Use of Biologically-relevant Enrichment to Improve Nursery-aged Pig Weaning Transition

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Summary and Implications

The objective of this experiment was to evaluate the effect of a novel nutritional "*biscuit*" on weaned pig feeder aggression and performance. Eighty mixed-sex pigs, 19 to 24 days of age, were randomly allocated to 8 pens (10 pigs/pen). Pens were assigned 1 of 4 treatments: (1) biscuit with fecal semiochemical attractant, (2) biscuit with sugary attractant, (3) biscuit with no attractant (positive control), and (4) no biscuit (negative control). Each pen received 4 biscuits suspended from 2 ropes at the feeder for the first 7 days after weaning. Pig aggressive behavior at the feeder was recorded. Descriptive data including frequency (number) and duration (seconds) of aggressive interactions, average daily gain, average daily feed intake, and fecal score were evaluated. The negative control treatment had less feeder aggression than the enrichment treatments. On average, duration of aggression events around the feeder between all treatments was 1 second with the range from < 1 second to 21 seconds. During the first 4 days, the pens of pigs receiving the positive control treatment consumed the most feed when compared to other treatments. Overall, providing pigs the biscuit enrichment at the feeder did not result in increased pig removal due to aggressive interactions. Additionally, pens of pigs that were provided a biscuit enrichment with no attractant ate slightly more in the first few days following weaing. At a time where consumers are asking questions concerning the pig's quality of life and enriching their living environment, providing biscuit in the feeders within each pen of pigs may be a way to provide pigs an enhanced living environment.

Introduction

The time immediately after weaning is a stressful period in the pig's life. Weaning occurs when piglets are between 19 to 23 days of age on most U.S. commercial sow farms. This weaning age may provide some advantages to the pig, such as improved health and disease control, but pigs experience multiple stressors, such as dam separation, mixing with unfamiliar piglets, transportation, and abrupt transition from sow milk to solid feed. These stressors may result in a period of low feed intake immediately post-weaning. On average, pigs will not eat enough solid food to fulfill maintenance energy needs until 5 days post-weaning and may take up to 2 weeks to consume the same amount of energy as they consumed from their dam's milk immediately prior to weaning. Pigs that fail to recover from this growth lapse may experience increased morbidity and mortality. At weaning, pigs may also engage in aggressive behavior to establish their dominance hierarchy, which may result in stress and injury.

An interesting concept is how environmental enrichment (**EE**) might be utilized to support the newly weaned pigs' transition. Environmental enrichment is a modification to a captive animal's environment in an attempt to improve their welfare. Pigs are attracted to EE that are odorous, deformable, and chewable. Previous EE offered to nursery pigs has included straw, hanging and fixed rubber toys, and ropes. However, there is little documentation describing nutritional EE for the weaned pig. Nutritional enrichment involves presenting novel/and or varied food types and delivery methods. A nutritional enrichment "*biscuit*" may appeal to the pigs' oral-, nasal-, facial-nature, and may reduce aggressive interactions around the feeder and improve nursery performance. Therefore, the objective of this experiment was to evaluate the effect of a novel nutritional "*biscuit*" on weaned pig feeder aggression and performance.

Materials and Methods

All experimental procedures were approved by the Iowa State University Animal Care and Use Committee (IACUC#20-106).

Animals and housing

Eighty mixed-sex pigs (Camborough 1050 X 337, PIC), 19 to 24 days of age (~6 kg), were randomly allocated to 8 pens with 10 pigs/pen. Pigs were housed at the Iowa State University Swine Nutrition Farm. Each pen measured 2.4 m long x 1.2 m wide (~0.37 m^2/pig), and pen floors were made of slatted PVC that opened to a manure pit below the pens. Each pen was equipped with a 4-hole, dry self-feeder measuring 0.61 m long and 2 nipple drinkers to provide pigs with *ad libitum* access to feed and water. Nursery room temperature was set to 30.5˚ C when the pigs arrived, and this was decreased on a schedule by approximately 0.25˚ C daily for 7 days post weaning. Pigs were individually identified using a livestock-safe marking stick to aid in behavioral observations.

Experimental design and treatment

The pen was considered the experimental unit. Pens were assigned to 1 of 4 treatments: (1) biscuit with fecal semiochemical attractant (**SC**), (2) biscuit with sugary attractant (**JAM**), (3) biscuit with no attractant (positive control; **POS**), and (4) no biscuit (negative control; **NEG**). Each pen received 4 biscuits suspended from 2 ropes at the feeder for the first 7 days after weaning which will be referred to as "trial week" throughout the report. Treatments and enrichments were added to nursery pens at 1500 hours on Day 0 and at 1000 hours on Days 1 to 6.

