DESTROY PHYTATE TO INCREASE BROILER PRODUCTION PROFITABILITY

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How can broiler producers increase profitability while maintaining quality?

Phytase is commonly used in animal feed to improve phosphorus availability from phytate. However, the efficacy of phytase is dependent on its ability to rapidly and thoroughly degrade phytate in the stomach and upper part of the digestive tract. This has the effect of eliminating more anti-nutritional effects of phytate, and releasing phosphorus and other phytate bound nutrients. An efficacious phytase can improve digestibility of amino acids, energy and minerals, the main drivers for improved growth performance and feed efficiency in broilers.

Many broiler producers use a phytase dose of 500 FTU/kg. However, research shows that this only partially degrades phytate in the gastrointestinal tract (GIT) of animals. Using a higher dose and a highly effective phytase will degrade phytate more thoroughly in the upper part of the GIT, resulting in extra phosphoric effects and improved performance.

Academics and practitioners agree that Buttiauxella phytase has the highest activity at pH 3.0, showing high efficacy in degrading phytate. Studies have demonstrated that using Buttiauxella phytase at 1000 to 2000 FTU/kg can improve feed intake and body weight gain, as well as feed and energy efficiency, leading to higher economic benefits.

Phytase mode of action: Phytate degradation rate

A phytase dose of 500 FTU/kg only degrades 30-50% of the phytate (Dersjant-Li et al., 2015), depending on the type of phytase and the dietary phytate sources (Selle, 2012). Thus using higher doses of a more efficient phytase that is highly active at low pH, will enable thorough degradation of phytate and reduce anti-nutritional effects.

Not all phytases have the same *in vivo* activity. Standard phytase activity is determined at pH 5.5. Menezes- Blackburn et al. (2015) reported that the activities of different commercial phytase products varied significantly at pH 3.0 which represents the pH of the early digestive tract, from 12 to 235%, a 20 fold difference in activity. Buttiauxella phytase showed the highest activity, 235% of its activity at pH 5.5. This superior activity translates directly into high IP6 degradation rates when using both phytic acid or phytic acid-soy protein complex as substrates (Yu et al., 2014).

Extra-phosphoric effects in broilers

A recent study in broilers showed that Buttiauxella phytase used at 500 and 1000 FTU/kg degraded 53 and 75.2% of the dietary phytate, (Fig 1).

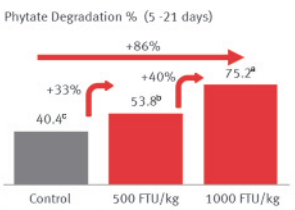

Fig 1. Effect of increasing Buttiauxella phytase dose on apparent ileal digestibility

Improved phytate degradation is also correlated to ileal amino acid digestibility (Fig 2). Increasing phytate degradation and ileal amino acid digestibility with Buttiauxella phytase reduces feed conversion rates by up to 12% and improves average body weight gain by up to 20%. Based on typical diets today, the economic benefits of increased dosing are compelling, and can lead to a 25 to 45% of additional feed cost savings above the 500 FTU/kg dose.

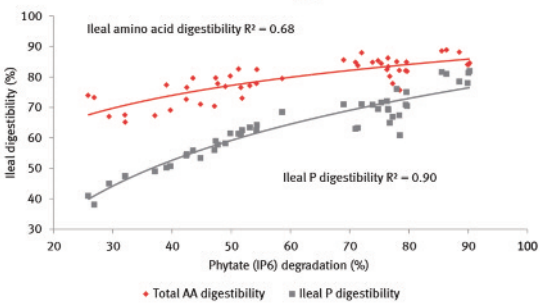

Fig 2. Correlation between phytate degradation and ileal digestibility (AID) of phosphorus and amino acids.

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First published in International Poultry Production volume 24.3

ENZYMES: Alternative solutions for AGP free poultry production

As the industry's search for the most effective alternatives to in-feed antibiotics continues, one thing seems clear, promoting positive gut health in the animal is essential to achieving optimal cost and performance. Gut health, described by Stephan Bischoff, is a balancing act that involves achieving homeostasis in interactions between the animal's gut microbiome, immune function and nutritive processes.

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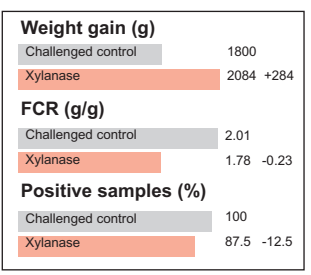
Can enzymes be part of the solution?

