Kansas Agricultural Experiment Station Research Reports

Volume 7
Issue 11 *Swine Day*

Article 4

2021

Effects of Providing Enrichment Cubes to Suckling Pigs in Late Lactation and After Weaning on Post-Weaning Pig Performance

Madie R. Wensley
Kansas State University, wensleym@ksu.edu

Mike D. Tokach
Kansas State University, Manhattan, mtokach@k-state.edu

Robert D. Goodband
Department of Animal Science and Industry, Kansas State University, goodband@ksu.edu

See next page for additional authors

Recommended Citation

Wensley, Madie R.; Tokach, Mike D.; Goodband, Robert D.; Gebhardt, Jordan T.; Woodworth, Jason C.; DeRouchey, Joel M.; McKilligan, Denny; and Upah, Nathan (2021) "Effects of Providing Enrichment Cubes to Suckling Pigs in Late Lactation and After Weaning on Post-Weaning Pig Performance," *Kansas Agricultural Experiment Station Research Reports*: Vol. 7: Iss. 11. https://doi.org/10.4148/2378-5977.8168

Effects of Providing Enrichment Cubes to Suckling Pigs in Late Lactation and After Weaning on Post-Weaning Pig Performance

Funding Source

Appreciation is expressed to TechMix Inc. (Stewart, MN) for their technical support in this trial.

Authors

Madie R. Wensley, Mike D. Tokach, Robert D. Goodband, Jordan T. Gebhardt, Jason C. Woodworth, Joel M. DeRouchey, Denny McKilligan, and Nathan Upah

K-STATE Research and Extension

SWINE DAY 2021

Effects of Providing Enrichment Cubes to Suckling Pigs in Late Lactation and After Weaning on Post-Weaning Pig Performance[1]

Madie R. Wensley, Mike D. Tokach, Robert D. Goodband, Jordan T. Gebhardt,[2] Jason C. Woodworth, Joel M. DeRouchey, Denny McKilligan,[3] and Nathan Upah[3]

Summary

A total of 28 litters (241 × 600, DNA) and 356 nursery pigs (241 × 600, DNA; initially 12.5 lb) were used in 28-d trial (4-d pre-weaning and 24-d post-weaning) to determine the effect of providing enrichment cubes (supersized pellets that resemble cattle cubes and range in size from 1.1 to 2.0 in. in length and 0.6 to 0.8 in. in diameter) to suckling pigs in late lactation and after weaning on post-weaning feed intake and growth. Treatments were arranged in a 2 × 2 × 2 factorial with main effects of: 1) pre-weaning treatment (without or with enrichment cubes); 2) post-weaning treatment (with or without enrichment cubes); and 3) body weight category (light or heavy). Overall, providing enrichment cubes to litters pre-weaning did not have a significant effect on piglet weaning weight ($P = 0.976$) or post-weaning ADG; however, pigs offered enrichment cubes prior to weaning had improved G:F ($P = 0.017$) in the nursery. Post-weaning cube application had no effect on the growth performance of pigs after weaning. The percentage of pigs that lost weight after weaning was reduced by 11.7 percentage points when pigs were offered enrichment cubes for 3 d post-weaning compared to no cubes ($P = 0.002$). Conversely, pre-weaning cube application had no effect on the percent of pigs that lost weight after weaning. In summary, providing enrichment cubes to pigs post-weaning appears to encourage activity around the feeder, therefore reducing the percentage of pigs that lost weight after weaning. However, more research is needed to validate these results in a commercial setting and to better understand the effect of reducing the percentage of pigs that lost weight after weaning on morbidity and mortality.

Introduction

It is well understood that providing creep feed to pigs during lactation encourages exploratory behavior and familiarizes pigs with solid feed before weaning. Bruininx et

[1] Appreciation is expressed to TechMix Inc. (Stewart, MN) for their technical support in this trial.

[2] Department of Diagnostic Medicine/Pathobiology, College of Veterinary Medicine, Kansas State University.

