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Review article

Influence of loading handling and facilities on the subsequent response to pre-slaughter stress in pigs

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ABSTRACT

At all times prior to arrival at the slaughter plant, pigs may experience stress from a range of on-farm handling practices. The quality of the design of the loading facilities and of the handling procedures plays a key role in determining the effects of the farm on pig response to preslaughter stress, as it may contribute to improve to reduce the load time, the staff workload and stress in pigs. Poor handling management will impair pigs' movement during loading, leading to rougher handling and stressful experiences, and ultimately reduced welfare. Thus, this paper overviews the effects of on-farm handling management factors during loading that may influence the response of pigs to pre-slaughter stress. In addition, this paper provides recommendations on how to sort and move pigs to the loading dock and into the truck. Handling practices (tools, group size, use of shipping pens, mixing) and physical features of the barn, such as light and sound, and alley and exit design (length, width and shape) will be examined. The design of the loading dock will also be discussed, in regards to the ramp design (bedding, cleat spacing and angle) and its alternatives.

1. Introduction

Transportation of live pigs to slaughter is a common practice in pig production that still appears necessary. Based on the proportion of dead-on-arrival and non-ambulatory pigs (Ritter et al., 2009), and the behavioural and physiological response (heart rate, body temperature and blood parameters; Goumon et al., 2013a, 2013b; Correa et al., 2013, 2014), transportation, including loading and unloading can be considered the most stressful step of the pork production chain (Bench et al., 2008; Schwartzkopf-Genswein et al., 2012; McGlone et al., 2014). Many in-transit factors, e.g. space allowance, ambient conditions (temperature, humidity, vibrations and noise), travel duration, vehicle design and driving conditions, have been shown to affect pig welfare (Marchant-Forde and Marchant-Forde, 2009; Schwartzkopf-Genswein et al., 2012). However, the response of pigs to these factors may also be influenced by events occurring even before the truck leaves the farm.

Loading is considered the most critical stage of the transport period as showed by the increase in heart rate (up to 160 heart beats; Correa et al., 2013) and stress indicators (salivary cortisol and blood lactate) values compared to levels the observed for a pig at rest, with consequences on its overall reaction to preslaughter handling (Hamilton et al., 2004; Bertol et al., 2005; Ritter et al., 2009; Correa et al., 2010; Edwards et al., 2010; Goumon et al., 2013c). A clear example is the occurrence of the fatigued pig syndrome that results from the additive effect of loading and transport stress (Benjamin, 2005; Ritter et al., 2009; Faucitano, 2013). The stressfulness of the loading procedure results from the combination of different factors, such as group splitting in the finishing pen, distance moved from the pen to the load point, group size, mixing, handling system, design of the alleys, light and sound environments and, eventually, the design of the loading device (either ramp or quay). Moreover, the training of personnel in pig handling is of paramount importance at this stage. Fitzgerald et al. (2009) reported that the use of untrained loading crews resulted in 0.22% increase in the number of downers on arrival at the plant.

The effects of loading procedures are included in those of the farm of origin, which has been showed to be a major contributor for animal losses during transportation, general stress response and carcass and meat quality variation (Dalla Costa et al., 2007; Dewey et al., 2009; Fitzgerald et al., 2009). An epidemiological study run in Canada reporting 0.17% DOA and 0.27% non-ambulatory pigs on arrival at the plant identified the major source of animal losses variation as being the farm (25%) followed by the transporter and the packer (16% each; Dewey et al., 2009). The between farms variation in handling management and barn design/features at loading may be considered as the main source of variation, which may be explained by the lack of

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standardization or regulation of equipment and handling techniques (e.g. electric prod use and features; Benjamin, 2005).

The objective of this review is to provide a comprehensive and up to date overview of current research findings on handling procedures and equipment used to move pigs from their home pen to the loading area and to discuss them in relation to the pigs' response to preslaughter handling.

2. The path between the finishing pen and the loading dock

Based on heart rate and variation of salivary cortisol concentrations, sorting pigs in the fattening pen and moving them to the loading area are the first intense stress and physical efforts which animals are exposed to during the transportation process (Bradshaw et al., 1996a; Correa et al., 2013). The major factors triggering this physiological response are group splitting in the finishing pen, walking a distance through the farm alley and interaction with the handler through narrow and enclosed spaces.

2.1. Sorting pigs from the home pen

The initial departure from the finishing pen is stressful as it involves a close human-animal interaction and an alteration of the social environment through separation from the group (Geverink et al., 1998a) which is one of the factors that influences aggressive behaviour (O'Connell et al., 2005). Group splitting at loading is applied to handle small groups of pigs through the alleys up to the truck gate in both all-out and split marketing strategies. All-out marketing strategy consists of marketing pigs (100–130 kg) from a pen together. However, the application of this practice reduces space allowance for the heavier pigs near the end of the finishing stage, which may lead to increased aggressiveness, especially under restricted feeding conditions (Conte et al., 2012). This practice may also result in animal losses (dead-on-arrival and downers) during transport due to inadequate provision of space in the truck for pigs of different liveweights (Ritter et al., 2007). In contrast, the split-marketing strategy implies the removal of the heaviest 25–50% of pigs from a pen to market them 1–2 weeks earlier than the other pen-mates. This practice is very common at finishing farms in North America (Scroggs et al., 2002; Johnson et al., 2013) and in some European countries, such as France and Spain (Chevillon, 2005; A. Velarde, IRTA, personal communication). Its advantage is the reduction of production costs due to shorter finishing phase and the opportunity to ship batches with a more uniform market weight to the abattoir (Scroggs et al., 2002; Conte et al., 2012). Furthermore, the removal of the heaviest animals increases the feed efficiency and growth rate of pigs remaining in the pen due to increased floor and feeder space (Scroggs et al., 2002; DeDecker et al., 2005). However, this practice may also alter their social environment leading to fighting aiming at establishing a new social hierarchy (Scroggs et al., 2002; Conte et al., 2012).

