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Effects of Replacing Lactose with Novel Carbohydrate Sources on Nursery Pig Growth Performance

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Effects of Replacing Lactose with Novel Carbohydrate Sources on Nursery Pig Growth Performance

Abstract

This experiment was conducted to determine the effects of replacing lactose in Phase 1 and 2 nursery pig diets with 1 of 2 novel carbohydrate (CHO) products (CHO-D and CHO-L; Cargill Starches, Sweeteners, & Texturizers, Blair, NE) on growth performance and fecal dry matter. A total of 360 barrows (DNA 200 × 400; initially 13.2 ± 0.10 lb) were used in a 42-d growth trial. Pigs were weaned at approximately 21 d of age, randomly allotted to pens in 1 of 2 weight blocks based on initial BW (initially 12.0 and 14.5 lb), and then allotted to 1 of 6 dietary treatments in a completely randomized design. There were 5 pigs per pen and 12 pens per treatment across 2 barns. Dietary treatments were corn-soybean meal-based with 5 to 7.5% DDGS and included: 1) negative control (NC; containing 0.08 and 0.04% lactose, phase 1 and 2, respectively); 2) positive control (PC; containing 10 and 5% lactose, phase 1 and 2, respectively); 3) 50% of lactose replaced with the dry novel CHO (50% CHO-D; containing 5 and 2.5% lactose, phase 1 and 2, respectively); 4) 100% of lactose replaced with CHO-D (100% CHO-D; containing 0.09 and 0.05% lactose, phase 1 and 2 respectively); 5) 50% of lactose replaced with the liquid novel CHO (50% CHO-L; containing 5 and 2.5% lactose, phase 1 and 2, respectively); or 6) 100% of lactose replaced with CHO-L (100% CHO-L; containing 0.09 and 0.05% lactose, phase 1 and 2, respectively).Treatment diets were formulated in two dietary phases and fed from d 0 to 10 and d 10 to 24, respectively, with a common phase 3 diet fed for the remainder of the study. During the treatment period (d 0 to 24) there was a weight block × CHO source interaction (P = 0.045) on ADFI, in which heavyweight pigs fed the PC diet had greater (P = 0.001) ADFI than lightweight pigs fed the same diet, while there was no significant difference due to weight block among any other CHO sources. Furthermore, overall (d 0 to 42) there was a tendency for a weight block × CHO source interaction (P= 0.067) on ADFI. Additionally, pigs in the heavyweight block had greater ($P \leq$ 0.001) BW, ADG, and ADFI compared to pigs in the lightweight block throughout the experiment. However, overall, pigs from the lightweight block had improved (P = 0.033) feed efficiency compared to pigs in the heavyweight block. There was a tendency for a main effect of CHO source (P = 0.057) on feed efficiency during the treatment period, in which pigs fed the NC diet had the lowest numeric F/G and pigs fed the 100% CHO-L diet had the highest numeric F/G. However, this did not persist throughout the overall study (P = 0.329). Additionally, there was no observed main effect of CHO source (P > 0.100) on ADG or ADFI throughout the overall study. In summary, feeding either of the novel CHO sources did not significantly affect growth performance, percentage of pigs that lost weight post-weaning, or fecal dry matter during nursery period compared with those pigs fed a traditional lactose source or a diet that did not contain any lactose. Based on the results herein, pigs fed diets containing either novel CHO product had equivalent performance to those on the PC treatment, but we were unable to detect incremental value as the PC treatment did not significantly differ from the NC treatment.

Keywords

carbohydrate, fecal dry matter, growth, nursery pig

Authors

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Effects of Replacing Lactose with Novel Carbohydrate Sources on Nursery Pig Growth Performance

Rafe Q. Royall, Jason C. Woodworth, Mike D. Tokach, Joel M. DeRouchey, Jordan T. Gebhardt,[1] Robert D. Goodband, Keith Mertz,[2] and John F. Patience[3]

