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THE EFFECT OF ENZYMES ON THE ECONOMICS OF POULTRY MEAT AND EGG PRODUCTION

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The aim of this paper was to study the effects of the Allzyme SSF® (ASSF) (Alltech Inc.)) in feed for broiler chickens and laying hens on the production results and economic effects. The first experiment comprised 1200 broiler chickens divided into 4 treatments: 1. Positive control; 2. Positive control with the addition of 0.02% of ASSF; 3. Negative control (containing 0.3 MJ of energy, 0.1% of adoptable P and 0.1% Ca less than in the treatment 1). 4. Negative control with the addition of 0.02% of ASSF. By the application of the enzyme the positive effects on the growth and feed conversion were obtained both in standard mixtures and the mixtures of decreased nutritive value. The economic analysis indicated that the improvement, brought about by the natural additive ASSF, exceeds the costs of its application. In the second trial with laying hens the treatments were as follows: A. Control; B. Control (as A) + 150 g/t ASSF instead of phytase; C. Reformulated feed with commercial phytase and energy reduced by 0.46 MJ; D. Reformulated feed (as C) + 150 g/t ASSF instead of phytase. The egg weight was not changed by dietary treatments but layers from both groups receiving ASSF (B and D) had a higher laying percentage. The economic analysis showed that the use of ASSF could lower the feed cost/kg of eggs in both standard and reformulated diets.

Key words: broilers; laying hens; enzymes; economic effect

ЕНЗИМИТЕ И НИВНОТО ВЛИЈАНИЕ ВРЗ ЕКОНОМСКИТЕ РЕЗУЛТАТИ ПРИ ПРОИЗВОДСТВО НА ЖИВИНСКО МЕСО И ЈАЈЦА

Целта на ова истражување беше да се испита влијанието на ензимскиот комплекс Allzyme SSF® (ASSF) (Alltech Inc.) додаден во храната за бројлерски пилиња и несилки врз производните резултати и економските ефекти во производството. Со првиот опит беа опфатени 1200 бројлерски пилиња поделени во 4 групи (третмани): 1. позитивна контролна; 2. позитивна контролна со додаток на 0,02% од ензимскиот комплекс; 3. негативна контролна (содржеше 0,3 MJ ME, 0,1% P и 0,1% Ca помалку во однос на групата 1); 4. негативна контролна со додаток на 0,02% од ензимот. Додавањето на ензимот имаше позитивен ефект врз прирастот кај пилињата и врз конверзијата на храната кај двете групи пилиња. Економската анализа покажа дека подобрувањата кои ги донесе примената на овој ензимски препарат во исхраната на пилињата ги надминуваат трошоците за неговата примена. Во опитот со несилките за консумни јајца беа вклучени следните групи: А. контролна; Б. контролна (А) +150 g/t ASSF наместо фитаза; В. храна чија енергетска вредност е намалена за 0,46 MJ ME и Г. храна В + 150 g/t ASSF наместо фитаза. Применетите третмани не влијаеја на масата на јајцата, но двете групи што добиваа ензимски препарати имаа поголем процент на несивост. Економската анализа покажа дека употребата на ASSF може да ја намали цената на чинењето на храната по килограм јајцева маса при стандардната исхрана, како и при исхрана со смески со пониска енергетска вредност.

Клучни зборови: бројлери; несилки; ензими: економски ефекти

1. INTRODUCTION

The main reason of adding enzymes into feed for poultry is to improve the utilization of feed and thus achieve better production performances. This is particularly interesting when there is a need for using feedstuffs of lower nutritional quality. Enzymes have a wide range of application in broiler feed as well as in the feed for laying hens. In general, the purpose of adding enzymes in poultry nutrition is to complement the enzymes insufficiently produced by the animal (amylases and proteases) and to provide animal those enzymes not synthesized by them (cellulases) (Fischer et al., 2002). Addition of enzymes to diets containing soybean meal as a protein source has been shown to produce not only direct benefits (increase in body weight gain, improved feed conversion, reduction in feed costs), but also indirect benefits such as improved litter quality and reduction in nitrogen released into the environment (Dale, 1997).

