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ECOLOGICAL ASPECT OF ADDITION OF DIFFERENT QUANTITY OF ENZYME PREPARATION TO MIXTURE FOR BROILER CHICKENS

EKOLOGICZNY ASPEKT DODANIA RÓŻNEJ ILOŚCI PREPARATU ENZYMATYCZNEGO DO MIESZANKI DLA KURCZĄT BROJLERÓW

Abstract: The aim of the research was to determine the effect of addition of different quantities of enzyme preparation containing xylanase to mixtures for broiler chickens on the excretion and retention of nutrients. The experiment was carried out on 75 one-day old broiler chickens divided into 3 groups each of 25 birds, in five replications, from 1 to 21 days of life. Chickens from group I were fed wheat mixtures with rape cake supplemented with enzyme preparation containing xylanase at the quantity of $0.2 \text{ g} \cdot \text{kg}^{-1}$. In mixtures for the remaining groups the quantity of enzyme preparation was increased up to 0.3 g in group II and to 0.4 g in mixture in group III. During the last week of the experiment the excreta were collected. The body weight of broiler chickens in the 21st day of life was not significantly affected, however, together with the increase in enzyme preparation quantity the body weight improved. The increasing in the quantity of enzyme preparation influenced the reduction of nutrient content in excreta. Together with the increasing in the quantity of enzyme preparation the retention of dry matter and crude nitrogen was improved and the most profitable retention of crude fat was found after applying $0.4 \text{ g} \cdot \text{kg}^{-1}$ of enzyme preparation.

Keywords: rape cakes, enzymatic preparation, broiler chickens

Grain, mostly wheat, which provides 55 % of the available energy and 35 % of the protein make up the largest part in the mixtures for broiler chickens. The other part of protein in broiler diets is satisfied by high protein feeds, most often by imported soyabean meal. Kocher et al [1, 2] showed that canola meal could replace soyabean meal in broiler diets without any negative effects on broiler performance, however the addition of commercial feed enzymes to the canola meal diet had no significant effect on feed uptake and feed conversion ratio. Poland is renowned among rapeseed producers. The rapeseed products are characterized by great deal of protein and rape cakes contain a lot of fat. The introduction of rape products can lubricate mixtures

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which facilitates keeping energy in balance, influences the improvement of nutrient utilization, may lead to better sanitary and environmental conditions and to reduction of production risk. The decrease in glucosinolates and elimination of erucic acid from rapeseed 00 give possibilities to replace soyabean meal by rape products [3, 4]. The nutritive value of grains for poultry is reduced by soluble fibre content, which comprise NSP – *non-starch polysaccharides* [5, 6]. These substances are characterized by much viscosity and absorbability, which worsens the digestibility and utilization mainly of fat, amino acids, starch and phosphorus [7]. Rapeseed contains a lot of NSP, whereas the content of available energy and phosphorus is low [8]. The introduction of rape cakes to wheat mixtures increases the content of NSP. The addition of enzymes which decompose the NSP can decrease the antinutritional effect of these substances and can improve the utilization of nutrients from mixtures. The efficiency of enzymatic preparations depends on the kind of enzyme and its quantity [9–13].

The improvement of the nutritive value of mixtures by using enzymatic preparations can influence the quantity of non-use nutrients and nutrients excreted to the environment [14].

The problem regarding excretion of nutrients from mixtures containing rape products as a result of applying enzymes that hydrolyze NSP was analyzed to a small extent.

The aim of the research was to determine the effect of addition of different quantities of enzyme preparation containing xylanase to starter mixtures for broiler chickens on excretion and retention of nutrients.

