Improving the iron status of the young pig with phytase superdosing

Traditionally in swine nutrition much focus is placed on energy, protein and/or amino acid requirements for the young pig, however improving their trace mineral status is also vital for optimal growth and efficiency.

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Of particular importance post-weaning is iron (Fe), which is a key component of the haemoglobin in red blood cells and, as such, is critical to oxygen transport through the bloodstream.

Higher levels of Fe are known to increase the level of haemoglobin in the blood, boosting oxygen supply to the cells and ultimately improving growth.

Importance and availability of Fe

In modern swine production systems, Fe injection at birth is a well recognised standard operating procedure. Fe supplementation is absolutely critical because piglets are born with low Fe stores (less than 50mg) and the sow's milk has an insufficient level of Fe to meet her litter's requirement (approximately 1mg Fe/day/piglet).

For optimal growth, it is estimated that piglets require 8-16mg of Fe per day and their stores at birth would be quickly diminished within the first few days of life, resulting in anaemia and poorer performing pigs.

Depending on the growth rate of the pig, veterinarians generally recommend giving newborn pigs within 48 hours of birth 100-300mg of Fe dextran as a parenterally injection or oral dose.

However, even with proper dosing of Fe at birth, faster growing piglets are susceptible to anaemia in early weaned pigs.

To complicate matters further, the use of animal proteins in starter diets that are rich in Fe, have been slowly replaced by cheaper vegetable protein sources, and often nutritionists do not adjust supplemental Fe levels of the diets when protein sources change. An example of this is replacing poultry meal (230-440ppm, Fe; NRC 2012) with soybean meal (98ppm, Fe NRC2012) thereby lowering dietary Fe level.

To further compound this problem, Fe in plant-based proteins is bound up by phytate and is not necessarily bioavailable to the pig.

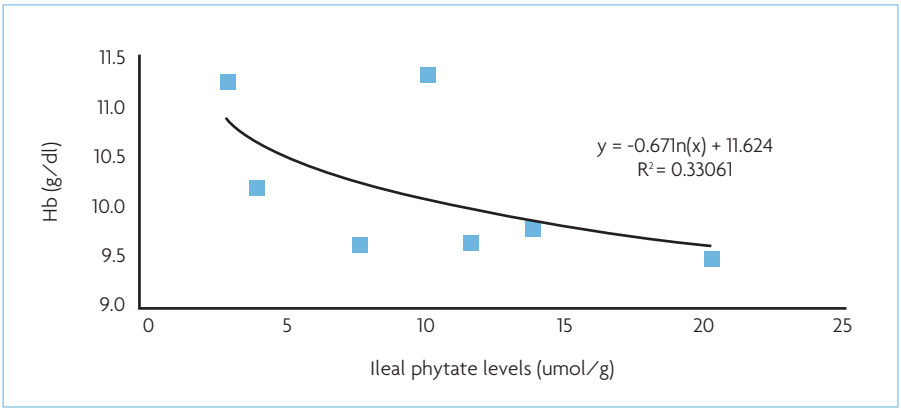

Fig. 1. The impact of superdosing with Quantum Blue phytase on blood haemoglobin concentration in 21 day old pigs (AB Vista Internal Data, 2015).

Phytate – the anti-nutrient

It is well accepted that dietary phytate, the storage form of phosphorus (P) within plants, is an anti-nutrient negatively impacting amino acid, and energy utilisation, while in addition, phytate and the lower esters (IP5, IP4 and IP3) also bind minerals such as zinc, Fe and copper.

Not only is this latter effect important in animals but research has been conducted in humans looking at the phytate x Fe interactions on Fe absorption which provides an insight into what may well happen in the weaned pig.

Human research has shown that, by decreasing phytate levels in bread, the phytate:Fe ratio decreases and this results in an increased level of Fe absorption.

If this model is used in relation to a typical pig starter ration, containing 0.82% phytate with 100mg/kg of supplemental Fe, it would estimate Fe absorption of only 30%. This could produce a perfect storm where weaned pigs are marginally Fe deficient and then moved to a starter diet that limits dietary Fe utilisation.

Hence, reducing phytate in this post-weaning period may be beneficial in terms of increasing Fe absorption and early pig performance.

