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Loading gantry vs. traditional chute - Effect on fresh pork loin quality attributes with challenges at loading

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Abstract
A major factor affecting fresh pork quality is the implementation of management technologies that improve market swine movement during the loading process for transport to the packing plant. An experiment was conducted to evaluate the effect of loading system at the farm (traditional chute with no handling delay vs. prototype loading gantry with handling delay) on the fresh quality pork loin. Pork loins (n=95 per treatment) from the close out (CO; defined as pigs harvested from the last marketing group from a barn) were utilised. Loins from pigs loaded with the traditional chute with no handling delay had greater (P=0.01) pH upon initiation of chilling, but lower (P=0.03) 24h pH than loins from pigs loaded with the prototype with a handling delay. The Japanese colour score (JCS) for the cut surface and for rib values were higher (P=0.02) for loins from pigs loaded with the traditional chute with no handling delay. These observations were consistent with lower L* values for loins from pigs loaded with the traditional chute with no handling delay (P=0.01) and had improved (85 to 76%) colour pass rate compared to loins from pigs loaded with the prototype loading gantry with a handling delay. This investigation demonstrates that unidirectional flow and consistent rate of movement are important in the optimisation of pork quality, even when using what most would consider an ideal loading gantry system.

Disciplines
Agriculture | Animal Sciences | Large or Food Animal and Equine Medicine | Meat Science

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ABSTRACT:

A major factor affecting **fresh pork quality** is the implementation of management technologies that improve market swine movement during the **loading** process for transport to the packing plant. An experiment was conducted to evaluate the **effect of loading** system at the farm (**traditional chute** with no handling delay vs. prototype **loading gantry** with handling delay) on the **fresh quality pork loin. Pork loins** (n=95 per treatment) from the close out (CO; defined as pigs harvested from the last marketing group from a barn) were utilised. **Loins** from pigs **loaded with the traditional chute** with no handling delay had greater (P=0.01) pH upon initiation of chilling, but lower (P=0.03) 24h pH than **loins** from pigs **loaded** with the prototype with a handling delay. The Japanese colour score (JCS) for the cut surface and for rib values were higher (P=0.02) for **loins** from pigs **loaded with the traditional chute** with no handling delay. These observations were consistent with lower L* values for **loins** from pigs **loaded with the traditional chute** with no handling delay (P=0.01) and had improved (85 to 76%) colour pass rate compared to **loins** from pigs **loaded** with the prototype **loading gantry** with a handling delay. This investigation demonstrates that unidirectional flow and consistent rate of movement are important in the optimisation of **pork quality,** even when using what most would consider an ideal **loading gantry** system.

FULL TEXT:

The swine industry strives to provide safe, high **quality** and nutritious **pork** products to the consumer. A major factor affecting **fresh pork quality attributes** is pig handling at marketing (defined as the movement from the grow-finish environment to stunning at the abattoir; Hill et al., 2007; Ritter et al., 2009). Improved handling of pigs at marketing is necessary to reduce expenses, mortalities and to avoid loss in **pork quality** due to unnecessary stress experienced by the market pig, and to avoid animal welfare concerns. The goal of any handling and **loading** system should be to provide a continuous, unidirectional pig flow throughout the entire **loading** process. Marketing for the finisher pig has been described as a succession of "additive stressors" (Hyun et al., 1998) that include handling during the sorting and **loading**

process onto transport trucks (Hamilton et al., 2004; Bertol et al., 2005), stocking density on truck (Rademacher and Davies, 2005) and other pre-slaughter stressors such as noise, novelty and close interaction with humans (Hambrecht et al., 2004a,b). It has also been recognised that **loading** is a stressful event for pigs due to the physical exertion, noise, and close contact with humans (Geverinket al., 1996) and recently, Berry et al. (2010) described a prototype **loading** system designed to reduce stress and the subsequent impact on **pork quality.**

Therefore, the objective of this study was to evaluate the on-farm **loading** system **effects;** a **traditional chute** with no handling delay vs. prototype **loading gantry** with a handling delay on **fresh pork loin quality attributes**.

Materials and methods

- Animals, farm site and pig handling

The protocol for this experiment was approved by the Iowa State University Institutional Animal Care and Use Committee. Finisher pigs (barrows and gilts; 114.9 ± 4.8kg) which were the progeny of PIC (Hendersonville, TN) sires and Genetiporc (Alexandria, MN) females were used. The experiment utilised pigs from one wean-to-finish growing facility and pigs were raised in mixed sex pens (approx. 24 pigs per pen). Each barn was environmentally controlled, utilising a tunnel ventilation system with non-insulated curtains for emergency ventilation. Flooring was fully slatted and manure was collected in deep pits below and mechanically removed. Pigs were provided ad libitum access to corn-soybean meal diets that met or exceeded National Research Council (NRC) requirements for pigs at the wean-to-finish production phase (NRC, 1998). Pigs had ad libitum access to water through a stationary nipple drinker system. Sort boards were used to move five pigs at a time from the home pen to the transport trailer. A single, five person **loading** crew was responsible for **loading** all pigs.

