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Rewarding memories? Behaviour of broiler chickens towards peat in flocks with and without previous exposure to peat

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ABSTRACT

Under commercial conditions, environmental provisions assumed to have an enriching effect on broiler chicken welfare may be offered infrequently and at limited locations, raising questions about their enrichment value. We hypothesized that, if broilers given limited access to peat remembered peat as rewarding, they would subsequently be quicker to exploit fresh peat compared to broilers never previously exposed to peat. We observed 9 control flocks without previous peat exposure and 18 flocks given peat from 1 week of age with variable regularity and in limited locations. During flock visits at approximately 4 weeks of age, we placed 10 L of fresh peat in one location (peat patch) and pretended to do so in another location (control patch, wood shavings litter only). From 20-min video recordings of the peat and control patches, we determined the mean latency for the first five birds to perform standing, lying, ground pecking, ground scratching and vertical wing shaking in each patch. We also recorded the total number of birds present, and proportion lying, per patch based on instantaneous scan sampling at 1-min intervals. We used linear mixed models to assess effects of previous flock exposure to peat, patch type and their interaction, with farm as a random factor. Birds were quicker to ground peck, and slower to stand and lie, in peat than control patches, and the proportion lying was lower (i.e. birds were more active) in peat patches. Birds in peat-exposed flocks were quicker to ground peck than birds without prior peat experience. They also had shorter latencies to stand on peat, and to commence ground scratching and vertical wing shaking in peat, compared to birds in peat-unexposed flocks whereas previous peat exposure did not affect these behaviours in the control patch. In peat-unexposed flocks, birds were slower to stand, in the peat patch than the control patch, and fewer birds were present in the peat patch than the control patch throughout the 20-min observation period. Thus, birds in the peat-exposed flocks were quicker to exploit fresh peat by performing behavioural elements of foraging and dustbathing whereas birds in peat-unexposed flocks showed more caution towards the peat. We conclude that, even though provisioning of peat was relatively sparse and ephemeral, it was sufficient to generate long-term positive memories of the resource and to activate the performance of natural behaviours, supporting its value as an enrichment for broilers under commercial conditions.

1. Introduction

Environmental enrichment can be viewed as a strategy for activating animals to engage in natural behaviours with positive effects on their welfare (Newberry, 1995), contributing to lives worth living (McMillan, 2000). Both consumers and producers are showing increased interest in environmental enrichment as a method for improving the welfare of broiler chickens (Riber et al., 2018; Saatkamp et al., 2019), typically by giving opportunities to perform behaviours in their natural behavioural repertoire that are not possible or relatively infrequent in unenriched housing (reviewed by Estevez and Newberry, 2017; Riber et al., 2018). Different point-source enrichments can be used to trigger natural behaviours specific to the given item. For example, maize roughage increases foraging activities in broiler chickens whereas platforms enable perching (Bach et al., 2019). Additionally, a specific type of enrichment can be used to increase the occurrence of multiple activities. Thus, straw bales and pecking stones are used not only for foraging but also as perching platforms (Bergmann et al., 2017), and substrates with small particles can be suitable both for foraging and dustbathing (Olsson and Keeling, 2005).

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Much of the research about substrate preference in poultry has been conducted with laying hens, though some studies have focused on how broiler chickens use various substrate materials. In laying hens housed on wire-mesh floors and offered wheat bran, two types of sand and peat, it was found that hens without former experience with any of these materials showed more ground pecking and ground scratching in the wheat bran compared with the other materials while peat was preferred over wheat bran and sand for dustbathing (Guinebretière et al., 2014). In male broiler chickens housed with a choice of wood shavings, sand, rice hulls and recycled paper, Toghyani et al. (2010) reported that the birds performed more sitting and less locomotion on the sand and wood shavings compared to the rice hulls and paper whereas, for feeding, sand and rice hulls were preferred and, for dustbathing, wood shavings were selected most often. This discrimination between substrates depending on activities is usually observed when birds have access to these materials simultaneously and continuously, and not when access is limited to short test periods (e.g. Shields et al., 2004). Correlations between ground pecking, ground scratching and dustbathing may also occur, either because the substrate is suitable for both foraging and dustbathing or because ground pecking and scratching naturally precede dustbathing sequences (Shields et al., 2004; Vestergaard and Baranyiová, 1996).

