

The Interactive Effects of Easyzyme and Phytase in Diets Containing High-Fiber Co-Products on Growth Performance of Nursery Pigs¹

A. B. Graham, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, S. S. Dritz², S. Nitikanchana², J. A. De Jong, and J. L. Nelssen

Summary

Two experiments were conducted to determine the effects of a dietary non-starch polysaccharide enzyme (Easyzyme, Archer Daniels Midland Co., Decatur, IL) or phytase (Phyzyme, Danisco Animal Nutrition, St. Louis, MO) addition in corn-soybean meal or high-fiber diets on nursery pig growth performance. In Exp. 1, 192 nursery pigs (PIC 327 × 1050, initially 21.8 lb) were allotted to 1 of 4 dietary treatments arranged in a 2 × 2 factorial. Main effects were diet type (corn-soybean meal or corn-soybean meal plus 30% wheat middlings) with or without added dietary enzyme (Easyzyme Mixer 1, 1 lb/ton). Each experiment involved 6 pigs per pen and 8 replications per treatment. All diets contained 340.5 phytase units (FTU)/lb. From d 0 to 21, pigs fed corn-soybean meal diets had greater ($P < 0.001$) ADG than those fed diets containing 30% wheat midds. Added Easyzyme had no effect on ADG. ADFI and F/G exhibited a diet type × Easyzyme interaction ($P < 0.03$). In corn-soybean meal diets, Easyzyme had no effect on ADFI or F/G, whereas in diets containing 30% wheat midds, Easyzyme increased ADFI and worsened F/G.

In Exp. 2, 350 nursery pigs (PIC 1050, initially 25.5 lb) were allotted to 1 of 7 dietary treatments arranged in a 2 × 3 factorial plus control. Pigs were fed either a corn-soybean meal-based diet with no Easyzyme or phytase (Phyzyme) or 1 of 6 diets containing 10% wheat midds, 10% hominy, and 10% corn germ meal with or without Easyzyme and 0, 500, or 1,200 FTU/kg phytase. In this experiment, available P was formulated to the pig's requirement before adding phytase to determine if it affected the digestibility of other nutrients that might enhance growth performance. In the experiment with 5 pigs per pen and 10 replications per treatment, from d 0 to 21, pigs fed the control corn-soybean meal-based diet had greater ADG, ADFI, and better F/G than pigs fed co-product-based diets. Added Easyzyme had no effect on ADG and ADFI, but worsened F/G. Increasing phytase had no effect on ADG, ADFI, or F/G. These results suggest that adding high-fiber co-products to diets decreased ADG and worsened F/G compared with corn-soybean meal diets. Added Easyzyme or high concentrations of phytase in diets adequate in P had no positive effects on growth performance.

Key words: by-products, enzyme, fiber, phytase, nursery pig

¹ Appreciation is expressed to Archer Daniels Midland Co., Decatur, IL, for providing the Easyzyme used in these experiments and for partial financial support.

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

Introduction

Co-product ingredients are increasingly used to reduce ever-rising feed costs. Diet formulation must account for the fact that most co-product ingredients are higher in fiber and lower in energy than corn (corn ME = 1,551 kcal/lb; wheat middlings ME = 1,372 kcal/lb; NRC, 1998³). Wheat middlings (midds), a co-product of wheat milling, are often used in swine diets, but the high fiber concentration in wheat midds has proven to have negative effects on growth performance in the nursery. In a recent study, increasing wheat midds decreased ADG as a result of decreased ADFI (De Jong et al., 2011⁴).

Because of the high fiber in diets containing wheat midds, supplemental enzymes are often added to the diet in hopes of making the fiber more digestible and improving growth performance. A recent hypothesis is that added phytase in diets already adequate in available P could potentially increase digestibility of nutrients other than P.

The objective of these experiments was to compare growth performance of pigs fed corn-soybean meal-based diets to those fed diets containing high levels of co-product ingredients with or without the addition of a dietary non-starch polysaccharide enzyme (Easzyme, Archer Daniels Midland Co., Decatur, IL) or supplemental phytase (Phyzyme, Danisco Animal Nutrition, St. Louis, MO).

Procedures

The protocol for this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. Experiment 1 was conducted at the Kansas State University Swine Teaching and Research Center, and Exp. 2 was conducted at the K-State Segregated Early Weaning Facility, Manhattan, KS.

