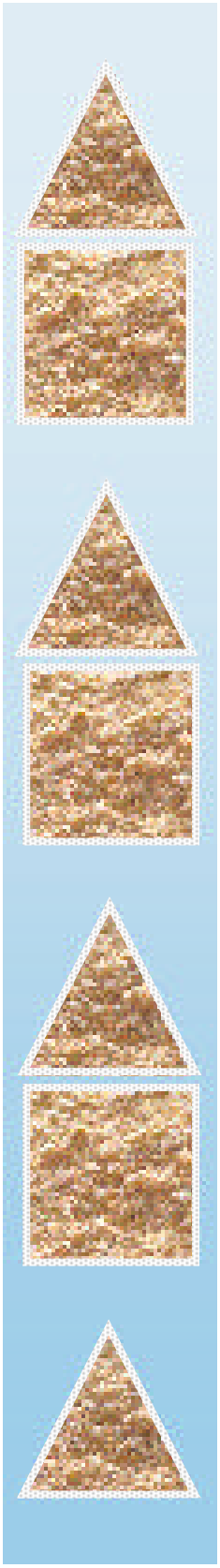
Enzymes improve economics of rice-bran based diets



A series of Asian trials show a xylanase enzyme system improves net profit by $4 per pig when rice bran diets are fed, write GENE JIN and GARY PARTRIDGE.

When the price of rice bran is not more than approximately 80% of the price of corn, rice bran can be a useful and economically interesting ingredient for pig diets. However the feeding value of rice bran for pigs is heavily influenced by its dietary fibre content and composition.

Creswell (1987) analysed 20 samples of rice bran collected from the Philippines, Thailand, Indonesia and Malaysia and found that its composition was extremely variable. Oil content, ranging from 19% down to 12% in this study, positively influences the energy level of fat rice bran, whilst the crude fibre content which ranged from 7.5% to 13%, will have a negative effect on energy level. He also reported that growth rates were reduced both in starter pigs when bran inclusion exceeded 10%, and in grower and finisher pigs when bran inclusion went beyond 25% (refer *Asian Pork Magazine*, December 2001/January 2002, P 13).

Arabinoxylans are the predominant cell wall fibre components (non-starch polysaccharides, NSPS) in rice bran, comprising about 60% of the total NSPs present (Table 1).

These predominantly insoluble plant cell fibres not only enclose or bind potentially useful nutrients, but also interfere with the digestion and absorption of nutrients from other raw materials in the diet (e.g. amino acids, fats, minerals). Pigs do not produce fibre-degrading enzymes to break down these plant cell fibres.

A potential solution to improve the feeding value of rice bran is to use a xylanase-based enzyme system. However, the xylanase must be effective at breaking down insoluble arabinoxylans, which is particularly challenging because of its complex chemical structure.

Xylanase in diets containing rice bran

A suitable xylanase enzyme can improve pig performance in fibrous diets by increasing digestibility, lowering water holding capacity, increasing feed intake, and reducing the viscosity of digesta in the small intestine.

Table 1: Fibre composition and nutrient values for rice bran and other grains and by-products.

	Corn	Full fat rice bran	Extracted rice bran	Wheat	Wheat bran	Wheat middlings/ pollard
Protein, %	8	13	15	12	16	16
DE, Kcal/kg	3525	3100	2250	3350	2520	2965
Crude fibre, %	2.2	8	11	2.5	11	9
Total dietary fibre, %	**9.5**	**19**	**27**	**10.5**	**44**	**27**
Total NSP	9	15	21	9.5	38.2	23.5
Cellulose	2.0	5	7	2.5	11	8
Lignin	0.5	4	6	1	5.8	3.5
Arabinoxylans	**3.7**	**9**	**11**	**5.5**	**21**	**15**
(% insoluble)	(94)	(96)	(97)	(77)	(99)	(97)

Data sources: Dierick & Decuypere (1994); NRC (1998); Partridge (1999); CVB (1999); Yin et al; (2000); Cresswell (2002).

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In corn-soy based diets containing rice bran, the total dietary fibre content (NSP's + lignin) can be considerable. For example, in a finisher diet containing 25% rice bran, the total dietary fibre content would be around 15%. This fibre has a negative effect on the overall digestibility of the diet, particularly in the small intestine.

Inclusion of 20% full-fat rice bran was found to substantially reduce the digestibility of both crude protein and dry matter in the small intestine by around 9% in a corn-soybean meal based diet (Schulze, 1996). Adding a xylanase-based enzyme product to such a ration gave substantial improvements in digestibility (Yin *et al*., 2000).

