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The effect of method of tail docking on tail-biting behaviour and welfare of pigs

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Abstract

The objective of this study was to explore the effects of tail docking and tail biting on pig welfare through an assessment of physiology and behaviour. In experiment 1, piglets were either tail docked using hot cautery iron (CAUT), blunt trauma cutters (BT), or their tails were left intact (CON). Blood samples were taken from pigs at 3 and 7 weeks of age to measure C-reactive protein (CRP). Tail-biting lesions were scored at 3, 5, and 7 weeks of age. Behaviour was recorded for 72 h when tail biting was observed in 7-week old pigs. Tail-biting lesion scores were similar among treatments at 3 and 5 weeks of age, however at 7 weeks lesion scores were greater among CON compared with CAUT and BT pigs. Bodyweights were lower among CON compared with CAUT or BT pigs and CRP was elevated among CON compared with CAUT and BT pigs at 7 weeks of age. In experiment 2, piglets were tail docked at a length of 2 cm (Short) or 5 cm (Long). Tail-biting lesions were scored every 2 weeks until the end of finishing. Tail-biting lesion scores were greater among Long compared with Short pigs. Compromised welfare of tail-bitten pigs was indicated by severity of lesion, level of CRP, and reduced pig bodyweights. More research is needed into understanding the causative factors behind tail biting in pigs, so that preventative measures can be adopted on farms to prevent this behaviour

Keywords: *animal welfare, behaviour, pigs, tail biting, tail docking, wound healing*

Introduction

Tail biting in pigs represents a serious animal welfare problem. Currently, the cause of tail-biting outbreaks among pigs is unknown, but would appear to be multifactorial. Tail biting may begin with an individual pig playing with or manipulating the tail of a pen mate and (or) through sucking and biting behaviours. The onset of tail-biting behaviour has been attributed to many factors including physical (ie floor type), environmental, nutritional, over-crowding, gender, genetics, length of tail, and lack of substrates (Fraser 1987; Fraser & Rushen 1987; McGlone *et al* 1990; McGlone & Nicholson 1992; Schrøder-Petersen & Simonsen 2001; Guy *et al* 2002; Jankevicius & Widowski 2003, 2004; Walker & Bilkei 2006). Despite this, however, the exact cause of tail-biting episodes remains elusive and tail docking is routinely carried out on farms as a solution to this problem.

Analgesics and anaesthetics are not routinely used to relieve the pain associated with tail docking on commercial pig farms in the US or at research or teaching institutions (FASS 1999). Sutherland *et al* (2008) compared the stress response caused by tail docking using either conventional blunt trauma cutting or a heated cautery iron and found that tail docking pigs using a cautery iron reduced the cortisol response compared to using the conventional cutting method. Prunier *et al* (2005) showed that cortisol concentrations did not differ between piglets tail docked using a heated docking iron and control handled piglets, for up to 180 min after docking. Cautery tail docking may delay wound healing which could possibly lead to chronic infections (Graham *et al* 1997). Therefore, one of the objectives of the present study was to compare the healing of the tail-docking wound of pigs docked using either the conventional cutting method or the cautery iron method.

While tail docking is a common management practice to prevent tail-biting behaviour in pigs, it causes acute trauma and pain, requires wound healing and may have variable effects on tail-biting behaviours. The objectives of this study were to determine: i) if tail docking using cautery is an efficacious method that reduces tail biting without causing problems due to wound healing; ii) the relationship between tail-biting behaviour and physiological measures, and iii) if tail-docking length influences tail-biting behaviour in pigs.

Materials and methods

Pigs used in this study were PIC USA genetics using the Camborough-22 sow line. All animals were fed a diet to meet or exceed NRC (1998) nutrient requirements. Water was provided *ad libitum*. All animal procedures were approved by the Texas Tech University Animal Care and Use Committee.

Figure 1

Score 1: Completely healed tail docking wound

Score 2: A slight scab still present at the tip of the tail

Score 3: Fully formed scab over the wound (thick and bumpy in appearance)

Score 4: Fully formed scab over the wound (thin in appearance)

Score 5: Wound is still open there is signs of fresh blood

Description of wound healing score.

Experiment 1

Eight, weight-matched, healthy piglets per litter (n = 10 litters), were allocated to one of two treatment groups; docked (n = 40) and non-docked (CON, n = 40). Within each litter, two gilts and two barrows were allocated to the CON treatment groups. Of the four pigs (two gilts and two barrows) allocated to the tail-docking treatment, one gilt and one barrow were allocated to one of two docking treatments: blunt trauma cutting (BT, n = 20) or hot iron cautery (CAUT, n = 20). Thus, the same number of gilts and barrows were allocated to each treatment.

