# Use of enzymes in corn soybean poultry diets.

Corn-SBM diets remain one of the most efficient diets for poultry and are known to be highly digestible, but the possibility of improving their digestibility still exists. Supplementing such diets with an enzyme or enzymes mixture that possess a broad-spectrum range of activities may improve their digestibility further and may result in an improved performance by the animal.

Plants and protein products are major components of animal feed. However, many plants have the capacity to synthesise unique chemicals that serve as defence mechanisms against insects. These compounds are mainly indigestible by animals and are referred to as anti-nutritional factors. These naturally occurring compounds – including protease and Trypsin inhibitors, goitrogens, alkaloids, oxalates, phytate, phyto-haemagglutins (lectins), urease, lipoxygenases, cyanogenic glucosides, anti-vitamin factors and microbial metabolites – may impair digestibility and metabolism, reducing growth in many species of animals. Legume seeds, such as soybeans and others are excellent protein sources, but their dietary inclusion is limited because they all possess one or more of the aforementioned antinutritional factors.

Even after the cooking/extraction process of soybeans into Soybean meal (SBM), such meals will still contain other anti-nutritional complex carbohydrates, including the β-Mannans and the anti-nutritional oligosaccharides stachyose and raffi nose.

Furthermore, in order to formulate to the high protein requirements of most young animals, farmers tend to use a number of byproduct meals that contain high amounts of protein sources such as meat and bone meal, fish meal, blood meal and the less digestible feather meal. Nevertheless, SBM remains to be the major protein source for monogastric diets. However, the presence of β-mannans in soybean meal, and especially in the 44% SBM, as well as the other anti-nutritional oligosaccharides will provide a favourable environment to the gut micro flora and along with the high-protein content of the diet might result in a disturbance to the natural colonisation of gut micro fl ora. Poultry in general lack the innate enzymes capability,

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The use of enzymes other than phytases in corn-soybean meal diets for broilers has been limited in the past decades. However, over the last few years, inclusion of enzymes in broiler diets has increased significantly mainly due to heightened feed ingredients prices.

e.g. mannanase, to degrade these antinutritional factors and have less than optimal levels of other enzymes such as amylases and proteases resulting in less than optimum utilisation of the diet and a lower overall performance by the animal. Supplementation of the diet with an enzyme or a mixture of enzymes will result in improving dietary response via degradation of specific substrates, resulting in an improvement of the general digestibility of corn-soybean diets.

## Beta-mannans

Beta-mannans are a group of closely related heat-resistant compounds that survive the drying/toasting phase of soy bean processing. β-mannans comprise about 1.3% of the 48%-CP SBM product and 1.5-1.7% of the 44%-CP SBM product, with an estimated β-galactomannan content of 1.83% and 2.22%, respectively. Mannans, mainly associated

with the hull and fibre fraction of SBM, are intensely anti-nutritional due to their highly viscous properties, likely decreasing the efficiency of the monogastric's carbohydrate utilisation by partially blocking key sites on the intestinal surface and resulting in a lower performance.

Beta-mannans' effects can be reduced by the use of dietary mannanase enzymes (β-D-mannanase) which degrade some of these complex polysaccharides into smaller units, some of which can be utilised for energy production.

Enzymes in a cornsoybean meal diet have shown to have the ability to reduce gut viscosity and improve the gut environment in favour of beneficial bacteria. To obtain better data, more research

## Anti-nutritional oligosaccharides

Approximately 40% of SBM is made up of crude fibre, and various polysaccharides and oligosaccharides. Stachyoses and raffinoses are non starch polysaccharides (NSP) that has anti-nutritional properties and are present in soya beans. Stachyose [Gal α(1-6) -Gal α-(1- 6)- Glu α-1-β-2Fru] and raffinose [Gal α-(1-6)- Glu α-1-β-2Fru] represent a significant amount of potential dietary energy present in SBM. However, the α-galactoside family of oligosaccharides has been implicated in reducing SBM true metabolisable energy (TMEn), fibre digestion, and transit time in chickens. It has been well documented that the α–galactoside oligosaccharides are also a major cause of hydrogen gas production from SBM in poultry. Endogenous enzymes in poultry are specifi c for α-linked carbohydrates similar to that in starch, but they are not active against SBM oligosaccharides because the α-galactosides cannot be hydrolysed due to the lack of α-1,6 galactosidase activity in the intestinal mucosa. Consequently, undigested oligosaccharides pass to the distal end of the intestine where they are fermented by gut micro fl ora to volatile fatty acids (VFA) and gases, thus yielding less energy and creating digestive disturbances. Raffinose and stachyose significantly reduced TMEn values of adult Leghorn roosters when added to the feed at levels equal to that normally found in SBM.
Dry matter digestibility also appears to be negatively affected thus, decreasing significantly as stachyose levels increase.
However, stachyose and raffinose can be hydrolysed to glucose, galactose, or corresponding disaccharides in the proximal small intestine via supplementing the feed with an enzyme mixture containing the proper oligosaccharidase.

