

Maximising phytase profitability

Phytase dominates the monogastric feed enzymes market and is worth over \$500M a year. Today's advanced phytases have the potential to deliver production savings of several times that amount through their ability to optimise phosphorus digestibility and uptake, and increase the availability of energy and amino acids.



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Despite the widespread adoption, and widely proven mode of action, the discussion on the best dose of phytase to use to ensure maximum profitability remains unresolved. Industry standard doses - 500 FTU/kg for broilers and 300 FTU/kg for layers - were introduced over 20 years ago when phytases were less bio-efficacious, phytase was more expensive and less was known about phytate. Continuing to follow these recommenda-

tions could result in producers losing out on considerable opportunities to maximise the return on investment they achieve from phytase use. There are some key considerations to be taken into account when calculating the optimal dose of phytase to maximise profitability.

The problem with phytate

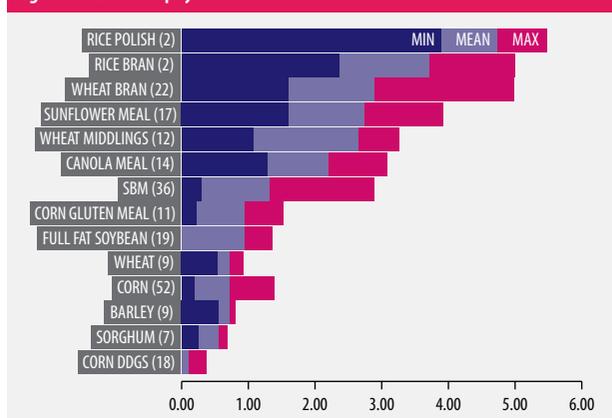
Phytate, an anti-nutrient that occurs naturally in feed materials, is estimated to cost the global poultry industry \$2.1M a year because of its negative impact on bird performance. It should, in theory, be a valuable source of phosphorus, but without phytase addition, this phosphorus 'pool' remains largely unobtainable to the bird because their own enzymes can't degrade phytate effectively. Phytate also reduces the availability of essential nutrients such as calcium, protein/ amino acids, iron and zinc to the animal because it binds with these nutrients in various parts of the digestive tract. As market pressures encourage producers to utilise increasing amounts of alternative feed ingredients - such as rapeseed meal, sunflower seed meal and rice bran - phytate levels in the diet will increase (Figure 1), exacerbating the challenge. There is compelling evidence that dosing above the traditional industry standard in diets with higher levels of phytate

can improve profitability. Higher doses of phytase break down the phytate molecules more rapidly in the digestive tract releasing more nutrients earlier in the gastrointestinal tract to improve growth performance and reduce challenges related to bone mineralisation, phosphorus and calcium metabolism, and skeletal disease.

Research has shown that achieving maximum degradation of phytate is a key factor in the release of 'extra-phosphoric' nutrients (e.g. amino acids and energy). Sands et al (2004) showed that an *E. coli* phytase improved ileal protein and amino acid digestibility at a broad range of phytate concentrations, but that its impact was greatest when phytate levels were high.

Ten broiler studies using *Buttiauxella* phytase clearly supported the correlation originally demonstrated by Sands et al (Schothorst Feed Research Institute, 2012) between the level of dietary phytate and amino acid digestibility response. Plumstead et al (2013) also showed that the improvement in amino acid digestibility from the same *Buttiauxella* phytase was dependent both on the dose of phytase and the phytate level of the diet in seven recent broiler trials. Non-linear models that use dietary phytate levels as an independent variable

Figure 1 - Levels of phytase.



can therefore predict the resulting response to added phytase over a range of phytase doses and dietary phytate levels. As phytase is often used with other additives such as carbohydrase and protease, it is also important for producers to have evidence of how these varying elements of the diet interact with dietary substrates to ensure the maximum value from the enzymes is achieved.

Choosing a bio-efficacious phytase

Choosing a phytase with the right characteristics to deliver quick and effective results is perhaps the most critical step on the path to profitability. The key metric is the amount of phosphorus that can be liberated from phytate and absorbed by the bird, especially considering the trend of inorganic phosphorus cost increases in recent years where we have witnessed a six-fold increase since 1999. A phytase's ability to replace expensive amino acids in the diet through rapid phytate degradation early in the gastrointestinal tract is another driver of value. Phytases have specific pH optima at which they function at their best. In order to improve phosphorous uptake and reduce the anti-nutrient effects of phytate, a phytase needs to be highly active at the low pH conditions prevailing in the upper digestive tract. The faster the phytase gets to work, the more the anti-nutrient effect of the phytate molecule in the upper gut can be reduced and the more nutrients are released for the animal to absorb from the digestive tract. The first *E. coli* phytase - launched back in 2003 - offered a 20% improvement in bio-efficacy and associated feed cost savings compared to traditional fungal phytases. However, the latest highly bio-efficacious *Buttiauxella* phytase is even more cost effective because it offers much higher activity earlier in the gastrointestinal tract. *Figure 2* shows that the activity of this advanced phytase against three other commercial phytases at this early stage is almost double the activity at pH 3.5, indicating the phytase is highly active at this lower pH. This ensures both that the anti-nutrient effects of phytate are minimised and that the time available for nutrient digestion and absorption is maximised. Independent trials at the Schothorst Feed Research Institute in 2012 showed that this phytase offers 79% higher bio-

efficacy than an *E. coli* phytase. This unprecedented ability to rapidly degrade phytate and maximise nutrient absorption equates to cost savings of ~\$1.50/tonne compared to *E. coli* phytases used at standard doses.

