Acta Agraria Kaposváriensis (2002) Vol 6 No 2, 245-252
Kaposvári Egyetem, Állattudományi Kar, Kaposvár
University of Kaposvár, Faculty of Animal Science, Kaposvár

The effect of multienzyme preparation on the growth performance of broilers

G. Kralik, I. [1]Bogut, Z. Škrtić, G. Kušec
Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, Osijek, HR-31000. Trg Sv. Trojstva 3., Croatia
[1]University of Mostar, Faculty of Agronomy, Mostar, BiH-81000 Trg Hrvatskih Velikana 1., Bosnia-Herzegovina

ABSTRACT

The multienzyme preparation, as a stabilised mixture of enzymes: β-glucanase, xylanase, α-amylase, protease, β-glucosidase, cellulase and chemicellulase, and its effect on fattening characteristics of broilers were investigated in this study. The research has been carried out on male Avian 34 broilers. Broilers in control group were fed with preparations containing 21.25% crude proteins and 13.3 MJ/kg ME, i.e. 19.45% crude proteins and 13.53 MJ/kg ME. The polienzyme preparation in the amount of 0.05% was added to the diets for broilers in experimental group. After 6 weeks of fattening, the average live weight of broilers in experimental group was 2088±69.89g, while the average live weight of broilers in control group was 1962±65.70g (P<0.01). Supplementation of multienzyme preparation influenced the achievement of higher live weights of the broilers from the experimental group for 6.42%, compared to the control and enhanced feed conversion for 5.52%. Evaluation of the inflection point (T_I) proved that the supplementation of multienzyme preparation into the broiler diets improves progressive growth stage of broilers.
(Keywords: broiler, enzyme, body weight, feed conversion)

INTRODUCTION

As energetic forage, maize, barley**,** triticale, rye and oats are used in the feeding of poultry. These cereals contain in the cell membranes non-starch polysaccharides such as cellulose, xylanase and beta-glucanase. Because of the presence of non-starch polysaccharides, the approach to amylolytical enzymes for starch decomposition and proteolytic enzymes for decomposition of proteins in aleuronic layer of the grain is made more difficult. For that reason, one part of nutritive substances does not dissolve in small intestine but in large intestine, what results in decrease of digestion efficiency. By adding enzymes into the broilers' food, digestibility and energetic value of forage is increased. Suggestions for adding the enzymes in the preparations (mixtures), which besides maize, contain also barley, are based on studies of *Rotter et al.* (1989), *Jeroch et al.* (1993) and *Salobir et al.* (1995). These results are related to the improved digestibility, higher energetic value of feedstuffs, increased feed consumption, increased daily live weight gain, propitious conversion and decreased frequency of sticky excrements. Enzymes can be added to diets separately or in the form of enzyme preparations, which has proved more effective because of its synergetic function (*Graham* and *Pettersson*, 1992). By using mixtures which contained polienzyme preparations, *Jeroch et* al. (1991) and *Richter et al.* (1991) have proved the improvement of broilers live weight for 5.6% and 2.5% respectively in relation to the control group.

Rajmane (1992) and *Brenes et al.* (1993) claim that, besides increased live weight for 5.7–9.7%, better food conversion of 8-16% is also achieved. By supplementation of polienzym preparation, which has also been used in our research, *Vranešić et al.* (1994, 1999) achieved better growth rate for 3.4-5.4% and better conversion for 1.92-8.34%. By using preparations with different enzyme mixture, *Kralik et al.* (1993, 1994, 1995) also achieved better growth of broilers for 8.2–12%, as well as better feed conversion into the live weight gain for 8-11%.

The aim of our research was to found out whether a multienzyme preparation "Pliva" containing beta-glucanase, xylanase, alpha-amylase, protease, beta-glucosidase, cellulase and chemicellulase, can improve utilization of the diets based on maize and barley (32.20% and 24.63%, and 40.90% and 22.20% respectively) and enhance the growth of broilers.

MATERIALS AND METHODS

The study of the multienzyme preparation effect on product results has been carried out on 140 Avian 34 male broilers. By a random choice they were divided in two groups (70 broilers in control and 70 broilers in experimental group) and kept in two separate boxes within the same object. The fattening period lasted 6 weeks. Starter and finisher diets were prepared of the same components so that they had the same chemical composition. The broilers were fed with starter diet from the 1st until 21st day and with finisher diet from 22nd until 42nd day of life. Enzyme preparation was supplemented into diets for experimental group in amounts of 0.05% or 0.5 g/kg diet (*Table 1*).

