Optimising feed cost savings through new feed enzyme application

Phytase was first introduced to the swine and poultry industries to make available the phosphorus (P) from plant-based feed ingredients in the diet. Its implementation also changed the practice of over supplementing P as a costly insurance factor, which was contributing to environmental pollution. At that point, the dietary phytase levels added to the diet were typically between 250 and 500 FTU/kg of diet.

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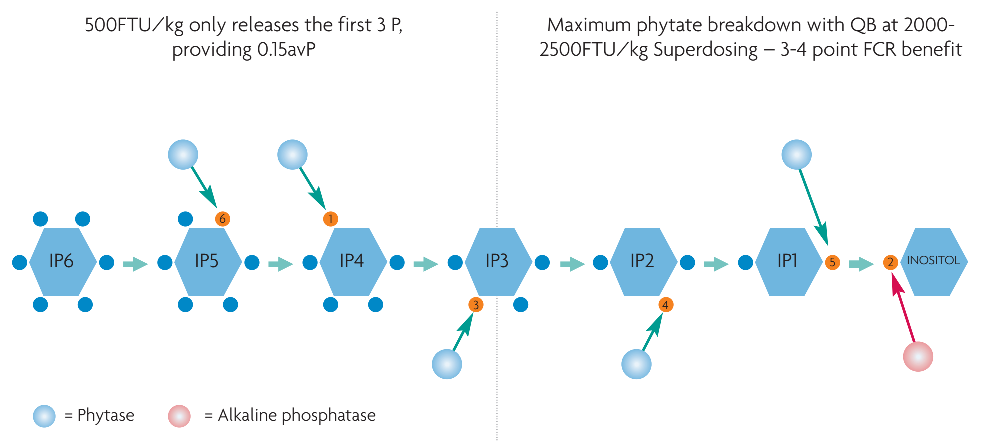
Today, although economic and performance benefits have been the main driver for the use of phytase in animal nutrition, environmental pollution from intensive swine production continues to be an area of concern. The primary concern is nitrogen (N) and P excretion, which pollute ground water and run off into surface water causing algal bloom and damaging the local ecosystem.

As the environmental impact is well established, regulations and directives have been introduced in different markets. The ecological hazards posed by P have been integral to the development and acceptance of phytase feed enzymes, as they have contributed to the amelioration of P pollution of the environment.



By releasing only the first two phosphorus molecules, you could be wasting two thirds of the value within and bound to phytate

Humankind has a growing interest in being more environmentally friendly. Traditionally we have calculated the environmental impact by determining all greenhouse gas emissions and then converting those back to a CO_2 equivalent (CO_2e).

Methodologies and models were developed and reviewed by the Intergovernmental Panel on Climate Change (IPCC); a United Nations body.

Based on IPCC standard methods, feed formulation represents around 70% of these emissions in swine production, reinforcing the key role that nutritionists can play in reducing emission from feed and consequently from pig production. A recent survey has shown that 26% of consumers are concerned about sustainability when shopping for meat products. This emphasises the need for the livestock production industry to demonstrate its commitment to reducing its environmental impact.

Improved understanding

Since early phytase implementation, the understanding of anti-nutritional effects of dietary phytate and a more comprehensive awareness of the benefits that adding a phytase can have on the animal has improved. Phytate, or IP6, is a highly negative molecule that binds to minerals (Ca, Zn, Mn, Cu, Fe, etc) and impairs amino acid digestion while increasing energy maintenance costs.

To overcome these challenges, a highly efficient phytase can be added to the diet at high doses (>1,500 FTU/kg) for complete phytate destruction to IP1, which can then be hydrolysed by the pig's own enzyme, alkaline phosphatase, releasing inositol.

Lee et al. (2018) and Aftab & Bedford (2018) published different studies demonstrating the value of utilising higher doses of phytase (>1,500 FTU/kg).

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Fig. 1. Trial comparing superdosing and cost reduction strategies to a control diet.

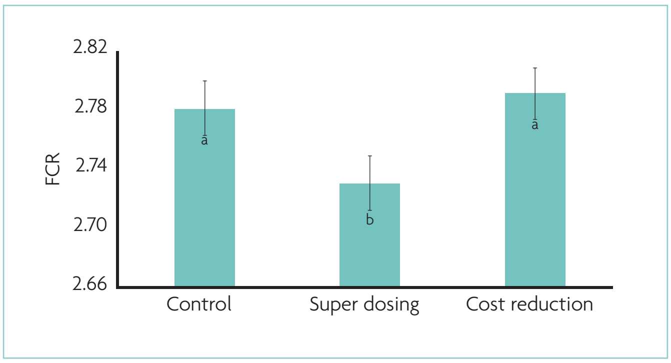
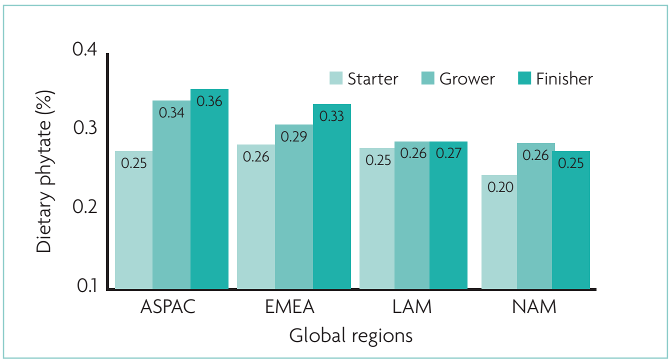


Fig. 2. Phytate-P analysis.



