Dietary Phytase Reduces Phosphorus Excretion in Weanling Pigs

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Summary

Excessive phosphorus (P) output in the manure is a concern because it can leach into groundwater and/or may limit manure application onto certain lands. The addition of phytase enzyme to the diet of weanling pigs decreased total and water-soluble P output in the manure. This effect was reduced when dietary calcium was high relative to P (Ca:P ratios above 1.7:1). Phytase had only modest effects on performance.

"Addition of phytase enzyme to the diet of weanling pigs resulted in approximately 1.4 g/d per pig less phosphorus excreted."

Introduction

The use of phytase in pig diets is rapidly increasing as extensive research has documented its efficacy in improving the digestibility of phosphorus (P) in cereal grains. This allows diets to be formulated with less total P (tP), resulting in decreased P output in the manure and potentially reducing feed costs. It is well known that when diets are formulated with less total P, the dietary calcium:P ratio (Ca:P) becomes extremely important in terms of maximizing the utilization of P. As the industry moves to diets with little or no excess P present, and the use of phytase increases, the need to clarify the Ca:P ratio increases.

It has been suggested that the environmental benefit of reduced phosphorus output in manure is partially dependent upon the solubility of the excreted P. If the use of phytase results in a greater proportion of the P excreted to be water soluble, then the environmental benefits may be reduced.

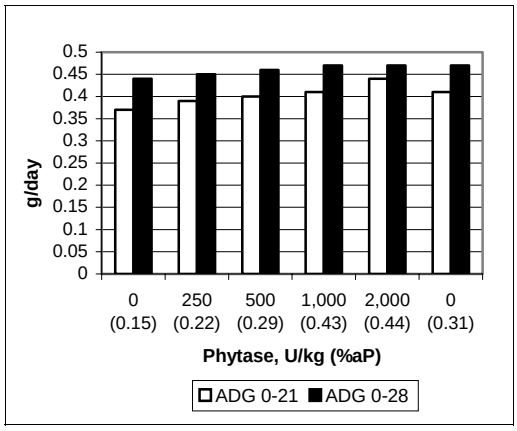

Figure 1. The effect of 0, 250, 500, 1000, or 2000 U/kg phytase on the ADG of weanling pigs (initial weight, 6.52 kg) during the initial 3 weeks of the trial (d0-21) or over the entire experimental period (d0 – 28). Numbers in parentheses refer to the calculated available phosphorus (aP). Dicalcium phosphorus was used to increase the aP concentration in the 0 (0.31) treatment.

The objectives of this experiment were to: 1) examine the effect of the dietary Ca:P ratio on phytase efficacy, and 2) determine the effect of the phytase enzyme on the amount and form of the excreted P

Experimental Procedures

Our objectives were achieved through a series of experiments. All the experiments used weanling pigs fed diets based on corn, soymeal and barley. Dicalcium phosphate was added to achieve different concentrations of total P in the diets. Additionally, the diets were supplemented with the phytase enzyme in various amounts. Typically, 500 U/kg is the recommended addition level. Figure 1 shows the ADG of pigs fed diets with up to 2000 units per kg of phytase enzyme. The calculated available P in these diets is shown in parentheses. The first two diets (0 (0.15); 250 (0.22)) were assumed to be deficient in available P for pigs of this age.

In a second experiment, diets were formulated to contain 0.56, 0.86 or 1.18 % Ca and about 0.50 % P. The Ca:P ratios were therefore approximately 1.1, 1.7, or 2.3. Either 0 or 500 U phytase/kg was added to each diet for a total of 6 treatments.

Results and Discussion

In experiment 1, there was a modest improvement in growth rate with the added phytase. Phytase had no effect on feed intake and therefore feed efficiency improved. Figure 2 shows the effect of phytase on the amount of phosphorus excreted. Total excreted P ranged from about 4 g/pig/day when dicalcium phosphate was added to the diet (0(0.31) treatment) to 2.1 g/pig/day when the diet contained no added dicalcium

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phosphate and 1000 U/kg phytase enzyme (1000(0.43) treatment). Additionally, the P excreted as soluble inorganic (hatched bars) ranged from 75 to 80% of total P and was not affected by treatment. Therefore, the pattern of excretion of the soluble inorganic P was similar to total P; ie. decreased with the addition of phytase.