[3] TechMix Inc., Stewart, MN.

al.[4] observed that pigs designated as eaters of creep feed had improved feed intake and ADG in the immediate post-weaning period compared to non-eaters. Furthermore, eaters required less time from weaning to initial consumption of feed. More recently, Middelkoop et al.[5] observed that providing creep feed in play feeders (conventional rotary feeders with canvas cloth, braided cotton ropes, and PVC spiral tubes attached on the feeder) elicited exploratory behavior, attracting more pigs to creep feed. This response followed pigs through the immediate post-weaning period where increased ADFI and ADG were observed. The authors suggested that providing creep feed in play feeders prior to weaning may develop a positive association between solid feed and object play, stimulating greater feed consumption. Feeding large pellets during lactation has also been shown to increase ADFI and weight gain after weaning.[6] This response may be due to increased preference for large diameter pellets compared to small pellets. Despite the beneficial effect of creep feeding, the expense of creep feeders and increased labor required to clean feeders limits the use of creep feed on many farms.

Offering suckling pigs enrichment cubes (supersized pellets that resemble cattle cubes) may encourage both feed intake and object play. Furthermore, object recognition may be achieved by providing the same cubes after weaning, subsequently preventing feed neophobia, reducing stress, and improving the weaning transition. Using enrichment cubes also eliminates the need for creep feeders because cubes can be directly applied on farrowing stall mats pre-weaning and in feeder pans post-weaning. Therefore, the objective of this study was to determine the effects of providing enrichment cubes to suckling pigs in late lactation and after weaning on post-weaning feed intake and growth.

Materials and Methods

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment.

A total of 28 litters (241 × 600, DNA) were used during one farrowing group at the Kansas State University Swine Teaching and Research Center in Manhattan, KS. Sows were fed a common lactation diet throughout the experimental period. Four days prior to weaning, pigs were weighed and litters allotted to 1 of 2 treatment groups in a randomized complete block design based on sow parity and average piglet body weight. Treatments consisted of a negative control (no enrichment cubes) or an enrichment cube treatment, in which approximately 100 g of cubes (7 cubes) were provided to litters once daily (AM) for 4 d prior to weaning. Cubes were placed directly on the floor in the center of farrowing stalls on the opposite side of the heat lamp. Pigs were weaned at approximately 21 d of age.

[4] Bruininx, E. M. A. M., G. P. Binnendijk, C. M. C. van der Peet-Schwering, J. W. Schrama, L. A. den Hartog, H. Everts, and A. C. Beynen. 2002. Effect of creep feed consumption on individual feed intake characteristics and performance of group-housed weanling pigs. J. Anim. Sci. 80:1413-1418. doi:10.2527/2002.8061413x.

[5] Middelkoop, A., N. Costermans, B. Kemp, and J. E. Bolhuis. 2019. Feed intake of the sow and playful creep feeding of piglets influence piglet behavior and performance before and after weaning. Nature. 9:16140. doi:10.1038/s41598-019-52530-w.

[6] van den Brand, H., D. Wamsteeker, M. Oostindjer, L. C. M. van Enckevort, A. F. B. van der Poel, B. Kemp, and J. E. Bolhuis. 2014. Effects of pellet diameter during and after lactation on feed intake of piglets pre- and postweaning. J. Anim. Sci. 9 2:4145–4153. doi: 10.2527/jas2014-7408.

At weaning, a total of 356 pigs (241 × 600, DNA; initially 12.5 lb) were weighed and evenly divided into light or heavy BW categories within pre-weaning treatment and allotted to nursery pen. Each pen was randomized to 1 of 4 treatments with 4 or 5 pigs per pen and 18 replications per combination of pre- and post-weaning treatment, with body weight category equally distributed across treatment groups. Treatments were arranged in a 2 × 2 × 2 factorial with main effects of pre-weaning treatment (without or with enrichment cubes), post-weaning treatment (without or with enrichment cubes), and BW category (light or heavy). Pens of pigs assigned to the enrichment cube treatment group were offered approximately 100 g of cubes (7 cubes) once daily (AM) in feeder pans for 3 d after weaning.

The enrichment cubes ranged in size from 1.1 to 2.0 in. in length and 0.6 to 0.8 in. in diameter and were manufactured by Form-A-Feed in Stewart, MN (Figure 1 and 2). The main ingredients used for cube formulation were soy hulls, soybean meal, wheat midds, digestible sugars, and other palatable ingredients. Cubes were not intended to be a complete diet replacement, but rather to provide a form of environmental enrichment. Therefore, the nutrient profile of cubes was not complete and balanced. In addition to the enrichment cubes, all pigs received 9/64 in. pelleted diets for the 24-d feeding program after weaning. Pens of pigs were fed a common corn-soybean meal-based phase 1 and 2 diet throughout the duration of experiment. Phase 1 diets were provided from d 0 to 7 and phase 2 diets from d 7 to 24.

