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Dustbathing, pecking and scratching behaviours of laying hens in furnished cages are enhanced by the presence of rubber mats and litter distribution

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ABSTRACT

Furnished cages for laying hens exist in a wide variety of sizes and designs and should be equipped to allow hens to express some of their behavioural priorities. European Council Directive 1999/74/EC stipulates that litter must be provided for pecking and scratching but the type of litter and the pad where litter is delivered are not defined. In the same way, neither the maximum nor the optimum number of birds per cage has been defined. Two successive experiments were carried out to analyse pecking, scratching (PS) and dustbathing (DB) behaviours performed in different furnished cages with different designs. Three group sizes of ISA brown laying hens (20, 40 or 60 hens, with the same density in all the cages), with or without additional feed distribution as litter substrate, were compared in the first experiment. The second experiment focussed on DB behaviour and compared two pecking and scratching pads (artificial turf or rubber mats), with or without wheat bran distribution as litter substrate, in groups of 60 hens per cage. Irrespective of litter presence, group size, and type of pad, DB and PS were mainly performed in the pecking and scratching area, showing the attractiveness of this area. In the first experiment, feed–litter provision in pecking and scratching area increased PS and DB behaviours, while group size did not affect them. In the second experiment, hens performed more DB in the pecking and scratching area when wheat-bran litter was present than when it was absent. Rubber matting was more attractive to hens for DB than artificial turf matting. Durations of DB bouts were not affected by the presence or absence of wheat-bran litter or the choice of pecking and scratching pad. In furnished cages, hens clearly seek out pads and litter to perform PS, and providing litter (feed or wheat bran) or rubber in pecking and scratching area is attractive for hens to DB in it. However, the cage design could be improved to promote more DB activity, for instance by increasing space of pecking and scratching area in the cage.

1. Introduction

Furnished cages providing 750 cm^2 of space per hen, a nest area, perches and a litter area have been developed in Europe since Directive 1999/74/EC came into force in 2012 (European Commission, 1999) with the aim of giving laying hens the opportunity to perform certain behaviour such as nesting, perching and foraging while maintaining the economic and hygienic advantages associated with cages. Different sizes, designs and furniture of cages have been marketed and sold to producers in an attempt to meet the combined needs of the hens (welfare), farmers (budget), and consumers (health, egg quality).

Although initial models of furnished cages were not much larger than conventional cages, furnished cages now house between 10 and 80 hens. The effect of group size in furnished cages with equal density of birds has been studied mainly in small groups with fewer than 10 hens (Abrahamsson and Tauson, 1997; Appleby, 1998; Shimmura et al., 2009) or with various models of cages which could not strictly be compared (Vits et al., 2005). More recently, Huneau-Salaün et al. (2011) detailed the effects of larger group sizes (20, 40 and 60 hens) with the same density of animals per cage,

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allowing assessment of group size effect. They showed some impact of group size on zootechnical performances and egg quality, but also on laying and perching behaviours (Guinebretière et al., 2009).

A major issue in the development of furnished cages is the requirement in the Directive to provide hens with litter, defined as "any friable material enabling (laying hens) to satisfy (their) ethological needs". In furnished cages, setting up an area which promotes both pecking, scratching (PS) and dustbathing (DB) involves some technical problems. In practice, the pecking and scratching area (PSA) included in furnished cages commonly consists of a solid, flexible or hard surface (called a pad in this article) designed to catch any loose material dumped on it automatically. The remaining floor of the cage is made of wire mesh, through which the litter may fall before landing on the manure belt. In most furnished cages, additional litter can be supplied automatically by a spiral conveyor pipe which runs longitudinally through all the compartments of the cage. The kind of litter distributed has to suit the distribution system and satisfy the hens. However, the conveyor system is incompatible with the two substrates most frequently cited as being preferred by laying hens: peat and sand (de Jong et al., 2007; Petherick and Duncan, 1989; Sanotra et al., 1995; Shields et al., 2004; Toghyani et al., 2010; van Liere et al., 1990; Vestergaard and Hogan, 1992). Peat particles are too light and agglutinate, blocking the system, and sand is too abrasive for the mechanism. Although Scholz et al. (2011) found that food particles may not be a suitable dust-bathing substrate for laying hens due to their high lipid content, they are still used as litter in the majority of commercial poultry farms providing litter to hens, because it is easy to distribute without adding a supplementary distribution system.

Wheat bran could be an interesting alternative to the feed usually provided as litter in commercial settings. It is less expensive, usable in an automatic distribution system and rich in fibre. Providing more fibre within the diet could improve the welfare of laying hens according to Hetland et al. (2003). Furthermore, wheat bran promoted PS behaviours better than sand and peat during ex situ preference tests (Guinebretière et al., 2014). Moreover, although peat induced more dustbaths than wheat bran, the preference for DB in wheat bran increased with time of exposure during the experiment. In addition, wheat bran can be distributed automatically in furnished cages, without consequences on health (Guinebretière et al., 2012, 2013), and even with improved laying performances (Huneau-Salaun et al., 2014).