Summary

This experiment was conducted to determine the effects of replacing lactose in Phase 1 and 2 nursery pig diets with 1 of 2 novel carbohydrate (CHO) products (CHO-D and CHO-L; Cargill Starches, Sweeteners, & Texturizers, Blair, NE) on growth performance and fecal dry matter. A total of 360 barrows (DNA 200 × 400; initially 13.2 ± 0.10 lb) were used in a 42-d growth trial. Pigs were weaned at approximately 21 d of age, randomly allotted to pens in 1 of 2 weight blocks based on initial BW (initially 12.0 and 14.5 lb), and then allotted to 1 of 6 dietary treatments in a completely randomized design. There were 5 pigs per pen and 12 pens per treatment across 2 barns. Dietary treatments were corn-soybean meal-based with 5 to 7.5% DDGS and included: 1) negative control (NC; containing 0.08 and 0.04% lactose, phase 1 and 2, respectively); 2) positive control (PC; containing 10 and 5% lactose, phase 1 and 2, respectively); 3) 50% of lactose replaced with the dry novel CHO (50% CHO-D; containing 5 and 2.5% lactose, phase 1 and 2, respectively); 4) 100% of lactose replaced with CHO-D (100% CHO-D; containing 0.09 and 0.05% lactose, phase 1 and 2 respectively); 5) 50% of lactose replaced with the liquid novel CHO (50% CHO-L; containing 5 and 2.5% lactose, phase 1 and 2, respectively); or 6) 100% of lactose replaced with CHO-L (100% CHO-L; containing 0.09 and 0.05% lactose, phase 1 and 2, respectively).Treatment diets were formulated in two dietary phases and fed from d 0 to 10 and d 10 to 24, respectively, with a common phase 3 diet fed for the remainder of the study. During the treatment period (d 0 to 24) there was a weight block × CHO source interaction ($P = 0.045$) on ADFI, in which heavyweight pigs fed the PC diet had greater ($P = 0.001$) ADFI than lightweight pigs fed the same diet, while there was no significant difference due to weight block among any other CHO sources. Furthermore, overall (d 0 to 42) there was a tendency for a weight block × CHO source interaction ($P = 0.067$) on ADFI. Additionally, pigs in the heavyweight block had greater ($P \leq 0.001$) BW, ADG, and ADFI compared to pigs in the lightweight block throughout the experiment. However, overall, pigs from the lightweight block had improved ($P = 0.033$) feed efficiency compared to pigs in the heavyweight block. There

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was a tendency for a main effect of CHO source ($P = 0.057$) on feed efficiency during the treatment period, in which pigs fed the NC diet had the lowest numeric F/G and pigs fed the 100% CHO-L diet had the highest numeric F/G. However, this did not persist throughout the overall study ($P = 0.329$). Additionally, there was no observed main effect of CHO source ($P > 0.100$) on ADG or ADFI throughout the overall study. In summary, feeding either of the novel CHO sources did not significantly affect growth performance, percentage of pigs that lost weight post-weaning, or fecal dry matter during nursery period compared with those pigs fed a traditional lactose source or a diet that did not contain any lactose. Based on the results herein, pigs fed diets containing either novel CHO product had equivalent performance to those on the PC treatment, but we were unable to detect incremental value as the PC treatment did not significantly differ from the NC treatment.

Introduction

Milk-derived products (i.e., dried whey powder or whey permeate) are commonly included in early nursery pig diets to help transition the weaned pigs from a milk-based liquid diet to a solid, plant-based diet. However, in recent years the cost of feeding traditional lactose sources has risen exponentially, leading producers to seek alternative solutions to help acclimatize weaned pigs to solid feed. It has been demonstrated that a portion of dried whey may be replaced by non-lactose carbohydrate sources (sucrose, dextrose, etc.) without negatively impacting nursery pig performance.[4,5] The Starches, Sweeteners, and Texturizers division of Cargill produces many CHO products through their corn wet-milling activities, but it is unknown whether any of the products can elicit beneficial growth performance in weaned pigs. Therefore, the objective of this study was to determine the effects of replacing increasing levels of lactose with 1 of 2 novel CHO sources on nursery pig growth performance, feed efficiency, and fecal dry matter.

Procedures

The Kansas State University Animal Care and Use Committee approved the protocol used in this experiment. The experiment was conducted at the Kansas State University Segregated Early Weaning Research Facility in Manhattan, KS. Each pen contained a 4-hole, dry self-feeder, and nipple waterer for *ad libitum* access to feed and water.

