Exposing pigs to a ramp and platform during the nursery period improves ease of loading at market weight

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Pigs exposed to a ramp and platform in their pen during the nursery period (3-9 weeks of age) required less time and fewer handler interventions to ascend a semi-trailer loading ramp when they reached market weight (5-6 months of age). Additionally, the presence of the ramp and platform within the pen had no negative effects on pig behavior or performance during the nursery and grow-finish phases of production. Therefore, early and limited exposure to a ramp and platform may be a reliable strategy for reducing novelty associated with loading ramps and improving the welfare of market-weight pigs during the loading phase of transportation.

Summary

Transportation is an essential component of commercial swine production in the United States. Stressors experienced during transportation, including loading and unloading, can result in poor welfare outcomes and economic losses. This study evaluated whether early life exposure to a ramp in the nursery pen (when pigs were approximately 3-9 weeks of age) improved pigs' ability to navigate the ramps required for loading and unloading when they reached market weight (approximately 5-6 months of age). A secondary study objective evaluated whether presence of the ramp in the nursery pen affected nursery behavior and growth performance during the nursery and grow-finish phases of production.

Experimental pigs (N = 540; 17-21 days of age) housed in 20 pens (27 pigs per pen) were assigned to one of two experimental treatments: 1) access to a ramp in the pen during the nursery phase (RAMP), or 2) a standard pen with no access to a ramp during the nursery phase (CONT) (Fig. 1). After the six-week nursery period (when pigs were approximately 9 weeks of age), ramps were removed from RAMP pens and all pigs were raised under standard conditions until marketing. Nursery behavior (posture, eating, drinking, aggression) and growth performance during the nursery and grow-finish phases were evaluated. No differences in nursery behavior or growth performance were observed ($P > 0.05$).

At marketing, pigs were loaded in groups of four pen mates onto a semi-trailer and unloaded in mixed treatment groups upon arrival at the processing facility. During loading, time to ascend the ramp to the trailer was quantified, along with the number of trips displayed by any animals and handler electric prod usage. Pigs in the RAMP treatment required less time to ascend the ramp compared to the CONT pigs ($P = 0.002$). An electric prod was used more frequently with CONT pigs compared to RAMP pigs ($P = 0.02$). During unloading, the total time required for pigs to descend the ramp, as well as the number of trips, turnarounds on the ramp and pigs descending the ramp backwards were quantified. Rattle paddle usage by the handler and the number of pigs dead upon arrival were also recorded. CONT pigs required a shorter time to descend the ramp compared to the RAMP pigs ($P = 0.03$). Additionally, a greater number of RAMP pigs descended the ramp backwards compared to CONT pigs ($P = 0.02$). No other treatment differences were observed. In conclusion, exposing pigs to a ramp during the nursery phase improves ease of loading at marketing and has no negative effect on nursery behavior and growth performance throughout the nursery and grow-finish phases.

Introduction

Modern commercial swine production in the United States relies heavily on pig transportation, with most pigs undergoing transportation at least twice during their lives. This is because of increased specialization in the swine industry that has resulted in the separation of the

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farrowing, wean-to-finish, and marketing phases to different, distinct production sites. Transportation, while essential for the industry, is a known stressor for pigs that can result in injured, non-ambulatory, or dead pigs upon arrival (DOA) to their destination. Approximately 1% of market-weight pigs are injured or lost every year due to transportation (Ritter et al., 2020), which accounts for annual economic losses of approximately $90 million (Ritter et al., 2020).

Stressors experienced by pigs during the transportation process extend beyond the actual act of moving pigs from one location to another via semi-trailer (Goumon and Faucitano, 2017). The act of loading and unloading can be a major source of stress, likely due to several factors including human handling and the pigs' lack of experience navigating ramps or chutes required for movement onto the semi-trailer. As a result, pigs may perceive the loading and unloading process to be a greater stressor than actual transportation (Rioja-Lang et al., 2019). Therefore, methods for reducing novelty and stress associated with the loading and unloading phases of transportation are needed.

One potential method for reducing stress caused by loading and unloading during the transport process is to modify the nursery housing system by adding a ramp and platform to individual nursery pens. Early exposure to the ramp during the nursery phase may allow the pigs to become familiar with ascending and descending ramps before loading onto a trailer later in life. Animals exposed to increased environmental complexity and stimuli during early life may be better equipped to cope with future challenges encountered in their daily lives (Crofton et al., 2015). While the effects of early life exposure to increased environmental complexity on the welfare of market pigs are largely unknown, previous preliminary work conducted at North Dakota State University suggested that the addition of ramps to nursery pig housing increases speed of loading at marketing and has no negative effects on pig growth (Novak et al., 2020).

