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Efficiency of synthetic antioxidants mixture additive in turkey hens' diet

Efektywność dodatku mieszaniny syntetycznych przeciwutleniaczy
w żywieniu indyczek

Summary. The research was aimed at determining the influence of supplementing turkey hens complete feed with synthetic antioxidants on the performance, carcass yield and blood biochemical parameters. The experiment was conducted on 120 turkey hens Big-6. From 6 to 16 weeks of life the birds had free access to feed and water. Group I (control) was fed a complete mixture. Birds from group II received a complete feed supplemented with antioxidant L100 (BHT, propyl gallate, etoxyquin, citric acid). Feed intake, body weight of the birds and their mortality during transportation as well as WEO were noted. In blood samples (taken at the end of the 9, 13 and 16 weeks of birds life), the content of TP, GLU, CHOL, HDL and LDL-chol. and TG was determined. At the end of the trial, the birds were slaughtered and a simplified dissection was carried out. Dressing percentage, content of breast meat in the carcass, content of leg meat, leaf fat as well as giblets, were calculated. The synthetic antioxidants mixture supplement resulted in no substantial increase in performance. The results of blood analyses showed, however, that the supplement of synthetic antioxidants mixture improved indicators of the lipid profile in turkey hens' blood.

Key words: turkey hens, antioxidants, rearing effects, blood

INTRODUCTION

Poultry is a popular type of food consumed in Poland. Hence, the quality of the components used in preparing feed mixtures is of high significance, as it has a direct effect on animals' health, their productive performance and the quality of meat. The oxidation of the lipids found in meat is one of the fundamental reasons for its lower

quality, i.e. changes in the taste, smell and color of meat and its products [Karpieńska-Tymoszczyk *et al.* 2004, Jang *et al.* 2008]. Reducing or slowing down the processes of oxidation due to limiting the number of free reactive forms of oxygen may be obtained by supplementing animal feeds with anti-oxidating substances [Weitzel *et al.* 1989, Noguchi 1998, Marcinčak *et al.* 2008]. Antioxidants may be either natural substances or they may be obtained in a chemical synthesis. Natural antioxidants of a significant role are vitamins E (tocopherol), C (ascorbic acid), beta-carotene (provitamin A), vitamin A (retinol) [Grela *et al.* 1998, Florou-Paneri *et al.* 2005, Ognik and Sembratowicz 2007]. Due to the fact that using natural antioxidants in feeds does not always lead to satisfactory results, synthetic antioxidants, such as BHT (2,6-di-tert-butyl-4-methylphenol), BHA butylhydroxyanisole (3-tert-butyl-4-hydroxyanisole), EQ ethoxyquin (2,2,4-trimethyl,1,2-dihydro, 6-ethoxyquinolin), and also gallic acid esters are widely used alongside natural antioxidants occurring in feeding materials or added to feeds (mainly tocopherols).

The aim of the research was to determine the effect of adding synthetic antioxidants mixtures to complete feed mixtures for turkey hens on the performance, carcass yield and biochemical blood parameters.

