Enzymes: feeding for optimised poultry performance

Ensuring feed is efficiently digested for optimal nutrient uptake and assimilation in poultry requires appropriate enzyme activity. In young birds, endogenous enzyme production from organs such as the pancreas is typically insufficient for complete digestion of feed materials.

by Dr Jules Taylor-Pickard, Alltech.
www.alltech.com

Even in older birds, the presence of certain antinutritional or indigestible compounds can compromise feed digestion and conversion efficiency. These compounds include phytate, arabinoxylans and beta-glucans, amongst others, and they have been widely studied since the 1980s.

Since the early 1990s, exogenous feed enzymes have been used to negate these antinutritional factors and promote digestion. However, not all feed enzymes are produced in the same way, and they have different specificities and activities on feedstuffs.

Commonly, feed enzymes are produced by batch fermentation processes, followed by filtration, drying and addition to a carrier. Source organisms are often genetically modified to ensure overexpression of the desired activities required for in-feed applications. However, other specialised feed enzymes are produced by solid state fermentation (SSF), in which the source organism Aspergillus niger is grown on the main feed ingredient used in the target diet.

This production method utilises the organism's ability to respond to the substrates available from the feedstuff, producing the appropriate enzymes required to optimise digestion. These enzymes include pentosanase, cellulase, protease, amylase, pectinase and beta-glucanase.

Raw materials used in this type of enzyme production include corn cobs, wheat bran, soybean meal and palm kernel meal. The resulting mix of feedstuff and enzymes is then dried and can be used directly in animal feeds without any losses in activities.

Digestibility trials

Digestibility trials in poultry showed that Allzyme SSF addition increased 11% more P from phytate in wheat-based diets and 8% in corn-based diets, compared to a liquid fermentation phytase enzyme. In addition, amino nitrogen was increased by 1.7% and 6.2% and sugars were reduced by 2.9% and 6.2%, respectively, in wheat, or corn, based feed.

This demonstrated the benefits of using Allzyme SSF to liberate more nutrients from poultry diets, thus supporting a reduced nutrient matrix value during formulation.

Hence, many feeding trials have given an energy and mineral reduction applied to the formulation of feed, to allow for increases due to Allzyme SSF activity, thus reducing diet costs for producers without compromising performance.

From commercial trials in various types of poultry, broiler weight gain and FCR were equalled or improved with addition of Allzyme SSF in down-specified diets, and egg weight increased by an average of 3% with equal feed-to-egg FCR.

Calculated cost savings due to increased feed efficiency, and return on investment from layers over 53 weeks of production, were €0.04 per egg.

Early research in broilers showed that, when diets were reduced from 0.35% P down to 0.25% P and supplemented with Allzyme SSF at levels of 300 phytase units/kg feed, weight gain and FCR were not significantly different.

High-phytate diets containing 10% rice bran, which are low in available P, were supplemented with Allzyme SSF or phosphorus for young broilers (3-15 days old). There were no significant differences in performance, and bone strength was increased for the birds fed Allzyme SSF-supplemented diets.

Commercial scale trials with laying hens have been conducted in Latin America. The trials were run using Lohmann Brown laying hens

A mix of feedstuffs and enzymes is dried and can be used directly in poultry feed without any loss in activity.

receiving either a control diet (2,885kcal/kg metabolisable energy) or a reduced energy diet (-120kcal/kg) supplemented with 150g/t Allzyme SSF, which had also been down-specified by 0.2% protein, 0.029% lysine, 0.011% methionine and 0.1% each calcium and available phosphorus.

The resulting data showed that egg production and quality was maintained in the down-specified diet containing Allzyme SSF, although the energy reduction proved slightly ambitious and was calculated to be 75kcal/kg, which was used as the basis for subsequent trials.

Hence, energy efficiency recommendations for use in diet matrix values and formulations were established.

Broiler trials in India and Australia

A six-week broiler trial, using 72,000 birds, was run in India, using corn-soy based diets supplemented either with a commercial phytase, with Allzyme SSF at 200g/t, or with a much cheaper diet containing local pearl millet plus 200g/t Allzyme SSF. Prestarter diets were down-specified by 65kcal/kg energy, 0.08% available P and 0.1% calcium (Ca); starter by 75kcal/kg energy and the same Ca and P as prestarter; and finisher had the same energy reduction as the starter, with 0.1% each Ca and P.

Birds fed both Allzyme SSF-supplemented diets showed better performance compared to the group fed with the commercial phytase. Cost savings were US$4.90 of the corn-soy diets and reached US$11.50 in the birds fed supplemented diets containing cheaper pearl millet.

Other trials in broilers fed down-specified corn-soy based diets to six weeks of age showed significantly increased tibial bone ash.

A further trial run in Australia (DPI, Queensland Poultry Research and Development Centre) used broiler diets formulated with wheat and soybean meal to meet commercial standards, or reduced by 150kcal/kg metabolisable energy and supplemented with Allzyme SSF.

Broilers fed the unaltered control diet had a 42-day live weight of 2.73kg, and the same (2.74kg) was recorded in birds receiving the down-specified diet plus Allzyme SSF. Conversion efficiency showed the same pattern, with the control-fed group having an FCR of 1.72, whereas it was 1.70 in the birds fed the down-specified diet plus Allzyme SSF.

