Loading gantry *vs.* traditional chute – Effect on fresh pork loin quality attributes when properly loaded

Keywords
- Finisher pig
- Loading system
- Loins
- Pork quality attributes

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A major factor affecting fresh pork quality is the implementation of management technologies that improve swine movement at the time of loading. Two experiments were conducted to evaluate the effects of the loading system at the farm (traditional chute T *vs.*prototype loading gantry P) on the quality attributes of fresh pork loins. Two marketing groups were utilised. Experiment 1 used 100 pig loins per treatment, when pigs came from the first pull (FP; defined as pigs harvested from the first marketing group of a barn), while Experiment 2 used 120 pig loins per treatment from pigs marketed from the close out (CO; defined as pigs harvested from the last marketing group from a barn). Loins from FP pigs loaded with the P loading gantry had higher ($P < 0.05$) pH upon initiation of chilling and 24 h pH and tended ($P = 0.08$) to have higher Japanese colour score (JCS) values. These observations were consistent with lower L* values in loins from pigs loaded with P loading gantry ($P = 0.03$). Loins from CO pigs loaded with the P loading gantry had higher ($P = 0.01$) pH upon initiation of chilling and JCS rib values. Loins from pigs loaded on the P loading gantry tended to have lower ($P = 0.06$) L* values. In conclusion, this investigation demonstrates that loading systems that reduce the incidence of poor pork quality attributes can be designed.

The U.S. swine industry strives to provide safe, wholesome, and nutritious pork products to the consumer. A major factor that can affect fresh pork quality attributes is the handling of the pigs at marketing (defined as the movement from the grow-finish environment to stunning at the abattoir; HILL et al., 2007). Improvement in the 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. The goal of any handling and loading system should be to provide a continuous, unidirectional pig flow throughout the entire marketing process. The marketing process for the finisher pig has been described as a succession of „additive stressors" (HYUN et al., 1998; RITTER et al., 2009) that can include handling (HAMILTON et al., 2004; BERTOL et al., 2005), stocking density (RADEMACHER and DAVIES, 2005) and pre-slaughter stress (HAMBRECHT et al., 2004a, b) which in turn may detrimentally affect pork quality. It has also been recognised that loading is a stressful event for the individual pig due to the physical exertion, noise, and the effects of close contact with humans (GEVERINK et al., 1996). Unfortunately, there is little information available to link on farm loading system design features and fresh pork loin quality. Therefore, the objective of this study was to evaluate the effects of the loading system at the farm (traditional chute T *vs.* prototype loading gantry P) on the quality attributes of fresh pork loin.

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) which were the progeny of PIC (Hendersonville, TN) sires and Genetiporc (Alexandria, MN) females were used. The farm utilised 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 double pleated non-insulated curtains for emergency ventilation. Flooring was fully slatted and manure was collected in pits below and mechanically removed. Pigs were provided *ad libitum* access to corn-soybean meal diets that met National Research Council (NRC) requirements for pigs at each phase of the wean-to-finish production cycle (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 loadout crew consisting of five persons was responsible for loading all pigs.

▸ Loading system design

Two loading system design treatments were compared. **Traditional metal covered chute (T):** The chute was 76.2 cm in width, 2.3 m in height, and 4.6 m in length, and used square stock (2.5 cm) metal cleats which were spaced 20.3 cm apart. The T 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

Fig. 1: Traditional metal covered chute (T). The chute was 76.2 cm in width, 2.3 m in height, and 4.6 m in length, and used square stock (2.5 cm) metal cleats which were spaced 20.3 cm apart.

Received: 12 August 2009 | reviewed: 31 August 2009 | accepted: 14 October 2009

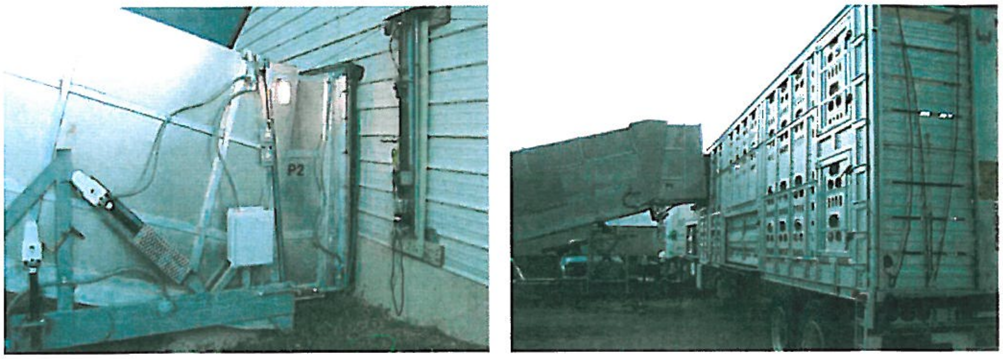

Fig. 2: Prototype loading gantry (P): The loading gantry was constructed of an aluminum covered chute and measured 91.4 cm in width, 3.1 m in height, and 9 m in overall length, including a 7.9 m sloped section and two dual pivoting extension systems that allowed for proper positioning to both the barn (left) and trailer (right).

degrees to the bottom deck. The trailer included an internal ramp raised 23 degrees for access to the upper deck. One incandescent lamp fixture (60 W) was placed at the entrance to the T chute. **Prototype loading gantry (P):** The loading gantry was constructed of an aluminium covered chute and measured 91.4 cm in width, 3.1 m in height, and 9 m in overall length, including a 7.9 m 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 2.5 cm in height and spaced 20.3 cm apart. The gantry slope was approximately 7 degrees to the bottom deck and 18 degrees to the upper deck of the trailer. The P loading gantry utilised an industrial rope lighting system designed to provide a soft, continuous light source that minimized shadowing.

