

# Maximising phytase performance

Calcium plays a significant role in phosphorus (P) utilisation, which is important for broiler production performance. Therefore, optimising available calcium levels, relative to phosphorus, can contribute to better diet results. Maximising phytase performance begins with an optimised calcium matrix.

BY DR YUEMING DERSJANT-LI, DUPONT

**W**hen creating a diet to maximise production profits, nutritionists have paid less attention to calcium (Ca), a cheap ingredient often extracted from limestone. The role of limestone in feed processing and formulation has traditionally been to serve as a carrier or filler material. Its role in phosphorus utilisation has been greatly undervalued.

## The link between Ca and P

The goal in feed formulation is often to meet an animal's minimum requirement for available phosphorus using the break-point method, also called the requirement estimate, which aims to reduce phosphorus excretion. An animal's calcium requirement is determined by an optimal calcium/phosphorus ratio, which is defined by the poultry breeding company. Maintaining the calcium/phosphorus (Ca/P) ratio demands a careful balancing act because there are complex molecular reactions involved.

It is important to note that it is the ratio, not necessarily the calcium level itself, which has the potential to affect performance. Too high a Ca/P ratio will lead to a decrease in performance. When phosphorus only meets the minimum requirement for growth, calcium will chelate with phytate in the small intestine making the phosphate from phytate inaccessible to the bird. The result could be a possible phosphorus deficiency and subsequent reduced digestibility and performance. High levels of calcium will also increase the pH in the proventriculus and gizzard, which will also negatively impact digestion. Excess calcium will have less impact when phosphorus levels meet or exceed an animal's minimal

requirement. However, the animal will excrete excess calcium through the urine, increasing the energy cost of maintaining the Ca/P balance.

Phytase is an enzyme commonly used in the diet to break down phytate, releasing digestible phosphorus. Ideally the phytase should be highly active in the upper gut at low pH, so it will break down the phytate quickly and before it can bind with calcium. It is possible to maintain a balance of phosphorus and calcium in the presence of phytase.

## Calcium matrix

It is well known that calcium levels, as well as the particle size of the Ca source (a factor in solubility) can impact

PHOTO: SHUTTERSTOCK





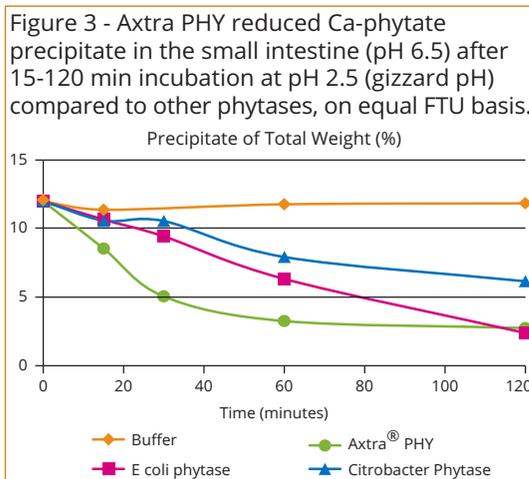
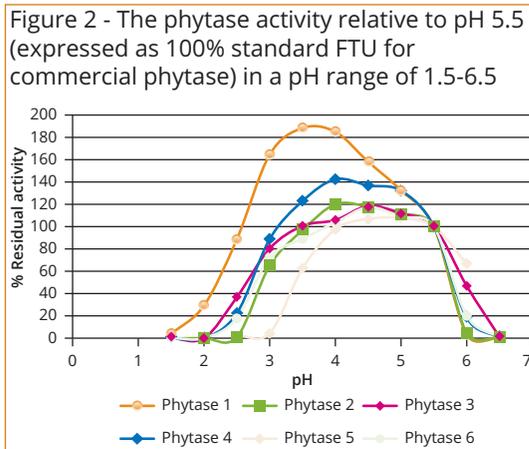
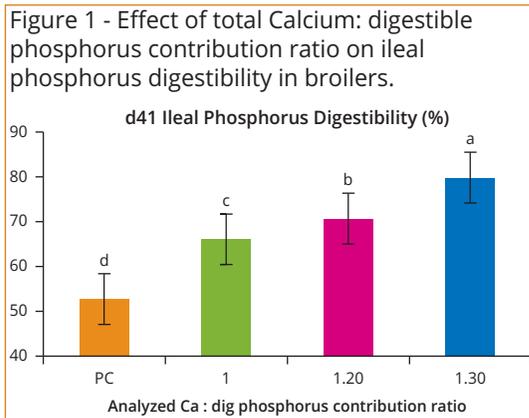
phytase efficacy. For example, in one study, adding just 0.5% calcium from limestone reduced phosphorus digestibility by 63% in the absence of phytase, by 26% in a diet supplemented with a 3-phytase and by 41% with a 6-phytase. The impact of Calcium on phytase efficacy is directly related to phytase activity in the upper part of the gastrointestinal tract (GIT) where phytate is more soluble because of the low pH. A phytase that is highly active at the low pH in the upper GIT will break down phytate more quickly and completely, thus less phytate remains to be bound by the excess Ca in the small intestine, which reduces the negative impact of excess calcium. In this way, availability of Ca is also increased by phytase. For that reason,