The preference for specific substrates can change over time due to deterioration with use, and associated changes in texture and content (Toghyani et al., 2010). Other reasons for changes in responses to a substrate over time include diurnal changes in behavioural priorities and ontological changes during behavioural development (Shields et al., 2005), although changes have not been observed in all studies (Shields et al., 2004). Nonetheless, use of substrates may also change over time due to increasing experience with the specific substrates. In one study, laying hens reared on one material (sand or wood shavings) initially chose the known material for dustbathing when presented with multiple choices but their preference subsequently changed as they gained experience with the other substrates (van Liere and Siard, 1991). The importance of experience on preference was also observed in a study in which inexperienced hens showed similar levels of ground pecking in wheat bran and peat on the first day of exposure, and were more likely to dustbathe in peat than wheat bran. By the fourth test day, however, more pecking was observed in freshly-supplied wheat bran than peat and similar numbers of hens were performing dustbathing in each substrate type (Guinebretière et al., 2014). In that study, fine particle sand was not preferred for either activity.

Accessibility of enrichment materials can also vary in time, with some provisions being continuously available and allowing possible access to all birds in the flock (even if not necessarily simultaneously). Examples include physical structures such as perches (e.g. Abeyesinghe et al., 2009; Arnould et al., 2004; Bizeray et al., 2002a), vertical cover panels (e.g. Bach et al., 2019; Cornetto and Estevez, 2001; Newberry and Shackleton, 1997), and platforms (e.g. Baxter et al., 2020; Kaukonen et al., 2017; Norring et al., 2016; Tahamtani et al., 2018). Availability of other provisions may be limited in time, such as natural light from windows depending on time of day and weather conditions (Bailie et al., 2013), or provision of ephemeral materials such as food items scattered in the litter (Bizeray et al., 2002b; Pichova et al., 2016) or dustbathing materials (Baxter et al., 2018a; Vasdal et al., 2019) that degrade and become dirty and indistinguishable from the litter over time or disappear due to consumption.

Peat (also known as peat moss) is generally found to be highly valued by domestic fowl as a substrate for dustbathing and foraging (e.g. de Jong et al., 2005, 2007; Wichman and Keeling, 2008; Widowski and Duncan, 2000). It may also have some beneficial effects when ingested (Trckova et al., 2005). It is, therefore, provided as a component of some commercial environmental enrichment programmes for broilers (e.g. BenSassi et al., 2019; Vasdal et al., 2019). However, the amount given may be limited in quantity, locations in the house and frequency of provisioning, raising questions about the extent to which the peat serves as an enrichment throughout the flock.

According to the theory of approach and avoidance conflict, a novel material can evoke both fear and curiosity, resulting in cautious approach as the nature of the material is explored (Miller, 1944; Montgomery, 1955). Familiarity with the material develops over repeated exposures and, in the absence of adverse consequences or a predisposition to remain neophobic, fear and avoidance typically decline (Greenberg and Mettke-Hofmann, 2001; Jones et al., 1996). Consequently, vigilance is expected to decline leading to an increase in the performance of relatively vulnerable behaviours (Beauchamp, 2019; Newberry et al., 2001; Newberry and Shackleton, 1997), such as ground pecking, ground scratching and dustbathing in the material. If, during repeated exposures, the material becomes associated with rewarding consequences from performing such behaviours, these behaviours should increase (Skinner, 1938; Thorndike, 1898). Thus, subsequent access to the material can be expected to result in quicker approach and exploitation for these activities. Such behaviours could, thus, be used as indicators of the extent of prior exposure to peat within a flock, the reward value of the material and the extent to which peat is serving as an enrichment.

