Optimising growth in fattening pigs with a multi-enzyme complex

The use of enzymes, especially carbohydrase, in feed for swine and particularly in weaned piglet production, is a common strategy to reduce the negative effects caused by non-starch polysaccharides (NSP). These polysaccharides reduce digestion of proteins, fat, and some minerals.

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When piglets are weaned their gut, secretions and endogenous enzymes are immature and the transition from milk to solid feed is a strong challenge for the animal.

The incomplete digestion that occurs during this period has motivated studies about the inclusion of amylases and NSP enzymes in pig diets.

Several studies show that weaning stress is characterised by a sudden decline in most enzyme activities. A period of time ranging from 2-3 weeks post weaning is required to reach the right concentrations in endogenous enzymatic production (Fig. 1).

When enzymatic activity is compromised during this period, NSP reaches the small intestine undigested. This undigested NSP is a great nutrient source for bacteria, which ferment it and increase the populations causing digestive disorders, intestinal alterations and enteric processes.

Table 1. The two main effects of NSP on animal performance.

- **Cage effect:** It acts as a barrier for digestion of intracellular nutrients (AA, proteins, minerals, lipids, etc).
- **Viscosity effect:** Water-soluble NSP increases viscosity in the gut, limiting the mix of nutrients with pancreatic enzymes and bile acid, and reduces digestion and absorption of nutrients.

Adapting pig diets to make production more profitable

A fattening pig's intestinal transit time is long enough to produce a complete digestion of the ration.

However, if we analyse the ingredients of current pig diets, the main cereals, such as wheat, barley and corn are incorporated, and the rest of the ingredients are protein sources (soya, sunflower, rapeseed meals, etc), and other by-products (wheat bran, wheat or corn DDGS).

Nowadays, the tendency is to design more complex diets (richer in fibre) in order to reduce feeding costs.

If we evaluate these ingredients more deeply, we can observe that all of them have an important dietary fibre complex, and one of the most important components of this fraction is the NSP (xylanase betaglucans, celluloses, hemicelluloses and amylopectins).

It could be said that at least 14% of the fattening pig diet is NSPs. Returning to the enzymatic activity of the fattening pigs, we can observe that although it is highly developed, pigs do not produce the endogenous enzymes required to breakdown the cell wall NSP.

Therefore, the use of this 14% NSP is subject to the complex bacterial ecosystem fermentation in the large intestine, where nutrient absorption in that part of the intestine is virtually zero.

Effects of exogenous enzymes on fibre utilisation

To make enzyme application more economical, there continues to be interest in improving extant enzymes.

New approaches optimise the activity of the next generation of enzymes and are designed to increase their effectiveness toward the substrate target.

There is evidence that demonstrates the multi-enzyme complexes are more efficient than enzyme cocktails or purified enzymes.

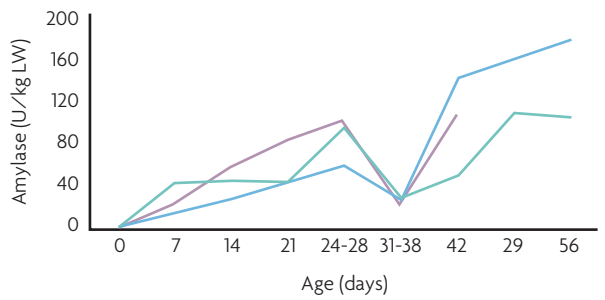

Fig. 1. The development of amylase and other enzyme activity decreased post-weaning (Lindemann et. al., 1986; Jensen et al, 1997).

The main reason for the use of multi-enzymes is to hydrolyse complex carbohydrates that pigs are unable to hydrolyse by themselves.

This advantage is one micro-organism can produce a battery of enzyme complexes, each one with different catalytic units by complex interaction with microfibres of different antinutritive compounds and separating these microfibres and liberating a bigger amount of nutrients.

Endofeed DC is a multi-enzyme complex, with a wide range of synergistic activities, obtained through a non-GMO fungal fermentation, specific for Aspergillus niger.

It was the first enzyme registered in the EU (No. E1601) as a feed additive for chickens and laying hens, and recently it obtained EU authorisation for fattening pigs and minor poultry and porcine species (No. E-4a1601).

In a comparative test several products were evaluated for their ability to release sugar enzymatically from raffinose series oligosaccharides (RSO) of soybean meal (SBM).

At the end of trial, Endofeed DC degraded more RSO in SBM compared with other treatments, resulting in some significant levels of glucose released by Endofeed DC compared with competitors (Fig. 2).