In Exp. 1, a total of 192 nursery pigs (PIC 327 × 1050, initially 21.8 lb and 35 d of age) were used in a 21-d trial to determine the effects of a dietary non-starch polysaccharide enzyme, Easzyme, in corn-soybean meal or high-fiber diets on nursery pig growth performance. After weaning, pigs were fed common pretest diets for 15 d. Pens of pigs were then allotted to 1 of 4 dietary treatments with 6 pigs per pen and 8 replications per treatment. Each pen (5 ft × 5 ft) had metal slatted floors, one 5-hole self-feeder, and a nipple waterer. Throughout the study, the pigs had ad libitum access to feed and water.

The dietary treatments were arranged in a 2 × 2 factorial with main effects of diet type (corn-soybean meal vs. corn-soybean meal plus 30% wheat midds) with or without Easzyme (Table 1). All diets contained phytase at 340.5 FTU/lb of complete diet. All pigs and feeders were weighed on d 0, 7, 14, and 21 to determine ADG, ADFI, and F/G.

In Exp. 2, the objective was not only to evaluate Easzyme in high-co-product diets, but also to examine the effects of superdosing phytase in diets with adequate available P. A total of 350 nursery pigs (PIC 1050, initially 25.5 lb and 42 d of age) were used in a 21-d trial to determine the effects of Easzyme and Phyzyme addition in corn-soybean meal or high-fiber co-product diets on nursery pig growth performance. Pigs were fed

³ NRC. 1998. Nutrient Requirements of Swine. 10th ed. Natl. Acad. Press, Washington, DC.

⁴ De Jong et al., Swine Day 2011, Report of Progress 1056, pp. 114.

either a corn-soybean meal–based diet with no Easyzyme or Phyzyme or 1 of 6 diets containing 10% wheat midds, 10% hominy, and 10% corn germ meal with or without Easyzyme and 0, 500, or 1,200 FTU/kg phytase (Table 2). The assigned ME energy values in diet formulation for wheat midds, hominy, and corn germ meal were 1,372, 1,456, and 1,399 kcal/lb, respectively. Hominy and corn germ meal were provided by Archer Daniels Midland.

After arrival at the nursery, pigs were fed common pretest diets for 21 d. Pens of pigs were then allotted to 1 of 7 dietary treatments with 5 pigs per pen and 10 replications per treatment. Each pen (4 ft × 5 ft) had slatted floors, one 5-hole self-feeder, and a nipple waterer. Throughout the study, the pigs had ad libitum access to feed and water.

Data were analyzed in a completely randomized design with pen as the experimental unit. Analysis of variance was used with the MIXED procedure of SAS (SAS Institute, Inc., Cary, NC). Exp. 1 evaluated main effects of diet type and added Easyzyme and their interaction. In Exp. 2, contrasts were made to compare diet type (corn-soybean meal vs. high-fiber co-product diets), then main effects of added Easyzyme and increasing Phyzyme and their interaction were evaluated within the high-fiber co-product diets.

Results and Discussion

In Exp. 1, pigs fed the corn-soybean meal–based diet had 8% greater ($P < 0.001$) ADG than pigs fed the diets with 30% wheat midds (Table 3). This ADG response is consistent with the findings of De Jong et al. (2011⁴), who observed a 6% decrease in ADG with the addition of 20% wheat midds. In the present study, there was a diet type × enzyme interaction ($P < 0.03$) for ADFI and F/G. In pigs fed the corn-soybean meal diet, addition of Easyzyme had no effect on ADFI or F/G, but in pigs fed diets with 30% wheat midds, added Easyzyme increased ADFI and worsened F/G. Jones et al. (2010⁵) observed no improvement in pig growth performance when diets contained 30% dried distillers grains with solubles (DDGS) with or without Easyzyme, the same enzyme used in this experiment. Jacela et al. (2010⁶) also observed no beneficial effects on pig growth or feed efficiency for a variety of dietary enzymes in either corn- or corn-DDGS–based diets.

For Exp. 2, similar to Exp. 1, pigs fed the corn-soybean meal–based diet had 9% greater ADG and 6% better F/G ($P < 0.001$) than pigs fed the co-product-based diet (Tables 4 and 5), and added Easyzyme had no effect on ADG or ADFI but worsened ($P < 0.001$) F/G.

