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Review

Can tail damage outbreaks in the pig be predicted by behavioural change?

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ABSTRACT

Tail biting, resulting in outbreaks of tail damage in pigs, is a multifactorial welfare and economic problem which is usually partly prevented through tail docking. According to European Union legislation, tail docking is not allowed on a routine basis; thus there is a need for alternative preventive methods. One strategy is the surveillance of the pigs' behaviour for known preceding indicators of tail damage, which makes it possible to predict a tail damage outbreak and prevent it in proper time. This review discusses the existing literature on behavioural changes observed prior to a tail damage outbreak. Behaviours found to change prior to an outbreak include increased activity level, increased performance of enrichment object manipulation, and a changed proportion of tail posture with more tails between the legs. Monitoring these types of behaviours is also discussed for the purpose of developing an automatic warning system for tail damage outbreaks, with activity level showing promising results for being monitored automatically. Encouraging results have been found so far for the development of an automatic warning system; however, there is a need for further investigation and development, starting with the description of the temporal development of the predictive behaviour in relation to tail damage outbreaks.

Introduction

Tail biting, resulting in outbreaks of tail damage among pigs, is a multifactorial welfare and economic problem (D'Eath et al., 2014). Several negative consequences of tail damage have been reported, including experienced pain and stress in the animals (Munsterhjelm et al., 2013a; Valros et al., 2013), spread of infection (Heinonen et al., 2010; Sihvo et al., 2012; Munsterhjelm et al., 2013b), reduced performance (Camerlink et al., 2012; Sinisalo et al., 2012; Valros et al., 2013) and carcass condemnation at slaughter (Huey, 1996; Hunter et al., 1999; Valros et al., 2004; Harley et al., 2012). Multiple definitions of tail biting have been used, ranging from mild tail manipulation to cannibalism (Taylor et al., 2010). In the current review, unless stated otherwise, the term 'tail biting' will refer to the performance of the tail biting behaviour while the term 'start of a tail damage outbreak' will refer to tail damage seen as freshly bleeding tail wounds (Zonderland et al., 2008; Statham et al., 2009).

Tail docking is a measure often used to prevent tail biting, and experimental studies support the idea that tail docking is partially effective in reducing, though not completely eliminating, the problem (Krider et al., 1975; McGlone et al., 1990; Sutherland et al., 2009). Most abattoir studies support this view as well (e.g. Hunter et al., 2001; Penny and Hill, 1974), although data from abattoirs do not include on-farm culling due to tail biting and do not make it possible to state the direction of the relationship. Furthermore, abattoirs may not score consistently and may not be able to distinguish between historic tail biting of undocked pigs and tail docking. In addition, tail docking does not necessarily decrease the actual tail biting behaviour (Paoli, 2013), does not eliminate tail damage entirely, and has negative consequences on the welfare of the docked pig (e.g., acute pain and possibility for long-term pain with the formation of neuromas in the tail stump) (Edwards, 2011).

The discussion of welfare complications with tail biting and tail docking, and the comparison of the two, is reviewed by Valros and Heinonen (2015). According to European Union (EU) legislation, tail docking is not allowed on a routine basis in the EU (2001/93/EC amending Directive 91/630/EEC, The Council of The European Union, 2001); thus it is important to search for alternative strategies to prevent tail biting and tail damage outbreaks successfully while keeping the tail of the pigs intact.

Which is the best strategy?

Some countries have already banned the use of tail docking (e.g., Finland, Norway, Sweden, and Switzerland). One strategy to prevent tail damage outbreaks is to reduce the existence of known risk factors, for example, by ensuring a lower stocking density, increasing the number of feeders or providing enrichment material (EFSA, 2007; Taylor et al., 2012). This strategy, where the source of the problem is being removed, is seen as the most ideal and is also the

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strategy encouraged by the EU legislation, stating that other measures should first be applied before resorting to tail docking. However, under commercial conditions, it may be complicated to identify the risk factors triggering tail biting on single farms, and interventions to reduce the occurrence of the risk factors once identified are often considered either too expensive or not a possible solution within the current production systems (e.g., decreased stocking density through the entire production period and/or continuous provision of straw).

Another strategy is to monitor pigs for indicators of a future tail damage outbreak, such as a behavioural change. When problem individuals or pens at risk of an outbreak have been identified, the known preventive measures can be used temporarily in these pens to avoid that tail biting develops into a tail damage outbreak. This strategy seems appropriate since tail biting behaviour often develops both sporadically and periodically. Furthermore, this is a feasible strategy as tail damage can be reduced by, for example, the provision of straw both before (D'Eath et al., 2014) and after (Zonderland et al., 2008) the occurrence of a tail damage outbreak. However, before this strategy can be used in practice, it presents several challenges: (1) which indicators can be used as predictive of a tail damage outbreak? (2) how can these indicators be monitored under farm conditions? (3) how reliable are the indicators in terms of sensitivity and specificity?

