Tail docking and tail biting

Tail biting in pigs is a problem of modern pig production and can occur at all stages in the production cycle. It leads to tail damage of varying severity (see Hunter et al., 1999) and can include swelling and infection, which travels up the spinal cord causing abscesses in the lungs, and pyaemia (a type of septicaemia causing widespread abscesses in the organs (see Schroder-Pedersen and Simonsen, 2001 for full details). Tail biting is therefore a serious welfare issue. In order to reduce the risk of tail biting in modern pig production systems, producers dock the tails of pigs, either with sidecutting pliers or gasheated cautery clippers. Tail docking does not eliminate tail biting however, and is a procedure that causes acute and transient pain, with potential long term chronic discomfort.

During tail docking, piglets performed more squeals (at a higher pitch), grunts and escape attempts than piglets held with no procedure or held and blood tested (Marchant-Forde et al., 2009). Following tail docking, piglets performed tail wagging, jamming, vocalisation (Noonan et al., 1994) and posterior scooting (dragging back end along ground) (Sutherland et al., 2008). These behaviours along with a rise in cortisol, which took 45 and 90 minutes to cease and return to normal, respectively (Sutherland et al., 2008), indicate acute and transient pain associated with the procedure. Nerve structure and neuroma formation indicate the longer term effects of the procedure. Peripheral nerves were traced to the tip of day old piglets and fattening pigs with the nerve structure indicating entire pigtail sensitivity (Simonsen et al., 1991). Docked tails had an uneven distribution of peripheral nerves with some regressive changes and in some cases traumatic neuromas (Simonsen et al., 1991), indicating sensitivity to pain and chronic discomfort due to tail docking.

In light of the pain and chronic discomfort associated with the practice, routine tail docking is not permissible under EU legislation, however, more than 90% of pigs in the EU are still tail docked (ESFA, 2007).

Incidence of tail biting

To date no standard scoring scheme or approach has been adopted across studies investigating the incidence of tail biting; most authors use a definition that includes lesions as opposed to tail manipulation, and results are reported on a pig, pen or farm basis for data that is collected either on-farm or at the abattoir.

On reviewing the literature, Taylor et al (2010) reported prevalence rates (from 100 pigs inspected X were tail bitten) at the pig level of between 1.3% and 7.2%, with a Finnish outlier at 34.6%. In a study of almost 63,000 pig tails at six UK abattoirs, Hunter et al (1999) found on average 3.1% of docked pigs and 9.2% of long tailed pigs (tipped or undocked) showed evidence of tail biting; the odds of a long tail pig being bitten were 2.73 times higher than the odds for a docked pig. Tail biting is also found in outdoor systems. Average group prevalence of bitten tails at slaughter on five outdoor farms was between 14.1 and 20.1 %; the odds of a barrow being bitten were 2.9 times higher than those for a gilt (Walker and Bilkei, 2006).

Financial costs to the industry from tail biting, include reduced weight gain, on-farm veterinary costs and culls, part and whole carcase condemnation at the abattoir, and were estimated at £3.5 million in the UK in 1999 (Moinard et al., 2003), and calculated at over € 8 million in the Netherlands in 2011 (Zonderland et al., 2011).

Risk factors

Various studies have investigated the risk factors associated with the incidence of tail biting. A combination of light daily straw provision (enrichment), use of natural ventilation or automatically controlled natural ventilation (atmosphere and environment), meal or liquid feeding and use of double or multi-space feeders (food and drink provision) and mixed sex grouping, reduced the probability of long-tailed pigs being bitten (Hunter et al., 2001). For both long and short tailed pigs, the probability of tail biting was highest in systems with no straw. Early experience of straw in the creep area reduced the risk of tail biting, whilst housing pigs on part or fully slatted systems and stocking pigs at densities of 110kg/m^2 or above increased the risk (Moinard et al., 2003) as did high pre-wean mortality and incidence of respiratory disease (health).

A large scale research project conducted by Bristol University (funded by the RSPCA and BPEX) used existing knowledge on tail biting to develop a husbandry advisory tool (HAT) for producers which could be used to anticipate and prevent outbreaks of tail biting. The risks associated with tail biting were identified from scientific literature and expert opinion, and the HAT (a detailed questionnaire and observation document) was developed to identify risks at farm and pen level. Each farm can receive a risk score, and advice which is specific for their situation, rather than generic advice about risk factors. The HAT covered issues of atmosphere and environment, health, transport and mixing, feed and water, stocking density and indicators of pig behaviour. The risk scores obtained proved to be highly predictive of tail biting, suggesting this could be a useful advisory and management tool. The pilot version of the HAT is available as a spreadsheet and online resource at (http://www.vetschool.bris.ac.uk/webhat/). Factors associated with the highest risk of tail biting were: removing straw provision from pigs with previous experience of it, previous history of tail biting in the group, incidence of disease (especially ileitis, respiratory disease and PMWS), salt and amino acid imbalance in the diet, temperature in the lying area outside the thermo-neutral comfort zone of pigs, high ammonia levels and the presence of draughts, and insufficient feeding space.

