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Effects of Increasing Oat Groats on Nursery Pig Performance[1]

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Abstract

In Exp. 1, a total of 225 pigs (241 × 600, DNA, Columbus, NE; initially 13.9 lb BW) were used in a 28-d study to evaluate the effects of increasing ground oat groats on nursery pig growth performance. Pigs were weaned at 21 d of age and randomly allotted to pens and fed a commercial starter diet for 7 d prior to the start of the experiment. Pens of pigs were assigned to 1 of 5 dietary treatments in a randomized complete block design by body weight (BW) with 4 or 5 pigs per pen and 10 pens per treatment. Dietary treatments consisted of 0, 7.5, 15, 22.5, or 30% oat groats added in replacement for corn in the diet. Treatment diets were fed for 14 d with pig weights and feed disappearance collected weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed-to-gain ratio (F/G). A common diet was fed from d 14 to 28. Data were analyzed using PROC GLIMMIX with pen as the experimental unit. For the experimental period (d 0 to 14), increasing oat groats resulted in no evidence for differences ($P > 0.05$) in ADG, ADFI, F/G, or d 14 BW. There was no evidence ($P > 0.05$) for treatment differences during the common phase (d 14 to 28) or the overall period. In Exp. 2, a 7-d preference study was conducted to evaluate the response when pigs were given the choice between the diet with 0% groats compared to either the diet with 7.5 or 30% groats. A total of 48 pigs were used with 4 pigs per pen and 6 replications per comparison. Pigs were weighed on d 0 and 7, and feeders were weighed and rotated position within the pen twice daily to determine ADFI of each diet offered. When given the choice, there was no evidence for difference ($P > 0.05$) in ADFI or percentage of diet consumed between the 0 and 7.5% oat groat diets. When given the choice between the 0 or 30% oat groat diets, pigs had increased ($P = 0.001$) ADFI (0.11 vs. 0.64 lb) for the 30% oat groat diet compared to the diet without oat groats. In conclusion, increasing oat groats in nursery diets did not improve growth performance; however, when given the choice, pigs preferred the 30% oat groat diet compared to diets without oat groats.

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Introduction

The post-weaning growth lag is a result of multiple dietary and environmental stressors associated with weaning. Many nutritional strategies seek to target the early nursery phases with highly digestible energy and protein sources to help mediate the lapse in performance. One such nutritional strategy is the use of oat products. Rantanen et al.[3] conducted two experiments comparing various oat products to a corn/soybean control diet. Both studies concluded that refined oat products (steam-flaked oat groats and oat flour) had better feed efficiency than corn in Phases I and II; however, much of this efficiency was lost in Phase III when all pigs were fed a sorghum-based common diet. Furthermore, Solà-Oriol et al.[4] investigated 37-lb pig preference of 24 diets varying in cereal grain and cereal grain processing method in a 4-d palatability study. This study included 3 raw sources of oats, thick rolled, cooked, raw naked oats, extruded naked oats, and micronized naked oats at levels ranging from 15% to 100% of the grain portion of the diet. Compared with the control diet, micronized naked oats and thick rolled oats were preferred. While these studies compared the use of many different oat products, there is little research on the sole use of oat groats in nursery pig diets. Groats are the product of the mechanical removal of the hull from whole oats. Thus, the objective of this study was to determine the effects of increasing oat groats on nursery pig growth performance and feed preference.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The trial was conducted at the Kansas State University Swine Teaching and Research Center in Manhattan, KS. All diets were manufactured at the Kansas State University O.H. Kruse Feed Technology Innovation Center. Oat groats were sourced from Minnesota, and National Research Council (NRC[5]) ingredient values were used for diet formulation (Table 1).