Animals and diets

A total of 360 barrows (DNA 200 × 400; initially 13.2 ± 0.10 lb BW) were used in a 42-d growth trial. Pigs were weaned at approximately 21 d of age, randomly allotted to pens in 1 of 2 weight blocks based on initial BW (initially 12.0 and 14.5 lb BW), and then allotted to 1 of 6 dietary treatments in a completely randomized design. There were 5 pigs per pen and 12 pens per treatment across 2 barns. Pigs were provided *ad libitum* access to water and to feed in a pellet form in phases 1 and 2, and meal form in phase 3. The experimental diets for phases 1 and 2 were manufactured at Provimi North America in Lewisburg, OH, while the common phase 3 diet was manufactured at Hubbard Feeds in Beloit, KS.

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[4] Stephas, E. L., and B. L. Miller. 1998. Evaluation of dextrose as a replacement for crystalline lactose in phase I and phase II nursery diets. J. Anim. Sci. 76(Suppl. 1):66 (Abstract).

[5] Dunmire, K. M., T. A. Wickersham, L. L. Frenzel, S. R. Sprayberry, L. C. Joiner, L. P. Hernandez, A. M. Cassens, B. Dominquez, and C. B. Paulk. 2020. Effects of adding liquid lactose or molasses to pelleted swine diets on pellet quality and pig performance. Transl. Anim. Sci. 4:616-629.

Dietary treatments were corn-soybean meal-based with 5 to 7.5% DDGS and included: 1) negative control (NC; containing 0.08 and 0.04% lactose, phase 1 and 2, respectively); 2) positive control (PC; containing 10 and 5% lactose, phase 1 and 2, respectively); 3) 50% of lactose replaced with the dry novel CHO (50% CHO-D; containing 5 and 2.5% lactose, phase 1 and 2, respectively); 4) 100% of lactose replaced with CHO-D (100% CHO-D; containing 0.09 and 0.05% lactose, phase 1 and 2, respectively); 5) 50% of lactose replaced with the liquid novel CHO (50% CHO-L; containing 5 and 2.5% lactose, phase 1 and 2, respectively); or 6) 100% of lactose replaced with CHO-L (100% CHO-L; containing 0.09 and 0.05% lactose, phase 1 and 2, respectively). Novel CHO sources (CHO-D or CHO-L) replaced whey powder on a carbohydrate basis in phase 1 and 2 diets (Tables 1 and 2). The NC diet, as well as the 100% CHO-D and 100% CHO-L diets, contained trace amounts of lactose due to the inclusion of whey protein concentrate which was included in the diet to balance CP% across diets. Ratios of other AAs to Lys were maintained well above requirements to ensure that there were no limiting AAs. Individual pigs were weighed, and feed disappearance was recorded on d 0, 7, 10, 17, 24, 31, and 42 to determine ADG, ADFI, and feed efficiency.

Fecal samples were collected on d 10 and 24 to determine fecal dry matter percentage from the same three randomly selected pigs from each pen. After collection, fecal samples were dried at 55°C (131°F) in a forced air oven for 48 h, and the ratio of dried to wet fecal weight determined the fecal dry matter. Fecal samples were maintained separately for each pig and the average of the three samples from each pen was then used for statistical analysis.

Statistical analysis

Experimental data were analyzed using R Studio (Version 3.5.2, R Core Team, Vienna, Austria) with pen serving as the experimental unit in a completely randomized design. Treatment, body weight block, and the associated interaction served as a fixed effects within the statistical model, with barn serving as a random effect. Differences between treatments were determined using estimated marginal means. When treatment was a significant source of variation, differences were determined by the preplanned pairwise comparisons using the Tukey-Kramer multiplicity adjustment to control for type I error. Results will be considered significant at $P \leq 0.05$ and marginally significant at $P \leq 0.10$.

Results and Discussion

There was no main effect of CHO source ($P \geq 0.100$) on BW at any weighing event (d 0, 7, 10, 17, 24, 31, 42; Table 3). However, pigs in the heavyweight block had significantly greater ($P \leq 0.001$) BW than pigs in the lightweight block at each weighing event (Table 4).

