Improving the performance of corn-soy diets with fungal enzymes

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Most research on feed enzymes in poultry has focused on reducing high intestinal viscosity resulting from soluble fibre fractions in cereal grains, especially wheat and barley.

Reducing intestinal viscosity in poultry fed wheat-barley diets is an important benefit, but a second, equally important, effect is the destruction of cell walls encapsulating key nutrients.

Cell walls hinder exposure of nutrients to digestive (or exogenous) enzymes. This second effect allows nutritionists to improve the digestibility and performance, not only in wheat-barley diets, but also in corn-soy diets, traditionally considered less susceptible to improvement by exogenous enzymes.

The effectiveness of different products on the market can be understood better by examining key characteristics of the producer strains. In this article we review the differences between enzymes of different origin, focusing in particular on the type of micro-organism used for enzyme production. We also illustrate the efficacy of a multi-enzymatic complex (Endofeed DC) in corn-soy diets for broilers.

Endofeed DC is a multi-enzymatic complex produced by fermentation of a non-GMO Aspergillus niger strain. This product contains high amounts of beta-glucanase and xylanase as the main activities and is commercialised by Materias y Actividades SL (Pintaluba Group) in, Spain.

So, how important are these two characteristics, fungal and non-GMO, on the mode of action?

Fungal or bacterial enzymes

Most feed enzyme products are produced by fungi rather than bacteria. An exception is amylase, which in many commercial products is bacterial in origin.

Fungi prefer a lower pH than bacteria, and consequently produce an enzyme spectrum with the desired lower pH preference (Fig. 1).

Fungal enzymes are compatible with a lower feed pH induced by the use of organic acids in starter diets, whereas the activity of bacterial enzymes in such applications is questionable.

Why use non-GMOs?

GMO producer strains confer some advantages, but more disadvantages, to feed enzymes. For example, one advantage of GMOs is the capacity to achieve higher yields of specific enzymes. One main disadvantage is that GMO enzymes lack the ancillary enzymes and other factors that assist in the breakdown of the complex substrates found in feed ingredients.

A second disadvantage is that there is only a single isozyme (form) that functions across a narrow band of the pH spectrum, unlike natural products which contain many isozymes of the same enzyme and are active over a broader pH range.

In non-GMO fermentations, and especially in the case of Endofeed DC, conditions closely resemble natural ('wild') fermentations. Hence, the production organism is forced to produce a viable enzyme complement to survive in a highly competitive environment.

A few of the secondary enzyme activities that occur in addition to the guaranteed activities in Endofeed DC are:

- Cellulolytic enzymes, responsible for the degradation of cellulose.
- Hemicellulolytic enzymes that degrade linear β-1,4-xylan to xylose.
- α-Galactosidases release galactose from anti-nutritional oligosaccharides such as raffinose, stachyose, and verbascose, which occur in most plant proteins (soybean, lupin, pea, and canola meals).
- Galactomannase degrades mannose-based cell wall elements.

Secondary enzymes, acting in concert with a variety of poorly understood factors, assist enzymes in binding to their respective substrates, and are critical for the degradation of intact feed materials.

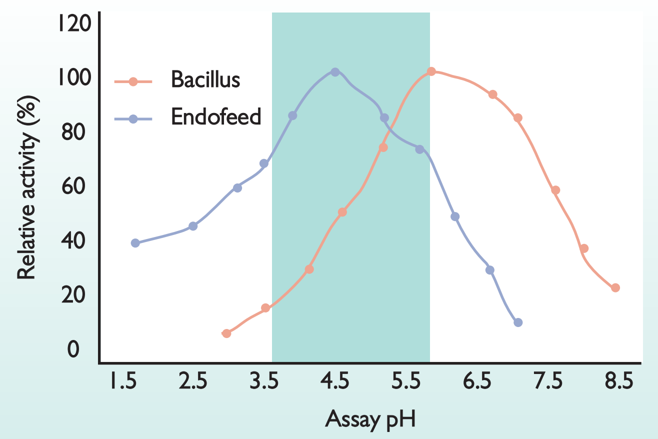
Fig. 2 shows the degradation of the carbohydrate fractions (raffinose, stachyose and verbacose) of soybean meal using different commercial GMO and non-GMO enzymes used in European markets, monitored by the remaining RSO (Raffinose Series Oligosaccharides), and compared with a control group. At pH 4, Endofeed degraded almost 100% of the RSO.

Practical applications

As mentioned above, viscosity is not a concern in corn-soy diets, so only an improvement in performance and consequently improved production margins justify the use of feed

Continued on page 17

Fig. 1. Relative xylanase activity of fungal and bacterial enzymes.



