

## THE EFFECTS OF ENZYME PREPARATION POLIZYME<sup>®</sup> -BX ON THE PERFORMANCE AND INTESTINAL VISCOSITY OF BROILER CHICKENS FED WHEAT-AND MAIZE/WHEAT BASED DIETS

## UTJECAJ ENZIMSKOG PREPARATA POLIZYMA<sup>®</sup> -BX NA PERFORMANCU BROJLERA I INTESTINALNU VISKOZNOST KRMIVA NA OSNOVI PŠENICE I KUKURUZA/PŠENICE

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### SUMMARY

The effect of enzyme preparation Polizyme-BX on growth performance, feed efficiency and intestinal viscosity was studied in an experiment with 840 broiler chickens. The experiment was divided into two periods: day 0-21 and day 21-42. In the first period all animals received wheat based starter diet unsupplemented or supplemented with Polizyme<sup>®</sup> -BX (0, 100, 200 or 300 mg/kg). In the second period animals received wheat (W) based or maize/wheat (M/W) based finisher diet unsupplemented or supplemented with Polizyme<sup>®</sup> BX (W: 0: 100, 200 or 300 mg/kg; M/W: 0 or 200 mg/kg). The results of the experiment show that enzyme preparation Polizyme<sup>®</sup> -BX significantly improved growth performance (2-3 %) and feed conversion (5-7 %) in all supplemented wheat based broiler chickens diets. The improvement was more pronounced in starter than in finisher diet. The overall effect of enzyme preparation in M/W diet remains unclear, because the preparation was tested only in finisher diet, where the results are similar to those obtained on W diet. All Polizyme<sup>®</sup> -BX concentrations significantly reduced intestinal viscosity (W starter diet: 53-58 %, W-finisher diet: 20-36 %, M/W-finisher diet: 13 % (not sig.)). The dose effect of Polizyme<sup>®</sup> was not very pronounced.

### INTRODUCTION

There is considerable evidence that cell wall non-starch polysaccharides (NSP) of plants play an important nutritional role in many monogastric species. The structure of the cell wall material varies from cereal to cereal, but all contain non-starch polysaccharides predominantly of  $\beta$ -glucans and arabinoxylans with smaller amounts of cellulose and polysaccharides containing galactose, mannose and glucose (Annison, 1993). The most important NSP of wheat are (soluble arabinoxylans, but the content of  $\beta$ -glucanes can also be very high

(Chesson; 1991). NSP content in wheat, which is one of the most important ingredients in broiler chicken diets, can markedly influence its AME value. Annison (1991) demonstrated that there is a high negative correlation between the AME of wheats and their soluble NSP contents.

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The negative role of NSP is still not clearly understood, but there are at least some very important factors, which can play an important role in lowering nutritional value of wheat and other cereals. One of them is the restricted access of nutrients found in the endosperm, the other, perhaps even more important, is the influence of the NSP on the intestinal viscosity. Dissolved NSP are capable to create viscous solutions and thereby reduce the diffusion rate of enzymes in the intestinal content, diffusion of digested nutrients to the gut wall and intestinal rate of digesta transport (Chesson, 1991; Classen and Bedford, 1991; Campbell and Bedford, 1992; Bedford and Classen, 1992). This leads to inhibited digestion of starch, lipid and protein and, as consequence, depression in bird performance occurs (Choct and Anison, 1992). In the fowl which do not synthesise specific enzymes for degradation of non-starch polysaccharides and where the contribution of fermentation of NSP in caecum and large intestine is insignificant (Ratcliffe, 1991), the negative effects of NSP can be very pronounced. The addition of appropriate enzyme prepara-

tions can markedly increase nutritional value of wheat and other cereals (Salobir et al., 1994).

The purpose of present growth experiment was to specify the optimum dosage of enzyme preparation Polizyme® -BX (Krka, Novo mesto, Slovenia) containing mainly  $\alpha$ -amylase and  $\beta$ -glucanase added to wheat- and wheat/maize pelleted broiler diets. In addition the influence of enzyme supplementation in these diets on the viscosity of intestinal content was studied.

