Loading Gantry Versus Traditional Chute for the Finisher Pig: Effect on Fresh Pork Quality Attributes at Close Out

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Summary and Implications

Pig mortalities from the farm to the harvest facility have been estimated to cost the U.S. swine industry over 55 million dollars annually. Improved understanding of the major factors impacting the behavioral and physiological responses of the finisher pig during transportation and its effects on final meat quality is needed. Fresh pork loin quality attribute evaluations were performed over two experiments. ***Experiment one – closeout pull (no-piling):*** (n = 2 loads, average number of pigs load = 172, average weight / head = 131.5 ± 1.7 kg) included the comparison of two loading systems on the last pigs marketed (closeout [CO] pigs) from a finishing facility. ***Experiment two – closeout pull (piling):*** (n = 2 loads, average number of pigs / load = 172, average weight / head = 114.9 ± 4.8 kg) included the comparison of two loading systems on the last pigs marketed (closeout [CO] pigs) from a finishing facility that experienced a 10 minute delay due to piling on the P loading system. Two loading system designs were compared in the study. The first loading system design (**T**) was the production system's traditional metal covered chute. The second design (**P**) used was a prototype loading gantry constructed of an aluminum covered chute. After loading was complete, pigs were transported ~88.5 km to a commercial packing plant. Initial pH, 24-h pH, Japanese Color Score (JCS) cut, JCS rib, color pass rate and Loin L* were scored on each loin. ***Experiment one – closeout pull (no piling):*** Loins from pigs loaded with the P loading system had higher (P = 0.01) 24-h pH and JCS rib values. Pigs loaded on the P loading system tended to have lower (P = 0.06) L* values compared to the T pigs. Although not statistically different (P = 0.14), pigs loaded with the P loading system had 8 % more loins qualify for upper-end foreign markets as evidenced by the color pass rate values. ***Experiment two – closeout pull (piling):*** Loins from pigs loaded with the T loading system had higher (P = 0.01) initial pH, but lower (P = 0.03) 2 pH values. Pigs loaded on the T loading system also had higher (P = 0.02) JCS cut values and rib scores, and lower (P = 0.01) L* values, all indicative of a darker, redder meat. Although not statistically different (P = 0.07), pigs loaded with the T loading system had 7 % more loins qualify for upper-end foreign markets as evidenced by the color pass rate values. In conclusion, this investigation has provided data to support changes in facility/loading system design that may ultimately lead to the improvement of pork quality. Results indicate that pigs loaded on the P chute, under routine handling management, have superior meat quality attributes. However, differences in results in this investigation implicate when handling challenges arise these may in turn negate any advantages that the loading system provides.

Introduction

Animal "*movement is accomplished by making the target location, or route to it, more attractive than the starting location.*" Pigs are motivated by several factors including natural curiosity, odors, sounds, conspecifics, food, water and fear. Traditional handling and loading systems may have been either poorly planned or not planned in the design and construction of finishing facilities. Therefore, during handling and marketing opportunities the industry is forced to rely heavily on negative motivators or repulsive forces, most notably fear and pain, to move the animal. 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 at close out.

Materials and Methods

Experiment one – closeout pull (no-piling): (n = 2 loads, average number of pigs load = 172, average weight / head = 131.5 ± 1.7 kg) included the comparison of two loading systems on the last pigs marketed (closeout [CO] pigs) from a finishing facility. Fresh pork loin quality attribute evaluations were performed on a total of 240 (n = 120 per treatment) pigs. Meat quality evaluations were performed on a random sample of approximately two-thirds of the pigs per load. This level of sampling was based on the integrators standard operating procedures.

Experiment two – closeout pull (piling): (n = 2 loads, average number of pigs / load = 172, average weight / head = 114.9 ± 4.8 kg) included the comparison of two loading systems on the last pigs marketed (closeout [CO] pigs) from a finishing facility that experienced a 10 minute delay due to piling on the P loading system. Fresh pork loin quality attribute evaluations were performed on a total of 190 ((n = 95 per treatment) pigs.

Loading System Design: Two loading system designs were compared in the study. The first loading system design (**T**) was the production system's traditional metal covered chute. 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 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 watts) was placed at the entrance to the T chute. The second design (**P**) used was a prototype loading gantry constructed of an aluminum covered chute. The loading gantry was 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 allow 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 a 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 utilized 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 ~88.5 km to a commercial packing plant. All animal transport procedures complied with the Transport Quality Assurance Program™ (TQA™; NPB, 2007). All transport trailers were 16.5 m in length, double-deck straight trailers (Barrett Trailers LLC, Purcell, Oklahoma; Wilson Livestock Trailers, Sioux City, IA). All trailers utilized natural ventilation with punched sides and flooring was diamond plate.

