Phytase improves phosphorus digestibility in lactating sows

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Take Home Message

Around two-thirds of the phosphorus (P) present in diets for lactating sows is not digested, because sows do not produce sufficient phytase themselves to detach P from its complex phytate form. We tested the efficacy of a novel phytase on nutrient digestibility in lactating sows. Three diets were prepared: 1) adequate P, 2) low P, and 3) low P + 500 units of phytase/kg diet. Feeding the low P diets supplemented with phytase increased digestibility of P compared to low P diet and did not affect sow and piglet performance. In conclusion, the addition of microbial phytase to sow diets increased P digestibility by 12%-units, reduced feed cost, and reduced P excretion. Reduced P excretion reduces the environmental footprint of swine production.

Introduction

Phosphorus (P) is an essential nutrient required by pigs for important physiological functions and must be supplied in the diet. Phosphorus is the third most expensive nutrient, after energy and protein, in swine feeding. Around two-thirds of P in cereal grains, grain by-products, and oilseed meals is in the form of a complex called phytate. Pigs lack sufficient endogenous phytase to breakdown phytate P and thus large amounts of unutilized P are excreted in feces. Manure containing high concentration of P may pollute surface and groundwater if not managed properly, and increases the environmental footprint of pig production.

Dietary phytase increased digestibility of P and Ca in piglets and grower-finisher pigs. However, data on efficacy of phytase in lactating sows are limited. Thus, effects of adding a 6-phytase on apparent total tract digestibility of P, calcium, crude protein, and energy and the performance of lactating sows were assessed.

The trial

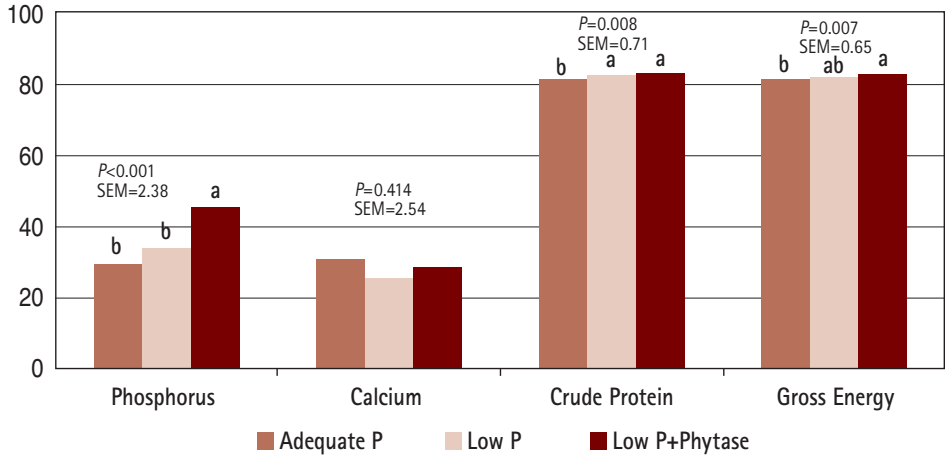
A trial was conducted to determine the impact of feeding diets supplemented with a novel bacterial 6-phytase

(Ronozyme® HiPhos; DSM Nutritional Products, Basel, Switzerland). The trial was conducted at Swine Research and Technology Centre, University of Alberta, Edmonton, Canada.

In total, 45 gestating sows (Large White x Landrace; Hypor, Regina, Saskatchewan, Canada) were housed individually and fed three experimental diets for 15 observations per diet. Major feedstuffs in the lactation diets (Table 1) were wheat, soybean meal, field pea, and corn DDGS. Three diets were prepared: 1) Adequate P, 0.52 per

CONTINUED ON PAGE 56

Figure 1. Effects of phytase supplementation on apparent total tract digestibility (%) in lactating sows



cent available P containing 1.54 per cent dicalcium phosphate as inorganic P source; 2) Low P as negative control containing 0.20 per cent available P without inorganic P; and 3) Low P plus 500 U of phytase/kg diet. The Adequate P and Low P diets were formulated to identical NE (2.425 Mcal/kg) and SID Lys (1.07 per cent). Each diet was fed to 15 randomly-selected sows for 21 days (from 5 days prior to farrowing to 15 days post farrowing).

Pregnant sows were moved to farrowing pens by 5 days prior to farrowing. Sows were fed experimental diets for a minimum adaptation of five days prior to farrowing. Feces were collected from each sow on day 15 of post farrowing. Sows were weighed before farrowing (day –5) and on day one and 15 post farrowing.

