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Effects of xylanase and wheat middlings in diets for finishing pigs

Abstract

A total of 312 finishing pigs (average initial weight of 142 lb) were used in a 62-d experiment to determine the effects of xylanase and wheat middlings on growth performance, nutrient digestibility, and carcass characteristics. Treatments were a control diet based on corn-soybean meal, without and with 750 g/ton xylanase product (to supply none and 1,050 units of xylanase activity per lb of diet), and wheat middlings (none, 15%, and 30%) arranged as a 2 × 3 factorial. The pigs were sorted by sex and ancestry and blocked by weight, with 13 pigs/pen and 4 pens/treatment. Feed and water were provided on an ad libitum basis until the pigs were killed (average weight of 266 lb) at a commercial slaughter facility. Overall, there were no interactions among xylanase addition and concentration of wheat middlings in the diet for ADG, ADFI, F/G, dressing percentage, last-rib backfat thickness, or percentage carcass lean ($P>0.26$). For main effects, addition of xylanase did not change growth performance or carcass measurements ($P>0.16$), but, as concentration of wheat middlings was increased from none to 30%, there were linear decreases in overall ADG ($P<0.003$); efficiency of gain ($P<0.002$); hot carcass weight ($P<0.001$); dressing percentage ($P<0.002$); and digestibility of DM ($P<0.001$), N ($P<0.04$), and GE ($P<0.001$). Last-rib backfat thickness ($P<0.06$) decreased and percentage carcass lean increased ($P<0.03$) as wheat middlings concentration in the diet was increased from none to 30%. But these improvements in carcass leanness resulted from the light carcasses for pigs fed wheat middlings, and disappeared when hot carcass weight was used as a covariate ($P>0.12$). In conclusion, increasing the concentration of wheat middlings, in diets from none to 30% reduced growth performance and nutrient digestibility in finishing pigs. Addition of xylanase did not prevent these negative effects.; Swine Day, 2006, Kansas State University, Manhattan, KS, 2006

Keywords

Kansas Agricultural Experiment Station contribution; no. 08-83-S; Swine day, 2006; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 966; Finishing pig; Wheat middlings; Xylanase; Swine

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EFFECTS OF XYLANASE AND WHEAT MIDLINGS IN DIETS FOR FINISHING PIGS

C. Feoli, J. D. Hancock, C. R. Monge,
C. L. Jones, and C. W. Starkey

Summary

A total of 312 finishing pigs (average initial weight of 142 lb) were used in a 62-d experiment to determine the effects of xylanase and wheat middlings on growth performance, nutrient digestibility, and carcass characteristics. Treatments were a control diet based on corn-soybean meal, without and with 750 g/ton xylanase product (to supply none and 1,050 units of xylanase activity per lb of diet), and wheat middlings (none, 15%, and 30%) arranged as a 2×3 factorial. The pigs were sorted by sex and ancestry and blocked by weight, with 13 pigs/pen and 4 pens/treatment. Feed and water were provided on an *ad libitum* basis until the pigs were killed (average weight of 266 lb) at a commercial slaughter facility. Overall, there were no interactions among xylanase addition and concentration of wheat middlings in the diet for ADG, ADFI, F/G, dressing percentage, last-rib backfat thickness, or percentage carcass lean ($P>0.26$). For main effects, addition of xylanase did not change growth performance or carcass measurements ($P>0.16$), but, as concentration of wheat middlings was increased from none to 30%, there were linear decreases in overall ADG ($P<0.003$); efficiency of gain ($P<0.002$); hot carcass weight ($P<0.001$); dressing percentage ($P<0.002$); and digestibility of DM ($P<0.001$), N ($P<0.04$), and GE ($P<0.001$). Last-rib backfat thickness ($P<0.06$) decreased and percentage carcass lean increased ($P<0.03$) as wheat middlings concentration in the diet was increased from none to 30%. But these improvements in carcass leanness re-

sulted from the light carcasses for pigs fed wheat middlings, and disappeared when hot carcass weight was used as a covariate ($P>0.12$). In conclusion, increasing the concentration of wheat middlings, in diets from none to 30% reduced growth performance and nutrient digestibility in finishing pigs. Addition of xylanase did not prevent these negative effects.