Motivation to tail bite

Rooting behaviour is an exploratory behaviour of high priority to the pig; if prevented from rooting, pigs will express this behaviour towards the pen fixtures and fittings and their pen mates (Studnitz et al., 2007). Taylor et al (2010) suggest that there are different types of tail biting behaviour ("two stage", "sudden forceful" and obsessive") each of which may have different underlying motivations. Studying tail biting by investigating the identities and motivations of the biters is still at an early stage, but could offer new insights into the behaviour. Until then we must consider lowering the risk of tail biting by considering the factors discussed in the previous section; environmental enrichment and space allowance are discussed in more detail below.

Environmental Enrichment

Research into environmental enrichment provision has focussed on why enrichment is important and what fulfils the exploratory needs of pigs, as investigated systematically by Van de Weerd et al (2003). Successful enrichment should reduce the incidence of abnormal behaviour patterns and increase species-specific behaviours (such as exploration, foraging, play, and positive social interaction) which are within the animal's normal behavioural repertoire (Van de Weerd and Day, 2009). Many studies indicate straw provision stimulates exploratory behaviour and reduces redirected behaviour towards pen mates (reviewed by Studnitz et al., 2007); the more straw available the more exploratory behaviour is seen. Straw bedding is the single most effective means of reducing the risk of tail biting in pigs, but is not always available or compatible with current commercial systems. Alternatives to straw have therefore been sought.

The ranking of various enrichment materials was conducted via a computer model (RICHPIG) based on the scientific literature investigating enrichment devises for pigs (Bracke, 2008). Materials were scored on a scale of 1 (poor) to 10 (excellent) according to the value for the pig; there was a high correlation between these scores and expert opinion, and score 5 was agreed as a cut off point below which the device had little value to the pig. Enrichments scoring **< 5** were: Reference pen (barren 0.7-1m^2/pig) (score 1.46); metal chain (2.24), plastic ball (2.32), rubber hose cross (3.04), rope (3.29), pinewood beam (4.25) and earth (4.71). Enrichments scoring **>5** were: Foodball (5.20), mushroom compost (6.53), straw rack device (6.54), straw twice daily (7.08), fodderbeets (7.09), long straw and branches (8.34) and straw and beet roots (8.54).

It is generally agreed (Studnitz et al., 2007) that environmental enrichments should be:

- complex, changeable, and hygienic (pigs do not root soiled objects on the floor, suspended objects are better)
- destructible (but not too destructible otherwise they are quickly destroyed, and caution is needed for hazards of plastic materials ingested by pigs or entering the slurry system)
- manipulable (encourages chewing, rooting and exploration, which pigs have an underlying motivation to carry out)
- edible (i.e. non-toxic, and with some value in terms of gut fill and nutrition if possible)
- contain sparsely distributed edible parts if possible

They must also be practical to employ, see the following leaflet for further information:
http://www.ciwf.org.uk/includes/documents/cm_docs/2011/p/providing_enrichment_for_pigs_july_2011.pdf
Toys and other point-source devices were generally considered inadequate (Spoolder et al., 2011) with their novelty value quickly wearing off, even if objects were rotated from week to week (Trickett et al., 2009).

Table 1 indicates the effectiveness of different enrichments in occupying the pig. Toys, Bite Rite^{TM}, and feed or liquid dispensers occupied pigs for less than 2% of their time; pigs then manipulated the fixtures of the pen significantly more than pigs provided with straw bedding, which occupied pigs for 11.6% and 21.6% of their time (Van de Weerd et al., 2006; Scott et al., 2007, respectively). Maize silage and chopped straw were effective at occupying pigs in part-slatted systems, but increased manipulation of pen mates and fixtures before daily allocation of material, suggesting the levels provided were insufficient to maintain material manipulation, (380g silage/pig/ day or 90g chopped straw/pig/day, providing 3.8 litres material/pig/day), (Jensen et al., 2010). Destructible ropes occupied pigs for just over 10% of their time (O'Connell 2010 also supported by Trickett et al., 2009).

Previously, Jensen et al (2005) had shown pigs preferred peat and branches over long or chopped straw, and that the order of preference for more complex and compound rooting materials was: maize silage with straw, spruce chips, compost, sisal rope, and seed grass hay over chopped straw (Jensen and Pedersen 2007).

