Research & Development

Enzymes provide a buffer against the variability of corn

The true picture regarding the variability of dietary energy specification in corn has only just become apparent, writes Dr MIKE BEDFORD.

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It is an often overlooked fact that each and every sample of cereal, whether it be barley, wheat or corn (maize), is unique. This means that variability between samples exists, which has enormous implications for poultry producers.

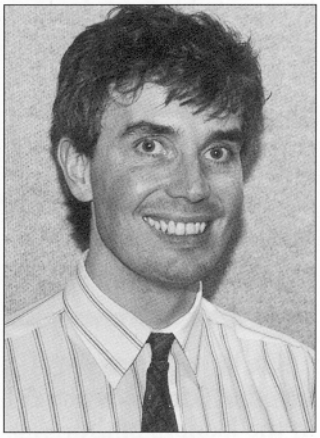
However, it is only recently that the true picture regarding variability in corn has become apparent. In addition, it is now clear that the degree to which cereal batches differ is dependent not only on variety and growing conditions, but also on the feed manufacturing processes employed.

Figure 1 summarises AME data from several studies, and clearly shows the considerable variation that occurs from sample to sample, regardless of cereal type. It is also interesting to note that both the degree and range of variability (ie difference between best and worst sample) is actually very similar between the three grains, a fact which is surprising given the commonly held belief that corn is not only the better grain, but also less variable than wheat or barley.

This previously ignored variation in corn feeding quality is highly relevant to the poultry producer. Each week, feed mills throughout Asia receive many distinct samples of corn, the histories of which are rarely, if ever, known. As such, whilst the formulation for a given broiler diet may not alter, the quality of the raw materials used in its manufacture clearly does. The result is that both the nutrient density of the diet, and the subsequent FCR of birds fed such diets, will also vary substantially.

The mechanics of variability

In corn and sorghum, both the rate and extent of grain digestibility appear to be strongly influenced by the structure of the starch present. Digestion of corn starch is inherently slower than that of wheat or barley, and is controlled by factors such as the makeup of the starch itself, grain drying and storage conditions, and processing.



Dr Mike Bedford

Changes in the structure of corn starch that can occur following high temperature processing, for example, can significantly reduce the digestibility of the starch. The extent of this effect is highly dependant upon the structure of the starch, which is itself variable from batch to batch. It is also likely that similar processes may occur during wet harvest years, when grain is dried vigorously in forced air driers. In addition, storage of recently harvested grain in vertical silos with metal sides can result in silo temperatures exceeding 50°C (Finnfeeds internal data), which over a period of time can lead to a similar effect.

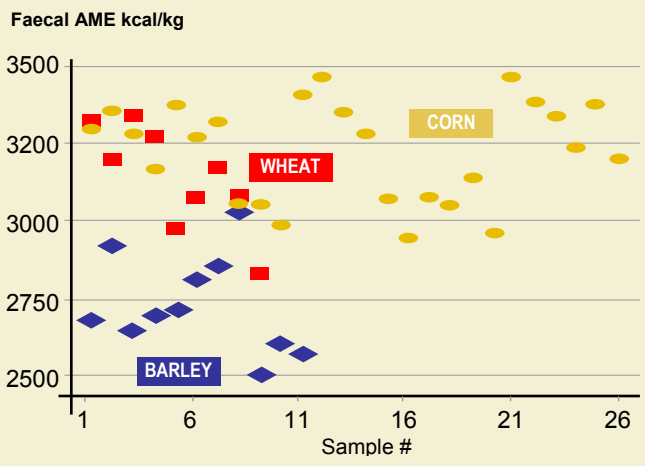
The importance of grain digestibility becomes apparent when it is considered that the growing chick retains feed in its small intestine for little more than two hours. Any factor which delays the rate of starch digestion will therefore increase the amount of starch which escapes digestion in the small intestine, and is therefore not utilised by the bird.

The true level of corn digestibility

Despite the evidence outlined above, it is probably fair to state that most nutritionists still consider corn or sorghum starch digestion to be greater than 98%. However, this figure is based on data relating to faecal digestibility, a measurement that is poorly related to the levels of starch actually available to the bird. Recent evidence presented by Noy and Sklan (1995) suggests that at the ileal level, starch digestibility rarely exceeds 85% throughout the life of the bird.

These interacting factors are responsible for the considerable variation actually present in corn and sorghum-based poultry diets, and the resulting impact on bird performance. This has led to the development of an enzyme complex by Finnfeeds (Subtilisin amylases and proteases, and Trichoderma xylanases) specifically designed to reduce corn and sorghum variability and improve poultry performance in these diets.

Figure 1: Variation in faecal AME of corn (Leeson et al, 1993), wheat (Classen et al, 1995) and barley (Scott and Boldaji, 1997).