(Key Words: Finishing Pig, Wheat Middlings, Xylanase.)

Introduction

Worldwide, there is more land committed to production of wheat than to any other cereal crop. Kansas is the leading state in production and processing of wheat for human consumption, and co-products of the milling industry are easily available in the area. According to the American Association of Feed Control Officials, wheat middlings are "fine particles of wheat bran, wheat shorts, wheat germ, wheat flour, and some of the offal from the tail of the mill". Wheat has arabinoxylans (complex and difficult to digest carbohydrates) in its bran and seed coat and, unfortunately, these compounds are concentrated in middlings. Thus, wheat middlings often can be used to reduce diet costs, but their high fiber and arabinoxylan content will reduce nutrient density, and possibly the digestibility of nutrients. Therefore, the objective of the experiment was to determine the effects of a xylanase enzyme (added to help digest the arabinoxylans in wheat middlings) on growth performance, nu-

trient digestibility, and carcass characteristics in finishing pigs.

Procedures

A total of 312 finishing pigs (initial weight of 142 lb) were used in a 62-d growth assay. The pigs were sorted by sex and ancestry, blocked by weight, and assigned to pens. There were 13 pigs/pen and 4 pens/treatment. The experimental diets were fed in two phases and formulated to 1.2% lysine, 0.65% Ca, and 0.25% available P for d 0 to 30, and 0.9% lysine, 0.60% Ca, and 0.22% available P for d 30 to 62 (Table 1). Treatments were a diet based on corn-soybean meal, without and with xylanase product (added as 750 g/ton of Safizym® XP 500 to supply 1,051 units of xylanase activity per lb of diet) and wheat middlings (none, 15%, and 30%).

Pigs and feeders were weighed on d 0, 30, and 62 to allow calculation of ADG, ADFI, and F/G. Approximately mid-experiment, 0.25% chromium oxide was added to the diets as an indigestibility marker, and fecal samples were collected (d 35). Concentrations of DM, N, GE, and Cr in the diets and feces were determined to allow calculation of apparent digestibilities. Feed and water were provided on an *ad libitum* basis until the pigs were killed on d 62 (average weight of 266 lb). The carcass data that were collected included hot carcass weight, last-rib backfat thickness, dressing percentage, and percentage carcass lean. All data were analyzed as a 2 × 3 factorial, with main effects of xylanase addition and amount of wheat middlings in the diet.

Results and Discussion

For d 0 to 30, there were no interactions ($P>0.28$) among xylanase addition and concentration of wheat middlings in the diet for ADG, ADFI, or F/G (Table 2). For main effects, addition of xylanase did not affect growth performance, but as wheat middlings concentration in the diet was increased from none to 30%, there were linear decreases in rate ($P<0.02$) and efficiency ($P<0.08$) of gain. Overall, pigs fed diets with increasing concentrations of wheat middlings had lower ADG and poorer F/G (linear effects at $P<0.003$ and 0.002, respectively). Apparent digestibility of DM, N, and GE decreased by 10% (linear effect, $P<0.001$), 6% (linear effect, $P<0.04$), and 10% (linear effect, $P<0.001$), respectively, as wheat middlings in the diet increased.

For carcass characteristics, as concentration of wheat middlings was increased in the diet, last-rib backfat thickness decreased ($P<0.06$) and percentage carcass lean increased ($P<0.03$). But hot carcass weight was 10 lb less (linear effect, $P<0.001$) for pigs fed 30% wheat middlings, compared with weight of pigs fed the control diet. When hot carcass weight was used as a covariate in statistical analyses, the advantages in carcass leanness with addition of wheat middlings disappeared ($P>0.12$).

In conclusion, increasing the concentration of wheat middlings in diets for finishing pigs reduced rate and efficiency of gain and apparent digestibility of DM, N, and GE. Addition of xylanase did not prevent these effects.