Many authors have established that the production performance of broilers can be improved up to 10% by the application of enzymes (Bergh et al., 1999; Cowieson et al., 2000), whereas some authors have reported that the positive effect of enzymes was not established (McNab and Bernard, 1997; Perić et al., 2002; Iji et al., 2003). Evidently, the positive effect of the application of these additives depends on the amount and quality of feedstuffs included in the mixture, the applied level and type of enzymes as well as the environmental conditions (Acamovic, 2001). Recently published results indicate that the best effect is obtained by adding two or more than two enzymes to the feed (Silversides and Bedford, 1999; Chesson, 2001; Wu et al., 2003). Application of enzymes in feeding laying hens was also investigated by many authors, but to a lower extent. It has been suggested that less response to exogenous enzymes could be expected from layers due to their more mature digestive system (Considine, 1997).

The addition of the exogenous enzymes in poultry feed for the improvement of feed based on wheat and barley has been applied in wide practice, but the effects of the application of these enzymes in the feed based on maize are much less known (Cowieson et al., 2006). That is why the new combinations of enzymes and other natural feed additives as well as their optimum doses are constantly studied with the aim to achieve a positive financial effect through the increased utilization of feed. The aim of this paper was to show the effect of the addition of natural additive Allzyme SSF® (Alltech Inc.) to the mixtures of various nutritive values, on the performances of broilers and laying hens, with the accent on financial effects.

2. MATERIAL AND METHODS

The research was carried out on the experimental farm of the Faculty of Agriculture in Novi Sad. The experiment comprised 1200 chickens, which were divided into 4 groups with 8 replicates. Each replicate consisted of a floor pen with 38 broilers of Cobb 500 line hybrid. During the experiment the chickens were fed ad libitum in a three-phase feeding program (Table 1).

Table 1

Composition of the feed in broiler trial

Feed ingredients,%	Starter (1–21 days)		Grower (22–35 days)		Finisher (36–42 days)	
	PC	NC	PC	NC	PC	NC
Maize	47.5	50.6	53.0	56.3	59.3	62.7
Soybean meal	27.0	28.0	20.6	19.5	20.0	20.6
Full fat soya	17.0	14.7	18.0	18.0	12.0	10.0
Oil	4.0	2.6	3.8	2.0	4.0	2.5
Limestone	1.7	1.6	1.7	1.7	1.7	1.6
Monocalcium phosphate	1.3	1.0	1.4	1.0	1.5	1.1
Salt	0.3	0.3	0.3	0.3	0.3	0.3
Methionine	0.2	0.2	0.2	0.2	0.2	0.2
Premix	1.0	1.0	1.0	1.0	1.0	1.0
Chemical composition						
Crude protein, %	22.0	21.78	19.98	19.76	18.18	17.79
ME, MJ/kg	13	12.66	13.20	12.9	13.27	12.97
Lysine %	1.30	1.28	1.15	1.12	1.0	0.98
Methionine %	0.54	0.54	0.52	0.52	0.49	0.49
Ca, %	0.98	0.89	0.99	0.91	0.99	0.88
Total P, %	0.68	0.60	0.68	0.59	0.68	0.59

PC – Positive control, NC – Negative control

The experimental treatments were as it follows:

1. (PC) Feed which did not contain enzyme additives – positive control.
2. (PC+EC) Positive control with the addition of 0.02% of enzyme complex.
3. (NC) Feed containing a lower level of nutrients (for 0.3 MJ energy, 0.1% of available P and 0.1% Ca) – negative control.
4. (NC+EC) Negative control with the addition of 0.02% of enzyme complex.

The applied additive (Allzyme®SSF, Alltech, Inc) is a fermented wheat bran product, produced using a non-GM strain of Aspergillus niger and containing a 3-phytase (EC 3.1.3.8).