The amount of water in the diets was determined by drying the sample at 105°C up to constant mass. The protein content was established by Kjel-Foss type of nitrogen analyser (protein content=N%x6.25). Crude fibres of the diet mixture were determined by *Hennberg-Stockman* method. The content of amino acids was established by automatic analyser (LKB 4101) using Merck standards (Merck, Germany).The inflection point and individual stages of growth were established by asymmetric S-function (*Kralik* and *Scitovski*, 1993):

$$f(t) = \frac{A}{(1 + be^{-c\gamma t})^{1/\gamma}} \quad \text{A, } \gamma > 0$$

$$t_B = \frac{1}{c\gamma} \ln \frac{2b}{\gamma(\gamma+3) + \gamma\sqrt{(\gamma+1)(\gamma+5)}}$$

$$t_C = \frac{1}{c\gamma} \ln \frac{2b}{\gamma(\gamma+3) - \gamma\sqrt{(\gamma+1)(\gamma+5)}}$$

Asymmetric S-function with one inflection point is continuously increasing in the whole area, in which it has been defined. The parameters of the function, *b* and *c*, are determined on the basis of experimental data using the least square method, while biological maximum A and coefficients of asymmetry are given empirically. Herewith, the point t_B is the maximum in the region of intensive growth (convex region) and point t_C is minimum in the region of depressive growth (concave region). The interval $t \leq t_B$ represents the stage of growth preparation, the interval $t_B \leq t \leq t_C$ the stage of intensive

growth, and the interval $t \geq t_C$ is the stage of growth retardation (*Kralik* and *Scitovski*, 1993). The results of the investigations of particular traits were presented by arithmetic mean and standard deviation ($\bar{x} \pm s$) and differences between the groups of broilers were tested by t-test. Statistical data were processed on personal computer using Statistica v.5.0 for Windows software.

Table 1

Composition and nutritive value of the diet

Ingredient (%)	Starter		Finisher	
	Control	Experiment	Control	Experiment
Maize	32.20	32.20	40.90	40.90
Barley	24.63	24.63	22.20	22.20
Soybean meal (42% c. protein)	30.80	30.80	25.90	25.90
Fish meal (65% c. protein)	4.50	4.50	3.50	3.50
Animal fat	4.10	4.10	3.50	3.50
Lysine	0.10	0.10	0.10	0.10
Methionine	0.22	0.22	0.20	0.20
Salt	0.25	0.25	0.20	0.20
Limestone	1.20	1.15	1.50	1.45
Monocalcium phosphate	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50
Enzyme polizyme	-	0.05	-	0.05
Total	100.00	100.00	100.00	100.00
Calculated values (%):				
Crude protein	21.25	21.25	19.45	19.45
Crude fat	6.35	6.35	5.70	5.70
Crude fiber	3.68	3.68	3.49	3.49
Lysine	1.10	1.10	0.96	0.96
Methionine	0.56	0.56	0.48	0.48
Threonine	0.74	0.74	0.65	0.65
Triptophane	0.25	0.25	0.20	0.20
Leucine	1.36	1.36	1.30	1.30
Cystine	0.31	0.31	0.25	0.25
ME (MJ/kg)	13.33	13.33	13.53	13.53

RESULTS AND DISCUSSION

The effect of multienzyme preparation supplementation was monitored on the basis of live weights of the broilers and conversion of feed into live weight gain. At the beginning of the fattening period, the average live weight of broilers was the same in control and experimental group. At the end of the study period of 42 days, average live weight of the broilers in control and experimental group was 1962±65.70 g and 2088±69.89 g, respectively. The live weight of the broilers from experimental group was 126 g (6.42%) higher than in control group. Statistically significant differences in live weights between experimental and control group were established after the first week ($P<0.01$) and they remained constant until the end of the fattening period (*Table 2*).

Significantly higher daily weight gains throughout the fattening period were found in the experimental group and were higher for 6.25% in the 1st week and 15.8% in the 6th week than in control group.

