NEW CROP SOLUTION

Digestive upsets can upset the feeding of newly-harvested cereals to pigs and poultry. Despite often being cheaper than the previous year's harvest, new crop grains are frequently stored for several weeks and then incorporated into rations. This phasing-in can prove costly to both compounder and producer.

While a number of theories have been raised and investigated, no real cause for this new crop problem has been identified. It tends to vary from country to country, season to season and between cereal type and variety. However, a number of pig producers have been successfully feeding new crop barley supplemented with Porzyme, a fibre-degrading enzyme, with none of the expected digestive disorders.

What researchers at Finnfeeds International and elsewhere have established is that digesta viscosity - the stickiness of the gut contents - influences the nutritive value of barley and wheat-based feeds and that the degree of this viscosity is implicated in new crop barley feeding problems. Also, it is associated with certain soluble fibres, predominantly beta-glucans in barley.

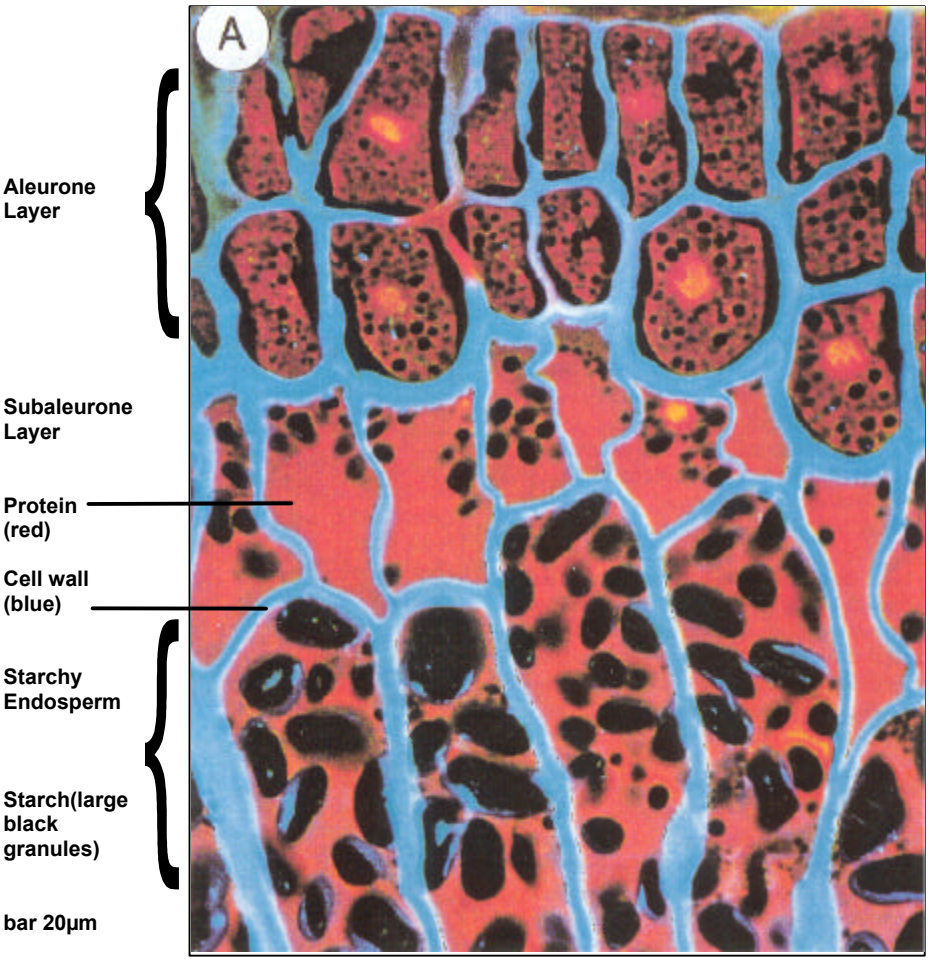
"Trials have shown the mixed-link beta-glucan content of barley and oat kernels increase to peak around harvest and then begin to fall afterwards," says Dr Gary Partridge, technical services manager for Finnfeeds International. The company is coordinating a series of trials worldwide looking at the nutritional potential of enzyme supplementation in cereal-based diets for both poultry and pigs.

