of broilers sitting on the side bars was almost 13 times higher compared to the number of broilers sitting on the perches (see Figure 5). When comparing the different types of side bars, slower-growing broilers seemed to have a slight preference for sitting on the flat-shape wooden side bars at 2 weeks of age, which switched to a clear preference for the square metal side bars at 4 and 6 weeks of age.

Table 4 *Measurements (in cm) of different types of side bars used on the rest enrichments.*

Enrichment	Side bar	Shape	Diameter/width of side bar
Round metal	Round metal		3 cm
Mushroom plastic	Square metal		2.5 x 2.5 cm
Flat-shape plastic	Square metal		2.5 x 2.5 cm
Round wood	Flat-shape wood		1.7 cm



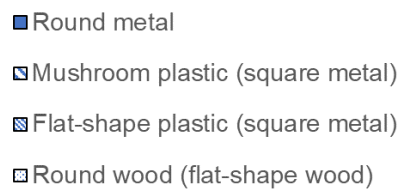


Figure 5 *Average number of birds per m on perches (left) and on side bars (right) of the rest enrichments. Side bars material and shape are given between brackets, unless they had the same material and shape as perches provided (i.e. for round metal).*

3.2 Use of activity enrichments

Sitting on activity enrichments
When comparing the different activity enrichments, slower-growing broilers seemed to have a preference for sitting on the loosely pressed straw bales, especially at 2 weeks of age, but also at 4 and 6 weeks of age (see Figure 6 left).

Sitting around activity enrichments
When comparing the different activity enrichments, slower-growing broilers seemed to have a preference for sitting around the firmly pressed straw bales at 2 weeks of age, which switched to an almost equal preference for firmly pressed straw bales and lucerne bales at 4 and 6 weeks of age (see Figure 6 right).

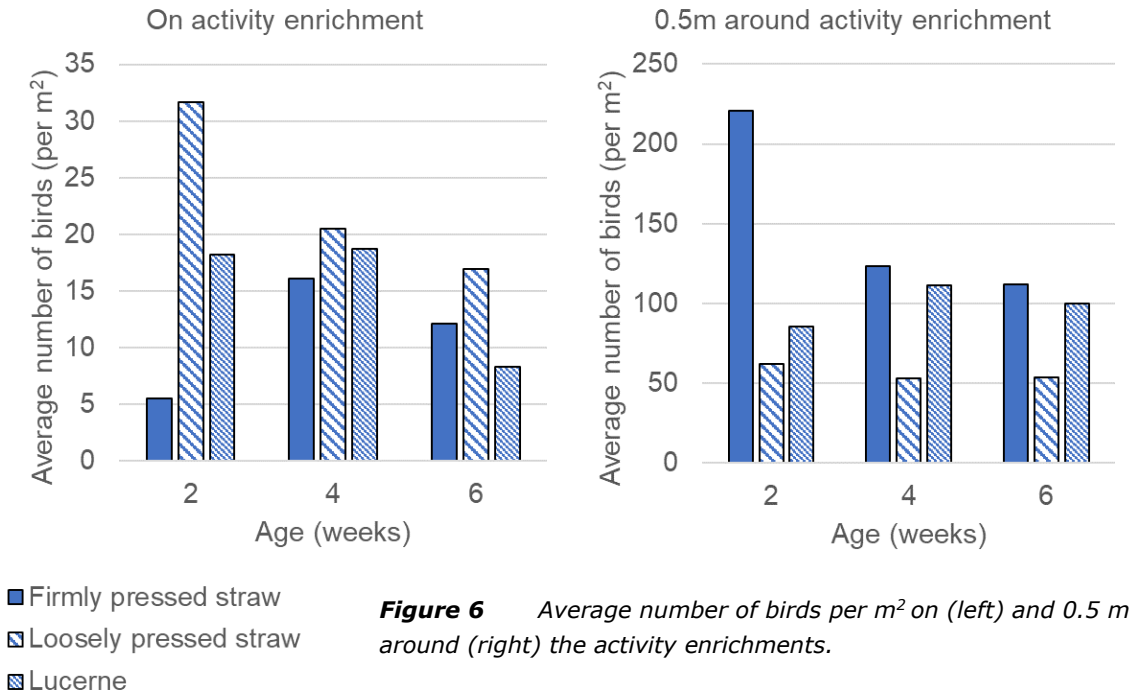


Figure 6 *Average number of birds per m^2 on (left) and 0.5 m around (right) the activity enrichments.*

3.3 Light measurements

The light measurements averaged per rest and activity enrichment over the whole production cycle are given in table 5. Light measurements did not differ between the rest and activity enrichments.