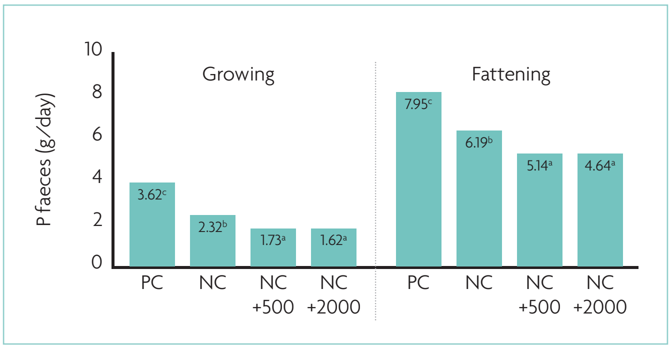


Fig. 3. Phosphorus excretion in faeces of growing and fattening pigs. The positive control (PC) diet was adequate in all nutrients. The negative control (NC) diet was reduced in P and Ca with no inorganic P added.

Continued from page 23

They observed a strong action on substrates (phytate) and a reduction of the deleterious effects of these anti-nutritional factors, resulting in a great cost saving opportunity for formulation with maintenance of performance and improved amino acids, minerals, and energy utilisation.

This suggests that the use of higher dietary phytase levels provide greater amino acid, energy and mineral release, thereby improving the ability of the producer to maintain productive performance while lowering feed cost.

There are two predominant strategies to incorporate the higher phytase levels into the diet. First, the phytase can be added to the diet 'over the top' of the normal levels.

This strategy is referred to in commercial and scientific literature as 'superdosing' and the main benefits are better performance, usually translated as better growth or even feed efficiency.

Alternatively, higher phytase levels are incorporated as a cost reduction strategy. Higher matrix values are applied to the enzyme (while assuring adequate dietary phytate levels) including minerals, amino acids and energy, thereby providing greater cost saving while maintaining productive performance.

A recent US study in finisher pigs (Fig. 1) demonstrates the benefits over a control diet, which contained a standard phytase level of 340 FTU/kg, compared to 'superdosing' phytase added over the top of the control diet to give 2,000 FTU/kg. This offered the same performance but at a cheaper cost by applying greater matrix values (amino acids, minerals and energy).

The results showed that superdosing phytase significantly improved feed efficiency, while increasing matrix value for energy, amino acid and energy gave the same performance but at a lower feed cost ($5/t).

The ability to measure dietary phytate (Fig. 2) is important when supporting the use of higher levels of phytase, such as the maximum matrix nutrition concept, as it is important to ensure that there is sufficient substrate for the nutrient release targeted.

AB Vista developed calibrations for near infrared (NIR) technology and has offered the service to customers since 2012. These can be utilised for determination of phytate concentrations in diets and ingredients.

Based on global sampling in swine feeds, the level of dietary phytate can vary from 0.20-0.36%. Higher dietary phytate levels give the nutritionist an opportunity to use a higher nutrient release from the phytase to provide greater feed cost savings. Hence, it is important when doing this application to test to ensure that adequate levels are present in the diet to support the desired level of phytase use.

The high use of phytase not only brings value in terms of performance or cost savings, it can also be used to reduce P excretion which is becoming an issue in differing markets across the world.

Globally, the pig population consumes seven million tonnes of inorganic (dicalcium) phosphate annually and 64% of total dietary P consumed is lost in the faeces or urine.

Extrapolating the data further, the use of phytase to replace 1.0-2.0g/kg of inorganic P supplied in the diet could reduce inorganic phosphate supplementation by 38-76%.

Internal studies have demonstrated that faecal P can be reduced by 25% in grower and 17% in finisher by supplementing the diet with traditional levels of phytase (500 FTU/kg).

However, using a superdosing level of phytase (2,000 FTU/kg), it was determined that the P excretion was reduced by 30% for the grower period and 25% for the fattening period.

In the study described above, the carbon footprint of each treatment was determined. Differences observed were driven by changes in diet formulation and growth performance. Emissions were reduced by addition to either the superdosing strategy (numerically by 1%) or the maximum matrix strategy by 4% ($P<0.05$) over the control diet.

Conclusions

Supplementation of 2,000 FTU/kg of phytase reduces nutrient excretion, improves pig performance, and reduces the carbon footprint of the diet.

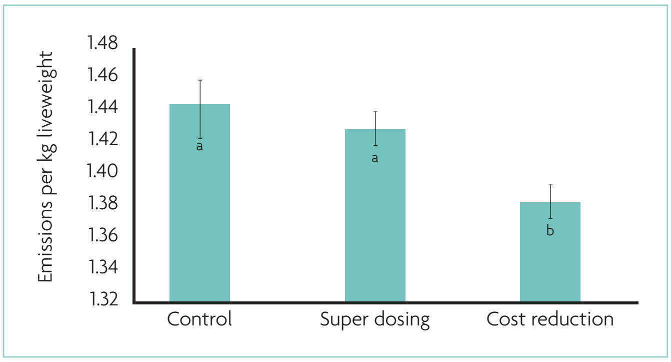
Application of these higher levels can be achieved by supplementing over the top of a traditional diet, permitting the producer to see added production benefits compared to the traditional levels.

Alternatively, the producer can achieve a more cost effective and more sustainable diet by applying greater matrix values and maintaining the performance at the traditional phytase levels.

These applications can be applied more routinely as the ability to measure and test dietary phytate allows the nutritionist to determine the potential for phytase use in their production system. ■

References are available from the authors on request

Fig. 4. Carbon emissions comparing superdosing and cost reduction strategies to a control diet.



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