Effects of pigs per feeder hole and group size on feed intake onset, growth performance, and ear and tail lesions in nursery pigs with consistent space allowance

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Summary

Objective: To determine the effects of varying the number of pigs per feeder hole and group size on feed intake onset, growth performance, and lesions in nursery pigs.

Materials and methods: A total of 630 pigs were randomly assigned at weaning (mean [SD] age of 20.5 [0.9] d and weight of 5.59 [0.9] kg) to one of four treatments: 3.75, 5.00, 6.25, or 7.50 pigs per feeder hole, which was achieved by altering group size with 15, 20, 25, or 30 pigs per pen, respectively. Pigs were fed a meal diet containing 1% iron oxide dye for three days post-weaning. Rectal swabs were evaluated to assess the onset of feed intake. Pigs were weighed weekly and presence of ear and tail lesions were recorded.

Results: Decreasing the number of pigs per feeder hole resulted in a decrease in onset of feed intake ($P < .001$). Average daily gain tended to increase linearly as the number of pigs per feeder hole decreased ($P = .06$). No statistically significant responses were observed for average daily feed intake and feed efficiency ($P > .12$). The lowest occurrence of tail lesions ($P < .05$) was observed in the treatment with 3.75 pigs per feeder hole. The highest incidence ($P < .05$) of ear lesions occurred in the treatment containing 7.50 pigs per feeder hole.

Implications: Decreasing the number of pigs per feeder hole in the nursery period may result in faster onset of feed intake, improved growth performance, and reduced ear and tail lesions.

Keywords: swine, nursery, growth, ear lesions, tail lesions

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Resumen – Efectos de cerdos por abertura de comedero y tamaño de grupo en el inicio del consumo de alimento, desempeño de crecimiento, y lesiones de cola y oreja en cerdos en el destete con acceso de espacio consistente

Objetivo: Determinar los efectos al variar el número de cerdos por abertura de comedero y tamaño de grupo en el inicio del consumo de alimento, desempeño del crecimiento, y lesiones en cerdos en el destete.

Materiales y métodos: Se asignaron al azar un total de 630 cerdos al destete (media [DS] con edad de 20.5 [0.9] d y peso de 5.59 [0.9] kg) a uno de cuatro tratamientos: 3.75, 5.00, 6.25, ó 7.50 cerdos por abertura de comedero, lo que se logró al alterar el tamaño del grupo con 15, 20, 25, ó 30 cerdos por corral, respectivamente. Los cerdos fueron alimentados con un alimento con un contenido de 1% de colorante de óxido de hierro por tres días post destete. Se evaluaron hisopos rectales para determinar el inicio del consumo de alimento. Los cerdos se pesaron semanalmente y se registró la presencia de lesiones de cola y oreja.

Resultados: La reducción del número de cerdos por abertura de comedero resultó en un descenso en el inicio del consumo de alimento ($P < .001$). La ganancia diaria promedio tendió a aumentar linealmente al disminuir el número de cerdos por abertura de comedero ($P = .06$). No se observaron respuestas estadísticamente significativas en el consumo de alimento diario promedio y la eficiencia alimenticia ($P > .12$). La ocurrencia más baja de lesiones de cola ($P < .05$) se observó en el tratamiento con 3.75 cerdos por abertura de comedero. La incidencia más alta ($P < .05$) de lesiones de oreja ocurrió en el tratamiento con 7.50 cerdos por abertura de comedero.

Implicaciones: La reducción del número de cerdos por abertura de comedero en el periodo de destete puede resultar en un inicio más rápido del consumo de alimento, un mejor desempeño de crecimiento, y una reducción de las lesiones de cola y oreja.

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Résumé – Effets du nombre de porcs par espace d'alimentation et de la taille du groupe sur le début de la prise d'aliment, les performances de croissance, et les lésions aux oreilles et à la queue chez des porcs en pouponnière avec une allocation d'espace constante

Objectif: Déterminer les effets d'une variation du nombre de porcs par espace d'alimentation et de la taille du groupe sur le début de la prise d'aliment, les performances de croissance, et les lésions chez des porcs en pouponnière.

