Ronozyme® HiPhos GT - Optimizing the Performance and Value of Phytase and Swine

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The improved digestibility of phytate-bound phosphorus (P) in feeds by phytase allows nutritionists to reduce the use of expensive inorganic phosphates with a $3-7/ton feed savings. Furthermore, phytases play a vital role to support the sustainability of pork production by reducing P in manure.

But How Do We Compare Phytases?

Manufacturer's recommendations vary considerably in terms of units (FTU, FYT, or U/kg diet) to replace a given amount of P. This difference can be attributed to several factors.

- The source of the enzyme production gene directly impacts several enzyme characteristics, including stability and efficacy.
- Phytase analytical procedures can express the units differently. Differences in buffer, for example, can "reduce' the number of expressed units by 50% or more to falsely suggest a phytase is twice as effective. In such cases, assayed activity is a poor predictor of *in vivo* activity across different phytases.

In the swine industry, a considerable amount of swine feed is prepared and fed as mash/meal. For these diets, the stability of phytase is seldom considered. History bears out that differences in the stability of commercial phytases can exist when included in concentrated premixes and/or stored under stressful conditions.

HiPhos™

While the efficacy and value of phytases are determined from animal feeding trials, the quality and handling characteristics of a phytase within a production system is important to avoid P deficiencies. Together, this information reveals which phytase provides the most benefit.

We recently compared the stability (by analytics) of Ronozyme® HiPhos GT and two competitive phytase products over a 90-day storage period. This storage study was dovetailed with a feeding trial to evaluate the *in vivo* efficacy of the stored phytases. Our objective was to learn how pigs respond to phytases stored in summer conditions and extend this to include phytases stored in a vitamin-trace mineral premix (VTM).

Trial at Kansas State University

All trial work was completed by Vier, et al. (2018, unpublished) at Kansas State University who independently obtained the phytases. Each came with a Certificate of Analysis to ensure that products met expected claims and were of similar production date.

Stability Study

Based on the manufacturer's phytase recommendation to replace 0.15% avP, each phytase was added to a common nursery VTM. The VTM was a customer formula to be added at 3 lbs./ton feed. The remainder of each phytase was kept in the original concentrated product form. The six (6) phytase sources were sampled for analysis on days 0, 30 and 90 of sheltered storage in summer conditions (avg. 85°F and 70% relative humidity, ranges of 75°F to 95°F and 60% to 82%, respectively).

The sources were:

- Ronozyme® HiPhos GT (product form, 20,000 FYT/g)
- Competitive product A (product form, 40,000 FTU/g)
- Competitive product B (product form, 20,000 FTU/g)
- Ronozyme HiPhos GT in VTM
- Competitive product A in VTM
- Competitive product B in VTM

Feeding Trial

After a 90-day storage, the six (6) phytase treatments were added to a common corn-soybean meal-based diet for a 21-day growth experiment. The manufacturer label claims for phytase activity were applied to each source in diet formulation to provide 0.15% avP. Three hundred (300) pigs (DNA 241 × 600) with a mean body weight (BW) 25.9 lbs. were allotted to one of eight dietary treatments in a randomized complete block design. There were four or five pigs/pen, depending on the block, and eight pens/treatment.

The eight treatments were:

1. Negative Control (NC, 0.12% dietary avP)
2. Positive Control (PC, NC + 0.15% avP from monocalcium P, or 0.27% dietary avP)
3. Ronozyme HiPhos VTM (NC + 1000 FYT/kg HiPhos in VTM)
4. Competitive product A VTM (NC + 500 FTU/kg competitive product A in VTM)
5. Competitive product B (NC + 650 FTU/kg competitive product B in VTM)
6. Ronozyme HiPhos concentrate (NC + 1000 FYT/kg HiPhos from concentrated product)
7. Competitive product A (NC + 500 FTU/kg competitive product A from concentrated product)
8. Competitive product B concentrate (NC + 650 FTU/kg competitive product B from concentrated product)

All diets were formulated to a total Ca:P ratio of 1.16 to indirectly provide equal credit for improved Ca digestibility across phytase sources. All phytase diets were formulated to meet the nutrient requirements of 25- to 50-lb. pigs (NRC, 2012) and fed as mash.

Weekly and overall average daily gain (ADG), average daily feed intake (ADFI), feed/gain (F/G), and mean BW were determined for each pen. Additionally, one (1) pig closest to the mean pig weight per pen was euthanized to collect femur and fibula to determine percent bone ash. Feed samples (4) from each diet were submitted to DSM North America lab and New Jersey Feed Labs for phytase analysis.

Stability During Storage

In the concentrate form, analyzed levels of Ronozyme HiPhos and competitive product A were close to label claim, whereas competitive product B was 78% of expected (day 0; Figure 1). However, when added to the VTM, all phytases analyzed within 11% of target (day 0; Figure 2).