Table 1. Composition of Diets

Ingredient, %	Day 0 to 30 ^b			Day 30 to 62 ^b		
	0% Midds	15% Midds	30% Midds	0% Midds	15% Midds	30% Midds
Corn	67.17	55.87	44.60	76.36	65.09	53.75
Soybean meal	27.70	24.01	20.32	18.87	15.18	11.56
Wheat middlings	-	15.00	30.00	--	15.00	30.00
Soy oil	2.00	2.00	2.00	2.00	2.00	2.00
Limestone	1.10	1.20	1.30	1.08	1.17	1.27
Monocalcium phosphate	0.84	0.62	0.40	0.76	0.54	0.32
Salt	0.35	0.35	0.35	0.30	0.30	0.30
Lysine HCl	0.27	0.34	0.40	0.19	0.26	0.32
Threonine	0.08	0.11	0.13	0.06	0.08	0.10
Methionine	0.06	0.07	0.07	-	-	-
KSU vitamin premix	0.20	0.20	0.20	0.15	0.15	0.15
KSU mineral premix	0.10	0.10	0.10	0.10	0.10	0.10
Antibiotic ^a	0.13	0.13	0.13	0.13	0.13	0.13
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated Analysis						
Lysine, %	1.20	1.20	1.20	0.90	0.90	0.90
Met:lys ratio, %	30	30	30	28	27	27
Met & Cys:lys ratio, %	57	57	57	59	59	58
Threonine:lys ratio, %	64	64	64	68	68	68
Tryptophan:lys ratio, %	18	18	18	18	18	18
ME, Kcal/lb	3393	3340	3286	3412	3359	3306
Calcium, %	0.65	0.65	0.65	0.60	0.60	0.60
Phosphorus, %	0.55	0.59	0.62	0.50	0.54	0.57
Available phosphorus, %	0.25	0.25	0.25	0.22	0.22	0.22
Sodium, %	0.16	0.16	0.17	0.14	0.14	0.15
Chloride, %	0.25	0.25	0.25	0.22	0.22	0.22

^aTo provide 100 g/ton of tylosin.

^bFor the enzyme additions, Safizym® XP 500 was added (750 g/ton) to provide 1,051 units of xylanase activity per lb of diet.

Table 2. Effects of Xylanase and Wheat Middlings in Diets for Finishing Pigs^a

Item	Without Xylanase			With Xylanase			SE	P value				
	0% Midds	15% Midds	30% Midds	0% Midds	15% Midds	30% Midds		Xylanase (1)	Midds Lin (2)	Midds Quad (3)	1 × 2	1 × 3
d 0 to 30												
ADG, lb	2.18	2.16	2.03	2.18	2.12	2.05	0.12	-	0.02	-	-	-
ADFI, lb	6.04	6.12	5.86	6.10	6.04	5.98	0.27	-	0.14	-	-	-
F/G	2.77	2.83	2.89	2.80	2.85	2.92	0.15	-	0.09	-	-	-
d 0 to 62												
ADG, lb	2.08	2.02	1.95	2.09	2.02	1.97	0.08	-	0.003	-	-	-
ADFI, lb	6.31	6.53	6.41	6.53	6.52	6.63	0.30	-	-	-	-	-
F/G	3.03	3.23	3.29	3.12	3.23	3.37	0.16	-	0.002	-	-	-
DM dig (d 35), %	83.6	80.1	75.9	83.9	81.1	74.5	1.3	-	0.001	-	-	-
N dig (d 35), %	78.8	79.3	74.6	80.5	79.8	74.8	2.3	-	0.04	-	-	-
GE dig (d 35), %	82.6	79.4	75.9	83.6	80.5	74.5	1.4	-	0.001	-	-	-
HCW, lb	201.5	198.0	191.5	201.5	197.2	194.0	3.6	-	0.001	-	-	-
Dress, % ^b	74.6	74.3	73.2	74.5	74.1	73.5	0.4	-	0.002	-	-	-
Last-rib backfat, in ^b	0.9	0.8	0.8	0.9	0.8	0.9	0.1	-	0.06	-	-	-
Carcass lean, % ^b	52.9	53.3	53.7	52.6	53.4	53.1	0.9	-	0.03	-	-	-

^aA total of 312 finishing pigs (13 pigs per pen and 4 pens per treatment) with an average initial weight of 142 lb.

^bEffects of wheat middlings on carcass traits disappeared ($P > 0.12$) when the data were adjusted to the same hot carcass weight.

^cDashes indicate $P > 0.15$.