The objective of this study was to determine if exposing pigs to a ramp and platform during the nursery phase of production (approximately 3-9 weeks of age) would affect ease of loading and unloading at the time of marketing (approximately 20-24 weeks of age). Additionally, we wanted to determine if the addition of a ramp and platform in the nursery pen would affect pig behavior during the nursery phase and pig growth throughout the nursery and grow-finish phases.

Materials and Methods

This study was carried out at South Dakota State University's wean-to-finish facility (Brookings, SD) from March to August 2022. At approximately 21 days of age, 540 weaned piglets were transported to the SDSU wean-to-finish facility. Upon arrival, pigs were placed in 20 pens (21 m^2) in groups of 27 pigs. Each pen had fully slatted concrete floors. One five-space dry feeder and two cup waterers were provided in each pen. Temperatures and ventilation in the facility were continuously adjusted automatically to maintain thermoneutral temperatures in the pens. Artificial lighting was provided in the facility between 8:00 AM and 7:00 PM.

Pigs were assigned to one of two experimental treatments: 1) access to a ramp in the pen during the nursery phase (RAMP; n = 10 pens; Fig. 1A) or 2) a standard pen with no access

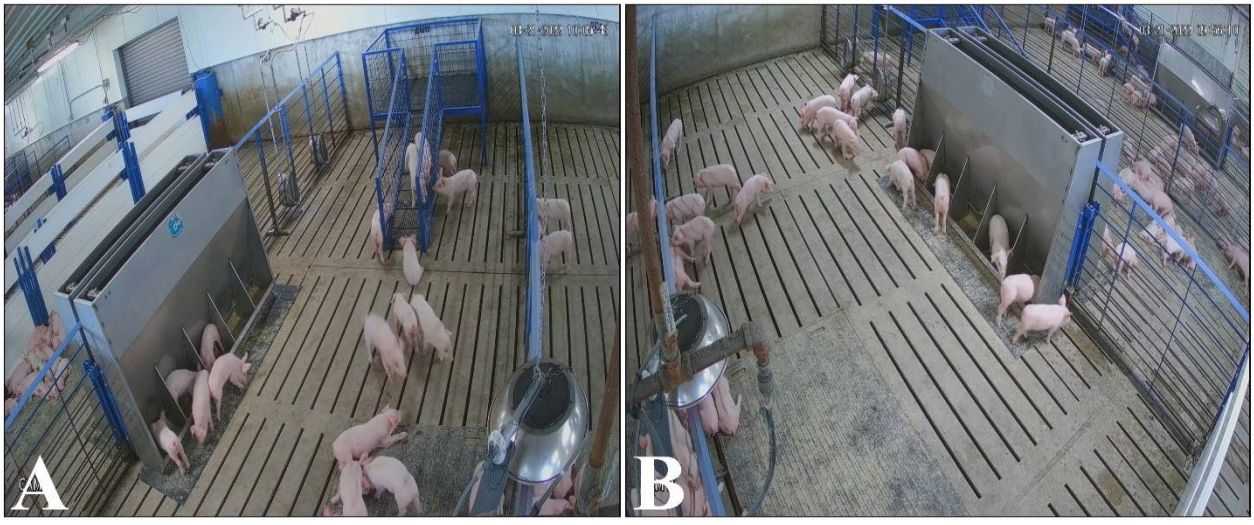

Figure 1. RAMP (A) and CONT (B) pens. The RAMP pen had a platform that pigs could access via a ramp during the nursery phase. The CONT pen had no platform and ramp during the nursery phase.

to a ramp during the nursery phase (CONT; n = 10 pens; Fig. 1B). Pigs in the RAMP treatment had access to a ramp (1.7 x 0.5 m, 20° angle) and resting platform (1.1 x 1.6 x 0.7 m) at the top of the ramp. Pigs in the CONT treatment were in a conventional pen without a ramp and platform. At the end of the nursery phase (i.e., on experimental day 40), the ramps were removed from the RAMP pens. All experimental pigs then remained in their conventional pen until they reached market weight at approximately 5.5 months of age.

