



Ferdinando Almeida



Finding Phosphorus Solutions for Weaned-pig Diets



Hans Stein

Refining swine diets is an on-going effort, and with such dramatic changes in feed costs, it will continue to be a long-term priority.

According to recent University of Illinois research, weanling pigs can be fed diets containing no inorganic phosphorus if the diets contain 20 percent distillers' dried grains with solubles as well as 500 units of phytase (FTU) per kg. By formulating diets with DDGS and phytase, the piglets can utilize a greater proportion of the organic phosphorus that's in the diet, which eliminates the need to add inorganic phosphorus. By formulating weaned-pig diets this way, it can reduce costs and the phosphorus excreted in the pig's manure.

Inorganic phosphorus adds cost to the diet

Diets fed to piglets contain organic phosphorus that is intrinsic in the feed ingredients — mainly corn and soybean meal. However, organic phosphorus is poorly utilized by pigs, so inorganic phosphorus in the form of dicalcium phosphate or monocalcium phosphate needs to be added to the diet in order to meet the piglet's requirement for digestible phosphorus. But dicalcium phosphate is one of the more expensive components in the diet and adds to the overall cost. Certainly that's motivation enough to look for other options.

Because of the piglet's poor utilization of organic phosphorus that's contained in the diet, considerable quantities of phosphorus are excreted in the manure,

TABLE 1. FINDING THE PHOSPHORUS BALANCE

Experiment 1 looked at the effects of phytase on phosphorus balance, the apparent total tract digestibility (ATTD) and the standardized total tract digestibility (STTD) of phosphorus in corn, soybean meal and distillers' dried grains with solubles.

FTU/kg ¹	Corn		SBM		DDGS	
	0	500	0	500	0	500
Feed intake, g/day	423	433	505	524	497	495
Phosphorus intake, g/day	1.19	1.21	1.42	1.52	2.14	2.03
Phosphorus output, g/day	0.97	0.52	0.81	0.48	0.66	0.59
ATTD of P	20%	58%	42%	68%	69%	71%
STTD of P ²	26%	64%	48%	75%	73%	76%

¹ FTU = Phytase units

² Values for STTD were calculated by correcting values of ATTD for basal endogenous losses of phosphorus (i.e., 199 mg P per kg dry-matter intake).

TABLE 2. NO NEGATIVE PERFORMANCE EFFECTS

Experiment 2 looked at the effects of distillers' dried grains with solubles and phytase on growth performance of weanling pigs fed corn/soybean meal-based diets.

FTU/kg ¹	Corn/SBM		Corn/SBM/DDGS	
	0	500	0	500
Dicalcium phosphate	1.15%	0.35%	0.65%	–
Weight in, kg	11.14	11.16	11.14	11.15
Weight out, kg	21.79	21.30	21.87	21.96
Average daily gain, kg	0.507	0.483	0.511	0.515
Average daily feed intake, kg	0.772	0.789	0.811	0.806
Gain:feed ratio	0.661	0.614	0.634	0.640

¹ FTU = Phytase units.

TABLE 3. IMPACT ON MANURE EXCRETION

Experiment 3 looked at the phosphorus balance for pigs fed diets of corn/soybean meal or corn/soybean meal/distillers' dried grains with solubles without or with microbial phytase, and the resulting influence on phosphorus manure excretion.

FTU/kg ¹	Corn/SBM		Corn/SBM/DDGS	
	0	500	0	500
Dicalcium phosphate	1.15%	0.35%	0.65%	–
Feed intake, g/day	633.3	657.8	652.8	658.0
Phosphorus intake, g/day	3.74	2.89	3.79	3.16
Phosphorus retention, g/day	2.05	2.07	2.35	2.33
Phosphorus excretion, g/day	1.68	0.82	1.43	0.82

¹ FTU = Phytase units.

and phosphorus is a regulatory concern. To avoid over-supplementation of phosphorus on cropland, swine manure needs to be spread over a large area. So finding a solution to this challenge is equally important as cost.

Three experiments

To address these issues, we conducted three experiments. In the first experiment, the standardized total tract digestibility (STTD) of phosphorus in corn, soybean meal and DDGS was measured both without and with added phytase (500 FTU per kg). The results revealed that the STTD of phosphorus in corn without phytase is 26 percent, but if phytase is added to corn, the digestibility improved to 64 percent. (See Table 1.)

For soybean meal, the STTD without and with phytase was 48 percent and 75 percent, respectively, while for DDGS, the values were 73 percent and 76 percent,

respectively. The phytase used in the experiment was Optiphos 2000.

The conclusions were that phytase is very effective in improving the STTD of phosphorus in corn and soybean meal, and that DDGS offers a much greater digestibility of phosphorus than corn and soybean meal if no phytase is used. However, if phytase is used, the STTD of phosphorus in corn and soybean meal is almost the same as in DDGS.

The values for the STTD of phosphorus in corn, soybean meal and DDGS measured in experiment 1 were used to formulate corn/soybean meal and corn/soybean meal/DDGS diets without and with microbial phytase for experiment 2. All diets were formulated to contain 0.32 percent digestible phosphorus; the two diets with DDGS contained 20 percent. The corn/soybean meal diet without phytase contained 1.15 percent dicalcium phosphate, but if phytase was added then only 0.35 percent dicalcium phosphate was needed. The corn/soybean

meal/DDGS diet contained 0.65 percent dicalcium phosphate, but if phytase was added then no dicalcium phosphate was needed.

These four diets were fed to weanling pigs from 11 to 22 kg. Performance results revealed that there were no negative effects of removing dicalcium phosphate from the diets. Pigs fed the corn/soybean meal/DDGS diet with no added dicalcium phosphate had comparable performance to pigs fed the other diets. (See Table 2.) The conclusion was that when diets are formulated on the basis of the STTD of phosphorus, growth performance of weanling pigs from 11 kg can be maintained in diets containing no dicalcium phosphate if both microbial phytase and DDGS are used.

The third experiment investigated phytase and DDGS' effects on phosphorus excretion in the manure. Four pig groups were fed diets used in experiment 2, but the pigs' feces and urine were collected to calculate the balance of phosphorus for pigs on each diet. Results indicated that the phosphorus excretion is reduced from 1.68 g per day for pigs fed the corn/soybean meal diet without phytase to 0.82 g per day for pigs fed the diet containing phytase and DDGS — a reduction of more than 50 percent. (See Table 3.)

Take-home message

The overall conclusions from these experiments are that both DDGS and phytase may be used to improve organic phosphorus utilization in diets fed to weanling pigs and that dicalcium phosphate may be reduced if either phytase or DDGS is used. If both phytase and DDGS are included in the diet, no inorganic phosphorus in the form of dicalcium phosphate is needed. Piglets weighing approximately 11 kg can be fed diets without inorganic phosphorus as long as they contain both phytase and DDGS.

If such diets are used, the phosphorus excretion in manure declines by approximately 50 percent, and because no dicalcium phosphate has to be purchased, diet cost also is reduced. **PK**