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Effect of increasing amounts of straw on pigs' explorative behaviour

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ABSTRACT

According to European legislation, pigs must have permanent access to sufficient quantity of material to enable manipulation activities. However, few studies have quantified how much straw is needed to fulfil the requirements of growing pigs. We investigated the effect of increasing amount of straw on pigs' manipulation of the straw, and hypothesised that after a certain point increasing straw amount will no longer increase oral manipulation further. From 30 to 80 kg live weight, pigs were housed in 90 groups of 18 pigs in pens (5.48 m × 2.48 m) with partly slatted concrete floor and daily provided with fresh uncut straw onto the solid part of the floor. Experimental treatments were 10, 80, 150, 220, 290, 360, 430 or 500 g straw per pig and day. At 40 and 80 kg live weight, the time spent in oral manipulation of the straw by three focal pigs per pen (large, medium and small sized) were recorded along with the percentage of pigs manipulating straw simultaneously. This was recorded in three 1-h intervals (1 h before and 1 h after straw allocation in the morning, as well as from 17 to 18 h in the afternoon). With increasing quantity of straw provided, we found a curvilinear ($P < 0.01$) increase in the time spent in oral manipulation of the straw. Smaller pigs spent more time manipulating straw than larger and medium sized pigs (367, 274 and 252 s/h for small, medium and large sized pigs, respectively; $P < 0.001$), and pigs spent more time manipulating straw at 40 kg than 80 kg live weight (356 vs. 250 s/h; $P < 0.001$). At both live weights, pigs spent most time manipulating straw during the hour after allocation of straw. Similar effects of increasing amounts of straw were found for the percentage of pigs engaged in simultaneous manipulation of the straw. Post hoc analyses were applied to estimate the point, after which additional straw did not increase manipulation of straw any further. For the time spent manipulating straw the estimated change point was 253 (approx. 95% confidence limits (CL) 148–358) g straw per pig and day. For the number of pigs simultaneously manipulating straw the change point was 248 (CL 191–304) g straw per pig and day. These results show that increasing the quantity of straw from minimal to approximately 250 g per pig and day increased the time spent in oral manipulation of the straw, as well as the occurrence of simultaneous straw manipulation.

Hence, data from the current experiment identified 250 g straw per pig per day as the amount of straw where a further increase in straw provision did not further increase neither time spent on oral manipulation of straw, nor the percentage of pigs simultaneously manipulating straw. This suggests that, within the current housing system and using this criterion, this amount of straw may be the biological turning point for increasing oral manipulation of straw.

1. Introduction

According to European legislation, pigs must have permanent access to sufficient quantity of material to enable manipulation activities (Commission Directive, 2001/93/EC). Domestic pigs have a high motivation to perform explorative behaviour which is motivated by novelty seeking and appetitive foraging. Manipulative and destructible materials, such as straw, provide an outlet for the explorative behaviour of pigs (Studnitz et al., 2007) and reduce the occurrence of oral manipulation directed towards pen mates (Jensen and Pedersen, 2010; Pedersen et al., 2014). However, while several studies have focussed on the effect of different types and qualities of material (for review see Studnitz et al., 2007; Van de Weerd and Day, 2009) only few have addressed how quantity affects the time spent investigating and manipulating the material. For instance, Day et al. (2002) investigated the effect of increasing quantities of straw provided to the pigs on the level of oral manipulation of the straw. They found that increasing the quantity of

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straw from minimal (approximately 10 g per pig and day) to substantial (approximately 1 kg per pig and day) resulted in increased straw-directed explorative behaviour and a corresponding reduction in the level of oral manipulation of pen mates. Investigating the effect of straw allocation in a narrower interval, Oxholm et al. (2014) found that pigs were more active and performed more oral manipulation of the straw when provided with 100 g per pig and day compared to 25 or 50 g, whereas oral manipulation of the pen mates was not reduced by the increased quantity of straw.

From an animal welfare perspective, it is important that there is enough straw to stimulate explorative behaviour of all pigs in a pen, irrespective of pig size and rank. This is because pigs synchronise their behaviour, including the manipulation of materials (Docking et al., 2008). Hence, effects of the quantity of straw provided per pig should be investigated to explore how this limits investigation and manipulation of the material in groups of pigs. However, it may be argued, that pigs should merely be provided with the minimum quantity of straw required to reach the level where additional provision of straw does not induce increased straw manipulation, and does not reduce the oral manipulation of pen mates any further. In order to identify this level, experimental allocation of various quantities of straw covering a considerable range is needed. In a previous experiment, no additional reduction in oral manipulation of pen mates was found when straw allocation was increased from 500 to 1000 g per pig and day (Pedersen et al., 2014). A subsequent experiment, involving eight different straw levels, ranging from 10 to 500 g per pig and day, showed that only after approximately 390 g straw per pig and day provision of further straw did not reduce the abnormal behaviour any further (Pedersen et al., 2014). These studies were based on the premise that a reduction in manipulation of pen mates reflects an increased level of satisfaction of pigs' behavioural need to explore. Many studies have suggested such an inverse relationship between the oral manipulation of straw and pen mates (Day et al., 2002; Scott et al., 2009; Jensen et al., 2010). However, to date no study has investigated the dose-response relation between quantity of straw and oral manipulation of straw.

