Proc. 3rd All Africa Conf. Anim. Agric. & 11th Conf. Egyptian Soc. Anim. Prod., Alexandria, Egypt, 6-9 November 2000: 607-611

FEED ENZYMES: EFFECT OF XYLANASE AND β-GLUCANASE SUPPLEMENTATION OF WHEAT OR WHEAT AND BARLEY BASED DIETS ON THE PERFORMANCE OF MALE TURKEYS

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SUMMARY

An experiment was conducted to evaluate the efficiency of Quatrazyme HP (Nutri-Tomen, France) containing xylanase and β-glucanase activities (28 000 and 140 000 IU/g of product respectively) in growing turkeys (BUT strain) fed with diets based on wheat or wheat and barley. The addition of Quatrazyme HP at the level of 20 mg/kg of diet (560 and 2800 IU of xylanase and β-glucanase respectively per kg of diet) significantly increased the apparent metabolizable energy corrected for nitrogen balance ($A.M.E._N$) of all diets. Moreover, the Quatrazyme HP supplementation significantly improved the body weight gain and the feed conversion ratio (F.C.R). In fact the F.C.R was improved by 5.5 %, 3.35 % and 6 % in diets based on 50 % of wheat, 39.4 % of wheat and 10 % of barley and 18 % of wheat and 30 % of barley respectively.

Keywords: Xylanase and β-glucanase, wheat, barley, turkeys

INTRODUCTION

Turkey producers have considered wheat, and to a lesser extent barley, as partial alternatives to corn for rations because of their competitive price. These cereals mainly contain complex carbohydrates refered to as non-starch polysaccharides (NSP). One of the major constituents of the cell wall of wheat is arabinoxylan (Englyst *et al.*, 1989). However β-glucan is the major constituent of the cell wall of barley (Edney *et al.*, 1991). These NSP exhibit an anti-nutritional activity which can negatively affect poultry performances (Fuller *et al.*, 1995). Choct and Annison (1992) confirmed that the viscosity of arabinoxylans and β-glucans that exerts their anti-nutritive activity. This viscosity disrupt the digestion and absorption processes (van der Klis *et al.*, 1993). The addition of a specific enzyme activities (xylanase and β-glucanase) to wheat- and barley- based poultry diet decreases viscosity, reduces the anti-nutritional effect of NSP and as a consequence improves the productive performance of poultry. The result for feed manufacturers is a greater flexibility in feed formulation (Petterson and Aman, 1988 ; Dänicke *et al.*, 1999). In fact many studies in the published literature demonstrate the beneficial effect of exogenous enzymes in chickens fed on various diets based on wheat, barley or rye. However, published data on the effect of exogenous enzymes (xylanase or β-glucanase) in turkeys is sparse.

The objective of this experiment was to evaluate the effect of xylanase and β-glucanase addition to wheat or wheat- and barley- based diets for turkeys from 1 to 6 weeks of age.

MATERIALS AND METHODS

Two hundred and fourty day-old male turkeys (BUT strain), raised on the floor, were fed a starter wheat based diet containing 26.6 % of crude protein and 3040 kcal of ME/kg for 7 days. The basal grower diet (8 – 28 days) contained 22 % of crude protein and 3035 kcal of ME/kg. The basal finisher diet (29 – 42 days) contained 21 % of crude protein and 3060 kcal of ME/kg. These diets were formulated (Table 1) according to the nutritional requirements for turkeys (Larbier and Leclerca, 1992). Feed and water were supplied at libitum throughout the entire experiment. All diets were fed in mash form and contained no growth factors, coccidiostats or antibiotics. The exogenous enzyme used in this experiment was a commercial preparation, Quatrazyme HP (Nutri-Tomen – SA, France) with xylanase and β-glucanase activities of 28 000 and 140 000 IU per g of product respectively. Quatrazyme HP was added at the level of 20 mg/kg of diet (560 and 2800 IU of xylanase and β-glucanase respectively per kg of diet). At 7 days of age all the poults were weighed, divided into three homogenous groups of 80 birds each, housed in individual cages and fed either diet 1 (wheat), 2 (wheat + 10 % or 15 % barley) or 3 (wheat + 30 % or 35 % barley). Half of the birds in each group received the basal diet, the other half received the basal diet supplemented with Quatrazyme HP. The Birds were also weighed at 28 and 42

days of age. Feed intakes were recorded collectively during the first 7 days of age then individually during the 7 – 28 day and 29 – 42 day periods. These results were used to calculate the feed conversion ratios as g of feed intake / g of body weight. From 22 to 25 days of age, the excreta were collected daily, dried, ground and passed through a 0.5 mm sieve. The gross energy of diet and excreta samples was determined using an adiabatic bomb calorimeter.