Feed intake (FI) and body weight (BW) were determined on experimental days 0, 47 (post-nursery phase), and 135 (end of grow-finish phase) for calculation of average daily gain (ADG), average daily feed intake (ADFI), and feed to gain ratio (F:G). Eating, drinking, lying, standing, and aggressive behaviors were determined using video recordings collected on experimental days 1, 2, 3, 6, 19, 26, 33, and 39. On each of those days, observations were conducted for 60 min at 0800, 1200, and 1600 h using a five-minute instantaneous scan sampling method. At each scan sampling interval, the percentage of pigs in a pen performing the behaviors of interest was determined.

The loading process at marketing began on experimental day 138 and took place on six different transport days over a four-week period during August 2022. During each transportation day, four pigs from each pen (20 total groups each transport day; one group of four pigs from each pen) were loaded onto a standard pot-belly semi-truck trailer by the same experimental personnel. Each group of four pigs was required to ascend a covered load-out ramp (6.06 m long; 0.9 m wide, 11.1° incline angle). Two cameras collected the total time taken by each group of four pigs to navigate the load-out ramp. Additionally, the number of times an animal lost its footing (i.e., trips) and the frequency of electric prod usage were recorded. Data collection began when the front limbs of the first pig in the group stepped onto the ramp and ended when the hind limbs of the last pig in a group stepped onto the trailer. If the experimental handler was not able to move individual pigs or the group up the ramp during the initial 60-sec period of loading, an electric prod was applied to the stopped animal(s) by a second, non-handling experimental personnel, according to approved Transport Quality Assurance (TQA) guidelines (National Pork Board, 2022).

Once the last pig in each group stepped onto the trailer, the truck driver (same individual for all loading days) moved the group of four pigs into one of four upper-level trailer compartments or the lower-level compartment closest to the cab of the semi-truck, where they remained throughout the remainder of the transport process. Each compartment was large enough to hold 14-19 experimental pigs. Experimental treatments were not kept separate from one another within the compartments.

After loading, all experimental pigs were transported approximately 325 km to the processing facility. Upon arrival, pigs were unloaded in variable-sized mixed treatment groups (minimum group size = 1; maximum group size = 15) by facility employees, according to company guidelines. The floor of the trailer was the same as the height of the unloading floor in the facility so no ramp was required for pigs to exit the trailer. However, since the experimental pigs were housed in four upper-compartments in the trailer and one lower-level compartment (i.e., lower-level experimental pigs were required to ascend a ramp to the upper trailer level and then descend the ramp to exit the trailer and enter the facility), the total time taken by each pig to descend the main internal ramp (1.68 m long x 1.0 m wide; 20.8° angle) in the trailer from their transport compartment to the lower level of the trailer was quantified. One camera was mounted at the top of the trailer ramp facing the entrance of the processing facility, and another camera was mounted in the processing facility where the pigs walked off the trailer. Together, the two cameras allowed experimental personnel to calculate unloading time, the number of trips, turnaround attempts by individual pigs and the number of pigs that descended the ramp backwards. Additionally, the number of times a rattle paddle was used by a handler to encourage movement and the number of pigs DOA were collected.

Data were analyzed using the MIXED and GLIMMIX procedures in SAS (v. 9.4; SAS Institute, Inc., Cary, NC, USA). Pen served as the experimental unit for all behavioral and performance measures collected during the nursery and grow-finish phases, as well as time to ascend the ramp during semi-trailer loading. Individual pig served as the experimental unit for time to descend the ramp at unloading (since pigs were housed on the trailer and unloaded in mixed groups). A chi-square test was used with the FREQ procedure to determine whether differences in treatment occurred for the incidence of trips (loading and unloading), electric prod application (loading only), rattle paddle application (unloading only), turnarounds on the ramp (unloading only), pigs descending the ramp backwards (unloading only), and DOAs (unloading only). A *P*-value of less than 0.05 was used as the level of significance in all models.

Results

No differences between treatments were detected for eating (CONT: 2.30 ± 0.13 vs. RAMP 2.20 ± 0.13 %; $P = 0.48$), drinking (CONT: 0.48 ± 0.06 vs. RAMP 0.53 ± 0.07 %; $P = 0.52$), aggressive (CONT: 0.79 ± 0.12

vs. RAMP 0.79 ± 0.12 %; $P = 0.98$) or postural behaviors (lying: $P = 0.34$; standing: $P = 0.60$) during the nursey period.

