INSPIRING BEST PRACTICE

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Understanding enzyme characteristics the solution to reliable xylanase performance

Xylanase feed enzymes vary greatly, not only in their source, but also in terms of the key characteristics that determine efficacy in the bird. Even similar enzymes from the same family of xylanases can differ significantly, so it should be no surprise that the broad range of xylanase products currently available often perform very differently under commercial conditions.

Key xylanase characteristics

Being able to withstand the high temperatures of pelleting, yet at the same time be highly active at the body temperature of the target animal, is critical. So too is a high level of activity at the point of action, namely in the animal gut, along with ease of assay in the manufactured feed to ensure enzyme survival and dose accuracy.

All are characteristics that should be on any checklist for assessing potential xylanase purchases if return on investment is to be maximised.

Substrate specificity matters

There are also substantial differences in the way xylanases interact with the target substrates found in corn- and wheat-based diets. Critically, these specific non-starch polysaccharides (NSP), predominantly xylans, can differ widely, even within a diet.

For example, the chain length of the xylan present varies depending on the number of xylose sugars that make up the 'backbone' of the molecule, whilst differing numbers and placement of arabinose and other side-chains create a multitude of potential structures. Both the backbone length and side-chain structure have a substantial effect not just on the impact within the bird – for example, long-chain, soluble xylans are responsible for increased gut content viscosity – but also on the type of xylanase needed to degrade them.

> ***"Know your processes, know your animals and know your enzymes."***
>
> Dr Christophe Courtin, Inspire Forum UK, 2014

Maximising performance response

Just as importantly, it is the specific oligosaccharide end products, produced from the xylan with the use of a xylanase that have been linked to performance response in the animal. In fact, according to the latest research, it appears that performance benefits are maximised only when those end-products include specific short-chain arabinoxylo-oligosaccharides (AXOS) that have the potential to act as prebiotics in the animal gut.

The net result is most often an improvement in overall digestion efficiency, leading to an increase in the digestibility of the whole diet, not just the NSP fraction. It also explains the strong performance response to Econase XT xylanase seen in birds fed corn-based diets, where increased digesta viscosity isn't an issue, as well as in wheat-based diets where it is.

Effective xylanase selection

The target for xylanase use should therefore never be complete xylan degradation, and any over-dosing or inclusion of additional NSP enzyme activities risks destroying these important prebiotic AXOS. A clearer understanding of how xylanases overcome the limitations xylans place on nutrient utilisation and bird performance should also mean it's no surprise that when it comes to raising standards and delivering the most consistent and reliable results, the solution is the highly targeted, dose-optimised, single enzyme xylanase Econase XT.

Watch experts discuss the varying characteristics of xylanases

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Mohamed Habboul, AB Vista
Regional Technical Manager

Substrate knowledge the key to correct enzyme targeting and success

Despite the negative impact of non-starch polysaccharides (NSP) on bird performance being widely recognised, the complexities, structures and properties of those NSPs remain much less well understood. Yet such characteristics have a direct influence, not only on any anti-nutritional effects within the bird, but also on the efficacy of NSP-degrading enzymes.

If NSP-degrading enzymes are to be used to greatest effect, it is therefore essential that a good understanding of the primary NSPs is developed. It's easy to see why the proliferation of feed enzyme products containing multiple NSP enzyme activities has produced more confusion in end-users than it has success in the bird if the substrate being targeted is not clearly defined in the first place!

Xylans the dominant NSPs

Of the NSPs present within plant hemicellulose, xylans are the most abundant, making up 30-35% of the cell wall material in cereals. However, these xylans are a very diverse and heterogeneous group of substances, with structures that differ widely in terms of branching, substitution (arabinose side chains) and the length of the xylose 'backbone'.

Just as importantly, these structures and their resulting properties can vary significantly between plants, varieties, parts of the plant and even from one growing year and location to the next. Differences between growing sites have in some cases been shown to exceed varietal variations.

> *"The xylans…are a very diverse and heterogeneous group of substances."*
>
> Dr Kim Langfelder, Inspire Forum UK, 2014

Important structural differences

Such structural differences are hugely important. The level of soluble arabinoxylan can dictate digesta viscosity effects, for example, whilst the location of any side-chains will affect how and where xylanases can act to break down these long-chain molecules.