Materials and methods

The investigations were carried out on 75 one-day-old broiler chickens Ross 308, which were divided into three homogeneous experimental groups, 25 birds in a group (5×5 birds), in a period from the 1st to 21st day of chicken life. Broilers were kept in metabolic cages and fed isocaloric and isoprotein experimental starter diets. The diets (in a mashed form) and water were given *ad libitum*. All diets were balanced according to the Nutritional Requirements for Poultry [15]. The broilers from group I were given the experimental starter diet based on wheat (57.85 %), soyabean meal (24 %), rapeseed cake of Lirajet cv. (15 %) supplemented with $0.2 \text{ g} \cdot \text{kg}^{-1}$ of enzymatic preparation containing xylanase. In the remaining mixtures the quantity of enzymatic preparation increased up to 0.3 g group II and up to $0.4 \text{ g} \cdot \text{kg}^{-1}$ in mixtures for group III. According to the suppliers' information the enzyme preparation derived from *Aspergillus oryzae* and contained endo-1,4- β xylanase (min. 1000 FXU(W)/g).

In the 1st and 21st day of age, the birds were weighed and their feed consumption was analysed. During the last week of the experiment the balance test of basic nutrients and phosphorus were carried out. During the following 3 days, all excreta were collected and feed consumption was designated. Prior to the analyses the excreta were dried at $60 \text{ }^\circ\text{C}$ and ground. In the feeds and excreta the basic nutrient contents were determined by the AOAC procedure [16] and the crude phosphorus content was tested by the colorimetric method (PN-76/R-64781). The excretion of basic nutrients and phosphorus as well as the balance between these feed components were designated. The obtained

data were statistically analyzed by the analysis of variance, and Duncan's multiple range test was used to separate means when the significant effects ($p \leq 0.05$) were detected by the analysis of variance.

Results and discussion

In Table 1 the content of basic nutrients and crude phosphorus in feeds used in experimental mixtures is shown.

Table 1

Content of basic nutrient and crude phosphorus in feeds [$\text{g} \cdot \text{kg}^{-1}$]

Specification	Nutrient content [$\text{g} \cdot \text{kg}^{-1}$]					
	Dry matter	Crude ash	Crude nitrogen	Crude fibre	Crude fat	Crude phosphorus
Wheat meal	926.5	17.3	17.3	24.9	13.5	3.2
Soyabean meal	921.3	73.9	79.1	25.6	23.5	6.5
Rape cake of Lirajet cv.	951.7	57.2	41.2	69.9	253.7	9.7

The content of crude nitrogen in wheat was on a slightly lower level than it is given in Nutritional Requirements for Poultry [15], soyabean meal contained similar quantity of crude nitrogen content and rape cake had a slightly smaller amount of the nutrient than in the above-mentioned norms. The basic nutrients and crude phosphorus contents in mixtures were on a similar level (ME – 11.55MJ; crude protein – 21.4 %). The body weight of 21 day-old chickens was similar in all groups and ranged from 603 to 631 g, and it had the highest value when the enzymatic preparation level was the highest, but the obtained results between groups were not significantly different. The contents of basic nutrients and crude phosphorus in broiler excreta from each group were shown in Table 2, whereas in Table 3 the percentage of reductions of basic nutrients and phosphorus in excreta as a result of higher quantity of enzyme preparation in mixtures were showed.

Table 2

Content of basic nutrient and phosphorus in excreta [$\text{g} \cdot \text{kg}^{-1}$]

Group	Nutrient					
	Dry matter	Crude ash	Crude nitrogen	Crude fibre	Crude fat	Crude phosphorus
I + 0.2 g of preparation	808.3a \pm 0.99	101.5 \pm 1.26	37.9a \pm 0.15	85.7a \pm 0.44	42.9 \pm 0.40	9.55 \pm 0.79
II + 0.3 g of preparation	690.4b \pm 5.92	85.9 \pm 0.82	33.4b \pm 0.35	71.7b \pm 1.03	39.2 \pm 0.39	8.68 \pm 0.53
III + 0.4 g of preparation	695.9b \pm 2.47	95.7 \pm 1.13	31.4b \pm 0.13	74.9b \pm 0.58	36.9 \pm 0.25	8.91 \pm 0.60

a, b – means in columns followed by different letters are significantly different ($p \leq 0.05$); \pm – standard deviation.

