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Review

Welfare measurements of finishing pigs on the day of slaughter: A review

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ABSTRACT

Animal welfare on the day of slaughter is of increasing concern to the authorities and consumers alike, creating a need not only to optimize the welfare of the animals but also to document the level of welfare. The day of slaughter is composed of a variety of stages, initiated when the pigs leave the home pen and including pick-up facilities, transport, lairage, stunning and sticking. At each of these stages, the animals are exposed to different stressors that, both individually and in interaction with one another, can compromise welfare. As part of the initial work aiming to document the welfare of finishing pigs on the day of slaughter, this paper provides an overview of the individual stages including a discussion of potential stressors and potential welfare measurements. These measurements are discussed with regard to their relevance and suitability for documentation of animal welfare on the day of slaughter for development of on-site tools for continuous automatic monitoring of animal welfare.

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1. Introduction

A recent EU regulation (Council Regulation (EC) No. 1099/2009) stipulates that large slaughterhouses slaughtering more than 1000 animal units per year should be able to document animal welfare. Compliance with these requirements necessitates the development of on-site tools for continuous monitoring of welfare of finishing pigs on the day of slaughter, tools that can be applied even at a high commercial slaughter line speed. Furthermore, market demands with regard to animal welfare cover the entire chain from farm to slaughter, making it relevant to also include the earlier stages (e.g. loading and transport) rather than focusing solely on the slaughterhouse.

The day of slaughter consists of a chain of potential stressors such as regrouping and housing in pick-up facilities (a separate housing unit designed to obtain maximum protection against disease), loading, transport including stops during the journey, unloading, regrouping and housing in the lairage, stunning and killing (Barton Gade, 2004). Previous studies have investigated the effect of single potential stressors within this chain, such as repeated regrouping (Coutellier et al., 2007), handling during moving (Correa et al., 2010; Edwards et al., 2010b), exposure to an unknown environment

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(Lewis, Hulbert, & McGlone, 2008), high stocking density (Warriss, 1998), high ambient temperature (Sutherland, McDonald, & McGlone, 2009) or CO_2 concentration at stunning (Nowak, Mueffling, & Hartung, 2007; Velarde et al., 2007). However, so far no animal welfare assessment approach has considered the accumulated effects of the different potential stressors pigs encounter from the pick-up facilities at the farm until killing at the slaughterhouse.

Existing animal welfare protocols used on the day of slaughter are typically based on resource-based measurements such as the slope of the loading ramp, the number of water nipples etc. Critical control points for pre-slaughter handling have been proposed with regard to vehicle requirements, transport logistics and the health status of the animals (von Borell & Schäffer, 2005). Attention has recently been focused on the inclusion of animal-based measurements in welfare assessment protocols (Welfare Quality®, 2009). The WQ® protocol has been used to assess animal welfare on the farm (Temple, Manteca, Velarde, & Dalmau, 2011) and also from unloading at the slaughterhouse until killing, including measurements of resources, management and animals (Dalmau, Temple, Guez, Llonch, & Velarde, 2009). However, the WQ® protocol does not consider the welfare of the animals while they are at the farm pick-up units, or when they are being loaded onto vehicles on the farm or transported, which are also important potential stressors on the day of slaughter. Thus, at present there is a need to combine the whole chain of elements in an investigation that examines the suitability of biological responses for the documentation of welfare on the day of slaughter. Covering the whole chain from farm to slaughter is a challenge, since the individual incidents can interact with one another, and a certain response measured at one stage might influence the response measured at another stage.

One approach to combining protocols based on resource- and animal-based measurements was put forward by Grandin (2010), who suggested that animal welfare at slaughterhouses can be assessed using an animal-based scoring system that includes recordings of stunning efficiency, percentage rendered insensible, falls, vocalization and the use of electric prods. It was concluded that these five measurements can be used to improve animal welfare at slaughterhouses and are easy to implement and highly repeatable (Grandin, 2010). However, these recordings are labor-intensive and are therefore not recommended for continuous documentation of animal welfare at slaughterhouses. Furthermore, the five measurements can only be used at the slaughterhouse and not as documentation of the entire chain from farm to slaughter.

The development of tools for continuous automatic monitoring of animal welfare is therefore required. Furthermore, even though several measurements e.g. blood values, body temperature and meat quality traits seem highly relevant in the assessment of animal welfare on the day of slaughter (Becerril-Herrera et al., 2010; Correa et al., 2010, 2013; Hambrecht et al., 2004; Mota-Rojas et al., 2006, 2009, 2012) and have potential for automation and cost reduction, these have not yet been included in the proposed welfare schemes.

