A quantum leap introduces low phytate nutrition

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Research conducted by Primary Diets through the years has continually shown that using vegetable protein at high levels at the expense of milk proteins results in poorer post-weaning and therefore poorer lifetime piglet performance.

This can be illustrated by a trial conducted at Leeds University (Primary Diets' Independent Research Partner) which compared a typical US-type diet high in vegetable protein with a conventional milk based UK diet.

The results showed that by 20 days post-weaning the UK-type diet gave an improvement in average daily gain (ADG) of 35g/day (+12.5%) and food conversion ratio (FCR) of 7 points (+5.4%).

Whilst the US-type diet was approx £40/t cheaper, the UK-type diet resulted in an increased margin over feed of £0.80 per pig due to improved performance and feed efficiency (weaner valued at £1.05/kg live weight). Although a cheaper feed is undoubtedly attractive to pig producers, it does not usually deliver the best value/profit.

Vegetable proteins

It is well known that vegetable proteins have many anti-nutrient components. Soya based products, for example, have negative factors including trypsin inhibitors that reduce protein digestibility oligiosaccharides (short chain carbohydrates), such as raffinose and stachyose that make up 7% of the soybean meal and are not readily digested by the newly weaned pig, and high levels of reactive phytate that bind nutrients (Fig. 1) and increase endogenous losses.

All these factors negatively affect the performance of the newly weaned pig, as highlighted by some other recent Primary Diets research.

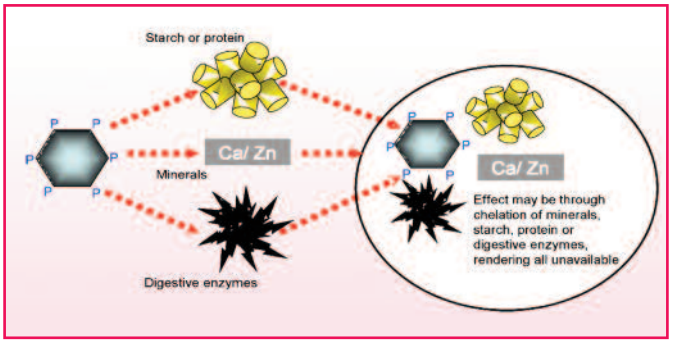


Fig. 1. Phytate can decrease intestinal digestibility by the formation of insoluble complexes of nutrients and digestive enzymes.

In this trial the addition of 7.5% hipro soya to the control resulted in a 15% decrease in ADG and deterioration in FCR by over 5%. Much is known about the impact of trypsin inhibitors and oligosaccharides and how to counteract their negative effects. Less is known about the negative effects of phytate and how to overcome them.

The addition of vegetable proteins into the diet increases the level of dietary phytate. If the dietary phytate is not broken down in the newly weaned pig, it forms insoluble complexes with minerals and protein in the upper gastrointestinal tract.

It is this reduced solubility that is responsible for the compromising effects of phytate on amino acids, energy, calcium, sodium and trace minerals digestibility. Insoluble complexes induce hyper secretion of HCl (Fig. 2), mucin, pepsin, bile and sodium bicarbonate which results in increasing endogenous losses and interferes with active transport.

This, in turn, can impact on water absorption and may even cause a nutritional post-wean scour.

Increasing dietary phytate has a large negative impact on the solubility and digestibility of dietary nutrients and consequently reduces animal performance.

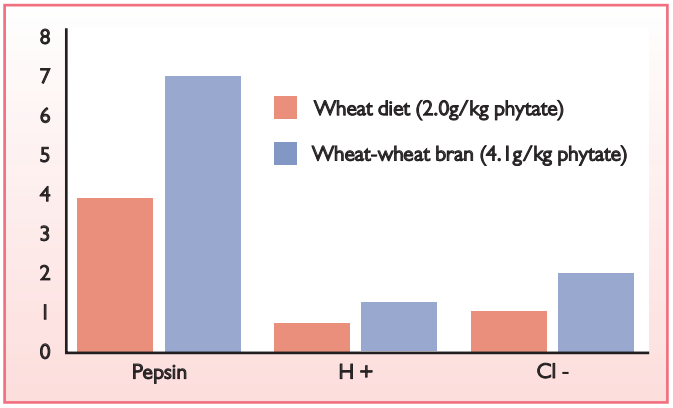
Utilising higher levels of vegetable proteins should only be tolerated when it can be used without the loss of pig performance typically observed (as highlighted earlier).

Consequently this has been one of the main areas of focus for Primary Diet's research over the past two years. This research, conducted by Primary Diets in collaboration with AB Vista at the University of Leeds, has led to a fundamental breakthrough in our ability to utilise higher levels of vegetable proteins through a new understanding of the impact of their phytate contribution.

The breakthrough has been the development of low phytate diets using 'superdose' (>1000 FTU) levels of Quantum Phytase.

The innovative use of Quantum Phytase targets phytate removal rather than just a phosphorus and calcium release which is the normal application of phytase enzymes.

Fig. 2. Effect of a wheat diet (2.0g/kg phytate-P) and a wheat-wheat bran diet (4.1g/kg) on gastric secretion of pepsin and HCl in pigs (after Korczynski et al 1997).