▶ Truck and transportation

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

Tab.: Subjective and objective fresh pork loin quality attributes means and standard errors from a study evaluating two different loading systems when pigs are marketed

	Chute Type		
Item	T	P	P-value
Experiment 1 – First pull			
No. of loins	100	100	
JCS cut values	3.1 ± 0.04	3.2 ± 0.04	0.08
JCS rib values	3.3 ± 0.05	3.2 ± 0.05	0.20
Loin L*	46.72 ± 0.31	45.74 ± 0.31	0.03
Experiment 2 – Closeout pull			
No. of loins	120	120	
JCS cut values	3.1 ± 0.04	3.2 ± 0.04	0.10
JCS rib values	3.1 ± 0.04	3.3 ± 0.04	0.01
Loin L*	46.78 ± 0.38	45.76 ± 0.38	0.06

Source: Berry et al   Fleischwirtschaft International 1/2010

▶ Experiment one – first pull (FP)

First pull refers to the first group of pigs marketed from a finishing acility (average weight per pig; 111.7 ± 1.9 kg).These pigs were not fed ractopamine hydrochloride (trade name: Paylean®; Elanco Animal Health, Greenfield, IN) prior to harvest. A total of 200 pork loins were collected in January 2007 from pigs loaded with the T (n = 100) or the P loading system (n = 100) over two loads (both treatments represented on each load).

▶ Experiment two – closeout pull (CO)

Close out was defined as the last group of pigs marketed from a finishing facility (average weight per pig; 131.5 ± 1.7 kg). These pigs were fed ractopamine hydrochloride (trade name: Paylean®; Elanco Animal Health, Greenfield, IN). A total of 240 pork loins were collected in February 2007 from pigs loaded with either the T (n = 120) or the P loading system (n = 120) over two loads (both treatments represented on each load).

▶ Processing

Pigs were harvested at a commercial facility on two processing days (day one = 200 FP pigs, day two = 240 CO pigs). Both treatments were presented on each harvest date. Pigs were held in lairage for 4 h, and food was withheld; however, pigs had continual access to water. A CO_2 anesthetising system was used to render the pigs unconscious. The carcasses were held in a blast-chiller for a period of approximately 120 min at –26 °C (Huff-Lonergan and Page, 2000). Following the blast-chill, carcasses were held in a conventional cooler (2.2 °C) until fabrication 24 h postmortem.

▶ Fresh pork quality attributes

All measures were collected on the left side of the pig's carcass (Gardner et al., 2006). The pH upon initiation of chilling (approx. 35 min postmortem) was measured at the 10th rib of the same *longissimus dorsi* (LD) of each carcass prior to entering the blast chill chamber. A 24 h 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 24 h postmortem, after which time they were fabricated. Colour measurements (L* values) were measured on a cross-section of the LD 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). 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 in-

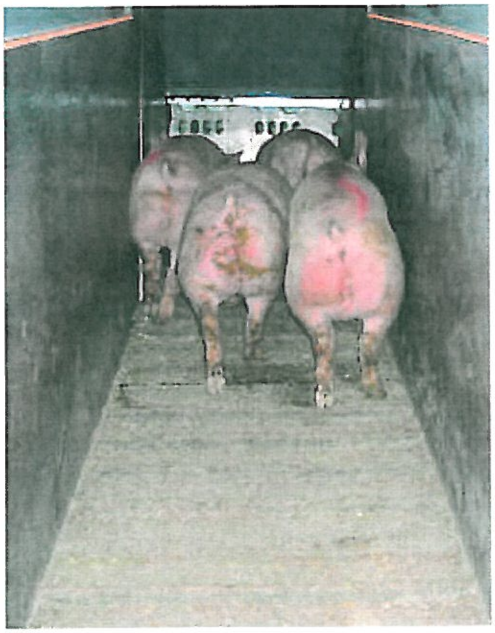

Fig. 3: Finisher pigs loading using the prototype loading gantry.

cluded the parameter of interest (pH upon initiation of chilling, 24 h pH, JCS cut score, JCS rib score and loin L*), treatment (traditional – T or prototype – P) and gender (barrow or gilt). Data were analysed using the Proc Mixed of SAS®(SAS Inst., Cary, NC). Harvest date was a covariate (two harvesting dates with both P and T represented on both dates). 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 and discussion

▶ Experiment one – first pull

There were no treatment differences detected for JCS rib values ($P=0.20$; Tab.). Loins from pigs loaded with the P loading gantry had higher ($P<0.05$; Fig. 4) pH upon initiation of chilling and 24 h pH and tended ($P=0.08$) to have higher JCS cut values. These observations were consistent with lower ($P=0.03$) L* values observed in loins from pigs loaded with the P loading gantry (Tab.).

