Effects of Increasing Dietary Wheat Middlings on Nursery Pig Growth Performance

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Summary

A total of 180 nursery pigs (PIC 327 × 1050, initially 25.2 lb BW) were used in a 21-d trial to evaluate the effects of increasing dietary wheat middlings on growth performance. Pens of pigs were balanced by initial BW and were randomly allotted to 1 of 5 dietary treatments with 6 replications per treatment. The 5 corn-soybean meal-based diets contained 0, 5, 10, 15 or 20% wheat middlings.

Overall (d 0 to 21), pigs fed increasing wheat middlings had decreased ADG (linear, $P < 0.05$) and ADFI (linear, $P < 0.005$), but F/G was not affected by dietary wheat middlings. Despite the linear decrease in ADG and ADFI, the biggest reduction in performance was not observed until wheat middlings increased beyond 15% of the diet. This suggests that in some cases, the slight decrease in ADG with a low inclusion of wheat middlings (< 15%) to the diet might be economically justified, so its inclusion needs to be evaluated on an income over feed costs basis.

Key words: nursery pig, wheat middlings

Introduction

Wheat middlings are a wheat milling by-product consisting of fine particles of wheat bran, wheat shorts, wheat germ, and wheat flour, and contains no more than 9.5% crude fiber. With the increased price of corn, wheat middlings have become a more common ingredient in various swine diets. Wheat middlings have higher crude protein and fiber but lower dietary energy than corn (corn ME = 1,551 kcal/lb; wheat middlings ME = 1,372 kcal/lb; NRC, 1998[2]), which must be accounted for when used in swine diets.

Although extensive research has been conducted with wheat middlings and its effects on growing and finishing pigs, there is no data available on its effects in corn-soybean meal-based nursery diets. In a recent review of finishing pigs fed wheat middlings or closely related wheat co-products, it was shown that pigs fed 20% had decreased ADG and worse F/G but relatively unchanged ADFI.[3] Thus, although the effects in growing and finishing pigs have been quantified, research needs to be completed with nursery pigs to determine if a similar response exists.

Therefore, the objective of this study was to determine the effects of increasing dietary wheat middlings on growth performance of nursery pigs from 25 to 50 lb.

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[2] NRC. 1998. Nutrient Requirements of Swine, 10th ed. Natl. Acad. Press, Washington DC.

[3] Barnes et al., Swine Day 2010, Report of Progress 1038, pp. 104-114.

Procedures

The Kansas State University Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the K-State Swine Teaching and Research Center in Manhattan, KS.

A total of 180 pigs (PIC 327 × 1050, initially 25.2 lb BW and 39 d of age) were used in a 21-d growth trial to determine the effects of dietary wheat middlings on pig growth performance. Pigs were allotted to pens by initial BW, and pens were assigned to treatments in a completely randomized design with 6 pigs per pen and 6 replications per treatment. The 5 treatment diets included 0, 5, 10, 15, or 20% wheat middlings (Table 1). All diets were fed in meal form and were prepared at the K-State Animal Science Feed Mill.

Each pen contained a 4-hole, dry self-feeder and a nipple waterer to provide ad libitum access to feed and water. Pens had wire-mesh floors and allowed approximately 3 ft^2/pig. Pig weight and feed disappearance were measured on d 0, 7, 14, and 21 of the trial to determine ADG, ADFI, and F/G.

Wheat middling and complete diet samples were collected and submitted to Ward Laboratories, Inc. (Kearney, NE) for analysis of DM, CP, ADF, NDF, CF, Ca and P (Tables 2 and 3). In addition, bulk density of the wheat middlings and complete diets was determined.

Data were analyzed as a completely randomized design using the PROC MIXED procedure of SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Contrasts were used to compare linear and quadratic effects of increasing wheat middlings. Differences between treatments were determined by using least squares means ($P < 0.05$), and trends were declared at $P < 0.10$.

Results and Discussion

The chemical analysis of the wheat middlings (Table 2) revealed that CP levels were close to the formulated values and that crude fiber, calcium, and phosphorus were all slightly lower than the formulated values. Also, the analysis of the dietary treatments showed that ADF ranged from 3.20 to 4.10, NDF from 8.10 to 11.60, and CF from 2.40 to 3.20 across treatments, respectively. The bulk density decreased from 53.09 to 43.18 across dietary treatments.

Overall (d 0 to 21), as dietary wheat middlings increased, ADG decreased (linear; $P < 0.05$; Table 4). The reduction in ADG was primarily a result of decreased (linear; $P < 0.005$) ADFI in pigs fed increasing wheat middlings. There was no difference in F/G as wheat middlings increased. These data indicate that nursery pigs fed increasing wheat middlings responded differently than previously reported for growing and finishing pigs. Unlike finishing pigs, nursery pigs in the present study had decreased ADFI as wheat middlings increased as feed intake may have been limited by gut fill due to the low bulk density of the wheat middlings. This led to the reduction in ADG with no change in feed efficiency. On the other hand, finishing pigs increased feed intake as a response to offset the low energy in diets containing wheat middlings.

