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MINERAL Writes

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Todd M. Owens, M.S., P.A.S.
Director of Nutrition and Technical Services
ILC Resources
3301 106th Circle
Urbandale, Iowa 50322-3740
(515) 243-8106
Fax (515) 244-3200
1-800-247-2133

www.ilcresources.com

toddo@ilcresources.com

Practical Applications of Phytase Considering Current Research

Phytase is a very important enzyme in monogastric nutrition. They are challenging because so many variables influence their effectiveness. Any use of phytase in diets, needs to be implemented only after careful review of available data to reduce inconsistent or under –delivery of phytase benefits.

Today's broiler nutrition places an emphasis on increased efficiency and avoiding nutrient excesses or deficiencies. This is a difficult job for nutritionists because the specific available nutrient content of all raw materials is not realistically available and because of changes from genetic advances. Based on what information is known, our goal is to match producer requirements with the nutrient contents of ingredients being used at least cost. Nutritionists must consider the enzyme matrix, since this will influence formulation savings and the likelihood of success in implementing the enzyme. Overestimating the enzyme may lead to lost performance, potential animal welfare concerns, and lost opportunity. The matrix or matrices used to define enzyme capabilities must be realistic and applicable in commercial settings.

Enzymes directly influence feed digestibility and indirectly influence post absorptive nutrient use and feed intake. Experimental conditions may not be accurately applicable to enzyme matrices in commercial applications, which may result in underutilizing the product(s). So many factors influence enzyme value that industry professionals should be cautious in using enzyme matrix values based on experimental data in literature.

Phytase measurements in research attempt to establish nutrient sparing effects by looking at the relationship between the dosage of the enzyme and concentrations of "spared" nutrients. This analysis allows us to determine the return on investment (cost of the enzyme) and the optimum inclusion rate. While the focus of current research is on phosphorus, Bedford, et al., (2015),

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assert that all nutrients spared by phytase use are also spared proportionally to the phosphorus released.

Determining the matrix value of a phytase can be done with several methods. One is growth and bone ash studies. These studies show a standard curve from an inorganic source of phosphorus used. Other methods include retention or digestibility studies, which do not require using a standard curve. There are differences in the potential results and their interpretation of the different methods. Growth and tibia ash studies may provide data that is relevant to the end use (like performance and bone strength), and do determine the effects of P levels and phytase dose over a period of time. The challenge of the calculated matrix determined by these studies depends on the materials used in the standard curve. Producers and nutritionists should understand that results may not be able to be replicated unless the same materials are used for comparative work or in the field. Digestibility methods measure phosphorus digestion in the diet and are determined at one point in time. This may not reflect an equilibrium status and more research is needed to standardize this method. Retention methods are based on the collection of composited feces and urine over time, which overcomes the issue of achieving equilibrium.

Digestibility methods pose other challenges. Feed intake increases when P or phytase is added to P-deficient diets. This effect can be missed, if feed is not offered ad libitum and not recorded in studies. Digestibility methods use test or control diets for a limited period of time, which may lead to incomplete diet adaptation. These nutrient determination methods could lead to longer-term systemic effects by not reaching equilibrium in the animal's system.

Reviewing the data from current literature clearly indicates the need for caution when applying the findings into industry practice (Bedford et al, 2015). Regardless of method, results are variable among any of the studies. Several variables have been identified in these variations and are examined in the following section.

Summary of influencing factors

The dose of phytase used in the diet is the most obvious influence on the scale of response in diets. Equivalent responses (average release of P) using different phytase supplements may require greater enzyme activity. The predictability of phytase response calculations needs to be determined using logical evidence for basing the commercial use of supplementation on an optimum dose instead of the current fixed rate with a discounted matrix. The current practice is driven by the varying responses and the consequences of inadequately delivering phosphorus and calcium levels (resulting in rickets and bone disorders).

Ten factors have been identified as capable of influencing the scale and direction of the phytase response (Rosen, 2002):

1. Control animal performance
2. Year of test
3. Dietary P content
4. Caged vs. pens
5. Corn % (substituting for other cereals)
6. Duration of the trial
7. Dose of phytase used
8. Mortality of the control group being in excess of 5%
9. Presence of a coccidiostat
10. Dietary fat content

The first five variables are negatively associated with phytase and the last five are positively associated. For example, better control of animal performance or higher dietary P levels lead to a poorer phytase response. The addition of a coccidio-

