# Why are most EU pigs tail docked? Economic and ethical analysis of four housing and management scenarios in the light of EU legislation and animal welfare outcomes

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**Supplementary material**

**Welfare consequences of tail biting and tail docking**

*Welfare effects of tail biting*

Being the recipient of tail biting is undoubtedly very negative for a pig’s welfare. The immediate effect is injuries to the tail which are presumably painful (Van Putten, 1969), although this has not been systematically studied. However, it seems highly likely that a series of bites over time resulting in a messy wound and loss of part or all of the tail is rather painful. In response to being bitten, pigs show changes in behaviour including avoidance of biting pigs and changes in tail position ('tucked under' Statham *et al*., 2009; Zonderland *et al*., 2009), which are likely to be defensive reactions, and vocalisations (Blackshaw, 1981) which indicate pain and distress (Manteuffel *et al*., 2004). Tail bitten pigs show changes to their heart-rate patterns which could indicate psychological disturbance (Zupan *et al*., 2012). Even tail chewing that does not result in obvious wounds may cause an inflammatory response (Munsterhjelm *et al*., 2013; Simonsen *et al*., 1991).

Further challenges to pig welfare occur subsequent to biting. As well as the direct trauma and blood loss, there is an increased risk of bacterial infection in the tail (Heinonen *et al*., 2010; Munsterhjelm *et al*., 2013). The infection can spread locally leading to osteomyelitis in the coccygeal vertebrae and abscesses in the surrounding tissue (Huey, 1996). In addition, haematogenous spread of bacteria through the body of the pig can lead to septicaemia and pyaemia. The pyaemic processes resulting from tail lesions include osteomyelitis, especially in the vertebrae, and abscesses in the lungs and other organs (Huey, 1996; Kritas and Morrison, 2007; Valros *et al*., 2004). Lesions in the vertebrae may in some cases lead to paralysis of the hind limbs (EFSA, 2007). The pig’s experience of infections, the formation of abscesses and paralysis must represent a considerable challenge to its welfare (Millman, 2007).

*Short-term effects of tail docking on welfare*

Tail docking is acutely painful for piglets (Guatteo *et al*., 2012; Sutherland and Tucker, 2011). This is indicated by behavioural changes including disrupted suckling, increased activity, lying separately from other piglets, tail wagging, jamming, sitting and bottom scooting (sitting, dragging bottom along the floor (Noonan *et al.*, 1994; Rutherford *et al*., 2009; Sutherland *et al*., 2008; Torrey *et al*., 2009). Tail docking can also result in physiological stress, indicated by elevated cortisol and/or ACTH in some studies (Sutherland *et al*., 2011) but not others (Prunier *et al*., 2005) or only for certain docking methods (Sutherland *et al*., 2008). The stress of docking is also indicated by a short-term decrease in skin temperature (Kluivers *et al*., 2010) and in white blood cell counts (Sutherland *et al*., 2008).

The exact period after the procedure during which piglets experience pain and discomfort is unknown, as few studies have attempted to track piglets in the days after docking. Studies generally only investigate behavioural responses in the immediate minutes after the procedure (Noonan *et al*., 1994; Rutherford *et al*., 2009), or for a small number of hours afterwards (Sutherland *et al*., 2008 and 2011; Marchant-Forde *et al*., 2009). Some studies have extended behavioural analysis for longer, and behavioural effects have been seen in the days following docking (tail docked piglets showed more tail jamming on day 3: Torrey *et al*., 2009). Physiological assessment, for instance of stress physiology, is also generally conducted for only one to three hours after the procedure, and in any event, findings are variable: some studies (Marchant-Forde *et al*., 2009; Prunier *et al*., 2005) found no effect of docking on cortisol levels, whereas increased cortisol in tail docked piglets relative to handled controls has been seen at 30 (Sutherland *et al*., 2011) and 60 (Sutherland *et al*., 2008) minutes after the procedure, but not later. A full account of the welfare significance of tail docking would require further studies to examine behavioural and physiological effects beyond the first few hours after docking.

Although there are no direct statistical comparisons between tail docking and other painful procedures performed on piglets, a comparison of the degree of biological alteration seen following the procedures can be made. For instance, compared to cold tail docking, there were around five to eight times as many squeals in response to castration by cutting or tearing respectively, and there were three to four times as many escape attempts following castration compared to docking (Marchant-Forde *et al*., 2009). Peak vocal frequency (in Hz) was also between 60 and 80% higher during castration than during tail docking (Marchant-Forde *et al*., 2009). Prunier *et al*. (2005) found a significant increase in ACTH (up to 60 minutes) and cortisol (up to 90 minutes) following castration but no response to tail docking, or teeth resection. Comparison to other procedures is more equivocal: Noonan *et al*. (1994) found that the immediate vocalisation reaction to tail docking was greater than that seen in response to teeth resection or ear notching. However, in a different study, teeth grinding or clipping was associated with similar levels of grunting to tail docking, and the number of escape attempts seen following docking was lower than after teeth resection (Marchant-Forde *et al*., 2009). On the basis of these studies, tail docking could be considered to be less painful than piglet castration (Marchant-Forde *et al.*, 2009; Prunier *et al*., 2005), and roughly similar in painfulness, or slightly more painful than teeth resection (teeth clipping or grinding), ear notching or ear tagging (Marchant-Forde *et al*., 2009; Noonan *et al*., 1994).

A limited amount of research has been carried out to investigate ways to reduce tail docking pain either by comparing different methods of docking, or by using analgesia (Kluivers *et al*., 2010; Marchant-Forde *et al*., 2009; Sutherland *et al*., 2011). Refinements in the methods used have the potential to considerably reduce the welfare challenge of tail docking.

*Long-term effects of tail docking on welfare*

The suggestion that tail docking alters sensory function in tails, and possibly causes chronic pain (continuing after the tail has healed) is based on identification of neuromas in docked tails (Done *et al*., 2003; Herskin et al 2014; Simonsen *et al*., 1991). However, no research has yet attempted to establish whether pigs experience chronic pain as a consequence of tail docking (FAWC, 2011). Sandercock *et al*. (2011) found no difference at 5-8 weeks of age in nociceptive function (altered sensitivity to mechanical or cold stimuli) in tail-docked pigs.

Other (non-pain) effects of tail docking have been found: reproductive development was altered (at day 40), with docked pigs showing lower oestradiol, and males having reduced testis weight and females having reduced proliferation of Leydig cells (Ashworth *et al*., 2011). Central physiological stress pathways are also altered: tail-docked female pigs show increased expression of mRNA for CRH receptor 1 in the amygdala, while both sexes show increases in CRH receptor 2 mRNA expression (Rutherford *et al*., 2014). The significance of these changes for welfare is not known.

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