Processing: Pigs were harvested at a commercial facility. Pigs were held in lairage for an average of 4-h, and food was withheld, however, pigs had continual access to water. A CO_2 anesthetizing system was used to render the pigs unconscious. The carcasses were held in a blast-chiller for a period of approximately 90 min. Blast-chilling requires an air temperature of – 20 to -40° C with an average air velocity of 10 to 16 f/s for 1 to 3 hours. Following the blast-chill, carcasses were held in a conventional cooler until fabrication 24 h postmortem.

Fresh Pork Quality Attributes: Initial pH (~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 same muscle 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. The 24 h pH, objective (CIE L*), and subjective Japanese Color Score (JCS cut and JCS rib) measurements were determined on the LD of the selected carcasses by personnel that were both trained and experienced in subjectively evaluating quality of pork carcasses. Objective color was determined using a Minolta CR-400 Chroma Meter (Minolta Camera Co., Ltd., Japan) with illuminant C and 20 standard observer. Color measurements (L* values) were measured on a cross-section of the LD at the last rib. Subjective color was evaluated using the JCS system consisting of six plastic discs that ranged from scores of 1 to 6 (1=pale grey, 6=dark purple). Japanese color scores were obtained from the outer surface (lean) of the LD and from the cross-section of the LD at the last rib. Color pass rate (defined as a loin that meets specified color requirements) was determined utilizing an internally-approved scale used for identification of loins that met specifications for high value domestic and international markets. All measures were collected on the left side of the pig's carcass. Methods for collection of meat quality attributes were developed.

Statistical Analysis: The experimental unit was the pork loin and a complete randomized experimental design was utilized. The statistical model included 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 analyzed 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 $P \leq 0.05$ was considered significant.

Results and Discussion

Experiment one – closeout pull (no piling): Loins from pigs loaded with the P loading system had higher ($P = 0.01$) 24-h pH and JCS rib values. Pigs loaded on the P loading system tended to have lower ($P = 0.06$) L* values compared to the T pigs. Although not statistically different ($P = 0.14$), pigs loaded with the P loading system had 8 % more loins qualify for upper-end foreign markets as evidenced by the color pass rate values (Table 1).

Table 1. Subjective and objective fresh pork loin quality attributes from a study evaluating two different loading systems when close out pigs are marketed and there was no piling.

	Chute Type		
Item	**T**	**P**	***P*-value**
No. of animals	120	120	
Initial pH	6.5 ± 0.03	6.5 ± 0.03	0.35
24 h pH	5.7 ± 0.01	5.7 ± 0.01	0.01
JCS cut	3.1 ± 0.04	3.2 ± 0.04	0.10
JCS rib	3.1 ± 0.04	3.3 ± 0.04	0.01
Color pass rate	77.9 ± 3.94	86.2 ± 3.96	0.14
Loin L*	46.8 ± 0.38	45.8 ± 0.38	0.06

Experiment two – closeout pull (piling): Loins from pigs loaded with the T loading system had higher ($P = 0.01$) initial pH, but lower ($P = 0.03$) 2 pH values. Pigs loaded on the T loading system also had higher ($P = 0.02$) JCS cut values and rib scores, and lower ($P = 0.01$) L* values, all indicative of a darker, redder meat. Although not statistically different ($P = 0.07$), pigs loaded with the T loading system had 7 % more loins qualify for upper-end foreign markets as evidenced by the color pass rate values (Table 2).

Table 2. Subjective and objective fresh pork loin quality attributes from a study evaluating two different loading systems when close out pigs are marketed and there was piling.

	Chute Type		
Item	**T**	**P**	***P*-value**
No. of animals	95	95	
Initial pH	6.6 ± 0.02	6.5 ± 0.02	0.01
24 h pH	5.7 ± 0.01	5.8 ± 0.01	0.03
JCS cut	3.2 ± 0.04	3.0 ± 0.04	0.02
JCS rib	3.3 ± 0.04	3.2 ± 0.04	0.02
Color pass rate	85.0 ± 3.61	75.8 ± 3.61	0.07
Loin L*	45.1 ± 0.34	46.4 ± 0.34	0.01

In conclusion, this investigation has provided data to support changes in facility/loading system design that may ultimately lead to the improvement of pork quality. Results indicate that pigs loaded on the P chute, under routine handling management, have superior meat quality attributes. However, differences in results in this investigation implicate when handling challenges arise these may in turn negate any advantages that the loading system provides.