The main aim of this study was to evaluate effects of limited previous provisioning of commercial broilers with peat on their current behaviour when given peat. In commercial flocks with and without prior peat exposure, we compared the behaviour of chickens in two different locations of the house, one offering fresh peat and the other serving as a control. We hypothesized that, if broilers in flocks previously given access to peat remembered peat as a rewarding substrate, they would be quicker to approach and exploit peat compared to broilers in flocks never previously given access to peat. Specifically, we predicted that birds in flocks previously exposed to peat would be quicker to stand in fresh peat, and to start ground pecking, ground scratching and vertical wing shaking (a component of dustbathing) sooner, compared to birds in flocks without such exposure. In contrast, we expected that birds in flocks lacking peat exposure would be more cautious towards peat, with fewer birds being found in a patch of fresh peat, and a lower proportion lying down in the peat, than in a comparable peat-free area elsewhere in the house.

2. Materials and methods

2.1. Ethics statement

Commercial broiler production farms were visited during the study. All the farmers gave their consent, which was voluntary, and no sensitive personal data or biological samples were collected. As treatments and testing was part of or similar to normal commercial routines, data on behaviour were collected in a non-invasive way, and animals were not handled, no permission from the Norwegian Food Safety Authority was needed to perform the study (Lovdata, 2015).

2.2. Animals, housing and management

The study was carried out in southeastern Norway on 15 production farms keeping broiler chickens (Ross 308, mixed sex) that were members of a producer cooperative. They were selected from the cooperative's projected annual production schedule based on their plan to produce two consecutive flocks between January and May whereby, in a balanced order, one flock would be provided with enrichments including peat and the other (control) flock would not receive enrichments. In practice, two of the non-enriched flocks received peat throughout the house as litter, and these flocks were excluded. A third flock was excluded due to loss of video for technical reasons, leaving 27 flocks for analysis. Six additional flocks originally scheduled to receive no enrichment were given peat. Thus, the study was conducted with 18 flocks provided with peat and 9 control flocks receiving no peat.

The birds were kept in houses ranging from 700 to 2050 m^2 in size (mean ± SE: 1287 ± 40 m^2), and in flocks of 9335–34657 birds (mean ±

SE: 18881.4 ± 913.6 birds). The houses were well-insulated, with concrete floors, mechanical ventilation and whole-house heating. They were thoroughly cleaned between flocks, and supplied with fresh wood shavings litter. The photoperiod was gradually reduced to 16−18 h by one week of age. Enriched flocks were given peat in scattered locations of the house (roughly 1 patch/50 m^2) starting from 1 week of age, and replenished at least weekly, for a total of 0.015 to 0.15 L/bird throughout the production cycle. On different farms, peat was offered in chunks, loose piles or contained within frames. Most of the flocks given peat also received one or two other forms of enrichment including compressed wood shavings bales (typically ½ bale/100 m^2), and boxes serving as low perching platforms (typically 1 box/50 m^2). Farmers checked the chickens at least twice a day, and removed any seriously ill, injured, or dead chickens. Flocks were slaughtered at 32–35 days old age at a stocking density of 31.7 ± 0.7 (range: 25.8–39.5) kg live weight/m^2.

2.3. Data collection

We visited each flock once at 28 ± 0.1 (range: 26–31) days of age when the space allowance averaged 0.067 ± 0.001 (range: 0.058 – 0.076) m^2/bird. We set up two video camcorders (Handycam HDR-CX240E, Sony Corporation, Tokyo, JP) on tripods approximately 8 m apart in a central row of the house (bounded by a line of feeders and a line of water nipples). Each camera recorded an area between the feeder and drinker line in the same adjacent row, which contained no existing enrichments. The distance between the recorded areas was selected to obtain a different random sample of chickens, and independence of behaviour, in the two areas during the recording period. One researcher started the recordings while another poured 10 L of fresh peat from a bucket into one of the recorded areas, dispersing the material with her hand so it was approximately 2 cm deep (peat patch). In the other recorded area, she performed the movements of pouring and dispersing peat, but with an empty bucket (control patch, wood shavings litter only). Both researchers left the house for a 20-min period to allow video recording of behaviour undisturbed by human presence. To avoid any distraction from extra novel stimuli and to allow birds free access to the peat, we did not use a frame to contain the peat, but the provision of a standard quantity and method of dispersion served to standardize the peat patch area to about 0.5 m^2.