## MATERIALS AND METHODS

840 day-old sexed broiler chickens (Ross) were obtained from a commercial hatchery and assigned to 3-deck battery with wire floors at controlled temperatures. The experiment lasted for 42 days and was divided into two periods: period 1 (day 0 to day 21) and period 2 (day 21 to day 42). In period 1 (Starter diet) each of the four treatments was replicated seven times (7 cages with 30 bird per treatment). Experimental diets in period 1 were

Table 1: Composition of experimental diets  
Tablica 1: Sastav pokusnih krmnih smjesa

	Starter diet Day 0-21	Finisher diet Day 21-42	
	Početna krmna smjesa dana 0-21	Završna krmna smjesa dana 21-42	
	Wheat based Osnova pšenica	Wheat based Osnova pšenica	Maize/wheat based Osnova kukuruz/pšenica
Wheat-pšenica (%)	63,21	63,68	30,96
Maize-kukuruz (%)	-	-	30,00
Soybean meal Sojina sačma %	26,09	25,27	27,92
Fish meal riblje brašno %	4,00	2,00	2,00
Sunflower oil suncokretovo ulje	3,16	5,49	5,50
Salt-sol (%)	0,01	0,05	0,02
Limestone-vapnenac (%)	0,90	0,87	0,67
Ruekana (%)	0,98	1,08	1,38
DL-methionine (%)	0,15	0,06	0,05
Binder-vezivo (%)	1,00	1,00	1,00
Vitamins and mineral premix (%)	0,50	0,50	0,50
Dry matter ST (%)	88,66	88,38	88,14
Metabolizable energy* (MJ ME/kg)	12,20	12,69	12,90
Crude protein s. bjelančevine (%)	20,93	19,99	19,85
Crude fat s. mast (%)	4,88	6,82	7,62
Crude fibre s. vlaknina (%)	3,10	3,46	3,82
Lys* (%)	1,13	1,00	1,02
Met+Cys* (%)	0,85	0,70	0,69
Ca (%)	1,01	0,94	0,96
P (%)	0,69	0,66	0,67
P-available* (%)	0,41	0,38	0,38
Na (%)	0,15	0,14	0,14

\* calculated content - kalkulirani sadržaj

as follows: 1) W-0 = wheat, no enzymes, 2) W-100 = wheat plus 100 mg Polizyme® -BX/kg, 3) W-200 = wheat plus 200 mg Polizyme® -BX/kg, 4) W-300 = wheat plus 300 mg Polizyme® -BX/kg. On the 21st day the birds were individually weighed and each cage was splitted into three cages with ten birds per cage (84 cages with 10 bird). In period 2 (finisher diet) each of the six treatments was replicated 12 or 15 times (12 or 15 cages with 10 birds per treatment). Experimental diets in period 2 were as follows: 1) W-0 = wheat, no enzymes, 2) W-100 = wheat plus 100 mg Polizyme® - BX/kg, 3) W-200 = wheat plus 200 mg Polizyme® -BX/kg, 4) W-300 = wheat plus 300 mg Polizyme® -BX/kg, 5) M/W-0 = maize/wheat, no enzymes, 6) M/W-200 = maize/wheat plus 200 mg Polizyme® -BX/kg. The enzyme preparation Polizyme® -BX (Krka, Novo mesto, Slovenia) contained following main enzyme activities: xylanase (19200 U/g),  $\beta$ -glucanase (1350 U/g),  $\alpha$ -amylase (9930 U/g) and protease (3050 U/g).

The compositions of experimental diets are presented in Table 1. All birds received ad libitum access to feed and water. Feed was provided in fine crumbs (0 to 21 days) and pellets (21 to 42 days). The average pen weights were recorded at the day 0 and the individual bird weight at the 21st and the 42nd day. Feed intake was determined per each cage. Health status and mortality of birds were monitored daily. All the birds that died in first four days of experiment were substituted with birds of appropriate weight.

For the intestinal viscosity analysis, at the 20th and the 41st day twelve birds per treatment were randomly selected and killed. Total intestinal contents were collected from gizzard to Meckel's diverticulum, immediately homogenised and placed in a microcentrifuge tubes and centrifuged at 9500 x g for 8 minutes. The supernatant was withdrawn and frozen. The viscosity was determined by using a rotational Brookfield digital viscometer (model LVDVCP-II+) maintained at 25 °C and at a shear rate 75 s<sup>-1</sup>.

Data were analysed using the General Linear Models (GLM) procedure from SAS® software (SAS Institute Inc., 1990) with the enzyme concentration, type of diet (wheat or maize/wheat) and sex main effect. By the statistical analysis of viscosity data also weight at slaughter was taken in the model as covariable.

## RESULTS AND DISCUSSION

The results are presented in table 2. No interaction between enzyme treatment and sex were found for any

performance parameter and therefore the pooled values for both sexes are given. The health status and mortality of the chickens were not affected by enzyme treatment and are therefore not included in the table 2.

In the first period of the experiment (starter diet, day 0-21) all levels of the enzyme preparation Polizyme® -BX resulted in a significant improvement ( $p < 0,05$ ) of both growth rate and feed conversion. Enzyme supplementation increased weight on the 21st day for 8, 10 and 7 % respectively. The feed intake remained on the same level in all supplemented as well as in unsupplemented groups (there was only a numerical decrease in feed intake in group W-100), and therefore also feed conversion in all supplemented groups in comparison to unsupplemented group was markedly improved. The improvement in supplemented groups ranged from 8 % in group W-300 to 10 % in groups W-100 and W-200. The improvement of growth had feed efficiency parameters in Polizyme® -BX supplemented groups was accompanied with significant decrease in intestinal viscosity. The reduction ranged from 53 % in groups W-100 and W-200 to 58 % in group W-300.