Environmental enrichment device

Six ingredients were used to make the biscuit: dried whey powder, corn starch, soybean oil, flour, sugar, and water. Ingredients were combined into a dough and stamped into 4 cm diameter cutouts with a 1 cm hole in the middle. Biscuits were baked at 190˚ C until golden brown. All biscuits were utilized in the nursery pens within 24 hours after baking. Two biscuits were threaded onto a 3 stranded, 0.5 cm diameter plain cotton rope, and the 2 biscuits were positioned on top of a 1 cm diameter flat washer (Figure 1). Each enrichment device was tied to the pen bars and secured in place with duct tape, so that the rope hung over the feeder and the biscuit hung at pig eye-level (Figure 2).

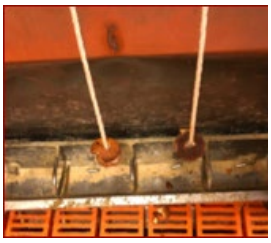

Figure 1. Enrichment device placement.

Figure 2. Nursery pig interacting with the environmental enrichment.

Behavioral data acquisition

Color video was continuously recorded in real time (30 fps) using cameras and a DVR Recorder. Cameras were mounted to the ceiling so that a single camera could capture images from 1 or 2 pens. The recording system was monitored daily to ensure proper video capture and view.

One observer (GM) was responsible for data collection. To control for potential bias, the observer was blinded to a variety of identifying factors on all video data, including treatment and pen number. Blinding procedures involved assigning a random number to each 1-hour video clip and presented to the observer in a randomized sequence. One researcher (ES) with 2 years of behavioral research experience was responsible for training the observer and served as the gold standard.

Inter-observer reliability was calculated using an index of concordance, as a proportion of all agreements (A) and disagreements (D) in behavioral occurrences between observer and trainer, with the formula (A / [A+D]) * 100 ≥ 85%. Once the observer reached ≥ 85% reliability agreement with the trainer, data collection began. Two randomly selected video clips were duplicated during data collection to confirm intra-observer reliability.

The observer used a pre-determined ethogram (Table 1) to quantify behavior outcomes.

Table 1. Ethogram for nursery pig feeder aggression.

Behavior	Description
Feeder aggression	Ramming, pushing, or head turns towards pen mate, with or without biting, that begins while at least 1 involved pig is interacting with or attempting to interact with the feeder or enrichment device.

Observations were performed on 2 pens/treatment using continuous sampling of all pigs in the pen for the first hour after EE placement on Days 0 to 6 (56 total hours, 7 hours/pen).

Performance information

All pigs were individually weighed on Day 0 and 7. Average daily gain (ADG) in kg, averaged between the 2 pens/treatment, will be presented for trial week. Feeders were weighed daily between Day 0 and 7, and pen level feed intake was calculated over trial week. Pen level feed intake was divided by the number of pigs in the pen and was presented as pig average daily feed intake (ADFI) in kg/day. Over Day 1 to 7, all pens were fecal scored using a 0 to 3 scale, where: score 0 = normal/solid, score 1 = semi-solid/soft, score 2 = semi-liquid, and score 3 = liquid/diarrhea. Morbidity and mortality data were collected, but no deaths or removals to the hospital pen occurred during the trial.

Data calculations

All data were recorded in Excel where the original data were used to make several calculations including averages and standard deviations for nursery pig feeder aggression

(frequency [number] and duration [seconds]), ADFI, and ADG. Aggression data were sorted by increasing number to find the range of aggressive interaction durations. Pen average fecal scores are presented descriptively as a way to evaluate gut health.

Results and Discussion

Average daily frequency of nursery pig aggressive interactions over trial week following biscuits placement was NEG: 18.4 ± 19.3, POS: 56.8 ± 29.5, JAM: 51.8 ± 27.4, and SC: 83.6 ± 61.1 (Fig. 3). Average duration for an aggressive interaction was 1 second per treatment, except for JAM pigs which was < 1 second. The range of aggressive interaction durations was NEG: < 1 second to 6 seconds, POS: < 1 second to 21 seconds, JAM: < 1 second to 11 seconds, and SC: < 1 second to 9 seconds.

