

The positive effects of carbohydrases on the environment

The use of feed enzymes is common practice in barley and wheat-based poultry diets around the world. It is now well established that in these two grains (likewise in triticale and rye) the viscous non-starch polysaccharides (NSP) account for as much as 70-80% of the variation in feeding values (Barrier-Guillot *et al* 1997, Bedford and Morgan 1996, Bedford 1997, Choct *et al.* 1996, Smits and Annison 1997). These NSPs include the soluble β -glucans in barley and soluble arabinoxylans in wheat, triticale and rye.

When high levels of these types of cereals are included in poultry diets, they produce a viscous solution in the bird's gut, which depresses nutrient digestibility and hence reduces bird performance. Enzymes targeted at wheat, barley, rye and triticale based poultry diets reduce the levels of soluble, non-starch polysaccharides in the cereal such that the intestinal viscosity in the bird is reduced and consequently bird performance improved.

Whilst corn and sorghum have traditionally been considered as highly consistent feed ingredients for poultry, recent research conducted (both independently and in collaboration with Finnfeeds,) has revealed significant

The overall effect of using feed enzymes is that bird performance is increased and the efficiency of feed use is improved. An additional effect is that they can help in reducing the animal's nitrogen output.

By Milan Hruby and Andrea Barratt

variability between batches of corn and sorghum, in terms of differences in starch digestibility. Enzyme combinations have been developed to improve starch digestibility, thereby reducing corn and sorghum variability and increasing energy availability to the bird.

Impact on environment

Improving the digestibility of nitrogen containing compounds can have a significant impact on the environment in terms of reducing nitrogen excretion from the bird. It is known that use and disposal of nitrogen present in poultry manure may pollute surface and ground waters if sound management practices are not employed.

Polluted ground waters contain increased levels of nitrates and disease

causing bacteria. Such contamination poses serious health risks to both man and livestock.

Reducing crude protein in diet

One option open to the poultry producer could be to reduce the level of nitrogen containing compounds in poultry diets, for example by reducing the crude protein content of the diet. Yamazaki *et al.* (1996) found that the amount of nitrogen excreted over four days was 3.93, 3.26, 2.35 and 2.19g per chick per day in 7-14 days old chicks fed 23, 21, 19 and 17% crude protein diets, respectively. The researchers concluded that nitrogen excretion could be reduced by 10 to 20% if dietary crude protein in broiler diets is reduced from 21 to 19%.

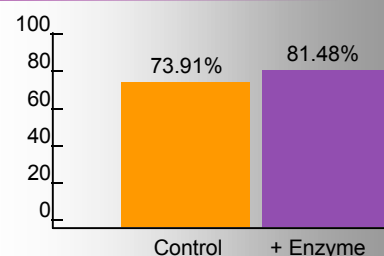
However, they also concluded that reducing the level of crude protein in the

Table 1 - The effect of a Trichoderma based beta-glucanase, xylanase and Subtilisin protease enzyme complex (Avizyme® 1100) on ileal and faecal protein digestibility

Ileal protein digestibility (%)		Faecal protein digestibility (%)		Research Institute
Control	+Enzyme	Control	+ Enzyme	
62.5 ^b	75.5 ^a	Not measured	Not measured	Montana State University, USA
63.1 ^b	73.3 ^a	Not measured	Not measured	Montana State University, USA
69.4 ^b	80.9 ^a	77.1 ^b	83.4 ^b	IRTA, Spain
74.1 ^b	83.4 ^a	Not measured	Not measured	IRTA, Spain

^{ab}Means not sharing a common superscript differ significantly (P<0.05)

Figure 1 - The effect of enzyme supplementation on ileal protein digestibility in laying hens at 37 weeks of age





Adding enzymes to a feed not only improves digestibility of grains, but can also help lowering nitrogen output of the bird.