The results of second experimental period (finisher diet, day 21- 42) showed that enzyme addition significantly stimulate broiler chicken growth (+ 3 %) only in group W-100. The improvement in both groups supplemented with higher Polizyme® -BX dose was only numerical, although there was not a big difference between all supplemented groups. The difference in feed conversion between supplemented and unsupplemented groups is also not of statistical importance, but the tendency of improvement could be seen in groups W-100 and W-200. The results obtained in first and second period confirmed the results of other studies, which showed that the enzyme supplementation was more efficient in the first weeks of growth (Classen and Bedford, 1991; Salih et al., 1991). The intestinal viscosity of unsupplemented group receiving wheat based diet on the 42nd day was lower than on the 20th day; which could be expected due to the development of gastrointestinal tract during growth. Nevertheless our experimental data have shown that even in older animals (42 days) the enzyme addition significantly reduced the intestinal viscosity and stimulate (maintain) better conditions for feed digestion. The intestinal viscosity of supplemented groups was significantly reduced; for 20 % in group W-100, 25 % in group W-200 and for 36 % group W-300. In the case of starter diet, as well in this case the reduction was dose related. The dose related response of digesta viscosity was also found in studies of Bedford and Classen (1992) and Inbarr and Bedford (1994).

**Table 2: Effects of graded levels of enzyme preparation Polizyme® -BX on performance and intestinal viscosity of broiler chickens receiving wheat or Maize/wheat based diets**

**Tablica 2: Utjecaj različitih količina enzima Polizym® -BX na proizvodna svojstva i crijevni viskozitet brojerskih pilića koji su dobivali pšenicu ili kukuruz / pšenicu u hrani**

Treatment - Tretman	Wheat based Osnova pšenica				Maize/wheat based Osnova kukuruz/pšenica	
	W-0	W-100	W-200	W-300	M/W-0	M/W-200
<b>STARTER DIET (day 0 to 21) Početna krmna smjesa</b>						
Number of pens x birds Broj grupa x pilići	7x30	7x30	7x30	7x30		
Live weight-day 0 (g) Živa vaga-0 dan	41,4	40,0	40,3	40,6		
Live weight-day 21 (g) Živa vaga 21 dan	544 <sup>a</sup>	586 <sup>b</sup>	597 <sup>b</sup>	585 <sup>b</sup>		
Index (%)	100	108	110	107		
Daily gain (g/d) Dnevni prirast	23,9 <sup>a</sup>	26,0 <sup>b</sup>	26,5 <sup>b</sup>	26,0 <sup>b</sup>		
Feed intake (g) Uzimanje hrane	945	916	942	942		
Index (%)	100	97	100	100		
Feed conversion (kg/kg) Iskorištenje hrane	1,874 <sup>a</sup>	1,679 <sup>b</sup>	1,692 <sup>b</sup>	1,725 <sup>b</sup>		
Index (%)	100	90	90	92		
Viscosity-Viskozitet (cPs)	5,03 <sup>a</sup>	2,39 <sup>b</sup>	2,39 <sup>b</sup>	2,10 <sup>b</sup>		
Index (%)	100	47	47	42		
<b>FINISHER DIET (day 21 to 42) Završna krmna smjesa</b>						
Number of pens x birds Broj grupa x pilići	15x10	15x10	15x10	15x10	12x10	12x10
Live weight-day 42 (g) Živa vaga-42 dan	1996 <sup>a</sup>	2061 <sup>b</sup>	2051 <sup>ab</sup>	2039 <sup>ab</sup>	1963	2004
Index (%)	100	103	103	102	100	102
Daily gain (g/d) Dnevni prirast	69,3	70,3	68,9	69,5	67,2	68,7
Feed intake Uzimanje hrane (g)	2883	2895	2792	2882	2757	2789
Index (%)	100	100	97	100	100	101
Feed conversion (kg/kg) Iskorištenje hrane	1,981	1,965	1,933	1,976	1,956	1,931
Index (%)	100	99	98	100	100	99
Viscosity- Viskozitet (cPs)	3,19 <sup>a</sup>	2,54 <sup>b</sup>	2,38 <sup>b</sup>	2,05 <sup>b</sup>	2,41	2,09
Index (%)	100	80	75	64	100	87
<b>STARTER AND FINISHER DIET (day 0 to 42) POČETNA I ZAVRŠNA KRMNA SMJESA (0 do 42 dana)</b>						
Number of pens x birds Broj grupa x pilići	15x10	15x10	15x10	15x10		
Live weight-day 42 (g) Živa težina 42 dan	1996 <sup>a</sup>	2061 <sup>b</sup>	2051 <sup>ab</sup>	2039 <sup>ab</sup>		
Index (%)	100	103	103	102		
Daily gain Dnevni prirast (g/d)	46,5	48,2	47,9	47,6		
Feed intake Uzimanje hrane (g)	3837	3805	3748	3814		
Index (%)	100	99	98	99		
Feed conversion (kg/kg) Iskorištenje hrane	1,935 <sup>a</sup>	1,798 <sup>b</sup>	1,810 <sup>b</sup>	1,840 <sup>b</sup>		
Index (%)	100	93	94	95		

