

Existing practices and current research on feedback of tail slaughter findings

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Scope and Background

Meat inspection is done to ensure food safety and quality and to protect consumers from foodborne hazards. However, the recording and feedback of the ante- and post-mortem findings collected at the abattoir also may serve as an important basis for the retrospective assessment of animal health and welfare of pigs on farm (Aalund et al., 1976; Alban et al., 2022; Blaha and Neubrand 1994; Hoischen-Taubner et al. 2011; Horst et al., 2019; Klinger et al., 2021; Minkus, 2003). In addition, feedback may also help farmers to improve the animal welfare and health status of their animals (Bottacini et al., 2018; Harley et al. 2012a; Kagerer, 2013; Minkus, 2003; Steinmann et al., 2017), and to increase the productivity and profitability of their farms (Teixeira et al., 2016). Further, slaughter findings can facilitate the risk-based on farm controls by Competent Authorities (CAs) to comply with EU Regulation 2017/625, Art. 9 (Ghidini et al., 2021). In terms of an official monitoring, the 'conspicuous' farms could be identified, monitored, and controlled in a targeted manner (Blaha and Richter, 2011; Patzkéwitsch, 2022). Despite the potential usefulness of meat inspection data, it is clear that a wide range of welfare problems cannot be reflected by these data per se. Problems may have occurred earlier in life and are no longer visible. Certain dimensions of animal welfare such as restrictions in behaviour are not reflected by meat inspection anyway. Thus, meat inspection data cannot replace the on-farm assessment but can serve as a supporting measure in identifying problems that may exist. On-farm assessments are very time-consuming and expensive (Larsen et al., 2021) and it is hardly possible to assess each animal on a farm. Abattoirs are a bottleneck at which nearly each animal will arrive. Thus, data recorded at the slaughterhouse offers at least in part the possibility of assessing aspects of animal welfare and health in a short time with little effort (Alban et al., 2015). In addition, lesions are better visible due to cleaned carcasses (EFSA, 2022). Thus, assessments of aspects of animal welfare and health at abattoirs increasingly has been come into focus in recent years (De Luca et al., 2021; European Commission, DG Health and Food Safety, 2022).

Tail biting is known as a multifactorial problem. Various studies have shown that tail biting lesions are often associated with carcass condemnations, trimmings and reduced carcass weight (Große-Kleimann et al., 2021; Harley et al., 2012b, 2014; Kongstedt et al. 2017; Kritas and Morrison, 2007; Marques et al., 2012; Teixeira et al. 2016; Valros et al., 2004; Walker and Bilkei, 2006). Based on these associations, tail lesions have been suggested as an iceberg indicator (EFSA, 2022) that potentially provides a general overview of animal welfare problems on farms (EFSA, 2022; van Staaveren et al. 2017, Starosta et al, 2021). This supports the

possibility to use data on tail lesions collected at the abattoir for welfare assessment. However, there are several aspects that also question these data. It is difficult to distinguish whether fresh tail lesions occurred on farm, during the transport to the abattoir or within the lairage pens (Harley et al., 2012a). At present, the results of several studies indicate that abattoir assessments of tail damages as currently performed in connection to meat inspection are not a reliable indicator of tail biting problems on farm, neither for tail-docked (Bottacini et al., 2018) nor for undocked (Kongsted et al., 2020) pigs. Finally, a unified and harmonized monitoring protocol (Nalon and De Briyne, 2019, Harley et al., 2012a) and cost-effective methods are needed in order to allow a valid monitoring of tail damages at the abattoir (Kongsted et al., 2020).

In summary, tail lesions recorded at the abattoir in the context of meat inspections do not allow valid conclusions on the occurrence of tail biting on farm. However, beside the limitations addressed above assessing tail damage at the abattoir potentially can serve as an iceberg indicator for on farm welfare and health if (a) functioning feedback systems are available and (b) standardized assessments of tail lesions at the slaughterhouse are implemented.

