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The effect of enzyme supplementation of triticale-barley feeds on fattening performance of turkeys

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ABSTRACT

The study was carried out on 456 one-day old BUT-9 tom poults divided into 4 groups (3 replicates x 38 poults per group) fattened until the age of 154 days.

The control group was fed a wheat-maize feed. These cereals were replaced by triticale and barley in the experimental diets. Mixture 1 was given without enzymatic supplements, feeds 2 and 3 contained different enzyme preparations. Less soya oil was added to enzyme-supplemented feeds, on the assumption that the addition of enzymes can increase the AMEN of triticale and wheat by 6%, of barley by 10%.

Body weight and feed utilization indexes, nutrient digestibility and dressing percentage were similar in all of the groups. Enzyme-supplemented feeds were more economical in comparison with the control triticale-barley diets (by 5.0-7.5%) and wheat-maize diets (by 8.5-11.0%).

KEY WORDS: turkeys, feeding, enzymes

INTRODUCTION

The polysaccharides found in the endosperm of kernels, i.e. β-glucans and arabinoxylanes and pectins, limit the nutritive value of cereals by increasing the viscosity of intestinal contents, making the faeces excessively moist and viscous, and causing diarrhoea in birds (Brenes et al., 1993; Ferket,1993; Jeroch et al.,1995; Choct, 1996; Classen,1996; Marquardt et al.,1996). Adding exogenous enzymes such as β-glucanase, pentosanase and cellulase can improve the efficiency of cereal diets for poultry by hydrolyzing non-starch polysaccharides, improving the digestibility of nutrients and increasing the energy value of the diet.

The effects of enzymes have been studied mainly on feeds containing substantial amounts of barley or rye, and better weight gains and feed utilization were achieved (Rotter et al., 1990; Mohammed, 1995; Al Bustary, 1996; Kaoma et al., 1996). In the case of feeds containing triticale or wheat, the addition of enzymes also had favourable effects (Salobir et al., 1994; Richter and Müller, 1995).

Enzymes are added to improve the economy of feeding, but their effectiveness depends on the type and amount of enzymes as well as on the substrate (Muramatsu et al., 1992; Brenes et al., 1993; Jeroch et al., 1995; Mohammed, 1995; Al Bustary, 1996; Faruga et al., 1996; Kaoma et al., 1996; Marquardt et al., 1996).

The objective of this study was to determine the effectiveness of two enzyme preparations as additives to feedstuffs containing substantial amounts of triticale and barley used in the fattening of meat turkeys.

MATERIAL AND METHODS

The experiments were carried out at the State Turkey Evaluation Station of the Olsztyn University of Agriculture and Technology in Olsztyn from April to October 1996. Four hundred and fifty-six one-day-old tom poults of the BUT-9 hybrid were used in the experiment. Thirty-eight were randomly assigned to 12 pens (3 replicate pens) to each of 4 feeding groups.

The feed mixtures (Tables 1 and 2) for the toms in the control group contained wheat and maize as the main cereals, while groups 1, 2, and 3 received triticale and barley. The feed given to group 2 contained an enzyme preparation denoted as A in an amount supplying 250 units of β-glucanase and 375 units of xylanase, while the group 3 feed was supplemented with enzyme preparation B in an amount supplying 3250 units of β-glucanase, 2250 units of xylanase and 1000 units of cellulase per kilogram of feed. The enzymatic activities of the enzyme preparations are given in agreement with the information provided by the manufacturer. The energy value of all of the feed mixtures was balanced by adding soya oil. The energy calculations for groups 2 and 3 accounted for higher energy for wheat and triticale (6%) and barley (10%), in the case of the enzyme-supplemented diets. The initial energy value of cereals was based on the Nutrient Requirements of Poultry (1993).

Fattening was continued until 154 days (22 weeks) under standard conditions and in accordance with the recommendations of animal husbandry (Faruga and Jankowski, 1996). Granulated feeds were provided *ad libitum* according to