For Exp. 1, a total of 225 pigs (241 × 600, DNA, Columbus, NE; initially 13.9 lb BW) were used in a 28-d experiment. Pigs were weaned at 21 d of age and fed a commercial starter diet for 7 d prior to the start of the experiment. Pigs were randomly allotted to pens and were assigned to 1 of 5 dietary treatments in a randomized complete block design by BW with 4 or 5 pigs per pen and 10 pens per treatment. Dietary treatments consisted of 0, 7.5, 15, 22.5, or 30% dietary oat groats replacing corn in the control diet. Treatments were fed for 14 d and a common diet was fed from d 14 to 28. Pigs were weighed and feed disappearance was measured on d 0, 7, 14, 21, and 28. Each pen (4 × 5 ft) contained a 4-hole, dry, self-feeder and a nipple waterer to provide *ad libitum* access to feed and water.

In Exp. 2, a 7-d preference study was conducted to evaluate the response when given the choice between the 0% groats and either 7.5 or 30% groats. A total of 48 pigs were used with 4 pigs/pen and 6 replications/comparison. Pigs were weighed on d 0 and 7, and

[3]Rantanen, M. M., M. R. Cabrera, L. L. Burnham, R. H. Hines, and J. D. Hancock. 1994. Influence of oats and oat products in phase I and II diets on growth performance of weanling pigs. *Kansas Agricultural Experiment Station Research Reports*: 0:10. doi:10.4148/2378-5977.6436.
[4]Solà-Oriol, D., E. Roura, and D. Torrallardona. 2009. Feed preference in pigs: Effect of cereal sources at different inclusion rates. *J. Anim. Sci.* 87:562-570.
[5]NRC. 2012. Nutrient requirements of swine. 11th rev. ed. Natl. Acad. Press, Washington, DC.

feeders were weighed and rotated position within the pen daily to determine ADFI of each diet offered.

Samples of treatment diets were collected upon manufacturing at the feed mill, and proximate analysis (Ward Laboratories, Inc., Kearney, NE) and particle size analysis were conducted on both the composite diet samples and the groats using standard procedures.[6]

Data were analyzed as a randomized complete block design using PROC GLIMMIX in SAS (Version 9.4, SAS Institute, Inc., Cary, NC) with BW as a blocking factor and pen as the experimental unit. For the preference study, ADFI and % of feed consumed for total intake were compared between diets fed within each comparison. Results were considered significant at $P < 0.05$.

Results and Discussion

For the 14 d experimental period, increasing oat groats resulted in no evidence for differences ($P > 0.05$) in ADG, ADFI, F/G, or d 7 and 14 BW. There was also no evidence ($P > 0.05$) for treatment differences during the common phase (d 14 to 28) or the overall period, with the exception of a marginally significant linear improvement ($P = 0.067$) in ADG for pigs previously consuming the highest oat groat diet.

The preference study concluded that when given the choice between the 0 and 7.5% oat groat diets, there was no evidence for difference ($P > 0.05$) in ADFI or percentage of diet consumed. However, when the nursery pigs were given the choice between the 0 or 30% oat groat containing diets, pigs had increased ($P < 0.001$) ADFI for the 30% oat groat diet compared to the diet without oat groats.

In conclusion, this experiment demonstrated that increasing oat groats in nursery diets did not impact growth performance; however, when given the choice, pigs preferred the 30% oat groat diet compared to diets without oat groats. Additionally, there was a marginally significant response for improved ADG during the common period for pigs fed the highest concentration of dietary oat groats. Further research should evaluate an oat groat diet immediately post-weaning to determine if there is potential for increased intake during the first week in the nursery.

[6]ASABE Standards. (2008 R2012). S319.4: Method of determining and expressing fineness of feed materials by sieving. St. Joseph, Mich.: ASABE.

Table 1. Oat groat composition[1]

Item, %	
Dry matter	87.10
Crude protein	13.90
Ether extract	5.90
Ash	2.40
Total AA, %	
Arg	0.85
His	0.24
Ile	0.55
Leu	0.98
Lys	0.48
Met	0.20
Phe	0.66
Thr	0.44
Trp	0.18
Val	0.72
SID coefficients, AA%	
Arg	86
His	83
Ile	83
Leu	83
Lys	79
Met	86
Phe	86
Thr	80
Trp	82
Val	82
Particle size[2]	
Dgw, µm	763
Sgw	2.97

[1]Oats were sourced from Minnesota and values represented are from the NRC (2012).
[2]Particle size analysis was done at the Kansas State University Swine Nutrition Laboratory (Manhattan, KS).