There were no observed weight block × CHO source interactions or main effect of CHO source ($P > 0.100$) on the percentage of pigs that lost weight from d 0 to 7. However, there was a tendency ($P = 0.063$) for a greater percentage of pigs in the lightweight block to lose weight compared to those in the heavyweight block.

Throughout the treatment period (d 0 to 24) there was a weight block × CHO source interaction ($P = 0.045$) for ADFI, in which heavyweight pigs fed the PC diet containing lactose had greater ADFI than lightweight pigs fed the same diet, while there was no significant difference due to weight block among the other treatments. There were no observed weight block × CHO source interactions or main effect of CHO source ($P \geq 0.100$) on ADG. However, there was a tendency for a main effect of CHO source ($P = 0.057$) on feed efficiency, but the means did not separate. Moreover, pigs in the heavyweight block had greater ($P < 0.001$) ADG than those in the lightweight block.

During the common period (d 24 to 42), there was no observed weight block × CHO source interaction or main effect of previously fed CHO source ($P \geq 0.100$) on ADG, ADFI, or feed efficiency. However, pigs in the heavyweight block had greater ($P < 0.001$) ADG and ADFI than those in the lightweight block, leading to poorer ($P = 0.020$) feed efficiency.

Overall (d 0 to 42), there was a tendency for a weight block × CHO source interaction ($P = 0.067$) for ADFI. There was no observed main effect of CHO source ($P > 0.100$) on any observed growth performance characteristic. However, pigs in the heavyweight block had greater ($P < 0.001$) ADG and ADFI than those in the lightweight block, leading to poorer ($P = 0.033$) feed efficiency.

There were no observed 2- or 3-way interactions or any observed main effects of weight block or CHO source ($P > 0.100$) on percent fecal dry matter.

In summary, feeding either of the novel CHO sources did not significantly impact growth performance, percentage of pigs that lost weight post-weaning, or fecal dry matter during the nursery period compared with those pigs fed a traditional lactose source. Furthermore, the addition of lactose to the diet did not influence any response criteria compared to a diet without lactose. This response was not expected and prevented the ability to determine if either CHO source could replace lactose in nursery pig diets.

Table 1. Composition of phase 1 diets (as-fed basis)[1]

	Dietary treatment					
Item	**NC[2]**	**PC[3]**	**50% CHO-D**	**100% CHO-D**	**50% CHO-L**	**100% CHO-L**
Ingredient, %						
Corn	63.27	51.68	52.32	52.93	51.54	51.40
Soybean meal (46.5% CP)	14.84	14.74	14.79	14.80	14.58	14.37
Enzymatically treated SBM[4]	5.00	5.00	5.00	5.00	4.93	4.85
Spray-dried bovine plasma	2.50	2.50	2.50	2.50	2.46	2.43
Corn DDGS	5.00	5.00	5.00	5.00	4.93	4.85
Menhaden fish meal	2.50	2.50	2.50	2.50	2.46	2.43
Whey powder, 72.9% lactose	---	13.90	6.88	---	6.77	---
Whey protein concentrate, 50% lactose	1.50	---	0.90	1.80	0.89	1.75
Choice white grease	1.00	1.00	1.00	1.00	0.99	097
Limestone	0.68	0.63	0.63	0.65	0.62	0.61
Monocalcium phosphate (21% P)	1.43	1.08	1.30	1.48	1.28	1.46
Salt	0.75	0.40	0.60	0.75	0.59	0.73
BioLys	0.63	0.63	0.63	0.63	0.62	0.61
DL-Met	0.13	0.15	0.15	0.15	0.15	0.15
L-Thr	0.16	0.16	0.16	0.17	0.16	0.16
L-Trp	0.03	0.03	0.03	0.03	0.03	0.03
L-Val	0.05	0.07	0.07	0.07	0.07	0.07
Zinc oxide[5]	0.40	0.40	0.40	0.40	0.39	0.39
VTM Premix with phytase[6]	0.15	0.15	0.15	0.15	0.15	0.15
CHO-D[7]	---	---	5.00	10.00	---	---
CHO-L[8]	---	---	---	---	6.41	12.62
Total	100	100	100	100	100	100

continued

Table 1. Composition of phase 1 diets (as-fed basis)[1]