Each pen (4 × 4 ft) contained a 4-hole, dry self-feeder, and nipple waterer for *ad libitum* access to feed and water. Pigs were weighed and feed disappearance measured on d 3, 7, 14, and 24 after weaning to determine ADG, ADFI, and G:F. The percentage of pigs that lost weight from d 0 to 3 and d 0 to 7 was also determined.

Data analysis

Pre-weaning data were analyzed as a randomized complete block design using the PROC GLIMMIX procedure of SAS v. 9.4 (SAS Institute, Inc., Cary, NC) with litter as the experimental unit. Treatment was considered a fixed effect. Block was included in the model as a random effect which incorporated both sow parity and average piglet BW.

Post-weaning data were analyzed as a 2 × 2 × 2 factorial with main effects of: 1) pre-weaning treatment (without or with enrichment cubes); 2) post-weaning treatment (without or with enrichment cubes); and 3) body weight category (light or heavy). Pen was considered the experimental unit and no random effect was used for the analysis. Least square means were applied to estimate the interactive and main effects of pre-weaning treatment, post-weaning treatment, and body weight category. A binomial model was used to determine the percent of pigs that lost weight from d 0 to 3 and d 0 to 7 post-weaning. Results were considered significant at $P \leq 0.05$.

Results and Discussion

Enrichment cubes had limited effects on the growth performance of pigs after weaning. These results were not unexpected as the goal of enrichment cubes was to increase exploratory behavior and subsequent feeder interaction.

Providing enrichment cubes to litters pre-weaning did not influence piglet weaning weight *(P* = 0.976; no = 12.5 lb; yes = 12.5 lb). Interestingly, a 3-way interaction was observed between pre- and post-weaning cube offering and body weight category (Table 1). Heavy pigs that were provided enrichment cubes before weaning, but not after, grew slower and ate less feed from d 7 to 14 and d 0 to 24 after weaning, compared to heavy pigs that were provided enrichment cubes before and after weaning, with the opposite effect found for lightweight pigs. If pigs did not receive enrichment cubes before weaning, providing the cubes after weaning had no impact on performance in either light or heavy pigs. These interactions led to a similar interaction for BW on d 14 and 24. No evidence for growth performance differences after weaning were observed for the 2-way interaction between pre- and post-weaning treatment (Table 2), as well as the interaction between post-weaning treatment and BW category. However, an interaction was observed for pre-weaning treatment and BW category. Providing enrichment cubes pre-weaning increased overall ADFI ($P = 0.037$) after weaning in the lightweight pig population (no = 0.69 lb; yes = 0.73 lb), whereas providing enrichment cubes pre-weaning decreased ADFI after weaning in the heavyweight pig population (no = 0.88 lb; yes = 0.84 lb). No differences in ADG or G:F were observed between post-weaning treatment and BW category.

For the main effect of pre-weaning cube application, no overall differences were observed on post-weaning ADG or ADFI (Table 3). However, a main effect was observed for G:F. Pigs offered enrichment cubes prior to weaning had improved post-weaning G:F ($P = 0.017$) compared to pigs that were not offered enrichment cubes. Similarly, post-weaning cube application had no effect on the ADG or ADFI of pigs after weaning. There was a tendency for pigs offered enrichment cubes post-weaning to have poorer G:F ($P = 0.078$) than pigs that were not offered enrichment cubes. Heavyweight pigs had improved overall ADG ($P < 0.001$*)* compared to lightweight pigs. This was in response to increased ADFI ($P < 0.001$*)*. No evidence for differences were observed in G:F.

While limited effects of enrichment cubes were observed on the growth performance of pigs after weaning, the true value of enrichment cubes lies in the percentage of pigs that lost weight in the first week post-weaning. No evidence for a 2-way or 3-way interaction was observed. Likewise, no evidence for treatment differences was observed for the main effect of pre-weaning treatment (Figure 3). Conversely, the percentage of pigs that lost weight after weaning was reduced by 11.7 percentage points when pigs were offered enrichment cubes for 3 d post-weaning compared to no cubes ($P = 0.002$; Figure 4). There was no evidence for differences for the main effect of BW category at d 7 post-weaning; however, the percentage of pigs that lost weight 3 d post-weaning was 15 percentage points greater for the heavyweight pig population than the lightweight pig population (Figure 5). This suggests heavyweight pigs have an easier time recovering from the initial weight loss that occurs after weaning.