TABLE 1

Composition and nutritive value of feed mixtures, %

Indices	Feeding period, days											
	1-35			36-77			78-112			113-154		
	Groups											
	control	1	2-3	control	1	2-3	control	1	2-3	control	1	2-3
Wheat	20.00	15.00	15.00	41.31	15.00	15.00	63.42	–	–	57.80	–	–
Barley	–	10.00	10.00	–	15.00	15.00	–	30.00	30.00	–	35.00	35.00
Triticale	–	11.51	13.22	–	31.29	34.67	–	42.47	46.78	–	41.60	46.22
Maize	26.16	10.00	10.00	20.00	–	–	10.00	–	–	20.00	–	–
Soyabean oilmeal (46% CP)	39.33	37.76	37.38	25.22	23.68	22.78	13.80	12.58	11.44	11.30	9.80	8.57
Meat meal (58% CP)	9.58	10.00	10.00	6.50	6.50	6.50	6.00	6.00	6.00	5.00	5.00	5.00
Soya oil	0.57	1.49	0.22	2.72	4.30	1.90	2.51	4.72	1.66	1.90	4.65	1.35
NaCl	0.15	0.15	0.12	0.23	0.23	0.15	0.24	0.25	0.14	0.26	0.26	0.16
Limestone	0.09	0.11	0.19	0.34	0.42	0.44	0.25	0.29	0.32	0.40	0.47	0.51
Dicalcium phosphate	2.44	2.30	2.19	2.20	2.09	2.06	2.18	2.10	2.07	1.81	1.70	1.66
Cytromix	0.20	0.20	0.20	–	–	–	–	–	–	0.10	0.10	0.10
DL-Methionie 99	0.25	0.25	0.25	0.25	0.25	0.25	0.28	0.27	0.26	0.21	0.21	0.20
L-Lysine 99	0.23	0.23	0.23	0.23	0.24	0.25	0.32	0.32	0.33	0.22	0.21	0.23
Premiks (Ekstramix)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Crude protein	28.49	28.48	28.51	22.00	22.00	22.00	18.00	18.00	18.00	16.50	16.50	16.50
Crude fat	4.17	4.77	3.53	5.78	6.78	4.43	5.40	7.15	4.16	4.87	6.96	3.73
EM, MJ/kg (calculated)	11.69	11.69	11.73	12.55	12.55	12.55	12.76	12.76	12.76	12.76	12.76	12.76

TABLE 2

Content of some amino acids, vitamins and minerals/1kg feed mixture

Components	Feeding period,days			
	1-35	36-77	78-112	113-154
Methionine	0.66	0.57	0.54	0.46
Methionine –cystine	1.10	0.94	0.86	0.77
Lysine	1.78	1.35	1.15	0.95
Arginine	1.94	1.42	1.09	0.97
Tryptophan	0.31	0.24	0.19	0.17
Vitamin A, IU	15 000	13 000	12 000	12 000
Vitamin D_3, IU	4 000	3 000	2 500	2 500
Vitamin E, mg	40	35	30	30
Vitamin K_3, mg	2.5	2	2	2
Vitamin B_1, mg	2.5	2	2	2
Vitamin B_2, mg	10	8	6	6
Vitamin B_6 , mg	5	3.5	3	3
Niacin, mg	70	65	65	65
Pantotenic acid, mg	20	18	15	15
Folic acid, mg	2	1.5	1.3	1.3
Biotin, mg	0.3	0.2	0.15	0.15
Choline, mg	600	400	300	300
Ca, g	1.4	1.2	1.1	1.0
P (available), g	0.77	0.65	0.65	0.57
Mn, mg	120	100	100	100
Zn, mg	90	80	70	70
Fe, mg	60	50	45	45
Cu, mg	10	8	7	7
J, mg	1	0.8	0.7	0.7
Se, mg	0.3	0.3	0.3	0.3

from 1 to 77 days cocidiostatic Diclazuril (qmg) and growth stimulator Flawofosfolipol (5 mg) were added

a program entailing 4 feeding stages: starter (1-35 days), grower 1 (36-77 days), grower 2 (78-112 days) and finisher (113-154 days). All of the birds were weighed at the ages of 35, 56, 77 and 154 days, group feed intake was measured weekly. Mortality and culling were ongoing, and the causes were also recorded.

At the age of 10 weeks, 4 birds from each group were placed in individual metabolic cages and fed grower mixture no. 1 *ad libitum*. The amount of consumed feed and excrement were registered for five successive days. Faecal nitrogen was distinguished from urinary nitrogen by the method of Ekman et al. (1949). The content of basic nutrients was determined in the feed mixtues and faeces by conventional methods, the content of structural carbohydrates was determined according to Van Soest and Wine (1967) using a Tecator AB Fibertec

M apparatus and the gross energy content in a KL – 10 calorimeter. The apparent digestibility of nutrients, neutral detergent fibre (NDF), acid detergent fibre (ADF), and hemicellulose were determined on the basis of the obtained results.

The Fattening Efficiency Index (FEI) was calculated using the following formula:

$$\mathrm{FEI} = \frac{(\text{sum of final body weight})^2 \times 10\,000}{\text{days of fattening} \times \text{number of birds} \times \text{feed consumption}}$$

At the end of the fattening period, 8 toms from each group were selected, fasted (12 h), slaughtered, and carcass dressing analysis performed.