Table 1. The amount of time pigs are occupied with different enrichment materials

Substrate	Enrichment (%)	Other pigs (%)	Fixtures (%)	Reference
Straw bedding	21.6	5.1	3.2	Scott et al., 2007
Toys (n=4)	1.4	6.2	11.1	
Maize silage	22.8	2.2	3.3	Jensen et al., 2010
Chopped straw	18.5	4.5	2.9	
Rope & sawdust	11.2 (R) 2.8 (S)			O'Connell, 2010
Straw bedding*	11.6	0.6	0.8	Van de Weerd et al., 2006
Straw dispenser	3.8	0.6	7.2	
Feed dispenser	1.5	0.8	6.9	
Liquid dispenser	0.5	0.7	6.9	
Bite Rite	1.2	0.6	7.2	
Straw bedding	17.6	6.2	4.6	Scott et al., 2006
Fully-slatted	-	7.8	11.3	

* in converted fully-slatted pens

The results in Table 1, suggest pigs need to be occupied by the enrichment provided for at least 20% of their time to significantly reduce the incidence of tail biting, and is in line with that reviewed by Van de Weerd et al (2009). Tail bite incidence was high with alternative enrichments to straw bedding occurring in 100% of the pens with liquid dispensers, and 83%, 50% and 33% of pens with Bite Rite^{TM} devices, and straw and feed dispensers, respectively (Van de Weerd et al., 2006). Straw bedded systems was the most effective at reducing tail biting, with 11.7% tail bitten pigs removed from fully-slatted systems compared to 1.4% from straw bedded systems (Scott et al., 2006); there was also less lameness in straw systems (3.9% compared to 7.4%).

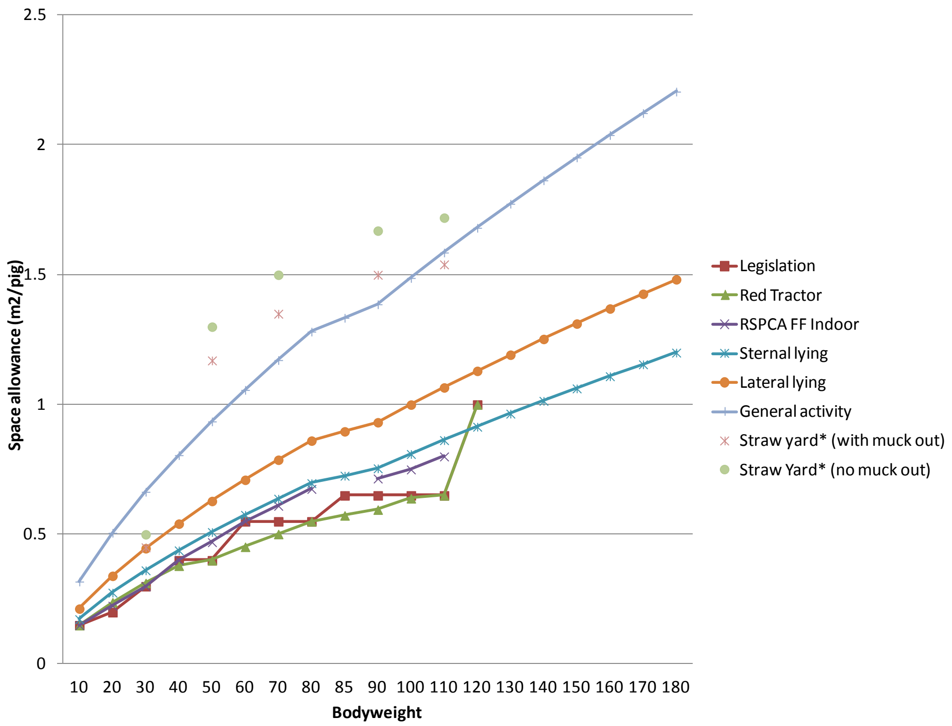
Straw bedding has other benefits. It provides physical and thermal comfort, bulky gut fill when ingested, and pigs reared on straw have fewer gastric ulcers, injuries and wounds, improved cognitive function (ability to learn) and are generally less fearful (Van de Weerd and Day, 2009). Every effort should be made to design systems with incorporation of sufficient manipulable material, preferably straw (or similar) bedding and in combination with another form of material such as woodchip, peat, or root crops.