In summary, providing enrichment cubes to pigs post-weaning appears to encourage activity around the feeder, therefore reducing the percent of pigs that lost weight after weaning. Conversely, pre-weaning application had no effect. More research is needed to validate these results in a commercial setting and to better understand the implication of litter size on enrichment cube application. Similarly, the potential impacts of pre-

and post-weaning intervention on morbidity and mortality needs to be considered, as well as the nutrient content, hardness, and texture of the enrichment cubes.

Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Persons using such products assume responsibility for their use in accordance with current label directions of the manufacturer.

Table 1. Interaction of body weight category and pre- and post-weaning pellet application on nursery pig growth performance[1,2]

BW category:	Light				Heavy				
Pre-wean cube:	Without		With		Without		With		*P* =
Item Post-wean cube:	Without	With	Without	With	Without	With	Without	With	Interaction
Post-wean BW, lb									
d 14	14.5^{c}	14.2^{c}	14.9^{c}	14.3^{c}	19.8^{a}	19.5^{ab}	18.8^{b}	19.8^{a}	0.046
d 24	22.7^{cd}	22.4^{d}	24.2^{c}	22.8^{cd}	30.5^{ab}	29.7^{ab}	29.2^{b}	31.0^{a}	0.034
d 7 to 14									
ADG, lb	0.46^{cde}	0.44^{de}	0.50^{bcd}	0.41^{e}	0.62^{a}	0.54^{abc}	0.47^{cde}	0.57^{ab}	0.005
ADFI, lb	0.50^{d}	0.51^{cd}	0.56^{cd}	0.51^{cd}	0.71^{a}	0.69^{a}	0.58^{bc}	0.65^{ab}	0.044
d 14 to 24									
ADG, lb	0.83^{d}	0.82^{d}	0.94^{bc}	0.85^{cd}	1.08^{a}	1.02^{ab}	1.04^{ab}	1.11^{a}	0.047
ADFI, lb	1.13^{d}	1.16^{d}	1.22^{cd}	1.17^{d}	1.46^{a}	1.38^{ab}	1.33^{bc}	1.44^{ab}	0.026
d 0 to 24									
ADG, lb	0.51^{de}	0.50^{e}	0.58^{cd}	0.52^{de}	0.66^{ab}	0.63^{abc}	0.61^{bc}	0.67^{a}	0.028
ADFI, lb	0.68^{d}	0.70^{d}	0.74^{cd}	0.71^{d}	0.90^{a}	0.86^{ab}	0.80^{bc}	0.88^{a}	0.042

[1]For the pre-weaning portion of the experiment, a total of 28 litters (241 × 600, DNA; Columbus, NE) were used. Treatments consisted of a negative control (no enrichment cubes) or an enrichment cube treatment, in which approximately 100 g of cubes (7 cubes) were provided to litters once daily (AM) on the floor of farrowing stalls for 4 d prior to weaning. For the post-weaning portion of the experiment, a total of 356 pigs (241 × 600, DNA) were used in a 24-d growth trial with 4 or 5 pigs per pen and 18 replicates per treatment. Treatments were arranged in a 2 × 2 × 2 factorial with main effects of pre-weaning treatment (without or with enrichment cubes), post-weaning treatment (without or with enrichment cubes), and BW category (light or heavy). Pens of pigs assigned to the enrichment cube treatment group were offered approximately 100 g of cubes (7 cubes) once daily (AM) in feeder pans for 3 d after weaning.

[2]For ease of interpretation, only the significant response variables are shown.