The results were subjected to statistical analysis using the STAT 1 program and variance analysis, followed by Duncan's multiple range test.

DISCUSSION

When balancing the energy value (AME_N) of the feed mixtures, it was taken into account studies reported by Jeroch et al. (1995) and Marquardt et al. (1996), were the addition of enzymes increased the energy value of feeds. This increase was accepted as 6% in the case of wheat and triticale, and 10% in the case of barley, and the amount of soya oil added to the enzyme-supplemented triticale-barley mixtures was reduced accordingly.

No differences were found among groups with respect to the crude protein, NDF and ADF digestibilities of grower 1 feeds (Table 3). The fat in the triticale-barley mixtures was not digested as well as that from the wheat-maize mixtures (-2.6-3.6%). In the case of the wheat-barley supplemented with enzyme preparation B, the digestibility of hemicellulose and nitrogen retention decreased ($P \leq 0.05$), the reason for which was not obvious. The differences in the digestibility of some components and structural carbohydrates, although statistically significant, did not result in distinct changes in the results of fattening. In other studies (Muramatsu et al., 1992; Salobir et al., 1994; Kaoma et al., 1996; Marquardt et al., 1996) increased digestibility of dietary nutrients was usually found as the result of adding exogenous enzymes. This applies in particular to fat, protein and nitrogen retention, and in some cases, to crude fibre as well.

The assumption made in this study that adding exogenous enzymes, increased the AME_N of wheat and triticale by 6% and barley by 10%, was confirmed by the balance studies on turkeys. The energy values (AME_N) of feeds 1 to 3 were similar (12.22-12.40 MJ/kg), however, in comparison with the control feed they

TABELA 3

Balance experiment

Indices	Groups				SEM
	control	1	2	3	
Digestibility coefficients, %					
crude protein	82.9	83.0	82.1	82.1	0.228
crude fat	64.7^{a}	63.0^{b}	63.0^{b}	62.4^{b}	0.477
NDF	43.6	42.3	43.0	41.3	0.747
ADF	7.7	9.5	9.8	11.0	1.186
hemicellulose	58.3^{a}	59.5^{Aa}	58.9^{a}	56.2^{Bb}	0.545
N retention, % of N intake	47.9^{a}	48.9^{a}	47.6^{ab}	46.5^{b}	0.666
AME_N, MJ/kg*	12.63^{Aa}	12.35^{ABb}	12.22^{B}	12.4^{ABb}	0.271
AME_N / GE, %	70.15^{a}	67.08^{b}	68.45^{b}	70.13^{a}	0.413
Droppings DM, %,	18.6	19.7	17.6	18.4	0.732

* calculated according to equation from European Table of Energy Values for Poultry Feedstuffs, 1989: AME_N, kJ/kg = 18.03 digestible crude protein + 38.83 digestible fat + 17.32 N-free extractives

a, b, c – $P \leqslant 0.05$

A, B – $P \leqslant 0.01$

were about 1.8-3.2% lower ($P<0.05$). Gross energy utilization of feed 3 and the control feed were about 70.1%, while that of feeds 1 and 2 was lower by 4.3 and 2.3%, respectively ($P<0.05$).

The addition of enzymes to the feeds did not have the expected effects of reducing excrement moisture content (Table 3), as reported by other authors (Salobir et al., 1994; Al Bustary, 1996; Marquardt et al., 1996).

The results of fattening tom turkeys are presented in Table 4. Up to day 56 the birds from group 3 (preparation B) showed poorer weight gains ($P<0.05$). Later (at 77 and 112 days of age), the body weights of toms in all groups were similar. At the completion of fattening (154 days) the body weights of the toms were not significantly different, ranging from 16.59 kg (group 3) to 17.02 (control group). A similar relationship was found for feed utilization per kilogram body weight (Table 4). In none of the studied periods was there any significant difference in this trait among the groups. The body weights of 22-week-old toms and feed utilization (2.82-2.93 kg/kg) in fattening did not differ significantly from the optimal values given for moderately heavy BUT 9 tom turkeys (BUT 9 – Performance goals, 3rd Edition, British United Turkeys).

The addition of either enzyme preparations lowered the cost of feed used per kilogram weight gain of the tom turkeys by 7.5-11.0% in comparison with the control group and by 5.0-8.5% in comparison with the group fed the triticale-barley diet not supplemented with enzymes.

