Determining Sow Performance and Mineral Requirements With Phytase Supplementation of the Lactating Sow Ration – Preliminary Report

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Introduction

Supplemental phytase offers interesting opportunities for farmers to reduce feed costs and lessen environmental pollution of minerals. Restrictions coming from Ontario's Nutrient Management Act may further increase interest about the use of supplemental phytase. In most cases the nutrient limiting quantity of hog manure that can be spread on land will likely be phosphorous. Farmers with limited land base or who wish to decrease manure transportation costs could consider phytase as a viable option to decrease phosphorous content of manure. In addition to binding up phosphorous, making it poorly available, phytate also renders calcium, iron, zinc, manganese and copper poorly available (Vohra et al. 1965). Much research has shown the effectiveness of adding phytase to hog rations to improve phosphorous availability (Ketaren et al. 1993; Young et al. 1993; Harper et al. 1997; Johnston et al. 2004; Omogbenigun et al. 2004). Recently, Shelton et al. (2004) sought to capitalize on the use of phytase to improve availability of calcium and the trace minerals as well. Shelton et al. (2004) observed no difference in growth performance and no negative response on carcass traits and pork quality when calcium and phosphorous were each reduced by 0.10% and the supplemental trace minerals were removed entirely.

Little has been done with respect to phytase with sows. Kemme et al. (1997b) observed that supplementation of phytase improved calcium, phosphorus and magnesium digestibility. They also observed that sows in different parities did not react differently to phytase supplementation in terms of mineral digestibility (Kemme et al. 1997b). Kemme et al. (1997a) and Nyachoti et al. (2004) observed an increase in calcium and phosphorus digestibility with phytase supplementation in lactating but not dry sow rations.

In lactating sows, no work has been done concerning the response due to phytase supplementation with respect to: 1) improved digestibility of trace minerals, 2) response of milk production and quality, and 3) piglet performance. Before farmers can safely incorporate such a product into their rations, these questions must be answered.

Objectives

The objectives of this project are threefold. The first is to determine whether phytase supplementation decreases the requirement for calcium, phosphorus and trace mineral supplementation for lactating sows similarly to growing-finishing hogs by determining the extent of improvement in mineral digestibility. Secondly, if there are going to be changes to the sow's nutrition, it must be determined what effect it will have on milk production and milk composition. Thirdly, and related to the previous point, any changes that occur in sow nutrition must occur for the improvement, or at least maintenance, of current piglet performance.

Experimental Procedures

After farrowing, sows were randomly assigned to one of four mineral-phytase treatments: A) calcium and phosphorus balanced at NRC levels and a trace mineral premix included with no phytase (control treatment), B) treatment A except with phytase (500 units/kg),

C) treatment A with calcium content reduced by 0.12 percentage units and phosphorus content reduced by 0.10 percentage units of NRC requirements (differential reductions set to maintain calcium to phosphorus ratio of diets across treatments) and no supplemental trace minerals with no phytase, and D) treatment C except with phytase (500 units/kg). Table 1 shows the ration content and predicted analysis of the diets.

Table 1. Diet content and predicted analysis.

	% in ration for each treatment			
Ration content	A	B	C	D
Corn	64.2	64.2	64.2	64.2
Soybean meal	29.2	29.2	29.2	29.2
Fat	3.0	3.0	3.0	3.0
Limestone	0.83	0.83	0.85	0.85
Dicalcium phosphate	1.50	1.50	0.95	0.95
Salt	0.45	0.45	0.45	0.45
Trace mineral premix	0.12	0.12	0	0
Vitamin premix	0.40	0.40	0.40	0.40
Chromic oxide	0.30	0.30	0.30	0.30
Inert filler	0.00	0.00	0.65	0.65
Phytase (units/kg)	*0*	*500*	*0*	*500*
Predicted nutrient supply				
True ileal digestible lysine (%)	0.92		0.92	
Metabolizable energy (kcal/kg)	3426		3426	
Calcium (%)	0.75		0.63	
Phosphorus, total (%)	0.66		0.56	
Phosphorus, available (%)	0.35		0.25	
Calcium to Phosphorus ratio	1.13		1.13	

Before entering the farrowing crate sow weight was recorded. All farrowing data (numbers of piglets born alive, mummified piglets and still born piglets; live born piglet weight and sex) was recorded. Piglets born within 12 h were cross-fostered to establish equal litter sizes on day 0. Pre-weaned piglet data (mortalities and weight gain) were recorded. Sow feed and water intake (individual water meters) was recorded daily. On days 14 and 28 of lactation the following samples were taken: 1) Feed and water samples were taken and frozen until further analysis. 2) During a milk let-down cycle, a milk sample was taken equally from 3 nipples (front-middle-hind). The sample was sent fresh for analysis. 3) A venous blood sample was taken from sows, centrifuged and frozen until analysis later. 4) A fecal grab sample was taken and frozen for later analysis.

