Applied Animal Behaviour Science 160 (2014) 46–55

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

How much is enough? The amount of straw necessary to satisfy pigs' need to perform exploratory behaviour

Lene J. Pedersen[a,*], Mette S. Herskin[a], Björn Forkman[b], Ulrich Halekoh[c], Kristian M. Kristensen[d], Margit B. Jensen[a]

[a] Department of Animal Science, Aarhus University, AU-FOULUM, PO Box 50, 8830 Tjele, Denmark
[b] Department of Large Animal Science, Faculty of Health Sciences, University of Copenhagen, Grønnegårdsvej 8, 1870 Frederiksberg C, Denmark
[c] Institute of Public Health, University of Southern Denmark, J.B. Winsløws Vej 9, 5000 Odense C, Denmark
[d] Department of Agroecology, Aarhus University, AU-FOULUM, PO Box 50, 8830 Tjele, Denmark

ARTICLE INFO

Article history:
Accepted 28 August 2014
Available online 6 September 2014

Keywords:
Abnormal behaviour
Activity
Straw
Rooting material
Growing pigs
Welfare

ABSTRACT

Since 10 years, EU-legislation states that 'pigs must have permanent access to sufficient quantity of material to enable proper investigation and manipulation activities'. While much research has focused on which materials 'enable proper investigation and manipulation activities', little has been done to determine what constitutes 'sufficient quantity' and 'permanent access'. Based on the hypothesis that a reduced level of oral manipulation of pen mates reflects an increased level of fulfilment of pigs' behavioural need to explore, we chose oral manipulation of pen mates as target behaviour. In three batches, we investigated the relation between oral manipulation of pen mates and amount of straw provided to the pigs in order to identify the amount of straw, where additional provision of straw did not reduce the occurrence of oral manipulation of pen mates any further. From 30 to 80 kg body weight, the pigs were housed in groups of 18 animals in pens (5.48 m × 2.48 m) with concrete floor (1/3 solid, 1/3 drained and 1/3 slatted). Pens were cleaned manually twice a week and fresh uncut straw was provided daily onto the solid part of the floor. In the first batch, 48 pens were assigned to either 10, 500 or 1000 g straw per pig and day ($N = 16$ pens per straw allocation). A reduction in oral manipulation of pen mates was found when pigs were given 500 compared to 10 g ($P = 0.03$), but no further reduction when increasing the straw amount to 1000 g was detected. In the second and third batch, a total of 96 pens were assigned to 8 treatments (10, 80, 150, 220, 290, 360, 430 or 500 g straw per pig and day) ($N = 12$ pens per straw allocation). There was a linear relation between straw amount and oral manipulation of pen mates, the latter being reduced from 8.4% to 6.7% of active time, when pigs were provided 500 compared to 10 g ($P = 0.01$). Based on the concept of bioequivalence, 387 ± 10 g straw per pig and day was identified as the amount of straw where a further increase in straw provision did not reduce the oral manipulation of pen mates. Thus, the straw amount identified to meet pigs' need to explore was close to 400 g straw per pig and day. A criterion of permanent access (defined by a minimum of 1 l (approx. 60 g) unsoiled straw in a pen 24 h after allocation) was achieved at lower levels of straw provision, especially during the initial weeks of the growing period.

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* Corresponding author. Tel: +45 87157907
E-mail addresses: lene.juulpedersen@agrsci.dk, LeneJuul.Pedersen@agrsci.dk (L.J. Pedersen).

http://dx.doi.org/10.1016/j.applanim.2014.08.008
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1. Introduction

When housed under intensive production conditions without suitable rooting material, pigs redirect their exploratory behaviour towards pen mates, and this behaviour is regarded as abnormal (Bolhuis et al., 2005; Scott et al., 2006a; Day et al., 2002). The occurrence of abnormal behaviour indicates the thwarting of a highly motivated behaviour and the potential existence of a behavioural need (Jensen and Toates, 1993). Among the additional negative welfare consequences of this abnormal behaviour are lesions on the victims' ears and tails (Schrøder-Petersen and Simonsen, 2001; Moinard et al., 2003; Munsterhjelm et al., 2009).