Added phytase improves the digestibility of phytate P in feed ingredients for swine and poultry. In addition, phytase may improve the digestibility of other nutrients in the diet. The diets in Exp. 2 were adequate in P; therefore, the objective was to determine if

⁵ Jones, C. K., J. R. Bergstrom, M. D. Tokach, J. M. DeRouchey, R. D. Goodband, J. L. Nelssen, and S. S. Dritz. 2010. Efficacy of commercial enzymes in diets containing a variety of levels and sources of dried distillers grains with solubles for nursery pigs. *J. Anim. Sci.* 88:2084–2091.

⁶ Jacela, J. Y., S. S. Dritz, J. M. DeRouchey, M. D. Tokach, R. D. Goodband, and J. L. Nelssen. 2010. Effects of supplemental enzymes in diets containing dried distillers grains with solubles on finishing pig growth performance. *Prof. Anim. Sci.* 26:425–434.

high levels of phytase might positively affect pig performance. In this study, increasing added phytase had no effect on ADG or F/G (Table 6).

In conclusion, with the high-fiber co-product diets used in these experiments, neither Easyzyme nor added phytase improved pig performance.

Table 1. Composition of diets, Exp. 1 (as-fed basis)¹

Item	Corn-soybean meal	30% wheat middlings
Ingredient %		
Corn	63.74	41.17
Soybean meal, 46.5% CP	32.79	25.41
Wheat middlings	---	30.00
Monocalcium P, 21% P	1.05	0.60
Limestone	0.95	1.20
Salt	0.350	0.35
Vitamin premix	0.250	0.25
Trace mineral premix	0.150	0.15
L-lysine HCl	0.330	0.45
DL-methionine	0.14	0.14
L-threonine	0.13	0.17
Phytase 600 ²	0.13	0.13
Easyzyme Mixer 1 ³	---	---
Total	100	100
Calculated analysis		
Standard ileal digestible (SID) amino acids, %		
Lysine	1.28	1.28
Isoleucine:lysine	61	57
Leucine:lysine	129	117
Methionine:lysine	34	33
Met & Cys:lysine	58	58
Threonine:lysine	63	63
Tryptophan:lysine	17	17
Valine:lysine	68	66
Total lysine, %	1.42	1.40
ME, kcal/lb	1,504	1,455
SID lysine:ME, g/Mcal	3.86	3.99
CP, %	21.15	20.71
Ca, %	0.69	0.70
P, %	0.63	0.70
Available P, %	0.42	0.42

¹ Treatment diets fed for 21 d.

² Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) provided 340.5 phytase units (FTU)/lb, with a release of 0.12% available P.

³ Easyzyme Mixer 1 (Archer Daniels Midland Company, Decatur, IL) was added to the diet in place of corn at a rate of 1lb/ton.

Table 2. Composition of diets, Exp. 2 (as-fed basis)¹

Item	Corn-soy	High fiber co-products
Ingredient, %		
Corn	62.05	26.65
Soybean meal, 46.5% CP	33.95	29.45
Hominy feed	---	10.00
Wheat middlings	---	20.00
Corn germ	---	10.00
Monocalcium P, 21% P	1.65	1.15
Limestone	1.20	1.45
Salt	0.35	0.35
Vitamin premix	0.15	0.15
Trace mineral premix	0.15	0.15
L-lysine HCl	0.30	0.38
DL-methionine	0.13	0.15
L-threonine	0.12	0.15
Phytase 600 ²	---	---
Easyzyme Mixer 1 ³	---	---
Total	100	100
Calculated analysis		
Standard ileal digestible (SID) amino acids, %		
Lysine, %	1.28	1.28
Isoleucine:lysine	63	59
Leucine:lysine	130	116
Methionine:lysine	33	34
Met & Cys:lysine	58	58
Threonine:lysine	63	63
Tryptophan:lysine	18	18
Valine:lysine	69	1
Total lysine, %	1.42	1.48
ME, kcal/lb	1,493	1,438
SID lysine:ME ratio, g/Mcal	3.89	4.04
CP, %	21.50	22.20
Ca, %	0.90	0.90
P, %	0.75	0.87
Available P, %	0.42	0.42

¹ Treatment diets fed for 21 d.

² Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO) was added in place of corn to provide either 500 or 1200 phytase units (FTU)/kg phytase.

³ Easyzyme Mixer 1 (Archer Daniels Midland Co., Decatur, IL) was added in place of corn at a rate of 1lb/ton.