The data of this experiment were analysed by the General Linear Models procedures of Statview software for Windows 4.5 (1992 – 1996) as a completly randomised design. Mean differences were determined using Fisher's test of least significance.

Table 1. Percent formulation and calculated analysis of control turkey diets containing wheat and barley as the cereal component

Ingredients	Starter diet (0 – 7 days)	Grower basal diets (8 – 28 days)			Finisher basal diets (29 – 42 days)		
		1	*2*	*3*	*1*	*2*	*3*
Wheat	46	50	39.4	18	54	38.4	18
Barley	-	-	10	30	-	15	35
Corn gluten	6	6	6	6	6	6	6
Soybean meal	36	33.5	33.9	34.6	30	30.3	30.6
Vegetable oil	5.80	5.10	5.30	6.10	5	5.30	5.5
L-Lysine HCl	0.50	0.17	0.16	0.14	0.10	0.09	0.07
DL Methionine	0.30	0.10	0.10	0.10	0.07	0.07	0.07
$CaCO_3$	1.40	1.30	1.30	1.30	1.20	1.20	1.20
$CaHPO_4$	3	2.80	2.80	2.75	2.60	2.60	2.60
Minerals, vitamins	1	1	1	1	1	1	1
Nutrient composition[1]							
ME[2] (kcal/kg)	3040	3035	3037	3040	3065	3060	3060
CP[3] (N x 6.25) (%)	26.2	22	22	22	21	21	21
Lysine (%)	1.87	1.38	1.37	1.36	1.22	1.22	1.22
A.A.S (%)	1.10	0.90	0.90	0.90	0.86	0.86	0.86
Ca (%)	1.37	1.35	1.35	1.35	1.30	1.30	1.30
Available phosphorus (%)	0.80	0.80	0.80	0.80	0.70	0.70	0.70

[1] : Calculated using PROFAL software version 2 (ITP – INRA, France).
[2] : Metabolisable energy
[3] : Crude protein

RESULTS

The results of this trial are presented in Tables 2, 3, 4 and 5. No mortality was observed during the entire experiment (42 days). The apparent metabolizable energy corrected for nitrogen balance (AME_N) decreased when the barley content in the diet increased from 0 to 10 % corresponding to a decrease of AME_N from 2950 to 2890 kcal/kg.

The xylanase and β-glucanase activities provided by Quatrazyme HP at a concentration of 20 mg/kg of diet significantly increased the AME_N by 140, 130 and 140 kcal/kg in basal diets containing 50 % of wheat, 39.4 % of wheat and 10 % of barley and 18.4 % of wheat and 30 % barley respectively. In addition, the AME_N / gross energy ratio increased from 64.3 to 67.4 %, from 62.7 to 65.5 % and from 61.9 to 64.9 % in diets containing 50, 39.4 and 18.4 % wheat and 0, 10 and 30 % barley respectively.

During the growing period, the body weight gain decreased when the dietary barley content was increased. At 28 days of age, the birds fed on the wheat-based diet grew faster then those given the basal diet containing 30 % of barley. The feed conversion ratio (FCR) increased significantly when the turkeys were fed on diets rich in barley. The xylanase and β-glucanase addition improved significantly body weight gain and FCR of turkeys fed on diets based on wheat or wheat and barley.

During the second rearing period (29 – 42 days), the body weight gain decreased only when the diet contained 35 % of barley. However the FCR increased significantly when the dietary barley content increased. The addition of xylanase and β-glucanase only increased the body weight of turkeys fed on diet containing 35 % of barley, but improved the FCR of all groups.

Table 2. Influence of xylanase and β-glucanase addition on the energetic value of grower diets

Diets						
Wheat (%)	50		39.4		18	
Barley (%)	-		10		30	
Xylanase (IU/kg)	-	560	-	560	-	560
β-glucanase (IU/kg)	-	2800	-	2800	-	2800
Feed dry matter (%)	89.3	89.7	90.1	90.2	90.1	90.0
Feed gross energy (kcal/kg)	4587	4587	4608	4608	4630	4630
AME_N (kcal/kg)	2950^a	3090^b	2890^c	3020^d	2865^c	3005^d
AME_N/gross energy (%)	64.3^a	67.4^c	62.7^b	65.5^d	61.9^b	64.9^a

a-d : means followed by different letters are significantly different (P<0.05).

