HOW FEED ENZYMES CAN REDUCE MANURE PROBLEMS

by Dr Johan Inborr

During the last few years scientists have been trying urgently to find ways of reducing the pollution risk from pig production. For this, one of the principal objectives defined has been to improve the animal's utilisation of dietary nutrients so that less passes through the body to be excreted in the manure.

The contribution which better feed utilisation can make to easing problems of manure disposal is easy to illustrate. For example, see from the figures in Table 1 how increasing the drymatter digestibility of a diet from 85% to 90% would result in a one-third reduction in the drymatter output in the faeces. Similar calculations can be made for each of the dietary components regarded as potential environmental pollutants, such as nitrogen and phosphorus.

Although a 5 percentage points improvement in nutrient digestibility or feed utilisation is not an easy target to achieve, with modern feeding programmes and genetically superior stock, any increase is a step in the right direction and should not be neglected. Similarly, if more of the protein sources in the diet are digested, less nitrogen will be passed out in the urine. About half the nitrogen excreted by the pig is of urinary origin, representing the proportion of nitrogen that has been absorbed but not incorporated in the body tissues. So it is an important source of pollution. The only way it can be limited is by improving protein/ nitrogen utilisation through digestibility and availability.

The question is then, how to ensure that feeds are better utilised. Various methods are being tried, but the approach which we have been investigating is the addition of appropriate enzymes to the diet. Our results show that they can significantly improve nutrient digestibility in both young and adult pigs, with beneficial consequences for waste handling.

In one experiment pigs between 6-25kg liveweight were given a wheat/ barley-based starter diet ad lib, with or without enzymes, for 6

weeks. Nutrient digestibility was determined by collecting and analysing faeces and urine during Weeks 2 and 6. Drymatter digestibility was significantly improved in both periods by adding enzymes (Table 2), resulting in a 39% reduction in the output of faeces in Week 2 and an 18% lowering in Week 6.

In this trial enzyme supplementation also increased the drymatter content of the faeces, contributing to the reduced faecal volumes. It did not affect nitrogen retention as a percentage of intake. However, due to the reduction in volume of faeces and a lower than expected crude protein content of the

Dr J. Inborr is director of research and development for Finnfeeds International Ltd, based in the UK.

Table 1: Influence of drymatter digestibility on faecal output.

	Liveweight (kg)	
	10 to 30	25 to 105
Drymatter intake (kg)	30	200
Faecal DM output (kg)		
at 85% digestibility	4.5	30
at 90% digestibility	3.0	20
difference (kg)	-1.5	-10
difference (%)	-33	-33

Table 2: Enzyme supplementation effect on drymatter digestibility and faeces weight in early weaned pigs (Source: Inborr and Graham, 1990).

Liveweight Range	Control	Test*	Difference
7-9 kg			
DM intake (kg)	2.83	2.58	- 8%
DM digestibility (%)	88.0[a]	91.6[b]	+ 4%
Faecal DM output (kg)	0.302	0.196	- 35%
DM content of faeces (%)	27.8	29.6	+ 6%
Faeces weight (kg)	1.09	0.66	- 39%
23-30 kg			
DM intake (kg)	9.79	9.30	- 5%
DM digestibility (%)	88.7[a]	89.7[b]	+ 1%
Faecal DM output (kg)	1.11	0.96	- 14%
DM content of faeces (%)	29.0	30.3	+ 4%
Faeces weight (kg)	3.81	3.13	- 18%

a, b; significant difference (P<0.05)
*** Porzyme-SP, Finnfeeds International Ltd.**

Table 3: Daily nitrogen retention (g) in pigs fed diets with or without added enzymes.

Liveweight (kg)	Main feed Ingredient	Enzyme* -	Enzyme* +	Improvement (%)	Source
7 –16	Barley, Oats	6.4[a]	7.1[b]	11	Shen, 1990
8 – 20	Barley	3.3	3.9	15	Low and Longland, 1988
45 – 60	Soyabean meal, Barley	30.4	32.4	8	Larsen and Eggum, 1988
45 – 60	Barley	21.8	23.0	6	Larsen and Eggum, 1988

*Supplied by Finnfeeds International
a,b; significant difference ($p<0.05$).

diet with enzymes, overall nitrogen excretion was markedly reduced.

Other research has shown a substantially decreased nitrogen output from pigs given enzyme-supplemented feeds, due to improvements in both the digestibility and the retention of the dietary nitrogen. Table 3 summarises 4 experiments with pigs of various liveweights, where nitrogen retention was increased by between 5-15%.

From this data it seems that there is a greater relative reduction in the younger pig. However, in terms of actual nitrogen volumes, the biggest benefits are to be found in the larger animals. Increasing nitrogen retention by 5% with a pig of 20kg liveweight means about 0.2 grams less nitrogen excreted each day. This rises to 2 grams daily with the same percentage change at 60kg liveweight.

Based on the data we have today, it can be estimated that adding the right enzymes to feeds can reduce the nitrogen output per pig by 10-15%, equivalent to about 200 grams. In terms of the total production of faeces by the pig from birth to a slaughter weight of about 100kg, these data support an estimate of 5kg less drymatter or between 15-20kg less manure per pig. That would correspond, on the typical unit, to a 10-15% reduction in the amount of effluent to be handled.

It should be mentioned that the degree of response to enzyme supplementation depends on the raw materials used for making the feed. Each ingredient contains one or more components (fibre would be one example) able to decrease the availability of nutrients and so limit their utilisation. Unless these components can be identified and characterised, and effective enzymes developed for their degradation, a significant response cannot be expected.

A combination of enzymes of different origin has been shown to give a better and more consistent response than using only one single source. Consequently, multi-enzyme products should be used.

Moreover, the effect depends not only on the activity and stability of the enzymes chosen but also on the age of the animal. While it is true that the response to enzyme supplementation tends to decrease with age, there remains a strong case for using the products in feed right through to slaughter weight.

They can alleviate a number of detrimental effects, such as wet faeces, which are caused by some feed ingredients and do not disappear as the pig grows older. No less important, of course, is the fact that significant improvements in liveweight gain and feed utilisation have also been obtained when growing-finishing pigs were fed enzyme-supplemented diets. (A list of references can be sent on request.)

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