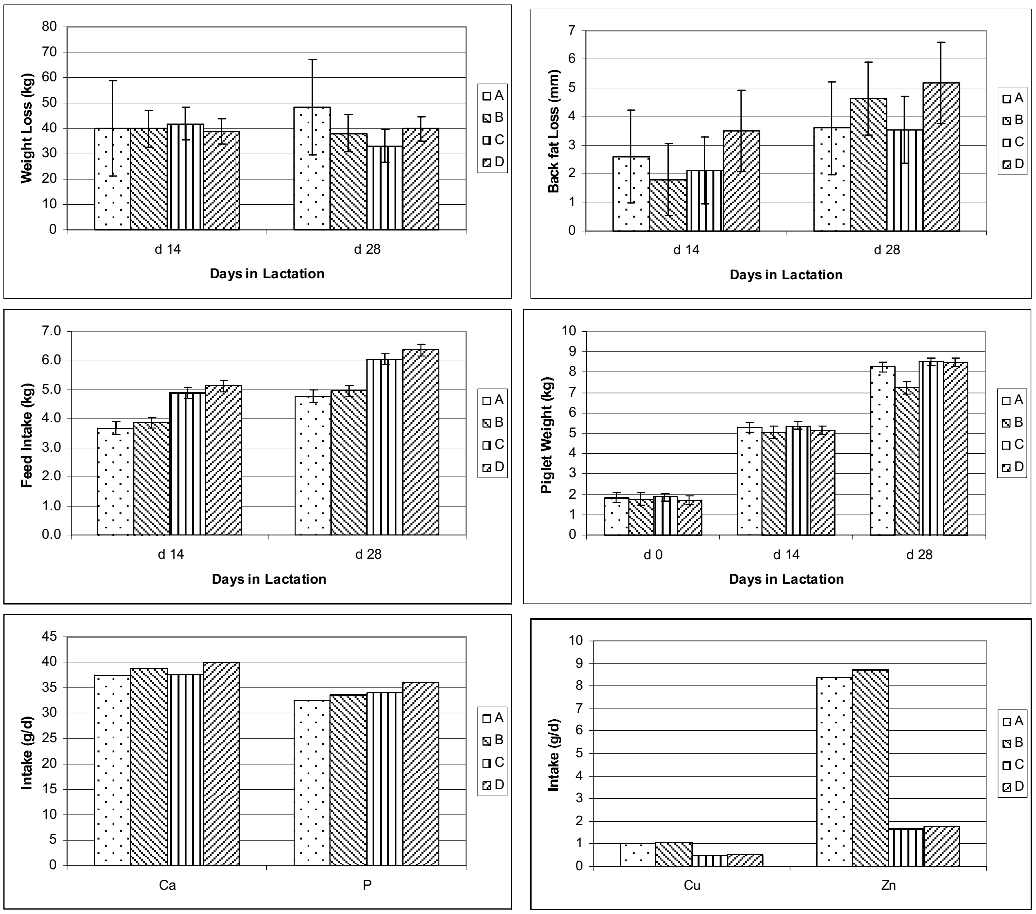
Feed, water, feces, milk and blood samples will be sent for analysis to reputable laboratories in Ontario for analysis of appropriate nutrients (including minerals). In addition, feed and feces samples will be analyzed for chromic oxide. Apparent digestibility of dry matter, crude protein, ME and minerals will be determined.

Preliminary data will be discussed for sow and piglet performance for 5 replicates of the experiment as the trial is incomplete and feed, water and fecal samples have not been analyzed.

Results to Date

Data presented in Figure 1 are raw means with standard errors. Copper (Cu) and zinc (Zn) are presented as examples of trace minerals. As the trial is incomplete and complete statistical analysis has not been done, results should be interpreted with some caution.

Figure 1. Results of trial to date.*



* Top left is sow weight loss at days 14 and 28 for the various treatments (see text). Top right is sow back fat loss at last rib at 14 and 28 for the various treatments. Middle left is average sow daily feed intake to days 14 and 28 for the various treatments. Middle right is the average piglet weights at birth, 14 days and 28 days for the various treatments. Bottom left is average sow intake of calcium (Ca) and phosphorus (P) based on actual feed intakes and table values of mineral concentrations in the component feeds for the various treatments. Bottom right is average sow intake of copper (Cu) and zinc (Zn) based on actual feed intakes and table values of mineral concentrations in the component feeds for the various treatments.

Discussion

So far, it appears even the sows on the treatment with restricted calcium, phosphorus and trace minerals and no phytase (C) perform (in terms of piglet weaning weight) as well as the sows on the control (A) treatment. Interestingly, sows consuming the two treatments receiving lower mineral supplementation (C & D) appear to have consumed more feed than those sows consuming full mineral supplementation (A & B). This increase in intake led to those sows consuming equal amounts of calcium (Ca) and phosphorus (P) (assuming book values for mineral concentrations in feed). The sows receiving trace mineral restriction treatments (C & D) did consume less trace minerals such as copper (Cu) and zinc (Zn) shown above – again assuming book values for concentration of minerals in the feed. Caution must be used in interpreting these data but, if these trends translate into statistical significance, it would suggest that trace mineral supplementation for sows is not required. As this trial only followed the sows for one parity, any effect possible depletion of trace minerals would have on subsequent parities and longevity has not been investigated. More substantial conclusions will be possible as total tract disappearance of the minerals is determined.

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