An increasing number of trials demonstrate the impact nutrition has on the animal's gut health and performance. Enzymes are a key nutritional consideration and player in these effects. Exogenous enzymes are categorised according to the substrates they target, exogenous xylanases target the soluble and insoluble arabinoxylans in cell walls. Use of xylanase has multiple benefits, from releasing encapsulated nutrients such as starch and protein from the cells to reducing the viscosity of the digesta, both leading to improvements in digestibility (Choct, 2006). Non-starch polysaccharide (NSP) content in animal feed is one variable needing to be managed as it affects satiety, gut motility, nutrient digestion and absorption, as well as changes in gut microbiota. The breakdown of NSPs by xylanase can create a positive environment for beneficial bacteria to grow by reducing viscosity and producing small oligomers. Recent scientific studies shed light on enzymes' effectiveness in maintaining a stable gut environment by favouring host and beneficial microflora and creating specific conditions detrimental to the growth of non-beneficial bacteria.

The mechanism of action behind the effectiveness of enzymes differ in the upper and lower gastrointestinal tract (GIT). In the upper GIT, exogenous enzymes increase the digestibility of nutrients, leading to a reduction in the availability of indigestible substrate for microbial growth. Furthermore, viscosity of the chyme is also reduced when feeding viscous grains such as wheat or barley, increasing the passage rate of digesta. These conditions lead to a reduced microbial population in the upper GIT, consequently reducing the threat of proliferation of non-beneficial bacteria. While degrading viscous β-glucans and arabinoxylans from wheat and barley, small oligomers and free sugars are produced and some of these are poorly absorbed in the upper intestinal tract.

These oligomers and sugars are utilised by certain beneficial bacteria in the hind gut leading to increased volatile fatty acids (VFA) production and containment of proliferation of non-beneficial bacteria. Choct et al (1999) found that VFA production was lower in an enzyme treated group in the ileum, while in contrast in the caecum VFA production of the enzyme treated group was higher than the control. These results underline the earlier mentioned degradation of fibre fractions into smaller oligomers and sugars which are fermented further down the tract in caecum. This shift can benefit intestinal health and microbial balance in the lower GIT.

These effects were evident in several published studies, showing higher performance of the animals along with reduction of non-beneficial bacteria in the GIT. Amerah et al (2012), showed a significant reduction in Salmonella prevalence in broilers, when xylanase was added to the diet. Some studies also reported positive effects of xylanase inclusion on gut barrier function when birds were challenged by C. perfringens (Liu et al 2012).



Enzymes are known for their effects on the anti-nutritional factors in the feed, however, their impact on the gut environment, and consequently on gut health is receiving growing attention. The ability of enzymes to boost animal performance, reduce feed cost and positively affect the gut environment and health, support their use as an important feed additive in the post-AGP era.

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First published in International Poultry Production volume 24.4

PHYTASE CHOICE AND DOSING: SEPARATING FACT FROM FICTION

Despite widespread use of phytase in poultry diets there still remains a lack of clarity regarding how to maximise value by selecting the best phytase and dose. In this article we will separate fact from fiction regarding the value of different phytases and doses.

Milan Hruby, Global Applications Sr. Manager, Danisco Animal Nutrition

All phytases work economically at high doses – Fiction

The value of a phytase dose can be affected by many different factors including the source of the phytase chosen. The latest generation of phytase products (e.g. Buttiauxella phytase) offer higher efficacy in dealing with phytate and phytate-protein complexes. They also work at increasingly lower pH levels to ensure speedier and more complete degradation of phytate earlier in the digestive tract. As a result, this next generation product offers available phosphorus release values that are 50% higher than the older generations at the same analysed phytase inclusion level.

It is important to choose a phytase that degrades phytate rapidly and more efficiently at low pH – Fact.

To eliminate the anti-nutritional effects of phytate it is important to degrade it as quickly and as completely as possible in the upper gastrointestinal tract of the animal. The Buttiauxella phytase has an optimal pH that better matches the pH level found in the proventriculus and gizzard of a broiler, where pH can be as low as 2.5 and feed has a residency time of 40-60 minutes.