## β-mannanase

Mannanase enzymes are endo-hydrolyases that are typically fermentation products of Bacillus spp. This enzyme typically degrades β-Mannans present in feed. β-Mannanases cleaverandomly within the 1,4-β-D-mannan main chain of alactomannan, galactugluco-mannan, and mannan. Since β-endo-mannosidases improve the digestibility of all types of mannan, and because a major source of mannan in soya is the hull, the effect of β-mannosidase seems to be more pronounced when supplemented to diets containing SBM-44, which contains hulls, as opposed to SBM-48.
Use of mannanases in feed has increased over the last two decades, constituting almost 10% of the overall enzymes used in corn-SBM poultry diets globally.

## Alpha-galactosidases/Endo-xylanases.

The increased use of different feed ingredients requires the use of exogenous Pentosanases such as galactosidases, xylanases and glucanases. The use of such enzymes, either individually or in a blend, results in degrading the complex NSP and releasing other nutrients that might be bound or otherwise trapped within the complex net-like NSP. The use of these enzymes will result in liberating energy and limited amounts of proteins resulting in improving growth performance parameters in all types of poultry.

## Proteases

Much of the early work in the 1950s and 1960s involving proteases supplementation to cereal based diets did not result in improvements in bird performance. However, recently, supplementation of poultry diets with enzyme mixtures, including proteases and amylases, have produced significant improvements in growth performance. More recently, researchers were able to estimate the value such enzymes play in sparing protein sources both in vivo and in vitro. The use of enzyme mixtures, such as phytases with protease, xylanases and amylases has been on the rise. While the synergistic effect of these enzymes, if present, is not completely understood, their effects are complementary rather than substitutive as previously thought. A few years ago, many researchers reported that supplementing corn-soybean broiler starter diets with enzyme preparations containing a mixture of xylanase, protease and amylase resulted in improvements in BW but the effects were seldom significant on feed conversion ratio (FCR). However, higher doses of enzyme mixtures were recommended in order to produce a significant effect on apparent ileal nitrogen digestibility or faecal nitrogen digestibility. Short et al., (2002) also reported an improvement in average egg production upon supplementing the diets of laying hens with an enzyme mixture that contained both xylanase and protease. Prior to work carried out in 2002, there was no reporting of benefits of individual proteases in corn-soybean poultry diets. In

addition, a reduction of the viscosity of the contents of the small intestines of birds fed diets supplemented with protease enzyme have been reported (Odetallah et al, 2003). Over the past few years, and with the increased prices of SBM and corn, the need to use proteases in corn-soy diets became indispensable to help save on feed costs by reducing the amount of proteins in the diet. Cibenza DP100 (Novus International, Inc), a broadspectrum protease for example allows the producer to use diets formulated with proteins and amino acids that are on average 5-10% lower than the recommended industry standards and still obtain the same performance sought by the producer and thus significantly reducing the cost of the diet.

## In conclusion

Over the last decade, interest in the use of commercial enzyme preparations in corn-soybean diets has increased dramatically. Still, other than phytase, there are only a handful of commercial and experimental enzyme preparations available for use in corn-soybean diets.

Such preparations normally contain one or more of the following enzyme activities: β-mannanase, α-galactosidase, α-amylase, xylanase and β-glucanase, and most recently, proteases.

Most of the research reported so far indicates that supplementing corn-SBM diets with these enzymes results in increased body weight and improvement in feed efficiency accompanied in some instances with a reduction of gut viscosity and a shift to a more favourable gut environment for the growth of benefi cial bacteria. While the main objective of including enzymes in corn SBM poultry diets is to reduce feed costs, less is known about the change in nutrient digestibility and utilisation of such diets upon the use of these commercial enzymes, which requires further investigation. AAF

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