

How consistent is corn as

During the past four years, Danisco Animal Nutrition has collected and analysed over 2,000 corn samples from more than 30 countries, the results of which highlight variations of up to 15% in nutrient content and starch digestibility. These results shatter the long-standing myth surrounding corn's consistent feed value, and have substantial economic implications for poultry producers.



By Julian Cooksley

Poultry producers, nutritionists and feed manufacturers tend to regard corn as an ingredient which is consistent in terms of nutritional value, regardless of where in the world it is grown and under what conditions. This is a myth, says Dr Ceinwen Gilbert, technical manager for Danisco Animal Nutrition. Over the most recent four years, Danisco Animal Nutrition has conducted wide-ranging studies that have proved conclusively that corn exhibits remarkable variations, which have major implications for all sectors of the global poultry industry.

Assessing variability

Scientific evidence has shown that corn can be an inconsistent grain and that its Apparent Metabolisable Energy (AME) can vary dramatically. A number of factors contribute to this variability including the corn's genotype, the location in which it is grown, seasonal variations in growing and harvesting conditions, as well as

drying and storage conditions.

Feed manufacturers and commercial poultry producers who require uniform feeds from batches of corn produced in different harvest years, locations or growing conditions, therefore face serious challenges.

To help nutritionists, feed manufacturers and poultry producers manage the issue of corn variability more effectively, Danisco's research focuses on two areas. Firstly, what are the key factors affecting corn quality, and secondly, how can specific enzymes reduce variability and improve the nutritional value of feed derived from different batches of corn?

Danisco's analysis of 220 corn samples harvested in 2005 and 2006, grown in eight countries and collected from commercial feed mills and poultry integrators proved conclusively that dry matter, starch, crude protein, oil content and starch digestibility can vary widely between samples of corn (Table 1).

Dry matter ranged from ~79-91%, levels of starch from ~68-73%, crude protein from ~6-11%, oil from ~3-6% and *in vitro* starch digestibility from ~28-56%. Interestingly, similar variations in nutritional content were also evident between samples from within the same country.

Since starch contributes about 65-70% of the energy value of corn, it is interesting to note that an analysis of the 220 corn samples highlighted

Figure 1 - Starch content and *in vitro* starch digestibility can be highly variable between batches of corn

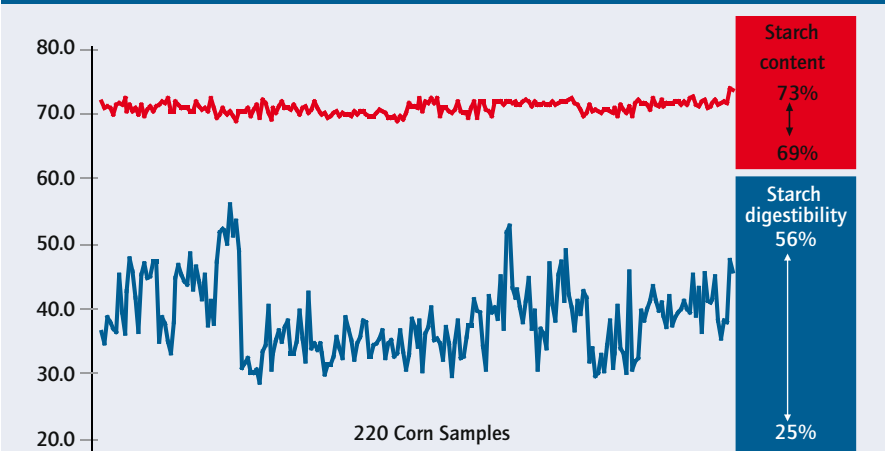


Table 1 - Corn analytical values from harvest 2005 - 2006

Country	Dry matter (%)	Starch (%)	Protein (%)	Oil (%)	Starch digestibility (<i>in vitro</i>) (%)
Average	86.7	70.6	8.5	4.4	38.2
CV (%)	1.7	1.3	9.7	11.4	14.5
Minimum	79.6	68.5	6.3	3.3	28.4
Maximum	90.7	73.4	10.8	6.0	55.7

Source: Danisco Avicheck Corn database

a feed ingredient?



Corn grown in different parts of the world or harvested in different parts of a country may look the same, but that does not guarantee the same nutritional value.

the fact that both the starch content and starch digestibility can be highly variable between batches of corn (Figure 1)

Variable bird performance

Consistent bird performance is the goal of the poultry producer. Since a typical corn-soy diet contains 65-70% corn, significant variation in the nutritive value of corn will clearly lead directly to variation in bird growth and feed conversion.

Danisco set up a research programme to establish the effect of corn variability on bird performance. The research programme involved obtaining 59 corn samples from 13 countries worldwide representing the US, South America, Europe and Asia. These samples were included in different batches of feed, formulated to contain 55% of each corn sample in an otherwise constant diet. The diets were fed to broilers and the ileal digestible energy of each diet, as well as liveweight gain of birds, were measured at 28 days.

