International Journal of Agricultural Technology 2016Vol. 12(7.1):1195-1198
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Xylanase-Enzymes in Poultry and Pig Nutrition

Tapio Juokslahti[1]

[1]Faculty of Veterinary Medicine, Helsinki University, Finland; P.O.Box 57, 00014 Helsinki University, FINLAND

Tapio Juokslahti (2016). Xylanase-Enzymes in Poultry and Pig Nutrition. International Journal of Agricultural Technology 12(7.1): 1195-1198.

Hemicellulose is one of the three major constituents of plants. Together with cellulose and lignin, hemicellulose builds up the supporting material in plant cell walls. The most abundant hemicellulose in wheat, rye and triticale is xylan. In nature the hemicellulolytic enzymes, in addition to cellulases, ligninases and pectinases, are responsible for converting structural plant polymers to soluble monomers. Xylanases and other hemicellulases have been isolated from wood-rotting micro-organisms and from rumen microflora. The use of these enzymes in animal feed applications is based on their succesful production in industrial scale.

Xylans are polysaccharides, of which the backbone is most often a homopolymer of 1,4-linked -D-xylanopyranose units. Depending on the plant species and structural location of the xylans in plant, the backbone may be substituted with -L-arabinofuranosyl, 4-O-methylglucuronosyl or acetyl groups.

In the study of grass and cereal hemicelluloses, several names have been used for these polysaccharides: hemicellulose, pectin substances, pentosans, cereal gums, linear and branched xylans and others. In addition to the various xylans which occur as structural polysaccharides in lignified tissues, the term hemicellulose also includes certain carbohydrates in the cereal endosperm, the non-starch polysaccharides called cereal gums or pentosans. The straw and hulls of wheat, rye, barley and rice yield about 20 % of their dry weight, the corresponding cereal grains somewhat less, as xylose in total acid hydrolysis. Xylan is accordingly an esssential component in cereals and agricultural residues and must be taken into account when considering enzymatic up-grading of animal feeds containing these raw materials.

Xylans can be converted to lower molecule components and to monosaccharides by enzymatic hydrolysis. As the substrates to be hydrolysed are heteropolymers, several different enzymes are needed for

*** Corresponding author**: Tapio Juokslahti; **Email:** tapio.juokslahti@kolumbus.fi

their complete hydrolysis. The most important enzyme is endo-1,4- -D-xylanase, which attack the backbone of xylans endo-wise to produce shorter oligomers, xylobiose and even xylose. -Xylosidases are exoglycosidases hydrolysing short oligosaccharides, especially xylobiose, to xylose. Also enzymes releasing the substituents of the xylan backbone: -L-arabinosidases, -D-glucunoridases or acetyl xylan esterases are important. The action of these enzymes is necessary for achieving total hydrolysis of xylan to monosaccharides, because they act in synergism with xylanases.

There is clear evidence that all the enzymes needed for xylan hydrolysis exist in the enzyme system produced by *Trichoderma reesei* (Antarios Ltd. Biotec feed enzymes). This organism produces high levels of endoxylanase and -xylosidase activities together with cellulolytic enzymes. It produces also other xylanolytic enzymes, like -arabinosidase, -glucuronidase and acetyl xylan esterase.

There is substantial evidence that supplementary enzymes for poultry diets function by hydrolysing soluble -glucans or arabinoxylans thereby reducing digesta viscosity. In the case of wheat and rye-based diets fed to poultry, it has been shown that as much as 60-70 % of the variation in body weight and feed conversion rate could be described by intestinal viscosity alone. This demonstrates the importance of viscosity in wheat and rye based diets and the possibility that other, though somewhat less important mechanisms play a role in chicken such as the release of entrapped nutrients by cell wall disruption (Bedford and Classen 1992).

Investigation of the enzyme dose, chicken performance and intestinal viscosity has revealed that there is an optimum dose for feed efficiency (Bedford and Inborr 1993).

To study the efficacy of *Trichoderma reesei* to decrease the viscosity of intestinal contents in different parts of the intestinal tract, en experiment was done using *Trichoderma reesei* enzyme supplementation of rye feed. The results are presented in Table 1.

Table 1. Viscosities (cP) of the centrifuged supernatants of the intestinal contents in chickens fed enzyme-supplemented (Enzyme group) and unsupplemented (Control group) rye feed (Juokslahti T. & al. 1996)

Group	Anterior intestinal contents		Posterior intestinal contents	
Control group	40,2	23,1	75,2	26,7
Enzyme group	18,1	4,1	36,4	8,8

The study clearly shows that the enzyme addition decreases the viscosity of intestinal contents both in the anterior part and in the posterior part of the chicken intestines.

Boros *et al*. (1995) in their recent study using enzyme addition in rye diet for chicks concluded that enzyme supplemented rye diet approached the performance of wheat and barley based diets, but that an enzyme preparation not only high in xylanase but also high in arabinofuranosidase activity is required to completely reduce the viscosity of rye. They were using Kyowa cellulase in their study.

Another postulated effect of the added feed enzymes is that they liberate intracellular nutrients, by breaking the cell walls. Thus for instance proteins inside wheat bran, wheat middlings, wheat pollards, rice bran etc could be taken into effective nutritional use, specially in swine.

Juokslahti and Wang conducted an experiment to see the effect of *Trichoderma reesei* enzymes on high wheat pollard feeding in pigs. As a comparison also commercial Chinese pig feed was included in the experiment. The results are presented in Table 2.

Table 2. The effect of Trichoderma reesei enzymes on 40 % wheat pollard feeding on pigs during 48 days after 20 kg TBW, and comparison to commercial Chinese pig feed (Juokslahti and Wang 2009)

Group	Daily Weight Gain (g)		Change	Feed Conversion Rate	Change
Commercial Feed	622	55	- 11,9 %	3,01	- 5,6 %
40 % Wheat Pollard	706	52	Control	2,85	Control
40 % Wheat Pollard + Enzyme	763	17	+ 8,1 %	2,72	+ 4,6 %

The results show that daily weight gain was improved by 8,1 % in enzyme supplemented 40 % wheat pollard group, as compared to similar control feed without the enzyme addition. The feed conversion rate was improved by 4,6 %. A striking finding was that both the unsupplemented and specially the enzyme supplemented wheat pollard groups were better than the commercial Chinese pig feed, this was true for both daily weight gains and feed conversion rates. The postulation is, which still remains to be tested in further experiments, that enzymes exert ”an protein increasing effect” compared to Chinese normal feeds, and this increasing effect is seen as striking improvement in production parameters of the pigs.

References:

Bedford M. and H. Classen, 1992, In Xylans and Xylanases, Ed. J. Visser & al., 1992), pp 361-370.

Bedford M. and J. Inborr, 1993, Proceedings of World`s Poultry Science Association, September 1993, Jelenia Gora, Poland.

Boros D., R. Marquardt and W. Guenter, 1995, Rye as an Alternative Grain in Commercial Broiler Feeding, J.Appl.Poultry Res. 4:341-351.

Juokslahti T., T. Parkkonen and M. Bedford, 1996, The Effect of Enzyme Supplementation of Chicken Rye Feed on the Viscosity and Microstructure of Digesta, Zes.Naukowe Akad.Rol.Wroclawiu.297:89-98.

Juokslahti T. and J. Wang, 2009, Effects of *Trichoderma reesei* Enzyme Supplementation to High Wheat Pollard Diet on the Performance of Growing Pigs in China, CAAS, Haidian, Beijing, China 2009.