Interaction of Dietary Energy and Phytase on Performance of Weanling Pigs

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SUMMARY

Adding 500 FTU/kg phytase enzyme to a barley, corn, SBM diet improved the performance of weanling pigs, regardless of the energy content of the diet. Growth of pigs fed low energy diets deficient in available phosphorus was equal to that of a high energy diet with sufficient aP (available phosphorus).

INTRODUCTION

Approximately 60 to 80% of the phosphorus (P) in cereal grains and oil seeds is bound to phytate and unavailable to monograstics, including swine. Supplementing swine diets with the phytase enzyme improves P availability and retention (ie. Prairie Swine Centre, Inc., Annual Research Report, 2004). The phytate molecule complexes other minerals, proteins, and starch, however, the research examining the effect of the phytase enzyme on the utilization of these nutrients has demonstrated inconsistent responses and the conclusions are equivocal.

Phytase, a protein, is subject to heat damage and is thus not suitable for use in pelleted diets. However, the developer of the enzyme used in this study reported improved thermotolerance, thus we examined the efficacy of this enzyme in pelleted diets. The overall objective of this experiment was to examine the interaction between phytase and dietary energy content. Secondly, the results we report are relevant for producers using pelleted feed.

EXPERIMENTAL PROCEDURES

The experiment used a total of 406 pigs housed in two nurseries of 28 pens each. Pigs were started on the 42-day trial at 5 days post weaning (9.30 ± 0.51 kg). Pigs were blocked by weight and assigned to one of 7 dietary treatments. The treatments consisted of a positive control (PC) and 6 treatments arranged as a 3 x 2 factorial (3 dietary energy levels x 2 phytase levels). Diets were fed in two phases; phase 1 was fed for 2 weeks and phase 2 for 4 weeks. Diets were formulated using barley, corn, soybean meal, canola oil, spray dried plasma, red blood cells, and the necessary minerals, vitamins and amino acids to meet the requirements (except P) for pigs of this age. Energy, Ca and P content of the treatment diets is described in Table 1.

RESULTS AND DISCUSSION

Supplementing diets with 500 FTU phytase/kg increased average daily gain (ADG) from 500 to 560 g/d ($P < 0.01$), feed intake (ADFI) from 900 to 950 g/d ($P < 0.01$) and feed efficiency (FCE) from 0.58 to 0.62 ($P < 0.05$; Figure 1, Table 2). Increasing the energy content linearly improved ADG and FCE ($P < 0.02$), and quadratically improved ADFI ($P < 0.03$). The phytase by energy interaction was not significant for any performance variable. This indicates that the improvement observed with phytase is not dependent on dietary energy content (Table 2).

'Improved performance was observed when weanling pigs were fed lower energy diets supplemented with phytase.'

The ADG of pigs fed the PC diet, which was formulated to be adequate in Ca and P, and was higher in energy than the treatment diets, was similar to the ADG of pigs fed a diet containing 3.45 Mcal DE/kg regardless of phytase supplementation. When the pigs were fed the lower energy and 0 phytase treatment diets (treatments 4 and 6) the ADG was lower than seen with the PC ($P < 0.05$). However, the ADG of the low energy treatment diets was similar to the PC when these diets were supplemented with phytase ($P > 0.05$; Figure 1). From these results we conclude that the phytase enzyme, either directly or indirectly, improved energy availability to the pigs fed the lower energy diets in this experiment.

In our earlier work , the apparent digestibility of energy was not affected when weanling pigs were fed diets supplemented with 500 FTU/kg phytase. This both agrees and disagrees with various experiments reported by others. This discrepancy may be due to differences among experiments in nutrient concentrations, ingredients and length of feeding period. Explaining the effect of the phytase enzyme on overall performance is apparently more complex than simply meeting the P requirements of the pig.

CONCLUSION

An improvement in performance was observed when weanling pigs were fed lower energy diets and supplemented with phytase. Further research is needed to fully understand the mechanism responsible for this observation. The phytase enzyme continued to work even when used in pelleted diets.

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Table 1. Energy, calcium and phosphorous content of the experimental diets (as fed basis) compared to the requirements (NRC, 1998) for pigs of this weight class

Treatment	1	2	3	4	5	6	7	Requirement
Phytase, FTU/kg	0	0	500	0	500	0	500	
				Phase 1				10-22kg
DE, Mcal/kg	3.48	3.45	3.45	3.41	3.41	3.37	3.37	
Ca, %	0.70	0.58	0.58	0.58	0.58	0.58	0.58	0.70
tP, %	0.58	0.45	0.45	0.45	0.45	0.45	0.45	0.60
aPa, %	0.32	0.18	0.18	0.18	0.18	0.18	0.18	0.32
aPb, %	0.32	0.18	0.32	0.18	0.32	0.18	0.32	
				Phase 2				20-50 kg
DE, Mcal/kg	3.52	3.49	3.49	3.49	3.49	3.49	3.49	
Ca, %	0.60	0.48	0.48	0.48	0.48	0.48	0.48	0.60
tP, %	0.53	0.39	0.39	0.39	0.39	0.39	0.39	0.50
aPa, %	0.23	0.09	0.09	0.09	0.09	0.09	0.09	0.23
aPb, %	0.23	0.09	0.23	0.09	0.23	0.09	0.23	

[a]The available P content assuming the phytase enzyme is ineffective.
[b]The available P content using the values reported by the enzyme manufacturer for improvements in P availability.

Table 2. The performance response of weanling pigs when fed diets with 0 or 500 FTU phytase/kg and increasing DE content.

Treatment	1	2	3	4	5	6	7
Phytase, FTU/kg	0	0	500	0	500	0	500
ADG, kg/d	0.58a	0.54a	0.59a	0.48b	0.55a	0.49b	0.54a
ADFI, kg/d	0.95a	0.92a	0.94a	0.85b	0.94a	0.93a	0.95a
FCE	0.63a	0.61a	0.64a	0.58b	0.62a	0.56b	0.59a
P values	ADG	ADFI	FCE				
Phytase	0.0004	0.003	0.04				
Phytase x energy	0.66	0.10	0.99				
Energy, linear[c]	0.02	0.64	0.003				
Energy, quadratic[c]	0.05	0.03	0.74				

[a,b]Means in a row with the superscript "b" (and are in bold) are different ($P < 0.05$) from the positive control (treatment #1)
[c]Analysis excluded the PC and the 500 FTU/kg phytase treatments.