Matériels et méthodes: Un total de 630 porcs a été réparti de manière aléatoire au moment du sevrage (moyenne [ET]; à l'âge de 20.5 [0.9] j et au poids de 5.59 [0.9] kg) à l'un de quatre traitements : 3.75, 5.00, 6.25, ou 7.5 porcs par espace d'alimentation, qui a été obtenu en modifiant la taille du groupe avec 15, 20, 25, ou 30 porcs par enclos, respectivement. Les porcs ont reçu un aliment contenant 1% d'un colorant d'oxyde de fer pendant trois jours post-sevrage. Des écouvillons rectaux ont été évalués pour déterminer le début de la prise d'aliment. Les porcs étaient pesés à chaque semaine et la présence de lésions aux oreilles et à la queue était notée.

Résultats: Une diminution du nombre de porcs par espace d'alimentation a résulté en une diminution du moment de la prise d'aliment ($P < .001$). Le gain quotidien moyen avait tendance à augmenter de manière linéaire à mesure que le nombre de porcs par espace d'alimentation diminuait ($P = .06$). Aucune différence statistiquement significative ne fut observée pour la quantité quotidienne moyenne d'aliment ingéré et l'efficacité alimentaire ($P > .12$). La fréquence la plus faible de lésions à la queue ($P < .05$) a été observée dans le groupe avec 3.75 porcs par espace d'alimentation. La fréquence de lésions aux oreilles la plus élevée ($P < .05$) s'est produite dans le groupe avec 7.50 porcs par espace d'alimentation.

Implications: Une diminution du nombre de porcs par espace d'alimentation pendant la période en pouponnière pourrait résulter en un début plus rapide de la prise d'aliment, une amélioration des performances de croissance, et une diminution des lésions aux oreilles et à la queue.

Low feed intake in the post-weaning period and consequent low growth can impair performance and negatively affect metabolism and health status in pigs.[1,2] Although the effect of the number of pigs per feeder hole has been widely studied in production settings, few studies have evaluated its impact on growth performance, the onset of feed intake after weaning, and the incidence of ear and tail lesions. Wolter et al[3] investigated the effects of feeder space and space allowance in wean-to-finish barns and observed a decrease in feed intake in pens with 18 pigs per feeder hole compared to those with 9 pigs per feeder hole up to 98 days post-weaning. However, no significant differences were observed in the overall growth rate and final body weight.

Lindemann et al[4] suggested that when feed is provided ad libitum, pigs do not need to eat in groups or to have access to the feeder simultaneously, which would lessen the impact of the availability of feeder space. This phenomenon, however, has not been documented when ad libitum feed is provided during the nursery phase under high stocking density conditions. Preferable space allowances per pig, within the body weight ranges of 5 to 6 kg and 25 to 30 kg, are from 0.25 m^2 to 0.30 m^2, on slatted floors.[5] With higher stocking densities, there is a competition for space and the likelihood of animals having a limited access to the feeder is increased. DeDecker et al[6] evaluated the effect of stocking density on pig performance in a wean-to-finish production system and suggested that the feeder space may have a negative influence on the growth rate of animals under a higher stocking density. This supports our idea that higher stocking density without an increase in the number of feeder holes can impair the performance.

The competition for feed can not only reduce growth performance but also trigger aggressive interactions between the animals.[7] Botermans et al[7] observed that the most common interactions between pigs experiencing a feed competition during the growth phase included biting, pushing, and knocking of heads. The occurrence of tail biting indicates that some or all pigs within a pen are experiencing reduced welfare.[8] However, very few studies have been published to evaluate the effects of number of pigs per feeder hole in pigs housed under commercial conditions and higher stocking density on ear and tail biting during the nursery phase. Therefore, this study aimed to determine the effects of number of pigs per feeder hole and number of pigs per pen on the onset of feed intake post-weaning, growth performance, and the incidence of ear and tail lesions in nursery pigs under commercial conditions and with consistent space allowance.

Materials and methods

Institutional ethics committee approval

The Institutional Animal Care and Use Committee of the Federal University of Rio Grande do Sul approved the protocols used in this experiment according to the process PROPESQ-UFRGS 30556.

