

Growth performance and digestive processes in broiler chickens fed diets supplemented with xylanase and fructooligosaccharides

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Objective: The effect of xylanase and fructooligosaccharides on broiler chickens body weight, feed conversion (kg feed/kg weight), caecal volatile fatty acids (VFA) concentration and glycolytic enzymes activity was investigated. **Methods:** Six hundred birds were divided into three groups and for 35 days were fed basal diet (control) and diets contained 0.1% xylanase and 2% fructooligosaccharides and a combination of both supplements. Body weight was recorded individually and feed conversion per group. The concentration of VFA in caecal digesta was measured by gas chromatography. The glycolytic activity in caecal digesta was measured by the rate of p- or o-nitrophenol release from their p- or o-nitrophenylglucosides. The results were analyzed using the one-way ANOVA test. Differences were considered significant at $P \leq 0.05$. **Results:** Addition of xylanase to the basal diet improved body weight 5% and feed conversion decreased 8%, compared to control. Body weight was increased 6% and feed conversion decreased 6% versus control in addition of xylanase and fructooligosaccharides. It was found xylanase addition to diet increased VFA, except valeric acid concentration. Supplementation of xylanase and fructooligosaccharides to diet increased acetic, propionic and isobutyric acid concentration. The glycolytic activity of the caecal digesta was generally alike in all groups.

Keywords: xylanase; fructooligosaccharides; broiler chickens

Introduction

Many feed additives are designed to secure animal's health status and to optimize growth performance. Among others, antibiotics have been used as growth promoters for a number of years in intensive animal production systems. With increasing concerns about antibiotic resistance for certain bacteria, use of antibiotic growth promoters in feed for poultry is banned in many countries (Patterson and Burkholder, 2003). Inbarr (2000) has reported that with the aid of number of alternatives including probiotics, prebiotics (mainly oligosaccharides) and feed enzymes not only has the general health status of the poultry been maintained, but also the growth performance and feed efficiency improved.

The arabinoxylans and β -glucans present in the endosperm cell walls of cereals have been identified as major cause of poor growth rate and low nutrient digestibility in broiler chickens (Ward and Marquardt, 1987). Antinutritive effects are attributed to an increase in intestinal digesta viscosity. Xylanase can be used to decrease gut viscosity and enhance diffusion on enzymes and acids into the food mass, resulting in

more complete feed ingredients digestion, absorption and availability of nutrients (Choct and Annison, 1992).

In large intestine of broiler chickens fructooligosaccharides act by enriching beneficial bacterial populations, which subsequently provide protection against enteric infections. Some studies show response for improvements in growth performance and digestive processes for broiler chickens when fructooligosaccharides are fed (Ao and Choct, 2003; Yusrizal and Chen, 2003). Despite reports on effects of fructooligosaccharides or xylanase, data of their combination on broiler chickens caecal metabolism is limited.

Materials and methods

Animals and dietary treatments. Six hundred chicks of the strain Cobb 500 were reared from 1 to 35 days old. The birds were given free access to diets formulated to meet nutrient requirements of broiler chickens (NRC, 1994). The birds were assigned to three dietary treatments. First group was control (basal diet), second group diet was supplemented with 5,600 EXU/g xylanase *Natugrain*[®] *Wheat G* (100 g/t of feed) and third group diet was supplemented with combination of 5,600 EXU/g xylanase (100 g/t of feed) and fructooligosaccharides *Raftifeed*[®] *OPS* (20kg/t of feed). *Natugrain*[®] *Wheat G* is endo-1,4- β -xylanase (EC 3.2.1.8.), produced by *Trichoderma longibrachiatum*. *Raftifeed*[®] *OPS* is powder containing mainly oligofructose produced by partial hydrolysis of chicory inulin.

During all experimental period individual body weight and feed conversion of broiler chickens was recorded.