There were very few aggressive feeder interactions on Day 0. The NEG pigs had the highest frequency of aggressive interactions on Day 0 compared to the 3 EE treatments. These findings agree with previous work where pigs weaned into less stimulating environments showed higher levels of aggression. Aggression peak occurred on Day 3, and we could hypothesize that this coincided with the nursery pigs' maximum interest in the biscuit.

In this proof-of-concept study, most feeder aggressive interactions seemed to be displayed by pigs assigned to SC, followed by pigs assigned to POS, JAM, and NEG treatments, respectively. This result was unexpected because previous work using fecal semiochemical reported a 30% reduction in aggression. However, the range and average duration a pig engaged in aggressive interaction were short, and we question if these aggressive displays around the feeder are biologically relevant, and in-turn negatively affected pig welfare. Although little to no aggression occurred in the NEG (no biscuit) treatment, we noted that aggression was occurring in other areas of the nursery pen. Therefore, we encourage future work to look at effects on overall aggression, around the feeder, EE device, and in other areas of the nursery pen. Another important consideration is the aggressive interaction type. In this study we did not delineate threat displays, but most aggressive interactions were recorded as head turns at a quick speed with little direct physical contact. Therefore, this biscuit enrichment did not detrimentally change nursery pig aggression around the feeder over the first 7 days after weaning.

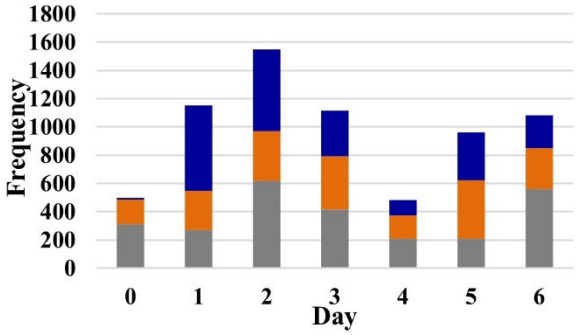

Figure 3. Nursery pig average frequency of aggressive interactions in the first hour that a nutritional biscuit enrichment was placed into the pen from day of placement (Day 0) to Day 6.

Average ADFI by treatment over trial week was NEG: 0.17 ± 0.10, POS: 0.19 ± 0.11, JAM: 0.17 ± 0.09, and SC: 0.16 ± 0.09 kg/week. ADFI was lowest on Day 0, and increased slightly daily, peaking on Day 6 (Fig. 4). Average ADG (kg) by treatment over the trial week was NEG: 0.47 ± 0.02, POS: 0.45 ± 0.02, JAM: 0.45 ± 0.01, SC: 0.40 ± 0.03. The average fecal score was 2 (semi-liquid) for all pens and treatments.

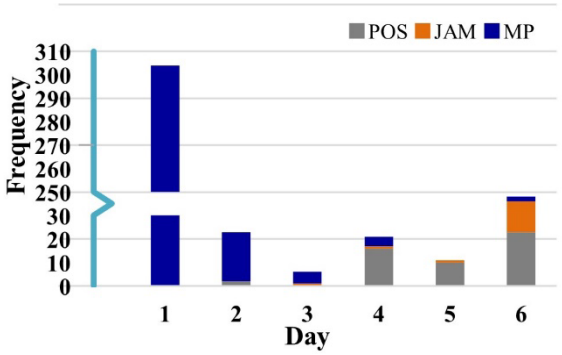

Figure 4. Nursery pig average daily feed intake (ADFI) when provided with nutritional enrichment during the trial week.

Nursery pigs consumed small quantities of feed (less than 200g/day) in the first 3 days after weaning, which agrees with other studies. Pigs in the POS treatment had the highest average ADFI, and pigs in the SC treatment had the lowest average ADFI, indicating that the POS enrichment helped increase feed intake. Furthermore, ADG was the same for NEG, POS, and JAM pigs.

Recently weaned nursery pigs are susceptible to gut health challenges that can result in diarrhea. Therefore, when adding a nutritional enrichment, it is important to determine that this treatment does not impair pig gut health. Gut health was measured indirectly through fecal scores. It as encouraging to report that all treatments had an average fecal score of 2.

In this study, short-term pig morbidity and mortality were not impacted. The lack of fallout pigs during the enrichment period is particularly important because they are at risk for mortality due to failure to thrive and are, therefore, important to identify and evaluate when considering nursery pig livability.

In conclusion, at a time where customers and consumers are questioning a pig's quality of life, all of these biscuits may be a viable option to enrich their lives. It is cost effective, easy to implement, and fits well into commercial North American nursery systems. Therefore, this study has yielded intriguing results that need further investigation commercially.

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