- **Loading** system design

Two **loading** system design treatments were compared.

Traditional chute: The metal covered **chute** was 76.2cm in width, 2.3m in height and 4.6m in length, and used square stock (2.5cm) metal cleats which were spaced 20.3cm apart. The **traditional chute** included a flat pivot section on each end to accommodate the angle that the trailers were positioned relative to the finishing facility. The slope of the **chute** used to load the pigs onto the trailer was approximately 19 degrees to the bottom deck. The trailer included an internal ramp raised 23 degrees for access to the upper deck. One incandescent lamp fixture (60W) was placed at the entrance to the **traditional chute**. Prototype **loading gantry**: The **loading gantry** was constructed of an aluminium covered **chute** and measured 91.4cm in width, 3.1m in height and 9m in overall length, including a 7.9m sloped section and two dual pivoting extension systems that allowed for proper positioning to both the barn and trailer. A cushioned bumper dock system was incorporated into the **loading gantry** design to completely eliminate gaps from the barn to the **loading gantry**. The flooring material consisted of metal coated with epoxy (designed to mimic the feel of concrete on the pigs feet) and had an inverted stair step design with cleats 2.5cm in height and spaced 20.3cm apart. The **gantry** slope was approximately 7 degrees to the bottom deck and 18 degrees to the upper deck of the trailer. The prototype **loading gantry** utilised an industrial rope lighting system designed to provide a soft, continuous light source that minimised shadowing (Berry et al., 2010).

- Truck and transportation

After **loading** was complete, pigs were transported over 88.5km to a commercial harvest facility. All animal transport procedures including stocking densities, trailer boarding and bedding requirements complied with the Transport **Quality** Assurance Program(TM) (NPB, 2007). The trailer was 16.5m in length had two straight naturally ventilated decks and flooring was diamond plate (Wilson Livestock Trailers, Sioux City, IA).

- Treatment

Close out was defined as the last group of pigs marketed from a finishing facility (average weight per pig; 114.9 ± 4.8kg). These pigs were fed ractopamine hydrochloride (trade name: Paylean®; Elanco Animal Health, Greenfield, IN) per label directions. A total of 190 **pork loins** were collected in February 2007 from pigs **loaded** with the **traditional chute** with no handling delay at **loading** (n=95 **loins**) and the prototype **loading gantry** where pigs experienced a 10min handling delay at **loading** (n=95 **loins**). The delay in **loading** for the prototype **loading gantry** was defined as follows. To fill one deck of the trailer with pigs took approximately 16 groups (group defined as 5 pigs per group; 16 x 5=80 pigs/deck/trailer). The sixth group of pigs stopped half way up the **loading gantry** and refused to continue their unidirectional flow onto the trailer. Approximately 10 pigs that had already been **loaded** onto the trailer began coming back into the **loading gantry** off from the trailer. In addition, the seventh group of pigs began **loading** onto the **gantry** from the barn. This resulted in approximately 20 pigs piling half way up the **loading gantry**. It took three **loading** crew personnel 10min to sort and load all of these pigs onto the trailer.

- Processing

Pigs were harvested at a commercial facility on a single processing day. Pigs were held in lairage for approximately 4h and food was withheld; however, pigs had continual access to water. A CO2 anesthetising system was used to render the pigs unconscious. The carcasses were held in a blast-chiller for a period of approximately 120min at -26°C (Huff-Lonergan and Page, 2000). Following the blast-chill, carcasses were held in a conventional cooler (2.2°C) until fabrication.

- **Fresh pork quality attributes**

All were measured on the left side of the carcass (Gardner et al., 2006). The pH upon initiation of chilling (35min postmortem) was measured at the 10th rib of the left side of the longissimus dorsi (LD) from each carcass prior to entering the blast chill chamber. A 24h pH was evaluated on the LD and at the same location on the carcass. Both measures were collected using a Hanna 9025 pH / ORP meter (Hanna Instruments, Woonsocket, RI), which was calibrated at the expected carcass temperatures. The carcasses remained in the cooler until 24h postmortem, after which time they were fabricated. Colour measurements (L* values) were measured on a LD cross-section at the last rib using a Minolta CR-400 Chroma Meter (Minolta Camera Co., Ltd., Japan; illuminant C and 20° standard observer). An expert grader assigned colour scores using the Japanese colour scores (JCS) system consisting of six plastic discs that ranged from scores of 1 to 6 (1=pale grey, 6=dark purple; Nakai et al., 1975). The JCS scores were assigned for the outer surface lean (JCS cut values) of the LD and from the cross-section of the LD at the last rib (JCS rib values).

- Statistical analysis

The experimental unit was the **pork loin** and a complete randomised experimental design was utilised. The statistical model included the parameter of interest (pH upon initiation of chilling, 24h pH, JCS cut score, JCS rib score and **loin** L*), treatment (**traditional chute** with no handling delay or prototype **loading gantry** with a 10min handling delay at **loading**) and gender (barrow or gilt). Data were analysed using the Proc Mixed of SAS® (SAS Inst., Cary, NC). There were no main **effects** of gender or treatment by gender interaction and subsequently these were removed from the final model. A P-value of P 0.05 was considered significant.

