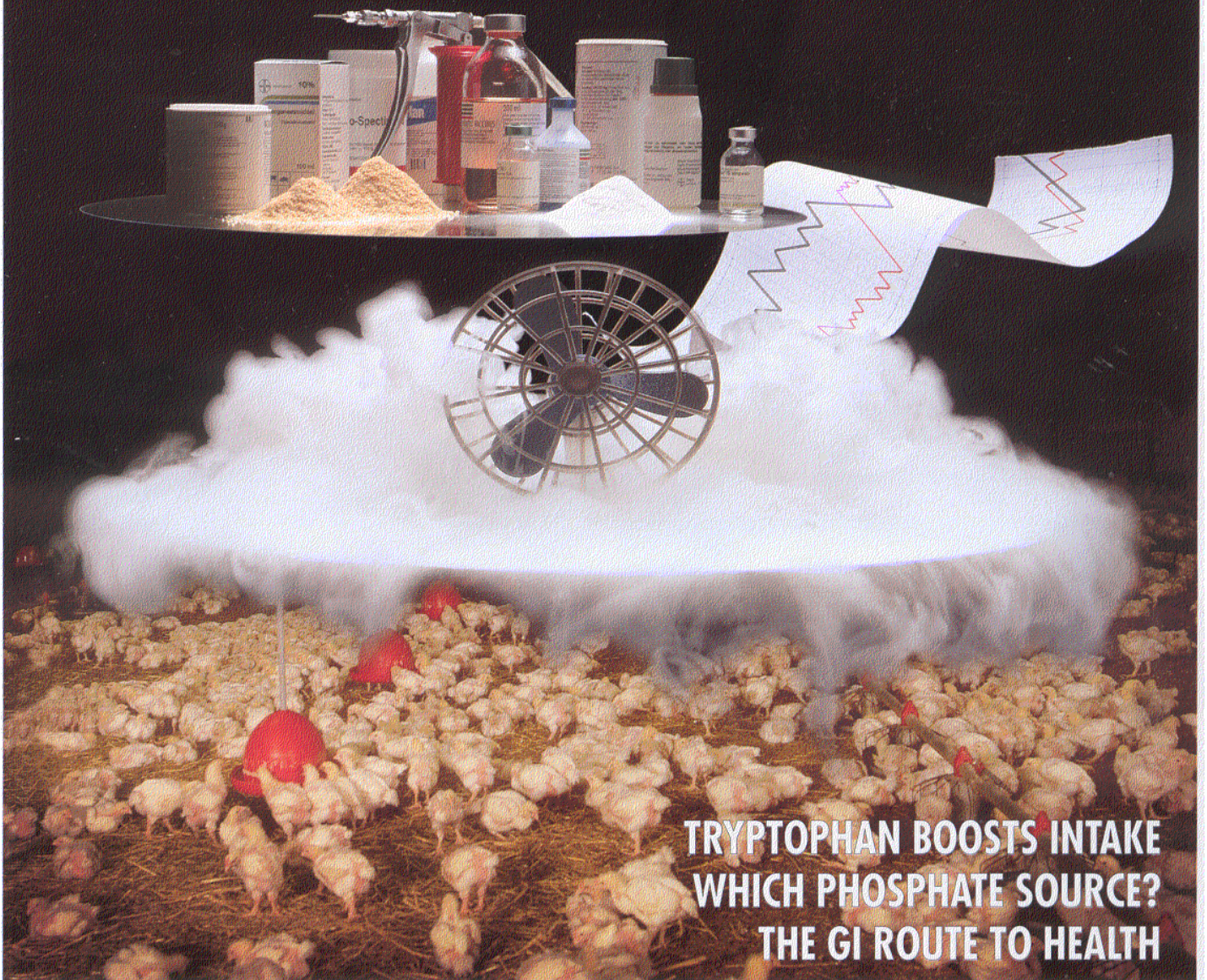


FEED MIX

THE INTERNATIONAL JOURNAL ON FEED, NUTRITION AND TECHNOLOGY

ELSEVIER INTERNATIONAL BUSINESS INFORMATION - VOLUME 6 NUMBER 1 - 1998

EARLY DISEASE DETECTION



**TRYPTOPHAN BOOSTS INTAKE
WHICH PHOSPHATE SOURCE?
THE GI ROUTE TO HEALTH**

ENZYMES' ROLE IN HEALTH

New results suggest that the use of an effective xylanase feed enzyme offers enormous potential to address one of the major causative factors of colitis.