Animals, housing, and experimental design

The trial was conducted at a commercial research nursery facility in Videira, Santa Catarina, Brazil from May to July of 2016. A double curtain-sided nursery room with 28 identical pens, each with a total area of 6.84 m^2, was used for the experiment. All pens had solid concrete flooring along the entire length of the feeder, and slatted plastic flooring in the remaining area. The room temperature was maintained at 28°C to 30°C in the first and second week of the trial, and 25°C to 26°C thereafter. The temperature was monitored using three data loggers and two thermometers located at the center and extreme sides of the room.

A total of 630 intact males and gilts (PIC 337 × Camborough, Pig Improvement Company, Hendersonville, Tennessee), with initial mean (SD) body weight (BW) of 5.59 (0.9) kg and weaning age of 20.5 (0.9) days, were used in a 42-day study. The piglets' needle teeth were ground after birth and one third of their tails were docked at 3 days of age. At weaning, pigs were individually weighed, ear-tagged, and assigned to pens to achieve balanced gender and weight across the pens. Pens of pigs were randomly allotted to one of four treatments in a completely randomized manner, with 7 replicate pens per treatment. Treatments consisted of 3.75, 5.00, 6.25, and 7.50 pigs per feeder hole, which were achieved by increasing group size with 15, 20, 25, and 30 pigs per pen, respectively. Adjustable pen gates were used to maintain a floor space allowance of 0.23 m^2 per pig across treatments. Therefore, the resulted pen dimensions were 4.28 × 1.6 m^2, 3.56 × 1.6 m^2, 2.85 × 1.6 m^2, and 2.15 × 1.6 m^2

for treatment groups with 3.75, 5.00, 6.25, and 7.50 pigs per feeder hole, respectively. Pen sizes were adjusted in the event of pig death or removal for poor health.

Each pen contained a semi-automatic feeder with a polypropylene reservoir and a stainless-steel tray with four feeding holes, each 16 cm wide by 14 cm deep (Veromix 40 C Premium Nursery Feeder, Magnani, Seara, Brazil), which provided a total space of 64 cm in length. Feeders were located at the front of the pens. Pigs had ad libitum access to a corn- and soybean-meal-based diet in a three-phase feeding program formulated according to the National Research Council.[9] All diets were manufactured at the on-farm feed mill and were fed in meal form. The feed budget was 1 kg of Phase 1 diet fed per pig (3.6 Mcal/kg of metabolizable energy [ME], 21.9% crude protein [CP], and 1.46% standardized ileal digestible [SID] Lysine), 4 kg of Phase 2 diet fed per pig (3.6 Mcal/kg of ME, 21.4% CP, and 1.42% SID Lysine), followed by a Phase 3 diet (3.5 Mcal/kg of ME, 20.1% CP, and 1.30% SID Lysine) with approximately 17 kg/pig fed until the end of the trial. In addition, the drinkers were placed in the back third of the pen, on the side opposite to the feeder. Pens with 15 and 20 pigs had 2 nipple drinkers, and pens with 25 and 30 pigs had 3 drinkers to achieve a relatively similar number of pigs per nipple drinker in each pen (7.5, 10, 8.3, and 10, respectively).

Pigs presenting any health issues were treated according to the production company's standard animal husbandry procedures.

Onset of feed intake

Four pens per treatment were randomly selected to receive the Phase 1 diet with the inclusion of 1% iron oxide as a red fecal marker. The onset of feed intake was evaluated for the first 66 hours post-weaning in each individual pig by rectal swab over seven time-intervals: 18, 26, 34, 42, 50, 58, and 66 hours. A red colored swab indicated the onset of feed consumption. This technique was followed as previously described by Bruininx et al[10] and Sulabo et al[11], who evaluated the percentage of pigs eating creep feed using fecal markers.

Ear and tail lesions

The presence of ear and tail lesions, which may be indicative of ear and tail biting, were recorded. Deeper lesions were considered, differentiating them from scratches. Observations were conducted by one veterinarian. Pigs with severe ear and tail lesions were removed from the pen but were included in the statistical analysis.

Growth performance

Individual pig weights on days 0 (weaning day), and 42 were used to determine the coefficient of variation (CV) within each pen. The total weight of pigs and feed disappearance of each pen were measured to determine average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (F:G). Growth performance data of the overall period were split into 3 periods of 14 days: period 1 (0 to 14 d); period 2 (15 to 28 d); and period 3 (29 to 42 d).