Within the first 3 days after farrowing, piglets were routinely castrated, ear notched (for pig ID), and given an intramuscular injection of 100 mg iron (Iron Dextran, Durvet Inc, Mo, USA) into the neck. Piglets were then allowed 3 days to recuperate from this processing experience. At 6 (± 2) days of age piglets were tail docked or left intact, depending on which treatment group the pig was assigned. Piglets were removed from the sow individually and taken to an adjoining room separated by a closed door, so as not to disturb the remaining sows and piglets in the farrowing room. Piglets were held by one handler with the tail facing outwards. The second handler marked a length of 2 cm on the pigs' tail starting at the base and then either sham cut each pig's tail or cut the tail using BT or CAUT. Sham cutting involved placing two fingers, one on either side of the tail, and making a cutting motion on the tail. Tail docking was performed using one of two methods: i) conventional BT cutting with disinfected stainless steel cutting pliers or ii) cutting with a commercial cutting cautery iron (Meador TNSC, Meador Swine Health Developers, Gretna, Nebraska, USA). Once all the piglets from one litter were tail docked or sham handled they were returned to their home pen as a group. The tail-docking treatment order was randomised over time. Pigs were weighed at tail docking, weaning, and at the end of the study.

At 21 (± 5) days of age, all pigs were moved into conventional nursery pens measuring 1.5 × 2.1 m (length × breadth) with woven wire floors. Each pen contained one feeder with six head spaces and one nipple drinker. Ten pigs were housed in each pen. Pigs from the same treatment were penned together so that tail length did not confound tail-biting behaviour. Treatment pens were randomly allocated throughout the nursery building. Bodyweights were recorded at weaning and at the end of the experiment (7 weeks of age).

Wound healing scoring

All tail-docked piglets were examined daily to assess wound healing from the day after tail docking until pigs were weaned and moved into the nursery. The purpose of assessing wound healing was to determine if one method of tail docking was better than the other in relation to wound healing. Wounds were scored from 1 to 6 with 1 being completely healed (no scab) and 6 still showing signs of fresh blood (Figure 1).

Tail-biting lesion scoring

Tail-biting lesion scores were recorded approximately every two weeks from weaning until the end of the study. Tail-biting lesions were scored using a modified scoring technique established by Zonderland *et al* (2003) (see Figure 2). Briefly, tail-biting lesions were scored using three categories based on tail length, the appearance of injuries, and the appearance of blood. The severity of the lesion was scored from 1 to 4 (injuries and blood) or 1 to 5 (tail length). The sum of all tail lesions was calculated for each individual pig. At 7 weeks of age, tail biting broke out amongst all pens of CON pigs and the study was terminated for humane reasons and to allow the affected pigs to be treated.

Collection of blood samples

At week 3 (weaning) and week 7 (once the study was ended) a subset of pigs (5 pigs per pen) were held in a supine position and blood was obtained by anterior vena

Figure 2

Tail length

Injuries

Blood

1. Complete tail

1. None

1. None

2. Three-quarters tail to almost complete

2. 'Bite spots': multiple little spots on tail

2. Black in colour (dried scab)

3. Half to 3/4 tail

3. Small wound(s)

3. A scab, cracked and revealing fresh blood

4. Quarter to 1/2 a tail

4. A severe wound

4. Fresh blood/raw wound

5. Less than 1/4 tail

Descriptions of tail-biting lesion scores.

cava puncture (catching and blood sampling took ~1 min). Blood (5 ml) was collected into vacutainers (Blood Collection Tubes, BD, NJ, USA) containing sodium heparin. Whole blood was analysed to determine white cell counts and differential leukocyte counts using a cell counter (Cell-Dyn® 3700, Abbott laboratories, Abbott Park, IL, USA) and the neutrophil-to-lymphocyte (N:L) ratio was calculated by dividing the percent of neutrophils by the percent of lymphocytes. Ten ml of blood was collected without an anticoagulant and samples were centrifuged and serum collected for analysis of C-reactive protein (CRP). C-reactive protein was analysed using a commercially available enzyme immunoassay kit (Tridelta development Ltd, County Kildare, Ireland).

Tail-biting behaviour

Once tail-biting lesions above a score of two (for the 'injury' and 'blood' categories) were observed, overhead cameras (Panasonic wv-BP70 and Panasonic wv-CP412, Tokyo, Japan) and time-lapse VCRs (Panasonic TL 500) on 72-h mode (0.8 frames s^{-1}) were set to record behaviour in each nursery pen where tail-biting lesions had been observed. Tail-biting lesions were observed in all four CON pens therefore behaviour was recorded in all these pens. All pigs in the pen were individually marked with a heavy duty marking pen (Super mark pen, Fearing International Ltd, Northampton, UK) using a series of lines to differentiate between individual pigs during the live observations. Tapes were watched continuously and behaviours were scored with The Observer 5.0 (Noldus, Leesburg, PA, USA) over the entire 72-h period for the incidence of tail-biting behaviour, the number of the pig carrying out the tail biting (perpetrators), the number of the pig being bitten (victims), and the location of these pigs in the pen at the time the tail biting was recorded.

