Maximising nutrition and feed ingredient value using multiple enzymes

The world has seen sharp rises in feed ingredient costs this year, thanks to a litany of issues relating to farm mandates, climate change, conflict and supply chain challenges. With feed accounting for as much as 70% of operating costs for poultry producers, innovative solutions are critically needed.

by Marquisha Paul,
Research Scientist,
Alltech Inc.
www.alltech.com

Feedstuff nutritional challenges

Although poultry are quite efficient at converting feed to protein, a significant portion of energy and nutrients in the feed is never fully digested and gets excreted into manure. This is partially due to the feed matrix and the bird's ability to fully digest grains, seeds, meals and other feedstuffs.

Plant-based ingredients are commonly used in poultry feeds, but energy and nutrient availability varies depending on the source. Energy can be one of the most expensive inputs in poultry diets, so maximising its use in poultry feed can improve efficiency and potentially lower feed costs.

Plants store energy-providing nutrients (like carbohydrates) as simple sugars, starch and non-starch polysaccharides (NSPs).

While simple sugars and starch are readily digested by poultry, NSPs are not because poultry do not produce the adequate digestive enzymes required to break down these complex molecular formations into absorbable carbohydrates.

NSPs can be categorised as insoluble or soluble; each has a different impact on nutrient digestibility.

- **Insoluble NSPs** occupy space in the digestive tract that can create a physical barrier against digestive enzymes and nutrients.
- **Soluble NSPs** increase the viscosity of digestive tract contents, disrupting the digestibility and absorption of proteins, lipids and other carbohydrates.

The NSP content in poultry feed ingredients ranges from approximately 10-30%, with higher amounts of NSPs typically found in cheaper, non-conventional feedstuffs and agricultural waste byproducts.

Phosphorus is an important nutrient for growth and production. It is abundantly present in a wide variety of plant-based feedstuffs, but the storage form of phosphorus in plants is not easily digested by poultry. Because of this, phosphorus is often supplemented in poultry diets as an inorganic mineral salt.

The preferred plant storage form of phosphorus is in a carbohydrate ring structure called phytic acid. In many common feed ingredients (corn, wheat, sorghum, barley, soybean meal, canola meal, cottonseed meal and others), phytic-acid phosphorus accounts for roughly two-thirds of the total phosphorus.

Poultry do not produce sufficient enzymes needed to separate enough phosphorus from the phytic acid molecule. Phytic acid also has a strong binding affinity to important minerals like calcium, magnesium, zinc, copper and iron.

This means that when phytic acid is consumed, it can bind minerals during the digestive process and form insoluble complexes, ultimately rendering them unavailable for absorption.

Furthermore, because of its negative charge, phytic acid can bind to positively charged molecules such as amino acids, natural digestive enzymes and protective gastrointestinal mucins, thereby reducing nutrient digestibility and absorption.

The practice of supplementing inorganic phosphorus in poultry diets contributes to

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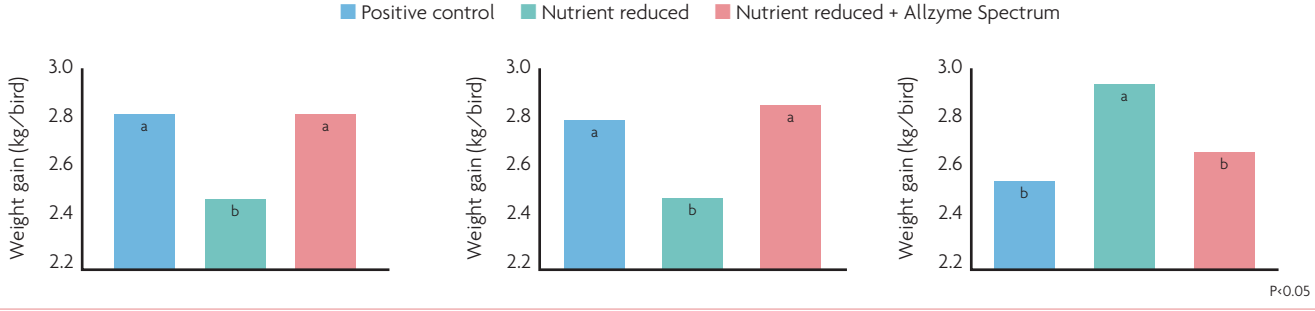
Fig. 1. 42-day performance of broilers fed nutrient-reduced diets containing multi-enzymes.



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the phosphorus pollution of soil and water, largely due to the excessive amounts excreted into poultry manure that is then used as a crop fertiliser.

How exogenous enzymes improve nutrient usage

Digestive enzymes are produced throughout the avian digestive tract and help initiate vital chemical reactions to process feed into usable energy and nutrients. Unfortunately, there are certain enzymes which poultry either completely lack or do not produce in sufficient quantities, essentially leaving antinutrients like NSPs and phytic acid molecules unchecked.

This can be remedied by adding exogenous enzymes to poultry diets. Carbohydrase and phytase enzymes – which turn carbohydrates into simple sugars and increase the digestibility of phytate phosphorus – are key to degrading NSPs and phytic acid and unlocking energy and nutrients from feedstuffs.

