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Rope test may indicate efficacy of tail-biting treatments in growing pigs

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Abstract

Tail biting is a most serious welfare problem in pigs raised for slaughter. In instances of an outbreak of tail biting, scientists have recommended that farmers take measures such as removal of affected animals, provision of enrichment materials and application of repellents to the pigs' tails. However, no scientific study has ever confirmed the efficacy of any of these suggestions in counteracting an ongoing outbreak. Here, the efficacy of two repellent ointments, Dippel's oil and Stockholm tar, were examined in a tail-chew test. For this, a novel piece of nylon rope was used as a tail model to measure biting behaviour semi-automatically in 24 single-sex groups of growing pigs (total 264 pigs). Repeated measures analysis showed no effect of time, gender or unit (12 pens per unit), but a highly significant effect of treatment, in that both Stockholm tar and Dippel's oil significantly reduced rope manipulation compared to controls. These results suggest that Stockholm tar and Dippel's oil may be effective in reducing tail biting. The approach taken may be valuable in further testing of strategies to reduce tail biting and improving pig welfare.

Keywords: *animal welfare, environmental enrichment, model, pigs, tail biting, treatment*

Introduction

Tail biting and tail docking are major welfare concerns for pigs, especially those kept in intensive husbandry systems (eg Anonymous 2001; European Food Safety Authority [EFSA] 2007). Tail-biting outbreaks have a tendency to escalate when there is no intervention and may result in production losses due to, eg infections and lameness. Tail biting is regularly seen despite the current practice of tail docking, which is permitted reluctantly under present EU regulations (Commission Directive EC 2001/93, article 8 of the annex). Thirty-to-seventy percent of farms have varying degrees of tail-biting problems, and the prevalence of lesioned tails, on-farm, has been estimated to be in the order of 1–5% at EU level (EFSA 2007). In the EU, on average about 3% of docked pigs show tail lesions at the time of slaughter, but in undocked pigs as many as 6–10% show tail lesions (EFSA 2007). While a considerable amount of scientific information is available on measures to prevent tail biting (reviewed most recently and extensively in EFSA 2007), much less is known about the efficacy of measures to counteract or treat tail biting.

When welfare is to be improved, it is most important not only to know how to prevent, but also how to treat, tail biting. For example, if tail docking, a welfare problem in itself, were to be omitted, the incidence of tail biting would be expected to increase dramatically (to about 30%; EFSA 2007). Also, an increased risk for tail biting can be expected when tail docking is omitted to show ('validate') that housing systems are 'welfare-friendly', eg for labeling and certification purposes. Therefore, effective measures to stop tail-biting outbreaks are important to improve pig health, production and welfare.

In order to counteract an ongoing outbreak of tail biting, scientists have suggested various measures, such as counteracting predisposing hazards (where a main factor is the lack of foraging materials to allow natural biting, rooting and play behaviour), alteration of the (social) environment (eg removing victim and biter pigs, providing enrichment), medical treatment (antibiotic injections, application of tar on the tail) and surgical intervention (amputation of the severely wounded tail and/or the teeth of biters [Schrøder-Petersen & Simonsen 2001; EFSA 2007]). As far as I know, so far only Zonderland *et al* (2008) published scientific work comparing tail-biting treatments, namely removal of the biter and twice daily provision of straw. Both treatments prevented further escalation of the problem, unfortunately, however, no significant differences were found between these treatments (lacking a true negative control). As a consequence, therefore, and despite widespread application in practice, it seems that no scientific study has ever confirmed the efficacy of any of the treatments suggested in the literature to counteract an ongoing outbreak of tail biting.

Several factors may have contributed to the current poor state of scientific knowledge. Firstly, farmers may have believed tail docking has solved (the majority of) the problems. However, since tail docking is increasingly questioned on welfare grounds, it may be banned in the future. Secondly, since the causation of tail-biting outbreaks is not fully understood, an experimental model to test treatments under controlled conditions is lacking and epidemiological studies with current behavioural and clinical measures are time consuming. Thirdly, even if a model were available, causing tail injuries and leaving some of these untreated (as 'controls') to effectively test different treatments can be expected to result in serious ethical questions. This argument also applies to epidemiological or other field research where treatments are advised (and compared) without a proper scientific basis. Therefore, alternative ways of studying the efficacy of tail-biting treatments are needed.