Figure 1. Stability as the product concentrate - Midwest summer conditions

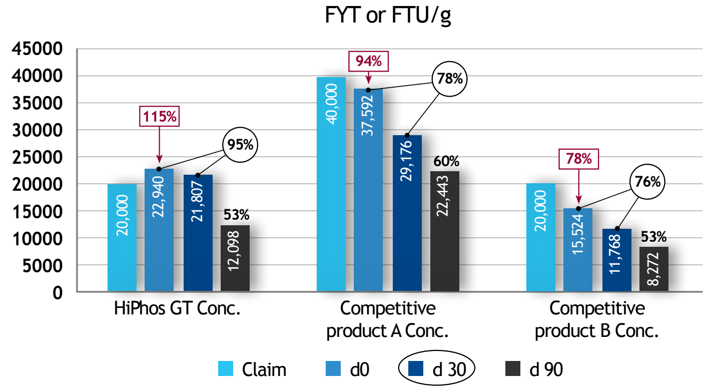
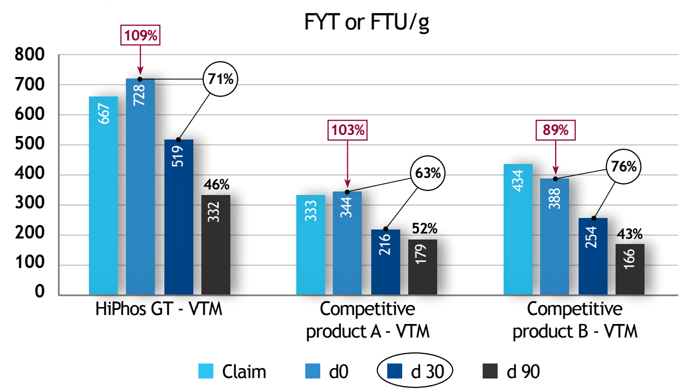


Figure 2. Stability in concentrated VTM nursery premix (3#/ton) - Midwest summer conditions



When stored in concentrate form:

- Ronozyme HiPhos experienced the least loss (-5%) in activity at day 30
- All phytase sources experienced considerable loss (40% to 47%) at day 90

When stored in a VTM:

- Loss in activity for all phytases was higher in VTM
- On day 30 and 90, loss in activity was similar across phytases

Growth Study – VTM and Concentrate

Across all diets, the 21-day ADG, ADFI, BW and bone ash responses for pigs fed the P-deficient NC diets were lower ($P<0.05$) than those fed the PC diet, while NC pigs had a higher F/G ($P<0.05$). All phytase sources improved ($P<0.05$) ADG and bone ash compared to pigs fed the NC diet.

VTM – The ADG of Ronozyme HiPhos, competitive product A and PC pigs did not differ ($P>0.05$) and was improved ($P<0.05$) over the NC, while pigs fed competitive product B in VTM failed to match the PC ADG ($P<0.05$). The F/G of Ronozyme HiPhos and PC pigs was equivalent ($P>0.05$), whereas more feed for gain was required by pigs fed competitive product A or competitive product B in VTM ($P<0.05$) than for the PC. Furthermore, while bone ash of pigs fed Ronozyme HiPhos exceeded ($P<0.05$) that of the NC and competitive product A pigs, bone ash of pigs fed competitive product A and competitive product B was similar ($P>0.05$) but less ($P<0.05$) than that of the PC pigs.

Concentrate – The ADG and final BW of pigs fed all three phytase sources was similar ($P>0.05$) to that of PC pigs, and all three phytase treatments exceeded ($P<0.05$) the ADG of the NC pigs. All phytase treatments also improved ($P<0.05$) ADFI above NC. Whereas the F/G of Ronozyme HiPhos and competitive product B pigs was not different ($P>0.05$) than the PC pigs, competitive product A pigs again failed ($P<0.05$) to attain the same F/G. While bone ash of Ronozyme HiPhos pigs was equivalent ($P>0.05$) to the PC pigs, both competitive product A and competitive product B fed pigs had lower ($P<0.05$) bone ash than PC pigs.

Summary

Although little difference in the retentions of phytase activity occurred across sources at day 90 of storage, two important features emerged.

- Retention of phytase was greatest during the first 30 days of storage, especially for the Ronozyme HiPhos GT and concentrated sources
- According to pig performance, Ronozyme HiPhos GT in VTM and concentrate provided superior pig performance

What We Learned

These data demonstrate important differences exist in commercial phytases which are seldom exposed by simple analytics. Although the stability of phytases in pelleted diets is critical, other factors need to be considered. Even when mash feeds are utilized, processes and conditions affect the stability of phytase and final product quality. Ronozyme HiPhos GT from DSM consistently exhibits superior stability and efficacy for the best pig performance, whether added directly to feeds or through a VTM.

Table 1. Effects of phytases stored 90 days in summer conditions on growth performance.

	PC	NC	HiPhos VTM	Product A VTM	Product B VTM	HiPhos 20,000	Product A 40,000	Product B 20,000	SEM	*P* <
d 0 - 21			1000 U	500 U	650 U	1000 U	500 U	650 U		
ADG, lb	1.42^{a}	1.07^{c}	$1.35^{a,b}$	$1.33^{a,b}$	1.27^{b}	$1.41^{a,b}$	$1.29^{a,b}$	$1.38^{a,b}$	0.052	0.001
ADFI, lb	2.18^{a}	1.91^{b}	2.13^{a}	2.24^{a}	$2.12^{a,b}$	2.17^{a}	2.15^{a}	2.23^{a}	0.091	0.005
F/G	1.54^{a}	1.80^{c}	$1.58^{a,b}$	$1.68^{b,c}$	$1.67^{b,c}$	1.54^{a}	$1.66^{b,c}$	$1.63^{a,b}$	0.031	0.001
BW/ lb										
d 0	25.9	25.9	25.9	25.9	25.8	25.9	25.9	25.8	1.45	1.000
d 21	55.7^{a}	49.0^{b}	54.2^{a}	53.9^{a}	53.4^{a}	55.6^{a}	53.0^{a}	54.7^{a}	2.33	0.00
Bone Ash, %	46.9^{a}	38.4^{d}	44.1^{b}	41.3^{c}	$42.8^{b,c}$	$44.6^{a,b}$	$42.8^{b,c}$	$43.3^{b,c}$	0.64	0.001

*Treatment means within each row that have different superscripts differ $P<0.05$.

Learn more about Ronozyme HiPhos