Experiment 2

Eight piglets from 10 sows were allocated to one of two treatment groups; docked short (Short; n = 40) and docked long (Long; n = 40). Within each litter, two gilts and two barrows were allocated to each of the two treatment groups. The same number of gilts and barrows were allocated to each treatment.

Within the first 3 days after farrowing, piglets were routinely castrated, ear notched (for pig ID), and given an iron injection (100 mg). Piglets were tail docked at 6 (± 2) days of age depending on which treatment group the pig was allocated to (as described in experiment 1). Pigs' tails were cut using blunt trauma at a length of 2 cm (Short) or 5 cm (Long) from the base of the tail.

At 21 (± 5) days of age all the pigs were moved into conventional nursery pens measuring 1.5 × 2.1 m with woven wire floors. Each pen contained one feeder with six head spaces and one nipple drinker. Ten pigs were housed in each pen. Pigs from the same treatment were penned together so that tail length did not confound tail-biting behaviour. Treatment pens were randomly allocated throughout the nursery building.

At 9 weeks of age all pigs were moved into conventional finishing pens measuring 2.1 × 3.7 m with fully-slatted floors. Each pen contained one feeder with four head spaces and one nipple drinker. Ten pigs were housed in each pen. Pigs from the same treatment were penned together so that tail length did not confound tail-biting behaviour. Treatment pens were randomly allocated throughout the finishing building.

Tail-biting lesion scoring

Tail-biting lesion scores were recorded approximately every two weeks from weaning until the end of the study. Briefly, tail-biting lesions were scored as described in experiment 1, except that tail length score was scored relative to the baseline tail length.

Statistical analysis

Experiment 1

All data were tested for constant variance and departures from normal distribution. Data lacking normality were transformed logarithmically using $\log_{10}$. Data were subjected to analysis of variance using the mixed model procedure of SAS version 9.1 (SAS Institute Inc, Cary, NC, USA). All analyses were performed as two-tailed tests. The study was a random complete block design with three treatments (BT, CAUT, and CON). The main fixed effects were gender, treatment, and time. The random effects were litter and piglet. The interaction between treatment and time were included in the model. The model had a repeated structure on time allowing incorporation of heterogeneity of variances across time. Behavioural data were also analysed using analysis of variance using the mixed model procedure of SAS. Correlations between behaviour and performance and physiological measures were determined using the correlations procedure of SAS version 9.1 (SAS Institute Inc, Cary, NC, USA).

Experiment 2

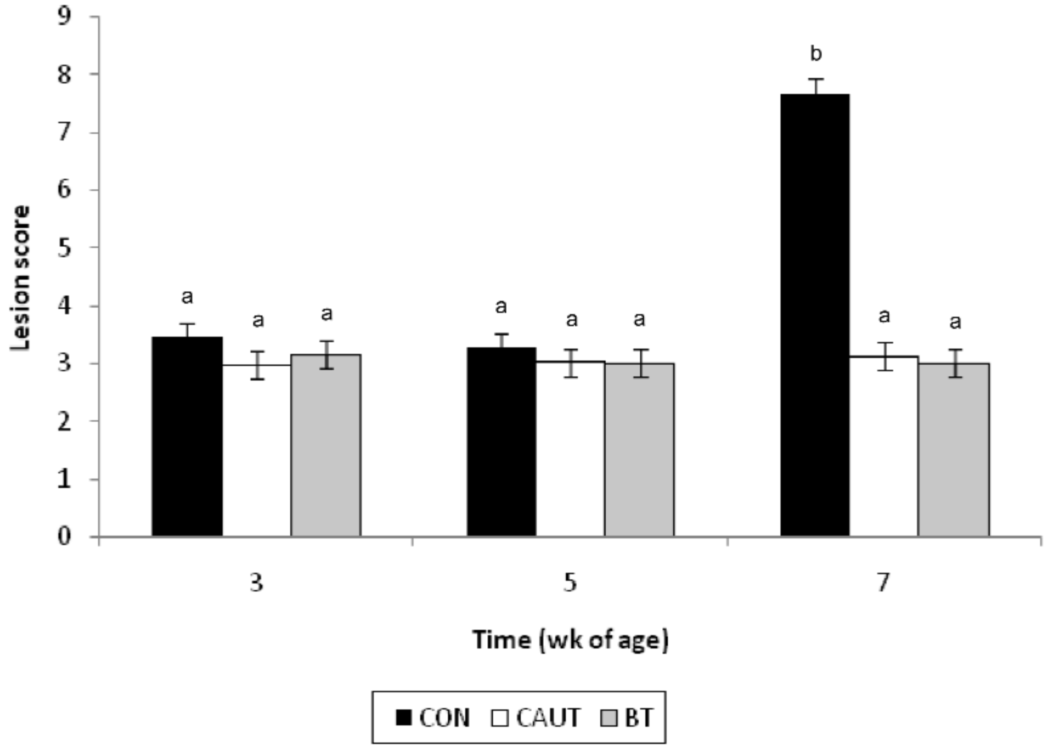
All data were tested for constant variance and departures from normal distribution. Data lacking normality were transformed logarithmically using $\log_{10}$. Data were subjected to analysis of variance using the mixed model procedure of SAS version 9.1 (SAS Institute Inc, Cary, NC, USA). All analyses were performed as two-tailed tests. The study was a random complete block design with two treatments (Short and Long). The main fixed effects were gender, treatment, and time. The random effects were litter and piglet. The interaction between treatment and time were included in the model. The model had a repeated structure on time allowing incorporation of heterogeneity of variances across time.