Such alternative ways may be available because rope-based and sometimes even automated models have been developed, mainly for the purposes of gaining a better understanding of the causal mechanisms involved in a tail-biting outbreak. Fraser (1987a,b) reported pigs' attraction to blood and the effects of mineral deficiency. McIntyre and Edwards (2002a,b,c) further investigated nutritional factors (proteins, energy, tryptophan, blood). Jankevicius and Widowski (2003, 2004) showed that pigs preferred to chew on tail models soaked in blood and dye to either of those soaked in just red food dye or salt plus red dye, and that the preference for blood was not mediated by ACTH. Beattie *et al* (2005) used ropes to investigate factors identifying known tail-biting pigs, and Breuer *et al* (2003) investigated the effects of breed and reported that gilts showed a tendency to manipulate a rope more often than boars. Feddes *et al* (1993) developed automated sensing of object manipulation, and Feddes and Fraser (1994) found that pigs interacted more with a cotton rope than with a less-destructible rubber strip, and that the amount of chewing on a loop of rope (which itself reduced biting compared to a piece of rope with a straight end) increased dramatically when a small cut was made allowing the material to be damaged more easily. The automated-sensing approach was also suitable and applied further to enhance the scientific understanding of pig preferences for enrichment materials (eg Zonderland *et al* 2003), and a fairly sensitive test has been designed to measure animal-material-interactions semi-automatically under commercial conditions (Bracke 2007; Bracke & Spoolder 2008). Bracke (2007) also reported that pigs 'demanded' destructibility and disliked chewing-model ropes soiled with excreta after a habituation period, as excreta did not seem to be sufficient to repel pigs from novel ropes. This observation led me to conjecture that rope-based tail models could also be used to study (some aspects of) the efficacy of tail-biting treatments, such as the application of repellent ointments, eg by showing that they can even reduce biting in (more) novel, somewhat destructible and hence highly-attractive ropes.

Many tail-biting repellents have been put on the market. Two repellent ointments were selected for testing in comparison with untreated control ropes: Stockholm tar and Dippel's oil. Several authors suggested that tar may be used (eg Arey 1991; Wallgren & Lindahl 1996). Hemsworth (1992) recommended the application of Stockholm tar and reduced lighting in case of a tail-biting outbreak. Stockholm tar is a product derived from wood. Dippel's oil (Oleum Animale, Bone oil, Hartshorne oil) is a by-product of the distillation manufacture of bone char and it contains the organic base, pyrrol. It has a long history of application in practice and is still commercially available on the market to treat tail biting (but see *Discussion* for a note of caution).

The objective of this study was to study the efficacy of two ointments, Stockholm tar and Dippel's oil, in reducing manipulation of a novel nylon rope in groups of growing pigs. A further objective was to point out that the approach taken could perhaps be used to (start to) provide a much-needed scientific basis for measures taken to counteract outbreaks of tail biting in pigs.

Materials and methods

Animals and farm

The observations were carried out in two very similar units of an experimental farm in Sterksel, The Netherlands (except that the pigs in one unit were [on average] one week older). Each unit contained 12 uniform (similar age and body size), unisex groups of 11 young, crossbred, growing pigs. Half of the pens contained groups of gilts and the other half contained unisex groups of barrows. All pens were 5.3 × 2.5 m (length × breadth). Pens had a partly solid, concave floor (2.5 m deep), measuring 1.3 m from the front wall to 1.5 m from the back wall, with concrete-slatted floors in the front and metal slats in the back. All pens had a long trough with 12 feeding spaces, providing wet feed three times daily, a drinking cup and a chain with a hard plastic ball hanging on the front pen wall.

Tail-chew test

A piece of orange, nylon rope was hung in all 24 pens from the front wall, reaching up to 40 cm above the floor of the pen. First, the pigs were allowed to explore the novel rope for a period of ten minutes. This initial exposure period was applied in order to mimic a recently-started tail-biting outbreak, where one or a few pigs have 'discovered' biting/chewing/pulling the tail/rope and have started the process of destruction of the 'material', while the material is still sufficiently novel to exert a very high level of attraction to the pigs in the pen.

After ten minutes, the ropes were removed, saliva was squeezed out and the ropes were then treated with (ie 'dipped in') Stockholm tar, Dippel's oil or sham-treated ('controls'; eight pens per treatment).

A semi-automated recording device (as reported previously in Bracke 2007; Bracke & Spoolder 2008) was attached to the ropes registering the pulls exerted on the rope. Recordings were made at six observation times, ie at 10, 20, 30, 40, 50 and 70 min following treatment of the ropes. The test period of 70 min was kept limited, because of a breakdown of the control ropes that could interfere with the measurements, and because it was considered that in the case of tail biting the duration of actual destructive biting in the tails would probably not be longer.