Means with different letter are significantly different ( $P < 0,05$ )  
 Prosjeci s različitim slovima razlike su značajne ( $P < 0,05$ )

Because wheat based and maize/wheat based diets were isocaloric, the obtained growth results were also on the same level. The supplementation of maize/wheat based finisher diet with Polizyme® -BX resulted in nearly statistically significant better growth (+ 2 %,  $p < 0,10$ ) and feed conversion (-1 %) results, which is similar to results obtained on wheat finisher diet. The intestinal viscosity in the unsupplemented maize/wheat based diet was as expected somewhat lower than in the wheat based diet. But even in these conditions the enzyme supplementation reduced intestinal viscosity for 13 % (not. sig.,  $p < 0,11$ ). Nevertheless remains unclear whether the enzyme addition to maize/wheat based diet in the first experimental period (day 0 to 21) would be more effective. According to very pronounced growth and feed efficiency improvement in wheat based diet and based on the results obtained on maize wheat finisher diet it could be speculated that also in diets with high maize part the enzyme addition could be beneficial.

The effects of graded levels of enzyme preparation Polizyme® -BX in wheat based diet on broiler chickens performance in the whole experiment (day 0-42, starter + finisher diet) are presented in the last part of table 2. The supplementation resulted in a significant improvement of growth rate in group W-100 and numerical improvement in groups W-200 and W-300. The feed intake of the supplemented groups was somewhat lower than in the unsupplemented group, but the feed conversion of all supplemented groups was significantly improved. The improvement in all groups was very high: 7 % in group W-100, 6 % in group W-200 and 5 % in group W-300. The differences between supplemented groups are not small, though statistically insignificant. It seems that all three levels of Polizyme® -BX supplementation in wheat based diet resulted in equally significant improvement of performance.

## CONCLUSIONS

The results of the experiment shows that enzyme preparation Polizyme® -BX efficiently improved growth performance and feed conversion and reduced intestinal viscosity in wheat based broiler chickens diets. The improvement was more pronounced in starter than in finisher diet. The overall effect of enzyme preparation in maize/wheat based diet remains unclear, because the preparation was tested only in finisher diet. The results are in general agreement with previous findings (Pettersson and Aman, 1989; Graham, 1991; Annison, 1992; Salobir et al., 1994) and confirmed the efficacy of the given enzyme complex (Kralik et al., 1993; Salobir et al., 1994).

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## SAŽETAK

U hranidbenom pokusu na 840 tovnih pilića istražen je utjecaj enzimskog preparata Polizyma® -BX na toвне karakteristike i viskoznost crijevnog sadržaja. Pokus je bio podjeljen na dva razdoblja: od 0-21. dan i od 21. do 42. dana. U prvom razdoblju svi pilići su dobivali početnu krmnu smjesu na osnovi pšenice (W) u koji je bio zamješšan Polizym® -BX (W: 0, 100, 200, 300 mg/kg). U drugom razdoblju pilići su dobivali završnu krmnu smjesu na osnovi pšenice (W) ili kukuruz/pšenice (M/W), u koje je bio umješšan Polizym® -BX (W: 0, 100, 200, 300 mg/kg; M/W: 0, 200 mg/kg). Rezultati ukazuju, da je Polizym® -BX u svim krmnim smjesama na osnovi pšenice tijekom cijelog razdoblja pokusa signifikantno poboljšao rast pilića (2-3 %) i konverziju hrane (5-7 %). Poboljšanje je bio izrazitije u prvom razdoblju pokusa. S obzirom da je Polizym® -BX u krmnoj smjesi na osnovi mješavine kukuruz/pšenica testiran samo u drugom razdoblju pokusa njegov ukupni učinak je nejasan, iako je njegova djelotvornost u završnoj krmnoj smjesi podjednaka kao u krmnoj smjesi na osnovi pšenice. Sve dodane koncentracije Polizyma® -BX signifikantno snižuju viskoznost intestinalnog sadržaja (W-početna: 53-58 %, W-završna: 20-36 %, M/W-završna: 13 % (ne signifikantno)). Utjecaj koncentracije Polizyma® -BX nije bio posebno izražen.



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