Results

Experiment 1

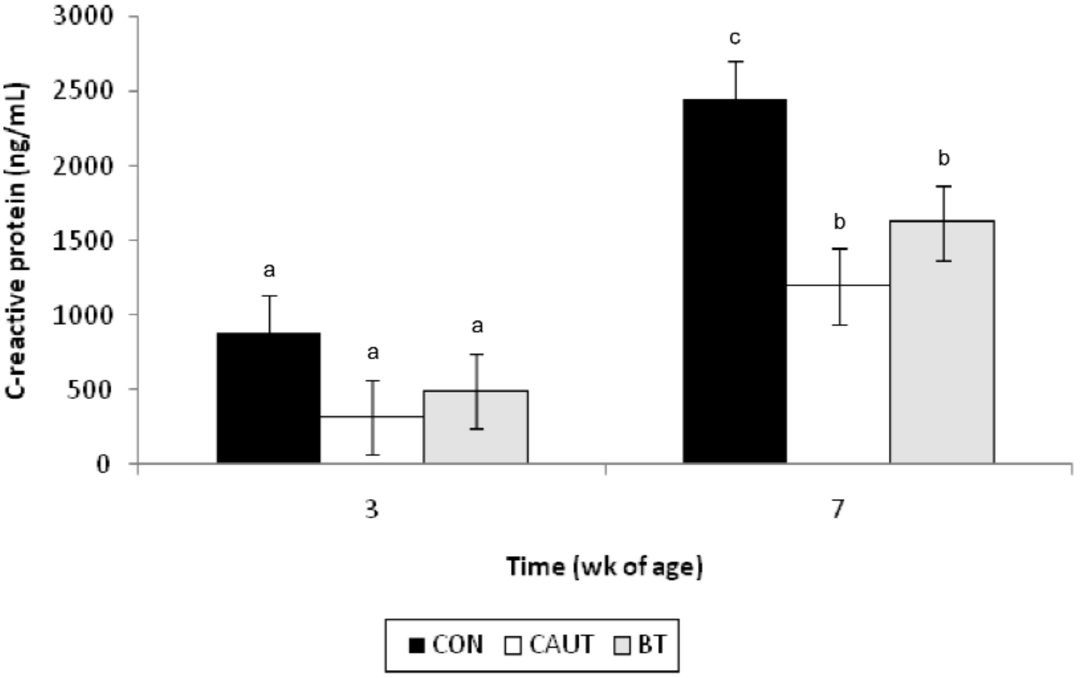
Wound healing was assessed in pigs tail docked using CAUT or BT, daily, until the pigs were moved into the nursery (approximately 15 days after tail docking). Pigs tail docked using CAUT had a higher ($P < 0.005$) wound healing score compared with BT pigs overall (CAUT: 2.5 [± 0.04]; BT:

Figure 3



The sum of all lesion score categories (length, injury, and blood) for pigs tail docked using cautery (CAUT; n = 20), blunt trauma cutting (BT; n = 20), or sham docked controls (CON; n = 40) at 3, 5 and 7 weeks of age. At each time, least square means accompanied by different subscripts are different at *P* < 0.05.

Figure 4



C-reactive protein concentrations of pigs tail docked using cautery (CAUT; n = 10), blunt trauma cutting (BT; n = 10), or sham docked controls (CON; n = 20) at 3 and 7 weeks of age. At each time, least square means accompanied by subscripts are different at *P* < 0.05.