Feed type must be taken into account when selecting a phytase dose – Fact

There is strong evidence that feed type and the efficiency of a high phytase dose are linked. Research shows that a new generation phytase more than doubles the rate of phytate degradation in a diet with average phytate levels. This effect is amplified in diets with higher phytate levels. Research also demonstrates that phytase not only improves digestibility of phosphorus but can also significantly increase fibre digestion.This is because phytate and fibre are present in a matrix in the feed and therefore any impact on either phytate or fibre will relax the matrix and impact hydrolysis of both. Hence response to a high dose of phytase may be influenced by the presence of other feed enzymes and their impact on antinutrients. More recently discussions have focused on impacts of calcium to phosphorus ratio on phytase efficacy. Reductions in phosphorus digestibility due to phytase addition have been observed when increasing the calcium to phosphorus ratio. This is thought to be due to higher amounts of calcium ions having more opportunity to chelate with phytate hindering the phytase's access to it. A higher dose of phytase would likely overcome this effect by hydrolysing the phytate molecules before they bind with calcium. The use of the latest, more efficacious phytases has been shown to be unaffected by changes in calcium level.

High doses always work well in all ages of animals – Fiction

Performance improvements using a high dose of phytase are more consistently seen in young animals than in older animals and poultry. Benefits of a high phytase dose are influenced by animal age, gut physiology and differences in available diets/ingredients. In young animals, higher dietary phytate levels are typically seen (e.g. due to inclusion of high-protein meals) where a quick removal of phytate can result in strong performance benefits. Differences in gut physiology, including pH and digesta transit time, between young and older animals can also explain some of the different responses to phytase dose that can be observed. At the same time, older animals may benefit from a high dose if specific ingredients (e.g. high phytate and fibre ingredients) or nutrients (minerals such as calcium) are included in the feed.

High doses of phytase increase myo-inositol levels which improves performance – Fiction

Research studies have shown phytase can effect myo-inositol levels in the blood and affect parameters such as serum glucose and serum lipids in poultry. Conclusive evidence for the complete dephosphorylation of phytate in feed does not exist so the mechanism is theoretical.

Conclusion

In my opinion, the question is not necessarily whether phytase is beneficial at a higher dose; rather it is, when can a dose-specific recommendation bring maximum value? Phytases should be strategically applied at levels appropriate for delivering the greatest benefit to poultry producers dealing with particular species, dietary and other conditions.

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First published in International Poultry Production volume 24.5

IMPROVING PERFORMANCE AND GUT HEALTH USING PROBIOTICS

by Dr Alexandra Wealleans, Danisco Animal Nutrition

Today's accelerated live production schedule leaves little time for birds' gut development. Birds are exposed to harmful pathogens like Escherichia coli, Clostridium perfringens and Eimeria daily. Without a healthy microbiome, these pathogens wreak havoc on health and performance – from reducing body weight gain and raising feed conversion to drastically increasing mortality. There is a global movement to reduce the use of antibiotics, both therapeutics and growth promoters (AGPs), to overcome antimicrobial resistance concerns and preserve the effectiveness of available antibiotics. Alternative strategies to support gut health and control microbial challenge are critical. Often overlooked is the transition period in which antibiotics are removed or reduced. This can have serious implications on bird performance if not managed accordingly.

Probiotics to support microbiota development

Research has shown that feeding probiotics from day one promotes the quick establishment of a positive microbiota and guards against colonisation by coliforms that negatively impacts growing animal performance. By helping to maintain optimum villi height and crypt depth, probiotics ensure the gut's ability to absorb nutrients for maintenance and growth in the presence of microbial challenge. They also help birds to cope better with nutritional stress in the gut. Of course, not all probiotic strains defend birds in the same way. Though most act as a shield by preventing harmful pathogens from adhering to the gut wall, products containing more than one probiotic strain are often more effective than a single probiotic strain, as functional diversity between the strains enables broader coverage and support. Both individually and together, each probiotic strain strengthens gut structure, slows the growth of non-beneficial bacteria, and encourages the growth of beneficial bacteria.

Busting antibiotic myths

A misconception has developed that Bacillus probiotics cannot be used effectively with common antibiotics. It is important to understand that probiotics and antibiotics have very different modes of action. Probiotics are living micro-organisms with multiple modes of action that work to strengthen gut function. By contrast, antibiotics are non-living chemical compounds that have a singular, specific effect such as killing the cell or stopping replication, and are often accused of reducing both pathogenic and beneficial bacteria counts. A recent study looked at performance and gut health in birds fed Avilamycin, a three-strain Bacillus probiotic (Enviva PRO) and their combination. (Avilamycin is approved as an AGP in Russia at 180g/ton feed. Avilamycin is not approved as an AGP in many global jurisdictions including the US and EU). The study demonstrated superior growth performance when both Enviva PRO and Avilamycin were used in combination versus Avilamycin only treatments (Table 1). The average daily gain of birds in the study showed the ability of Enviva PRO to improve daily gain on its own and with the use of Avilamycin. Clearly, the argument that antibiotics and Bacillus probiotics cannot be used together effectively is not true. For producers using antibiotics, these results offer a number of beneficial supplementation options, particularly during the transition period to reduced or no antibiotic use. For producers seeking to eliminate antibiotic use, it is perhaps most notable that the three-strain Bacillus probiotic enabled similar, and sometimes greater, improvements in growth and efficiency when used alone.