"We know that levels of beta-glucans cannot alone be relied upon to predict the feeding value of barley. For instance, in 1983, an experiment established that earlier harvested grain had lower levels of beta-glucans than grain harvested slightly later. This suggested that the earlier crop was cut before maximum glucan levels had been reached. More significantly, this harvested early barley showed a high extract viscosity.

""While the level of beta-glucans is important, it is more precisely both the content and the chain length of this fibre polysaccharide that determines the level of viscosity which, in turn, is thought to manifest itself in new crop barley situations, " he adds.

Furthermore, trials have looked specifically at the influence of weather conditions and variety on viscosity levels in barley. These have indicated that the combination of an early harvest, warm temperature and low rainfall contribute to high viscosity grain with levels taking as long as six to seven weeks after harvest to fall to acceptable levels for use in feeding.

Once a high level of viscosity-causing long chain beta-glucans had been established at harvest, researchers hypothesised that the subsequent reduction in both content and fibre chain length must be due to the action of endogenous grain enzymes.



▲ The microstructure of barley showing the presence of the beta-glucans in the cell walls using beta-glucan stain. *(Courtesy VTT Biotechnology and Food Research, Finland.)*

Further work focused on beta-glucanase enzyme supplementation on the productive value of broiler diets based on low-viscosity (late harvest) and high-viscosity (early harvest) barley. In the unsupplemented diets, the high viscosity (early harvest) grain gave rise to lower dry matter in the digestive tract and poorer digestibility of starch in the small intestine - with the extra flow of nutrients to the lower intestine potentially leading to excessive microbiol growth and potential digestive disorders. Addition of the enzyme virtually eliminated any variation between early and late harvest barley **(See Table 1.)**

While historically better demonstrated in poultry than pigs, it is certain that one major mode of action from adding feed enzymes to barley and wheat-based diets is to significantly lessen digesta viscosity by reducing levels of certain partially soluble fibres such as beta-glucans and arabinoxylans. The **Table 2** shows the effect of enzyme supplementation on young pigs fed a potentially high viscosity diet based on hulless barley. Apart from lowering gut viscosity, its addition positively influenced growth rate and feed efficiency.

"Some of our recent research data revealed marked changes in the levels of endogenous enzymes present in the digesta, following enzyme supplementation, " says Dr Partridge. *"Output of host enzymes appeared to fall*

"…levels of beta-glutans cannot alone be relied upon to predict the feeding value of barley. "Dr Gary Partridge, technical services manager, Finnfeeds.

following enzyme supplementation. This response leads us into further research because it may indicate a possible protein and energy 'sparing' effect which, at marginal protein intakes, could underlie improvements in animal performance where Porzyme is used" **(See table 3.)**

"It is possible that the energy and amino acids effectively saved by the reduced production of endogenous digestive enzymes is made available for production processes. This may explain increases in growth rate and feed utilisation that we've observed following addition of Porzyme. "

The concept of using feed enzymes as a vehicle for increasing the use, and digestion, of barley in broiler diets was first introduced to the UK feed industry in the late 1980s. The traditional mistrust of barley in broiler diets and the lack of any financial incentive originally limited its commercial use. However, in 1991, the price gap between wheat and barley leapt from the usual £6 a tonne to more than £20 in the first seven months of the year. This lead to the widespread use for the first time of barley-based ratios supplemented with Avizyme sx.

Later that year, the price gap had all but vanished but the ancillary benefits of enzyme supplementation had become firmly established - mainly because the improved digestibility of the feed was having a knock on effect in minimising the problems of wet, sticky litter.

"Currently, more than 95 per cent of UK broiler feed contains enzymes and we expect a similar, but slower trend in the pig industry, " adds Dr Partridge. "The broiler industry is highly integrated with 12 companies producing about 80 per cent of the UK output. Conversely, the pig industry is much more fragmented and new technology will take longer to filter through. For example, there are 10,000 UK pig producers, of which there are 4000 major players.

"Enzyme supplementation of newly-harvested barley provides a profitable window of opportunity for pig producers to test this new technology. As with their broiler producer counterparts, other important side benefits such as greater uniformity of growth and reduced incidence of digestive disorders will become important additional criteria in purchasing decision. There is already ample evidence of enzymes in pig feed. Consistency of response in pigs now becomes the key issue."