Pigs were removed from pens only upon death or if identified to be in a non-ambulatory condition and not responding to medical treatment. In such cases, adjustments were made at the pen level using adjustable gates to account for removed or deceased pigs and maintain the same floor space allowance of 0.23 m^2 per pig until the end of the trial.

Statistical analysis

Data were analyzed as completely randomized design using the GLIMMIX procedure of SAS software (Version 9.4, Institute Inc, Cary, North Carolina), considering pen as the experimental unit. Polynomial contrasts were implemented to evaluate the linear and quadratic effects of the dose-response (varying the number of pigs per feeder hole and pigs per pen) on average time of onset of feed intake, ADG, ADFI, BW, F:G, CV, mortality, and removal rate. For mortality and removal rate, a binomial distribution was fit to the data. The IML procedure of SAS was used to adjust linear and quadratic coefficients after accounting for unequally spaced treatments. The non-parametric NPAR1WAY procedure of SAS was used to analyze the percentages of ear and tail lesions, and groups were compared using the Kruskal-Wallis test. Results were considered significant at a $P \leq .05$ and a trend at $P \leq .10$.

Results

Throughout the experimental period, 20 pigs were removed, and 15 deaths were recorded; however, there was no effect ($P > .05$) of number of pigs per feeder hole on removals and mortality rate (Table 1).

Average time to onset of feed intake decreased as the number of pigs per feeder hole and the number of pigs per pen decreased (Linear, $P < .001$; Figure 1).

For period 1 (day 0 to 14), a decrease in the number of pigs per feeder hole by decreasing the number of pigs per pen resulted in a linear increase in ADFI ($P = .02$; Table 2). Variations in ADG and F:G and were not statistically affected by treatments ($P > .05$). For period 2 (day 15 to 28), ADG increased linearly ($P = .01$) as the number of pigs per feeder hole decreased to 3.75, or 15 pigs per pen. This was likely driven by a linear improvement in F:G as the number of pigs per feeder hole and pigs per pen decreased ($P = .02$). There was a tendency for a quadratic improvement in ADFI ($P = .068$) as the number of pigs per feeder hole decreased from 7.50 to 6.25 pigs per feeder hole (30 to 25 pigs per pen), with no improvement thereafter. During period 3 (day 29 to 42), none of the growth performance criteria were affected by treatments ($P > .05$). Overall (day 0 to 42), there was a tendency ($P = .06$) for a linear improvement in ADG as the number of pigs per feeder hole decreased from 7.50 (30 pigs per pen) to 3.75 (15 pigs per pen). There were no differences in ADFI, F:G, BW, and CV as the number of pigs per feeder hole and pigs per pen decreased ($P > .05$).

Percentages of ear and tail lesions are shown in Table 3. Pens with 3.75 pigs per feeder hole (15 pigs per pen) had no ear or tail lesions. Pigs in pens with 7.50 pigs per feeder hole (30 pigs per pen) had significantly more ear lesions than pens with fewer pigs per feeder hole ($P < .05$). Pigs in pens with 3.75 pigs per feeder hole (15 pigs per pen) had significantly fewer tail lesions when compared to the other 3 treatments ($P < .05$).

Discussion

In this study, the influence of variation in the number of pigs per feeder hole, by varying the number of pigs per pen while maintaining the same space allowance, on growth performance, the onset of feed intake, and incidence of ear and tail lesions was investigated.

A change in environment (eg, diet type, drinkers, cohort, etc) creates challenges to weaned pigs, especially relative to voluntary feed intake.[12] Pens with 3.75 pigs per feeder hole, or 15 pigs per pen, had the lowest average time to the onset of feed intake after weaning and highest ADFI in the first 14 days post-weaning compared to the other treatments. These results agree with those from Weber et al[13] who observed a tendency

Table 1: Effects of pigs per feeder hole on the removal rate and mortality of pigs with consistent space allowance during the nursery period*