No differences between treatments were detected for BW (58.9 vs. 59.5 ± 0.9 lbs; $P = 0.33$), ADFI (1.23 vs. 1.23 ± 0.02 lbs/d; $P = 0.91$), ADG (0.77 vs. 0.77 ± 0.02 lbs/d; $P = 0.97$), or F:G (1.66 vs. 1.58 ± 0.01; $P = 0.44$) on experimental day 47. Similarly, no differences between treatments were detected for BW (253.1 vs.251.8 ± 2.91.3 lbs; P = 0.95), ADFI (4.76 vs. 4.56 ± 0.09 lbs/d; $P = 0.16$), ADG (2.16 vs. 2.16 ± 0.04 lbs/d; $P = 0.77$), or F:G (2.18 vs. 2.10 ± 0.04; $P = 0.18$) on experimental day 135. Taken together, the presence of the ramp and platform in the nursery pen had no negative effect on pig behavior or performance during their respective measurement periods.

Pigs in the RAMP treatment exhibited a shorter time to ascend the loading ramp compared to CONT pigs ($P = 0.002$; Fig. 2). Additionally, RAMP pigs required fewer electric prod applications compared to CONT pigs (20 vs. 33 instances; $P = 0.02$). No treatment differences were observed for trips or turnarounds while ascending the ramp ($P > 0.05$). Time to ascend the ramp was affected by transport day (P = 0.004; data not shown), where time to ascend was greater on transport day 1 compared to transport days 3, 4, 5, and 6 (data not shown). Time to ascend the ramp was also greater on transport day 2 compared to transport day 6 (data not shown). The differences in time to ascend the ramp may be due to the experience of the experimental human handler as the experiment went on. However, we are not able to adequately determine the underlying cause of this result. No interaction between time to ascend the ramp and transport day was detected ($P > 0.05$).

CONT pigs descended the ramp slightly, but not meaningfully, faster than RAMP pigs (12.7 vs. 13.9 seconds; $P = 0.03$). Additionally, RAMP pigs descended the ramp backwards more often compared to CONT pigs (10 vs. 2 instances; $P = 0.02$). Our data do not provide a meaningful explanation for this behavior. However, descending the ramp backwards may be an attempt to avoid adverse situations (e.g., unfamiliar handlers) during unloading. The ability of an animal to successfully descend the ramp backwards may be beneficial for reducing ramp-related injuries. No differences in trips, turnaround, or rattle paddle application were detected between treatments during the unloading process ($P > 0.05$).

In conclusion, ramp and platform exposure during the nursery phase of production improves ease of loading at market weight, which is beneficial for the producer (i.e., faster loading) and the pig (i.e., reduced ramp novelty). Ramp exposure had no negative effects on behavior during the nursery period. Similarly, growth performance was not affected by ramp exposure during the nursery or grow-finish period. Future work on this topic should determine best practices for ramp design and exposure timing to improve practicality of application in a commercial system. Additionally, more work is needed to determine the effects of early life ramp exposure on physiological stress during the transportation process and meat quality at marketing.

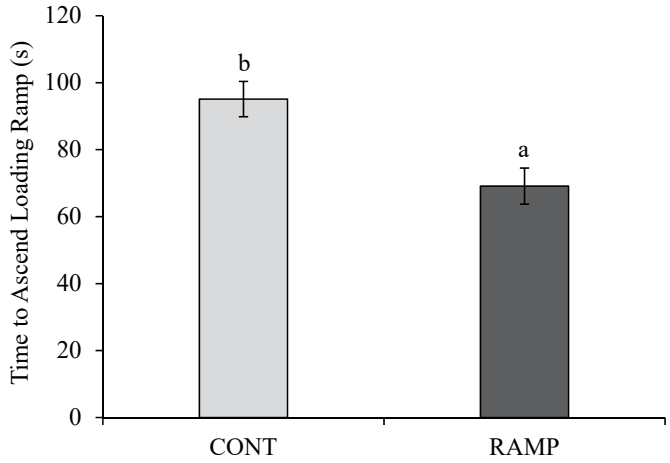

Figure 2. Time required for market-weight pigs to ascend a loading ramp to be transported for market according to experimental treatment. Different superscripts indicate significant differences ($P < 0.05$).

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