Additionally, fewer limb lesions (1.1% compared to 23.8%) and no oesphagogastric ulcers (compared to 17.5%) were observed in pigs kept in sawdust bedded barns compared to part-slatted systems with no bedding (Ramis et al., 2005). In hot climates, deep bedding with wood shavings or rice husks led to pigs spending more time standing or lying on the bedding than the concrete feeding platform (indicating the temperature lift was not uncomfortable), and to increased play, substrate manipulation and less pen mate directed behaviour (Hotzel et al., 2009).

Space allowance

Insufficient space is recognised as a high risk factor for tail biting. HAT, recommends lowering stocking density if it is at or will reach 100kg/m^2, or 1m^2 for a 100kg pig. This equates to the space required for pigs to lie in lateral recumbency given by the allometric equation A=0.0457W$^{0.67}$ (Petherick, 1983), where A is space in m^2/animal, W is the liveweight in kg and 0.0457 is a variable constant or 'k' value. The k value for lateral recumbency is very similar to that calculated for animals to move between standing and lying (Petherick, 2007). There is little information on the K value required for various active behaviours, but is estimated at 0.0608 for systems where general activity is higher than conventional enclosed systems. Figure 1 below, illustrates space allowance requirements for meat pigs of different bodyweights based on legislation, various assurance schemes, three estimates of k: 0.037 (sternal lying), 0.0457 (lateral lying), and 0.608 (general activity), and for pigs housed in straw yards. Legislation and Red Tractor do not meet the space needs of pigs for sternal recumbency at various bodyweights, RSPCA Freedom Food Indoor follows the requirements for sternal recumbency, and no scheme for indoor production meets the space needs for lateral recumbency. Space requirements for pigs in straw yards under the RSPCA Freedom Food scheme follows those for general activity.

Figure 1. Space requirements for pigs at different bodyweights, based on legislation, farm assurance schemes and allometric equations.



* RSPCA Freedom Food standard.

A 100kg pig is given 0.65m^2 by legislation and Red Tractor and 0.75m^2 by RSPCA Freedom Foods Indoors; the pig requires 0.81m^2 for sternal recumbency, 1m^2 for lateral recumbency and 1.5 m^2 for general activity. ESFA, (2012) recommend a k value of 0.037 (sternal lying) for pigs up to 100kg, and k=0.0457 (lateral lying) for pigs weighing 110kg and over, in line with previous recommendations for heavy pigs (Rossi et al., 2007).

Space provision affected both the lying and exploratory behaviour of pigs. As space increased (in a meta-analysis of 22 studies), no further time was spent lying on slatted floors in barren environments above a k value of 0.039, whereas on solid floors (with varying amounts of bedding) no further time was spent lying above a K value of 0.072 (Averos et al., 2010a). In a wider meta-analysis of 45 studies, Averos et al (2010) found the time pigs spent exploring other pen items decreased with increasing space when no bedding was provided, whilst total exploration increased with increasing space only when bedding was provided. Jensen et al (2010) also found that pigs provided with more space ($1m^2$) manipulated straw more than when provided with low space ($0.64m^2$). Sufficient space must be provided to pigs to maximise the use of environmental enrichments, allow for restful lying and reduce the risk of tail biting.

Predicting and reacting to tail biting

Non damaging tail interest at a young age was not associated with tail biting at a later age, however damaging tail interest and restless behaviour were found to be indicators of impending tail bite outbreaks (within 4 days)(Statham et al., 2009). Tail posture was also indicative of tail damage 2-3 days post observation; pigs with tails hanging between their legs had the highest risk of tail damage especially if their tails were observed in this position on two consecutive observations (Zonderland et al., 2009).

Producers generally do not notice tail biting until it occurs. Most producers removed bitten pigs and added novel objects (67% and 51%, respectively), 16% added straw and few reduced stocking density (Hunter et al., 2001). 'Remove the biter' and 'provide a twice daily application of straw' was recommended by Zonderland et al (2008) but did not fully eliminate the behaviour, whilst the application of Stockholm tar and Dippel's oil (Bracke, 2009) reduced chewing of ropes when applied, and is therefore a potential therapy.

Summary

The welfare of pigs will be greatly improved if systems are able to operate with 'no tail docking – no tail biting'. System design is important, and risk factors for the incidence of tail biting must be significantly reduced. Sufficient space and environmental enrichment must be provided and an effective contingency plan in case of tail bite incidence must be in place. Indoor space allowance should be $1m^2$/100kg pig where a fine layer of bedding is provided and $>1.5m^2$/pig where deep bedding is provided. Straw bedding, probably in combination with other destructible and edible enrichments (such as woodchip bark and root vegetables) are the most effective at reducing tail bite incidence. Enrichments must allow for proper investigation and manipulation, and competition for access must be minimised; materials should be changed frequently to add novelty and remain unsoiled.

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