Data collection from the video recordings was performed using the event recorder software Solomon Coder (András Péter©, 2019, https://solomon.andraspeter.com/). A single observer (JV), blind to the previous peat exposure status of each flock, performed all observations. The different flocks and patches were observed in a random order. The patches were variable in shape depending on how the peat fell from the bucket, and variation in the camera angle depending on the distance between the feeder and drinker lines (which varied between flocks). Therefore, in the Solomon Coder video screen, we defined the peat patch by drawing a line around the border of the peat-covered area at the start time of the observation, defined as the moment when both of the researcher's feet had left the camera view. We used the same drawing, when observing the video of the control patch for the same flock. From each 20-min recording, the latencies for the first five birds to perform each of the following behaviours were recorded and averaged per flock per patch:

- Standing: Standing or locomoting in an upright posture (i.e. active, not lying), with both feet fully in the patch
- Lying: Abdomen in contact with the substrate, with both feet fully in the patch
- Ground pecking: Pecking with the beak at substrate in the patch
- Ground scratching: Raking substrate in the patch backwards with the claws, while in an upright posture
- Vertical wing shaking: Rapidly raising and lowering both wings several times in rapid succession, scoping substrate into the feathers (a component of dustbathing), while lying in the patch

The latencies were timed from the defined start time of the observation. If no birds performed a behaviour within the 20-min observation, the maximum latency of 1200s was recorded for that behaviour. We also used instantaneous scan sampling at 1-min intervals throughout the 20-min recordings (20 scans) to determine the following:

- Present: The total number of birds with any body part at least partly in the patch, averaged across scans
- Proportion lying: The proportion of birds lying of those present in the patch.

2.4. Statistical analysis

Statistical analyses were performed in R software version 3.6.2, with model fit confirmed through examination of residuals. Data on latency to stand, lie and ground peck, and total number of birds present, were analyzed using linear mixed models (package `lmerTest`) based on Gaussian distribution with identity link function. The models were estimated using the restricted maximum likelihood method, with t-testing using Satterthwaithe`s method, to assess effects of previous peat exposure of the flock (vs no previous exposure), patch type (peat vs control) and their interaction, with farm as a random factor and flock as the subject. The effects of these factors on the proportion of birds lying in the patch were analyzed using a generalized linear mixed model (package`lmerTest`) based on binomial distribution with logit link, with Laplace approximation applied to counts of the number of birds lying vs not lying while in the patch. We also accounted for variation in flock density, which was likely to affect the number of birds in the vicinity of the observation patches, by including animal density (birds per m^2 on the day of visit) in the models. The reference category used for estimating differences was "no previous peat exposure, control patch type". For significant interactions ($P < 0.05$), post hoc pairwise means comparisons were made using the Tukey method to adjust for multiple comparisons (package`emmeans`). Ground scratching and vertical wing shaking were too rare in the control patches for inclusion of patch type in the models. Instead, we modelled the effects of previous peat exposure and animal density on latency to perform these behaviours in the peat patch only. Detailed results from the statistical analyses are presented in Supplementary material (Table S1).

3. Results

3.1. Latencies

There was an interaction between previous exposure and patch type ($P = 0.027$) on latency to stand in patches. Birds not previously exposed to peat had a longer latency to stand in a patch containing peat than in a control patch containing litter only. In contrast, birds in peat-exposed flocks had a similar latency to stand in each patch type, comparable to that of birds in unexposed flocks in the control patch (Fig. 1a). The latency to stand in a peat patch was higher than that for a control patch ($P = 0.001$), but there were no main effects of previous peat exposure or animal density on latency to stand in a patch ($P > 0.05$).

The interaction of previous exposure with patch type did not affect latency to lie ($P > 0.05$), but this behaviour was influenced by patch type ($P = 0.002$), with birds in the control patch being quicker to lie down compared to birds in the peat patch (Fig. 1b). Birds in flocks with previous exposure to peat tended to have shorter latencies to lie down compared to birds in unexposed flocks ($P = 0.082$). Density was negatively associated with latency to lie ($P = 0.034$), with shorter latencies being observed in flocks with higher densities.