Table 2. Interaction of pre- and post-weaning enrichment cube application on the growth performance of nursery pigs[1]

	Pre-wean cube:	Without		With			*P* =		
Item	Post-wean cube:	Without	With	Without	With	SEM	Pre-wean	Post-wean	Interaction
Post-wean BW, lb									
d 0		12.5	12.5	12.5	12.6	0.06	0.935	0.688	0.560
d 3		12.5	12.7	12.4	12.6	0.11	0.486	0.138	0.794
d 7		13.3	13.4	13.4	13.7	0.13	0.145	0.257	0.539
d 14		17.1	16.8	16.8	17.1	0.21	0.932	0.891	0.238
d 24		26.6	26.1	26.7	26.9	0.42	0.313	0.699	0.347
d 0 to7									
ADG, lb		0.11	0.12	0.13	0.16	0.017	0.170	0.181	0.507
ADFI, lb		0.26	0.27	0.25	0.29	0.014	0.849	0.114	0.387
G:F		0.37	0.45	0.48	0.54	0.052	0.064	0.171	0.821
F/G[2]		2.36	2.25	1.92	1.81	---	---	---	---
d 7 to 14									
ADG, lb		0.54	0.49	0.49	0.49	0.022	0.168	0.242	0.257
ADFI, lb		0.60	0.60	0.57	0.58	0.020	0.210	0.921	0.713
G:F		0.91	0.83	0.85	0.83	0.026	0.295	0.054	0.186
F/G[2]		1.11	1.22	1.16	1.18	---	---	---	---
d 14 to 24									
ADG, lb		0.95	0.92	0.99	0.98	0.026	0.061	0.468	0.745
ADFI, lb		1.29	1.27	1.28	1.30	0.030	0.799	0.999	0.374
G:F		0.73	0.73	0.78	0.75	0.013	0.009	0.279	0.508
F/G[2]		1.36	1.38	1.29	1.33	---	---	---	---
d 0 to 24									
ADG, lb		0.59	0.56	0.59	0.60	0.016	0.257	0.604	0.378
ADFI, lb		0.79	0.78	0.77	0.80	0.019	0.839	0.697	0.369
G:F		0.74	0.72	0.77	0.75	0.011	0.017	0.078	0.826
F/G[2]		1.34	1.39	1.31	1.33	---	---	---	---

[1]For the pre-weaning portion of the experiment, a total of 28 litters (241 × 600, DNA, Columbus, NE) were used. Treatments consisted of a negative control (no enrichment cubes) or an enrichment cube treatment, in which approximately 100 g of cubes (7 cubes) were provided to litters once daily (AM) on the floor of farrowing stalls for 4-d prior to weaning. For the post-weaning portion of the experiment, a total of 356 pigs (241 × 600, DNA) were used in a 24-d growth trial with 4 or 5 pigs per pen and 18 replicates per treatment. Treatments were arranged in a 2 × 2 × 2 factorial with main effects of pre-weaning treatment (without or with enrichment cubes), post-weaning treatment (without or with enrichment cubes), and BW category (light or heavy). Pens of pigs assigned to the enrichment cube treatment group were offered approximately 100 g of cubes (7 cubes) once daily (AM) in feeder pans for 3-d after weaning.

[2] Feed-to-gain was calculated from ADFI and ADG treatment LS Means. Therefore, statistical analysis was not conducted for F/G. For the statistical outcome of feed efficiency, refer to G:F.

Table 3. Main effect of pre- and post-weaning enrichment cube application, and body weight category on the growth performance of nursery pigs[1]

