New generation phytase shows

Phytase is commonly used in the poultry sector but there is more published information and experience with phytase use in broilers and layers than with turkeys. New trials have shown that use of a novel 6-phytase in turkey diets throughout the growing period resulted in reduced feed costs with added environmental benefits.

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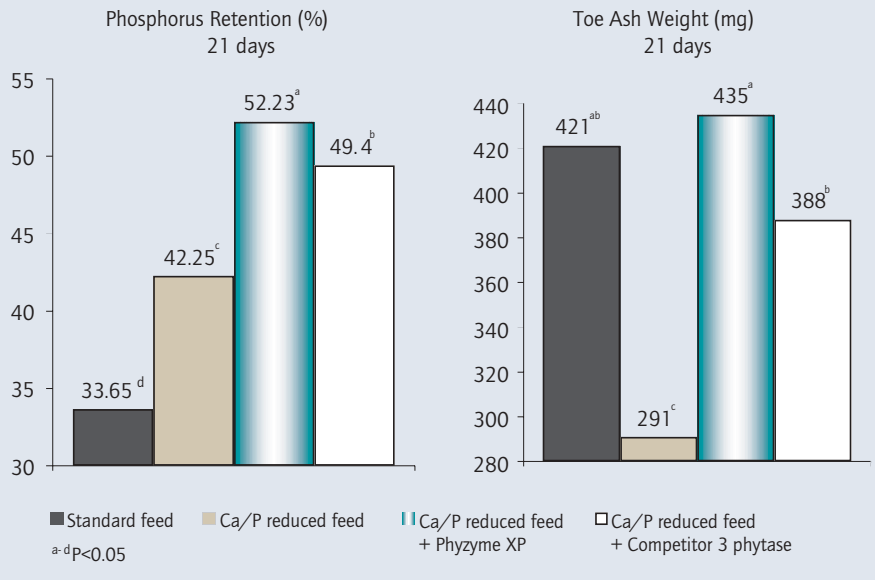
The new enzymes have the opportunity to obtain greater feed cost savings

Figure 1 - The efficacy of 6-phytase (Phyzyme XP) compared to a 3-phytase in turkeys



Around 250 million turkeys are produced annually worldwide, with over a third produced in the USA. Other major producing countries include France, Italy, Brazil, UK, Canada, Mexico and Israel.

Market-weight male turkeys can reach over 20kg, consuming nearly 60kg of feed in their lifetime. Compared to broilers the nutrient density of turkey feeds is significantly greater, especially for protein, amino acids, vitamins and minerals including calcium and phosphorus. For nutritionists this means a significant constraint on available space in the feed formulation when formulating feeds to achieve the high nutrient density at an acceptable cost with the available ingredients. The situation can be even more complex in markets where animal by-products, which are typically cost effective sources of crude protein, amino acids and minerals, are prohibited for use in poultry diet formulations (e.g. EU, countries exporting to the EU).

Turkey requirement for phosphorus

The phosphorus requirement of turkeys is high (about 30% greater than broilers). The availability of phosphorus from plant sources such as cereal grains, oil seed meals and their by-products is exceptionally low. Turkeys may actually utilize approximately 30% of this phosphorus. The remainder of the phosphorus is present in the form of phytate which is indigestible.

In order to meet the turkey's high phosphorus requirement, the nutritionist has two options. The first option is to supplement the feed with high levels of inorganic phosphorus sources, such as dicalcium phosphate (DCP). This option increases the cost of the feed due to the high cost of inorganic phosphorus and the additional space occupied in the feed formulation by these mineral sources. One consequence of reduced space in the feed formulation is that nutritionists have less flexibility to use lower nutrient dense, cheaper ingredients. The second and typically most cost effective option is to include phytase in turkey feeds. The enzyme phytase breaks down the indigestible phytate molecule in plant ingredients, thereby releasing phosphorus that may be utilized by the bird. Use of phytase significantly reduces the need for inorganic phosphorus supplementation, freeing some diet formulation space to allow the inclusion of cheaper ingredients. Reducing dependence on inorganic phosphate through use of phytase means that typically around 30% less phosphorus is excreted by the bird which clearly benefits the environment.

Phytase to the rescue

Phytases are produced by a number of micro-organisms, including yeasts and fungi. While most are manufactured industrially in fungi, Phyzyme™ XP (Danisco Animal Nutrition) is a novel phytase produced in the yeast *Schizosaccharomyces pombe*.

promising results in turkeys

Table 1 - The effect of Phyzyme XP on turkey feed cost

Ingredients Phyzyme	No phytase	+ XP1
Soybean meal, 48% CP	46.0	45.6
Corn	44.0	44.0
Dicalcium phosphate	2.68	1.91
Soy oil	2.48	2.35
Corn gluten meal	2.0	2.0
Limestone	0.98	1.15
Wheat midds	0.76	1.88
Vit/min premix	0.5	0.5
Other2	0.63	0.63
Phyzyme XP	-	0.01
ME, kcal (MJ)/kg	2850 ()	2850 ()
Crude protein, %	26.5	26.5
Lysine, %	1.6	1.6
TSAA, %	1.05	1.05
Calcium, %	1.2	1.2
Digestible phosphorus, %	0.55	0.55
Diet cost, US$/tonne3	250.27	247.27

1 Assumes Ca and P reduction
2 Other = DL-methionine, L-Lysine-HCl, NaCl
3 Excluding phytase cost

Figure 2 - Performance of 16-week turkeys fed calcium and phosphorus reduced feeds