Control weighing of the body weight and feed consumption were carried out once a week, and mortality was recorded daily. At the end of fattening the production index was calculated according to the formula:

$$\frac{body\ weight\,(\mathrm{g}) \times (100 - mortality\,(\%))}{feed\ conversion \times duration\ of\ the\ trial\,(\mathrm{days}) \times 10}$$

The results were analyzed by the MANOVA test as well as by the LSD test to compare the statistical significance of differences between groups in STATISTIKA 7 program (StatSoft, 2007).

In the second trial 480 ISA Brown layers were fed trial diets from 41 to 67 weeks of age. The trial was designed in 4 treatments × 4 replicates arrangement. Each replicate consisted of 6 cages with 5 layers per cage. The treatments were as it follows:

A) High energy diet (reduced Ca and P with a commercial phytase at 100 g/t).

B) High energy diet (as 1. + 150 g/t ASSF instead of phytase).

C) Low energy diet with commercial phytase, as control A, but energy reduced by 0.46 MJ.

D) Low energy diet with ASSF, as control B, but energy reduced by 0.46 MJ.

Laying performance, egg weight and feed consumption were recorded daily. The feed cost analysis was calculated based on prices and exchange rate from mid June 2008. The results were analyzed by the MANOVA test as well as by the LSD test to compare the statistical significance of differences between groups in STATISTIKA 7 program (StatSoft, 2007).

T a b l e 2

Composition of the feed in trial with laying hens

Feed ingredients,%	A	B	C	D
Corn	58.58	58.57	57.57	57.54
Full fat soya	12.00	12.00	7.36	7.58
Soyameal (44% CP*)	14.38	14.61	13.36	13.19
Sunflower meal (42% CP)	3.33	3.04	10.00	10.00
Limestone	9.52	9.61	9.51	9.60
Monocalcium phosphate	0.66	0.64	0.64	0.61
Salt	0.27	0.27	0.27	0.27
Sodium bicarbonate	0.10	0.10	0.10	0.10
DL Methionine	0.15	0.15	0.13	0.13
Lysine HCl	/	/	0.05	0.05
Ronozyme P L 5000 Lay	0.01	/	0.01	/
ASSF	/	0.015	/	0.015
Premix	1.00	1.00	1.00	1.00
Nutrient content, calculated				
Crude protein , %	16.5	16.5	16.5	16.5
ME MJ/kg	11.52	11.52	11.04	11.04
Lysine, %	0.82	0.82	0.80	0.80
Methionine, %	0.41	0.41	0.41	0.41
Calcium, %	4.1	4.1	4.1	4.1
Total P, %	0.51	0.51	0.55	0.55
Available P, %	0.35	0.35	0.35	0.35

*CP – crude protein

3. RESULTS AND DISCUSSION

The average body weight of chickens showed significant differences between groups already in the first week of age, when the chickens fed by the negative control had the lowest body weight, and that effect persisted till the end of the experiment. The addition of ASSF had a marked positive effect ($P< 0.05$) on the increase of body weight when added to both positive and negative control (Table 3).

The addition of enzyme preparation in this experiment also affected the efficiency of feed utilization. The best feed conversion was found in the group PC+EC, whereas the enzyme preparation added to the negative control also increased the degree of feed utilization and brought it to the level of the positive control group. The applied enzyme preparation did not affect the mortality of chickens in the experiment. The calculated production index indicated that the best result was

achieved by adding enzymes to a group marked as a positive control, which means that adding enzymes can improve the production performance even in the utilization of standard mixtures. In the group in which the content of energy, calcium and phosphorus was reduced, the enzyme addition made it possible to achieve the results at the level of the positive control.

Table 3

Production parameters and cost of feed per kg of body weight

Parameter	GROUP			
	PC	PC+EC	NC	NC+EC
Final body weight, kg	2073^{bc}	2160^{a}	2066^{c}	2105^{b}
Feed conversion ratio	1.96	1.93	1.99	1.96
Mortality rate, %	2.3	4.0	3.3	4.0
Productivity index EPEF	246	256	239	245
Relative cost of feed,%	100.00	101.29	96.88	98.17
Cost of feed per kg of body weight (Eur/kg)	0.722	0.715	0.702	0.696

^{a,b} Average values with different superscript differ significantly (P<0.05)

In the analysis of the economic aspect it is obvious that the increase in feed price which resulted from the addition of the enzyme complex was annulled through the increase of the body weight of chickens and a better feed conversion. In that way the feed price expressed through the live weight of the produced chickens is lower with the groups where the enzymes were added (PC+EC and NC+EC) in comparison to the positive and negative control (Table 3).