By Dr Gary Partridge

Improvements in performance parameters such as daily gain and feed utilisation are the major economic motivators for the use of feed enzymes. However, the positive effects on pig performance may result from the interaction between nutrition and chronic or acute disease. It is, therefore, increasingly recognised that feed enzymes can have an important role to play in maintaining animal health.

The colitis problem

In the UK pig herd during the mid 1980s, considerable problems were encountered with non-specific colitis, particularly in pigs offered predominantly wheat-based diets. This syndrome, which is characterised by the appearance of a diarrhoea of varying sensitivity, can affect pigs of any age from weaning to slaughter, but is particularly prevalent within the 10-40 kg weight range.

Non-specific colitis can appear in units regardless of disease status, whilst ad libitum feeding and solid floors encourage greater incidence in certain situations. The appearance of the syndrome is clearly apparent as a result of the significant reduction in faecal dry matter which occurs, with consequent loss of growth performance in the pigs

showing symptoms. The contents of the colon become very fluid, and epithelial damage to the colon may occur as the condition persists

Lincocin and monensin have been shown to help control the syndrome in some cases. But while spirochaete bacteria have been isolated, they may not be causative. Of particular interest is the fact that the incidence is significantly influenced by dietary processing.

Causes of the problem

A number of factors have been identified as contributors to the increase of the syndrome seen in recent years. An increase in wheat usage up to 45-55% of the ration as a result of relatively high corn and barley prices, plus an increase in pelleting temperatures to help reduce salmonella contamination of raw materials, are both major influences. Trials to investigate the impact of processing on colitis incidence have clearly demonstrated the detrimental effects of pelleting (figure 1a) and processing temperature

(figure 1b) on units where the syndrome is prevalent. However, examination of protein structure and starch degradation *in vitro* and *in vivo* did not provide an explanation of the results.

Numerous papers have been published on the detrimental effects of dietary fibre (non-starch polysaccharide) on digestion in poultry and faecal moisture (eg sticky droppings in barley-fed broilers). The heat of pelleting appears to solubilise additional fibre, leading to higher viscosity in the gut and further disruption of both digestion and water absorption. In pigs, this may offer an explanation for the increased incidence of colitis seen when pelleted feeds are used.

Changes in the varieties of wheat grown for animal feed, with coincidental changes in soluble non-starch polysaccharide contents, have compounded the problem by increasing ration arabinoxylan content.



Non-specific colitis can appear in units regardless of disease status

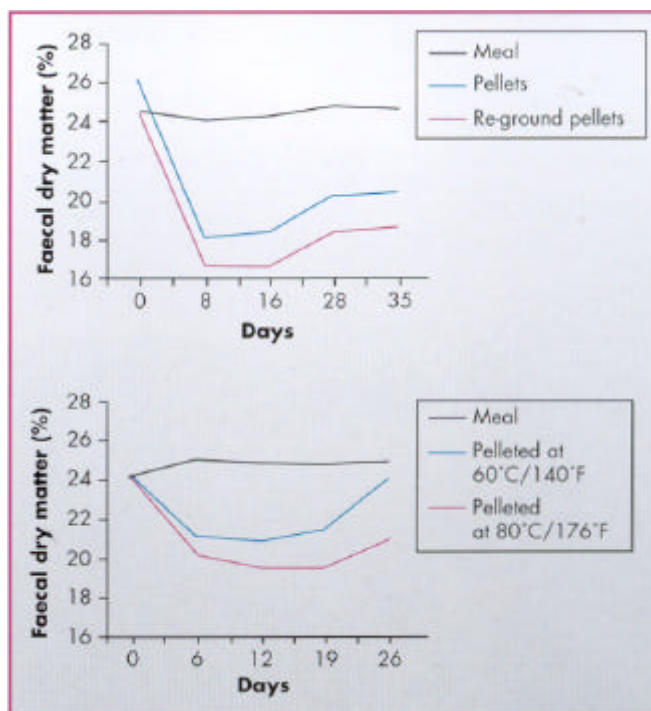


Figure 1 The influence of product form (a) and processing temperature (b) on the incidence of non-specific colitis in pigs offered wheat-based diets.