Table 1 Mean (± SEM) leukocyte values of pigs tail docked using cautery (CAUT), blunt trauma cutting (BT), and sham docking (CON) at 3 and 7 weeks of age.

Variable	Age (weeks)	Treatment			*P*-value
		CON (n = 10)	CAUT (n = 10)	BT (n = 20)	
Total white blood cell count (10^3 μL^{-1})	3	11.9 (± 2.34)	9.8 (± 2.49)	11.6 (± 3.19)	0.649
	7	18.0 (± 1.85)	19.6 (± 2.70)	17.3 (± 2.42)	
Neutrophils (10^3 μL^{-1})	3	2.0 (± 0.79)	0.8 (± 0.83)	1.3 (± 1.08)	0.930
	7	6.4 (± 0.88)	6.0 (± 1.28)	5.9 (± 1.14)	
Lymphocytes (10^3 μL^{-1})	3	9.5 (± 1.79)	8.5 (± 1.89)	10.1 (± 2.45)	0.487
	7	10.7 (±1.66)	13.2 (± 2.42)	9.7 (± 2.17)	
Neutrophils (%)	3	10.3 (± 4.18)	6.8 (± 4.77)	18.5 (± 5.75)	0.436
	7	36.3 (± 4.30)	33.4 (± 6.28)	33.4 (± 5.62)	
Lymphocytes (%)	3	86.4 (± 3.96)	88.6 (± 4.49)	79.9 (± 5.45)	0.769
	7	58.0 (± 4.66)	63.6 (± 6.82)	58.9 (± 6.09)	
Neutrophil to lymphocytes ratio	3	0.14 (± 0.076)	0.09 (± 0.086)	0.29 (± 0.105)	0.720
	7	0.76 (± 0.121)	0.63 (± 0.176)	0.73 (± 0.158)	

Table 2 Percentages of time tail-biting behaviour was performed by 7 week old pigs over a 72-h period at different locations in the pen.

Behaviour	Occurrence of behaviour (%)
Lying at the feeder	2.0
Lying in pen	47.9
Standing at drinker	11.8
Standing at feeder	30.5
Standing in pen	7.9

2.3 [± 0.04]). There was no interaction ($P > 0.05$) between tail-docking treatment and day after tail docking.

Tail-biting lesion scores (tail length, injury, blood, and sum of lesions) were greater ($P < 0.001$) in CON compared with CAUT and BT pigs seven weeks post tail docking (Figure 3). At 2- and 4-weeks post tail docking there was no difference ($P > 0.05$) in lesion scores (tail length, injury, blood, or sum of lesions) among treatment groups (Figure 3). There was no gender effect ($P > 0.05$) on any of the lesion score categories.

C-reactive protein was measured at 3 (weaning) and 7 (end of study) weeks of age (Figure 4). At 3 weeks of age, there was no difference ($P > 0.05$) in CRP concentrations among treatments. At 7 weeks of age, CRP concentrations were elevated ($P < 0.05$) in CON compared with CAUT and BT pigs, but CRP concentrations did not differ ($P > 0.05$) between CAUT and BT pigs. There was no gender effect ($P > 0.05$) on CRP concentrations.

Leukocyte counts, differentials, and the neutrophil-to-lymphocyte ratio did not differ ($P > 0.05$) among treatments at 3 or 7 wks of age (Table 1). There was no gender effect ($P > 0.05$) on leukocyte values.

The sum of lesion scores (Tail length + injury + blood) was negatively correlated with the bodyweights of pigs at the end of the study ($r = -0.36$; $P < 0.05$), the average daily gain of pigs from weaning until the finish of the study ($r = -0.41$; $P < 0.05$), and positively correlated with CRP concentrations ($r = 0.51$; $P < 0.001$).

The majority of tail-biting behaviour occurred while pigs were lying in the pen or standing at the feeder (Table 2). The duration ($r = 0.44$; $P < 0.005$) and number of occurrences ($r = 0.38$; $P < 0.05$) of perpetrating tail-biting behaviour was positively correlated with the sum of lesions. The duration of perpetrating tail-biting behaviour was negatively correlated with the end weight ($r = -0.41$; $P < 0.05$) of pigs and the average daily gain ($r = -0.42$; $P < 0.05$) of pigs from weaning until finishing. The duration of being 'victimised' was positively correlated ($r = 0.35$; $P < 0.05$) with tail length, but not injury, blood, or sum of lesion scores. The occurrence of being 'victimised' was positively correlated ($r = 0.60$; $P < 0.005$) with CRP concentrations at weaning. No other correlation ($P > 0.05$) coefficients were identified.