Table 2

Average live weight of chickens in fattening

Age of chickens	Number of chickens		Average live weight (g)		Significance of differences
	C	E	C	E	
1 day	70	70	41 ± 1.06	41 ± 0.90	
1	69	70	148 ± 4.60	151 ± 6.07	**
2	67	68	393 ± 16.91	415 ± 13.74	**
3	66	68	701 ± 22.97	724 ± 17.14	**
4	66	68	1081 ± 41.41	1147 ± 70.60	**
5	66	68	1626 ± 46.54	1688 ± 35.99	**
6	66	68	1962 ± 65.70	2088 ± 69.89	**

*C=control group; E=experimental group; ** P<0.01*

Comparing the results of feed conversion rate between control and experimental group of broilers, it is evident that broilers from the experimental group had 5.52% better feed conversion ratio at the end of the fattening period (*Table 3*). From these data it is evident that, during the 42 days of fattening period, the broilers in experimental group consumed negligible quantity of feed than the broilers in control group, but the food conversion into the live weight gain was better in experimental than in control group. The utilization of food (FU), presented as a relation 1 kg live weight and feed consumption in particular period of time, showed that polienzyme preparation enabled better digestion of nutritive substances, which affected digestion efficiency, as well as better feed conversion in experimental group of broilers in comparison to the control group of broilers (50.25% and 53.19%, respectively).

Table 3

Cumulative review of consumption, conversion and utilization of feed

Week	Consumption (kg)		Conversion (kg)		Feed utilization (%)	
	C	E	C	E	C	E
1	0.19	0.19	1.77	1.73	56.50	57.80
2	0.63	0.65	1.80	1.74	55.55	57.47
3	1.21	1.20	1.83	1.76	54.64	56.82
4	1.95	1.98	1.87	1.79	53.47	55.86
5	3.10	3.03	1.95	1.84	51.28	54.35
6	3.83	3.85	1.99	1.88	50.25	53.19

C=control group; E=experimental group

The parameters of asymmetric S-function used in modelling of the live weight growth of broilers from both groups are presented in *Table 4*. The parameters show different position of the inflection point (T_I: control group 33.75 days and 1478.84 g; experimental group 32.52 days and 1479.08 g). According to this, the supplement of

polienzyme preparation stimulated the progressive growth, so that the inflection point (T_I) occurred 1.23 day earlier in the experimental group than in the control group. Analysis of evaluated parameters shows that broilers in experimental group would reach the same weight (2736 g) in 53.38 days, whereas broilers in control group would reach the same weight in 55.74 days.

Table 4

Parameters of the function – growth model

Parameter	Chicken groups	
	Control	Experiment
b	0.044105	0.045141
c	4.396885	4.635193
γ	0.01	0.01
T_I	33.7507; 1478.8448	32.5167; 1479.0776
t_B	11.7605; 298.3351	11.6571; 298.4667
t_C	55.7409; 2736.6406	53.3763; 2736.8734

Curves and growth characteristics are described by asymmetric S-function and presented on *Figures 1* and *2*.

Control group $$y = \frac{4000}{(1 + 0.0441047 \cdot e^{-4.3968845 \cdot 0.01t})^{1/0.01}}$$

Experimental group $$y = \frac{4000}{(1 + 0.0451412 \cdot e^{-4.6351930.01t})^{1/0.01}}$$