	Corn	Wheat	Wheat middlings	Barley
Dietary fibre * (%)	10	11	30	19
Mixed- link β -glucans (%)	-	0.8	3.0	4.4
Arabinoxylans (%)	4.9	6.0	15.3	7.0
Cellulose (%)	2.6	2.5	6.5	4.3

Table 1 Typical dietary fibre levels and composition of corn, wheat, wheat middlings and barley

Tackling ANFs

The use of feed enzymes to improve the productive performance of pigs fed diets based on barley, oats, wheat, triticale or rye is gathering pace. The major enzyme activities required for these grains are carbohydrases (for example xylanases or beta glucanases) which target the particular fractions of the dietary fibre (arabinoxylans and beta-glucans, respectively) which the pig cannot digest. In their natural state, these fibres act as anti-nutrients within the diet, having no feeding value of their own. They interfere with the digestion and utilisation of other key nutrients in the diet, such as protein, starch and fat, and, if unaddressed, can have a detrimental effect on both pig performance and health.

Soluble arabinoxylans and beta-glucans, which predominate in wheat and barley respectively (table 1) impair digestion by reducing the effectiveness of the pig's digestive enzymes, slowing digesta transit and also encouraging proliferation of bacterial numbers in the small intestine.

Interaction with disease

Hampson *et al* (1997) highlighted the role of dietary ingredients in provoking the development of swine

dysentery. Diets which were low in soluble fibre and/or low in resistant starch, reduced incidence significantly.

Many of the other key anti-nutritional factors (ANF) in raw materials are proteins, and there is now increasing interest in the use of new enzymes specifically designed to target these (proteases) in addition to the traditional enzymes which act on the carbohydrate (particularly fibre) fraction. These proteinaceous ANFs act by impairing digestion and thereby can provoke digestive disturbance, particularly in young pigs. Trypsin inhibitors and lectins in soya products are typical examples.

A number of recent trials have demonstrated the benefits of adding enzymes to diets on the incidence of digestive disorders in young pigs and their subsequent treatment with orally or parentally administered antibiotics (table 2).

Trial looked at chronic colitis

We looked at whether a xylanase-based enzyme could be effective in reducing the incidence of colitis. In a trial carried out in the UK, a research group in co-operation with a local veterinary group, identified a farm with a long-standing chronic problem of non-specific colitis. At the start of the trial,



two diarrhoeic piglets (10-12kg) were slaughtered. Post-mortem examination by an independent veterinary research laboratory confirmed classical signs of non-specific colitis in these piglets.

A commercial pelleted ration containing predominantly wheat, barley and soya products was fed *ad libitum*. This diet, because of its wheat content, was predicted to exacerbate colitis on the selected farm. A positive control treatment incorporating monensin (100mg/kg) and chlortetracycline (500mg/kg) was included for comparative purposes. This is a standard veterinary treatment in the UK for units with non-specific colitis problems. Tylosin phosphate (40mg/kg) was incorporated in all experimental diets.

84 piglets (both male and female) were used. These were the lighter pigs from a group of 112 weaners. Individual weights were recorded at the beginning and end of the trial. Twelve random samples of freshly-voided faeces were collected from each pen, twice weekly for the 4-week duration of the trial. All faecal samples were analysed for dry matter content and visually assessed, both upon collection and at the laboratory. Faecal consistency scores measured on the farm and at the laboratory illustrated the same significant trends. Results are given in table 3. A clear benefit from enzyme addition was found in terms of increased daily gain of the animals and reduced wetness of the faeces. These results further confirmed studies done

	Weight range(kg)	Effects on daily gain		Effects on feed:gain		Antibiotics given for diarrhoea	
		control	enzymes	control	enzymes	control	enzymes
France	13-50	597	624	1.61	1.58	5	0
Australia	6-14	231	276	1.63	1.51	2.7	1.9
Germany	11-25	406	450	1.80	1.63	24	11
Germany	11-25	382	436	1.91	1.62	17	6

Table 2 Effects of feed enzymes on daily gain, feed: gain and antibiotic treatments for diarrhoea in young pigs offered unmedicated diets based on wheat, barley and soybean meal

	Control	Control + enzyme	Control + Monensin + CTC
Daily gain (g)	518 ^b	548 ^{ab}	603 ^a
Faecal dry matter (%)	23.57 ^b	24.32 ^b	26.57 ^a
Mean faecal consistency score ⁺	2.88 ^c	2.45 ^b	1.99 ^a
% of samples with <20% dry matter	17.7	13.5	3.1

abc Means not sharing a superscript differ significantly (P<0.05)

+ Score 1 = firm, matt, slightly crumbly; 2 = firm, slightly moist, glossy; 3 = slightly soft, glossy; 4 = consistency of wet cement; 5 = consistency of thick custard (Thomas diagnostic Services Ltd Scoring system).