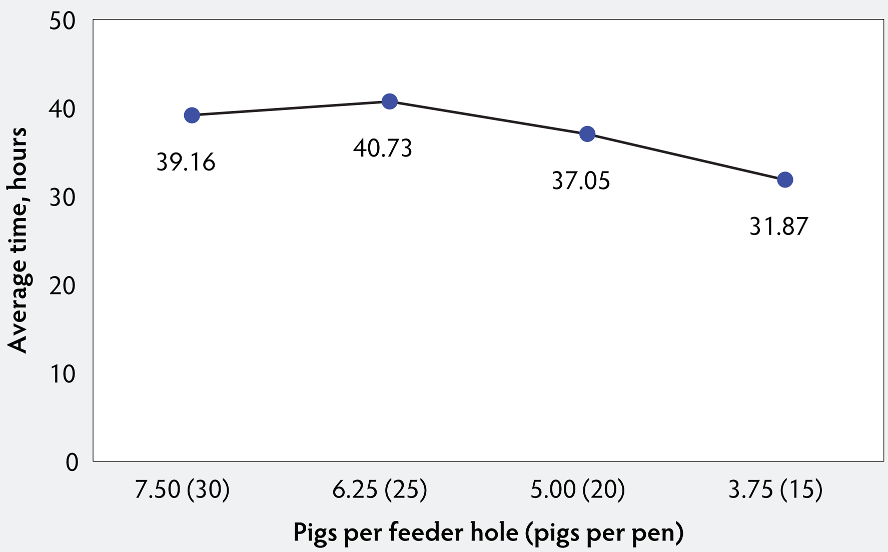
	Pigs per feeder hole (Pigs per pen)					Probability, *P*†	
	7.50 (30)	6.25 (25)	5.00 (20)	3.75 (15)	SEM	Linear	Quadratic
Removals, %	4.3	4.6	1.4	0.9	0.341	.14	.87
Mortality, %	1.0	2.9	3.6	2.9	0.453	.30	.19

* A total of 630 pigs (PIC 337 × Camborough; initial BW 5.59 ± 0.9 kg) were used with 0.23 m^2 of floor space allowance per pig and 7 replicate pens per treatment. The nursery period is classified as weaning to 42 days.

† Polynomial contrasts were implemented to evaluate the linear and quadratic effects.

SEM = standard error of the mean.

Figure 1: Average time to the onset of feed intake according to the number of pigs per feeder hole and pigs per pen during the nursery period. Polynomial contrasts were implemented to evaluate the linear and quadratic effects of a 42-d study on nursery pigs comparing different proportions of pigs per feeder hole. Standard error of the mean = 0.953; Linear, $P < .001$; Quadratic, $P = .08$.



for improved feed intake as the number of pigs per feeder hole was reduced. A positive relationship between feed intake and villous height or villus to crypt ratio has been previously reported.[14-16] Therefore, enhancing feed intake in the weaned pig is critical to overcome post-weaning challenges and prevent villous atrophy, reduce post-weaning diarrhea, and stimulate growth performance.[2]

In the present study, the difference between the two extreme treatments (3.75 and 7.5 pigs per feeder hole) was 3.75 pigs. In another study,[13] in which the difference between the two extreme treatments (8.9 and 12.4 pigs per feeder hole) was similar to that used in the present study, no differences were observed in growth rate until the end of the 8th week after weaning, at a floor space of 0.26 m^2 per pig. It is possible that the small variation in the number of pigs per feeder hole between treatments explains the linear increase in ADG observed only during the second period as well as the linear trend of overall increasing ADG, as the number of pigs per feeder hole was decreased by reducing the number of pigs per pen. When a greater difference in the number of pigs per feeder hole between treatments was evaluated (9 and 18 pigs per feeder hole) in a wean-to-finish system, no differences were observed in growth performance in the first six weeks post-weaning.[17] However, in the grower phase (7th and 8th weeks), the treatment of 9 pigs per feeder hole had higher ADG and BW compared with 18 pigs per feeder hole. Unlike the present work, these authors[17] used a floor space of 0.30 m^2 per pig, which may explain that once the space allowance becomes a limiting factor for the animals (> 6th week), a greater feeder space becomes more determinant for improving growth performance.