These treatments were then repeated to include lower available P as well as lower metabolisable energy. The broilers fed the down-specified diet in energy and P had a reduced weight gain of 2.15 compared to 2.35kg for the unaltered diet at 42 days, but this was improved in birds supplemented with Allzyme SSF on top of the

Continued on page 9

Continued from page 7
down-specified diet to the same level as the positive control. FCR was 1.76, 1.78 and 1.73 for the control, down-specified but unsupplemented, and down-specified plus Allzyme SSF groups, respectively.

Enzyme trials in poultry

Various replicated, research-based poultry trials have examined the benefits of using SSF-produced enzymes. These have been published at conferences and in peer-reviewed journals.

Kay et al. (2011) conducted a poultry growth trial using Allzyme SSF in a wheat soy-based diet. They housed 364 Ross 308 male and female broilers, randomly split between 24 replicated floor pens and separated by sex.

The effects of supplementation with 200g/t Allzyme SSF were compared against a control diet containing commercial phytase and xylanase enzymes. The basal diet for both treatments was reformulated to include a reduction of 0.2 MJ/kg (50 kcal/kg) metabolisable energy, 1% less calcium and 0.083 lower digestible phosphorus.

This was done to ascertain if Allzyme SSF supplementation alone could replace both phytase and xylanase in down-specified broiler diets and replace the removed energy and nutrients by increased digestion, preserving expected performance in the birds.

The basal feeds were formulated to contribute: 12.75MJ/kg (3060kcal/kg) metabolisable energy, 23.3% protein and 1.325% digestible lysine (DL) in the crumbed starter; 13.1MJ/kg (3144kcal/kg) ME, 20.2% protein and 1.1% DL in the pelleted grower, and 13.45 MJ/kg (3228kcal/kg) ME, 18.3% protein and 0.98% DL in finisher/withdrawal diets. Birds were reared to 40 days of age, and feed intake and body weight were recorded on days 0, 12, 24 and 40.

Foot and hock lesions were measured on a 1-3 (none to severe) scale on days 24 and 40. There were no significant differences in body weight, weight gain, feed intake or FCR between birds fed both treatments (Table 1).

Table 1. Effects of Allzyme SSF solid state fermentation enzyme on broiler performance up to 40 days of age.

Parameter (40 days)	Control	Allzyme SSF (200 g/t)
Body weight (kg)	2.521	2.551
Weight gain (kg)	2.438	2.513
Feed intake (kg)	4.044	4.052
FCR	1.636	1.615
EPEF	371	377

No significant differences between dietary treatments, as analysed by Analysis of Variance (ANOVA)

Parameter	Standard diet + Allzyme SSF (200g/t)	Reduced energy diet + Allzyme SSF (200g/t)
Cumulative feed intake (g)	4927[a]	4838[b]
Body weight 42 days (g)	2845	2813
Feed conversion ratio	1.73	1.71
Mortality including culls (%)	5.8	4.3
EPEF	369	375

[a,b] Means not sharing a letter differ significantly (P<0.05)

Table 2. Effect of Allzyme SSF solid state fermentation enzyme on broiler performance and mortality up to 42 days of age.

European production efficiency factor (EPEF) was calculated from the measured data and was higher for the Allzyme SSF diet.

From other published data, Allzyme SSF was used in a large-scale (1,280 birds), 42-day growth, performance and health study, using Ross 308 male broilers.

The birds were housed in floor pens and fed a commercial corn-soy diet using starter, grower and finisher phased formulations, with Allzyme SSF inclusion at 20g/t feed either at full dietary nutrient levels or in a down-specified formulation where 75kcal/kg energy was removed from the diet.

This was done to investigate whether supplementation with Allzyme SSF could replace the energy removed from the diet, maintaining growth and liveability in the birds. The researchers monitored feed intake, weight gain and mortality weekly and calculated feed conversion ratio and EPEF from the final dataset (Table 2).

The broilers fed the reduced-specification corn-soy diet plus Allzyme SSF had significantly lower feed intakes; however, their final average body weights and FCR were statistically the same.

Increased energy production

Both research trials demonstrated that using 200g/t Allzyme SSF in broiler diets to replace single or multiple commercial enzymes met or exceeded the control performance in terms of weight gain, feed intake, FCR and EPEF.

This is attributed to increased energy production from starch and other elements in the feed and reducing antinutritional factors by enzyme activity as well as to higher mineral availability, notably from Ca and P liberation from phytate in plant materials.

This was demonstrated not only in larger scale commercial broiler and layer diets, but also under more exacting research conditions, with pen replication, which could be assessed via statistics. Such benefits were evident in both corn and wheat-soy based diets, indicating the flexibility of Allzyme SSF as an enzyme for use in diets formulated with different basal ingredients.

In addition, Allzyme SSF is effective for maintaining or promoting performance in poultry fed cheaper, local feed materials.

The down-specification of diets in energy, Ca and P and the use of cheaper, or local, feedstuffs results in cheaper costs of production when Allzyme SSF is included in the formulation. This is due to the increase in digestibility and feed efficiency in the bird, increasing nutrient availability and uptake supporting or exceeding the expected growth or laying performance.

Conclusion

Using a single product, such as Allzyme SSF, to achieve all these benefits is a more simple, efficient and cheaper way of supplementing poultry diets, compared to having to source and add multiple commercial enzyme products.

In addition, nutrition trials where diets containing Allzyme SSF were heat-processed/pelleted at temperatures up to 90°C demonstrated no losses in efficacy in terms of bird performance, making Allzyme SSF an enzyme of choice for use in poultry feed which may be subject to higher thermal processing. ■

References are available from the author on request