Existing practices on feedback of slaughter findings and benchmarking

There are some examples of systems in which slaughterhouse findings are or will be reported back to farmers and authorities. These systems primarily serve as benchmarks between farmers, but also offer the possibility for CAs to carry out targeted and risk-oriented inspections in particular on farms with poorer results compared to others.

One of these systems is 'ClassyFarm' that has been funded by the Ministry of Health and implemented by the Experimental Zooprophyllactic Institute of Lombardy and Emilia Romagna with the collaboration of the University of Parma for risk analysis of livestock farms (pig, poultry, beef and dairy cows), which can be accessed by farmers, vets, and CAs. Individual farms are centrally registered in the system. The parameters assessed are assigned to the areas: biosecurity, animal welfare, sanitary and production parameters, animal feed, and consumption of antimicrobial drugs. The welfare assessment itself is performed by farm veterinarians. The presence of ear and tail lesions so far is assessed on-farm and included in the area "animal welfare". However, there are currently efforts to include slaughterhouse findings of ear and tail lesions in this system as well (pers. com. D. Castelluccio). Furthermore, ClassyFarm allows each farm to benchmark its results against the results of other farms in the same region or on a national level. As indicated on the [webpage](#), ClassyFarm allows the CAs to carry out an effective monitoring.

In Germany, the QS (QS Qualität und Sicherheit GmbH), a private organisation, includes about 95 % of all pigs reared and slaughtered in Germany. The meat inspection data collected at the abattoir can be assessed by the farmer at any time

via the platform 'IQAgrar¹' (Fig. 1) and are reported back in a written form every three months. Regarding tails, data are recorded on a 2-level score: 'without special findings' and presence of 'necrosis/inflammation'. However, these scores predominantly still relate to meat quality rather than to the problem of tail biting and tail docking. QS animal keepers can have the data released to the veterinary office on a voluntary basis (pers. com. K. Wissing).

Befund - Durchschnittswerte					
Merkmal	Mein Betrieb [Stk]	Mein Betrieb [%]	Vgl. Ø [%]	Differenz Betrieb zu Vergleichswerten	
Anzahl Tiere	157		≥ 1.000	← Schlechter Besser →	
Darmveränderungen Da-V	0	0,00	0,19	0,19	
Gelenkentzündungen Gel-V	0	n.a.	n.a.	0,00	
Schwanzveränderungen Schw-V	0	0,00	0,50	0,50	
Geruchsabweichung	0	n.a.	n.a.	0,00	
untauglich	0	0,00	0,04	0,04	

Figure 1: Slaughter findings recorded and reported back to farmer per batch in IQAgrar

Based on a short survey done by EURCAW-Pigs (pers. com. EURCAW-Pigs CA-Meeting, 2022) a feedback of slaughter findings to the farmers by CAs or private companies is also done in other EU Member States (MSs). However, there seem to be differences in how regularly and how systematically such feedback is given.

Lacking standardization of manual recordings at the abattoir

Within the EU, most often meat inspection is done by the CAs (involving official veterinarians and official auxiliaries) (Alban et al., 2015). Often, a 2-level score (e.g., affected/not affected) is available for the individual findings/codes at the slaughterhouse and often large differences between the scores given by different assessors within (Schleicher et al., 2013) as well as between abattoirs (Steinmann, 2018) are found. Thus, the possibility to compare the findings are very limited due to the low reliability (Bonde et al., 2010; Watson et al. 2011).

There are a variety of reasons for the low reliability of meat inspection data. For example, the slaughter line-speed, the visibility of pigs/carcasses, the changing staff, experience and motivation, the number of meat inspectors, and the data collection system have been described to be responsible for the considerable differences in the findings of meat inspection (Alban et al., 2015; Eckhardt et al., 2009; Elbers et al., 1992; Guardone et al., 2020; Horst et al., 2021; Stärk et al., 2014; Thomas-Bachli et al., 2012; Watson et al., 2011). In particular, the large differences are explained by the lack of standardised definitions of slaughterhouse findings (Alban et al., 2022; Eckhardt et al., 2009; Enøe et al., 2003; Harley et al., 2012b; Kosenko et al., 2021; Steinmann et al., 2014; Thomas-Bachli et al., 2012). Furthermore, the number of findings/codes which are used for assessments differ between MSs, but also within the same country between abattoirs. In some