	Dietary treatment					
Item	NC[2]	PC[3]	50% CHO-D	100% CHO-D	50% CHO-L	100% CHO-L
Calculated analysis						
SID AA, %						
Lys, %	1.35	1.35	1.35	1.35	1.35	1.35
Ile:Lys	56	56	56	56	56	56
Leu:Lys	126	121	122	122	122	122
Met:Lys	33	33	34	34	34	34
Met and Cys:Lys	57	57	57	57	57	57
Thr:Lys	64	64	64	64	64	64
Trp:Lys	19.0	19.0	19.0	19.0	19.0	19.0
Val:Lys	70	70	70	70	70	70
NE, kcal/lb	1,136	1,147	1,080	1,015	1,080	1,015
SID Lys:NE, g/Mcal	5.39	5.34	5.66	6.03	5.67	6.03
CP, %	21.9	21.3	21.3	21.2	21.3	21.2
Ca, %	0.71	0.70	0.70	0.71	0.70	0.70
STTD P, %	0.64	0.64	0.64	0.64	0.64	0.64
Ca:P	0.93	0.95	0.94	0.95	0.94	0.94
Na, %	0.41	0.40	0.41	0.41	0.41	0.41
Lactose, %	0.08	10.00	5.00	0.09	5.00	0.09

[1]Diets were fed to pigs from approximately 13 to 16 lb BW.
[2]Negative control (NC) containing 0.08% lactose.
[3]Positive control (PC) containing 10.00% lactose.
[4]HP 300; Hamlet Protein, Findlay, OH.
[5]Zinc oxide was included in the diet to provide 3,000 ppm of Zn.
[6] Ronozyme Hiphos (GT) 2700 (DSM Nutritional Products, Inc, Parsippany NJ), provided 302,400 phytase units (FTU/lb), for an estimated release of 0.13% STTD P.
[7]Dry novel carbohydrate source; Cargill Starches, Sweeteners, & Texturizers, Blair, NE.
[8]Liquid novel carbohydrate source; Cargill Starches, Sweeteners, & Texturizers, Blair, NE.

Table 2. Composition of phase 2 and 3 diets (as-fed basis)[1]

	Dietary treatment						
Item	**NC[2]**	**PC[3]**	**50% CHO-D**	**100% CHO-D**	**50% CHO-L**	**100% CHO-L**	**Phase 3**
Ingredient, %							
Corn	59.34	53.47	53.78	54.11	53.88	53.30	64.76
Soybean meal (46.5% CP)	21.46	2145	21.49	21.49	21.33	21.18	28.35
Corn DDGS	7.50	7.50	7.50	7.50	7.44	7.39	---
Enzymatically treated SBM[4]	5.00	5.00	5.00	5.00	4.96	4.93	---
Whey powder	---	7.00	3.44	---	3.41	---	---
Whey protein concentrate, 50% lactose	0.75	---	0.45	0.90	0.45	0.89	---
Choice white grease	1.00	1.00	1.00	1.00	0.99	0.99	---
Limestone	1.00	0.95	0.98	0.98	0.97	0.96	0.75
Monocalcium phosphate (21% P)	1.40	1.20	135	1.45	1.34	1.43	0.85
Salt	0.75	0.60	0.70	0.75	0.69	0.74	0.60
BioLys	0.85	0.85	0.85	0.85	0.84	0.84	---
L-Lys HCl	---	---	---	---	---	---	0.55
DL-Met	0.18	0.19	0.19	0.19	0.19	0.19	0.21
L-Thr	0.22	0.22	0.22	0.22	0.22	0.22	0.23
L-Trp	0.04	0.04	0.04	0.04	0.04	0.04	0.05
L-Val	0.11	0.12	0.12	0.12	0.12	0.12	0.16
Zinc oxide[5]	0.25	0.25	0.25	0.25	0.25	0.25	---
VTM premix with phytase[6]	0.15	0.15	0.15	0.15	0.15	0.15	---
Vitamin premix with phytase[7]	---	---	---	---	---	---	0.25
Trace mineral premix	---	---	---	---	---	---	0.15
CHO-D[8]	---	---	2.50	5.00	---	---	---
CHO-L[9]	---	---	---	---	3.22	6.40	---
Total	100	100	100	100	100	100	100

continued

Table 2. Composition of phase 2 and 3 diets (as-fed basis)[1]