Since end products of xylan hydrolysis are also influenced by xylan structure and xylanase action, both directly affect production of the prebiotic arabinoxylo-oligosaccharides (AXOS) that appear critical to bird performance response to xylanase addition, particularly in less viscous corn-based diets.

Consistent xylan targeting

The key to the success of an enzyme such as Econase XT xylanase is its ability to target the dominant xylans consistently across all corn-, wheat- and rye-based diets, regardless of any differences in diet formulation, feed ingredient batch or growing season.

In fact, the single xylanase Econase XT generally outperforms those products containing multiple NSP enzymes – matching enzyme characteristics to the dominant xylan substrate and the desired end-products is far more important than including additional enzyme activities!

So take the time to understand which of the NSPs in poultry diets are most important, and choose a xylanase such as Econase XT developed specifically for that target. The result will be better bird performance, a greater return on the investment made in feed enzymes and a consistency that has all too often been missing within the NSP-degrading feed enzyme sector.

Visit the Inspire website to watch a video about The Substrate Story

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Rahul Sawarkar, AB Vista
Technical Manager for South Asia

Make xylanase efficacy and quality control a top priority

Contrary to what many believe, xylanase thermostability and the ability to accurately confirm activity in manufactured feed is just as important as it is for phytases.

For too long, feed manufacturers, end users and nutritionists have accepted that it's simply not possible to accurately monitor xylanase recovery. However, thanks to the benefits of Econase XT, which offers an ease of assay not previously seen in the xylanase market, it's finally possible to focus on the important issue of thermostability and the impact it has on efficacy.

Reliable dose delivery

Reliably and consistently delivering the required dose of active enzyme to the site of action in the bird is essential, but low enzyme thermostability can also impact efficacy in other ways. Coating enzymes is a technique commonly used to boost thermostability but it can also potentially reduce dissolution rates and subsequent availability in the bird's gut.

Although the main site of xylanase activity is considered to be in the upper small intestine – not in the stomach, as is the case for phytase – few direct studies have examined what effect such coatings might have on in vivo efficacy.

Alternatively xylanases, such as Econase XT are intrinsically thermostable and therefore do not need a coating to improve thermostability.

> ***"There are many xylanases…they all differ in their abilities to survive these processes and these rigours."***
>
> Dr Mike Bedford, Inspire Forum UK, 2014

Intrinsic thermostability benefits

Independent testing has found that Econase XT xylanase is intrinsically thermostable at up to 90-95°C (194-203°F) under normal pelleting conditions. Stability tests performed in a range of commercial feed mills across Europe have demonstrated subsequent recovery rates typically around 90-110% of the level observed in the mash.

Such thermostability also opens up the opportunity to apply Econase XT as a dilute liquid into the batch mixer to achieve more uniform enzyme distribution within the feed. Coefficients of variation (CV) as low as 5% have been achieved in both mash and pellets, with the additional liquid reducing power consumption during pelleting by up to 4%.

Unique assay advantage

Combined with the unique enzyme-linked immuno-sorbent assays (ELISA) developed for Econase XT, the result has been to establish a new standard for xylanase feed enzymes - intrinsic thermostability to withstand feed processing, plus on-site assaying to confirm survival in as little as individual feed pellets in under five minutes using the ELISA 'QuickStix'.

Even accurate quantification of enzyme levels using the ELISA 'QuantiPlate' micro-titre kit takes less than three hours, and doesn't require complicated laboratories or highly trained staff.

It should be no surprise, therefore, that Econase XT is revolutionising xylanase application, efficacy and quality control procedures. That's great news for feed manufacturers, end users and nutritionists.

Visit the Inspire website to watch a video on examining enzyme solutions

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Dimcho Djouvinov, AB Vista Technical Manager

Correct xylanase targeting the key to consistent bird response

Despite 25 years of research into using feed enzymes to tackle the negative impact of non-starch polysaccharides (NSP) on nutrient utilisation in poultry, much is still not fully understood.

The NSPs within poultry feed ingredients are a diverse group with widely varying characteristics. As a result, the interactions that take place between these substrates, the NSP-degrading enzymes we add to the diet and the bird itself are extremely complex.

Improved NSP understanding

The drive for a greater understanding of NSPs, their impact on nutrient digestibility and how to optimise response to NSP-degrading enzymes was at the heart of the decision by AB Vista to host the first ever international forum on NSPs, INSPIRE Forum 2014.