Table 3

Degree of basic nutrients and phosphorus reduction
in excreta due increase quantity enzyme preparation [%]

Group	Reduction of nutrient in excreta [%]					
	Dry matter	Crude ash	Crude nitrogen	Crude fibre	Crude fat	Crude phosphorus
I + 0.2 g of preparation
II + 0.3 g of preparation	14.58	15.36	11.87	16.33	8.62	9.10
III + 0.4 g of preparation	13.90	5.71	17.15	12.60	13.98	6.70

The content of nitrogen in chicken excreta from group III, fed mixture with 0.4 g · kg⁻¹ of enzymatic preparation amounted to 31.4 g and from group I in broilers fed mixture with 0.2 g of the preparation – 37.9 g, and the obtained results were significantly proved. As a result of supplementing higher quantity of enzyme preparation, the content of nitrogen in excreta decreased in the range between 11–17 %. Dry matter content in excreta significantly decreased from 80.83 % at the level of 0.2 g of enzyme preparation to 69.04 % when the preparation was at the level of 0.3 and 0.4 g, while crude fibre content decreased from 8.57 to 7.17 %. The level of other nutrients and crude phosphorus in excreta as a result of increasing in the quantity of enzyme preparation decreased by 5.71–15.36 % (Table 3), whereas the content of crude fibre, crude nitrogen and dry matter decreased in the highest degree.

In Table 4 the daily balance of basic nutrients and crude phosphorus as well as coefficients of retention were presented.

Table 4

Balance and retention of basic nutrient and phosphorus

Group	Dry matter	Crude ash	Crude nitrogen	Crude fibre	Crude fat	Crude phosphorus
Quantity of nutrient uptake [g/bird/day]						
I + 0.2 g of preparation	32.2 ± 3.46	2.27 ± 0.24	1.18 ± 0.12	1.39a ± 0.14	1.81 ± 0.20	0.27 ± 0.03
II + 0.3 g of preparation	35.4 ± 2.78	2.57 ± 0.20	1.31 ± 0.10	1.62b ± 0.13	1.98 ± 0.16	0.31 ± 0.02
III + 0.4 g of preparation	34.4 ± 1.41	2.54 ± 0.11	1.28 ± 0.05	1.57b ± 0.06	2.39 ± 0.10	0.30 ± 0.01
Quantity of nutrient excretion [g/bird/day]						
I + 0.2 g of preparation	10.07a ± 0.56	1.26 ± 0.13	0.47a ± 0.03	1.07 ± 0.10	0.53a ± 0.07	0.111 ± 0.01
II + 0.3 g of preparation	11.40b ± 0.93	1.42 ± 0.13	0.55b ± 0.04	1.19 ± 0.20	0.64b ± 0.08	0.138 ± 0.01
III + 0.4 g of preparation	10.95ab ± 0.64	1.50 ± 0.17	0.49a ± 0.03	1.18 ± 0.11	0.58ab ± 0.03	0.136 ± 0.02

Table 4 contd.

Group	Dry matter	Crude ash	Crude nitrogen	Crude fibre	Crude fat	Crude phosphorus
Retention of nutrient [%]						
I + 0.2 g of preparation	68.73 ± 4.22	44.49 ± 9.23	60.17 ± 7.10	23.02 ± 9.98	70.71a ± 2.69	58.88 ± 5.64
II + 0.3 g of preparation	67.80 ± 0.38	44.74 ± 1.49	58.02 ± 0.81	26.54 ± 7.18	67.67b ± 1.70	55.48 ± 1.65
III + 0.4 g of preparation	68.17 ± 0.88	40.47 ± 5.67	61.72 ± 1.49	24.84 ± 5.30	75.73c ± 0.98	54.66 ± 1.76

a, b – means in columns followed by different letters are significantly different ($p \leq 0.05$); \pm – standard deviation.