	Dietary treatment						
Item	NC[2]	PC[3]	50% CHO-D	100% CHO-D	50% CHO-L	100% CHO-L	Phase 3
Calculated analysis							
SID AA, %							
Lys, %	1.35	1.35	1.35	1.35	1.35	1.35	1.30
Ile:Lys	56	56	56	56	56	56	53
Leu:Lys	122	119	119	119	119	119	111
Met:Lys	35	35	36	36	36	36	36
Met and Cys:Lys	57	57	57	57	57	57	56
Thr:Lys	64	64	64	64	64	64	63
Trp:Lys	19.0	19.0	19.0	19.0	19.0	19.0	19.3
Val:Lys	70	70	70	70	70	70	69
NE, kcal/lb	1,119	1,125	1,091	1,059	1,091	1,059	1,170
SID Lys:NE, g/Mcal	5.47	5.44	5.61	5.78	5.61	5.78	5.04
CP, %	21.6	21.3	21.3	21.3	21.3	21.3	19.8
Ca, %	0.74	0.72	0.74	0.73	0.74	0.73	0.62
STTD P, %	0.57	0.57	0.57	0.57	0.57	0.57	0.44
Ca:P	1.06	1.05	1.06	1.06	1.06	1.06	1.13
Na, %	0.35	0.36	0.36	0.35	0.36	0.35	0.28
Lactose, %	0.04	5.04	2.50	0.05	2.50	0.05	0.00

[1]Diets were fed to pigs from approximately 16 to 26 lb BW.
[2]Negative control (NC) containing 0.04% lactose.
[3]Positive control (PC) containing 5.04% lactose.
[4]HP 300; Hamlet Protein, Findlay, OH.
[5]Zinc oxide was included in the diet to provide 2,000 ppm of Zn.
[6] Ronozyme Hiphos (GT) 2700 (DSM Nutritional Products, Inc, Parsippany NJ), provided 302,400 phytase units (FTU/lb), for an estimated release of 0.13% STTD P.
[7]Ronozyme 2700 (DSM Nutritional Products) provided an assumed 0.13% release of STTD P with 567 FTU/lb inclusion in the final diet.
[8]Dry novel carbohydrate source; Cargill Starches, Sweeteners, & Texturizers, Blair, NE.
[9]Liquid novel carbohydrate source; Cargill Starches, Sweeteners, & Texturizers, Blair, NE.

Table 3. Effects of carbohydrate source on nursery pig performance[1,2]

	Dietary treatment							
	NC[3]	PC[3]	50% CHO-D	100% CHO-D	50% CHO-L	100% CHO-L	SEM	*P* =
Body weight, lb								
d 0	13.3	13.2	13.2	13.2	13.2	13.3	0.08	0.978
d 7	14.0	13.8	14.0	13.9	14.0	14.2	0.20	0.537
d 10	16.4	15.9	16.2	15.8	16.0	16.3	0.27	0.192
d 17	21.5	20.8	20.8	21.1	20.8	21.2	0.34	0.440
d 24	26.8	26.2	26.2	26.7	26.1	26.4	0.99	0.745
d 31	34.8	33.9	34.3	35.2	34.2	34.5	1.27	0.715
d 42	50.6	49.6	50.2	50.9	49.3	50.2	1.48	0.651
Treatment period (d 0 to 24)								
ADG, lb	0.558	0.537	0.538	0.554	0.535	0.546	0.0360	0.901
ADFI, lb[4]	0.683	0.661	0.666	0.687	0.680	0.699	0.0336	0.591
G:F	0.814	0.812	0.807	0.805	0.787	0.778	0.0157	0.057
F/G[3]	1.23	1.23	1.24	1.24	1.27	1.29	---	0.057
Common period (d 24 to 42)								
ADG, lb	1.317	1.297	1.304	1.342	1.289	1.322	0.0335	0.756
ADFI, lb	1.867	1.844	1.847	1.907	1.860	1.863	0.0397	0.811
G:F	0.706	0.704	0.707	0.703	0.694	0.711	0.0075	0.726
F/G[5]	1.42	1.42	1.41	1.42	1.44	1.41	---	0.726
Overall (d 0 to 42)								
ADG, lb	0.875	0.861	0.863	0.886	0.859	0.879	0.0333	0.869
ADFI, lb[6]	1.178	1.165	1.167	1.201	1.185	1.198	0.0342	0.766
G:F	0.742	0.740	0.740	0.737	0.725	0.733	0.0088	0.329
F/G[5]	1.35	1.35	1.35	1.36	1.38	1.36	---	0.329
BW loss (d 0 to 7), %[7]	17.9	23.3	20.0	15.5	19.1	14.3	0.06	0.941
Fecal DM, %[8,9]								
d 10	26.4	27.3	26.9	26.7	25.4	26.3	1.00	0.718
d 24	24.1	24.4	24.3	25.3	24.1	24.3	0.94	0.699