¹ (<https://www.iq-agrar.de/services/schlachtdaten/zugaenge-fuer-landwirte/>)

MSs meat inspectors only record one code per pig for condemnation and therefore must focus on the most relevant finding per pig, which limits the amount of information (Alban et al., 2022). An additional aspect reported by Blömke et al. (2020) is that individual auditors can get tired or inattentive during the meat inspection process leading to lowered inter-observer-reliabilities, which can only be improved to a certain degree by training programs (Gibbons et al., 2012). Therefore, regular and uniform training of official staff or automated recordings by video technology are suggested as solutions for the current problems regarding standardisation of records at abattoirs (Horst et al., 2021).

Future developments: Automated recording of tail at slaughter

The most relevant advantage of automated systems is that they can provide a consistent, objective, fatigue-proof assessment (Blömke et al., 2020). In broilers, such video- or camera-based monitoring systems are already used to monitor footpad dermatitis, for example, in larger German and Dutch poultry slaughterhouses (De Jong, 2013; Van Harn and De Jong, 2017). In pigs, such systems are still under development and tested in research projects. Blömke et al. (2020) developed and evaluated a system to detect ear and tail lesions in pigs at the slaughter line. This system was able to detect tail lesions in docked pigs with a sensitivity of 77.8%, a specificity of 99.7%, and an accuracy of 99.5%. The agreement between the human observers who assessed the tails at the slaughter line and the automated system was lowered because the observers only had a very short time to evaluate a given pig (about 8 seconds) and tails could not be observed at eye level. Brünger et al. (2018) also investigated the reliability of neural networks for assessing tail images of carcasses in comparison to trained human observers. Three trained observers assessed both tail lesions and tail losses based on automatically captured images. The agreement between the system and the human observers was similar to the agreement between the human observers. During their study, image quality was identified as the main reason for the differences between observers and the authors expected better results if high-quality images will be used for training of the system. Despite the possibility for further improvements the authors conclude that with this technique, reliable and repeatable assessments of tail lesions by images would allow automated tail classification of all slaughtered pigs. Another automated system for measuring tail length and tail lesions was developed by Larsen et al. (2019). Within this system, the so-called 'TailCam', high quality images of tails are captured that are linked to the individual carcasses, to the batch, and to additional findings of the meat inspection. Here, images were classified into 'Lesion', 'Small lesion', or 'No lesion' visually by one observer and by the TailCam. The system misclassified some 'Small lesions' as 'Lesions' or 'No lesion' but was able to distinguish exactly between 'Lesions' and 'No lesion' or vice versa. The sensitivity for 'Lesions' was 61% and for 'Small lesion' 75%, whereby 4% of the tails with no visual signs of tail bites were misclassified as "Small lesion", leading to a specificity of 96%. Further, the TailCam system calculated accurate values for the tail length with a deviation of less than 3 cm from the measured length. However, the authors discussed that

the calculation would become more precisely by removing bristles from the tails or sorting out tails with excess bristles.

Recently, the European Commission intends to launch a study on developing a system for the automated measuring of tail length and tail lesions of pigs at the slaughter line, following a European Parliament pilot project proposal (European Commission, DG Health and Food Safety, 2022).

Conclusion

The background presented and the results of recently published studies indicate that slaughter findings may play an important role for a retrospective assessment of certain aspects of animal welfare on farm. Slaughter findings can be used as a feedback to farmers and CAs in order to monitor and benchmark aspects of the welfare status of a herd, to derive measures to improve the welfare status, and to identify farms with a poorer performance. However, currently the meat inspection data on tail status is not a valid method for assessing tail biting on farm. Automated methods for recording tail lesions and lengths at the abattoir have been successfully developed and tested in research pilot projects. However, there is still a need for further improvements of the algorithms and technology before these systems can be put into practice.

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