Getting to grips with wheat variability

Are feed producers – and their customers – getting all they can from their wheat? That different wheats have different qualities and feeding values has been known for some time. But new research from Denmark, carried out in conjunction with Danisco Animal Nutrition, should be enough to persuade any sceptics that ignoring wheat variability in pig diets can cost producers dearly.

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Wheat is one of the world's most important feed grains. Modern advances in plant breeding and development of agronomic techniques means a widening of the range of latitudes at which it can be grown. Almost every month, somewhere in the world, a wheat crop is harvested.

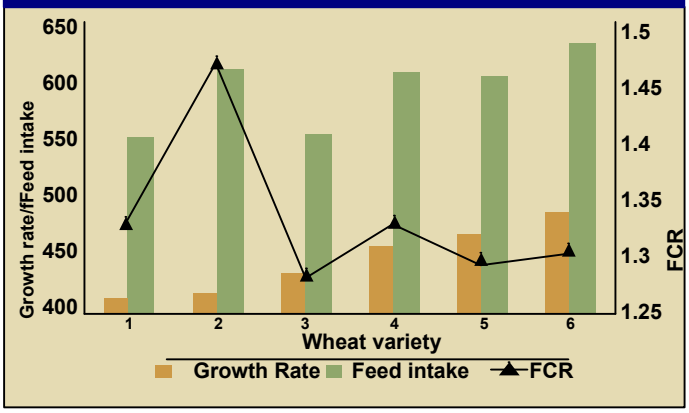
One fifth of this annual harvest is used in animal feeds, of which Europe's animals consume over two thirds. UK compound pig feeds, for example, typically comprise between 40 and 50% wheat. Has quality been overlooked in such a massive market?

Variations in wheat quality and feeding value are unsurprising, given the many factors that can influence the growth of the grain crop e.g. genetic varieties, climatic influences, differences in soil and fertiliser inputs and farmer skills. However, the lack of rapid, reproducible tests that can usefully differentiate 'good' and 'bad' wheat types for pig feeding has undoubtedly hampered progress in this area.

The release of UK research in 1997 illustrated the variability problem well. Six wheat varieties available to the animal feed industry were grown on the same plot of land and given identical agronomic inputs. When the resulting grain was incorporated into otherwise identical pig diets, the results showed a wide range (15-18%) in both feed intake (554 to 636g/day, CV 6%) and growth rate (415 to 488g/day, CV 7%) between the different varieties (*Figure* 1).

Australian research in 1999 supported the UK findings. Ten wheat varieties, obtained randomly from different parts of Australia and grown and harvested under varying conditions, were fed to weaner pigs. Pig performance was even more variable (CV 16%) than that reported in the UK research (feed intake range 271 to 514 g/day, growth rate range 233 to 447 g/day - *Figure* 2).

Figure 1 – Six wheat varieties grown on the same plot



Variation factors

Numerous factors could be responsible for the variations seen. For example, starch comprises up to 75% of the endosperm, the centre of the wheat grain, and provides the principal energy component of a wheat-based diet. However, wheat samples differ in grain fill, starch development and associated cell wall structure, all of which dictate the availability of the starch for digestion.

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Aside from starch, soluble and insoluble fibre found throughout the grain is the other important carbohydrate component, comprising over 10% of the whole grain.

Fibre has a well-understood anti-nutritive effect and can be one of the reasons for some nutritionists restricting high levels of wheat in a pig diet. Soluble fibre fractions (arabinoxylans) in wheat are known to cause viscosity within the digestive tract and these have been shown to be one exacerbating factor in the development of non-specific colitis on certain farms. Pigs suffering from colitis show not only the characteristic loose faeces, but also deterioration in growth rate and feed conversion efficiency. Arabinoxylans are also a substantial part of the insoluble fibre fraction. These, together with soluble fibre, can bind water and soluble nutrients like a sponge, slowing movement through the gut and encouraging microbial growth in the small intestine. This leads to greater competition for nutrients between the microflora and the pig, resulting in reduced pig performance and, at worst, can lead to proliferation of undesirable bacteria in the gut resulting in an increased risk of digestive disorders.