Figure 1

Growth curve of the control group of broilers

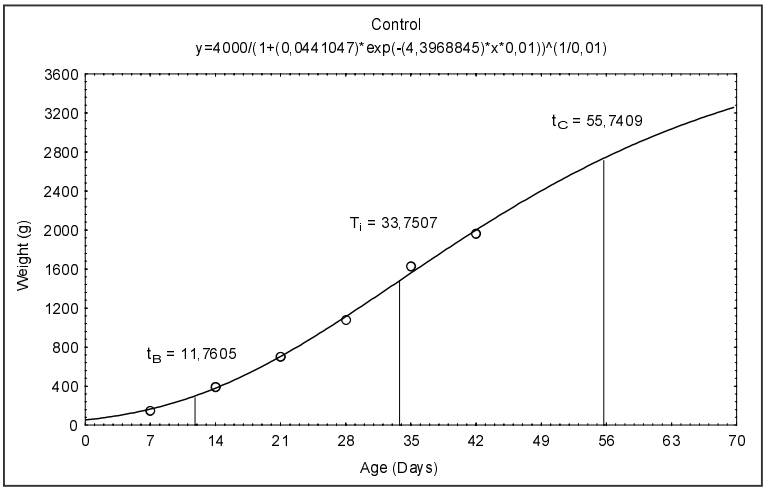
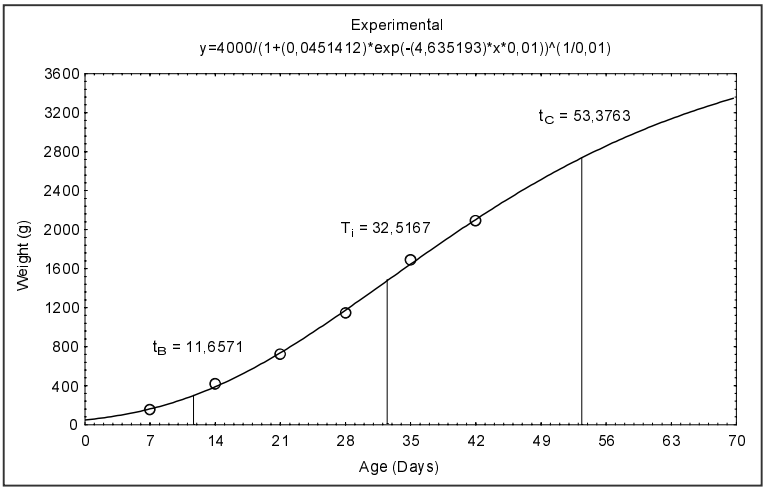


Figure 2

Growth curve of the experimental group of broilers



The analysis of fattening traits of broilers (*Tables 2* and *3*) shows positive effect of multienzyme preparation, which, as a stabilized mixture of enzymes: beta-glucanase, xylanase, alpha-amylase, protease, beta-glucosidase, cellulase and chemicellulase, resulted in better digestibility of nutrients and increased the energetic value of feed. Therefore, better feed utilization of 53.19% in comparison to 50.22% resulted in better weight gain of broilers in experimental group. These results are in accordance with results of *Rotter et al.* (1989), *Richter et al.* (1991), *Graham* and *Pettersson* (1992), *Jeroch et al*. (1993), as well as of *Salobir et al.* (1995). At the end of the fattening period, the increase of broilers live weight is approximately the same as the results of the quoted authors are. However, it should be emphasized that the efficiency of the enzyme depends on the feedstuffs and on the concentration of enzyme supplement of the diet. The results of our research concerning the feed conversion in the live weight gain are approximately the same as the results of *Rajmane* (1992) and *Šerman et al.* (1997), but they are considerably below those of *Brenes et al.* (1993). By adding polienzyme preparation into the diet, *Vranešić et al.* (1994) achieved approximately the same effect of the fattening traits of broilers as we did. Research results of adding multienzyme preparation in amount 0.05% to the broiler diet (21.25%/19.45% crude proteins and 13.3 MJ/13.53 MJ ME/kg) showed positive effects on the fattening traits of broilers. After 42 days of fattening the broilers live weight was increased for 6.42%. The feed conversion into the live weight gain was also increased for 5.52%. The mortality of the broilers was lower in experimental than in control group (2.86% and 5.71%, respectively). Supplementation of multienzyme preparation in the diet enhanced intensive stage of growth (group E 11.66-53.38 days, group C 11.76-55.74 days). The period of intensive growth in experimental group of broilers lasted shorter than in control group, which was proved by the different positions of inflection points (T_I=32.5167 for experimental group and T_I=33.7507 for control group). This research confirms positive effect of supplemented polienzyme preparation on the fattening characteristics of broilers what is in accordance with earlier studies (*Kralik et al*., 1993, 1994 and 1995).

CONCLUSIONS

On the basis of results of the study on effect of multienzyme preparation, supplemented to the diet in amount of 0.05%, on productive traits of the broilers, following conclusions can be defined: The average live weights of the broilers fed diets with multienzyme preparation were for 126 g or 6.42% higher ($P<0.01$) compared to the control group fed by the same diet without multienzyme preparation. Supplemented multienzyme preparation had positive effect on feed conversion ratio which was better for 5.52% in the experimental group, compared to the control group. It was found that supplementation of multienzyme preparation in the diet enhance intensive stage of live weight growth of broilers (group E 11.66-53.38 days, group C 11.76-55.74 days).