Table 3 Effect of a xylanase-based enzyme on pig growth performance, faecal dry matter and visual faecal consistency score on a farm with chronic non-specific colitis problems (Cambac JMC Research, UK)

earlier in conjunction with Dalgety Agriculture in the UK, on colitis affected farms (Partridge and Hazzledine 1997). In these trials addition of an effective xylanase successfully maintained normal faecal dry matter in pelleted wheat-based diets (Figure 2).

Additive approach

It should not be assumed that the routine addition of feed or oral medication removes the requirement for feed enzymes. Therapeutic and sub-therapeutic antibiotics influence the bacterial flora of the digestive tract, but do not deal with the anti-nutrients within the diet which may be encouraging the undesirable bacterial growth in the first place. For this reason, many trials have shown improved animal performance when enzymes are added to diets already containing antibiotics at growth promotant or therapeutic levels (table 4). In practice, therefore, the effects are seen as additive, and this is the

approach to feed enzyme use practised in most European markets currently.

Alternative feeding strategies

It is interesting to note that in certain countries where the routine use of in-feed antimicrobials has been banned (e.g. since 1986 in Sweden), feed enzyme technology has rapidly become established as an essential element of alternative feeding strategies.

In addition, enzymes have previously been shown to enhance absorption of fats and fat soluble vitamins (e.g. vitamins A and E, table 5)

	Control	+Enzymes	
Daily gain (g)	291	326	(+12%)
Daily feed intake (g)	388	401	(+ 3%)
Feed gain	1.33	1.23	(+ 8%)

Table 4 The effect of feed enzymes on the performance of pigs fed diets containing in-feed medication/ growth promoters (Zootechnical Institute, Czechnica, Poland)

when used in poultry diets based on viscous grains. It is likely, therefore, that similar responses would be apparent in the young pig offered energy dense (high fat) diets. Vitamins A and E are both important to the effective functioning of the immune system, and improvements in their absorption may have a positive influence on immune status development of the young pig, and, consequently, pig health.

It appears that use of an effective xylanase feed enzyme offers the potential to address one of the major causative factors of colitis and cost effectively return growth performance and health to normal.

Feed enzymes can produce effects that are additive to those of in-feed growth promoters as they have different modes of action. As part of a strategy to

	Fat source: soya oil		Fat source: tallow	
	Control	+enzymes	Control	+enzymes
Fat digestibility (%)	74.1	83.1	23.1	50.2
Vitamin A (mg/kg liver)	3.15	6.03	2.25	3.90
Vitamin E (mg/kg liver)	0.11	0.21	0.10	0.13

Table 5 The influence of adding xylanase to rye-based diets containing soya oil or tallow on fat digestibility and vitamin A and E retention (Danicke et al, 1995)

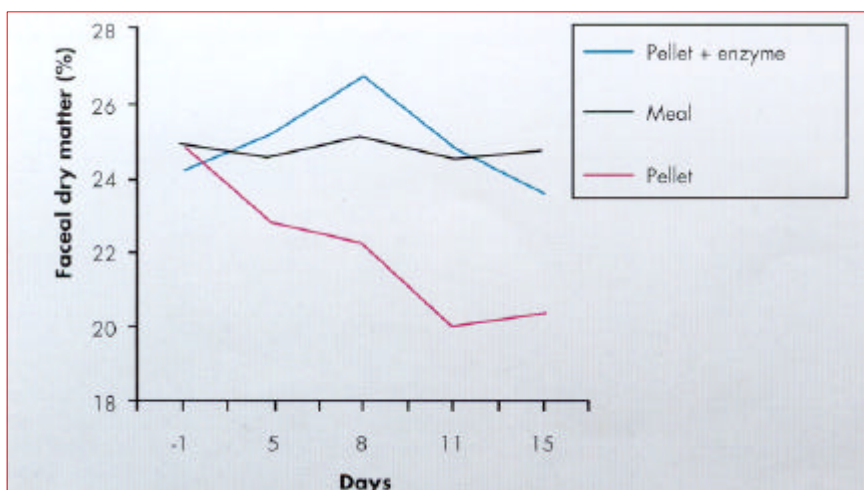


Figure 2 Influence of a xylanase premix on colitis and faecal dry matter in pigs

deal with the withdrawal of such products, enzymes undoubtedly have a place in the future of pig nutrition. ●

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