	Pre-wean pellet				Post-wean pellet				BW category[2]			
Item	Without	With	SEM	*P* =	Without	With	SEM	*P* =	Light	Heavy	SEM	*P* =
Post-wean BW, lb												
d 0	12.5	12.5	0.05	0.935	12.5	12.5	0.05	0.688	10.3	14.7	0.05	<0.001
d 3	12.6	12.5	0.08	0.486	12.4	12.6	0.08	0.138	10.5	14.6	0.08	<0.001
d 7	13.4	13.6	0.09	0.145	13.4	13.5	0.09	0.257	11.3	15.6	0.09	<0.001
d 14	17.0	17.0	0.15	0.932	17.0	17.0	0.15	0.891	14.5	19.5	0.15	<0.001
d 24	26.4	26.8	0.30	0.313	26.6	26.5	0.30	0.699	23.0	30.1	0.30	<0.001
d 0 to 7												
ADG, lb	0.12	0.14	0.012	0.170	0.12	0.14	0.012	0.181	0.13	0.13	0.012	0.904
ADFI, lb	0.27	0.27	0.010	0.849	0.26	0.28	0.010	0.114	0.25	0.29	0.010	0.003
G:F	0.41	0.51	0.037	0.064	0.43	0.50	0.037	0.171	0.48	0.44	0.037	0.426
F/G[3]	2.25	1.93	---	---	2.17	2.00	---	---	1.92	2.23	---	---
d 7 to 14												
ADG, lb	0.52	0.49	0.015	0.168	0.51	0.49	0.015	0.242	0.45	0.55	0.015	<0.001
ADFI, lb	0.60	0.58	0.014	0.210	0.59	0.59	0.014	0.921	0.52	0.66	0.014	<0.001
G:F	0.87	0.84	0.018	0.295	0.88	0.83	0.018	0.054	0.88	0.83	0.018	0.090
F/G[3]	1.15	1.18	---	---	1.16	1.20	---	---	1.16	1.20	---	---
d 14 to 24												
ADG, lb	0.94	0.99	0.019	0.061	0.97	0.95	0.019	0.468	0.86	1.06	0.019	<0.001
ADFI, lb	1.28	1.29	0.021	0.799	1.29	1.29	0.021	0.999	1.17	1.40	0.021	<0.001
G:F	0.73	0.76	0.009	0.009	0.76	0.74	0.009	0.279	0.74	0.76	0.009	0.110
F/G[3]	1.36	1.30	---	---	1.33	1.36	---	---	1.36	1.32	---	---
d 0 to 24												
ADG, lb	0.58	0.59	0.011	0.257	0.59	0.58	0.011	0.604	0.53	0.64	0.011	<0.001
ADFI, lb	0.79	0.78	0.013	0.839	0.78	0.79	0.013	0.697	0.71	0.86	0.013	<0.001
G:F	0.73	0.76	0.007	0.017	0.76	0.74	0.007	0.078	0.74	0.75	0.007	0.880
F/G[3]	1.36	1.32	---	---	1.32	1.36	---	---	1.34	1.34	---	---

[1]For the pre-weaning portion of the experiment, a total of 28 litters (DNA 241 × 600, Columbus, NE) were used. Treatments consisted of a negative control (no enrichment cubes) or an enrichment cube treatment, in which approximately 100 g of cubes (7 cubes) were provided to litters once daily (AM) on the floor of farrowing stalls for 4 d prior to weaning. For the post-weaning portion of the experiment, a total of 356 pigs (DNA 241 × 600) were used in a 24-d growth trial with 4 or 5 pigs per pen and 18 replicates per treatment. Treatments were arranged in a 2 × 2 × 2 factorial with main effects of pre-weaning treatment (without or with enrichment cubes), post-weaning treatment (without or with enrichment cubes), and BW category (light or heavy). Pens of pigs assigned to the enrichment cube treatment group were offered approximately 100 g of cubes (7 cubes) once daily (AM) in feeder pans for 3 d after weaning.

[2]At weaning, pigs were divided into light or heavy body weight categories within pre-weaning treatment and then equally distributed across post-weaning treatments.

[3] Feed-to-gain was calculated from ADFI and ADG treatment LS Means. Therefore, statistical analysis was not conducted for F/G. For the statistical outcome of feed efficiency, refer to G:F.

Figure 1. Enrichment cubes ranged in size from 1.1 to 2.0 in. in length and 0.6 to 0.8 in. in diameter and were manufactured by Form-A-Feed (Stewart, MN).