Table 2. Diet composition[1]

	Oat groats, %				
Ingredient, %	0.0	7.5	15.0	22.5	30.0
Corn	57.35	49.90	42.50	35.10	27.65
Soybean meal	25.05	25.00	25.05	25.00	25.05
Dried whey	7.00	7.00	7.00	7.00	7.00
Oat groats	---	7.50	15.00	22.50	30.00
HP 300[2]	5.00	5.00	5.00	5.00	5.00
Choice white grease	1.00	1.00	1.00	1.00	1.00
Calcium carbonate	0.95	0.95	0.95	0.95	0.95
Monocalcium phosphate	1.35	1.35	1.30	1.30	1.25
Salt	0.65	0.65	0.65	0.65	0.65
L-Lysine-HCl	0.47	0.45	0.43	0.42	0.40
DL-Methionine	0.22	0.21	0.21	0.21	0.20
L-Threonine	0.21	0.20	0.19	0.18	0.17
L-Tryptophan	0.03	0.02	0.02	0.01	---
L-Valine	0.11	0.09	0.07	0.05	0.02
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Phytase[3]	0.02	0.02	0.02	0.02	0.02
Zinc oxide	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0

continued

Table 2. Diet composition[1]

	Oat groats, %				
Ingredient, %	0.0	7.5	15.0	22.5	30.0
Calculated analysis					
Standardized ileal digestible (SID) AA, %					
Lysine	1.35	1.35	1.35	1.35	1.35
Isoleucine:lysine	57	58	60	61	62
Leucine:lysine	115	114	114	114	114
Methionine:lysine	37	36	36	36	36
Methionine and cystine:lysine	58	58	58	58	58
Threonine:lysine	64	64	64	64	64
Tryptophan:lysine	19	19	19	19	19
Valine:lysine	69	69	69	69	69
Histidine:lysine	36	36	36	36	36
Total lysine, %	1.49	1.49	1.49	1.5	1.5
Metabolizable energy, kcal/lb	1,505	1,511	1,518	1,525	1,532
Net energy NRC,[4] kcal/lb	1,119	1,120	1,122	1,123	1,125
SID lysine:NE, g/Mcal	5.47	5.47	5.46	5.45	5.44
Crude protein, %	21.1	21.5	21.9	22.2	22.6
Ca, %	0.82	0.82	0.82	0.82	0.82
P, %	0.71	0.72	0.72	0.73	0.73
STTD P, %	0.54	0.54	0.54	0.54	0.54

[1]Diet was fed for 14 d from approximately 14 to 32 lbs.
[2]Hamlet Protein (Findlay, OH).
[3]Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[4]NRC. 2012. Nutrient requirements of swine. 11th rev. ed. Natl. Acad. Press, Washington, DC.

Table 3. Common diet composition[1]

Ingredient, %	
Corn	64.50
Soybean meal	31.70
Calcium carbonate	1.05
Monocalcium phosphate	1.05
Salt	0.60
L-Lys-HCl	0.38
DL-Met	0.13
L-Thr	0.14
L-Trp	0.01
Trace mineral premix	0.15
Vitamin premix	0.25
Phytase[2]	0.05
Total	100.0
Calculated analysis	
Standardized ileal digestible AA, %	
Lysine	1.25
Isoleucine:lysine	60
Leucine:lysine	124
Methionine:lysine	33
Methionine and cystine:lysine	55
Threonine:lysine	62
Tryptophan:lysine	18.5
Valine:lysine	65
Histidine:lysine	39
Total lysine, %	1.40
Metabolizable energy, kcal/lb	1,480
Net energy NRC,[3] kcal/lb	1,092
SID Lys:NE, g/Mcal	5.19
Crude protein, %	21.0
Ca, %	0.77
P, %	0.62
STTD P, %	0.44