There was no interaction between previous exposure and patch type on latency to ground peck ($P > 0.05$), but a shorter latency was observed in patches where fresh peat was provided than in control patches ($P = 0.010$), and birds in flocks with previous peat exposure were quicker to perform ground pecking than birds in flocks without previous peat

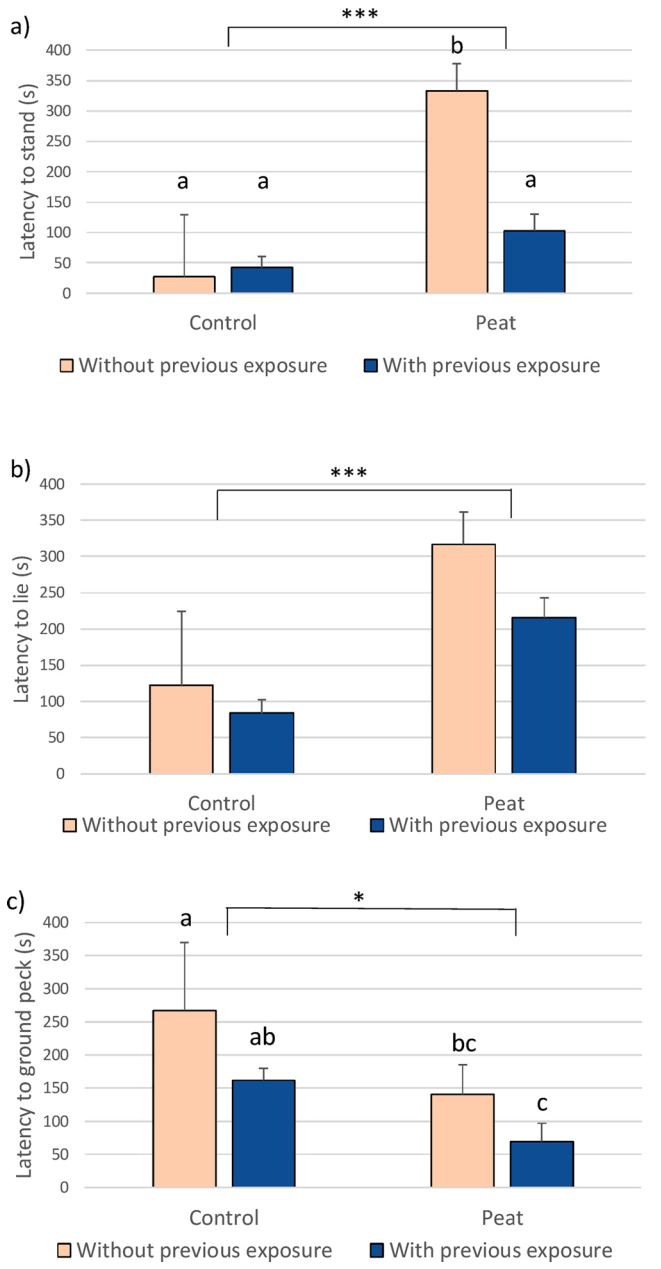

Fig. 1. Mean ± SE latency of the first five birds to (a) stand (b) lie and (c) ground peck, in flocks without or with previous exposure to peat, in patches without (control) or with fresh peat. Asterisks indicate a difference between patch types (* $P < 0.05$, *** $P < 0.005$), and a, b depict differences across all pairwise combinations ($P < 0.05$).

exposure ($P = 0.010$) (Fig. 1c). There was a tendency for shorter latencies to ground peck in flocks with higher densities ($P = 0.067$).

Ground scratching and vertical wing shaking were rarely shown by birds in control patches during the 20-min observation period (ground scratching: one bird in each of two peat-unexposed flocks and 12 birds across six peat-exposed flocks; vertical wing shaking: three birds across two peat-unexposed flocks and 20 birds across eight peat-exposed flocks). These behaviours were shown by fewer than five birds within the observed 20 min even in some peat patches. No ground scratching occurred in three peat-unexposed flocks and one peat-exposed flock, and no vertical wing shaking occurred in six peat-unexposed and three peat-exposed flocks. Previous peat exposure was associated with reduced latencies to ground scratch ($P = 0.016$, Fig. 2a) and perform vertical wing shakes ($P = 0.016$, Fig. 2b) in the peat patches. Density did not

