The importance of NSP-degrading enzymes in commercial practice

While phytase is used in almost all pig diets, there is still some reluctance towards NSP-degrading enzymes as they are perceived as being less consistent or predictable.

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The paradox is that NSP-degrading enzymes actually cope with such variation and save money by uplifting the average feedstuff quality, increase the flexibility to use a wider range of raw materials and reduce the risk of gut disturbances.

Compared to research conditions, the higher level of variation in commercial practice corresponds with more benefits from NSP-degrading enzymes.

Variation caused by differences in housing, climate, medication and vaccination, management, etc may also interfere, but remains out of the scope of this article. Genetics are more varied in swine compared to poultry, with an impact on the gut microbiota which is partly regulated by immunological mechanisms from the host.

Assay methodology

In animal nutrition, there is a long tradition of using Crude Fibre (CF) figures for the evaluation of this fraction of feed or raw materials. However, during Weende or Proximate Analysis only a small fraction of the total fibre is assayed by this figure. Implementing a different assay method reveals different figures. Fig. 2 highlights the huge difference in figures obtained for a 'low fibre' grower feed.

The figure for Neutral Detergent Fibre (NDF) as assayed by the Van Soest method is somewhat better correlated to the level of enzyme substrates compared to CF, but still only estimates the water-insoluble fractions.

Since gut viscosity is mostly induced by water-soluble NSPs, even the figure for NDF remains a poor prediction for enzyme effects. More reliable methods may further optimise the quantification of enzyme substrates, but are rather expensive.

Considering the huge discrepancy between the formulation figures or those on product labels compared to the actual NSP substrate levels, it is advised to consistently use NSP-degrading enzymes to ensure that low quality feedstuff batches are also well digested.

Feedstuff variability

Compound feed is formulated based upon tables (NRC, CVB) with figures that mostly represent the average assay figures for the feedstuffs. In reality, those feedstuffs vary from batch to batch. Especially the fibre content is highly influenced by environmental and climatic factors, thus the level of substrates for NSP-degrading enzymes may highly diverge from the table figures. This is highlighted in Fig. 3.

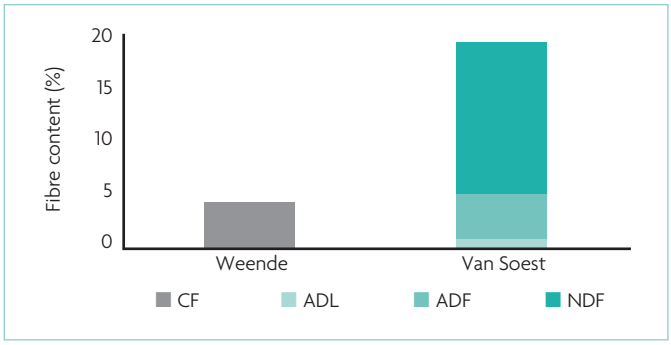

Fig. 2. Impact of assay method.

Fig. 3 shows the Van Soest figures for exactly the same feed composition (52% corn, 32% SBM and 7.5% wheat bran), but based upon four distinguished sets of table figures. While the average figures show an NDF content of 13.1%, the maximum figures from the Feedipedia tables result in 18.7% NDF.

In practice, the variation is even more pronounced. Assaying feedstuffs commonly used for Impextraco trials revealed Van Soest figures even below the Feedipedia minima. Selecting high quality feedstuffs for R&D thus resulted in an NDF content for this same feed composition of only 10.2%.

In contrast, the calculation was also performed by using the figures for the most fibrous feedstuffs in our database: 38.7% NDF or some three times the level predicted by the average table values.

Obviously, such huge variation in substrate levels results in poor predictability of the enzyme effects, even though the enzymes are well standardised in quality.

While low NSP feedstuffs may go along with lower or insignificant enzyme effects, the (very) high NSP feedstuffs will result in disastrous animal performance. The use of NSP-degrading enzymes therefore is an insurance for coping with feedstuff variability.

Variation in viscosity

That gut viscosity reduces feed digestibility is a well known fact; viscosity should be kept at the low-

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Fig. 1. Effect of Zympex 008 on feed cost for pigs.

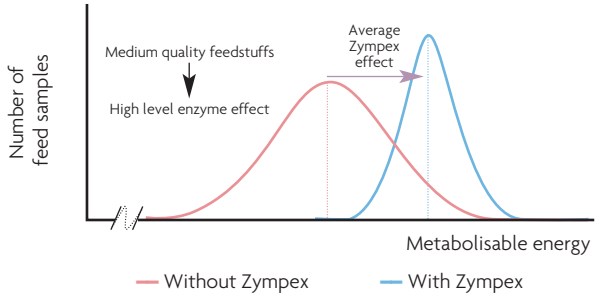
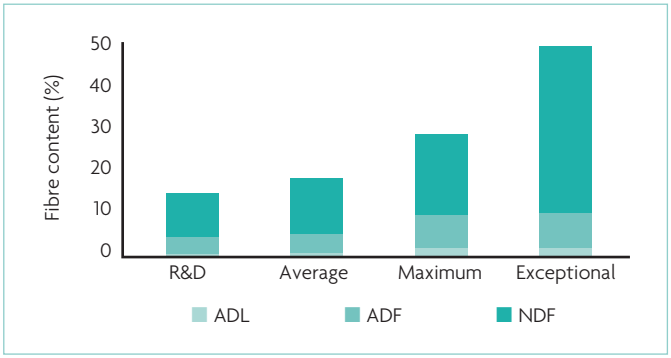


Fig. 3. Impact of feedstuff selection.