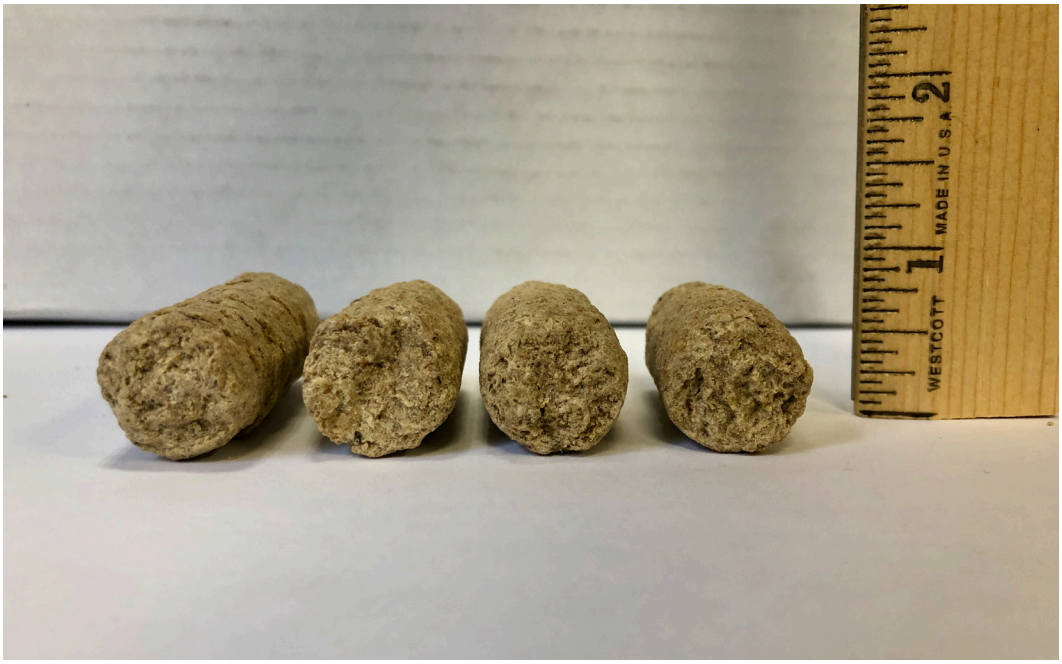

Figure 2. Enrichment cubes ranged in size from 1.1 to 2.0 in. in length and 0.6 to 0.8 in. in diameter and were manufactured by Form-A-Feed (Stewart, MN).

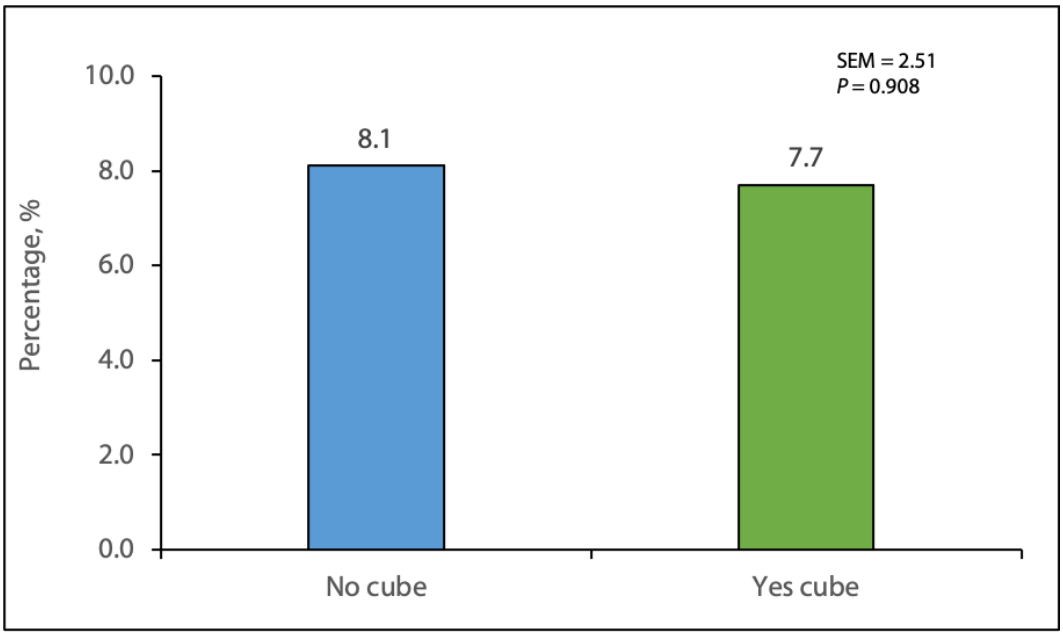

Figure 3. Main effect of pre-weaning enrichment cube application on the percentage of pigs that lost weight from weaning to d 7.