▶ Experiment two – closeout pull

Treatment did not significantly affect pH upon initiation of chilling (Fig. 5) and JCS cut values ($P>0.05$; Tab.). Loins from pigs loaded with the P loading gantry had greater ($P=0.01$) 24 h pH (Fig. 2) and JCS rib values. Pigs loaded on the P loading gantry tended to have lower ($P=0.06$) Loin L* values (Tab.).

It is well understood that perimortem stress can influence postmortem muscle metabolism and the rate and extent of pH decline. Rapid pH decline can result in protein denaturation and an increase incidence of poor quality pork (BARBUT et al., 2008). How individual pigs cope with aversive stressors has been shown to affect the quality of pork (GRANDIN, 1997) and in turn the profitability. Problems with colour (two-toning, dark, firm, and dry), bruising as well as pale, soft and exudative (PSE) meat has been estimated to cost the U.S. swine industry $254,104,500 or $2.44 per finisher head per year (STETZERand MCKEITH, 2003). GRANDIN (1999) reported approximately 10% more pork would be suitable for high quality exports to Japan if pigs were handled quietly. Pigs marketed at first pull can be subjected to additional handling stress when removed from their home pen environment, due to the sorting process in their home pen. In contrast, pigs marketed at close out are all removed from their home pen at once with no differential selection, potentially eliminating the stress due to sorting market ready pigs from the pen. In this study, despite the rigors of extra handling during sorting from the pen during first pull, loins from pigs loaded using the P loading gantry had fewer pork quality defects than loins from pigs in the T system. In addition, loins from pigs loaded with the P loading gantry on both experiments had improved 24 h pH and overall colour attributes than loins from pigs loaded with the T system.

Conclusion

This investigation demonstrates that loading systems that reduce the incidence of poor pork quality attributes can be designed.

Acknowledgements

This work was supported by the Pork Checkoff, National Pork Board, USA and by Hatch Funds through the Department of Animal Science, Iowa State University

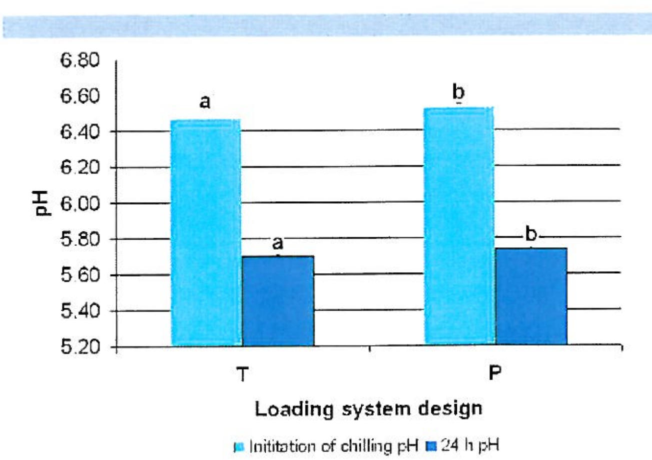

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Fig. 4: Initiation of chilling and 24 h pH for 200 fresh pork loins when crossbred pigs were loaded during the first pull (FP) using a traditional metal covered chute (T) versus a prototype loading gantry (P) in January 2007. Superscripts (a, b) indicate a difference between initiation of chilling and 24-h pH between loading system design. P values were different at $P<0.05$.

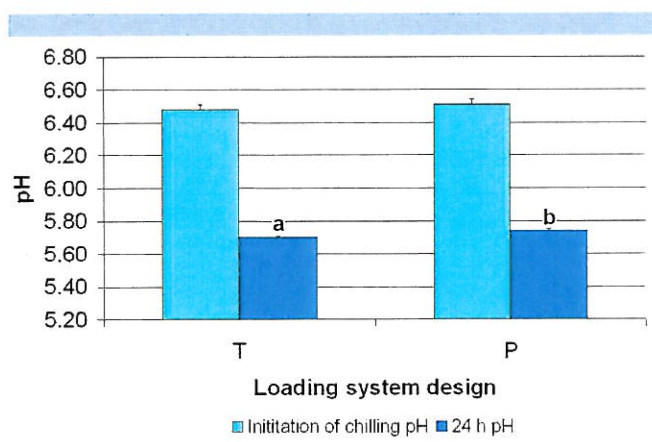

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Fig. 5: Initiation of chilling and 24 h pH for 240 fresh pork loins when crossbred pigs were loaded during the close out (CO) using a traditional metal covered chute (T) versus a prototype loading gantry (P) in February 2007. Superscripts (a, b) indicate a difference between 24 h pH between loading system design. P values were different at $P=0.01$.

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