Although the ADG response was linear, ADG was reduced by only 1.5% (approximately 0.50 lb for the 21-d trial) for those pigs fed up to 15% wheat middlings. Therefore, depending on the cost of wheat middlings and the value of gain, added wheat middlings might be economically justified in some situations, so its inclusion needs to be evaluated on an income over feed costs basis.

Table 1. Diet composition (as-fed basis)[1]

	Wheat middlings, %				
Item	0	5	10	15	20
Ingredient, %					
Corn	63.75	59.95	56.25	52.45	48.7
Soybean meal (46.5% CP)	32.80	31.55	30.35	29.10	27.85
Wheat middlings	---	5.00	10.00	15.00	20.00
Monocalcium phosphate (21% P)	1.050	1.000	0.900	0.825	0.750
Limestone	0.950	0.975	1.025	1.075	1.100
Salt	0.35	0.35	0.35	0.35	0.35
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
L-Lysine HCl	0.33	0.35	0.37	0.39	0.41
DL-Methionine	0.135	0.135	0.135	0.135	0.135
L-Threonine	0.125	0.135	0.140	0.145	0.155
Phytase[2]	0.125	0.125	0.125	0.125	0.125
Total	100	100	100	100	100
Calculated analysis					
Standardized ileal digestible (SID) amino acids, %					
Lysine	1.28	1.28	1.28	1.28	1.28
Isoleucine:lysine	61	61	60	59	59
Leucine:lysine	129	127	125	123	121
Methionine:lysine	34	34	33	33	33
Met & Cys:lysine	58	58	58	58	58
Threonine:lysine	63	63	63	63	63
Tryptophan:lysine	17.5	17.5	17.5	17.5	17.5
Valine:lysine	68	68	67	67	67
Total lysine, %	1.42	1.41	1.41	1.41	1.40
ME, kcal/lb	1,504	1,495	1,487	1,479	1,471
SID lysine:ME, g/Mcal	3.86	3.88	3.90	3.93	3.95
CP, %	21.2	21.1	21.0	20.9	20.9
Ca, %	0.69	0.69	0.69	0.69	0.69
P, %	0.63	0.64	0.65	0.66	0.67
Available P, %	0.42	0.42	0.42	0.42	0.42

[1] Treatment diets fed for 21 d.
[2] Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) provided 340.5 FTU/lb, with a release of 0.12% available P.

Table 2. Chemical analysis of wheat middlings (as-fed basis)

Item	Percentage
DM	89.70
CP	16.00 (15.90)[1]
ADF	9.80
NDF	30.60
Crude fiber	7.90 (7.00)
Ca	0.20 (0.12)
P	1.18 (0.93)
Bulk density, lb/bu[2]	21.94

[1] Values in parentheses indicate those used in diet formulation
[2] Bulk density of a material represents the mass per unit volume.

Table 3. Chemical analysis of diets containing wheat middlings (as-fed basis)[1]

	Wheat middlings, %				
Item, %	0	5	10	15	20
DM	89.56	88.93	89.39	89.19	89.58
CP	20.90	20.30	21.60	19.70	21.00
ADF	3.20	3.20	3.60	3.70	4.10
NDF	8.10	8.00	9.40	9.00	11.60
Crude fiber	2.40	2.40	3.00	3.00	3.20
Ca	0.75	0.85	0.86	0.90	0.87
P	0.64	0.64	0.65	0.65	0.66
Bulk density lb/bu[2]	53.09	50.69	47.80	46.91	43.18

[1] A composite sample consisting of 6 subsamples was used for analysis.
[2] Bulk density of a material represents the mass per unit volume.

Table 4. The effects of increasing wheat middlings on nursery pig growth performance[1]

	Wheat middlings, %						Probability, *P* <	
Item	0	5	10	15	20	SEM	Linear	Quadratic
d 0 to 21								
ADG, lb	1.27	1.25	1.25	1.25	1.21	0.020	0.05	0.66
ADFI, lb	2.08	2.08	1.99	2.02	1.97	0.029	0.004	0.80
F/G	1.64	1.66	1.60	1.61	1.63	0.019	0.36	0.38
Wt, lb								
d 0	26.16	26.14	26.10	26.16	26.19	0.521	0.96	0.92
d 21	52.90	52.43	52.25	52.46	51.53	0.755	0.26	0.85

[1] A total of 180 pigs (PIC 327 × 1050, initially 25.2 lb BW and 39 d of age) were used in a 21-d growth trial with 6 pigs per pen and 6 pens per treatment.