[1]Diet was fed for 14 d from approximately 32 to 54 lbs.
[2]Ronozyme Hiphos 2700 (DSM Nutritional Products, Inc., Parsippany, NJ), providing 184.3 phytase units (FTU)/lb and an estimated release of 0.10% available P.
[3]NRC. 2012. Nutrient requirements of swine. 11th rev. ed. Natl. Acad. Press, Washington, DC.

Table 4. Diet analysis[1]

	Oat groats, %				
Item	0.0	7.5	15.0	22.5	30.0
Chemical analysis, %					
Dry matter	90.82	90.28	90.66	90.64	90.77
Crude protein	21.30	22.50	22.60	23.20	22.60
Crude fiber	2.00	1.90	2.00	2.00	1.90
Ca	0.88	0.91	0.82	0.89	0.83
P	0.69	0.67	0.65	0.72	0.67
Particle size[2]					
Dgw, μm	475	483	497	533	509
Sgw	3.08	3.11	3.17	3.08	3.27

[1]Diets were analyzed for chemical composition at Ward Laboratories Inc. (Kearney, NE).
[2]Particle size analysis was done at Bioprocessing & Industrial Value Added Products (Manhattan, KS).

Table 5. Effects of oat groats on nursery pig performance (Exp. 1)[1]

	Oat groats, %						*P* <	
Item	0	7.5	15	22.5	30	SEM	Linear	Quadratic
Experimental period (d 0 to 14)								
ADG, lb	0.76	0.71	0.80	0.77	0.75	0.024	0.65	0.605
ADFI, lb	1.01	0.96	1.02	0.98	1.00	0.038	0.917	0.719
F/G	1.32	1.34	1.28	1.27	1.33	0.029	0.615	0.191
Common period (d 14 to 28)								
ADG, lb	1.22	1.18	1.24	1.24	1.27	0.03	0.067	0.524
ADFI, lb	1.95	1.9	1.94	2.00	1.95	0.05	0.513	0.934
F/G	1.6	1.62	1.56	1.62	1.54	0.03	0.162	0.445
Overall (d 0 to 28)								
ADG, lb	0.99	0.94	1.02	1.00	1.01	0.022	0.153	0.875
ADFI, lb	1.48	1.42	1.48	1.48	1.48	0.04	0.671	0.782
F/G	1.49	1.51	1.45	1.48	1.46	0.022	0.179	0.887
BW, lb								
d 0	13.9	13.9	13.9	13.9	13.9	0.17	0.967	0.756
d 14	24.6	24.2	25.1	24.7	24.7	0.41	0.689	0.717
d 28	41.7	40.7	42.5	42.1	42.4	0.71	0.186	0.876

[1]A total of 225 nursery pigs (initially 13.9 lb BW and 28 d of age) were used in a 2-phase nursery study with 4 or 5 pigs per pen and 10 replications per treatment.
ADG = average daily gain. ADFI = average daily feed intake. F/G = feed-to-gain ratio.

Table 6. Effects of added oat groats on feed intake preference in nursery pigs[1,2]

Item	ADFI, lb	ADFI, %[3]
Comparison I		
Control	0.34	44.9
7.5% oat groats	0.38	55.1
SEM	0.061	6.42
Probability, *P* <	0.617	0.288
Comparison II		
Control	0.11	16.3
30% oat groats	0.64	83.7
SEM	0.043	3.61
Probability, *P* <	0.001	0.001

[1]A total of 48 pigs (DNA 241 × 600, initially 13.8±2.9 lb) were used in a 7-d preference trial with 4 pigs per pen and 6 replications per comparison.
[2]Feeders were rotated once daily within each pen to eliminate any location bias of feeder.
[3]ADFI, % is the percentage of total feed intake for each diet within a comparison.