Pig weight and average daily gain did not differ ($P > 0.05$) among CAUT, BT, or CON treatments at weaning, but at 7 weeks of age CAUT and BT pigs had higher ($P < 0.05$) bodyweights than CON pigs (Table 3). Bodyweight was greater among barrows ($P < 0.01$) than gilts at 7 weeks of age (barrow: 19.9 [± 0.36] kg and gilt: 18.6 [± 0.32] kg). Average daily gain was greater among barrows ($P < 0.01$) than gilts from weaning until 7 weeks of age (barrow: 0.47 [± 0.010] kg per day and gilt: 0.43 [± 0.009] kg per day).

Table 3 Mean (± SEM) bodyweight and average daily weight gain of pigs tail docked using cautery (CAUT), blunt trauma cutting (BT) and sham docking (CON).

Variable	Period	Treatment			
		CAUT (n = 20)	**BT (n = 20)**	**CON (n = 40)**	***P*-value**
Bodyweight (kg)	Initial	2.7 (0.10)	2.9 (0.10)	2.8 (0.07)	0.551
	Weaning	6.2 (0.29)	6.8 (0.30)	6.7 (0.22)	0.256
	End*	19.5 (0.60)^a	20.5 (0.62)^a	17.8 (0.46)^b	0.002
Average daily weight gain (kg)	Weaning†	0.13 (0.009)	0.15 (0.009)	0.15 (0.006)	0.251
	End$^\#$	0.42 (0.018)	0.43 (0.018)	0.40 (0.0013)	0.498

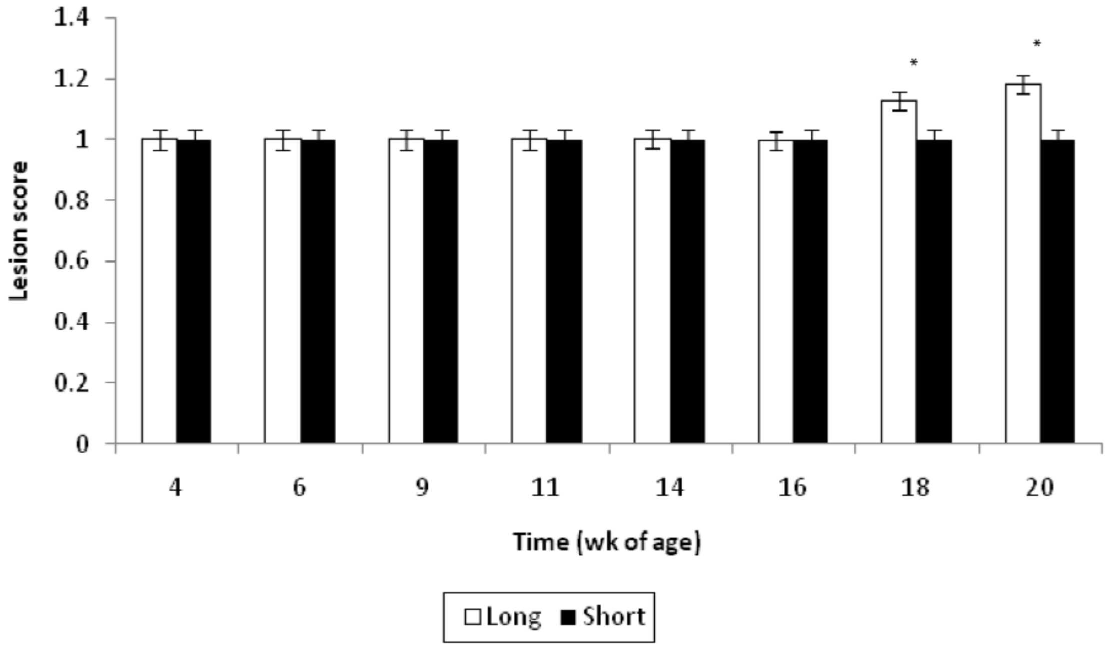
* End of the study (pigs approximately 60 days old).

† Average daily weight gain calculated between initial weight and weaning weight.

$^\#$ Average daily weight gain calculated between weaning and the end of the study.

^{a,b} Least square means accompanied by different superscripts are different at $P < 0.05$.

Figure 5



The tail lesion score category ‘tail length’ for pigs tail docked at 2 cm (Short; n = 40) or 5 cm (Long; n = 40) over time. At each time, least square means accompanied by * are different at $P < 0.05$.

