Improving the feeding value of grain by-products in swine feeds by enzyme addition

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Enzymes, which target the fibre components in feeds, are now routinely added to broiler, layer and swine diets containing wheat or barley. However the acceptance of enzymes for diets based on maize has been much slower, particularly in swine. This is due to the perception that fibre in such diets is present at relatively low levels and therefore has no, or little, negative effects on the animal. However, new research conducted by Finnfeeds has suggested that there is a role for such enzymes, particularly when grain by-products such as wheat bran/pollard ('wheaten bran'), or rice bran are also present in the ration.

This article describes some of this work, and its implications for more cost-effective feeding of growing/finishing pigs particularly when the by-product price is attractive relative to corn and soybean meal.

Why the need for enzymes?

In maize-based rations containing some grain by-products such as rice bran or wheat bran/pollard the amounts of fibre (non starch polysaccharides, NSP's) are quite considerable. This fact is not fully appreciated by some nutritionists, because when assayed as crude fibre, these NSP's are vastly underestimated. As a general rule, the total fibre in such ingredients is more than 3 times the amounts indicated by a crude fibre measurement. For example, maize contains 2.5% crude fibre, but actually contains 10% total fibre. Similarly wheat by-products contain 8-11% crude fibre, but in reality contain 30-40% total fibre. **Table 1** illustrates this point with several commonly used ingredients.

Not only are there large amounts of total fibre, but its location in the cell walls creates a protective 'box' effect whereby potentially useful nutrients (e.g. starch, amino acids, minerals) are unavailable for digestion in the small intestine. This fibre also acts like a 'sponge' in the gut, sucking up water-soluble nutrients and interfering with their effective digestion and absorption. The overall effect is that the bacteria in the hindgut get the benefit of many of these nutrients rather than the host animal, and growth and feed conversion suffers. (Dierick and Decuypere, 1994; Hazzledine and Partridge, 1996).

By adding appropriate enzymes to the feed, which the animal cannot secrete itself, we aim to reverse some of the negative effects of fibre on digestibility **(Table 2).** These extra nutrients released can be used by the pig for better lean gain and feed conversion and, importantly, to make savings in costs of production by using cheaper diets to maintain the same pig performance.

Trial results

Over the past 3 years a number of trials have been run in research institutes and commercial farms to test this concept using a xylanase specifically selected to target the insoluble fibres present in grain and grain by-products. Some recent examples are shown in **Tables 3 and 4.**

Table 1: Fibre composition of several ingredients.

%, as is	Maize	Rice bran	Wheat bran	Wheat pollard
Crude fibre	2.5	9	11	8
Total fibre*	10	20	40	29
Beta glucans	-	-	1.8	1.9
Arabinoxylans	4.4	10	20	14
Cellulose	2.0	6	11	8
Lignin	0.5	4.5	5.8	3.5

* defined as non-starch polysaccharides + lignin

Table 2: Effect of a specific in-feed xylanase on digestibility (%) of nutrients in a maize/wheat by-product diet compared to a maize-based control (Hazzledine and Partridge, 1996).

	Maize Control	Maize+25% wheat by-products	Maize+25% wheat by-products+xylanase**
Dry matter	87.2[a]	82.6[a]	86.9[a]
Protein	72.6[c]	71.1[b]	73.3[c]
Energy	80.2[b]	79.2[a]	80.2[b]

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

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Table 3. Effect of Porzyme 9300 in a high wheat pollard diet.

	Control (10% wheat by-product)	Downspecified diet (20% wheat by-product)	Downspecified diet (20% wheat by-product + Porzyme)
Initial weight, kg	39.4	39.4	39.4
Final weight, kg	81.2	78.9	81.2
Daily gain, g	696	659	696
Feed Intake, g/d	2 020	2 020	1 920
Feed:gain	2.89[ab]	3.07[b]	2.76[a]
Net profit per pig ($US) relative to control*	-	+3.53	+5.95

[ab] Means not sharing a superscript differ significantly (P<0.05)
* at time of trial
Source: University of Los Banos, Philippines
Reference: Partridge, Alcantara and Creswell (1998)

Table 4: Performance effects of Porzyme 9300 in an energy reduced diet (20% maize substituted by 20% wheat by-product).

	Maize-soy control	Maize/soy/wheat by-product (20%)	Maize/soy/wheat by-product (20%) + Porzyme
Initial weight, kg	28.2	28.1	28.6
Final weight, kg	61.2	59.1	61.4
Daily gain, g	944	886	938
Feed Intake, g/d	1812[a]	1 641[b]	1 705[ab]
Feed:gain	1.92	1.88	1.82

ab P<0.05 Means not sharing a superscript differ significantly
Source: The research unit of a large commercial pig producer, Australia
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In each of these trials, and others, the approach has involved comparison of a standard formulation with a cheaper, downspecified formulation (lower energy) containing higher levels of these fibrous ingredients. In each case performance of the specific xylanase-supplemented diet at least matched the 'standard' control and offered savings in costs of production.

Re-formulation of the diet to reduce energy and, in some trials, amino acid specification when using a specific xylanase enzyme, together with increased by-product inclusion level (+10% normally), is the principal approach in many markets for grower/finisher pigs. However, we also have a large number of trials where the product has been used 'on top' of an existing diet based on maize, soya and grain by-products to reap benefits in improved pig performance. A recent summary of 15 such trials showed an average improvement in weight gain and feed:gain of 7.4% and 6.1% respectively. The only proviso with this approach is that diet specifications in relation to animal nutrient requirement are sufficiently well understood to allow the pig to respond to the extra energy and amino acids made available. In other terms an unimproved, low lean deposition, high appetite pig already at or close to its lean deposition maximum, fed a high nutrient dense diet, has little opportunity to use the extra nutrients liberated for productive purposes!

Conclusions

It is now well recognised that ingredients such as maize, soybean and, particularly, grain byproducts contain relatively high levels of dietary fibre and that this fibre has negative impacts on feed digestibility and pig performance. The use of a well-researched xylanase based enzyme product (Porzyme 9300), which targets the relevant fibre, has the effect of overcoming some of these negative effects, leading to improved nutrient availability. This allows for the option of using the enzyme to improve pig growth and feed:gain or, alternatively, to use it in diets with lowered levels of energy and protein/amino acids, with higher by-product levels, to maintain performance with lower net feed costs.

References

Dierick N.A. & Decuypere (1994) 'Enzymes and growth in pigs' In Principles of pig science, Nottingham University Press, pp 169-195

Hazzledine M. & Partridge G.G. (1996) 'Enzymes in animal feeds - application technology and effectiveness' In Proc. 12th Carolina Swine Nutrition Conference, Raleigh, N. Carolina, USA pp 12-33

Partridge G.G., Alcantara P.F. & Creswell D. (**1998)** 'Effect of xylanase addition to corn/soybean meal/wheat pollard diets for grower/finisher pigs' Proc. 8th World Congress Anim. Prod. pp 626-627

Tan M.Y. (1999) 'Enzymes can he used effectively in swine diets' Asian Pork June/July pp36-37

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