With the use of Endofeed DC, rich in xylanases and beta-glucanases, SRO can be degraded and converted into glucose in the intestinal tract, increasing the nutritional value of the feed.

On the other hand, Endofeed DC released the nutrients masked by fibre (cage effect), releasing proteins, fats and amino acids that will improve the performance of animals and increase the economic benefit of animal production.

In recent tests developed by the Pintaluba Group in fattening pigs (from 20-100kg BW) Endofeed DC provided excellent results not only

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Table 2. The effect of Endofeed DC on fattening pig performance.

	Control	Endofeed DC	SEM	Differences
Body weight (kg)	95.9	98.2	0.48	2.3kg
ADWG (g/day)	729.8	734.8	6.08	5g/day
ADFI (g/day)	1,877	1,855	12.5	-22g/day
FCR	2.64[b]	2.58[a]	0.018	-0.06

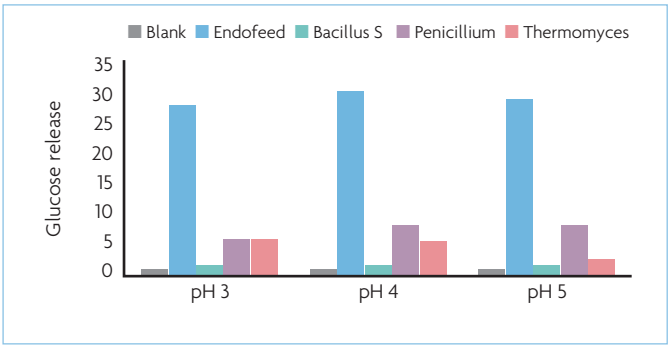

Fig. 2. Glucose release from soya bean meal samples, incubated with Endofeed DC and other enzyme products.

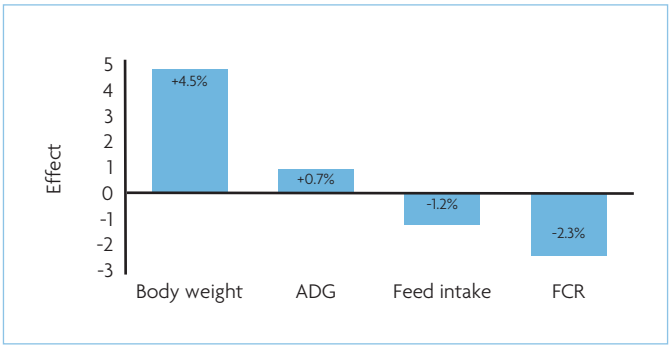

Fig. 3. The effect of Endofeed DC in fattening pigs.

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with the wheat-barley diets, but in diets with corn-soya rations too.

A database using four experiments (more than 1,400 fattening pigs) and reporting the effect of Endofeed DC on animal performance were used in the meta-analysis. Results show that animals fed Endofeed improved the FCR by 2.3% with a numerical difference of 2.3 kilos over the final weight of the control group.

The basis for the mode of action of Endofeed DC is the degradation of soluble NSP in the digestive tract, which directly decreases digesta viscosity and increases the passage rate. Simon (1998) indicated that nutrients that were initially unavailable to digestion processes, due to lower access of endogenous enzymes, now become available and thereby increase their digestibility.

The degradation of complex β-glucan and arabinoxylan to lower molecular weight compounds not only decreases viscosity and increases nutrient digestibility but may also facilitate the access of bacteria in the distal small intestine as well as the large intestine to fermentable substrate.

The products resulting from this NSP fermentation are the short chain fatty acids (predominantly acetate, propionate and butyrate).

These VFA are rapidly absorbed and have been shown to supply between 5 and 28% of the maintenance energy requirement of pigs. The meta-analysis definitely indicates that the use of multi-enzyme complex (Endofeed DC) targets different antinutritive compounds in feedstuffs to obtain the maximum benefit compared with each of the enzymes acting individually.

Conclusion

It is a reality that fattening pigs lack the ability to hydrolyse NSPs, which justifies the use of exogenous multienzyme complexes that complement the endogenous activity of the animal. But, we must be careful to select a more efficient multienzyme strategy that allows the maximum of inaccessible nutrients to be extracted, increasing their digestibility and resulting in a better animal performance.

Endofeed DC is a versatile multi-enzyme complex that is not only effective in wheat-barley diets, but has good performance in corn-soya based diets too, reducing anti-nutritional factors and leading to greater profitability and flexibility in formulation with important savings in feed costs. ■

References are available from the authors on request