TABLE 4

Performance of turkeys

Indices	Groups				SEM
	control	1	2	3	
Body weight, kg					
at day: 35	1.02^{A}	1.04^{A}	1.03^{A}	0.96^{B}	0.012
56	2.95^{ABa}	2.99^{Aa}	2.93^{ab}	2.85^{Bb}	0.029
77	5.69	5.59	5.64	5.53	0.055
112	11.19	11.08	10.91	10.87	0.098
154	17.02	16.63	16.86	16.59	0.169
Feed intake, kg/kg					
days: 1- 35	1.76	1.76	1.76	1.78	0.023
1- 56	1.91	1.92	1.92	1.92	0.012
1- 77	2.07	2.09	2.06	2.07	0.024
1-112	2.38	2.38	2.40	2.42	0.036
1-154	2.82	2.89	2.90	2.93	0.026
Relative cost of feed	100	96.2	88.9	91.5	–
per kg BW, %	104	100	92.5	95.1	–
Losses, %					
1-154 days	7.0	2.6	3.5	7.0	–
WEO	321	310	295	290	9.904

a, b – $P \leq 0.05$
A, B – $P \leq 0.01$

Loss of birds (Table 4) during the 154-day fattening period was small (2.6-3.5%; groups 1 and 2, respectively) and up to 7.0% (control and group 3). Losses were mainly due to mortality (poor health of chicks and inflammation of the yolk sac), and, to a lesser degree, to culling (cachexia and leg deformities).

The Fattening Efficiency Index (FEI) for the entire period of fattening birds fed the wheat-maize mixtures (control group) was higher by 3.5-10.5% than for birds fed the triticale-barley mixtures (groups 1 to 3).

TABELA 5

Indices of slaughter analysis, % of body weight

Indices	Groups				SEM
	control	1	2	3	
Dressing percentage	83.4	83.8	83.3	83.8	0.332
Giblets	1.7^{bc}	1.6^{Aa}	1.8^{Bb}	1.6^{ac}	0.052
Breast muscles	26.4	26.1	25.3	25.9	0.599
Leg muscles	19.2	19.3	19.7	20.3	0.506
Abdominal fat	1.3	1.3	1.3	0.9	0.141

a, b, c – $P \leq 0.05$
A, B – $P \leq 0.01$

The results of carcass dressing analysis and partial dissection of 22-week-old tom turkeys (Table 5) did not show distinct differences among the feeding regimens used; with respect to carcass dressing percentage (83.4-83.8%), the breast meat content (25.3-26.4%), thigh muscle (19.2-20.3%) or intermuscular fat content (0.9-1.3%).

CONCLUSIONS

Balanced feed mixtures containing a considerable proportion of triticale (up to 46.8%) and barley (up to 35.0%) had a similar nutritional value as wheat-maize mixtures.

A similar energy value of mixtures 1, 2, and 3 was found in the balance experiment, and as well, similar final body weights were obtained. The similarity in feed utilization for weight gain and carcass dressing confirm the assumption that the addition of enzymatic preparations can increased energy value (AME_N) of cereal feeds by 6-10%.

Feed mixtures supplemented with enzyme preparations were more economical in comparison with the control triticale-barley (by 5.0%-7.5%) and wheat-maize (by 8.5%-11.0%) feeds.

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STRESZCZENIE

Wpływ uzupełniania enzymami mieszanki pszenżytnio-jęczmiennej na wyniki odchowu indyków

456 jednodniowych indorów BUT-9, podzielonych na 4 grupy (3 powtórzenia x 38 sztuk w każdej grupie) odchowywano do wieku 154 dni. Grupę kontrolną żywiono mieszanką pszenno-kukurydzianą, w mieszankach doświadczalnych zastąpiono te zboża pszenżytem i jęczmieniem. Mieszankę 1 skarmiano bez dodatku enzymów, do mieszanek 2 i 3 wprowadzono dwa różne preparaty enzymatyczne. Do mieszanek uzupełnionych enzymami dodawano mniej oleju sojowego, zakładając, że na skutek dodatku enzymów AME_N pszenżyta i pszenicy może zwiększyć się o 6%, jęczmienia o 10%.

Masa ciała oraz wskaźniki wykorzystania paszy, strawność składników pokarmowych i wydajność poubojowa indyków były we wszystkich grupach zbliżone. Mieszanki z udziałem preparatów enzymatycznych były się bardziej efektywne ekonomicznie w porównaniu z kontrolnymi mieszankami pszenżytnio-jęczmiennymi (o 5.0-7.5 %) i pszenno-kukurydzianymi (o 8.5-11.0%).