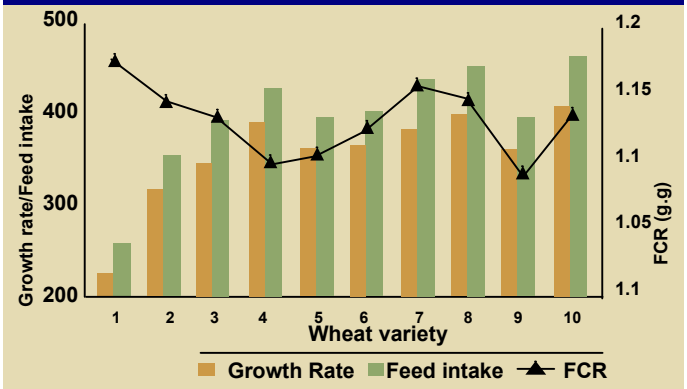
Fibre-digesting enzymes

The pig does not produce fibre-digesting enzymes. However, fibre in the diet does stimulate excessive secretion of the pig's own enzymes. This whole process of enzyme over-secretion consumes amino acids and energy, leaving less available for productive purposes e.g. growth and lean meat production.

By adding appropriate fibre-digesting enzymes to the pig's diet, these key anti-nutritive factors can be targeted. Xylanase, which targets arabinoxylans, for example, will break down cell walls, allowing the animal's own enzymes better access to the nutrients inside, as well as combating some of the anti-nutritive effects of soluble fibre e.g. viscosity.

As part of the trial shown in *Figure* 2, xylanase was added to selected varieties. The results in *Figure* 3 clearly demonstrated how the factors causing variability in wheat were removed by the addition of the enzyme, increasing both feed intake and daily gain, such that all diets containing xylanase showed similar animal performance. This approach offered clear potential to reduce substantial wheat variability by the addition of an appropriate enzyme.

Figure 2 – Effect of wheat variety on weaner (7-16 kg) performance

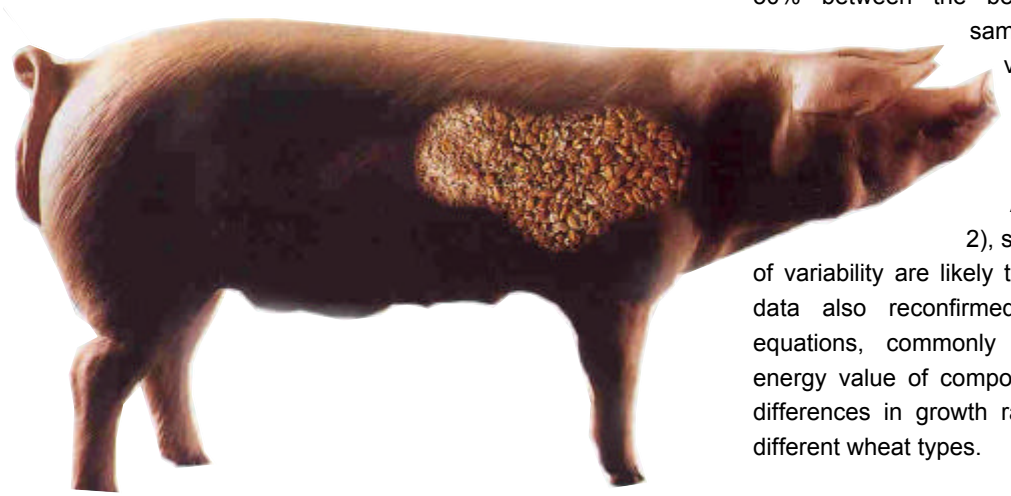


65% wheat in diets; Growth: P<0.001 Feed Intake: P<0.001 Feed Gain: NS Cadogan et al (1999)

Danish research

The Australian data was received with some scepticism in Europe, with suggestions that it would be unrepresentative of Northern European wheat samples. In an effort to address this, the Danish Institute of Agricultural Science, under the guidance of Knud Eric Bach Knudsen and in co-operation with Danisco Animal Nutrition, has recently undertaken more detailed research to validate these results using Danish wheat varieties. Samples of six wheat varieties grown in Jutland were randomly chosen, incorporated into standard pelleted diets and fed to weaner pigs from 10kg bodyweight, over a period of three weeks.

The results showed a variation in growth rate of 30% between the best and the worst wheat samples. Interestingly, this variation in growth rate was approximately equivalent to that seen between varieties 2 and 10 in the Australian studies *(Figure* 2), suggesting that similar levels of variability are likely to be found in Europe. The data also reconfirmed that existing prediction equations, commonly used for estimating the energy value of compound feeds, failed to reflect differences in growth rates between pigs fed the different wheat types.



Xylanase effect

When each variety-based diet was supplemented with xylanase (Porzyme® 9300, Danisco Animal Nutrition), average daily gain increased by 6.3% and FCR was improved by 6.2%; figures that are very consistent with previous Porzyme research trials (58 in total) involving around 7,000 piglets fed on predominantly wheat-based diets. In practical feed formulation this provides two choices for enzyme use:

- Either maintain the level of pig performance and cut feed costs by reducing the energy and amino acid levels in the feed i.e. allowing Porzyme to 'free' more nutrients from wheat, and account for this in the feed formulation process,

- Or increase overall pig performance by adding Porzyme to an existing formulation.