Bringing together leading industry experts to discuss the latest research, what became clear was that correctly identifying the predominant substrate, defining its critical characteristics and selecting the right type and dose of enzyme to target it were all vital.

> ***"The most important thing is to understand or define the mechanism of action."***
>
> Dr Usama Aftab, INSPIRE Forum UK, 2014

Targeting dietary xylans

The xylans that are the predominant NSPs in poultry diets can differ both within and between feed ingredients. The number of xylose sugars that make up the 'backbone' of each xylan molecule can vary substantially, as can the number and placement of arabinose and other side-chains.

The result is a range of potential structures that affects not just the impact on the bird, but also the type of xylanase needed for effective breakdown. For example, the long-chain, soluble xylans responsible for increased gut content viscosity are most effectively eliminated by endo-acting xylanases like Econase XT, which attack the long xylose backbones mid-chain.

The alternative is to continuously cleave single monosaccharides from the 'edges' of the NSP molecule using an exo-acting xylanase. This is not only largely ineffective in reducing gut content viscosity, but there is also data to suggest that the resulting free xylose and arabinose monosaccharides may be detrimental to bird growth.

Successful xylanase selection

Just as importantly, it now appears that certain of the short-chain oligosaccharides produced as a result of this mid-chain cleaving of xylans may potentially exert an indirect positive prebiotic effect on the bird.

Such end products are clearly dependent on both the composition of the substrate and where the xylanase acts to break it down. It is therefore highly likely that correct targeting of enzyme action plays a more crucial role in bird response to xylanase use than previously understood.

This is particularly true in non-viscous diets, where potentially prebiotic oligosaccharides may be the primary mechanism by which an efficient endo-acting xylanase like Econase XT is able to produce such consistent and reliable improvements in bird performance.

It also puts the spotlight firmly on xylanase specificity, highlighting why the results from xylanase use have sometimes been inconsistent, and why Econase XT xylanse is the top choice for so many poultry producers around the world.

Visit the Inspire website to learn more about xylanases

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Dr Rob ten Doeschate, Technical Director EMEA, AB Vista

The INSPIRE story – a technical perspective

The original INSPIRE event – the first ever international forum on non-starch polysaccharides (NSPs) – was born of a desire to bring together leading experts from the scientific and animal feed communities to discuss the substantial impact NSPs have on monogastric nutrition, and how NSP enzymes could help.

What did we know? What did we think we knew? What didn't we know?

Wide-ranging topics

The programme covered a wide range of subjects, with input from scientists of various disciplines, such as plant science, baking, animal science and enzyme technology. With this came presentations that approached similar topics in different, less familiar ways, resulting in stimulating debate among the delegates.

As practical implications emerged from the biological and chemical detail over the three days of the forum, the result was a much clearer picture of how the high-level science links to what's seen in commercial poultry production systems. One presentation, in particular, outlined the multitude of factors that interact to explain the indirect effect of NSP enzymes on positively impacting gut conditions and improving poultry performance.

> ***"It's good to do science, it's even better to do science that has application."***
>
> Prof. Hank Classen, INSPIRE Forum UK, 2014

A new hypothesis

Over the years, these positive effects of NSP enzymes have been seen across a variety of diets and target animals, which has required us all to think, and think again, on how to understand the mechanisms behind this. The single xylanase product Econase XT has performed particularly well in all diet types and animals, which raises questions about the need for additional enzymes.

The current hypothesis behind this is that the challenge for effective NSP-degrading enzyme use is not to break down every possible NSP substrate, but rather to produce the specific NSP breakdown products needed to stimulate optimum microbial fermentation.

Proven xylanase success

With xylanase there is sufficient substrate available in virtually all types of common diets to achieve this, which makes a xylanase a very versatile NSP enzyme. We have seen this with Econase XT, as it has been shown to work across a wide range of diets (including wheat-, corn- and rye-based diets) and with a variety of fibrous materials included.

The work to disseminate the outcomes of the INSPIRE Forum to the feed industry continues across all the major continents. Expanding the sector's understanding of NSPs, their impact on nutrient digestibility and how to optimise response to NSP enzymes is just as important today as it was when the Forum took place back in 2014.

It's also important to remember the wider context, taking into account the broad range of factors that can interact to affect NSP enzyme performance in commercial poultry production systems. Only then will we truly understand how to get the very best out of the enzymes, the feeds and the birds themselves.

Visit the INSPIRE website to learn more about xylanases

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