It is also important to break the paradigm that these more efficacious phytases can be used at lower doses. Indeed, since highly efficacious phytases release more phosphorus at comparable doses, they should be included at higher levels to maximise the value they can deliver in terms of replacing expensive inorganic phosphorus in the diet. Barnard et al (2014) adopted a value based approach to determine the optimal dose of *Buttiauxella* phytase in wheat-based laying hen diets. In this experiment, the optimal dose calculated was between 580-985 FTU/kg feed depending on the cost of inorganic phosphorus and the cost of phytase (based on +/- 20% of typical market costs from early 2013). In any case, the optimal dose was higher than the previously used recommendation; this was due to the high levels of phosphorus release achieved with the *Buttiauxella* phytase. By limiting the inclusion of phytase to 300 FTU/kg feed approximately 31% of the potential value to be captured from phytase was missed (*Figure 3*). Furthermore, this dosing method considered only the value from phosphorus and not any of the extra-phosphoric effects discussed earlier.

Evidence-based dosing

Factors such as the age and type of the bird, and its health status need to be taken into account as well as diet when calculating the optimum phytase dose. Animal trials to validate the bio-efficacy of a phytase and gauge responses to different levels of phytase addition are costly, particularly in birds with a longer production span like laying hens, but they are also very necessary. The amount of species specific performance and digestibility data behind a phytase will determine how confident producers can be in applying the matrix values in a feed formulation.

Dosing for a profitable future

Changes in recent years including the development of more bio-efficacious phytases, an improved understanding of

Figure 2 - Phytase activity at varying pH - *Buttiauxella* versus competitors.

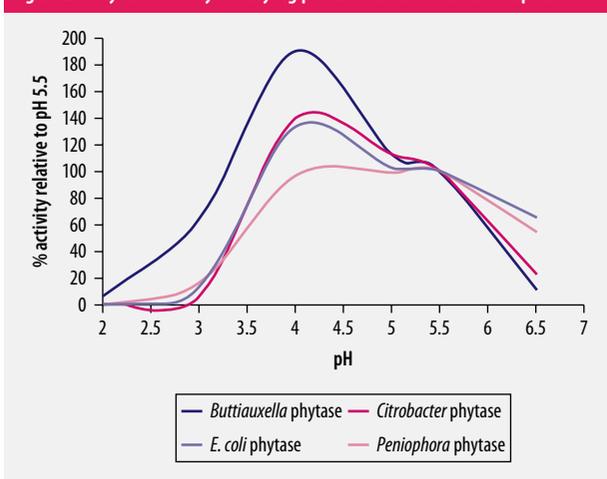
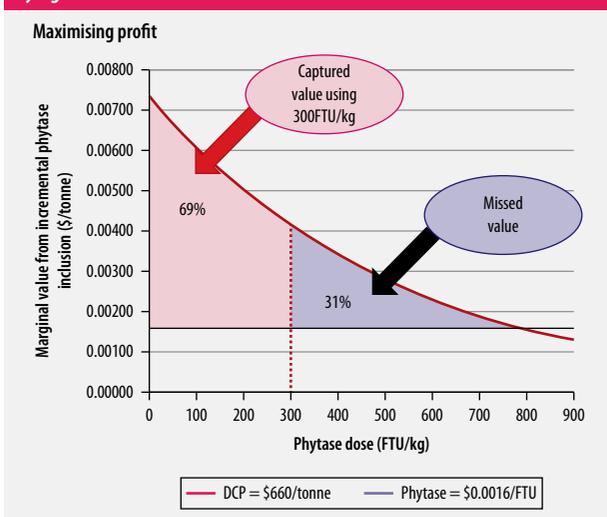


Figure 3 - A value-based approach to optimal phytase dose for laying hens.



phytate's negative impact on protein and starch, as well as phosphorus utilisation coupled with the rising cost of inorganic phosphorus have all challenged traditional views on the ideal dose of phytase. Phytases are constantly evolving in terms of the value they can bring to feed formulations. Our understanding of the role of phytate on energy and protein release will improve as animal trials reveal new findings. As science opens the door to new phytase benefits and opportunities, producers should work closely with their suppliers to ensure the dose they are using is maximising their return on investment. **WP**

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