Superdosing phytase

There are three possibilities to improve Fe absorption in these newly weaned pigs, either by supplementing more Fe (+100ppm Fe), destroying phytate with superdosed (›1500FTU/kg) levels of phytase, or combining both for optimal absorption.

Near elimination of phytate from the diet through phytase superdosing therefore has an important role to play in improving the Fe status of young pigs.

Not only does the existing Fe content of the diet become more available, but the majority of any extra Fe added to the diet is also available to be utilised by the pig rather than becoming bound up by phytate.

For example, studies have found the Fe binding potential of phytate to be as high as 69%.

Even the lower order esters of phytate (IP5, IP4 and IP3) produced when phytase is used at standard dose rates to release P were capable of binding Fe at rates of 70%, 34% and 26% respectively.

The breakdown of phytate to below IP3 by superdosing phytase however,

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dramatically reduces this binding potential. In fact, research has shown that the use of superdosing (>1500FTU/kg) Quantum Blue lowers the level of ileal phytate levels in the piglet and that the lower ileal phytate levels were associated with improvements in blood haemoglobin concentration (Fig. 1) and red blood cell distribution width (RDW), both sensitive indicators of Fe status.

Enhancing growth performance

The near complete absence of phytate binding that follows superdosing also creates an opportunity to achieve a worthwhile response from increased levels of supplemental Fe.

For example, the trial results in Fig. 2 show the effect of increasing dietary Fe levels from 200-350ppm on 20-day post-weaning growth performance either with, or without, addition of Quantum Blue phytase at 2000 FTU/kg.

Where superdosing was employed, the increase in supplemental Fe produced a significant 10% increase in ADG (282g/day versus 256g/day) along with a 7% improvement in FCE.

This result was in stark contrast to the lack of any significant, or worthwhile, response to additional Fe without superdosing.

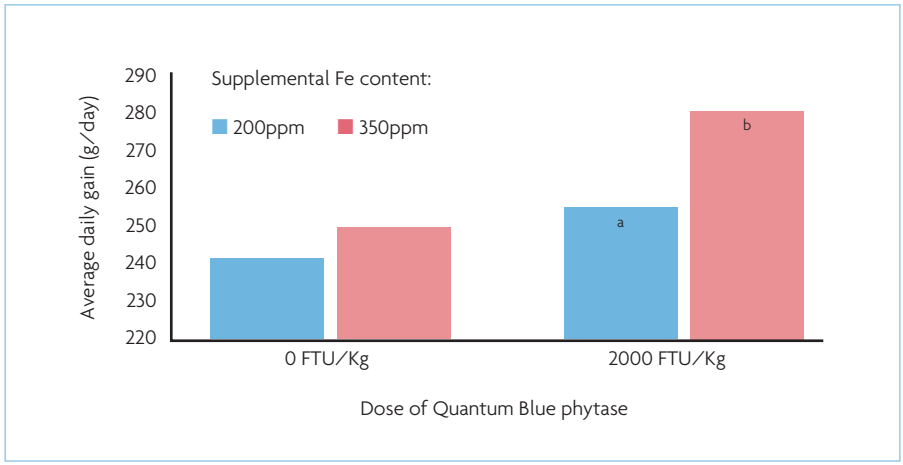

Fig. 2. The effect of supplemental Fe and Quantum Blue superdosing on 20-day post-weaning growth rate in pigs at 0 FTU/kg (Trial 1) and 2000 FTU/kg (Trial 2) (AB Vista customer trial, 2010).

Effective phytase selection

However, this use of phytase superdosing at 3-4 times the standard dose to increase availability of Fe in pig starter diets relies on the ability of the phytase to achieve near complete destruction of phytate and its lower order esters.

Not all phytases have the same characteristics especially in their ability to breakdown both phytate and lower phytate esters quickly.

It is therefore important to target a phytase such as Quantum Blue that has the ability for rapid phytate breakdown and near complete elimination of phytate.

The net result is an opportunity to significantly improve the Fe status of the young pig, increase feed efficiency and boost growth.

Whether used to get more out of existing diets, or gain a benefit from additional dietary Fe, it is a response that highlights the substantial potential for phytase superdosing to improve the effectiveness of pig starter diets. ■