Results and Discussion

Analyzed total P content was 0.86, 0.59, and 0.59 per cent (as-fed) for the Adequate P, Low P, and Low P + Phytase diets, respectively. At d 15 post farrowing, apparent total tract digestibility of P and calcium did not differ between the Adequate P and Low P diets, but crude protein digestibility was 1.4 per cent-units higher ($P < 0.05$) for the Low P than the Adequate P diet (Figure 1). Supplementation of phytase to the

Table 1. Nutrient composition (as-fed basis) of experimental diets

Ingredients, per cent	Adequate P	Low P	Low P + Phytase
Wheat	51.6	53.5	53.5
Soybean meal	13.9	13.3	13.3
Field pea	10.0	10.0	10.0
Corn DDGS	10.0	10.0	10.0
Canola meal	6.50	6.50	6.50
Fat	2.94	2.50	2.50
Limestone	1.86	2.51	2.51
Dicalcium phosphate	1.54	-	-
Others [1]	1.01	1.01	1.01
L-Lysine•HCL	0.40	0.41	0.41
L-Threonine	0.12	0.13	0.13
Methionine hydroxy analogue	0.11	0.11	0.11
Phytase, per cent	-	-	0.005
Analyzed composition			
Dry matter, per cent	90.1	90.2	89.8
Crude protein, per cent	23.3	23.2	23.2
Gross energy, Mcal/kg	4.05	4.06	4.04
Ash, per cent	9.05	7.54	7.54
Calcium, per cent	1.29	1.17	1.16
Total phosphorus, per cent	0.86	0.59	0.59
Digestible phosphorus, per cent	0.26	0.20	0.27
Cost, $/MT	307.3	294.0	294.0 + phytase

[1]Others per cent: salt, 0.44; vitamin and mineral premix, 0.25; ethoxyquin, 0.02; and marker (TiO_2), 0.30.

Low P diet increased ($P < 0.05$) the digestibility of P by 12 per cent-units at d 15 post farrowing compared to Low P. Phytase did not affect ($P > 0.05$) the digestibility of calcium, crude protein and gross energy.

Feeding the three test diets did not affect ($P > 0.05$) feed intake, body weight changes of sows during the lactation, and litter weight gain of piglets. Sows fed the phytase supplemented diet tended to eat 15 per cent less ($P = 0.067$), all other variables were similar.

Phosphorus is a key component in the proper development and mineralization of bones. Phytate is the major P storage compound of plant feedstuffs used in swine diets. Wheat contains 0.32 per cent phytate, which can form complexes with other nutrients thereby reducing their availability. Wheat also has intrinsic phytase activity, but steam pelleting of feed will likely reduce or eliminate intrinsic phytase activity, because wheat phytase is heat-labile. In the present study, supplementation of phytase to a low available P, wheat-based diet increased the digestibility of P, thereby confirming the liberation of P from phytate by phytase. The 35 per cent increase in P digestibility could be because new generation bacterial phytases resist proteolytic digestion more than fungal phytases and are more active in hydrolyzing phytate; thus liberating more P from phytate present in plant-based feedstuffs.

While P digestibility was much higher for Low P diet + phytase than Adequate P, the digestible P content was similar for the two diets. The rest of the digestibility and performance variables were similar; thus, the economic value of phytase is equivalent to the price difference between the Low P diet + phytase and Adequate P diet: $13.30 per MT of diet. The cost difference is caused by three reasons. First, the source of digestible P switched from partially being provided by inorganic P in dicalcium phosphate to being solely provided by organic P in feedstuffs. Second, the removal of dicalcium phosphate forced more limestone into the diet to maintain calcium balance (much cheaper than dicalcium phosphate). Third, the remainder of space created by removal of dicalcium phosphate could be filled with more wheat and less soybean meal and fat in the diet. Phytase provided thus more value that strictly by improving P digestibility: the value of extra digestible P was $3.00 per MT of feed with a price of $660/MT for dicalcium phosphate.

In conclusion, supplementation of bacterial 6-phytase increased P digestibility and reduced feed cost.

Implications

Using phytase supplementation to sows, feed cost during lactation can be reduced. Phytase increases P digestibility, with the potential to reduce P excretion of lactating sows and thereby reduce the environmental footprint of swine production.

Acknowledgments

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