Group splitting can be very stressful for pigs due to the close human-animal interaction and their separation from the group. Pre-sorting before loading may be seen as an alternative management practice to reduce stress of loading. When compared with groups of pigs split in the pen, Johnson et al. (2010) and Gesing et al. (2010) reported reduced physical signs of stress (open mouth breathing and skin discoloration) during loading in pigs pre-sorted from large pens (192 pigs/pen and 292 pigs/pen, respectively) prior to loading. While Gesing et al. (2010) did not observed any effect on the stress indicators or total losses at the plant, Johnson et al. (2010) found a 66% decrease in total losses on arrival at the abattoir in pre-sorted groups. However, it is unclear if this improvement is due to raising pigs in large pens and/or the management practice of pre-sorting market weight pigs prior to loading (Johnson et al., 2013). Raising pigs in large pens may allow them be more fit for handling and transport as they had more room to exercise during the grow-finish period and may reduce the number of unfamiliar pigs that are mixed during transportation (Johnson et al., 2013), resulting in fewer transport losses (Brumsted, 2004; Rademacher and Davies, 2005). Hayne et al. (2009) reported that when compared with small groups (16–18 pigs /pen), loading batches of pigs (4 pigs/batch) from large groups (250 pigs/pen) tended to take shorter time to climb the ramp (78.7 vs 52.6 s/batch).

2.2. Distance to the loading dock

In large swine units, animals are often imposed to walk long distances to get to the loading area. According to Ritter et al. (2008a), at US farms the average distance over which pigs are moved to reach the loading area is commonly greater than 100 m. This situation may result in muscle fatigue during loading and transportation as showed by the increased frequency of open-mouth breathing and skin discoloration (signs of acute stress) at loading at the farm and at unloading at the slaughter plant in pigs moved over a long distance (up to 91 m) compared with those moved over a short one (< 24 m) to reach the loading area (Ritter et al., 2007, 2008a). Similarly, greater post-loading lactate concentrations have been found in pigs moved over 46 vs. 15 m to the loading area (Edwards et al., 2011). Therefore, the distance to the loading area should be minimized as much as possible (Faucitano, 1998) by using, for example, shipping rooms that are usually located near the loading dock.

2.3. Shipping pen

After exiting the pen, it appears more beneficial to move pigs in a shipping pen (or pick-up pen) at least 4 h prior to loading. Besides being a recommended practice for biosecurity and feed withdrawal control (Chevillon, 2005; Carr, 2006; Faucitano et al., 2010; Brandt and Aaslyng, 2015), this procedure also improves animal welfare pre- and during transport. A 18 h wait in the shipping pen was reported to reduce the signs of stress (open-mouth breathing and skin discoloration) at loading (Gesing et al., 2010). Furthermore, Chevillon (2005) reported that sorting pigs preferably 7–8 h after the last meal and during the coolest hours of the day, and letting them recover for 2 h in the wait pen before the loading process occurs resulted in a more rapid heart rate return to basal values, a decreased transport mortality (−25%) and reduced time required to load 100 pigs (20 vs. 50 min). Nevertheless, these benefits can be only obtained if the shipping pen is ventilated and the pen size is adapted to the truck compartment size (no further sorting and mixing).

2.4. Mixing unfamiliar groups of pigs

Mixing pigs from different finishing pens at loading represents a major source of increased stress, injuries, carcass bruising and mortality (Bradshaw et al., 1996b; Warriss, 1996; Gosálvez et al., 2006; Aaslyng et al., 2013) due to fighting behaviour intended to establish a new hierarchy within the new group (Geverink et al., 1998a). Aggressiveness in mixed situation is increased in either fasted or unfasted pigs (Brown et al., 1999; Dalla Costa et al., 2016) and in entire males (Warriss and Brown, 1985; Thomsen et al., 2012). Mixing entire males with other males (castrated or not) prior to transport to slaughter was reported to increase aggression and mounting behaviour at the farm and lairage, leading to more body lesions (van Staaveren et al., 2015).

Split-marketing or the different size of shipping pens make mixing unfamiliar pigs a common and an unavoidable practice at this stage. In this situation, to limit the fighting rate, it is recommended to keep pigs in small shipping pens and adjust the stocking density according to the length of wait time before loading. In this respect, the European Scientific Committee on Animal Health and Animal Welfare recommends stocking densities ranging from 0.45 m^2/pig for < 30 min wait to 0.65 m^2/pig for periods longer than 3 h (SCAHAW, 2002). Weeks (2008) also reported a reduced fighting rate in mixed groups of pigs