XYLO-OLIGOSACCHARIDES AND XYLANASES IMPROVE THE PERFORMANCE OF BROILERS FED WHEAT-BASED DIETS

H. GRAHAM[1], G.A. GOMES[1], T.T. DOS SANTOS[1] and R.A.H.M. TEN DOESCHATE[1]

Summary

Xylanases are almost universally added to commercial wheat-based broiler diets, to improve bird performance and reduce welfare problems associated with wet litter. Recent research suggests that at least some of this improvement in performance can be attributed to the xylanase-mediated release of xylo-oligosaccharides (XOS) in the gut. This trial was designed to determine the influence of adding xylanase alone or with XOS to wheat-based diets on performance, water intake and carcass yield of broilers to 34 days. The results indicated that the xylanase could improve bird performance and reduce water intake and mortality. Addition of short-chain XOS to the xylanase supplemented diets further improved 24 day weight gain.

I. INTRODUCTION

Xylanases have been used in the poultry industry for 30 years, initially to improve litter quality in wheat-based diets but later to also improve performance or reduce costs in wheat, corn, sorghum and barley based diets. It is widely accepted that these benefits are the result of the enzyme partly degrading the insoluble cell wall arabinoxylans to release the enclosed nutrients and the soluble arabinoxylans to reduce digesta viscosity, hence improving nutrient digestibility. It is also known that degrading this fibre polysaccharide to free arabinose and xylose can be detrimental to broiler performance (Schutte, 1991), but that producing XOS can increase energy availability to the host and encourage a more effective fibre-degrading gut microbiota (Courtin *et al*, 2008; Bedford and Apajalahti, 2018). The present trial was designed to test if adding xylanases, alone or with XOS, to a wheat-based diet would influence broiler performance, carcass yield and water intake.

II. METHODS

A randomized complete block design was employed with 12 pen replicates (6 males, 6 females) of 24 birds (Ross 308) per diet. Birds were fed wheat/SBM-based diets in a three phase program. All plant-origin feedstuffs were analysed by NIR prior to diet formulation, with diets pelleted at 80-85^{o}C. All diets contained 500 FTU/kg of a phytase (Quantum Blue, AB Vista), with matrix values of 0.68 MJ/kg, 0.25 g/kg digLys, 1.65 g/kg Ca and 1.5 g/kg avP applied. Excluding these matrix values, the ME, crude protein, digLys, Ca and avP contents of the starter diets (1-13 days) were 12.6 MJ/kg, 236 g/kg, 11.5g/kg, 8.6 g/kg and 4.3g/kg, the grower diets (14-24 days) were 12.9 MJ/kg, 218 g/kg, 10.5 g/kg, 7.6 g/kg and 3.8 g/kg, and the finisher diets (25-34 days) were 13.2 MJ/kg, 204 g/kg, 9.9 g/kg, 6.6 g/kg and 3.3 g/kg, respectively. The Control diets were fed alone or supplemented with 16,000 BXU/kg xylanase (Econase XT, AB Vista) or the blend containing 16,000 BXU/kg xylanase and XOS (Signis, AB Vista).

Weight gain, feed and water intake, mortality and carcass yield were recorded up to 34 days, with feed conversion ratio (FCR), weight-corrected FCR (BWcFCR), water to feed ratio and European Production Efficiency Factor (EPEF = ((ADG×livability)/FCR)×100) calculated. Data were submitted to a two-way analysis of variance (diet x sex) using JMP Pro

[1] AB Vista, Marlborough, Wilts SN8 4AN, UK; hadden.graham@abvista.com, gilson.gomes@abvista.com, tiago.santos@abvista.com, rob.tendoeschate@abvista.com

14 statistical software. Least square means were compared using Students t-test, with significance reported at P < 0.05.