This allows poultry to make better use of energy and nutrients in feed ingredients. Considering the range and blend of ingredients used in poultry diets, the use of multiple enzymes can be advantageous to poultry producers.

Recent studies have shown the efficacy of exogenous enzymes in improving nutrient usage. Broiler and layer research trials have demonstrated the benefits of including Allzyme Spectrum, a multi-enzyme complex that contains phytase and carbohydrase, in nutrient-reduced diets. Allyzme Spectrum enhances nutrient utilisation and supports a healthy digestive system.

Multi-enzyme broiler research

The 42-day performance of commercial broiler chicks was evaluated after feeding the following corn-soybean meal-based diets:

- Positive control (commercial level energy and nutrients).
- Nutrient reduced (-90 kcal/kg ME, -0.15% available phosphorus (aP), -0.15% calcium (Ca) vs. diet 1).
- Diet 2 + 200g/ton Allzyme Spectrum.

Observations (Fig. 1):

- Broilers fed the nutrient-reduced diet without enzyme supplementation had the lowest weight gain, feed intake and poorest feed conversion ratio (FCR) .
- Broilers fed the nutrient-reduced diet with Allzyme Spectrum had the same weight gain, feed intake and FCR as positive control birds provided commercial level energy and nutrients.

Multi-enzyme layer research

The 44-week production performance of brown layers was evaluated after feeding the following corn-soybean meal-based diets:

- Positive control (commercial level energy and nutrients).
- Reduced Ca and aP (vs. diet 1 by 0.15%) + 250 FTU/g commercial phytase.
- Reduced Ca and aP (vs. diet 1 by 0.15%) + 200g per ton Allzyme Spectrum.
- Reduced nutrient (vs. diet 1 by 90kcal/kg ME, 0.15% Ca, 0.15% and aP) + 200g/ton Allzyme Spectrum.

Observations:

- When enzymes were provided in layer diets, there were no differences in feed intake, hen day production or feed conversion despite reduced nutrient inputs compared to the positive control (Table 1).
- Layers fed a commercial diet or diets containing reduced levels of nutrients with enzymes did not produce eggs of a different weight, eggshell breaking strength and eggshell percentage (Table 2).

Long-term feedstuff challenges and sustainability

The global population is projected to grow to 9.7 billion by 2050, and with that growth, the demand for food will surge. Pressure falls on the agriculture sector to become more efficient, create less waste, sustainably increase food production and become more resilient in response to short-term issues that may arise. The poultry industry can help meet these goals through the utilisation of multi-enzyme technologies such as Allzyme Spectrum in poultry feeds, which has been proven to offer both long- and short-term benefits. Maximising the nutritive value of poultry feed with multiple exogenous enzymes leads to more efficient poultry production. When enzymes are added, the amounts of certain feed ingredients formulated into poultry diets can be reduced, leading to immediate costs savings and, in the long term, a reduction in the use of land, water and energy used to produce those feed ingredients.

When the supply and price of conventional feedstuffs such as corn, wheat and soybean meal is a challenge, less conventional, lower quality feedstuffs and waste byproducts become more attractive to producers because they do provide some nutritional value.

Enzyme supplementation can help animals digest, absorb and utilise energy and nutrients from those less conventional feed ingredients, leading to improved performance and a reduced amount of environmental nutrient excretion. Over time, those benefits can have a major impact on the producer's bottom line and sustainability efforts.

Sustainable farming practices will continue to play a vital role in helping the agri-food community keep up with the dietary demands of our growing population. Innovative nutritional solutions – including multi-enzyme technologies like Allzyme Spectrum – can help improve the productivity and profitability of animal production while also providing significant sustainability benefits.

The agricultural community is uniquely positioned to support continuous economic, environmental and social progress – three critical pillars of sustainability – by providing nutrition for all, revitalising local economies and replenishing the planet's natural resources.

The adoption of sustainable farming practices, along with the adoption of new technologies and science-based solutions, like those described here, can help create a world where there is enough nutritious food for all, the world's resources are responsibly managed, and all living things thrive – a true Planet of Plenty. ■

References are available from the author on request

Table 1. Brown layer performance through 44 weeks of egg production.

Diet	Feed intake (g/layer/day)	Hen day production (%)	Feed conversion, (kg/dz)
Positive control	108.8	90.3	1.45
Reduced Ca & aP + phytase	109.2	88.7	1.48
Reduced Ca & aP + Allzyme Spectrum	107.5	90.3	1.43
Reduced nutrient + Allzyme Spectrum	108.6	88.2	1.48
P-value	0.85	0.12	0.29

Table 2. Brown layer egg quality through 40 weeks of egg production.

Diet	Egg weight (g)	Eggshell breaking strength, kilograms of force (kgF)	Eggshell (%)
Positive control	60.3	4.47	10.1
Reduced Ca & aP + phytase	59.2	4.48	10.2
Reduced Ca & aP + Allzyme Spectrum	59.5	4.52	10.2
Reduced nutrient + Allzyme Spectrum	59.9	4.58	10.3
P-value	0.52	0.68	0.67