A summary of a number of trials with the company's Porzyme in-feed enzyme demonstrate, on average four to six per cent improvements in liveweight gain and feed conversion in piglets on both barley and wheat-based diets **(Table 4.)** Trials have also shown successful substitution of cooked cereals by uncooked cereals plus Porzyme, without detriment to animal performance **(Table 5.)** Last summer, an increasing number of UK pig producers successfully overcame the traditional digestibility problems associated with feeding fresh barley straight off the combine, thanks to enzyme technology. They cashed in on attractive new crop prices by feeding the grain immediately with Porzyme in-feed for a six to seven week period following harvest. As new grain is £16 a tonne cheaper at the time, the saving in home mix rations at 50 per cent inclusion rates averaged £8 a tonne of finished feed - providing a net saving of £5 a tonne after taking the cost of the infeed enzyme into account. On one 640-sow unit, barley replaced wheat in grower, finisher, suckling and dry sow rations - resulting in a net saving of almost £4400 in feed costs over a six-week period. The use of in-feed enzymes is now becoming a well-established feature of many pig production enterprises.

Table 3. Effects of enzyme addition to barley diets for young pigs (9-15kg) on pancreatic enzyme output. (Inborr 1994).

	Control	+enzyme	P
Digesta viscosity (cps)	3.3	2.2	*
Digesta DM % Endogenous enzyme levels (mU/g of digesta DM)	13.6	14.3	*
Trypsin	10.0	5.8	*
Chymostrypsin	0.15	0.11	<0.1
Lipase	95.8	51.4	<0.1
Amylase	866	451	*

*** P<0.05**

Table 1. The influence of harvest time on beta-glucan content, extract viscosity, productive value and digestibility of barley fed to broilers.

	Early harvest Control	+ enzyme	Late harvest Control	+ enzyme
B-glucans (%. DM)	4.5		5.2	
Extract viscosity	13.1		4.5	
Liveweight (g over 21 days)	366	522 (+43%)	415	498 (+20%)
Feed: gain	2.04	1.83 (+10%)	1.93	1.83 (+5%)
Digesta DM	15.6	17.2 (10%)	16.9	17.5 (+4%)
content %				
Intestinal starch	44.2	81.2 (+84%)	62.6	80 (+28%)
digestibility (%)				

(Hesselman, 1983)

Table 2. Effects of enzyme addition to barley diets for young pigs (9-15 kg) on animal performance and intestinal viscosity (Trial 1 Inborr 1994. Trial 2 Bedford et al 1992).

	Trial 1			Trial 2		
	Control	+ enzyme	P	Control	+ enzyme	P
Growth rate (g/day)	212	219	0.07	524	614	*
Feed: gain	1.64	1.59	0.06	1.75	1.54	0.10
Viscosity in small intestine (cps)	3.3	2.2	*	3.1	2.8	n.s.
Digestive DM in ileum (%)	13.6	14.3	*	21.1	12.6	n.s.

*** P<0.05**

Table 4. Summary data from 53 trials showing the effects of multi-enzyme systems Porzyme sp & tp on pig performance (8-25kg).

	Barley-based diets	Barley + Porzyrne	Wheat-based diets	Wheat + Porzyme tp
Daily gain g/day	419	443 (+6%)	415	435 (+5%)
Feed intake g/day	792	793	681	683
FCR 1.88	1.79 (+5%)	1.64	1.57 (+4%)	

Table 5. Summary data from 6 trials where cooked cereals were replaced by raw cereals plus Porzyme (sp or tp).

	Control cooked cereals*	Raw cereals + Porzyme
Daily gain (g/d)	417	429 (+3%)
Feed intake (g/d)	671	661
FCR	1.61	1.54 (+4%)

*Levels of cooked cereal ranged from 15 to 55% in the diet

Keywords: Pig, Piglet, Barley, Endogenous enzymes, Raw/cooked cereals, Swine, ß-Glucanase, Digesta viscosity, Digestive disorders, Diarrhoea, Porzyme 8100, Porzyme 9100, Porzyme tp100