Table 1 – Performance in broilers fed wheat-based diets unsupplemented (Control) or supplemented with xylanase (16,000 BXU/kg) or the blend containing xylanase plus xylo-oligosaccharides (XOS)

	Control	C + Xylanase	C + Xylanase +XOS	P-value Diet	P-value Sex
Weight gain (d 1-24, g)	1086^{b}	1091^{b}	1126^{a}	<0.02	<0.01
FCR (d 1-24, g:g)	1.42^{a}	1.39^{b}	1.39^{b}	<0.01	0.03
Weight gain (d 1-34, g)	2010	1960	2025	0.23	<0.01
FCR (d 1-34, g:g)	1.57	1.55	1.53	0.19	0.29
BWcFCR (d 1-34, g:g)	1.57	1.57	1.53	0.32	<0.01
Mortality (d 1-34, %)	3.49^{b}	1.14^{a}	0.83^{a}	<0.03	0.72
EPEF (d 34)	364	367	387	0.09	<0.01
Carcass yield (g/kg 34 d BW)	637	640	642	0.42	0.66
Water intake (d 1-34, g)	6057^{a}	5754^{b}	5907^{ab}	<0.01	<0.01
Water:feed (d 1-34, g:g)	1.94	1.89	1.90	0.12	<0.01

$^{a-b}$P < 0.05

III. RESULTS

Analysis of all diets confirmed that nutrient contents and enzyme (phytase and xylanase) activities were as expected. The wheat used in this trial was relatively high in dietary fibre (119 g/kg, including 103 g/kg non-starch polysaccharides (NSP) and 16 g/kg lignin), total (68 g/kg) and soluble (21 g/kg) arabinoxylans. The diets were calculated to have 131-132 g/kg dietary fibre, 106-108 g/kg total NSP, 11-13 g/kg soluble and 40-48 g/kg total arabinoxylan.

There were no diet x sex interactions, and xylanase inclusion reduced (P < 0.03) 34-day mortality (Table 1). At the end of the grower period (24 days) supplementation with xylanase + XOS improved (P < 0.02) weight gain by approximately 40g relative to the other two diets, while both the xylanase and xylanase + XOS diets improved (P < 0.01) FCR by 3-points relative to the Control. By 34 days these differences were no longer statistically significant (P = 0.19). However, due to numerically better overall performance and lower mortality, the xylanase + XOS diets tended to give a better (P = 0.09) EPEF (387) than the Control diets (364), with the xylanase diets intermediate. The xylanase only diets reduced (P < 0.01) water intake to 34 days relative to the Control diets, potentially leading to an improvement in litter quality, but the water:feed ratio did not differ between diets (P = 0.12). Carcass yield, as a fraction of live weight, was not influenced by diet.

IV. DISCUSSION

Insoluble arabinoxylans are relatively resistant to degradation in the monogastric digestive tract, although the soluble fraction will be extensively degraded (Graham *et al*, 1988). Adding a xylanase to the feed will partly solubilize the insoluble xylans and degrade the soluble fraction to smaller fragments. The xylanase used in this trial can degrade *in vitro* arabinoxylans to short-chain oligosaccharides, primarily with a degree of polymerization (DP) of 3-8. However, *in vivo* it is likely that the action of feed xylanases will produce longer-chain soluble arabinoxylan fragments in the posterior gut that are then fermented by the microbiota in the lower gut, producing volatile fatty acids and thus improving the overall gut function. Fibre fermentation and its by-products could account for some of the performance benefits seen in this and other trials. This fermentation of XOS can lead to increased caecal butyric acid levels (Graham *et al*, 2004).

Research over the past decade has established that supplementing broiler diets with XOS (DP mainly >5) can improve performance (Courtin *et al*, 2008), and this has been attributed to a 'prebiotic' effect. However, a recent trial (Bedford and Apajalahti, 2018) has indicated that short chain XOS can stimulate the ability of the gut microbiota to hydrolyze dietary xylans.

V. CONCLUSION

The current trial suggests that a combination of short-chain xylo-oligosaccharides, to stimulate microbial fibre degradation, and a xylanase to partly degrade fibre, can act together to improve nutrient digestibility, make the fibre more susceptible to microbial degradation, and thus improve broiler performance.

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