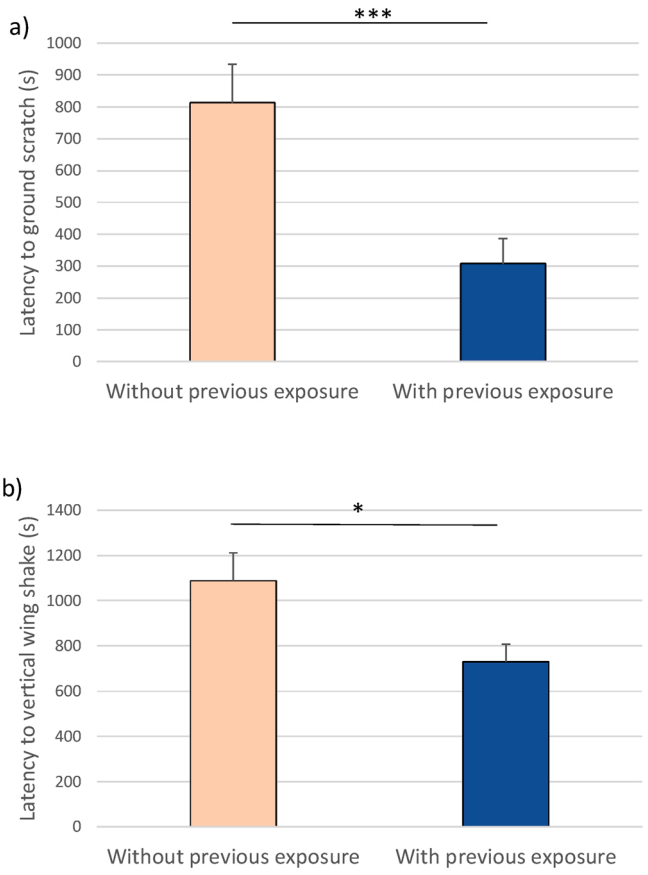

Fig. 2. Mean ± SE latency of the first five birds to (a) ground scratch, and (b) vertical wing shake in peat patches, in flocks without or with previous exposure to peat (* $P < 0.05$, *** $P < 0.005$).

affect these latencies ($P > 0.05$).

3.2. Number of birds present and proportion lying

There was a significant interaction between previous exposure and patch type on number of birds present in the patches ($P < 0.001$). Post hoc tests indicated that, while birds in flocks without previous exposure to peat were found less often in peat patches compared to control patches, there was no difference in numbers present between patches in flocks previously exposed to peat (Fig. 3a). We found that there were fewer birds in patches containing fresh peat than in control patches ($P < 0.001$). There was no main effect of previous exposure to peat ($P > 0.05$), but patches contained more birds in flocks with higher densities ($P = 0.039$).

A similar pattern was observed for the proportion of birds lying. There was an interaction between previous experience and patch type ($P = 0.028$) although specific differences were not detected in post hoc tests (Fig. 3b). There was a lower proportion of chickens lying in patches with peat compared to control patches ($P < 0.001$) and there was a tendency for a higher proportion of chickens lying in flocks with previous exposure ($P = 0.058$) whereas density had no effect on the proportion lying ($P > 0.05$).

4. Discussion

We hypothesized that the broiler chickens with previous experience of peat would be quicker to exploit the peat compared to the peat-naïve chickens, resulting in shorter latencies to stand in the peat patch, and to start ground pecking, ground scratching and vertical wing shaking. As predicted, birds in previously peat-exposed flocks had shorter latencies