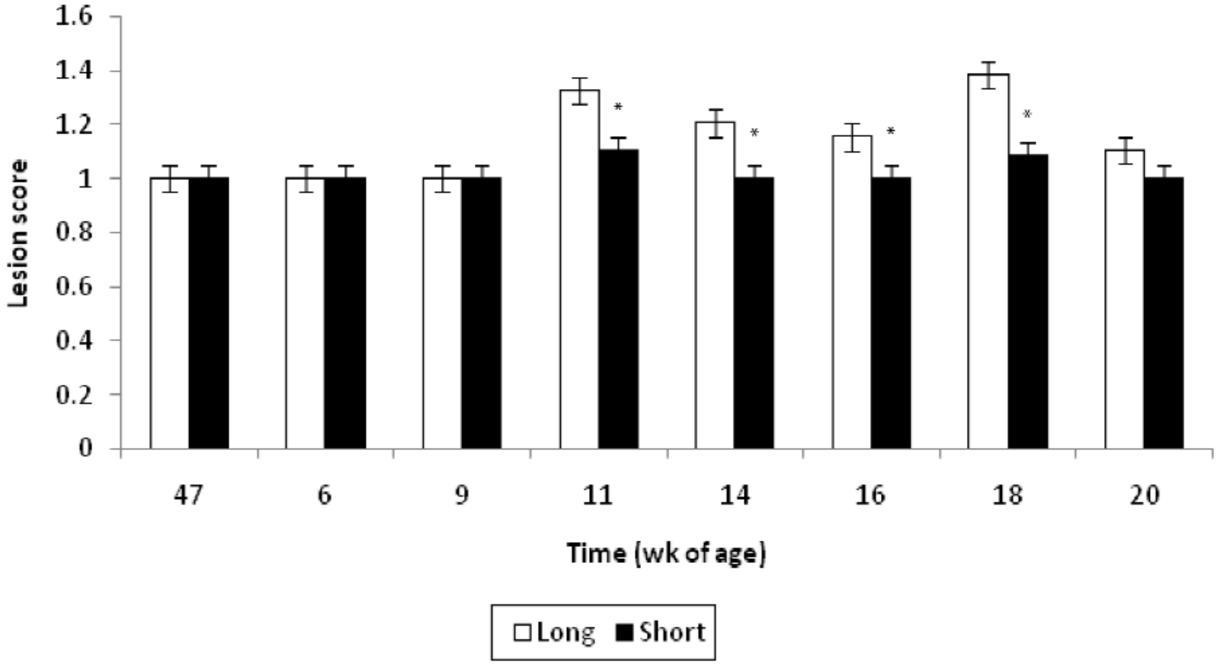
Experiment 2

The tail-biting lesion score category ‘tail length’ was greater ($P < 0.005$) among Long compared with Short pigs at 18 and 20 weeks of age (Figure 5). The tail-biting lesion score category ‘blood’ was greater ($P < 0.06$) in Long compared with Short pigs at 11, 14, 16, and 18 weeks of age (Figure 6). The tail-biting lesion score category ‘injury’ was greater ($P < 0.001$) in Long compared with Short pigs over the entire trail period (Short: 1.1 [± 0.03] and Long: 1.3 [± 0.03]). There was no gender effect ($P > 0.05$) on any of the lesion score categories (length, blood, injury, or sum) over the entire trail period.

Discussion

The effect of the method of tail docking and tail-biting behaviour on the physiology and behaviour of pigs was examined in this study. In previous research, tail docking using a cautery iron was shown to reduce the cortisol response to tail docking on 6-day old piglets (Sutherland *et al* 2008). It has been suggested that cautery may delay wound healing which could possibly lead to chronic infections (Graham *et al* 1997). In the present study, pigs’ tail wounds docked using CAUT took slightly longer to heal than BT pigs. However, there was no difference in the acute phase response, as measured by CRP, or the total white blood

Figure 6



The tail lesion score category 'blood' for pigs tail docked at 2 cm (Short; n = 40) or 5 cm (Long; n = 40) over time. At each time, least square means accompanied by * are different at $P < 0.05$.

cell count between pigs tail docked using CAUT or BT at weaning. Furthermore, there was no difference in the acute phase response or the total white blood cell count among non-docked and docked pigs, suggesting that at weaning there was no residual inflammatory response in pigs due to tail-docking methods. Tail docking using cautery was shown to reduce the acute stress response to tail docking and had no long-term detrimental effects on the health or discomfort experienced by the pig (Sutherland *et al* 2008) therefore cautery may be a practical alternative to reduce the stress caused by this procedure. Neuroma formation has been shown to be present in the tail stump of docked pigs (Simonsen *et al* 1991) and tail-docked heifers showed increased sensitivity to heat and cold (Eicher *et al* 2006), therefore tail docking may cause long-term pain. It would be interesting to determine if pigs docked using cautery experienced more chronic distress due to regeneration of nociceptors compared with pigs docked using the BT method.