The quantity of dry matter consumption ranged from 32.2 to 35.4 g, nitrogen from 1.18 to 1.31 g daily per bird and phosphorus from 0.27 g in group I to 0.31 g in group II. The quantities of consumed nutrients were not significantly different between groups, except fibre, the uptake of which by chickens from II and III groups was significantly higher. Significant differences between groups in the quantity of crude nitrogen, crude fat and dry matter excretion per bird during balance test were found. The retention of nutrients in the form of dry matter was on a level of 67–69 %, crude nitrogen was kept by chickens on a level of 58–62 %. The highest coefficient of retention for fat (75.73 %) at the level of 0.4 g of enzyme preparation was determined. Retention of phosphorus in groups ranged from 54.66 to 58.88 %, but it was not significantly different.

Mikulski et al [13] reported that the addition of the smallest dose of enzyme preparation containing xylanase (50 cm³/Mg of mixture) proved the tendency to improve digestibility of protein, fat and NDF, and the improvement of digestibility for the most nutrients at 150 cm³/Mg of mixture was found. The authors stated the improvement of digestibility of fat and dry matter and that the increasing quantity of enzyme preparation in the range of 50–150 cm³ profitable influenced rearing results in turkeys. According to Korol et al [14] mixtures, in which the level of fat was increased, decreased in about 10–20 % compared with non-fatted ones and the retention of nitrogen was higher by about 12–14 %. The quantity of phosphorus excretion decreased by 15 % and calcium excretion by 15–20 % per 1 kg of body weight.

Conclusion

An increase in the quantity of enzyme preparation influenced the reduction of nutrient content in excreta. Together with the increasing in the quantity of enzyme preparation the retentions of dry matter, crude nitrogen and crude fat were improved.

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EKOLOGICZNY ASPEKT DODANIA RÓŻNEJ ILOŚCI PREPARATU ENZYMATYCZNEGO DO MIESZANKI DLA KURCZĄT BROJLERÓW

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Abstrakt: Celem przeprowadzonych badań było określenie wpływu wzrastającej ilości preparatu enzymatycznego dodanego do mieszanki dla kurcząt brojlerów na wydalanie oraz retencję składników pokarmowych. Badania przeprowadzono na 75 jednodniowych kurczętach brojlerach podzielonych na 3 grupy po 25 ptaków, pięć powtórzeń po 5 sztuk, w okresie od 1. do 21. dnia życia. Kurczęta z grupy I żywiono mieszanką pszenną zawierającą makuch rzepakowy uzupełniony preparatem enzymatycznym zawierającym ksyłanazę w ilości $0,2 \text{ g} \cdot \text{kg}^{-1}$. W mieszankach skarmianych w dwóch pozostałych grupach zwiększono ilość dodanego preparatu do $0,3 \text{ g} \cdot \text{kg}^{-1}$ (grupa II) oraz do $0,4 \text{ g} \cdot \text{kg}^{-1}$ (grupa III). W ostatnim tygodniu doświadczenia przeprowadzono kolekcję odchodów w celu określenia ilości składników pokarmowych wydalanych oraz stopnia ich retencji.

Masa ciała kurcząt w wieku 21 dni nie różniła się znacząco między grupami, jednak wraz ze zwiększaniem ilości preparatu enzymatycznego wzrastała również uzyskana masa ciała. Zwiększenie ilości dodanego preparatu enzymatycznego spowodowało obniżenie zawartości składników pokarmowych w wydalanych odchodach. Wraz ze wzrostem ilości dodawanego preparatu enzymatycznego poprawiała się retencja suchej masy oraz azotu ogólnego, a najkorzystniejszą retencję tłuszczu surowego stwierdzono przy zastosowaniu $0,4 \text{ g}$ preparatu.

Słowa kluczowe: makuch rzepakowy, preparat enzymatyczny, kurczęta brojlery