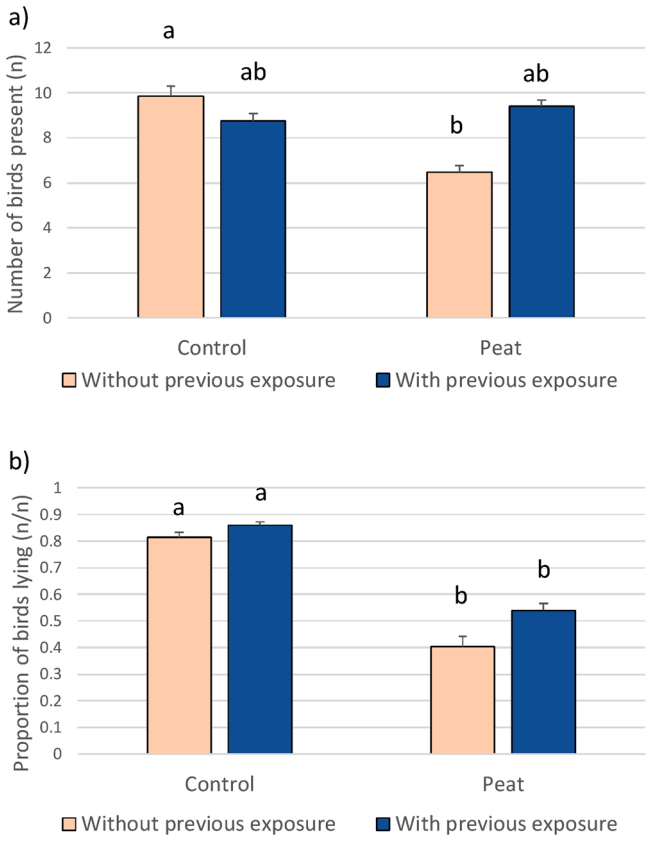

Fig. 3. (a) Mean ± SE number of birds present and (b) proportion of birds lying, in flocks without or with previous exposure to peat, in patches without peat (control) or with fresh peat. a, b depict differences across all pairwise comparisons ($P < 0.05$).

to stand on peat, and commenced ground pecking, ground scratching and vertical wing shaking in the peat sooner, compared to birds in peat-naïve flocks. These results are reinforced by the finding that previous exposure to peat did not specifically affect the latency to perform any of the behaviours in the control patch (though ground scratching and vertical wing shaking were too rare to compare latencies in the control patch statistically). The lack of differences in the control patch supports the interpretation that the effect of previous peat experience on behaviour in peat patches was specifically due to the peat rather than being related to other enrichments provided to the same flocks. Furthermore, these results support the assertion that the peat was not only familiar, reducing fear, but was also associated with positive memories of foraging and dustbathing in peat, thereby attracting the birds to perform these behaviours again in the freshly delivered peat instead of ignoring the known material.

We also hypothesised that the peat-naïve birds would show greater avoidance of peat than the birds in peat-exposed flocks, as indicated by lower numbers of birds in the peat patch, and a lower proportion lying down, than in the control patch. As predicted, fewer peat-naïve birds were present in the peat patch throughout the 20-min observation period compared to numbers in the control patch. They were also much slower to stand in the peat than the control patch. Comparison of the latencies across behaviours shows that the peat-naïve birds tended to direct ground pecking towards the peat before other behaviours (typically by reaching into the peat patch from outside its perimeter) whereas, in control patches, they were more likely to stand in the patch before ground pecking. As expected, the proportion of peat-naïve birds observed lying during the 20-min observation was lower in peat than control patches, and these birds also had longer latencies to lie in the peat patches. However, these effects were not specific to peat-naïve birds.

Regardless of previous peat experience, birds were slower to stand and lie in peat than control patches, and the proportion lying was lower in peat patches. This could be because, even for peat-experienced birds, fresh peat has some novelty value due to its heterogenous nature (Trckova et al., 2005). Furthermore, previously provided peat may have been consumed, diluted in the litter or fouled by faeces, reducing its attractiveness for foraging and dustbathing. Hence, adding fresh peat could be expected to have an arousing effect on the birds, stimulating active behaviours such as ground pecking, ground scratching and vertical wing shaking rather than sedentary ones such as lying and resting. Because resting birds are disturbed by active birds (Buijs et al., 2010; Cornetto et al., 2002), it is not surprising that a lower proportion of birds was found lying in peat than control patches.