Table 3 - The effect of enzyme supplementation in corn/soy-based diets on performance of laying hens (32-36 weeks of age)

	Control - 2650kcal/kg	+Enzyme
Egg production (%)	95.1	96.0
Egg weight (g)	58.7 ^b	59.8 ^a
Egg mass	55.9 ^b	57.4 ^a
FCR	1.89	1.85
Broken eggs (%)	5.55 ^b	3.26 ^a

^{ab} Means not sharing a common superscript differ significantly (P<0.1)

Nutreco Poultry Research Centre, Spain, 1999

increased by 9% in the enzyme supplemented diet (Figure 1).

Impact on N-excretion

What impact could this have on nitrogen excretion and its disposal in the environment? The above data shows that enzyme supplementation improved ileal protein digestibility by 9%. This takes no account of the urinary nitrogen, which contributes to the total faecal nitrogen output. However, because FCR and nitrogen accretion (expressed as egg mass) were improved, one can safely assume that relative urinary nitrogen contribution would be the same in both treatments.

According to Chambers and Smith (1998), 1000 layers produce 650 kg of nitrogen per year and this requires 2.6 hectares of land for its disposal in the EU. In this trial, because of the improvement in ileal protein digestibility, enzyme supplemented layers would be expected to produce 570 kg of nitrogen per year which would require 2.28 hectares of land to recycle. For every 1 million layers, 320 hectares less land would be required to dispose of the manure.

Summary

Not only do feed enzymes offer broiler and egg producers the opportunity to enhance the efficiency of meat and egg production in terms of better feed conversion ratios and improved uniformity, but they can also positively impact the environment by reducing nitrogen excretion.

Key words:

Avizyme 1300, Avizyme 1500, broiler, layer, xylanase, protease, amylase, ileal protein, digestibility, amino acid, egg mass, egg production, nitrogen

Table 2 - The effect of a Trichoderma based xylanase and Subtilisin protease enzyme complex (Avizyme® 1300) on ileal protein and faecal amino acid digestibility

Ileal protein digestibility (%)	Faecal amino acid* digestibility (%)	Research Institute
Control	Control	
62.5 ^b	79.3 ^d	SAC, Auchincruive, UK
+ Enzyme	+ Enzyme	
77.3 ^a	84.0 ^c	

^{ab} Means not sharing a common superscript differ significantly (P<0.007)

^{cd} Means not sharing a common superscript differ significantly (P<0.02)

*Average lysine, methionine & threonine

diet had a detrimental effect on carcass quality as abdominal fat content increased. In laying hens, Neiss (1993) reduced the crude protein of the diets from 17% down to 13.5% such that nitrogen excretion fell by up to 30%, however performance decreased by 2-3%. Therefore, the dilemma for poultry feed producers is how to efficiently produce meat and eggs of consistently good quality, whilst minimising the negative impact on the environment.

Enzymes supplementation

Another option available to the producer is to supplement the diet with feed enzymes, not only to enhance bird performance, but to also reduce nitrogen excretion. In barley-based broiler diets, studies with a *Trichoderma* based β -glucanase, xylanase and *Subtilisin* protease enzyme complex, have shown that ileal and faecal protein digestibility can be significantly increased (Table 1). Similar effects have also been observed in wheat-based broiler diets supplemented with a *Trichoderma* based xylanase and *Subtilisin* protease enzyme complex (Table 2).

In addition to the improved nitrogen digestibility at both the ileal and faecal level, enzyme supplementation also improved FCR in all of the trials reported above.

Because enzymes improve protein digestibility, another approach could be to lower the cost of the diet by reducing the crude protein and amino acid content to a level whereby enzyme addition improves the digestibility to such an extent that the actual amount of available nutrients to the bird is not reduced. At the same time, because the crude protein content of the diet has been decreased, the amount of nitrogen excreted by the bird would also be reduced.

Laying hens fed corn/soy-based diets supplemented with an enzyme complex (*Subtilisin* amylase and protease, and *Trichoderma* xylanase, (Avizyme® 1500)) performed better in terms of egg production, egg weight, egg mass, FCR and reduced percentage of broken eggs than layers fed corn-based diets without enzyme supplementation (Table 3). In addition to improving bird performance, the ileal protein digestibility, measured at 37 weeks of age was significantly