Ileal digestible energy varied substantially between samples from 2,361 kcal/kg feed (9.9 MJ/kg feed) to 3,930 kcal/kg feed (16.4 MJ/kg feed) (Figure 2) and bodyweight gain at 28 days ranged from 747g to 1301g (average 962g) (Figure 3). Since all diets were otherwise identical in composition, including source of ingredients (except for the

Figure 2 - Ileal digestible energy in broilers fed diets containing different corn samples

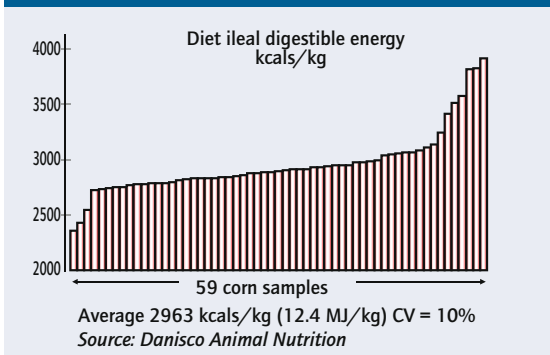
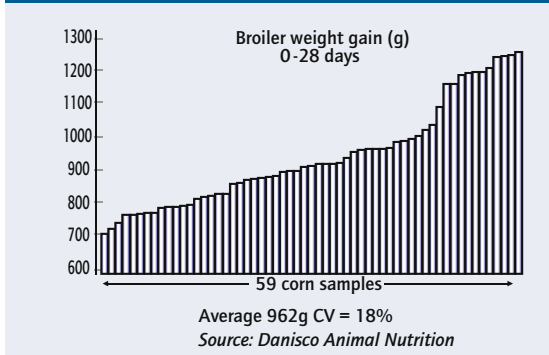


Figure 3 - Weight gain of broilers fed diets containing different corn samples



corn), any variation in ileal digestible energy and bodyweight gain between the birds could be directly attributed to variations in corn feeding value.

Improving corn quality

Proven to be effective in more than 70 research and commercial trials, Danisco's enzyme combination (Avizyme 1500), a unique blend of xylanase, amylase and protease, improves the rate of starch digestion within the small intestine. Amylase, a starch digesting enzyme, helps the bird to digest more of the starch in the corn. Since the major source of energy in corn-based diets is starch, increasing starch digestibility means an improvement in energy digestibility. Protease, a protein digesting enzyme, breaks down storage proteins which bind starch. The bound starch is then released and more available for digestion by both the birds own amylase and Avizyme 1500 amylase. Xylanase breaks down the fibre-rich cell walls, releasing enclosed starch, again increasing

its availability for digestion.

The net result is that the amylase, protease and xylanase in Avizyme 1500 work in combination to improve starch digestibility and hence increase corn energy digestibility.

The degree to which the enzyme blend can improve energy digestibility of corn is expressed as an Energy Improvement Value (EIV). Danisco identified that several factors influence the degree to which the enzyme blend can improve energy digestibility of corn. These include starch, protein and oil content, starch digestibility and protein solubility index (which provide an indication of the degree of protein binding with other nutrients in corn). These factors are measured routinely in the Danisco laboratory to assess the EIV of different corns.

Table 2 summarises the average EIV of 220 corn samples harvested in 2005 and 2006, as well as the key countries, being the US, Brazil, Thailand and Canada. The average EIV for all samples over the 2005 and 2006 harvest years was approximately 146 kcal/kg, within a

Table 2 - Enzyme addition improves the energy digestibility of corn

	Average EIV*	CV%	Minimum EIV*	Maximum EIV*
2005 corn harvest				
Overall	154	9.0	132	179
Brazil	166	5.1	148	176
Canada	156	10.1	132	179
USA	154	7.1	132	173
Thailand	139	3.7	133	146
2006 corn harvest				
Overall	146	13.4	109	232
Brazil	136	5.9	122	147
Canada	159	7.1	133	186
USA	134	11.0	109	167
Thailand	131	4.6	119	138

*EIV - "Energy Improvement Value" due to Avizyme 1500 addition

range from 108 kcals/kg to 186 kcals/kg.

The US, China, Brazil, Mexico, France and Argentina produce around 75% of the world's corn supply; the US alone being responsible for approximately 40% of that supply, making it the world's largest exporter of corn. Consequently, information on US corn variability will also be very relevant to feed manufacturers in many other countries that import US corn. In the US, for example, the average EIV of 62 samples from the 2006 harvest was 134 kcals/kg, but this concealed a range of 109 kcals/kg to 167 kcals/kg.

More profit

In broiler production systems, feed is the biggest single cost. Profitability therefore depends on the relative cost and nutritive value of the key ingredients. As indicated, corn is inherently variable and therefore maximising its nutritive value and minimising its variability can significantly improve the economics of broiler production.

The knowledge gained from Danisco's research into corn variability led directly to the development of a unique service - Avicheck™ Corn. The service enables broiler feed manufacturers to optimise their use of Avizyme 1500, according to the quality of corn used in the feed formulation. The service includes a unique laboratory assay that estimates how much Avizyme 1500 can improve the ME of corn, reported as the Energy Improvement Value (EIV). Including Avizyme 1500 and the new higher energy corn into the feed formulation provides opportunities to reduce feed costs. Typically, the higher energy corn replaces some more expensive high-energy ingredients, such as fat or oil.

The service also includes an economic model which estimates the value of the enzyme blend to the broiler producer accruing from both reduced feed costs and improved broiler bodyweight uniformity. The financial benefits are very attractive. For example, the current net financial benefit to a US broiler producer from using the enzyme blend, as predicted by Avicheck Corn, is approximately US\$12.80/tonne of feed. This currently equates to an additional US\$3 million of income annually for a broiler producer processing 1,000,000 birds a week.

It seems that high corn and fat/oil prices are here to stay for the foreseeable future. For commercial broiler producers looking to maximise production efficiency and improve bird uniformity, these latest advances in enzyme technology represent an exciting and significant step forward. ■