While studying straw directed behaviour, some studies have estimated time spent engaging in the target behaviour by individual pigs (e.g. Van de Weerd et al., 2003; Munsterhjelm et al., 2009) while others have recorded the number, or percentage, of pigs in a pen engaging in the behaviour simultaneously (e.g. Day et al., 2002; Jensen et al., 2010; Zwicker et al., 2014). In addition to assessing the occurrence of a certain type of behaviour, quantification of the proportion of pigs simultaneously engaged in the behaviour may be used to address the synchrony of the behaviour. Hence, in order to assess the stimulating value of different quantities of straw provided to pigs in an environment with limited space, such as a conventional growing pig pen, it may be valuable to collect a measure of synchrony in addition to a measure of average time spent manipulating the straw by individual pigs.

The present study investigated the effect of quantity of straw on pigs' explorative behaviour directed towards the straw, including the average time spent exploring as and the percentage of pigs in a pen performing the behaviour simultaneously.

2. Material and methods

Data presented here were collected from a subsample of the experimental animals described by Pedersen et al. (2014). The experiment was conducted in the spring of 2012 and complied with Danish Ministry of Justice legislation concerning experiments with animals and care of experimental animals (2009/561-1729). A detailed description of animals housing and management may be found in Pedersen et al. (2014). A brief summary is given below.

2.1. Animals, housing and management

The animals originated from a commercial Danish herd with conventional farrowing crates. Until weaning, each litter was provided with approximately 300 g uncut straw per day. After weaning the pigs were kept in conventional weaner pens and provided with 10 g straw per pig and day. When the pigs weighed an average of 30 kg live weight, they were transported to the resident barn at the Department of Animal Science, Aarhus University, AU-FOULUM, Denmark, where they were health checked and weighed before being allocated to experimental pens. Mean inter-individual variability in live weight within pens was 11.5 ± 2.6 (range 5–18) kg and the average live weight was 28.7 ± 5.9 (range: 16–49) kg for all pigs.

During the experimental period, pigs were housed in one of three sections of the same building. Each section had 15 experimental pens with concrete floor consisting of 1/3 solid, 1/3 drained and 1/3 slatted floor. Each pen measured 5.48 m × 2.48 m, including 0.5 m^2 occupied by a feeder, had two drinking nipples and held 18 experimental pigs corresponding to a space allowance of 0.7 m^2 per pig. The pigs were fed for ad libitum intake, by commercial dry feed for growing/finishing pigs, from one feeder containing three feeding places and filled automatically three times daily (at 03, 10 and 19 h). Inflow of natural light through windows was blocked and the artificial light was turned on automatically from 06 to 22 h. The pigs' health was monitored daily and pigs were placed in a hospital pen if ill or injured (including a bleeding tail). If more than two pigs from one pen had been removed due to tail damage, the pen was excluded from the experiment.

2.2. Experimental design

The experiment included two batches, each batch including 45 pens of 18 pigs. Eight experimental treatments involving the provision of 10, 80, 150, 220, 290, 360, 430 or 500 g uncut straw per pig and day was applied; treatments 220 g and 500 g were applied to 12 pens while the remaining treatments were applied to 11 pens. Within batch, the different experimental treatments were equally distributed within and between the three barn sections.

2.3. Provision of straw and removal of manure

Uncut wheat straw (Hereford, harvested 2011 in the Foulum area) was provided daily at a pre-determined time of day for each pen between 09 and 14 h. During the last batch, the straw length was estimated from weekly collections from the bale in use, and categorised as either 0 to 10 cm (67 ± 12%; range: 45–80%), 10 to 20 cm (28 ± 9%; range: 14–47%) or above 20 cm (5 ± 4%; range: 0–11%). The straw was provided manually on the solid concrete floor in the resting area.

Two times per week, pens were cleaned by removing all dung, and dirty as well as clean straw within 20 min. During this time the pigs were maintained in their group in a pen in a neighbouring room. These pens were supplied with maximum 10 g straw per pig.

2.4. Climate in the barn

The indoor climate was regulated by negative pressure ventilation (SKOV A/S, Glyngøre, Denmark) with the room temperature gradually decreasing from 21 °C when the pigs were introduced to the pens to 17 °C, when the pigs approached slaughter weight. Similar indoor climates were maintained for all experimental treatments.