MATERIAL AND METHODS

The experiment was conducted on 120 turkey hens of Big-6 breed, divided into two experimental groups, each of 60 birds (two replications for each group of 30 birds). Until the 16th week of their lives the hens were kept in bird-houses on straw bedding. Birds were selected for particular groups regarding their body mass, so that the mean value of that index at the beginning of the experiment should be similar in both groups. Rearing was carried out in standard zoo-hygienic conditions, optimal for breeding slaughter turkeys. The birds had free access to complete feed mixtures and water. Complete feed mixtures were prepared on the basis of premixes and recipes developed by POLSANDERS company. The content of vitamin E, selenium (Se) and the percentage share of soybean oil in the feed mixture was different at the particular fattening stages (3% Grower II: vitamin E – 50 mg kg⁻¹, Se – 10.0 mg kg⁻¹, oil – 3.5%; 3% Grower III: vitamin E – 45 mg kg⁻¹, Se – 10.0 mg kg⁻¹, oil – 4%; 2.5% Finisher I: vitamin E – 50 mg kg⁻¹, Se – 12.0 mg kg⁻¹, oil – 3%). The content of feed components in the mixtures remained in compliance with Polish Poultry Nutrient Recommendations [Normy... 2005]. Group K, which was the control group, received feed mixtures with a standard amount of vitamin E, following the recommendations for the adequate rearing period [Normy... 2005]. The birds in the MSP group were fed a feed mixture supplemented with a synthetic antioxidant mixture (MSP) amounting to 100 g t⁻¹. Since MSP is a powdered mixture including: 17% of BHT (E321), 6% of propyl gallate (E310), 2.4% of ethoxyquin (E324) and 25% of citric acid (E330), it was added manually to the remaining components while preparing the feed in a feed mixer for particular fattening stages.

During the experiment turkey hens' body weight (on the last day of each week of the birds' life), their mortality and feed intake were noted. On the basis of productive performance in the experimental groups, the value of the European performance index, WEO, was calculated, following the formula below:

$$\text{WEO} = \frac{\text{mean body mass after completing rearing period} \times \text{mortality} \times 100}{\text{days of rearing} \times \text{feed intake per 1 kg of body mass}}$$

At the end of 9, 13 and 16 weeks of birds' lives, blood was taken for biochemical analyses from their brachial veins, each time from the same birds. Blood samples were used to determine the content of total protein (TP), glucose (GLU), total cholesterol level (CHOL), HDL and LDL fractions and triglycerides (TG) with the help of Cormay monotests. At the end of the trial (16 weeks), the birds were slaughtered (30 birds in each experimental group) after a 12-hour fasting period. The slaughter and a simplified dissection were carried out following the recommendations given by Faruga and Jankowski [1996]. Slaughter performance and dressing percentage in breast meat of the carcass, the content of leg meat, leaf fat as well as giblets, were calculated.

The obtained results were subject to a statistical analysis and mean values as well as statistical errors were calculated with the use of Statistica 6.1 program.

RESULTS AND DISCUSSION

The basic results of turkey hens' rearing are presented in Table 1. The data referring to mortality have been ignored, as no falls were noted during the observation period (survival rate amounted to 100 %). Final results for body weight amounting to 9.00 kg (group K) and 8.67 kg (MSP group) in the experiment were similar. It should be noted, however, that turkey hens fed a supplement of synthetic antioxidants mixture (MSP) in their feed were slightly lighter during the whole duration of the experiment, which was also reflected in weekly body weight gains. FCR lower by 9.1% calculated by each kilogram of body weight gain was observed in the control group (K). Water consumption, noted in each week of the observation, was in compliance with the norms accepted for poultry [Normy... 2005]. While analyzing the WEO index, its value higher by 42.1 points was

Table 1. Productive performance of turkey hens
Tabela 1. Wyniki produkcyjne indyczek

Item Wyszczególnienie	Weeks of life Tygodnie życia	Feeding groups Grupy doświadczalne		SEM
		I	II	
Initial BW, kg Początkowa masa ciała, kg	6	1.54 ± 0.17	1.52 ± 0.15	0.03
Final BW, kg Końcowa masa ciała, kg	16	9.00 ± 0.93	8.67 ± 0.89	0.12
Weekly body weight gains, kg Tygodniowe przyrosty masy ciała, kg	6-9	2.07	1.93	0.05
	9-13	2.74	2.95	0.04
	13-16	2.43	2.00	0.08
Feed conversion ratio, kg kg ⁻¹ Zużycie paszy, kg kg ⁻¹	616	2.51	2.76	
WEO		465.6	423.5	