A solution to the problem

Initially selected using laboratory screening procedures, this enzyme mixture (Avizyme 1500) is based on a specific combination of protease, amylase and xylanase. Proven to be effective in more than 50 research trials, one of the major effects of this enzyme combination is an improvement in the rate of starch digestion within the small intestine, as shown by work conducted at the University of Sao Paulo, Brazil (figure 2). The results from this trial confirm that digestion of starch up to the end of the ileum is incomplete, and that the addition of the correct enzyme complex can consistently increase (in the order of 2%) the amount of starch digested in the ileum. The implications for overall energy digestibility are obvious. Interestingly, the effect of an appropriate enzyme complex on digestibility has been found to vary depending upon the nutritional quality of the corn batch used, producing greater improvements where quality is low (figure 3). The result is not only an increase in overall digestibility, raising the average in this instance by 97kcal/kg (3.3%), but also a significant reduction in the variability between samples, from a standard deviation of ±81 kcal/kg to just ±40 kcal/kg.

The energy response to enzyme supplementation of the two poorest batches of corn tested in this study, which had been locally sourced in Thailand and South Africa, was 204kcal/kg and 182kcal/kg, respectively. If this increase is attributed solely to the corn fraction of the diet (which was 53% of the total diet), this energy response equates to more than 340 kcal/kg, and represents a substantial and very worthwhile improvement in feeding value.

Table 1: Large scale commercial trial showing effects of feed enzymes when used to supplement corn-soybean broiler diets (Broiler integrator, Philippines).

	Medium density diets		High density diets	
	Control	+Enzymes[1]	Control	+Enzymes[1]
Number of birds	6000	6000	15000	15000
Liveweight (g)	1840	1895	1782	1865
Feed intake (kg)	3.25	3.22	3.22	3.21
Feed:gain	1.84	1.77	1.89	1.78
Mortality (%)	3.7	3.9	4.3	3.3
Relative feed cost per kg liveweight (%)[2]	100	94	109	101

[1] 3% lower in ME than control diets, plus Avizyme 1500, Finnfeeds
[2] Cost of enzyme included in calculation

Commercial implications

The practical application of this enzyme technology offers tremendous potential for increased profitability through improved and more consistent bird performance, and reduced feed costs. Table 1 shows the results of a large scale field trial conducted by a broiler integrator in the Philippines, where enzyme addition allowed formulated dietary energy levels to be reduced by 3% without loss in broiler performance. In fact, it can be seen that the diets containing enzymes actually produced 3.8% higher 42-day weights and 4.8% better feed conversion efficiency than the control diets.

The overall result was a reduction in feed cost/kg liveweight of nearly 7%, as a result of replacing more expensive oil with additional corn plus enzymes. The added benefits of greater uniformity between feed batches and, consequently, in bird performance would provide further economic gain.

The results of such trials clearly indicate the importance that potential improvements in corn digestion can have in broiler diets. Reductions in dietary energy specification of between 3% and 5% can be successfully compensated for by enzyme supplementation, producing substantial feed cost savings. For the commercial broiler producer looking to maximise production efficiency and reduce variability, the arrival of feed enzymes for corn-and sorghum-based diets represents a very significant step forwards. ■

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Figure 2: Effects of feed enzymes on ileal digestibility of starch in broiler chicks at 37 days of age. Corn soy diets containing different soybean products. (Sakomura et al, 1998; Univ. of Sao Paulo, Brazil)

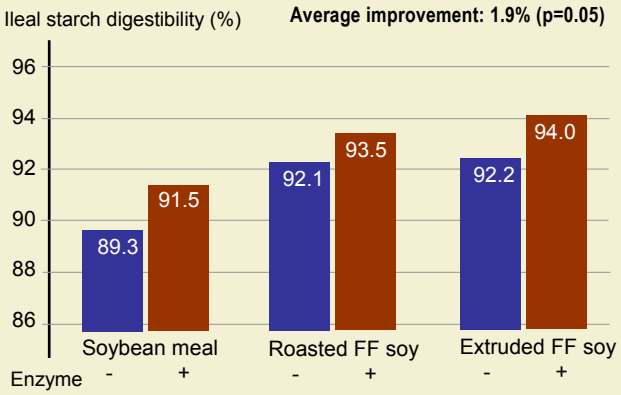
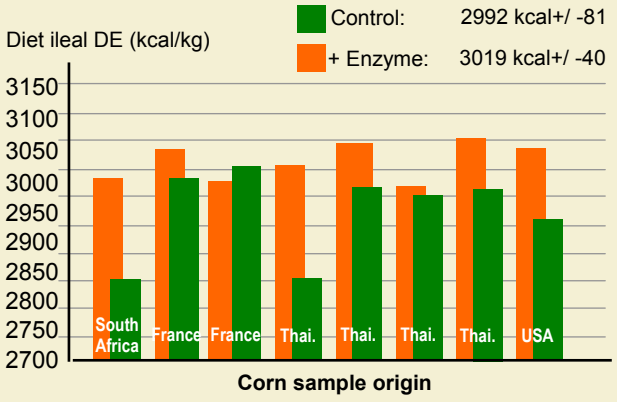


Figure 3: Effects of enzymes on ileal energy digestibility of corn-based diets in broiler chicks at 28 days of age across 8 different corn batches (Roslin Institute, Edinburgh, unpublished)



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