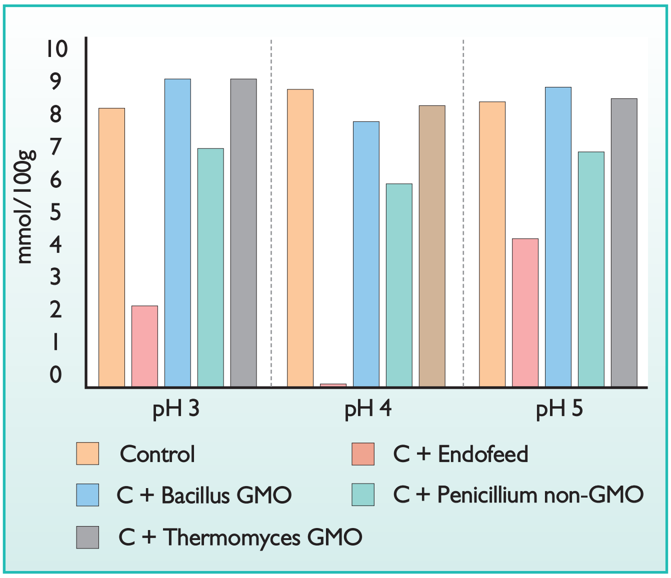


Fig. 2. RSO remaining in soya samples after incubation with different commercial enzymes.

Treatment	Endofeed DC	Body weight (g) 21 days	42 days
T1-T3	-	671	2,699
T2-T4	125g/Mt	698	2,734
Probability		0.0042	0.3284

Table 1. Effect of dietary treatment on body weight of the bird.

Treatment	Endofeed DC	Apparent ileal digestibility DM (%)	CP (%)
T1-T3	-	62.5	76.7
T2-T4	125g/Mt	65.4	76.9
Probability		0.0168	0.845

Table 2. Effect of dietary treatment on ileal apparent digestibility of dry matter (DM) and crude protein (CP) of broilers at 42 days of age.

Continued from page 15
enzymes in such cases. Two trials evaluated the effect of Endofeed in corn-soy diets. Both trials carried out at the University of Murcia in Spain.

Trial one

This study evaluated the efficacy of Endofeed DC in broilers fed mash diets based on corn and soybean meal from one to 42 days of age.

One-day-old Ross 308 chicks were allocated at random to four treatments (132 birds/group), with two different basal diets (high and low protein) with or without Endofeed DC (0 vs 125g/t). The design was completely randomised with 12 replicates (pens) per treatment.

Observations included growth, body weight, feed intake, feed efficiency, EPEF (European Production Efficiency Factor), general health, ileal apparent digestibility and percent mortality and culling.

Body weights are shown in Table 1. Endofeed DC supplementation increased body weight at 21 days of age (671 vs 698g; P = 0.0042).

The effect of treatment on nutrient digestibility is shown in Table 2. Broilers fed diets supplemented with Endofeed exhibited improved ileal digestibility of dry matter (62.5 vs 65.4%, P = 0.0168). Endofeed DC significantly increased body weight at 21 days (P<0.01).

Broilers fed diets supplemented with Endofeed DC showed better ileal apparent digestibility of dry matter than controls (P<0.05).

Trial two

One-day-old Ross 308 chicks were allocated at random to two dietary treatments, with or without Endofeed DC (0 vs 125g/t).

The trial design was completely randomised with 12 replicates (pens) per treatment. Body weights are shown in Table 3. Endofeed DC increased body weight of birds at 42 days of age (2,543 vs 2,612g; P= 0.0136).

Birds fed diets with Endofeed DC grew 2.7% faster than controls (59.6 vs 61.2g/d; P = 0.0137) (Table 4).

The addition of Endofeed DC to corn-soya diets significantly improved broiler growth to 42 days of age. Finally, from both research studies and field experience it was concluded that Endofeed DC, a non-GMO, fungal-derived, multi-enzymatic complex, used in viscose barley-wheat diets for many years, also offers economic advantages when corn is the main cereal in the broiler diet. ■

Treatment No.	Endofeed DC	Body weight (g) 21 days	42 days
T-1	-	768	2,543
T-2	125g/Mt	788	2,612
Probability		0.1137	0.0136

Table 3. Effect of dietary treatment on body weight of the bird.

Table 4. Effect of dietary treatment on growth.

Treatment No.	Endofeed DC	0-42 days ADG (g/d)	ADFI (g/d)	FCR (g/g)
T-1	-	59.6	97.8	1.64
T-2	125g/Mt	61.2	98.3	1.61
Probability		0.0137	0.6064	0.1795