A major competitor - poultry - is making great use of enzymes to improve chick digestion and feed efficiency, and so produce a cheaper product. By comparison, the pig industry has only just begun. Enzymes have tremendous potential. Here's how they work, and how they can benefit your bottom line.

Help lean growth to live up to great expectations

Various studies show that fast, early growth sets the scene for later performance, both in terms of weight for age and carcase leanness. Unfortunately, management regimes often make it hard to overcome the classic growth check of young pigs from weaning to 30 kg liveweight which is experienced on many commercial units.

Often, it is this inability to exploit fully the lean growth potential of young pigs at this time which explains why pig production sometimes fails to live up to expectations.

Nutrition plays a key role in making the changeover from weaning to conventional rations as smooth as possible. Finnfeeds International's Dr Gary Partridge has been studying the many dietary factors responsible for compromising performance at this key stage.

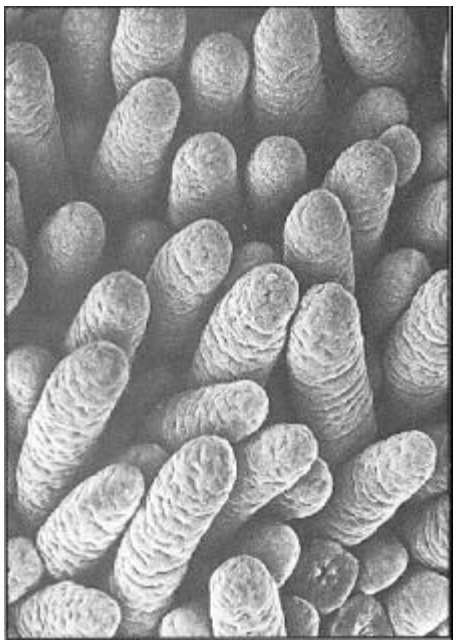
Problems

He identifies seven main problems:

- Insufficient quality and quantity of digestive enzymes to deal with new dietary components
- Major changes in gut structure at weaning
- Poorly-developed stomach acid secretion
- Removal of the natural antibacterial systems present in sows' milk
- Reduced feed intake
- Physical form of the post-weaning diet offered
- Environment changes and subsequent stress effects on the young pig's immune system development.

The small intestine of the newly-born piglet is lined with tiny projections (villi). These are covered in cells which manufacture digestive enzymes to help to break down food substrates such as lactose and proteins contained in the mother's milk.

These cells start off at the bottom of the villi in an area called the crypt, which is a cell-production factory, and migrate to the top over 2-4 days. Only when these cells reach the tip of the villi do they start to secrete these essential enzymes into the gut to start the digestive process.



The effects of weaning on gut structure in the piglet - before (above) and after. Photo: courtesy of Dr Denise Kelly, Rowett Research Institute.

"There are significant changes in gut structure and associated enzyme development after weaning," explains Dr Partridge. "At weaning, the shape of the villi changes from being long and slender to become short and club-shaped, providing a much reduced area for absorption. The height of the villi is frequently halved and the crypt depth doubled. The effect of this change is that the whole cell production process is speeded-up, leaving cells still immature by the time they reach the tip of the villi.

"Consequently, these cells have limited ability to produce sufficient or appropriate enzymes to break down some of the nutrients found in the new foodstuffs provided in the post-weaning rations. At the same time, the pancreas - important for producing enzymes - is undergoing change. All this leaves the animal short of enzymes and particularly vulnerable to digestive disturbance."

Stimulate intake

One solution is to stimulate feed intake at this critical period to hasten the development of the digestive enzyme system. Creep-feeding is one method. Another is to provide a wet diet immediately after weaning. Unfortunately, neither technique fully overcomes the effects of weaning on gut structure and subsequent growth rate.

Nutritionists believe there are other factors which may be involved, such as dietary antigenicity - a form of food allergy. In short, the weaned pig develops an allergy to certain foods prompted by earlier experiences of ingredients in the ration.

Soya protein in particular seems to cause problems. That's why specialist starter diets tend to include relatively expensive, highly-processed vegetable protein sources such as alcohol-washed, soya protein concentrates, which contain very low levels of the protein

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Table 1. Raw materials used in pig diets (10-30 kg) and their main anti-nutritional factors (ANFs).