Table 1. Bodyweight corrected feed conversion ratio (FCRc) from 0-42 days in 800 male broilers, and average daily gain (ADG).

	FCRc		ADG	
Control	169[a]		58.8[c]	
Avilamycin	166[b]		59.8[b]	
Enviva PRO	160[c]	3.6%	61.5[a]	2.8%
Avilamycin + Enviva PRO	1.62[c]	2.4%	61.5[a]	2.8%

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First published in International Poultry Production volume 25.5

USING ENZYMES TO FREE MORE PROTEIN

by Luke Barnard and Andres Belalcazar, Danisco Animal Nutrition

In many markets feed accounts for nearly 70% of live production costs for broilers. Maximising the nutritive value of feed is a crucial part of satisfying birds' dietary requirements while maximising growth performance and producer profitability. This is especially true for protein, which plays a vital role in helping birds realise their genetic growth potential. Even when high quality protein meals such as soybean meal are fed, protein is still not 100% digested by the animal. Between 15-20% of dietary protein escapes digestion by the animal's own endogenous proteases, passes through the gastrointestinal (GI) tract and is excreted. This undigested protein poses several problems:

- It represents an economic loss for producers paying for protein and consequently amino acids that are not utilised for growth.
- High levels of protein in the latter regions of the GI tract is associated with proliferation of non-beneficial bacteria which can impact gut health.
- Lower protein digestibility means higher protein excretion resulting in increased nitrogen in litter; bacteria in the litter can transform nitrogen into ammonia increasing pollution.

By applying an exogenous protease in feed, producers can reduce dietary crude protein while still meeting the birds' amino acid requirements and maintaining animal performance. This will reduce the cost of the diet and at the same time alleviate some of the negative effects of undigested protein.

Axtra PRO is a broad-spectrum protease active at a wide range of pH with a complementary mode of action to the endogenous proteases. It has the power to deliver more digestible amino acids from various feed ingredients, improving animal performance in a lower protein/amino acid diet (Fig. 1). Axtra PRO has demonstrated effects on different feed ingredients (Fig. 2), enabling utilisation of industrial by-products and alternative protein meals outside of soybean meal, which are often less costly, but are limited in their commercial inclusion by lower protein digestibility. With improved levels of protein digestibility some of these alternative ingredients are more attractive in least cost formulation.

The addition of Axtra PRO increases the efficiency of animal production by maximising protein utilisation and reducing waste. Producers can get more digestible amino acids from their feed, greater flexibility in ingredient selection, increased control of emissions, and maximum feed cost savings through nutritional research.

Fig. 1. The addition of Axtra PRO to a negative control diet deficient in digestible amino acids showed a decrease in 42 day FCR in broilers and an increase in ADG to a level comparable to the PC diet. The digestible amino acid levels in the NC diet were on average ~3% lower than in the PC diet and also reduced by ~40kcal/kg (Means with different superscript are significantly different, P<0.05).

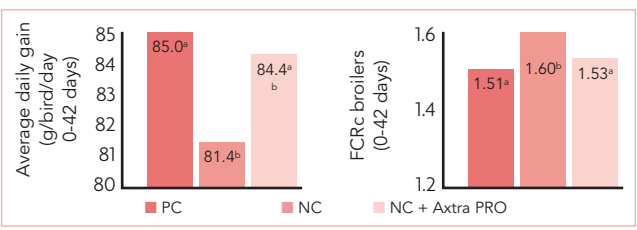
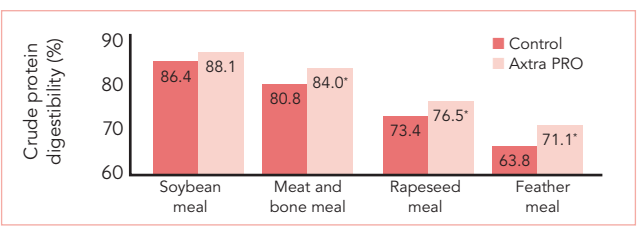


Fig. 2. The addition of Axtra PRO to semi-purified diets of soybean meal, meat and bone meal, rapeseed meal and feather meal in all cases resulted in an increase in protein digestibility (*indicates a significant difference to its relative control group, P < 0.05).



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First published in International Poultry Production volume 25.7