noted in the control group (465.6 points), compared to the group fed a supplement of synthetic antioxidants (423.5 points). Regarding the fact that at the end of the fattening period the body mass of the birds in both groups was relatively similar, it may be suggested that supplementing the turkeys' feed with a mixture of synthetic antioxidants, which is aimed primarily at protecting essential fatty acids present in the feed against oxidation, did not result in health deterioration or lower slaughter performance of the birds. Dissection results obtained in the experiment are presented in Table 2. The data obtained after performing a slaughter analysis of turkey hens suggest an influence of the experimental agent (MSP) on the studied slaughter features in the birds. It was noted that turkey hens fed a supplement of synthetic antioxidants mixture had slaughter performance lower by 5% and a significantly lower, by 18%, share of breast meat, compared to the control group. The mass of edible giblets did not reveal any significant differentiation in both groups.

Table 2. Slaughter analysis results of experiment turkey hens after 16 weeks of fattening (% of bodyweight before slaughter)

Tabela 2. Wyniki analizy rzeźnej indyczek doświadczalnych po 16 tygodniach odchowu (% masy ciała przed ubojem)

Item Wyszczególnienie	Feeding groups Grupy doświadczalne		P value
	I	II	
Slaughter performance, % Wydajność rzeźna, %	83.7 ± 1.59	79.5 ± 2.05	
Liver Wątroba	1.46 ± 0.18	1.47 ± 0.12	0.705
Heart Serce	0.39 ± 0.06	0.37 ± 0.04	0.281
Stomach Żołądek	1.67 ± 0.02	1.59 ± 0.04	0.667
Breast muscle Mięsień piersiowy	25.3 ^a ± 0.95	20.7 ^b ± 0.41	0.033
Thigh muscles Mięśnie udowe	10.42 ± 0.12	9.04 ± 0.32	0.291
Leg muscles Mięśnie podudzia	7.94 ± 0.40	7.41 ± 0.36	0.238
Leaf FAT Tłuszcz sadełkowy	0.79 ± 0.04	0.88 ± 0.02	0.435

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$

a, b – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

Table 3. Content of biochemical parameters in plasma of turkey hens
Tabela 3. Poziom wskaźników biochemicznych w osoczu krwi indydzek

Item Wyszczególnienie	Weeks of life Tygodnie życia	Feeding groups Grupy doświadczalne		P value
		I	II	
TP g l ⁻¹	9	35.45 ± 1.95	37.00 ± 2.67	0.081
	13	47.71 ^a ± 6.22	43.09 ^b ± 5.29	0.037
	16	35.80 ^b ± 1.64	41.67 ^a ± 2.33	0.014
	\bar{x}	39.65 ± 3.27	40.59 ± 3.43	0.448
GLU mmol l ⁻¹	9	13.37 ^a ± 2.17	10.99 ^b ± 1.60	0.012
	13	17.25 ^a ± 1.25	13.65 ^b ± 1.51	0.013
	16	11.24 ± 0.75	12.28 ± 0.94	0.026
	\bar{x}	13.95 ^a ± 1.39	12.31 ^b ± 1.35	0.021
CHOL mmol l ⁻¹	9	3.13 ^a ± 0.29	2.53 ^b ± 0.20	0.014
	13	2.14 ^a ± 0.31	1.62 ^b ± 0.21	0.015
	16	3.08 ^a ± 0.15	2.94 ^b ± 0.19	0.026
	\bar{x}	2.78 ^a ± 0.25	2.36 ^b ± 0.20	0.017
HDL mmol l ⁻¹	9	1.41 ^a ± 0.14	1.20 ^b ± 0.11	0.021
	13	1.12 ^a ± 0.19	0.94 ^b ± 0.11	0.039
	16	1.65 ± 0.08	1.67 ± 0.14	0.631
	\bar{x}	1.39 ± 0.14	1.27 ± 0.12	0.055
LDL mmol l ⁻¹	9	1.55 ^a ± 0.17	1.20 ^b ± 0.14	0.014
	13	0.88 ^a ± 0.18	0.52 ^b ± 0.22	0.016
	16	1.30 ^A ± 0.17	1.11 ^B ± 0.19	0.009
	\bar{x}	1.24 ^A ± 0.17	0.94 ^B ± 0.18	0.001
TG mmol l ⁻¹	9	0.37 ^a ± 0.06	0.28 ^b ± 0.04	0.031
	13	0.31 ^b ± 0.06	0.37 ^a ± 0.06	0.018
	16	0.29 ^a ± 0.04	0.33 ^b ± 0.04	0.017
	\bar{x}	0.32 ± 0.05	0.33 ± 0.05	0.846
% HDL	9	44.96 ^b ± 2.25	47.45 ^a ± 2.88	0.013
	13	52.42 ± 5.19	58.61 ± 3.57	0.474
	16	53.75 ^b ± 3.59	57.15 ^a ± 4.76	0.035
	\bar{x}	50.38 ^B ± 3.68	54.40 ^A ± 3.74	0.005
HDL/CHOL	9	2.23 ^a ± 0.12	2.12 ^b ± 0.13	0.017
	13	1.93 ^a ± 0.19	1.74 ^b ± 0.25	0.034
	16	1.87 ^a ± 0.14	1.76 ^b ± 0.15	0.045
	\bar{x}	2.01 ^A ± 0.15	1.87 ^B ± 0.18	0.008