Raw material	ANFs
Barley	Betaglucans; Arabinoxylans
Wheat	Arabinoxylans
Wheatfeed	Arabinoxylans; cellulose
Soya bean meal	Protease inhibitors; lectins; oligosaccharides; pectins
Rapeseed	Tannins; oligosaccharides; pectins; glucosinolates
Peas	Protease inhibitors; lectins; oligosaccharides; pectins
Beans	Protease inhibitors; lectins; tannins; oligosaccharides; pectins

fragments thought to cause the digestive upsets in the first place. This process also removes the oligosaccharides - a particular group of carbohydrates also thought to promote digestive disturbances in young animals.

Dr Partridge breaks down the dietary needs of the young pig into two periods - the immediate post-weaning period up to 10 kg liveweight and the transition phase between 10 kg to 30 kg when the pig moves onto more conventional diets using standard raw materials.

In the earlier period the choice of raw materials and their quality is all-important, given the immature digestive process of the newly-weaned pig. Their relatively high digestibility is why expensive protein sources such as milk and whey protein concentrates, plasma protein and low-temperature processed fishmeals are considered cost-effective.

Accelerating growth

Also, cereals are subjected to various cooking treatments to help to rupture the starch granules to make them more digestible.

‘Enzymes improved daily gain and reduced FCR in trials’

From 10-30 kg, growth should be accelerating fast on diets based on much simpler and cheaper raw materials. Dr Partridge believes this is often the period of missed opportunity because animals have to re-adjust to a new raw material mix. Also, this is the time when antinutritional factors (ANFs) start to play a more significant role in animal performance.

Table 1 shows the principal ANFs associated with a range of common raw materials used at this stage. "The problems of enzyme deficiency in the newly-weaned piglet and the effects of various ANFs on animal performance are particularly relevant to the potential for enzyme supplementation in rations," says Dr Partridge. “Effective feed enzyme systems are frequently blends containing mainly carbohydrase and protease activities.

“These work by disrupting plant cell walls to increase the release of 'packaged’ nutrients in the gut - making them more readily accessible to the animal's own digestive enzymes. Also, they ensure that maximum nutrient digestion and absorption is carried out in the small intestine and not further down the gut where it becomes a much more inefficient process.”

Another benefit is that feed enzymes eliminate or reduce the effects of ANFs in certain raw materials such as the betaglucans in barley and arabinoxylans in wheat. These soluble carbohydrates are known to interfere with nutrient absorption due to their gel-forming properties which can create viscous conditions in the gut. In pigs, this is less of a problem than it is in poultry, but it can still be nutritionally relevant. Enzyme supplementation can help to keep the absorption process functioning more efficiently.

A summary of 53 commercial trials reveals average responses to enzyme addition of 5-6 per cent in daily liveweight gain and 4-5 per cent in feed conversion (see diagram 1). Some