Results

Loins from pigs **loaded** with the **traditional chute** with no handling delay had greater (P=0.01) pH upon initiation of chilling, but lower (P=0.03) 24h pH compared to **loins** from pigs **loaded** with the prototype **loading gantry** with a handling delay (Fig. 1). Japanese cut (JCS) and JCS rib values were greater (P=0.02) for **loins** from pigs **loaded** with the **traditional chute** with no handling delay. These observations were consistent with lower L* values for **loins** from pigs **loaded** with the **traditional chute** with no handling delay (P=0.01). **Loins** from pigs **loaded** with the **traditional chute** with no handling delay tended to have improved (85 vs. 76 %) colour pass rate compared to **loins** from pigs that were **loaded** using the prototype system with a 10min **loading** delay (Tab. 1).

Discussion

It has been reported by Gonyou (1993) that pig movement is accomplished by making the target location, or route to it, more attractive than the starting location. Pigs are motivated by many factors including natural curiosity, odours, sounds, food and fear (McGlone et al., 2004). In most commercial settings in the Midwestern U.S., pigs are placed in finishing buildings at weaning, have little to no direct contact with humans and do not leave their pen until they are marketed. Because of the lack of human interaction, these pigs may be easily excitable and more difficult to move during **loading** (Abbott et al., 1997; Geverink et al., 1998). Even though the **traditional chute** used in this study was in accordance with industry recommendations, from the pig's perspective this design creates a multitude of challenges. For example pigs being unable to walk with a co-specific at **loading**, a wind tunnel **effect** and a steeper incline. Due to time and personnel constraints, rarely is the pig allowed to slowly and cautiously proceed through this obstacle course of angles, distractions and balk points at its natural pace. Instead, the caretaker may be forced to use aggressive negative motivators to move the animals. In addition, pigs that become wedged in the aisle or on the **loading** ramp are more susceptible to become non-ambulatory (Anderson et al., 2002) and may experience more bruising and poorer **pork quality attributes** (Lewis and McGlone, 2007). It is well understood that perimortem stress can influence postmortem muscle metabolism and the rate and extent of pH decline (Grandin, 1997). Rapid pH decline can result in protein denaturation and an increased incidence of poor **quality pork** (Barbut et al., 2008). How individual pigs cope with aversive stressors has been shown to affect the **pork quality** (Grandin, 1997) and in turn profitability. Problems with colour (two-toning, dark, firm and dry), bruising, and pale, soft and exudative (PSE) meat has been estimated to cost the U.S. swine industry over $250 million or $2.44 per market pig harvested per year (Stetzer and McKeith, 2003).

Berry et al. (2010) compared these two **loading** systems for first pull and close out pigs when **loaded** correctly following the farms standard operating procedure (unidirectional flow and constant rate). The authors reported that despite the rigors of extra handling during sorting from the pen during first pull, **loins** from pigs **loaded** using the prototype **loading gantry** had fewer **pork quality** defects than **loins** from pigs **loaded** with the **traditional** system. However, in this study, finisher pigs **loaded** using a prototype **loading gantry** designed with pig movement and optimal **loading** in mind, experienced a challenge at **loading** and were not **loaded** to the specifications of the standard operating procedure. This was the first time that a delay had occurred on this prototype **loading gantry** and the **loading** crew took some time to place the pigs onto the truck. Furthermore, the pigs **loaded** using the prototype **loading gantry** appeared to experience an additional perimortem stress that in turn influenced the rate of pH decline (as evidenced by the lower pH at 35min postmortem) and this resulted in poorer **fresh pork loin quality attributes** compared to pigs **loaded** using the **traditional chute** with no handling delay. Good animal handlers that understand animal behaviour, production systems and their impact on **pork quality** can minimise the impact of poor design (Hill et al., 2007), however, the best facility design can be rendered inadequate by poor pig handling.

Conclusion

This investigation demonstrates that even with an advanced **loading** system, if finisher pigs are not **loaded** in a unidirectional flow at a consistent speed, that it can increase the incidence of poor **pork quality attributes** at harvest. Therefore, the combination of proper **loading** facility design combined with good pig handling is critical for optimal pig welfare during **loading**, caretaker safety and final **pork quality attributes** at the plant.

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GRAPHIC: Tab. 1: Subjective and objective **fresh pork loin quality attributes** means (± SEM) from a study evaluating two different **loading** systems when pigs are marketed
Fig. 1: Initiation of chilling and 24-h pH for 190 **fresh pork loins** when crossbred pigs were **loaded** during close out using a **traditional** metal covered **chute** with no handling delay **versus** a prototype **loading gantry** with a handling delay in February 2007.
Loading gantry vs. **traditional chute - Effect** on **fresh pork loin quality attributes** with challenges at **loading** - Gesamter Artikel

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