Tail biting is a multi-factorial problem and factors that can induce frustration or psychological discomfort may trigger or intensify tail biting occurrence.[18] Among these factors, limited space allowance,[19] limited feed availability,[20] increased number of pigs per feeder hole,[21] and reduced feed space per pig[22] are associated with aggressive interactions such as ear and tail biting. Delays in accessing feed are associated with stress and increased restlessness among pigs.[23] Competition for food (such as access to the feeder) will increase the potential for some pigs to become frustrated, because they are not free to eat at desired times or to consume the desired amount of feed, hence leading to tail biting.[21,24] It has been shown that five or more pigs per feeder hole are 2.7 times more likely to be subjected to or to perform ear and tail biting than pigs kept at a lower number of animals per feeder hole during the growing and finishing phases.[19] In the present study, the treatment providing 3.75 pigs per feeder hole, or 15 pigs per pen, had no ear or tail lesions and was the only treatment with less than five pigs per feeder hole. Although more aggressive interactions among the pigs can be expected in large groups, the effect of group size on tail biting remains unclear.[18,25] No effect of group size (22 vs 44 or 18 vs 108 pigs per pen) has been observed in docked pigs,[18,26] but Kallio et al[27] reported that groups with more than 9 long-tailed pigs were at higher risk of tail biting in finishing units. Although aggression and competition to access feed were not assessed in the present study, the dispute for feed access was shown to be more influenced by the availability of feeder space per pig than the total number of animals in the pen.[28] We can speculate that

Table 2: Effects of pigs per feeder hole on growth performance of pigs housed with consistent space allowance during the nursery period*

	Pigs per feeder hole (Pigs per pen)					Probability, *P*†	
	7.50 (30)	6.25 (25)	5.00 (20)	3.75 (15)	SEM	Linear	Quadratic
Period 1 (0 to 14 days)							
ADG, g	176	181	170	185	0.008	.57	.41
ADFI, g	225	239	244	254	0.007	.02	.71
F:G	1.28	1.32	1.39	1.34	0.042	.34	.13
Period 2 (15 to 28 days)							
ADG, g	349	368	361	381	0.007	.01	.99
ADFI, g	509	538	525	525	0.007	.37	.07
F:G	1.47	1.47	1.48	1.38	0.025	.02	.07
Period 3 (29 to 42 days)							
ADG, g	509	504	539	545	0.023	.18	.81
ADFI, g	816	818	834	843	0.020	.28	.91
F:G	1.61	1.59	1.51	1.55	0.038	.20	.21
Overall period (0 to 42 days)							
ADG, g	343	351	357	370	0.010	.06	.91
ADFI, g	516	534	533	541	0.009	.11	.49
F:G	1.46	1.48	1.47	1.42	0.023	.22	.25
Body weight, kg							
d 0	5.58	5.59	5.60	5.58	0.010	.82	.23
d 14	8.07	8.10	7.99	8.27	0.010	.16	.21
d 28	13.18	13.29	13.03	13.42	0.206	.51	.40
d 42	20.73	21.22	21.12	21.55	0.314	.12	.84
Individual body weight CV, %							
Initial (weaning)	16.6	16.6	16.9	16.9	0.164	.39	.29
Final (42 d)	19.0	17.0	16.4	17.0	0.671	.20	.41

* A total of 630 pigs (PIC 337 × Camborough; initial BW 5.59 ± 0.9 kg) were used with 0.23 m^2 of floor space allowance per pig and 7 replicate pens per treatment. The nursery period is classified as weaning to 42 days.
† Polynomial contrasts were implemented to evaluate the linear and quadratic effects.
SEM = standard error of the mean; ADG = average daily gain; ADFI = average daily feed intake; F:G = feed for 1 kg of gain; CV = coefficient of variation.

Table 3: Ear and tail lesions according to the number of pigs per feeder hole during the whole nursery period*

	Pigs per feeder hole (Pigs per pen)			
	7.50 (30)	6.25 (25)	5.00 (20)	3.75 (15)
Ear lesions, %	5.7[b]	0[a]	0.7[a]	0[a]
Tail lesions, %	11.9[b]	9.7[b]	6.4[b]	0[a]

* A total of 630 pigs (PIC 337 × Camborough; initial BW 5.59 ± 0.9 kg) were used with 0.23 m^2 of floor space allowance per pig and 7 replicate pens per treatment. The nursery period is classified as weaning to 42 days.
[a,b] Percentages followed by different letters within the row differ statistically ($P < .05$). Groups were compared by the Kruskal-Wallis test.

the higher occurrence of ear and tail lesions in the treatment with 7.50 pigs per feeder hole was mainly associated with the increase in pigs per feeder hole since the space allowance was the same (0.23 m^2 per pig) for all pigs of the present study; however, a combined effect of the larger group size (30 pigs per pen) in this treatment cannot be discarded.