Low phytate nutrition

In order to target a 'low phytate' nutrition program it is important to select a phytase that is highly effective in quickly breaking down the intact phytate (IP6) into lower molecular esters of IP such as IP3 or less as these esters have lower chelation properties (for example IP3 had only 10% of the chelation capacity of IP6) than the intact phytate (IP6).

Quantum Phytase was selected for this application in part due to three key factors:

- Quantum is a third generation E. coli phytase developed to have a high gastric stability as well as broad pH activity profile with high activity at a low pH. This is critical as a high phytase activity is needed in the stomach where the low pH makes phytate more soluble and susceptible to phytase attack.
- Unlike other heat stable phytases, Quantum is not coated but is intrinsically thermostable. This ensures that it can be processed (pelleted) and still be quickly released into solution in the stomach to maximise phytate breakdown.

Coated phytases, although thermostable, have a delayed release in solution thereby lowering the rate of IP6 breakdown (see Fig. 3).

- Quantum has a high affinity for IP6 compared to other phytases so that even with very low phytate lev-

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els in the feed Quantum remains efficient in phytate breakdown.

The ability to target IP6 at low levels in the feed is therefore critical in the application of 'low phytate' nutrition.

Introducing superdosing

A large series of research trials (with zinc oxide at 3.1kg/tonne and copper at 170ppm) were carried out to elucidate the correct level of Quantum required to exploit the 'low phytate' nutrition concept in practical starter diets and ensure consistent performance benefits are observed.

One such trial (Table 1) shows that the addition of higher levels of soybean meal to a standard diet resulted in a poorer feed conversion, as expected.

However when the same diet was used with superdose levels of Quantum, FCR was restored to the level of the standard diet and ADG was improved over the standard diet by 44g/day.

Another consistent benefit observed with the use of superdose levels of Quantum Phytase was a reduction in diarrhoea, most likely a result of improved nutrient digestibility and gut health.

Based on the overall university data of over 20 trial comparisons, the results showed that when Quantum Superdosing was applied to starter feeds three weeks post-weaning, there was an average improvement in ADG of 5.8% and FCR of 4.7%.

On average, this resulted in an extra margin over feed of 40 pence per pig or £66 per tonne of feed assuming a typical starter feed usage of 6kg/pig.

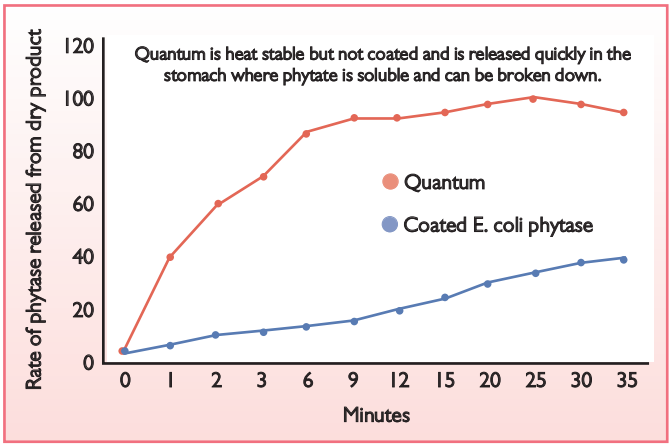

Fig. 3. Rate of phytase released from dry product based in phytate hydrolysis.

Table 1. Superdosing quantum phytase improves performance despite increased soya levels (University of Leeds exclusively for Primary Diets).

	Control	+ Soya	+ Soya + Quantum Superdose
Start weight (kg)	8.47	8.47	8.47
Overall FI (g/pig/d)	357	408	420
Overall LWG (g/pig/d)	323	335	367
Overall FCR	1.15	1.23	1.15
End weight (kg)	14.91	15.15	15.80

Table 2. Confirmatory trial on the benefits of two previously unresponsive additives when combined with superdosed quantum in post-weaning diets (University of Leeds exclusively for Primary Diets).

	Standard	Superdosed Quantum plus 2 additives	Difference
Start weight (kg)	7.19	7.18	
End weight (kg)	13.33	13.94	
Overall FI (g/pig/d)	343	362	+19g/day
Overall LWG (g/pig/d)	306	338	+32g/day
Overall FCR	1.13	1.07	- 6 points
Weight gain (kg)	6.14	6.76	+ 0.62kg
Cost/kg (relative %)	100	88	-12%

Cutting feed costs

Primary Diets believe this may only be the beginning of the exploitation of 'low phytate nutrition' as superdosing phytase is unlocking new avenues of investigation.

In a second phase of research, the latest trials have shown that some additives which have previously failed to generate responses in conventional (high phytate) diets are now showing performance responses when combined with superdose levels of Quantum phytase (for example in low phytate diets).

Primary Diets have already commercialised a combination of two previously rejected additives together with superdosed Quantum following promising and repeatable benefits (Table 2).

The results showed that the two additive combination in Quantum superdosed diets improved the 20 day post-weaning ADG, FCR and ADFI by 10.4%, 5.4% and 5.5% respectively.

The new technology of improved gut health through low phytate nutrition, coupled with improved nutrient digestibility and gut health support, means that the producer is now able to feed up to five extra pigs per tonne free through improved feed efficiency and superior growth rates. ■