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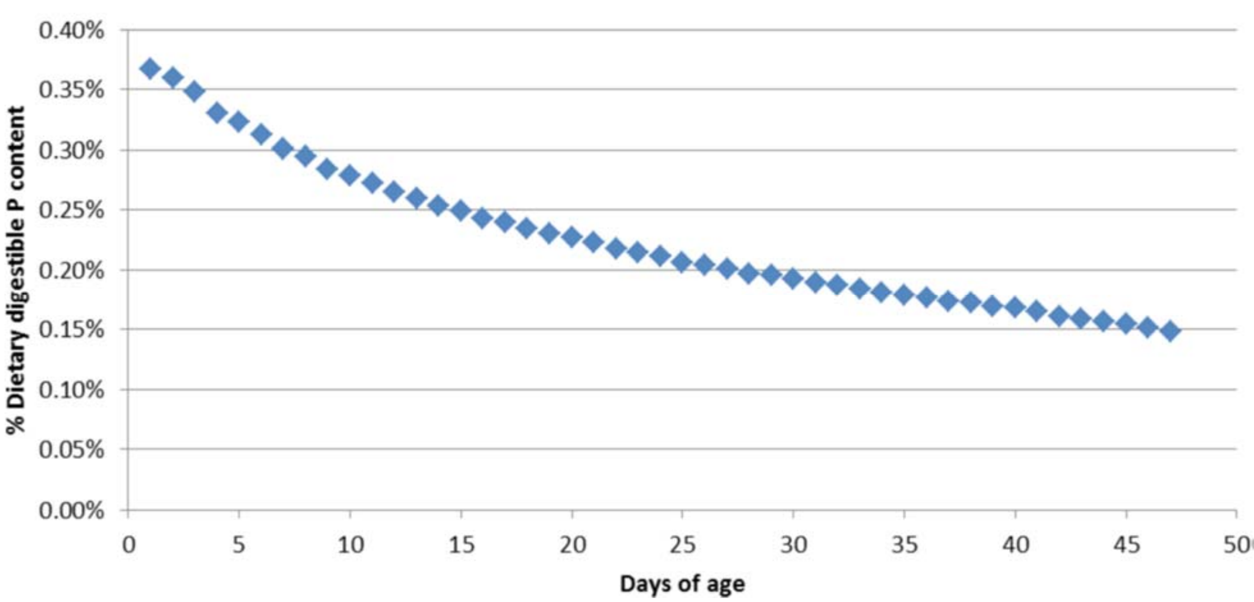
stat or the higher dietary fat levels improves the phytase effect. Rosen (2002), found that controlling animal performance was the most crucial predictor, and considered the variables of breed, sex, diet form, stocking, density, nutrient density (other than P and Ca), age, temperature, humidity, etc. Given all of these influences, commercial nutritionists must consider how management, breed and nutritional peculiarities of the trial influence controlling animal performance. After those considerations, producers and nutritionists should determine if those conditions are relevant for practical field application.

Additional phytase influencing factors include the inclusion of vitamin D with dietary Ca and P. With all of these factors, nutritionists need to determine the phytase capability to release the desired amount of phosphorus. Industry professionals should use relevant comparisons to the optimal application of the enzyme as reported in the research that accurately reflects their current field conditions.

Performance response to the added phosphorus is dependent on the same factors that influence phytase efficacy. Adding phosphorus in P-deficient diets generates non-linear responses. Daenner, et al. (2006) found that this response is due to an adaptive mechanism of the bird where the efficiency of P absorption decreases with incremental P increases. This shows that assigning an "available" P value to an ingredient is influenced by the P status of the animal.

Dietary calcium also requires consideration. Increasing dietary levels reduces the digestibility and use of additional phosphate. Calcium and P ions work together, and higher levels result in higher levels or precipitation as they enter the small intestine. Increasing the inclusion of limestone can generate higher calcium diets. Limestone is a buffer that raises the pH in the gizzard. The higher pH levels reduce Ca and P solubility and reduces the efficacy of pepsin digestibility. These examples indicate that growth depression may not just be limited by the P supply in the diet. Commercial nutrition must consider that Ca and P levels in the diet directly influence the phytase efficacy on the phyt-

Table 1. Estimated digestible P requirement as a function of age.



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ate.

If there is more Ca in the diet, the ability of the supplemental phytase to break down dietary phytate and release the same amount of phosphorus is hampered compared to the amount released by the same supplementation in a lower Ca diet. Phosphorus levels in the diet also make a difference. In test diets with higher P levels, the phytase is less active on phytate substrate and the P release is impaired. In the high-P diets, less P is released and is less available because of the Ca:P precipitation in the small instestine. The bell curve of the phytase response in the testing environment is disconnected from the phytase response to dietary Ca and P levels in field settings.

Supplemental phytase contributes to incremental gains but at diminishing rates as non-phytate phosphorus (NPP) increases. However, growth enhancement results using supplemental phytase does not correlate to adding a set rate of NPP, but depends on the initial levels of NPP. Ultimately, the levels of Ca and P and the mineral ratio needed to optimize performance are lower when using phytase.

Digestible P requirements can be determined by measuring incremental body phosphorus content over time. To calculate P requirements, divide the body weight increment in P (proportionate to gain) by the bird's intake over the same period of time. Table 1 shows how P requirements change based on the bird's age. Based on Table 1 and bird adaptability, measuring phytase efficacy on digestible P depends on how P deficient the diets are. The level of deficiency depends on the age of the bird at the time of measurement.

What this means for the industry

Determining the absolute requirements for P and Ca in poultry diets depends on multiple conditions in the production environment (environmental, management, and nutrition). Phytase efficiency in the diets depends on the same conditions that influence P and Ca requirements. The variables involved differ in their influence on hydrolyzing phytate compared to the effect on P requirements. Phytase values depend on the environment in which they are used. Industry users need to remember to look at the conditions used in the studies to determine phytase efficacies and compare the conditions to the practical environment. Producers and nutritionists need to review available data and make sure any evaluations of different products or doses are meaningful and discriminative. If tests are conducted in less than ideal or in poor conditions, producers may not be comfortable with the results, which may be outside of their established safety margins. Uniform testing that reflects commercial practices (relevant testing), will allow for reducing safety margins with no impact on performance or bone strength.

Information for this article taken from:

Bedford, M.R., C.L. Walk and H.V. Masey O'Neill. 2015. Assessing measurements in feed enzyme research: Phytase evaluations in broilers. *Journal of Applied Poultry Research.* 0:1-9.

Rosen, G.D. 2002. Multifactorial analysis of the effects of microbial phytase in broiler nutrition. Pages 88-101 in *Proceedings of the 49th Maryland Nutrition Conference for Feed Manufacturers*. University of Maryland, College Park, MD.