Table 5 *Light measurements averaged for rest and activity enrichments.*

Enrichment	LUX	Gallilux	Foot candle	Correlated Colour Temperature (CCT)	Colour Rendering Index (CRI)	% Flicker	Flicker index
Rest	25.94	36.81	1.78	3846	91.0	0.03	0.004
Activity	24.60	34.39	1.73	3929	92.8	0.03	0.004

4 Discussion and Conclusion

The aim of the pilot study was to identify the preference of slower-growing broilers for different types of rest and activity enrichments. To test this, five different types of rest enrichment (round metal perch, mushroom plastic perch, flat-shape plastic perch, round wooden perch and platform) and three different types of activity enrichment (firmly pressed straw bale (control, current standard), loosely pressed straw bale and lucerne bale) were provided in each quadrant of the broiler house. The use of these enrichments at different ages was studied as indication of the possible preference for a specific type of rest and activity enrichment.

4.1 Rest enrichments

Resting on elevated structures is considered an integral part of chicken behaviour and has been suggested to reduce leg/foot problems, heat stress and behaviour disturbances in broilers (Riber et al., 2018). In the current pilot study, broilers made use of all the rest enrichments provided, although there were clear differences in the extent to which the different types of rest enrichments were used. The number of birds sitting on the platforms was almost 12 times higher compared to the number of birds sitting on the four perch types combined at 4 and 6 weeks of age. It should be noted that rest enrichments (i.e. perches vs. platforms) slightly differed in overall space available, but especially at 2 weeks of age and less so at 4 and 6 weeks of age. Still our finding is in agreement with previous studies, where perch use seems to be quite variable whereas platforms are generally well used by slower-growing broilers (reviewed in Riber et al., 2018; Souza da Silva and de Jong, 2019). Interestingly, the number of broilers sitting on the side bars was almost 13 times higher compared to the number of broilers sitting on the perches. A potential explanation for this might be that chickens move more from the front of the house to the back (length of house) than from left to right (width of house). In this way, they would encounter the side bars, but not the perches. However, rest enrichments were placed over the length of the house with approximately 1m in between, thus other rest enrichment might also obstruct chickens from encountering the side bars. Other explanations might be that there was less space and more shelter on the side bars because of the unit construction, so that fewer birds could sit on it and relatively undisturbed. This was especially true for the square metal side bars which were preferred at 4 and 6 weeks of age.
When looking at the number of birds sitting under the different types of rest enrichments, birds seemed to have a slight preference to sit under the round metal perch, while the round wooden perch was least preferred at all ages. A possible explanation might be that more birds were sitting on the round wooden perch and side bars of the round wooden perch, especially at young age, making it less attractive for birds to sit under them because of faecal droppings or disturbance. One previous study found that slower-growing broilers had a slight preference to sit under platforms compared to perches (de Jong and Van Wijhe-Kiezebrink, 2014).

Age
At 2 weeks of age, only very few birds were sitting on the rest enrichments. Similarly, previous studies have reported that broilers start to use elevated structures from the 2nd week of age onwards (Bokkers and Koene, 2003; Kaukonen et al., 2017; Malchow et al., 2019a). At 4 weeks of age rest enrichments were most used to sit on and this slightly decreased at 6 weeks of age in the present study. Similarly, perch use was highest at 4-5 weeks of age in studies with fast growing broilers (LeVan et al., 2000; Ventura et al., 2012; Bailie and O'Connell, 2015), although in slower-growing broilers perch use remained high till 9 weeks of age (Bokkers and Koene, 2003). Thus, slower-growing broilers seem to start using elevated structures from the 2nd week of age onwards. Providing ramps might ease access to perches and platforms thereby increasing use at younger ages. However, it was reported that perches that broilers had to hop onto from the ground were preferred over perches that could be reached via a ramp (LeVan et al., 2000).
The number of birds sitting under the rest enrichments decreased with age, especially for the platform. Young chicks might prefer to sit under the rest enrichments instead of on them as they seek shelter or a darker area where they can rest. Similarly, young chicks like to sit under dark brooders

and of course in nature they regularly sit under the mother hen (Edgar et al., 2016). De Jong and Van Wijhe-Kiezebrink (2014) did not find a clear pattern, although the number of birds sitting under platforms and perches seemed to decrease somewhat with age. This could of course be caused by the fact that broilers were larger at older ages, resulting in less space being available for as many birds to sit under the rest enrichments compared to younger ages. It might further be caused by more birds sitting on the rest enrichments, making it less attractive for birds to sit under them because of faecal droppings or disturbance. Thus, especially at younger ages slower-growing broilers seem to use the area underneath the rest enrichments.