Despite these undoubted opportunities, the pig industry has been relatively slow to capitalise on the value of enzymes in the diet, certainly when compared to the poultry industry where its more integrated structure has allowed rapid capture of their economic benefits. In the pig sector, diets for young pigs have usually been the primary focus of attention for enzyme use, whereas their introduction into grower-finisher diets has seen much slower progress.

Capitalising wheat variety

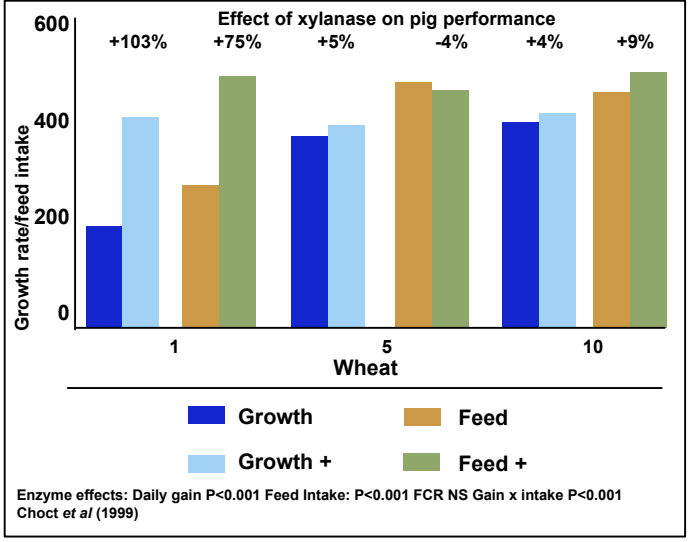
Published digestibility trials in grower-finisher pigs have shown digestible energy (DE) content of wheat varying by around 1.3 MJ/kg (310 kcal/kg) from 'good' to 'bad' samples, based on published work in the UK, Canada and Australia. Such variation when translated into animal performance using a growth simulation model can have a substantial influence on margin over feed and feed value, as illustrated in the example below.

Assume that a diet is formulated to contain 50% wheat and that the target growth rate of the pig over the range 30-100 kg bodyweight is, say, 885g/day. If this diet contains a 'good' sample of wheat, based on published studies, with a DE content of 14.4 MJ/kg (3440 kcal/kg) then the growth simulation model estimates an FCR of 2.53 when achieving the target daily live weight gain.

In contrast, if the diet were to contain a 'bad' sample of wheat, based on published studies, with a DE content of 13.1 MJ/kg (3130 kcal/kg), then more feed would have to be consumed to achieve the same target daily live weight gain - increasing the FCR by 13 points to 2.66.

For a diet cost of Euro 180/t, the difference in margin over feed costs between the two diets equates to a Euro 1.64 loss per pig. Alternatively, the value of that second feed to the end-user customer has dropped by around Euro 9/t.

Figure 3 – Xylanase reduces variation in performance between different varieties of wheat



Enzyme effects: Daily gain P<0.001 Feed Intake: P<0.001 FCR NS Gain x intake P<0.001
Choct *et al* (1999)

With this background in mind the Danish researchers continued their studies with two mid-range varieties using finisher pigs (60-110kg) fed pelleted diets with and without xylanase (Porzyme 9300). Both wheat types responded well to optimal xylanase addition, with one variety (Dirigent) showing a 13% improvement in daily gain and the other variety (Ritmo) an improvement in FCR of 7%.

Something to think about

Gary Partridge, technical services director with Danisco Animal Nutrition, believes that the Danish work has added significantly to the available knowledge base on the subject. "The Danish data puts the work on a European footing and will provide the industry with something to think about, particularly now that wheat from the 2003 harvest will soon be entering the market.

Dr Partridge says the new research highlights too many advantages for anyone to be cynical about the role of enzymes in efficient pig nutrition, from weaner through to finisher. "The industry must be looking towards consistency in performance," he says. "Variability in performance will be reflected in reduced throughput and reduced carcass payments. Enzymes provide commercial units with feed formulation flexibility - a valuable option in the drive to reduce costs without compromising output," he asserts.

"They also have a role in the wider, more complex strategy around the removal of antibiotic growth promoters and the increasing use of vegetable protein-based diets. There's little doubt now that if feed compounders overlook the variability in wheat, their customers will continue to fall short of reaching their target performance and economic potential."