REFERENCES

Brenes, A., Smith, M., Guienter, W., Marquardt, R.R. (1993). Effect of enzyme supplementation on the performance and digestive tract size of broiler chickens fed wheat- and barley based diet. Poultry Science, 72. 1731-1739.

Graham, H., Pettersson, D. (1992). A note on the effect of a Beta-glucanase and multi-enzyme on production in broiler fed a barley based diet. Swedish Journal of Agricultural Research, 1. 39-42.

Jeroch, H., Helander E., Schlöffel, H., Engerer, K. (1991). Prüfung der Wirhsamkeit des Beta-glukonase enhaltened Enzympräparates "Avyzime^{R}" zu einer Broilermast mischung auf Geedtaibasis. Archiv für Geflügelkunde, 1. 22-25.

Jeroch, H., Schurz, M., Müller, A. (1993). Einfluss des Beta-Glukanase enthaltenden Enzympräparates "Avizyme Reg trade mark" auf die Futterwirkung von Broilermastmischungen mit underschiedlichem Gersteanteil. Kühen-Archiv, 1. 74-87.

Kralik, G., Scitovski, R. (1993). Istraživanje značajki rasta brojlera pomoću asimetrične S-funkcije. Stočarstvo, 5-6. 207-213.

Kralik, G., Senčić, Đ., Maltar, Z., Mandić, B. (1993). Influence of added Polizymes^{R} in feed on broiler performance. Krmiva, 2. 47-57.

Kralik, G., Bogdanić, Č., Malenšek, A., Biuklija, I., Canecki, K. (1994). Broiler growth stimulation by addition of Polizymes$^{®}$ in the mixtures for fattening. Krmiva, 5. 223-228.

Kralik, G., Galonja, M., Petričević, A., Malenšek, A. (1995). Effect of Polizym$^{®}$ BX preparation in barley-based diet of broilers. Krmiva, 5. 247-254.

Rajmane, B.V. (1992). Direct fed enzymes for broilers. Feed International, 5. 32-34.

Richter, G., Cyriaci, G., Schwartze, I. (1991). Prüfung der Wirksamkeit von Enzymen in Broilerration. In Vitamine und weitere Zusatzstoffe bei Mensch und Tier., 3 Symposium, Jena, 26/27, September.

Rotter, B.A., Marquardt, R.R., Guenter, N. (1989). Optimising responses from enzyme in poultry and pig diets: new methods for nesuring response. V. Lyonstr. P. Biotechnology in feed industry. Proceeding of Alltech's 5th Annual Symposium, Alltech technical publications, Nicholasville, Kenticky, 149-160.

Salobir, J., Kermauner A., Bogdanić Č., Malenšek A., Stopar J., Štruklec M. (1995): Utjecaj enzimskog preparata Polizyma$^{®}$BX na performancu brojlera i intestinalnu viskoznost krmiva na osnovi pšenice i kukuruza/pšenice. Krmiva, 6. 323-328.

Šerman, V., Mikulec, Ž., Mas, N., Dumanovski, F. (1997). The effects of multienzyme preparation on production results of fattening chicks fed rye-based diets. Acta Veterinaria, Brno, 3. 147-154.

Vranešić, M., Baćar-Huskić, L., Marović, I., Groš, I., Stuburić, B. (1994). Učinkovitost Plivinog multienzimatskog preparata u tovu pilića. Međunarodno savjetovanje Krmiva '94, 1-15.

Vranešić, N., Bećar-Huskić, L., Marković, D., Stuburić, B., Groš, I., Marković-Devčić, B., Marković, I., Friganović, I., Dumanovski, F., Ljubičić, S. (1999). Rezultati istraživanja s multienzimskim pripravkom u hranidbi domaćih životinja. Krmiva, 1. 15-24.

Corresponding author:

Gordana Kralik
J.J. Strossmayer University of Osijek, Faculty of Agriculture
HR-31000 Osijek, Trg Sv.Trojstva 3., Croatia
Tel.: 385 31 224 241, Fax: 385 31 207 017
e-mail: gkralik@pfos.hr