The current review discusses the existing literature dealing with mainly the first two challenges and with a primary focus on identifying behavioural changes prior to a tail damage outbreak. It reviews and compares the relatively few existing publications on the topic, lists monitoring opportunities for the presented indicators, and presents future possibilities within this field of research.

Monitor at animal or pen level

Prediction of a tail damage outbreak can be done either at an animal or pen level. Prediction at the animal level makes it possible to remove potential biters and victims from the pen, which has been proposed as a potential treatment to an occurring tail damage outbreak (Zonderland et al., 2008) and might also be beneficial to do before an outbreak occurs. It has been shown for weaners that a few pigs in a pen perform or receive more tail biting than others, making it possible to distinguish between individuals in their tail biting activity (Beattie et al., 2005; Zonderland et al., 2011a). On the other hand, Zonderland et al. (2011a) found that before a tail damage outbreak, most pigs in a pen are involved in tail biting either by biting, being bitten or both. This makes it harder to distinguish the pronounced biters and victims from pigs being less involved. Ursinus et al. (2014) looked into pigs' consistency in being biters from weaning to slaughter and found that tail biters were not consistent in their tail biting behaviour between production phases. Based on this inconsistency in being a tail biter, the authors concluded that prediction of tail biting at pen level had the most promising value (Ursinus et al., 2014). In addition, Paoli (2013) did not see a correlation in tail biting behaviour across different weeks for either biters or victim pigs from weeks 5–8 of age. Furthermore, observations at the animal level are more time-consuming and less likely to be automatised than when done at the pen level and, therefore, less feasible under commercial production conditions.

Thus, prediction seems more promising at the pen level. However, this may depend on the predictive indicator and on the type of tail biting experienced. Taylor et al. (2010) described three types of tail biting: (1) two-stage tail biting; (2) sudden-forceful tail biting; and (3) obsessive tail biting. These three types are considered to have different motivational bases and, therefore, it might also be important to differentiate between them when trying to find solutions to tail biting. As far as monitoring, obsessive tail biting is mostly described as being performed by specific individuals with specific problems. Thus, the potential of pen level monitoring to capture this type of tail biting behaviour is not promising. On the other hand, two-stage tail biting is more appropriate for monitoring at the pen level, as it is likely to be present due to factors acting on the entire pen. Furthermore, per definition, only two-stage tail biting develops over time and, therefore, might be the only type of tail biting possible to predict. Sudden-forceful tail biting is supposed to develop due to frustrated feeding motivation and, therefore, a way to monitor this type of tail biting may be to look at activity around the feeder.

Predictive behaviour and monitoring

Presentation of the studies

The literature covering prediction of tail damage outbreaks is limited, and only five studies could be found where behaviour preceding an outbreak has been observed. All five studies used undocked pigs, but otherwise they differ in multiple parameters. Details on the studies can be seen in Tables 1 and 2 with the predictive ability of the presented behaviours shown in Table 2. The five studies have each focused on behavioural observations at different number of days prior to a tail damage outbreak. Statham et al. (2009), Zonderland et al. (2009) and Zonderland et al. (2011b) investigated behavioural change a few days prior to a defined tail biting outbreak, making it possible to relate these results to the timing of the outbreak. Statham et al. (2009) also observed in the post-farrowing weeks 7, 11, 15 and 19. Wallenbeck and Keeling (2013) investigated behavioural changes in week intervals as much as 10 weeks prior to a defined tail damage outbreak and, therefore, with a higher uncertainty to the timing and relevance of the outbreak. Ursinus et al. (2014) did not define actual tail damage outbreaks and, therefore, cannot relate the results to such. Instead, three

Table 1
Overview of the presented studies. All studies used pigs with undocked tails.

	Number of pigs (per pen)	Number of pens per treatment	Number of pens with outbreaks	Observational period	Definition of a tail damage outbreak
Statham et al. (2009)	700 (30 ± 9)	6[b]	6	1–21 weeks of age	Blood from damaged tail(s) seen in the pen
Ursinus et al. (2014)	987/480[a] (6)	40[c]	–	3–23 weeks of age	–
Wallenbeck and Keeling (2013)	460 (14)	21[d]	21	12–24 weeks of age	When the first pig in a pen was treated for tail damage due to tail biting
Zonderland et al. (2009)	992 (9.8)	101	–	5–9 weeks of age (32 days)	–
Zonderland et al. (2011b)	140 (10)	14[e]	14	5–9 weeks of age (32 days)	At least one pig with a tail wound or at least two pigs with bite marks

[a] Pre weaning/post weaning.
[b] Twenty-four pens divided between four straw treatments (no effect of treatment found).
[c] Eighty pens divided between enriched and barren pens.
[d] Twenty-one tail damage outbreak pens matched with 21 control pens.
[e] Fourteen tail damage outbreak pens selected from a larger study (Zonderland et al., 2008).
–, Not informed/not observed in the study.