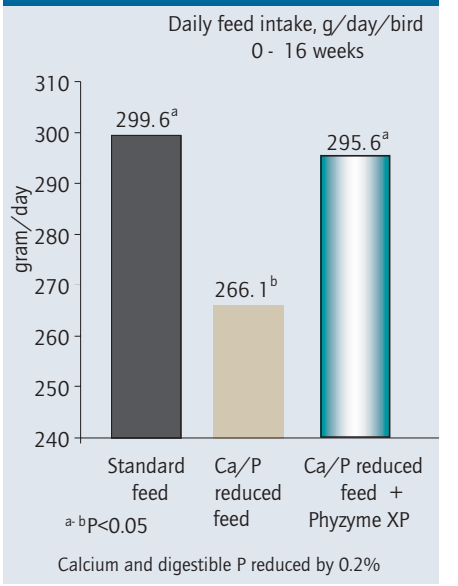


Figure 3 - Enzyme resistance level to breakdown by the bird's own proteases

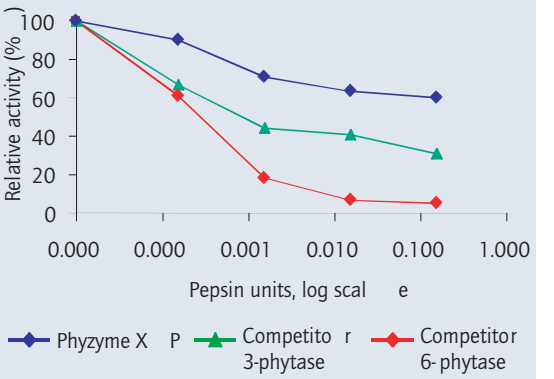
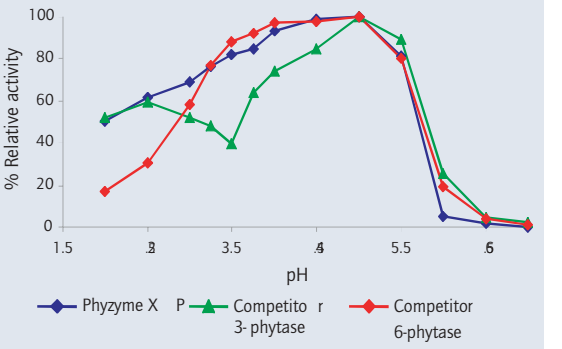


Figure 4 - Relative activity of different enzymes over a broader pH range



Phyzyme XP is known as a "6-phytase", meaning that it releases the phosphate group on position 6 of the phytate molecule first, while 3-phytases attack the bond at the 3 position first. However, there is no evidence to suggest that the order in which the phosphate groups are removed by phytase has any influence on its effect in the bird. A typical way to evaluate the efficacy of a phytase is to test it in turkey diets which have been reduced in phosphorus and calcium.

In a study conducted at the University of Missouri, Phyzyme XP was shown to have a high nutrient-releasing potential. When included in the feed at 500 FTU/kg feed ti fully restored performance (weight gain and feed intake) in turkeys fed a diet reduced in calcium and phosphorus by 0.34% and 0.24% respectively, when compared to turkeys fed the standard diet. Typical commercial recommendations for reducing calcium and phosphorus in phytase supplemented feeds is 0.1% and yet Phyzyme XP successfully restored performance of turkeys fed feeds with much greater reductions in calcium and phosphorus.

Another way to evaluate a phytase is to compare its efficacy to other phytases. The bioefficacy of Phyzyme XP was compared to that of a major commercial phytase (3-phytase produced by fungi) in another turkey study. The rate of weight gain with with the 6-phytase was two times greater than the competitor phytase and showed a 2.7 times greater rate of improvement in tibia ash percentage, which means better phosphorus utilization.

These results were further supported by another study with young turkeys, which also included a competitor phytase. The novel phytase restored performance of a Ca/P reduced diet to that of the standard diet for bodyweight gain, FCR, feed intake and bone mineralisation. This was despite a large reduction in digestible phosphorus and calcium of 0.31% and 0.24% respectively. In contrast, the competitor phytase gave significantly lower bone mineralisation (measured as toe ash weight) and phosphorus retention compared to the standard diet (Figure 1). In a 16-week study, Phyzyme XP at 500 FTU/kg feed restored FCR in diets reduced in Ca and digestible P by 0.10 and 0.28 - 0.18 % (starter – finisher), respectively. A further 16-week study showed that this enzyme restored performance in turkeys fed diets reduced in Ca and digestible P by 0.2% *(Figure 2)*. These studies further demonstrate that the nutrient releasing potential of Phyzyme XP is greater than other commercial phytases.

Implications

In turkey feeds, 6-phytase reduces feed costs through improvements in nutrient digestibility (eg. P and Ca), allowing reduced use of more expensive inorganic phosphorus sources. The results from trials also highlight an opportunity to obtain greater feed cost savings with this enzyme, when used at inclusion levels comparable to other phytases (*see Table 1*).

Why is it so effective?

Danisco Animal Nutrition's scientists have identified a number of possible reasons for the superior efficacy of Phyzyme XP seen in these turkey trials. Enzymes are proteins, which means that they are at risk of being digested by the bird's own protease enzymes. This phytase is more resistant to these proteases, such as pepsin (*Figure 3*). In addition, enzymes tend to work best within a certain pH range and they are sensitive to changes in pH. It retains its high relative activity over a broader pH range compared to other phytase products (*Figure 4*). This means it can work more effectively in different parts of the digestive tract where pH levels vary.