It is known that the addition of the exogenous enzymes to the feed based on cereal grains and soybean meal significantly increase the nutritive value of broiler feed (Charlton, 1997; Scutte and Pereira, 1998; Chesson, 2001). These authors, however, point out that by the application of enzymes the positive results are achieved particularly in very young chickens while in the older birds the positive effects are less obvious. In contrast to these results, Perić et al. (2002) did not obtain a positive effect by adding the enzymes to mixtures with a lower energy and protein level. The obtained results confirm the statement that the application of enzymes in the nutrition of broiler chickens is a complex issue and that it depends on a number of factors some of which are not always under our control.

The results of the second trial with laying hens showed that overall performance were good in all four treatments (Table 4). The production of eggs was high although it was the second part of the production cycle. Layers fed with ASSF (B and D) had a higher laying percentage. The differences were statistically significant (P<0.05) compared to groups A and C. Percentage of the second grade eggs was significantly lowered in group D compared to the positive and negative control. Egg weight was not changed by dietary treatments. Layers from groups fed the low energy diet (C and D) consumed more feed, but the value of the change was considered to be meaningless. FCR was reduced by the use of ASSF by 6 and 4 points respectively for high and low energy diets.

Table 4

Laying hens performance and economic evaluation of their production

Group	A	B	C	D
Laying percentage, %	83.70^{c}	86.30^{a}	83.70^{c}	84.90^{b}
Second grade eggs, %	2.74^{a}	2.38^{ab}	2.57^{ab}	2.17^{b}
Egg weight, g	66.8	66.6	66.6	66.6
Total egg mass produced, g/d	55.94	57.53	55.70	56.54
Daily feed intake, g	121.4^{b}	121.3^{b}	123.1^{b}	122.9^{b}
FCR	2.17^{ab}	2.11^{a}	2.21^{b}	2.17^{ab}
Feed cost (€/T)	282.8	284.5	272.5	274.0
Feed cost/1000 kg of eggs (€)	613.7	600.3	602.2	594.6

$^{a, b}$ Average values with different superscript differ significantly (P< 0.05)

The economic analysis showed that the use of ASSF could lower the feed cost/ kg of eggs in both high and low energy diets. Feed cost was reduced by 8.8 Euro per tone when comparing diet A and D, while the feed cost per 1000 kg of eggs produced was reduced by 19.1 Euro.

Results of other authors who investigated the effect of ASSF in feed for laying hens showed a significant effect on egg production, total egg mass produced and feed conversion (Costa et al., 2008). Feed intake and egg weight were not influenced by enzymes addition. Similar results by using enzymes in feed for laying hens were found by Vukic

and Wenk (1993), Scheideler et al. (2005) and Pan et al. (1998). Brake (1992) also demonstrated that supplementation of corn/soybean meal diets with ά-galactosidase increased the egg production and further suggested that enzymes would not only increase available energy of legumes but would also help in alleviating digestive disorders associated with these carbohydrates.

All these positive effects can lead to improved financial effect of poultry production by using multienzyme complexes in poultry nutrition.

4. CONCLUSION

By the application of the ASSF the positive effects on the growth of broiler chickens and feed conversion ratio were obtained both in standard mixtures and the mixtures of decreased nutritive value. The economic analysis of the obtained results indicated that the improvement, brought about by the enzyme preparation, exceeds the costs of its application, which leads to its wide application in practice.

The best production results were achieved with addition of ASSF to the high-energy diet (B) and the best economic output was obtained by adding ASSF to the low energy diet (D). It was concluded that addition of ASSF improves the profitability of egg production.

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