a defined calcium contribution number, or matrix value, would be desired in order to maintain proper Ca/P balance when phytase is used in the diet. Without it, a calcium/phosphorus imbalance may occur, thereby negatively impacting digestion and performance.

As each phytase has a unique pH profile, calcium matrix values should be defined for each individual phytase. In two studies, the optimal total Ca: dig phosphorus contribution ratio for Aextra PHY in broiler diets was determined. One study demonstrated that a calcium/dig phosphorus contribution ratio of 1.25:1 optimised feed conversion, while the other showed that increasing the calcium/dig phosphorus contribution ratio increased ileal phosphorus digestibility

**An animal's calcium requirement is determined by an optimal calcium/phosphorus ratio, which is defined by the poultry breeding company.**

(Figure 1). Increasing the calcium/dig phosphorus contribution ratio when supplementing with phytase also reduced the feed conversion ratio (FCR) and feed cost per kilogram of body weight gain (BWG). These data showed that a calcium relative to digestible phosphorus contribution ratio of 1.25 : 1 for Aextra PHY may maintain better Ca and P balance in broiler diets.



### Efficacy with fast-acting phytase

Maximising the efficacy of phytase plays an important role in animal production, because phytase has the ability to do much more than liberate phosphorus. Phytase has been shown to increase the availability of amino acids, energy and minerals—key drivers of improved growth performance and feed efficiency. The faster phytate is degraded, the better the outcome in the animal. To make that possible, the phytase must be highly active in the acidic environment of the upper GIT.

In one study, the activity of six different phytases were examined *in vitro* based on pH to determine the level of activity under normal gut conditions. Aextra PHY (shown as Phytase 1) was most active at typical stomach pH, demonstrating its ability to degrade phytate faster than competitive products (Figure 2).

Aextra PHY's superior bio-efficacy was further demonstrated in a second *in vitro* study (Figure 3), which showed that it required less incubation time at pH 2.5 to reduce calcium-phytate precipitation in the small intestine. This fast action is important as transit time through the upper part of the GIT is typically very short.

In addition to rapidly degrading phytate in the upper GIT for better release and faster absorption of nutrients, Aextra PHY has also been shown to increase bone mineralisation, amino acid digestibility and overall nutrient uptake.

### Tools for optimised dosing

While some feed producers leverage available calcium to formulate diets, most still rely on total calcium levels. However, it is clear that a well-proven, customised calcium contribution for phytase is an important component of maintaining an optimal calcium/phosphorus ratio, as more is not always better. In fact, an unrealistically high Ca contribution number may possess a risk of leg weakness, especially when using a limestone with poor Ca digestibility. The optimal Ca contribution value for phytase is a function of dietary composition, age and species of animals and dietary Ca levels. Using an optimal Ca contribution value may contribute to additional feed cost savings of US\$ 0.4-\$0.7 per ton of feed.

Achieving success with tailored dosing requires continuous investment in research and innovation to generate species, life stage and diet-specific data that can be applied by nutritionists.

Danisco Animal Nutrition supports optimised phytase dosing for maximum performance with the Optimize Feed program. Optimize Feed is a unique online tool that uses matrix values based on a meta-analysis of 10 broiler trials looking at ileal P, Ca digestibility and total tract retention of P and Ca. It calculates the optimum phytase dose for optimising performance and cost. For example, the cost saving per ton of feed is up to \$ 4 when using the recommended dig P and Ca matrix, and up to \$ 13 when including also the energy and digestible amino acids matrix.