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Evaluation of a dustbathing substrate and straw bales as environmental enrichments in commercial broiler housing

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ABSTRACT

The use of straw bales as an environmental enrichment is common for broiler chickens in enriched housing systems, however relatively little information exists about their effectiveness in improving welfare. There has also been no widespread introduction of a dustbathing material for broilers. The main aim of this trial was to evaluate the use of a dustbathing substrate (in the form of oat hulls), both as an alternative to straw bales and as a supplementary enrichment. Over four replicates, four commercial houses, each containing approximately 22,000 broilers, were assigned to one of four treatments over the 6-week production cycle: (1) straw bales (B; one per 155 m^2), (2) oat hulls as a dustbathing substrate (OH; provided in 1 m diameter steel rings, one per 155 m^2), (3) both oat hulls and straw bales (OH + B), and (4) a control treatment with no environmental enrichment (C). Observations of broiler behaviour and leg health were taken weekly, and performance data was collected for each cycle. Broilers housed in the OH and OH + B treatments had better gait scores in week 6 than those housed in the C treatment ($P < 0.05$), which suggests that the provision of oat hulls improved bird leg health. However, there was no associated increase in activity levels in unenriched areas of the houses. Conversely, more locomotion ($P < 0.001$), less sitting inactive ($P < 0.001$) and less sitting pecking ($P < 0.001$) were observed in the C treatment than in unenriched areas of B, OH and OH + B treatments. More birds were recorded around the bales compared to the oat hulls ($P < 0.001$), however birds performed significantly more foraging ($P = 0.019$) and dustbathing ($P = 0.045$) in oat hulls than around straw bales. Although oat hulls appear to be more suitable for stimulating active behaviours than straw bales, the high level of resting recorded around the bales suggests they may have a positive function as protective cover. The presence of an additional type of enrichment in the house did not affect the number of birds, or the type of behaviours performed in close proximity to either straw bales or oat hulls ($P > 0.05$). Treatment did not have a significant effect on pododermatitis levels or slaughter weight, on mortality rates, or on litter quality or atmospheric ammonia levels ($P > 0.05$). Overall, our results suggest that the oat hulls substrate was a successful enrichment in terms of promoting dustbathing and foraging, and improving bird leg health. The straw bales also appeared attractive to the birds, however, which suggests that a dustbathing substrate should be a supplementary enrichment.

1. Introduction

Broiler chickens are typically housed in indoor systems, in groups of several thousand, and bedded on deep litter. With the exception of feeder and drinker lines, the houses do not usually contain additional furniture or stimulation. Providing domestic fowl with more complex environments has improved stereotypical pecking behaviours (Nørgaard-Nielsen et al., 1993), fear reactions (Jones and Waddington, 1992; Reed et al., 1993), learning (Krause et al., 2006), activity levels (Kells et al., 2001) and leg condition (Mench et al., 2001; Bizeray et al., 2002a). Chickens will readily enter areas containing novel items (Newberry, 1999) and will spend more time in preferred foraging and dustbathing substrates when provided (Shields et al., 2004). Crucially, introducing barriers (Bizeray et al., 2002a) and straw bales (Kells et al., 2001) has been shown to increase activity levels in broilers. Modern broilers will spend up to 86% of their time sitting down (Weeks et al., 2000), with this inactivity linked to a high prevalence of skeletal conditions and leg disorders that get worse with age (Vestergaard and Sanotra, 1999; Danbury et al., 2000; Knowles et al., 2008). Providing broilers with a more complex environment is therefore likely to improve bird welfare, both by improving leg health and by providing a stimulating environment to promote natural behaviours (Newberry,

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1995).

Although there is no current legal requirement for broilers to be provided with environmental enrichment, those housed under conditions dictated by welfare assurance schemes are often supplied with some variation of natural light, perches and/or straw bales (e.g. CIWF, 2017). Foraging and dustbathing are highly motivated behaviours and preventing birds from performing them leads to observable frustration (Lindberg and Nicol, 1997; Vestergaard et al., 1997; Fraser and Duncan, 1998). Providing a foraging substrate, in the form of straw bales, should therefore have a positive effect on welfare. However, there is limited research on the use of bales provided at a commercial level. Kells et al. (2001) showed that providing broilers with straw bales increased their overall activity levels, however their trial used a higher number of bales than are supplied commercially. More recent research that involved lower straw bale densities, chosen to more closely reflect current industry practice, did not yield similar findings (Bailie et al., 2013; Bailie and O'Connell, 2014). Similarly, although smaller scale research has been conducted on the preference of broilers for different dustbathing substrates (e.g. Shields et al., 2004), there has been no widespread introduction of dustbathing enrichments. Dustbathing consists of birds kicking a loose friable substrate through their feathers and is a highly-motivated behaviour (van Liere et al., 1991; Vestergaard et al., 1997; Vestergaard and Sanotra, 1999). Broilers with tibial dyschondroplasia will dustbathe significantly less than their healthy counterparts, which may be due to dustbathing requiring rotation and movement of the legs (Vestergaard and Sanotra, 1999). Broilers have shown a preference for peat and sand as dustbathing materials (Shields et al., 2004; de Jong et al., 2007), however these substrates are expensive, unsustainable and may interfere with the litter removal process. A practical alternative has been suggested in the form of ground oat hulls, which are a by-product of oat milling. Broilers appear to identify oat hulls as a dustbathing substrate and perform comparable dustbathing bouts in oat hulls and peat (Baxter and O'Connell, 2016), however their effectiveness as a form of environmental enrichment has not yet been evaluated under commercial conditions.