[1]A total of 360 barrows (initial BW = 13.2 ± 0.100 lb) were used in a growth performance study with 5 pigs per pen and 12 replicates per treatment.
[2]ADG = average daily gain. ADFI = average daily feed intake. F/G = feed-to-gain ratio.
[3]Negative control (NC) containing 0.075 and 0.0% lactose, phase 1 and 2, respectively. Positive control (PC) containing 10 and 5% lactose, phase 1 and 2, respectively.
[4]Throughout the treatment period (d 0 to 24) there was a weight block × CHO source interaction (*P* = 0.045) for ADFI, in which heavyweight pigs fed the PC diet containing lactose had greater ADFI than lightweight pigs fed the same diet, while there was no significant difference due to weight block among the other treatments.
[5]F/G was calculated by taking the inverse of G:F. Statistics were not run on F/G, therefore no SEM is reported and P values are the same as reported for G:F.
[6] Overall (d 0 to 42), there was a tendency for a weight block × CHO source interaction (*P* = 0.067) for ADFI.
[7]Percentage of individual pigs that lost weight from d 0 to 7 per treatment.
[8]A main effect of day was observed (*P* < 0.001).
[9]No diet × day interaction (*P* = 0.816) was observed.

Table 4. Main effects of initial body weight block on pig performance[1,2]

Weight block:	Light	Heavy	SEM	*P* =
Body weight, lb				
d 0	12.0	14.5	0.06	< 0.001
d 7	12.7	15.3	0.17	< 0.001
d 10	14.6	17.6	0.22	< 0.001
d 17	19.2	22.9	0.24	< 0.001
d 24	24.3	28.5	0.92	< 0.001
d 31	31.9	37.1	1.17	< 0.001
d 42	46.8	53.4	1.35	< 0.001
Treatment period (d 0 to 24)				
ADG, lb	0.508	0.582	0.0332	< 0.001
ADFI, lb	0.632	0.727	0.0309	< 0.001
G:F	0.802	0.799	0.0135	0.711
F/G[3]	1.25	1.25	---	0.711
Common period (d 24 to 42)				
ADG, lb	1.246	1.378	0.0258	< 0.001
ADFI, lb	1.752	1.978	0.0285	< 0.001
G:F	0.711	0.697	0.004	0.020
F/G[3]	1.41	1.43	---	0.020
Overall (d 0 to 42)				
ADG, lb	0.820	0.921	0.0297	< 0.001
ADFI, lb	1.105	1.259	0.0295	< 0.001
G:F	0.742	0.731	0.0074	0.033
F/G[3]	1.35	1.37	---	0.033
BW loss (d 0 to 7), %[4]	23.7	13.7	0.03	0.063
Fecal DM, %[5,6]				
d 10	26.6	26.4	0.82	0.565
d 24	24.6	24.2	0.74	0.806

[1]A total of 360 barrows (initial BW = 13.2 ± 0.100 lb) were used in a growth performance study with 5 pigs per pen and 36 replicates per treatment.
[2]ADG = average daily gain. ADFI = average daily feed intake. F/G = feed-to-gain ratio.
[3]F/G was calculated by taking the inverse of G:F. Statistics were not run on F/G, therefore no SEM is reported and *P* values are the same as reported for G:F.
[4]Percentage of individual pigs that lost weight from d 0 to 7 per weight block.
[5]A main effect of day was observed ($P < 0.001$).
[6]No day × block interactions ($P = 0.812$) were observed.