NSP's can also hold a large amount of water, together with dissolved nutrients. This reduces not only nutrient availability, but also voluntary feed intake (Dierick and Decuypere 1994, Kyriazakis and Emmans, 1995). Enzyme addition in vitro has been shown to reduce the water holding capacity of various feed ingredients (Figure 1) and many in vivo trials in pigs where effective enzymes were added to fibrous diets showed an increase in voluntary feed intake. In turn, pig performance was improved (Table 2).

In wheat-based diets the presence of soluble arabinoxylans leads to increased digesta viscosity, which impedes the diffusion of nutrients and generally interferes with the digestive process.

The net effect in pigs can be poorer performance, combined with wetter faeces due to a disruption of water balance in the hindgut, which can manifest as 'non-specific colitis'. Adding an effective xylanase reduces digesta viscosity and the gut disturbances associated with it, giving increases in faecal dry matter content and improved performance (Hazzledine and Partridge 1996).

Trial results

In the last five years a number of trials conducted at research institutes or research farms of feed companies throughout Asia (Philippines, Taiwan, China, Thailand and Vietnam) have investigated the benefits of a xylanase-based feed enzyme product (Porzyme 9300, Finnfeeds) on the performance of grower and finisher pigs.

The trials were replicated and the majority of the trial results (70%) could be statistically analysed. Most diets were corn-soybean meal based either in pellet or mash form, with the exception of one trial (V9820) that was based on broken rice and soybean meal.

The inclusion of rice bran ranged from 5% to 25% in grower diets and from 10% to 35% in finisher diets. Diet specifications ranged from a digestible energy (DE) of 3200 to 3400 kcal/kg in the grower diets, and from 3070 to 3250 kcal/kg in the finisher diets. Corresponding lysine levels ranged from 1.0% to 1.11% in the grower diets, and 0.70%-0.96% in the finisher diets.

Table 3: Porzyme reduces feed costs of grower/finisher pigs fed diets based on broken rice, soybean meal and increasing inclusions of rice bran.

Trial 1: (20-95kg)	Control grower/finisher diets with 25/35% rice bran	Reduced spec diets (-4% DE and AA) with 32/40% rice bran + Porzyme 9300
Start weight (kg)	20.5	20.4
Finish weigh (kg)	93.3	93.7
Daily gain (g)	650	654
Daily feed intake (g)	1940	1950
Feed : gain	2.98	2.97
Lean, %	48.4	48.9
Backfat (mm)	23.8	23.9
Trial 2: (20-95kg)	Control grower/finisher diets with 20/30% rice bran	Standard grower diet and reduced spec finisher diets (-3% DE and AA) with 40% rice bran + Porzyme 9300
Start weight (kg)	20.0	19.9
Finish weigh (kg)	95.0	95.8
Daily gain (g)	626	633
Daily feed intake (g)	1896	1827
Feed : gain	3.03	2.89
Backfat, P2 (mm)	12.4	12.2

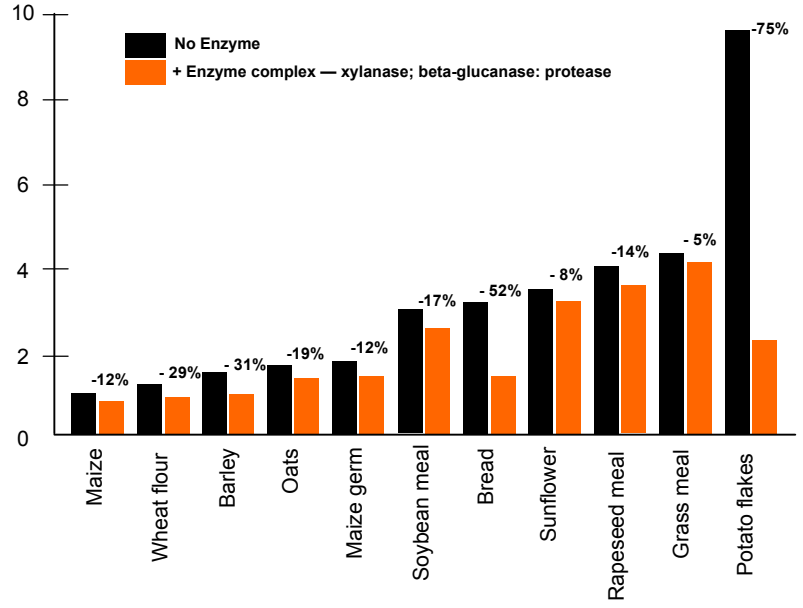
In all trials, Porzyme 9300 improved body weight gain and, in the majority of cases, feed conversion ratio. In two trials where FCR was unaffected, the enzyme improved average daily gain by 8% and 12%. Overall, average daily gain was increased by 6.9%, ranging from 4.0% to 12.0% (Table 2).