Our findings are consistent with earlier studies indicating that, compared to other substrates, peat was a highly explored and preferred enrichment (e.g. Baxter et al., 2018a; Guinebretière et al., 2014; Petherick and Duncan, 1989; van Liere and Siard, 1991), and that birds would work to gain access to it (de Jong et al., 2005, 2007; Wichman and Keeling, 2008; Widowski and Duncan, 2000). Moreover, our results suggest that birds without peat experience were curious about this novel material but their unfamiliarity with it inhibited dustbathing. Others have also noted effects of substrate novelty on behaviour. For example, Petherick et al. (1995) observed avoidance of peat during the first hour after placing it within the cages of 12-week-old peat-naïve pullets, though birds dustbathed in it when it was placed just below the familiar wire-mesh cage floor. Similar results were found with wood shavings as a novel substrate in laying hens (Nicol et al., 2001), where exposure to wood shavings influenced whether, at a later age, birds used the provided wood shavings only for foraging or for dustbathing as well. Caution towards novel substrates is probably only observable for a short period. We recorded behaviour for 20 min whereas the observation period was 1 h in Petherick et al. (1995) and Nicol et al. (2001). Ground pecking is a mechanism for exploring novel stimuli and, as the material becomes more familiar and its non-harmful nature is established, birds appear to relax sufficiently to use it for more vulnerable behaviours such as dustbathing and lying on the ground.

All flocks in the current study had wood shavings as the litter material. When offered simultaneously with peat or sand, wood shavings have been the least preferred material for ground scratching and dustbathing in some studies (e.g. de Jong et al., 2007; van Liere and Siard, 1991). In others, wood shavings were used comparably to peat for ground scratching (Petherick and Duncan, 1989) or for resting on when provided in bales (Baxter et al., 2018b). When wood shavings or sand were offered as the sole substrate, broilers showed comparable frequencies of foraging and dustbathing (Shields et al., 2005), suggesting that wood shavings were sufficient to meet any inelastic motivation to perform these behaviours and that peat increased the motivation to perform them above basic levels (Widowski and Duncan, 1990). However, it is possible that, had we added fresh wood shavings to the patch, we would have observed similar results to adding fresh peat in peat exposed flocks.

We included animal density in the statistical models to account for its predicted effects on the number of birds occurring in the patches. Indeed, we observed higher numbers of birds present in the patches in flocks with higher animal densities indicating that the open place created by our manipulations filled up more quickly at higher densities. The lower latency to lie down in higher-density flocks may have been due to a feeling of greater security to lie down sooner when surrounded by more birds (Newberry et al., 2001). This “safety in numbers” effect may have been countered by increased disturbances and decreased behavioural synchrony with higher group size in the patches (Buijs et al., 2010; Hall, 2001; Keeling et al., 2017), resulting in an overall absence of association between density and proportion lying throughout the 20 min observations. None of the results attributed to previous exposure were accompanied by a density effect. While higher densities can adversely

affect walking ability (BenSassi et al., 2019; Knowles et al., 2008; Sørensen et al., 2000), which could influence approach to, or avoidance of, a novel stimulus (Vasdal et al., 2017), this probably did not affect our results as birds stood in the control patches at comparable latencies irrespective of density.

In further research, it would be beneficial to identify similarly enriching but environmentally sustainable alternatives to peat. Attention is also needed to potential welfare costs of providing limited amounts of enrichment materials on an intermittent basis, such as competition for access and potential frustration when not accessible. Additionally, it would be instructive to follow individuals within flocks throughout the production cycle to assess the degree of individual variation in use of substrates provided as enrichments depending on the frequency of delivery, amount provided, and pattern of distributing the material in the house.

5. Conclusions

This study investigated effects of limited previous exposure on use of peat as an enrichment material by broiler chickens under commercial conditions. Our results indicate that, overall, broilers were quicker to peck at fresh peat in peat patches than at existing wood shavings litter in control patches. Additionally, a lower proportion of birds was observed lying down in peat than control patches, indicating that chickens were more active in peat patches. These findings confirm and extend previous reports regarding the effectiveness of fresh peat as an enrichment material stimulating chickens to perform active behaviours in their natural behavioural repertoire. Furthermore, we have demonstrated that broilers in peat-exposed flocks were quicker to exploit fresh peat by performing behavioural elements of foraging and dustbathing (ground scratching and vertical wing shaking, respectively) whereas birds in peat-naïve flocks showed more caution towards peat. We conclude that, even though provisioning of peat was relatively sparse and ephemeral, it was sufficient to contribute to long-term positive memories of the resource, supporting its value as an enrichment generating positive welfare for broilers under commercial conditions.

Declaration of Competing Interest

The authors report no declarations of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.applanim.2020.105129.

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