Pigs' explorative behaviour is motivated by novelty seeking and appetitive foraging. Hence, manipulative materials, such as straw or compost, can provide an outlet for pigs' explorative behaviour (Studnitz et al., 2007). Straw is a recommended rooting material within the EU, and the rooting material which has been included in most scientific studies investigating the effect of material access on behaviour, and the effect of alternative materials have often been compared to straw. Although pigs prefer rooting materials that are more heterogeneous and contain edible items (Beattie et al., 1998; Van de Weerd et al., 2003; Jensen and Pedersen, 2007), straw is the rooting material that combines feasibility and desirability (Van de Weerd and Day, 2009).

Since implementation of the EU directive (EU Directives 2001/88/EC and 2001/93/EC), several studies have addressed the question of rooting material quality, but only few have focussed on the question of sufficient quantity to enable proper exploratory behaviour. Studies have found that providing pigs with an increasing amount of straw, or other manipulative material, leads to increased exploratory behaviour directed at the material, and a concurrent decrease in exploratory behaviour directed towards pen mates (Fraser et al., 1991; Day et al., 2002; Scott et al., 2009). To determine the straw amount required to meet growing pigs' behavioural need to explore, one could investigate the effect of increased straw amounts on the exploratory behaviour directed towards the straw. However, part of this behaviour is inquisitive (internally motivated) and part of it is inspective (externally motivated; see Studnitz et al., 2007). Hence, the occurrence of exploratory behaviour directed towards the straw as such does not solely reflect the satisfaction of internally motivated exploratory behaviour. Furthermore, the occurrence of abnormal behaviour is suggested to reflect the thwarting of a behavioural need (Jensen and Toates, 1993), and as lack of straw results in the redirection of exploratory behaviour towards pen mates (e.g. Fraser et al., 1991), this behaviour is considered a more direct measure of the extent to which the quantity of straw is sufficient to enable proper exploratory behaviour. Thus, based on the premise that a reduction in the abnormal exploratory behaviour directed towards pen mates reflects an increased level of fulfilment of pigs' behavioural need to explore, we have focused on the level of oral manipulation of pen mates as target behaviour. Inline with this, Day et al. (2002) provided straw to pigs in concrete floored pens, and investigated the effect of different amounts of straw on the level of oral manipulation of pen mates. They found that increasing the level of straw provision from minimal (approximately 10 g per pig and day) to substantial (approximately 1 kg per pig and day) resulted in a reduction in the level of oral manipulation of pen mates, while no further reduction was seen when increasing the level from 1 to 2 kg straw per pig and day. One remaining question is then; at which point between 10 and 1000 g straw per pig and day does additional straw provision no longer reduce oral manipulation of pen mates? This knowledge is important from an animal welfare perspective as well as from an economic and practical perspective, since the cost and consequences of using straw as a rooting material depend on the amount of straw to be allocated.

In order to investigate at which point between 10 and 1000 g straw per pig and day provision of additional straw no longer reduces oral manipulation of pen mates, a dose–response curve of straw amount and oral manipulation of pen mates is needed. As outlined above, oral manipulation of pen mates most clearly reflects the extent to which straw quantity is sufficient to enable proper exploratory behaviour. Furthermore, by choosing only one response variable, the risk of finding statistically significant differences by chance is reduced. Also, the risk of post hoc subjective judgement on the importance of the various variables in relation to animal welfare is reduced (Tuyttens et al., 2014).

The EU directive also states that pigs must have permanent access to the material, which should enable proper investigation and manipulation activities. A manipulable and destructible material like straw will gradually be eaten, soiled or disappear into the manure system. Jensen et al. (2010) found that the level of straw-directed behaviour was lower and the level of oral manipulation of pen mates was higher before the daily allocation of fresh straw than at other times of day. However, there are no reports on how much straw is enough in order to ensure pigs kept in intensive production facilities permanent access to a sufficient quantity of straw.

This paper reports the results of two experiments focussing on straw provision to growing pigs. Based on the results from Day et al. (2002), we focussed on a range from 10 to 1000 g straw/pig/day. The aim of the study was two-fold. The first aim was to identify the amount of straw provision needed to reduce oral manipulation of pen mates to a minimum. To do this, we investigated the effect of increased straw provision on the level of oral manipulation of pen mates. The second aim was to identify the amount of straw required to ensure permanent access of unsoiled straw throughout the 24 h. To do this, we investigated the effect of straw provision on the availability of unsoiled straw just before the next daily straw allocation.

2. Materials and methods

2.1. Animals, housing and management

The experiment was conducted from the spring 2011 until spring 2012 and conducted in accordance with a

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