This experiment was designed to evaluate different environmental enrichment conditions for commercial broiler chickens. This included assessing the effectiveness of straw bales (when provided at a level that reflects practice on some commercial farms), a comparable quantity of oat hulls, both straw bales and oat hulls, and a control treatment with no straw bales or oat hulls. There was a particular interest in understanding whether oat hull dustbaths should be used as an alternative or supplementary form of environmental enrichment to straw bales. The effects of different enrichment treatments on general behaviour of the birds (both in close proximity to, and away from the enrichments), on measures of health and performance, and on environmental measures within the house were determined.

2. Methods

This trial was approved by the School of Biological Sciences (Queen's University Belfast) Research Ethics Committee (reference number QUB-BE-AREC-17-001).

2.1. Subjects and housing

A total of 355 400 Ross 308 broiler chickens (Aviagen Ltd, UK) were used in this study and were reared from a day old on a commercial farm in Northern Ireland. The trial was repeated for four production cycles between July and December 2015. Four metal framed, windowed broiler houses were used on this farm. Two houses had a floor space of 1398 m^2 and two had a floor space of 1395 m^2 due to different positioning of outbuildings. Approximately 22,000 birds were placed in each house 'as hatched', which gave an approximate 50:50 mix of males and females. This gave an initial stocking density of 16 birds/m^2. A proportion of the birds were removed for thinning at approximately day 30, and the remaining birds were cleared between days 37 and 42. Temperature and humidity were controlled automatically to maintain levels within the commercial standard. Natural light was provided through 43 windows along the long sides of the house (measuring 220 cm wide × 60 cm high, at a height of 1.5 m), artificial strip lighting was also provided. The lighting regime used followed EU regulations: time in darkness increased by 1 h per day, from 1 h at a day old to 6 h on day 7, and then decreased on day 29 by 1 h per day to 1 h of darkness which was maintained from day 33 to slaughter. Fresh woodshavings were used to bed the house at the beginning of each cycle, before the birds were placed, with additional shavings then distributed at the farmer's discretion across the cycle.

2.2. Treatments and experimental design

In order to investigate the effectiveness of different enriched conditions, the four commercial houses were assigned to one of four treatments: 1) Bales (B), 2) Oat Hulls (OH), 3) Oat Hulls and Bales (OH + B), 4) Control (C). This trial was repeated over four cycles, with each house assigned to each treatment once. In treatments containing straw bales, nine plastic-wrapped bales of chopped straw (approximately 0.8 m long × 0.4 m wide × 0.4 m high) were placed evenly around the house on Day 10, which matched normal practice on this farm. Five bales were placed down the central line of the house and four around the edge of the house. Oval cuts were made in the plastic at the sides of the bales to allow access to the straw (Fig. 1), and once the top of the bale had collapsed through use, it was replaced in the same location. Existing bales were dismantled (and plastic removed) just prior to thinning, and were replaced with nine new bales after thinning. In total, two bales per 1000 birds (46 bales; 1 per 155 m^2) were used across a 6-week cycle in a particular house.

Oat hulls were the ground outer hull of oats, produced locally as a

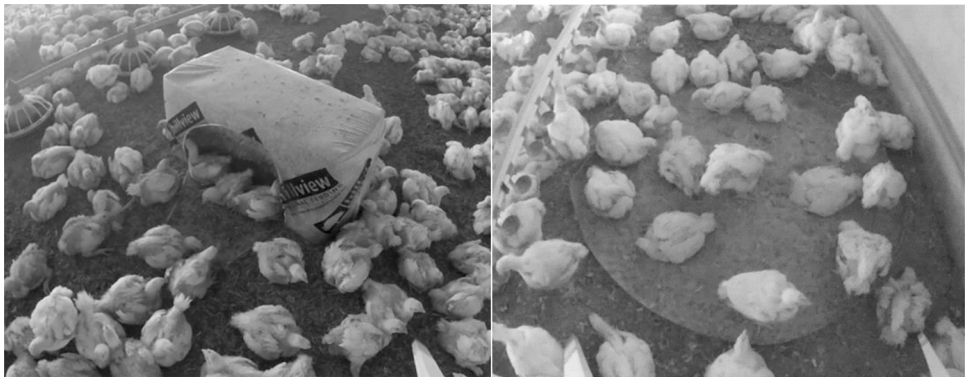

Fig. 1. Photograph of the enrichments used throughout the trial: plastic-wrapped, short cut straw bales (left) and steel rings of ground oat hulls (right).