The use of bacterial endoxylanase in layers

The use of NSP-enzymes not only reduce the anti-nutritional effects of the non-starch polysaccharides, but also create a prebiotic by product which in turn is converted to butyrate. This has both zootechnical as economic benefits.

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The improved performance seen when using NSP hydrolyzing enzymes in monogastric diets, is often explained as a result of reduced gut viscosity which improves nutrient digestibility. However, this mechanism is unlikely to be of much significance in relation to insoluble NSP's, as they have little or no effect on gut viscosity, but rather cause nutrient entrapment, also referred to as "cage-effect".

Furthermore, the amount of evidence of the indirect prebiotic effect of a certain type of xylanase keeps growing. The main idea is that a partial hydrolysis of soluble and insoluble AX into smaller arabinoxylan oligosaccharides (AXOS) makes them faster fermentable and favors desirable microbiota. This results in production of important levels of desired SCFA's, and additionally improves morphological and histological changes of the small intestine.

Improved intestinal health not only influences nutrient digestibility, but also affects carcass composition and quality of egg(shell)s. Poor eggshell quality is one of the most important issues in the poultry industry, influencing the economic profitability of egg production as well as hatchability. Mabe et al. (2003) indicated that cracked or broken shells account for 80-90% of eggs that are routinely downgraded. One of the main concerns is the decrease of eggshell quality as hen age increases, since the incidence of cracked eggs can exceed 20% at the end of the laying period (Nys, 2001). Furthermore, high breaking strength of eggshells and absence of shell defects are essential for protection against the penetration of pathogenic bacteria into the egg.

Effects on microbiota and intestinal morphology

In the past, several studies have shown effects of bacterial endoxylanase on microbiota composition. Alireza et al. (2015) designed a study to unravel the true mechanism by which gut microbiota are affected by the addition of feed enzymes.

The bacterial xylanase significantly increased the number of bacteria belonging to Clostridium cluster IV (butyrate producers), total bacteria and butyryl CoA-acetate CoA-transferase genes (table 1). Beside the effect on microbiota, the intestinal morphology was also clearly affected, since villus length and villus/crypt ratio increased by 24 and 42 %

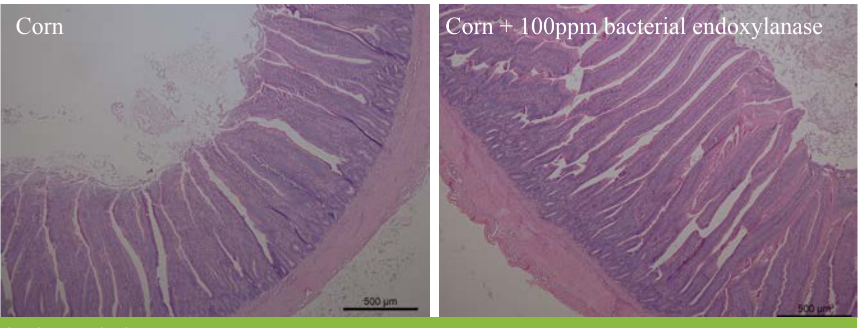

Table 1: Effects of bacterial endoxylanase on microbiota and intestinal morphology

		Dietary treatment	
	p-value	Corn	Corn + 100ppm bacterial endoxylanase
Butyryl CoA: Acetate CoA - tranferase	< 0,05	8,01	8,32
Clostridium cluster IV	< 0,05	9,39	9,74
Clostridium cluster XIV	NS	8,42	8,38
Villus height (µm)	< 0,05	963a	1202b
Crypt depth (µm)	NS	168	147
Ratio villus/crypt	< 0,05	5.9a	8.4b

respectively.
The results suggest that the tested bacterial xylanase likely affects the gut microbial profile by a combination of providing readily fermentable arabinoxylan fragments together with an overall change in digesta composition as substrate for the gut microbiota (Alireza et al., 2015).