The beneficial effect of phytase on the excretion of total and soluble P was repeated in experiment 2 (Figure 3). Moreover, this experiment demonstrated that the effect of phytase is mitigated when the dietary Ca:tP ratio exceeds 1.7:1.

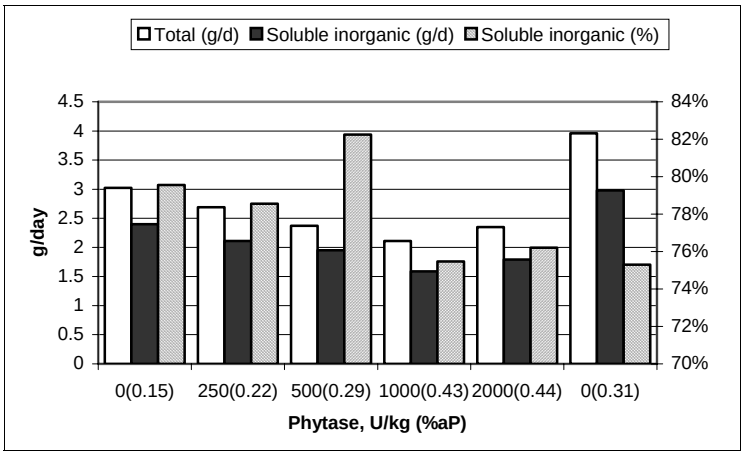

Figure 2. The effect of phytase on the excretion of total (solid bars, left axis) or soluble inorganic phosphorus (open bars, left axis) or soluble inorganic P expressed as a proportion of total P excreted (hatched bars, right axis). Numbers in parentheses refer to the calculated available phosphorus (aP). Dicalcium phosphorus was used to increase the aP concentration in the 0(0.31) treatment. Initial bodyweight averaged 21 kg.

Conclusion

The addition of phytase enzyme to the diet of weanling pigs resulted in approximately 1.4 g/d per pig less P excreted compared to the same diet with the phosphorus provided from an inorganic source (dicalcium phosphorus). The effectiveness of phytase is reduced at Ca:P ratios above 1.7. We saw no effect of phytase on the proportion of P excreted that was water soluble. Phytase allows us to formulate diets containing less total P and effectively reduces the excretion of total and soluble P.

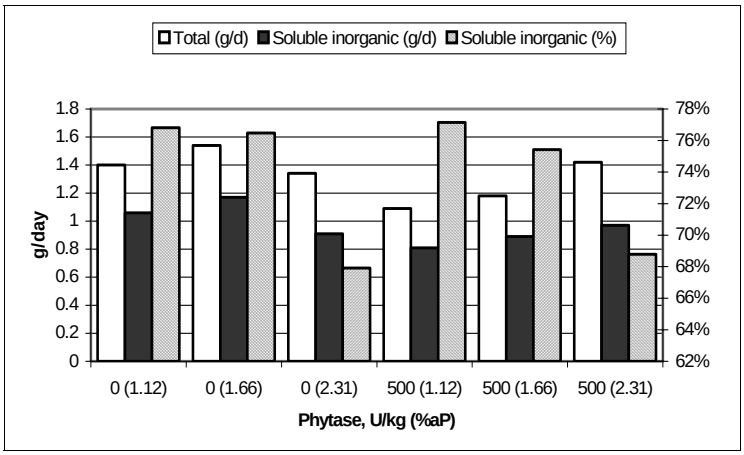

Figure 3. The effect of phytase and the dietary Ca:P ratio on the excretion of total (solid bars, left axis) or soluble inorganic phosphorus (open bars, left axis) or soluble inorganic P expressed as a proportion of total P excreted (hatched bars, right axis). Numbers in parentheses refer to the calculated available phosphorus (aP). Dicalcium phosphorus was used to increase the aP concentration in the 0 (0.31) treatment. Initial bodyweight averaged 9.1 kg.

"The effectiveness of phytase is reduced at Ca:P ratios above 1.7"

Acknowledgements

Strategic funding provided by Sask Pork, Alberta pork, Manitoba Pork and Saskatchewan Agriculture and Food Development Fund. Project funding from Zymetrics Inc. is greatly appreciated.