In large group sizes, social organization of the pigs may be altered, although the exact group size this occurs is unknown.[29] Given that group size and number of pigs per feeder hole changed simultaneously across the treatments, it is not possible to separate the relative effects from each of these factors on the responses observed in this study. However, results from previous research provide some indication that may explain the dynamic of the effects on performance caused by these two factors. Spoolder et al [28] reported no effect on growth performance (from 36 to 85 kg BW) with group sizes of 20, 40, and 80 pigs per pen. Likewise, Wolter et al[30] observed similar growth rates for groups of 25, 50, or 100 pigs in a wean-to-finish system. Evaluating the association between feeder space and group size, Turner et al[31] reported that a reduction in feeder space from 4.25 to 3.25 cm per pig during the growing and finishing periods significantly decreased feed intake regardless of group size (20 vs 80 pigs per pen). The range of group sizes of the present study (15 to 30 pigs per pen) was relatively narrower than that used in the aforementioned studies in which the growth performance was not affected by the group size. It is important to note that, in the current study, although the number of pigs per pen changed along with the number of pigs per feeder hole, the stocking density was kept the same across all treatments using movable gates.

Reducing the number of pigs per feeder hole through a decrease in group size can be a valid strategy to improve growth performance and animal welfare when space allowance is restricted. Importantly, number of pigs per feeder hole and group size should be considered when planning the placement of pigs in nurseries. Further research evaluating the effects of number of nursery pigs per feeder hole under restricted space allowance while maintaining constant group size is warranted.

Implications

Under the conditions of the present study, decreasing the number of pigs per feeder hole through a reduction in group size while maintaining a consistent space allowance:

- Reduced the incidence of ear and tail lesions.
- Tended to increase growth rate during the overall period.
- Reduced the time to onset of feed intake and increased feed consumption in the initial phase of the nursery period.

Acknowledgments

Conflict of interest

None reported.

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*Non-refereed reference.

Conversion tables

Weights and measures conversions

Common (US)	Metric	To convert	Multiply by
1 oz	28.35 g	oz to g	28.4
1 lb (16 oz)	453.59 g	lb to kg	0.45
2.2 lb	1 kg	kg to lb	2.2
1 in	2.54 cm	in to cm	2.54
0.39 in	1 cm	cm to in	0.39
1 ft (12 in)	0.31 m	ft to m	0.3
3.28 ft	1 m	m to ft	3.28
1 mi	1.6 km	mi to km	1.6
0.62 mi	1 km	km to mi	0.62
1 in^2	6.45 cm^2	in^2 to cm^2	6.45
0.16 in^2	1 cm^2	cm^2 to in^2	0.16
1 ft^2	0.09 m^2	ft^2 to m^2	0.09
10.76 ft^2	1 m^2	m^2 to ft^2	10.8
1 ft^3	0.03 m^3	ft^3 to m^3	0.03
35.3 ft^3	1 m^3	m^3 to ft^3	35
1 gal (128 fl oz)	3.8 L	gal to L	3.8
0.264 gal	1 L	L to gal	0.26
1 qt (32 fl oz)	946.36 mL	qt to L	0.95
33.815 fl oz	1 L	L to qt	1.1

Temperature equivalents (approx)

°F	°C
32	0
50	10
60	15.5
61	16
65	18.3
70	21.1
75	23.8
80	26.6
82	28
85	29.4
90	32.2
102	38.8
103	39.4
104	40.0
105	40.5
106	41.1
212	100

˚F = (˚C × 9/5) + 32
˚C = (˚F - 32) × 5/9

Conversion chart, kg to lb (approx)

Pig size	Lb	Kg
Birth	3.3-4.4	1.5-2.0
Weaning	7.7	3.5
	11	5
	22	10
Nursery	33	15
	44	20
	55	25
	66	30
Grower	99	45
	110	50
	132	60
Finisher	198	90
	220	100
	231	105
	242	110
	253	115
Sow	300	135
	661	300
Boar	794	360
	800	363

1 tonne = 1000 kg
1 ppm = 0.0001% = 1 mg/kg = 1 g/tonne
1 ppm = 1 mg/L