Promotion of good intestinal health and feed intake may help to obtain better eggshell quality. Due to the lower pH caused by enhanced production of SCFA, an increased bioavailability of minerals can be expected (Courtin et al., 2008). At the same time, increased production of butyrate may improve the absorptive capacity of the intestinal mucosa (Van Craeyveld et al., 2008).

To study the “side” effect of xylanases on egg quality, a number of trials were performed in co-operation with IRTA (Spain) and ILVO (Belgium). The main results of these trials are summarized in table 2.

FX supplemented counterparts. Due to their higher egg mass, as well as their lower feed intake, feed conversion was decreased by 28 points (1.934 vs. 1.962) (Delezie et al., 2014).
In addition, there was also a treatment effect on egg quality. Eggs from hens fed BX had a significantly thicker eggshell, and had less cracked eggshells compared to hens fed FX (Delezie et al., 2014).

Trial 3
This trial was set up to research the effect of bacterial endoxylanase (BX) on performance and egg shell quality in older layers (54 – 74 weeks of age). Supplementing the feed with BX significantly improved the laying percentage (87.9 vs 83.7%) and egg mass (58.3 vs 55.3 g), resulting in a significantly better feed conversion ratio (1.974 vs 2.085). The incidence of broken and dirty eggs was moderate and comparable between treatment groups, whereas the incidence of soft-shelled eggs was significantly lower (0.04 vs 0.47%) for the BX supplemented group. For Haugh units (HU) a significantly higher value for the laying hens fed the diets supplemented with BX (90.14 vs 87.60) was noticed.

Table 2 – Summary of layer trials.

		Laying rate (%)	FCR	Eggshell quality/cracked eggs (%)	"Egg thickness (1/100mm)"	Haugh Unit
Trial 1 (IRTA)	Negative control	92.4	1.959	2.33		
	Bacterial endoxylanase	95.3	1.859	1.63		
	p-value	< 0.05	< 0.05	< 0.05		
Trial 2 (ILVO)	Fungal enzyme cocktail	95.3	1.96	1.46	35.8	
	Bacterial endoxylanase	95.5	1.93	1.02	36.8	
	p-value	NS	NS	< 0.05	< 0.05	
Trial 3 (ILVO)	Negative control	83.4	2.085	2.27	38.9	87.6
	Bacterial endoxylanase	87.9	1.974	1.99	39.31	90.14
	p-value	< 0.05	< 0.05	NS	NS	< 0.05

Trial 1
During this trial, significantly increased laying rate (92,4 % vs 95,3 %) was observed for the hens in the bacterial endoxylanase group when compared to a negative control group. Also FCR improved significantly by 5,1% for the enzyme group versus the negative control group.
Besides the influence on performance, a significant enzyme effect on egg shell was also seen. The incidence of broken or cracked eggs decreased from 2,33 to 1,63 %.

Trial 2
The objective of this study was to evaluate if NSP-enzymes from different origins had similar effects on performance and eggshell parameters in commercial layers.
Feeding laying hens diets supplemented with either a fungal enzyme cocktail (FX) or a bacterial endoxylanase (BX) had no significant effect on their zootechnical performance. However, layer rate, egg weight and daily egg mass were numerically higher for the BX supplemented laying hens compared to their

Supplementing a bacterial endo-1,4-b-xylanase resulted in more efficient egg production and increased HU when compared to the negative control diet (Delezie et al. 2015).

Based on these results, we conclude that NSP-enzymes not only reduce the anti-nutritional effects of the non-starch polysaccharides, but also create prebiotic arabinoxylan-oligosaccharides which are fermented in the ceca to produce high levels of butyrate. The benefits of butyrate in terms of eggshell quality are widely accepted, therefore if use of certain NSP-enzymes can reduce or replace the addition of butyrate, feed price will drop distinctly.

Since eggshell quality has a significant impact on the profitability of layer farms, enzyme choice must be made considering not only the effects on energy uplift and zootechnical performance, but also on egg quality.