Table 3. Effects of wheat middlings and Easyzyme on nursery pig performance (Exp. 1)¹

Item	Easyzyme:	Corn-soybean meal		30% wheat midds		SEM	Enzyme × diet type	Enzyme	Diet type
		No	Yes	No	Yes				
Initial wt, lb		21.85	21.84	21.82	21.81	0.34	1.00	0.99	0.93
d 0 to 21									
ADG, lb		1.19 ^b	1.21 ^b	1.12 ^a	1.10 ^a	0.02	0.34	1.00	0.0003
ADFI, lb		1.92 ^a	1.88 ^a	1.89 ^a	2.03 ^b	0.04	0.03	0.18	0.14
F/G		1.61 ^{ab}	1.55 ^a	1.69 ^b	1.85 ^c	0.04	0.01	0.15	0.001
Final wt, lb		46.87	47.33	45.33	44.86	0.62	0.46	0.99	0.003

^{a,b,c} Within a row, means without a common superscript differ ($P < 0.05$).

¹ A total of 192 pigs (PIC 327 × 1050, initially 21.83 lb BW and 35 d of age) were used in a 21-d growth trial with 6 pigs per pen and 8 replications per treatment.

Table 4. Effects of high-fiber co-products, phytase, and Easyzyme on nursery pig performance (Exp. 2)¹

		Corn-soy diet	Co-product diet												
		No phytase	No phytase		500 FTU ² /kg phytase		1,200 FTU/kg phytase		Enzyme × phytase		Enzyme	Phytase			
Item	Easyzyme:	No	No	Yes	No	Yes	No	Yes	SEM	Linear	Quadratic	Diet type	effect	Linear	Quadratic
Initial wt, lb		25.79	25.28	25.20	25.75	25.76	25.78	25.20	0.53	0.62	0.75	0.61	0.61	0.70	0.37
d 0 to 21															
ADG, lb		1.22	1.12	1.12	1.11	1.11	1.17	1.09	0.03	0.20	0.62	0.004	0.39	0.69	0.61
ADFI, lb		1.91	1.85	1.89	1.82	1.90	1.85	1.86	0.06	0.67	0.49	0.34	0.22	0.80	0.87
F/G		1.57	1.66	1.69	1.64	1.72	1.59	1.71	0.03	0.08	0.80	0.001	0.001	0.41	0.50
Final wt, lb		51.38	48.30	48.24	49.52	48.90	50.25	48.33	1.15	0.41	0.91	0.05	0.36	0.40	0.61

¹ A total of 350 pigs (PIC 1050, initially 25.53 lb BW and 42 d of age) were used in a 21-d growth trial with 5 pigs per pen and 10 replications per treatment.

² FTU: phytase units.

Table 5. Main effects of Easyzyme inclusion in high-fiber co-product nursery diets (Exp. 2)¹

Item	Easyzyme ²		SEM	P-value
	No	Yes		
Initial wt, lb	25.60	25.38	0.30	0.64
ADG, lb	1.13	1.11	0.02	0.37
ADFI, lb	1.84	1.89	0.05	0.24
F/G	1.63	1.70	0.02	0.001
Final wt, lb	49.36	48.49	0.66	0.38

¹ A total of 350 pigs (PIC 1050, initially 25.53 lb BW and 42 d of age) were used in a 21-d growth trial with 5 pigs per pen and 10 replications per treatment.

² Easyzyme Mixer 1 (Archer Daniels Midland Company, Decatur, IL) was added in place of corn at a rate of 1 lb/ton.

Table 6. Main effects of added phytase in high-fiber nursery diets (Exp. 2)¹

Item	Phytase, FTU/kg ²			SEM	Probability, P<	
	0	500	1,200		Linear	Quadratic
Initial wt, lb	25.24	25.76	25.49	0.37	0.70	0.37
ADG, lb	1.12	1.11	1.13	0.02	0.69	0.61
ADFI, lb	1.87	1.86	1.86	0.05	0.80	0.87
F/G	1.67	1.68	1.65	0.03	0.41	0.50
Final wt, lb	48.27	49.21	49.29	0.81	0.40	0.61

¹ A total of 350 pigs (PIC 1050, initially 25.53 lb BW and 42 d of age) were used in a 21-d growth trial with 5 pigs per pen and 10 replications per treatment.

² Phyzyme 600 (Danisco Animal Nutrition, St. Louis, MO.) was added in place of corn to provide either 500 or 1,200 phytase units (FTU)/kg phytase.