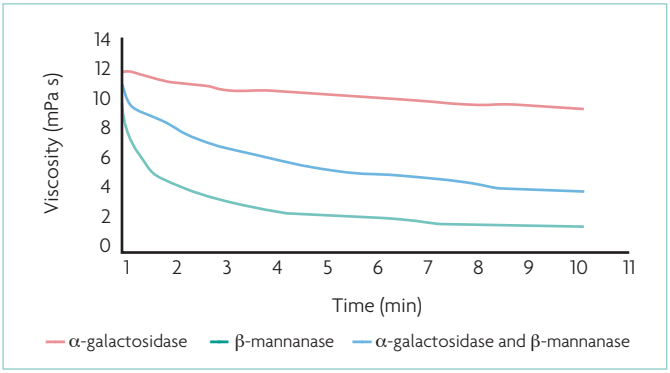


Fig. 4. Galactomannan viscosity.

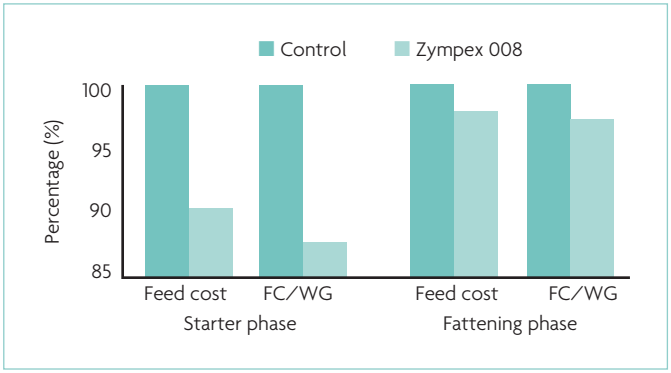


Fig. 5. Effect of Zympex 008 on feed cost for pigs.

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est level possible. Although present in all vegetable feedstuffs, arabinoxylans and β-glucans are respectively linked to wheat and barley. The appropriate NSP-degrading enzymes (xylanase and β-glucanase) therefore allow higher inclusion levels of wheat and barley in the diet, thus often saving money.

Most vegetable proteins, such as soybean, belong to the legume family of plants; those contain another NSP with high viscosity inducing effect: galactomannan. Its viscosity is somewhat reduced by β-mannanase, while a synergistic combination with α-galactosidase gives a faster and more pronounced viscosity reduction.

Combination products such as Zympex 008 and Zympex 014 allow a higher flexibility in feed formulation. High-galactomannan feedstuffs such as copra and PKM can be incorporated in the diet, leading to cheaper formulas.

Variation in digestibility

Although corn is a non-viscous cereal, enzymes also produce significant performance improvement in corn-based diets. Corn indeed has only a very low level of water-soluble NSPs, which explains the low impact of viscosity related effects. So, enzyme effects in corn are based upon hydrolysis of water-insoluble NSPs: release of extra protein and energy from within intact cell wall structures.

Overcoming such 'cage effect' partly explains how enzyme effects are materialised without viscosity issues being involved.

Soybean and other galactomannan sources also have an impact on pancreatic enzymes. Such is only partly related to viscosity: high viscosity impairs the mixing of pancreatic enzymes and other digestive juices with the gut content. More specific for SBM galactomannan, there is evidence that the production of pancreatic enzymes is reduced, even void from viscosity. Zympex 014 provides α-amylase and protease and is therefore recommended for high galactomannan diets (or young animals), while for low to moderate galactomannan diets Zympex 008 may be sufficient.

Variation in prebiotic effects

Even more important are the effects via modulation of the gut microflora. The gut microflora is highly variable in both quantity and quality. After all, one to two log units difference in bacterial counts equals a 10- to 100-fold variation: reducing the numbers at the end of the small intestine from 10^9 to 10^7 CFU/gram, is going down from one billion microbes per gram gut content to 'only' 10 million. This not only means less competition for nutrients, but also a lower spending on endogenous proteins in the form of antibodies and immunity regulating cells.

Bearing a huge variation in mind, the protein transfer from small to large intestine may well be in a 1/1 ratio originating from ingested feed respectively from endogenous origin (pancreatic enzymes, antibodies, mucin). NSP-degrading enzymes reduce both the digestion efficacy of feed protein and simultaneously diminish the requirements on endogenous proteins.

Apart from the above impact, there is also a huge interaction between microflora and the NSPs from the feed via 'prebiotic' effects. A few examples may highlight this:

- Xylanases produce xylo-oligosaccharides, which have a positive impact on beneficial bifid bacteria.
- Gas producing bacteria will not multiply as fast when the Rafinose series of oligosaccharides are eliminated by α-galactosidase before bacteria are able to consume those as food for growth.
- Salmonella eliminating effects are observed with both mannan-oligosaccharides from yeast cell walls added to the feed as well as by adding oligosaccharides obtained from vegetable galactomannans (carob, guar). Without adding prebiotics to the feed, NSP-degrading enzymes frequently show a positive impact on the gut microflora. After all, within the gut lumen those enzymes produce similar prebiotics from the substrates that are anyhow present in feedstuffs. Positively influencing the gut microflora are key enzyme effects, thus NSP-degrading enzymes are an insurance for smooth animal growth.

Conclusion

A wide range of NSP-degrading enzymes allow a higher flexibility in feed formulation; compared to corn and SBM, cheaper and local feedstuffs are permitted in a higher level. The enzymes cope with the variation in fibre content, avoid slow gut transit by viscosity reduction, improve digestibility and refrain bad bacteria from overgrowing the gut content.

R&D centres invest in selecting all parameters, thus reducing variation to the extent possible. In contrast, commercial viability is based upon balancing the available materials, which are prone to variation, with the best strategies for optimum performance.

Zympex enzymes are a cornerstone in balancing economic variation with profitable outcome. ■