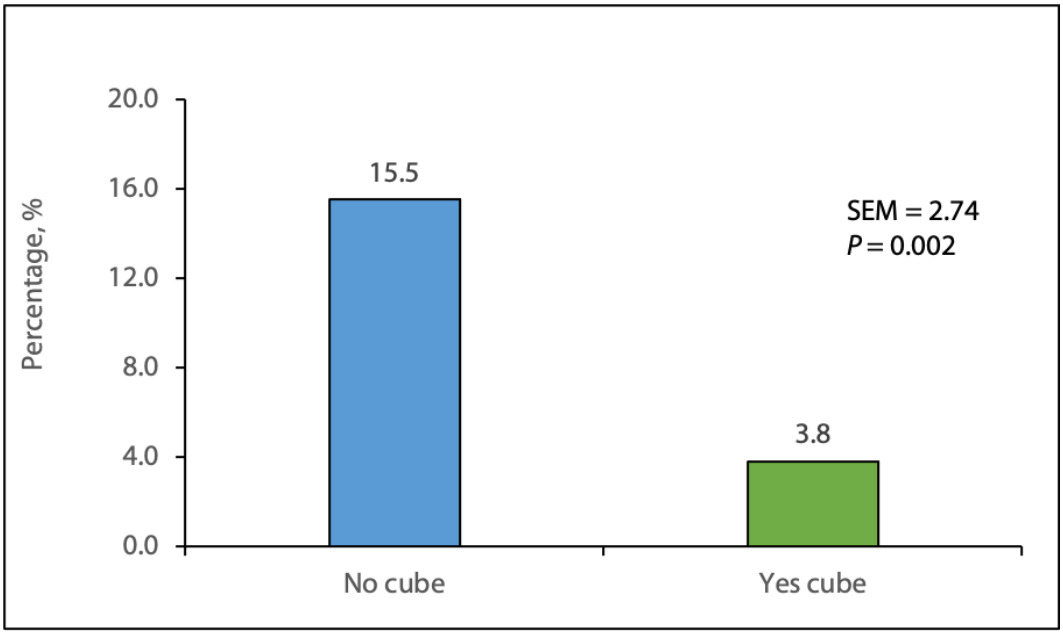

Figure 4. Main effect of post-weaning enrichment cube application on the percentage of pigs that lost weight from weaning to d 7.

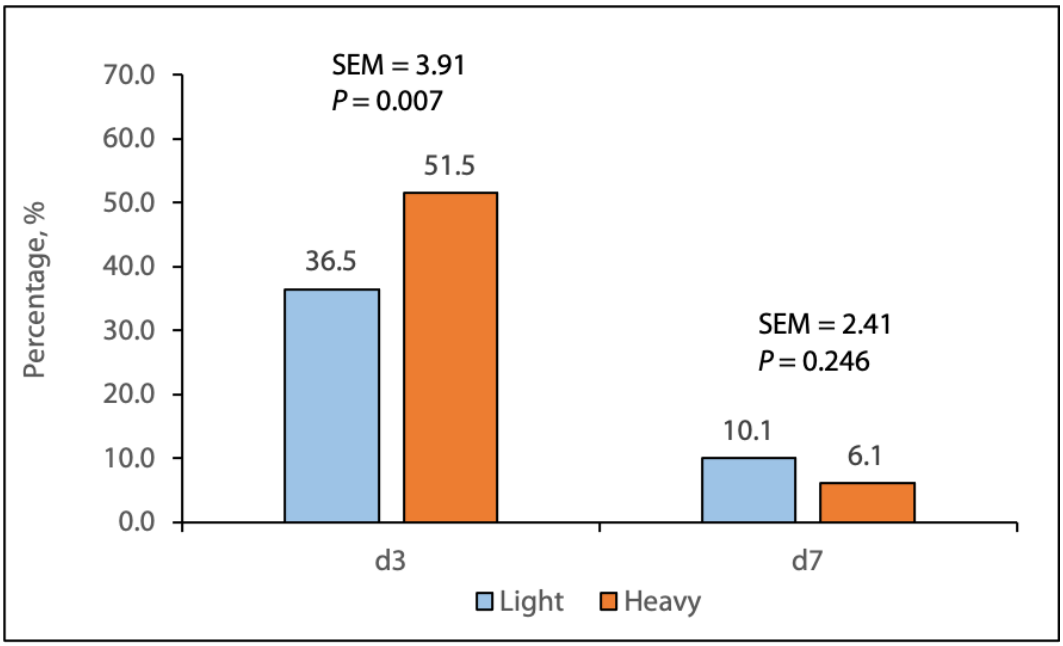

Figure 5. Main effect of body weight category on the percentage of pigs that lost weight from weaning to d 3 or from weaning to d 7.