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Statistical analysis

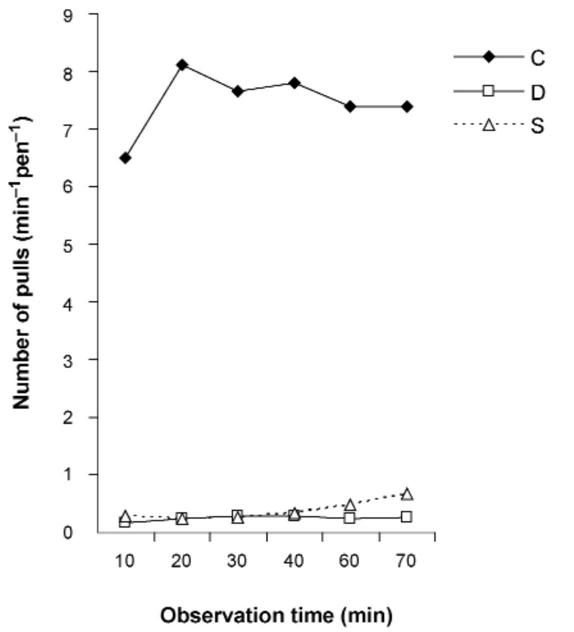
A mixed model analysis was performed using Genstat 11.1 (Genstat 2000) to determine the effects of observation time, treatment (Dippel's oil, Stockholm tar, control), gender (barrows, gilts), unit and their interactions on pulling frequencies (number of pulls per minute per pen). The response variable was analysed on the log-scale. Random effects for unit and pen (within unit) were included in the model, where autocorrelation between two sequential observations was also estimated (power model).

Results

The analysis showed a highly significant effect of treatment. Ointment-treated ropes elicited significantly lower levels of animal-material interactions than control ropes.

Predicted means for the control, Dippel's oil, Stockholm tar were 2.0[a], –1.4[b] and –1.0[b] (with superscripts indicating a highly significant effect [$P < 0.001$]; standard errors were 0.60 for the control and Dippel's oil, and 0.63 for Stockholm tar). No further effects of observation time, gender, unit or interactions were found (all $P > 0.1$). Figure 1 illustrates the recorded pattern over time.

Figure 1



Back-transformed predicted means of rope-pulling frequency (n = 8 pens per treatment) over 6 observation times. Observation times were taken respectively at 10, 20, 30, 40, 60 and 70 min after treatment (C: controls; D: Dippel's oil; S: Stockholm tar). There were no significant effects of observation time, but treatments differed in that both ointments significantly reduced pulling frequency compared to controls (standard errors of predicted means were approximately 0.6).

Discussion

This study shows that ropes treated with Stockholm tar and Dippel's oil were manipulated significantly less than control ropes, suggesting that these ointments may indeed be effective in reducing tail biting. Before using these substances, however, it is important to verify that these substances are allowed under present national and private regulations, and to realise that the present findings still require scientific confirmation in actual tail-biting outbreaks. The results of this study, however, do suggest that the approach, previously designed to measure properties of enrichment materials (Zonderland *et al* 2003; Bracke & Spoolder 2008) and applied to measure positive emotions (Bracke & Spoolder 2008), may also be useful to start to provide a scientific basis to solve ('treat') negative welfare problems.

This is much needed, despite the fact that the EFSA working group of European experts (including myself; EFSA 2007) did not explicitly prioritise such a need. When intensive husbandry must continue both to provide large quantities of meat for the world market and at the same time substantially improve its sustainability, including improved animal welfare, then the problems with tail docking and tail biting will need to be resolved. While prevention of tail biting is a main route, any transition will have to deal with cases of tail-biting outbreaks over and above the numbers of tail biting already occurring. It is important for tail-biting treatments to acquire a scientific basis (as in science-based medicine).

Rationale underlying the rope test

Following earlier work in relation to tail biting (see *Introduction*), this study used a rope model. It was confirmed that the intensity-related parameter of counting rope-pulling behaviour may be a useful parameter as it was able to detect clear effects of the repellent ointments with relatively few experimental units (n = 8). It may also provide a suitable model to test tail-biting treatments, because the eagerness with which pigs may bite the tails of pen mates seems to resemble the eagerness with which they chew novel ropes, and because tissue breakdown resembles the gradual destruction of the rope. There are, however, also some possible objections that need to be considered.

It is a commonly shared view in science (EFSA 2007) that tail biting occurs in outbreaks that tend to escalate when no measures are taken to counteract it, possibly due to the taste of blood or enhanced activity in the pen (Fraser 1987a,b; EFSA 2007). The tail-model rope, on the other hand, did not contain a nutritional reward, and the measurements did not show an increase in rope pulling over time. The view that tail-biting outbreaks tend to escalate is not always supported by quantitative data (eg Zonderland *et al* 2008). In fact, in the rope test there was a progressive breakdown of material, and if similar breakdown would occur in actual tail biting, then it would almost certainly be called an escalating problem. The rope model clearly increased activity, probably due to the novelty of the rope and its destructibility, which is in itself rewarding (Fedders & Fraser 1994; Bracke 2007). An advantage of the formal lack of an escalation effect (ie that no significant effect of time was found) is that future tests may be run with less frequent observation times.

Animal welfare implications

The considerations above, together with the need to provide tail-biting treatments with a scientific basis and the need to avoid ethical problems associated with inducing actual tail biting and prescribing ineffective treatments, lead to the suggestion that, at least for the time being, the rope test appears a suitable tool for further research to start provide a scientific basis for tail-biting treatments.

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