For practical and financial reasons, under commercial conditions no friable litter is provided in many cases, or distribution is infrequent. In this latter case, litter is often insufficient because the rapid scattering of litter through the wire mesh during PS and DB activities makes frequent redistribution necessary, increasing costs especially when feed is used as litter. As litter is not provided permanently, pads need to be very attractive to promote DB and PS in hens on PSA. Previous studies found that artificial turf matting (AstroTurf®) proposed without litter was preferred to wire mesh for DB (Alvino et al., 2013) and was also used by hens for PS (Merrill et al., 2006). However, Guinebretière et al. (2012) showed that artificial turf mats used in PSA were dirtier than rubber mats and also difficult to clean, potentially decreasing cage hygiene and egg safety. Hygiene in furnished cages is a major concern: cleaning pads in commercial barns is costly and time consuming, without any guarantee of complete cleaning.

To sum up, group size has some impact on zootechnical performances and affects some hen behaviours, but there is no data available about impact of group size on PS and DB in furnished cages. Moreover, the requirement to have PSA in cages raises several problems, as the litters preferred by hens for DB are not suitable in cages. Feed is commonly used in commercial conditions although it is not an ideal litter, but as far as we know its impact on PS and DB behaviours has never been studied in furnished cages. Wheat bran could be an interesting alternative to feed as litter, but has not been tested in furnished cages to assess PS and DB behaviours. Rubber mats could be an alternative to artificial turf mats commonly used as PSA materials to reduce hygiene problems, but this has never been assessed regarding hens' DB and PS behaviours.

The aim of this study was therefore to evaluate the hen's PS and DB behaviours and hen distribution in furnished cages according to different group sizes, litter types and PSA pads. Two successive experiments with specific objectives were performed. The objectives of the first experiment were to study the group size effect (20, 40 or 60 hens per cage with same stocking density), as well as the effect of additional feed distribution as litter substrate on artificial turf matting (pad and litter type commonly used under commercial conditions), on PS and DB behaviours in standardised conditions, and hen distribution into cages. The second experiment focussed on DB behaviour. It aimed firstly to check if wheat bran could promote DB if distributed as litter on rubber PSA mats; and secondly to test which type of PSA pad (artificial turf or rubber mats) enhanced DB behaviours more when no litter distribution is provided. In the 2 experiments, analyses were first done on the entire cage and per cage area (PSA, nest and others areas). Moreover, PS and DB behaviours were compared between areas in order to determine where the hens perform PS and DB behaviours in furnished cages. The location of DB in relation to trough position was assessed in order to check if DB were stimulated by feed in the trough. In addition, in order to know how the hens were attracted in PSA, the distribution of hens in cages was compared to a homogenous distribution.

2. Materials and methods

2.1. Animals and housing

The two experiments were a part of a large study carried out on two successive batches of 4320 Isa Brown laying hens. Hens were beak-trimmed at one day old, reared in on-floor systems with wood shavings as litter until the 18th week of age, then transferred into furnished cages distributed in three 3-tier batteries for the laying period, following standard management practices until the 73rd week of age. Each tier contained a total of 1440 hens. Several physical, zootechnical and physiological parameters relevant to their production and health were investigated in all the hens (results published in Guinebretière et al., 2012, 2013; Huneau-Salaün et al., 2011). Only the hens from the upper tiers were used for the experiments described here, as their behaviour could be observed more easily from above by video recording.

Feed (2700 kcal of metabolisable energy/kg, 17.0% crude protein, 3.7% Ca, and 0.3% available P) was distributed automatically 3 times per day at 07:00 h, 15:00 h, and 19:00 h. Hens had permanent access to the feed. Water was also provided ad libitum. Egg collection was carried out automatically on a daily basis. Temperature was kept at $19 \pm 1\,^{\circ}C$. During the light period, artificially maintained from 06:00 h to 23:00 h, average light intensity values in front of the nest in the cages and in front of the PSA were 2 and 10 lx respectively.

2.1.1. Experiment 1

The 1440 hens from the upper tier of the batteries used in Experiment 1 were housed in 36 cages: 12 cages housing 20 laying hens, 12 cages housing 40 laying hens and 12 cages housing 60 laying hens, randomly distributed within the tier. Each of these furnished cages (Zucami Poultry Equipment, Spain) were 455 mm high at the rear of the cage. 60-hen cages were 1260 mm deep × 3660 mm wide; 40-hen cages were 1260 mm deep × 2440 mm wide; 20-hen cages were 630 mm deep × 2440 mm wide. They all offered a total surface area of 768 cm^2 per hen with wire mesh floor, including