Chemical analysis. The amount of nutrients and amino acid analysis of feed was determinate according Naumann and Bassler (1993). The glycolytic activity in faeces was measured by the rate of p- or o- nitrophenol release from their p- or o-nitrophenylglucosides (Juśkiewicz *et al.*, 2003). The concentration of short-chain fatty acids (SCFA) in the faecal digesta was measured by gas chromatography as described in Zduńczyk *et al.*, 2004.

Statistical analysis. The results were analyzed using the one-way ANOVA test. The significant differences between groups were determined by the Duncan's multiple range test. Differences were considered significant at $P \leq 0.05$.

Results and discussion

There was a positive effect on growth performance and digestive processes of broiler chickens upon xylanase alone and in combination with fructooligosaccharides (*Table 1*).

Table 1 Performance and caecal indices of broiler chickens

	I group (control)	II group	III group	SEM²
Body weight (g/broiler)	1813.73	1905.11	1926.62	10.75
FCR ¹ (kg feed/kg weight gain)	1.62	1.49	1.52	0.02
Enzyme activity (U/g fresh caecal digesta)				
α -glucosidase	1.96 ^b	1.40 ^b	2.87 ^a	0.18
β -glucosidase	0.82	0.50	0.59	0.06
α -galactosidase	6.96	5.12	6.88	0.57
β -galactosidase	4.01	3.39	4.53	0.41
β -glucuronidase	2.98 ^a	1.72 ^b	1.53 ^b	0.23
SCFA (μ mol/g)				
acetic	38.24	41.20	40.95	0.99
propionic	25.70	25.83	29.45	120
isobutyric	1.53	1.76	1.68	0.12

butyric	20.45	24.52	20.05	0.91
isovaleric	2.26	2.58	2.11	0.10
valeric	3.27	3.19	3.19	0.18
total	88.18	95.90	94.23	2.52

¹Feed conversion ratio

²SEM – standard error of the mean

a, b – values within each row with different superscripts are different at $P \leq 0.05$

In addition of xylanase body weight of broiler chickens increased 5% and FCR decreased 8%, compared to control ($P \geq 0.05$). Whereas diet supplementation with xylanase and fructooligosaccharides increased body weight 6% and FCR decreased 6%, compared to control ($P \geq 0.05$). It has been shown that enzymes increases the availability of starch, protein, lipid and minerals that are physically or chemically sequestered by thick plant cell wall (Castanon *et al.*, 1997; Malathi and Devegowda 2001). Prebiotics can modify the composition of intestinal microflora that a few of the potentially health promoting bacteria (especially, but not exclusively, *Lactobacilli* and *Bifidobacteria*) become predominant (Kailasapathy *et al.*, 2000). If the health of broiler chickens can be improved, thereby growth performance of birds can be increased. It was found that compared to control, xylanase gave lower caecal α -glucosidase ($P \leq 0.05$), β -glucosidase, β -galactosidase, β -glucuronidase ($P \leq 0.05$) enzymes activity. Xylanase combination with fructooligosaccharides lowered β -glucosidase, α -galactosidase and β -glucuronidase ($P \leq 0.05$), while α -glucosidase ($P \leq 0.05$) and β -galactosidase increased, compared to control. β -galactosidase and α -glucosidase activities can improve fermentation on non starch polysaccharides and stimulate lactose division to SCFA and lactic acids, which are the main resource of energy for host tissues (Roberfroid 2000). Compared to control, concentration of SCFA increased while valeric acid decreased with addition of xylanase. In the case of xylanase and fructooligosaccharides increased acetic, propionic and isobutyric acids, but decreased butyric, isovaleric and valeric acids concentration, compared to control. As it is known from studies *in vitro* that probiotics can metabolize oligosaccharides and that this fermentation leads to the generation of SCFA. SCFA are important anions in the gastrointestinal tract, affecting colonocytes morphology and function. Acetic and propionic acids stimulate colonic sodium and fluid absorption and exert proliferative effects on the colonocytes. Butyrate has been reported to be preferential energy source of colonocytes (Roberfroid 2000).

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