Animal welfare assessment necessitates the use of an explicit animal welfare definition, and we used the 12 criteria in the WQ® Protocol: absence of prolonged hunger, absence of prolonged thirst, comfort around resting, thermal comfort, ease of movement, absence of injuries, absence of disease, absence of pain induced by management procedures, expression of social behavior, expression of other behaviors, good human-animal relationship and positive emotional state (Welfare Quality®, 2009).

In order to facilitate the establishment of a welfare documentation system that covers as many elements of the day of slaughter as possible, our objective was to review the main elements, methods and measurements that have been used to quantify animal welfare on the day of slaughter. This review consists of eight sections covering the different stages to which pigs are exposed when destined for slaughter: the pick-up facility, loading, transport, unloading, lairage, race to the stunning chamber, stunning and sticking. The review includes potential stressors at the individual stage combined with both animal-based and resource-based potential ante- and post-mortem welfare measurements. These measurements are discussed with regard to their relevance and suitability in a documentation protocol for animal welfare on the day of slaughter followed by suggestions for possible measures with the potential for automatic recordings. The eight stages during the day of slaughter addressed in this review are summarized in the WQ® template in Table 1.

2. The pick-up facility

In Denmark, pigs are typically collected at on-farm pick-up facilities prior to arrival of the lorry. The pick-up facility is usually a separate housing unit leading directly to the loading ramp and may vary from one large outdoor pen without access to food or water to indoor pens with ad libitum access to water and the possibility of feeding. The pick-up facilities must comply with common practice such as ventilation, stocking density and floor surface. The pigs are moved from their home pen to a pick-up pen on the day before slaughter or in the morning before slaughter (Barton Gade, 2004). In this novel environment, the pigs are often mixed with unfamiliar pigs, tattooed on the hindquarters for identification and subjected to fasting. Pigs are often fasted before transport to the slaughterhouse to minimize the risk of carcass contamination by the contents of the gut (Barton Gade, 2004), and a fasting period of between five and 12 h prior to loading is recommended (Pig Research Center, 2013), which means that the pigs are seldom fed in the pick-up facilities. On farms that do not have specialized 'pick-up' facilities, pigs are tattooed and fasted in their home pens and are either loaded directly from these or are held in passageways approaching the loading facilities as the load is assembled. Mixing is also common in such circumstances. Even though several potential stressors can be listed for the pick-up facilities, studies on animal welfare at this point are sparse. In the WQ® protocol, the absence of prolonged hunger (more than 12 h) and thirst is complied with by the measurements "food provision" and "water supply" (Welfare Quality®, 2009). The suggested welfare compromises at this stage defined in the WQ® criteria are summarized in Table 1.

Even though it has not been directly investigated with regard to the pick-up facilities, it is generally known that mixing of unfamiliar pigs leads to increased aggression and thereby more skin damage compared with unmixed animals (Barton Gade, 2008). Agonistic behavior and aggression are displayed when forming the hierarchy in a new group, but they are also an important part of social behavior, for example when competing for resources (Deen, 2010). The fact that the pigs are fasted in the pick-up facilities could further aggravate aggression at this stage (Brown, Knowles, Edwards, & Warriss, 1999). Aggression leads to skin damage and other physiological stress reactions (Coutellier et al., 2007), which indicates that, even though aggression is a normal behavior in pigs, it is still stressful, especially repeated aggression among the lower ranking animals. Particularly, in groups of entire males increased mounting behavior is observed (Thomsen, Bonde, Kongsted, & Rousing, 2012). Repeated introduction into novel environments and repeated regrouping may also affect resting behavior. Behavioral recordings in the pick-up facilities might therefore include mounting, aggression and posture.

A recent study on the assessment of skin damage in pigs at specific stages from the day before slaughter until slaughtering shows that one of the main stages on the day of slaughter at which skin damage occurs in finishing pigs is in the pick-up facilities (Aaslyng, Brandt, Blaabjerg, & Støier, 2013). Skin damage can be assessed on both the live pig and the carcass, and three-, four- and five-point scales have been developed and documented (Aaslyng et al., 2013). It has been recommended to assess skin damage at the slaughter line 45 min post mortem, since damage is more easily seen on the carcass than on the live pig (Barton Gade, Warriss, Brown, & Lambooij, 1996). However, the assessment of skin