Table 3. Turkey growth performances affected by xylanase and β-glucanase addition and diet composition (7 – 28 days)

Diets						
Wheat (%)	50		39.4		18	
Barley (%)	-		10		30	
Xylanase (IU/kg)	-	560	-	560	-	560
β-glucanase (IU/kg)	-	2800	-	2800	-	2800
Body weight gain (g)	1020^a	1080^b	950^c	1020^a	861^d	920^c
Feed intake (g)	1463	1470	1422	1480	1428	1440
FCR	1.44^a	1.36^b	1.50^c	1.45^a	1.66^d	1.56^e

a-e : means followed by different letters are significantly different (P<0.05).

Table 4. Turkey growth performances affected by xylanase and β-glucanase addition and diet composition (29 – 42 days)

Diets						
Wheat (%)	54		38.4		18	
Barley (%)	-		15		35	
Xylanase (IU/kg)	-	560	-	560	-	560
β-glucanase (IU/kg)	-	2800	-	2800	-	2800
Body weight gain (g)	1160^a	1185^a	1060^a	1090^a	1029^b	1120^c
Feed intake (g)	2100	2125	2125	2150	2180	2240
FCR	1.81^a	1.79^a	2.00^b	1.97^c	2.13^d	2.00^b

a-d : means followed by different letters are significantly different (P<0.05).

Table 5. Summary data for the whole experimental duration (7 – 42 days)

Diets						
Wheat (%)	50 then 54		39.4 then 38.4		18	
Barley (%)	-		10 then 15		30 then 35	
Xylanase (IU/kg)	-	560	-	560	-	560
β-glucanase (IU/kg)	-	2800	-	2800	-	2800
Body weight gain (g)	2180^a	2265^b	2010^c	2110^d	1890^e	2040^c
Feed intake (g)	3563	3595	3577	3630	3608	3680
FCR	1.63^a	1.59^b	1.77^c	1.72^d	1.90^e	1.80^c

a-e : means followed by different letters are significantly different (P<0.05).

DISCUSSION

The results of the current study showed that at the higher inclusion rate of barley in the diet, body weight gain decreased and the FCR increased. In fact β-glucan is the major factor which reduces the

feed value of barley (Salih *et al.*, 1991). β-glucan increases the viscosity of intestinal contents of poultry and thereby reduces nutrient absorption (Ikegami *et al.*, 1990). Thus Stevens *et al.* (1988) reported a decrease in the body weight gain of poults fed hulless barley-based diet. Similar results were obtained by Jevne *et al.* (1988) and Ferket (1992) who reported that the body weight and feed conversion ratio of turkeys fed the barley-based diets were inferior to those of turkeys fed the corn-based diets. Thus, at the higher inclusion rate, it is likely that barley might decrease the digestive and absorption processing of nutrients in turkeys.

In addition, according to the current study, the young birds (7 – 28 days) seemed to be less tolerant than older birds (29 – 42 days) to barley inclusion in the diet. In fact, young birds have a limited lipid digestion ability due to a lack of digestive enzyme production and excretion (Polin and Hussein, 1982).

The addition of xylanase and β-glucanase to the diet based on wheat or wheat and barley improved the body weight and FCR of turkeys for the entire experiment. Grimes (1997) reported that the addition of the pentosanase to the North Carolina wheat-based diet improved the performances of poults which were equal to those fed a corn-based diet. However he did not found the same results with the Canadian wheat-based diet. A Significant body weight improvement was also reported in turkeys by Leeson *et al.* (1996) with a wheat-based diet supplemented with exogenous enzymes. In an earlier study Vülker and Tüller (1993) reported that the exogenous enzyme addition improved both body weight and FCR in turkeys fed a wheat-based diet. The beneficial effect of exogenous enzymes in turkeys is not only limited to wheat-based diets. Stevens *et al.* (1988) and Ferket (1992) reported that the addition of β-glucanase to a barley-based diet improved the body weight gain of turkeys.

However our results differ from those reported by Pettersson *et al.* (1990) and Ritz *et al.* (1995) who found no beneficial effect of exogenous enzymes in turkey diets. Finally, according to the current study, young birds fed wheat- and barley-based diets have been shown to be more responsive to supplemental xylanase and β-glucanase than older birds. Similar results were obtained by Nasi (1988).

In conclusion, turkey growth performances depend on the barley content in the diet. The addition of xylanase and β-glucanase resulted in a significant improvement of body weight gain and feed conversion ratio. Thus wheat and barley could be used in growing turkeys with the some dietry manipulation.

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