Height
Only very few birds actually used the highest level of the perches (40cm), although the highest level of the platforms were used (60cm) in the present study. Similarly, broilers mostly used lower level perches (10cm) and not higher level perches (30cm), but overall most birds preferred platforms (30cm) over perches (Norring et al., 2016). Furthermore, Riber et al. (2018) indicated that perches should be low (less than 10cm high) to increase usage by broilers. Still, other studies report that broilers increasingly use higher perches and platforms with age (Estevez et al., 2002; Malchow et al., 2019a), although for Malchow et al. (2019a) broilers almost exclusively used platforms over perches as well. In addition, slower-growing broilers preferred the lowest (40cm) and highest (140cm) perch levels over the levels in between (65, 90 and 115cm) (Nielsen, 2004). However, it should be noted that in the present study effects of different rest enrichments (perches vs. platforms) and height cannot be disentangled from each other. Slower-growing broilers in the present study might have had difficulty reaching the higher perches. Birds could jump on the lower perches directly from the ground whereas the higher perches were probably only accessible from the lower perches and side bars.

Material and shape
The mushroom plastic and flat-shape plastic were least preferred to sit on, this might be due to plastic being slippery and the wider size of these perch types (4 and 3.5cm, respectively). The first is contradicted by the finding that more birds were sitting on the round metal perch and square metal side bars at older ages, since metal is slippery too. The latter is supported by the finding that more birds were sitting on the round wooden perches at young ages (1.5cm diameter) and flat-shape wooden side bars (1.7cm), while at older ages they preferred to sit on the round metal perch (3cm diameter) and square metal side bars (2.5cm). Yet, previously it was shown that width had no effect on perch use by broilers (Norring et al., 2016) and Riber et al. (2018) indicated that wider perches would provide better support to broilers. To our knowledge no other studies have looked at preferences for perch material or shape in broilers.
Fast- and slower-growing broiler breeders showed no clear preference for perch type (material: plastic, wood, or metal and shape: round, mushroom, oval or rectangular) (Brandes et al., 2020), while laying hens preferred wooden perches over plastic or metal perches and rectangular perches over round perches (Chen et al., 2014). Furthermore, perches with a larger diameter and rubber coating improved stability of laying hens compared to smaller diameters and wooden or metal perches (Pickel et al., 2010). In support of this, slipperiness and grip quality have been reported to be low for metal and round perches (Struelens and Tuyttens, 2009). However, broilers differ in their body conformation from laying hens and it should further be noted that in the present study effects of material and shape cannot be disentangled from each other.

Overall, it is clear that slower-growing broilers, like fast-growing broilers, preferred platforms over perches. Platforms might be better used by broilers as they have fewer problems with finding their balance when resting on platforms in comparison to perches. Especially when considering their relatively high body weight, weak bones and body confirmation with heavy breast muscles.

4.2 Activity enrichments

Bales can be used as an area to rest on or against with reduced disturbance (Riber et al., 2018) and therefore provide additional benefits next to just providing an elevated resting space, substrate for foraging and exploration (de Jong and Gunnink, 2019). Recent studies showed that providing both bales (straw or lucerne) and other enrichments reduced leg problems in broilers (Baxter et al., 2018;