Individual pigs that spent more time engaged in tail-biting behaviour during the 72-h recording period, had lower weights at the end of the study and lower average daily gain from weaning until the end of the study. Beattie *et al* (2005) found that pigs that spent 1.5% of their time engaged in tail-biting behaviour were lighter at weaning and tended to be lighter at 7 weeks of age than pigs that spent less that 1.5% of the time tail biting. A nutritional or mineral deficiency in the diet could account for the association between reduced average daily gain and the increased performance of tail biting in pigs (Fraser *et al* 1987b). However, in the present study, pigs were fed a diet to meet or exceed NRC nutrient requirements (1998), suggesting that another reason may underlie the performance of tail biting in pigs in this study. In this study, 30% of tail-biting behaviour occurred while pigs were standing at the feeder. Competition for feeder space may lead to smaller, lower ranking pigs performing tail-biting behaviour while other, more dominant pigs are feeding (Rasmussen *et al* 1962; Geers *et al* 1985). Reduced access to feed could lead to reduced feed intake and average daily weight gain in these lower ranking pigs. Reduced weight gain in pigs performing tail-biting behaviour makes tail biting not simply an issue of welfare but also an economic one for producers.

The acute phase response occurs in animals in response to infection, inflammation or trauma. Part of the acute phase response is the release of acute phase proteins, such as haptoglobin and CRP, into the circulation. Eckersall *et al* (1996) demonstrated that CRP and haptoglobin are good markers for the identification of inflammatory lesions in pigs. In the present study, CRP concentrations were positively correlated with the severity of tail-biting lesions. Heinonen *et al* (2006) showed that CRP, serum amyloid-A (SAA), and haptoglobin were elevated in pigs with tail-bit lesions and acute phase protein concentrations were positively correlated with the severity of the tail-bit lesion. The acute phase response is mediated by a combination of cytokines, including interleukin-1, interleukin-6, and tumour necrosis factor-α. The cytokines associated with the acute phase response are also responsible for somnolence, anorexia, and reduced growth. Therefore, reduced growth in pigs with severe tail-bit lesions may be the result of sickness behaviour induced by the activation of the acute phase response rather than a nutrition deficiency or competition for feeder space.

Tail docking is the most commonly used preventive measure for tail-biting behaviour. It has been suggested that tail docking may prevent tail-biting behaviour due to increased sensitivity in the tip of the tail caused by nerve regeneration and the formation of neuromas after tail docking (Simonsen *et al* 1991). The increased sensitivity in the tip of the tail may cause the pig to react more vigorously to pen mates chewing on their tails and therefore motivate the pig to move preventing further tail biting and potential injury. If this is the case, then it should be sufficient to remove only part of the tail to reduce tail-biting behaviour in pigs. In the present study, tail-biting lesions were greater in pigs tail docked at a longer length compared with conventionally short tails. Hunter *et al* (2001) found that pigs tail docked at a longer length or left intact tails were more than 3 times as likely to be bitten compared with conventionally docked pigs. Tail-biting lesions observed in pigs with longer docked tails occurred in the later stages of finishing compared with the tail-biting outbreak that occurred amongst pigs with intact tails in the nursery. In other studies, tail biting was also more commonly observed in older pigs (Haske-Cornelius *et al* 1979; Sambraus 1985). Furthermore, the tail-biting lesions observed in pigs with longer docked tails were considerably less severe than the tail lesions observed in pigs with intact tails. However, it would still not be recommended to leave pigs with longer docked tails due to the increased risk of tail biting compared with conventionally docked pigs. Furthermore, tail docking pigs at a longer length still results in acute pain and therefore does not benefit the welfare of the pig in the short term. We recommend docking pig tails at the shorter length in that it reduces the risk of tail biting and tail wounds.

Conclusion and animal welfare implications

Tail docking causes acute pain in pigs. Cautery did not delay wound healing or increase the incidence of infections in pigs, suggesting that cautery may be a viable alternative compared to conventional tail docking. The incidence of tail-biting behaviour was greater in pigs with intact or long tails compared with pigs with tails docked shorter. Tail biting reduced the welfare of pigs as measured by an increase in the acute phase response and reduced performance along with the behavioural problem of tail biting. Tail biting has a major negative impact on the welfare of pigs and it is therefore important to find management practices that can reduce incidences of this behaviour. In the authors' judgment, until root causes of tail biting are understood and preventative measures adopted, the long-term benefits of tail docking (short) outweigh the acute stress caused by this procedure. In the interim, more research is needed to study methods to prevent tail-biting behaviour and the use of effective analgesic treatments to prevent the pain caused by tail docking in pigs.

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