FCR was improved by on average 4.8% with a significant improvement in seven out of the 10 trials. Based on the feed usage and the heavier final weight, the use of Porzyme 9300 resulted in an improvement in average net profit per pig of US$ 4, allowing for product cost.

A further two trials measured the effect of Porzyme 9300 on performance of growing/finishing pigs offered a re-formulated diet with reduced DE and amino acid levels, and containing increased levels of rice bran (Table 3).

In the first trial, the control group was fed a broken rice/soybean/rice bran diet, and the enzyme group was offered a diet where DE and essential amino acid (AA) levels were reduced by 4%. In the second trial the control pigs were fed a corn/soybean meal/rice bran based diet, while the Porzyme group was offered a reduced specification diet, 3% lower in DE and AA. In both trials performance of the enzyme-supplemented groups at least matched the higher specification control rations (Table 3). However, the effective use of these cheaper diets gave savings of 5% in production cost,

Figure 1: Effect of an enzyme complex on water holding capacity of raw materials.



allowing for the cost of Porzyme. There was also no difference in carcass quality in terms of both lean percentage and back-fat depth between the control and Porzyme groups.

Conclusions and recommendations

The low cost of rice bran relative to corn at certain times of the year makes it an economically attractive ingredient, but the potential savings in feed costs may be offset by poorer pig performance. The solution is to supplement the diets with a suitable, xylanase enzyme system, specifically designed for pig grower and finisher diets containing rice (or wheat) bran. In practice, feed formulators have three options when using the enzyme product:

1. For pig producers already feeding diets containing significant quantities of rice bran (e.g. 10-30%), add Porzyme 9300 to the diet and look for performance improvements of 6-7% (Table 2) and associated benefits in net profit e.g. US$4/pig in the examples quoted.
2. Replace up to 200 kg/t of corn or wheat with rice bran, without other adjustments. Supplement with Porzyme and look for at least equal performance from these cheaper diets. This approach has been used successfully in a number of recent trials with Porzyme 9300 (details available on request).
3. Reduce dietary energy and digestible amino acid levels by up to 4%, and allow up to 200 kg/t extra rice bran into the diet. Supplement with Porzyme 9300 and look for at least equal performance for a lower feed cost. This approach will give greater feed cost savings than a simple 1:1 replacement of corn or wheat by rice bran, as the least cost program will find the most economic way to replace a portion of the energy and digestible amino acids.

Not all xylanases are equal in terms of their ability to effectively break down insoluble fibre in the pig's gut - environment. *In vivo* trials are the only recognised way to prove the efficacy of an enzyme product. Potential users of feed enzymes are advised to ask for evidence of a product's effectiveness, which may be in terms of a large dataset of well-replicated trials where enzymes have been added to diets containing high levels of insoluble fibre (e.g. rice bran; wheat bran).

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Key words: Porzyme 9300, xylanase, rice bran, water holding capacity

Table 2: Porzyme improves performance of grower/finisher pigs fed diets containing rice bran.

Trial	No of pigs in trial	Replicates/treatment	Weight range (kg)	Rice bran in diet grower/finisher, %	ADG (g/day)		FRC (feed:gain)	
					Control	+Porzyme	Control	+Porzyme
T9601	48	6	30 – 100kg	20/20	634	684	2.96	2.97
T9602	24	3	47 – 85	15/15	717	803	2.76	2.78
V9605	160	4	17 – 76	15/25	586	623	3.18	3.12
T9611	36	6	46 – 90	15/15	700	741	3.10	2.82*
V9820	180	5	20 – 95	25/35	650	679*	2.98	2.88*
V9824	288	12	20 – 50	20	488	533*	2.80	2.62*
V9825	144	6	20 – 95	20/30	626	651*	3.03	2.82*
V9930	144	6	21 – 95	5/10	598	631*	2.98	2.74*
V0033	240	6	19 – 55	15	577	632*	2.70	2.48*
V0034	240	6	19 - 95	15/25	644	673*	2.95	2.81*
Mean	150	6		16/22	622	665	2.94	2.80
Improvements due to Porzyme 9300					**+ 6.9%**		**+ 4.8%**	

* P<0.05