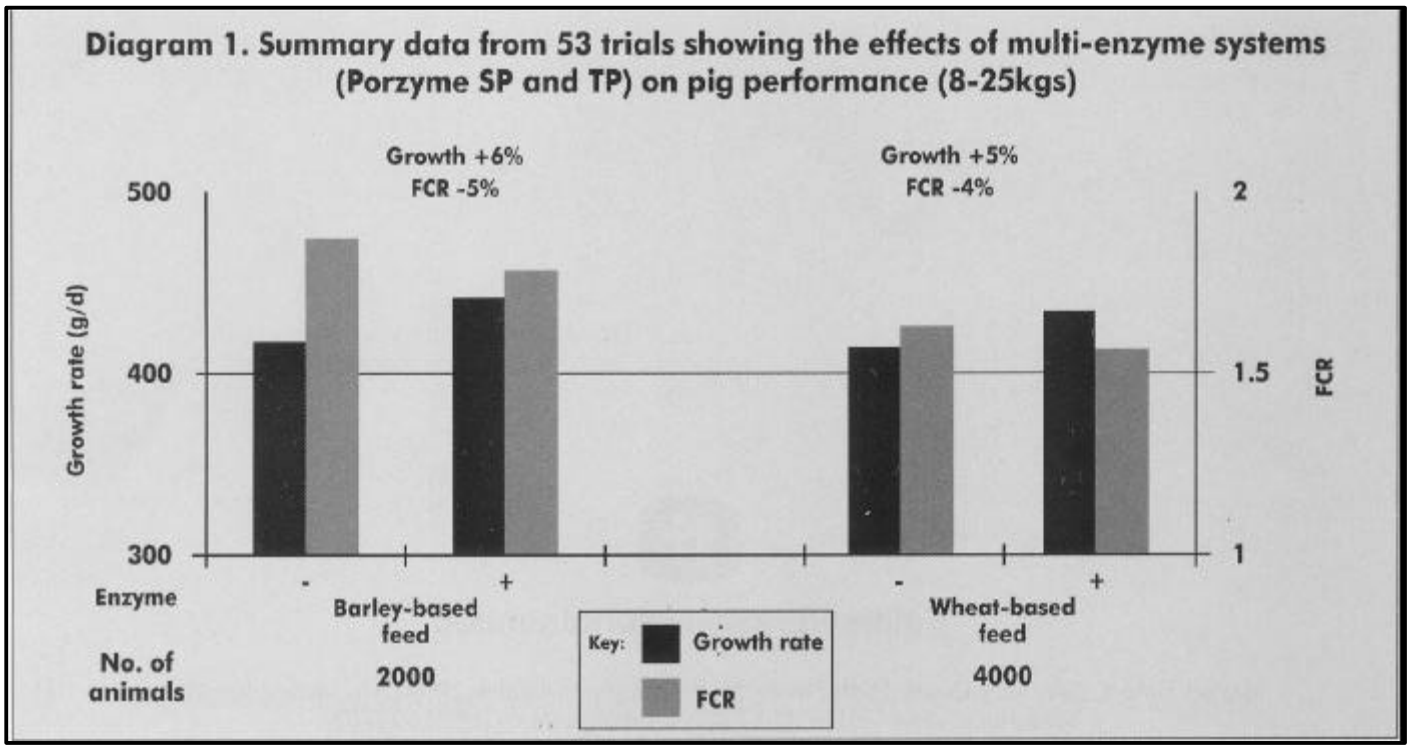

Table 2. Effects of enzyme preparations on pig performance (10-25 kg) fed wheat and barley-based diets.

	Wheat-based diets		Barley-based diets	
Enzyme*	-	+	-	+
Growth rate (g/day)	406	450	382	436
FCR	1.80	1.63**	1.91	1.62**
Final weight variation (% cv)	5.6	2.8	6.9	2.4
Antibiotic treatments	24	11	17	6

*Porzyme TP (wheat) and SP (barley.) **Significant difference (p<0.05).

Source: Bohme (1990)

other studies report reductions in the incidence of diarrhoea and/or antibiotic treatments where feed enzymes have been incorporated. Also, such supplementation has helped to reduce the weight variability within a pen of littermates (see table 2).

“Incorporating feed enzymes in young pig rations provides opportunities for using uncooked, instead of cooked, cereals,” says Dr Partridge. "The advent of expanded feeds for young pigs may increase the need for a further post-process application of liquid feed enzymes. Recent experience with poultry nutrition shows that using expanded feed can increase problems of gut viscosity which is being corrected by the use of feed enzymes.

Response differences

Substantial inroads have already been made by enzyme suppliers into the poultry industry, whereas progress in the pig sector has been less spectacular. Research shows there are important species differences in response to enzyme treatments, both in terms of amount fed and their characteristics. But Dr Partridge believes that there is a vast potential for enzyme use in young pig diets, specifically in relation to the protein components.

"Starter diet formulation places heavy reliance on highly pre-processed raw materials to reduce the effects of certain ANFs which can cause problems to the immature digestive tract.

“Enzymes are now being used in several of these production processes to remove certain ANFs. The next step is to use the pig gut as a reaction vessel to improve the feeding value of these raw materials at realistic costs. Also, the increasing use of wet feed systems for all ages of pig offers the opportunity to allow steeping in the presence of suitable enzyme blends before feeding.

"These exciting possibilities provide much greater flexibility in diet formulation, enabling pig managers to exploit fully the genetics from today's top breeding lines by appropriate nutritional inputs on the farm," he says.

Keywords: Porzyme 8100, Porzyme tp100, Porzyme 8300, Piglet, Endogenous enzyme, Soybean meal, Beta-glucanase, Amylase, Protease, Xylanase, Endogenous losses, Swine, Viscosity, Digestive disorders, Diarrhoea