Vasdal et al., 2019). In the present study, the number of birds sitting on the loosely pressed straw bales was higher compared to the number of birds on the firmly pressed straw and lucerne bales. This might be related to less birds sitting around the loosely pressed straw bales compared to the firmly pressed straw and lucerne bales. Thus, birds sitting on the loosely pressed straw bales might have been less disturbed by other birds around the bales. Previously, Berghout et al. (2018) found no differences in use of wood shaving or lucerne bales by broilers. To our knowledge no other studies have looked at preferences for different types of bales in broilers.
Bales might further be attractive as explorative pecking objects and therefore broilers are possibly more active around the bales. Indeed, slower-growing broilers were found to be more active when straw bales were provided (Bergmann et al., 2017) and in fast-growing broilers some studies found increased activity levels while others did not (Kells et al., 2001; Bailie et al., 2013; Bach et al., 2019). Although we did not look at activity levels or exploratory behaviour, birds made use of activity enrichments provided, especially loosely pressed straw and lucerne bales. Loosely pressed straw bales were replaced once and lucerne bales 2.5 times during the production cycle, while firmly pressed straw bales were not replaced at all. This might indicate that especially lucerne and loosely pressed straw bales were used as explorative pecking objects, thereby disintegrating bales and causing the need for replacement.

Age
Bale use (sitting on or around bales) seemed to decrease with age, especially from 2 to 4 weeks of age. Previously, bales were shown to be used as shelter for resting behaviour at young ages, while they were later used as pecking objects and elevated resting areas (Bergmann et al., 2017). Similar to rest enrichment use, the decrease could of course be caused by the fact that broilers were larger at older ages, resulting in less space being available for as many birds to sit on or around the activity enrichments compared to younger ages.

Overall, slower-growing broilers seem to prefer to sit on loosely pressed straw bales, while they seem to prefer to sit around firmly pressed straw and lucerne bales. Loosely pressed straw bales might be suitable as both rest and activity enrichment. While lucerne bales seem to mostly be used for explorative pecking and might even be consumed by birds.

4.3 Practical aspects to be considered

From a practical point of view, the materials used as rest enrichments should be easy to clean and move. The farmer indicated that cleaning was not very easy for any of the rest enrichments, but especially for the platforms used in the current experiment. This was due to the shape of the plastic wire that was used which caused that litter and manure were difficult to remove. Therefore, platforms that could be cleaned more easily (smoother surface) are advised if they will be used in practice. Furthermore, it is important that the farmer should be able to check the birds, especially the birds under the platforms. The farmer further indicated that a winchable rest enrichment would reduce time needed to move units out of the house and make it further easier to clean top and bottom of the rest enrichments.
Regarding the activity enrichments, lucerne bales are quite expensive in comparison to the straw bales, especially considering that these had to be replaced most often. The total costs for lucerne bales was 4.5 times more and for loosely pressed straw 1.5 times more than firmly pressed bales. Furthermore, older birds might consume large amounts of lucerne, which may interfere with the intake of their regular diet. The farmer did indicate that birds were consuming lucerne and that birds moved around the house with pieces of straw without consuming them.
It should be noted that performance (growth, mortality, etc.) was similar to previous flocks in the same house.

4.4 Further research

This pilot was performed to identify preferences of slower-growing broilers for certain types of rest and activity enrichments and will be followed-up by an experiment where we want to identify how providing the preferred rest and activity enrichments affects behaviour and welfare parameters in slower-growing broilers. We would further like to include the following ideas in the follow-up experiment.

In this study we only observed use of rest and activity enrichments during the light period. For further research it would be interesting to include observations during the dark period. Previous studies show that use of elevated structures differs during the day. Percentage of fast-growing broilers using elevated structures (mostly platforms) was highest at dawn, followed by the light period and was similar for dusk and the dark period (Malchow et al., 2019a). In addition, platforms were used more during the light than the dark period (Malchow et al., 2019b). Yet, perch use by slower-growing broilers was higher during the dark than the light period (Nielsen, 2004), while for fast-growing broilers there was no difference between the light and dark period (Norring et al., 2016). Thus, there seem to be differences between use of platforms and perches during the day that should be taken into account in future studies.

In addition, both types of enrichments were provided in the same location with respect to windows (daylight) and lights, hence no differences were found in light measurements. It would be interesting to place rest enrichments in darker areas and active enrichments in lighter areas of the house. Previously it was shown that broilers showed more resting and perching at low light intensities, while active behaviours (eating, drinking, foraging and locomotion) were shown more at high light intensities (Davis et al., 1999). Thus, behaviours performed on, under and near enrichments should be observed in relation to light aspects.

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Appendix 1

Figure 1.1 *Overview of the different sections in the house at 4 weeks of age.*

Figure 1.2 *Overview of the different sections in the house at 6 weeks of age.*

To explore the potential of nature to improve the quality of life

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