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$

a, b – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

A, B – values in the same rows with different letters differ significantly at $p \leq 0.01$

A, B – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,01$

A vital element in assessing the efficiency of feed supplementation in animal nutrition may be the course of metabolic processes, which is expressed e.g. in changes concerning the biochemical parameters of the blood [Ganong 2005]. An addition of synthetic antioxidants mixture (MSP) resulted in changing the values of lipid components of the blood (Table 3). The turkey hens in this particular group revealed after 9, 13 and 16 weeks of fattening a significant reduction in the content of total cholesterol (by 19, 24 and 5%, respectively), as well as its LDL fraction (by ca. 25%). The observed effect may have been a consequence of a better utilization of lipid components (bile acids synthesis, steroid hormones) [Ganong 2005]. The group of birds fed an additive of an antioxidant mixture in the 9th and 16th weeks of fattening revealed also a reduced content of triacylglycerols ($p \leq 0.05$) which are the main form of storing fat reserves in the organism and are accumulated in fat cells and released, when needed, into blood circulation. Turkey hens receiving a mixture of synthetic antioxidants in the 9th and 13th weeks of fattening revealed also a reduced content of HDL-cholesterol fraction (by ca. 15%). However, the percentage share of this particular fraction was significantly higher in the birds from this group, which is very advantageous regarding the health of these animals. Lipids, especially LDL, are protected by antioxidants. On the other hand, when the organism is lacking low-density antioxidants, e.g. in stressful environment, they may become subject to peroxidation or exchanging lipids between different classes of lipoproteins, since lipoproteins of high density (HDL) contain more lipid peroxides than LDL and the former are more easily oxidized [Knapik-Czajka 1998, Baggio *et al.* 2002, Cerolini *et al.* 2003, Bartosz 2004].

CONCLUSION

Using a synthetic antioxidant mixture additive (MSP) at the dose of 100 g t⁻¹ in a feed given to turkey hens did not result in improving their body weight gain at a lower feed conversion ratio, yet it contributed to enhancing lipid profile parameters in the birds' blood. Thus, in order to state unambiguously whether the tested additive may be commonly used as an antioxidant in feeds used in turkey hens' nutrition, the obtained results need to be verified in more studies including bigger populations, different dosage patterns and an increased number of the analyzed blood parameters, as well as an additional analysis of tissues and feeds.

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Streszczenie. Celem badań było określenie wpływu dodatku mieszaniny syntetycznych antyoksydantów do mieszanek pełnodawkowych dla indyczek na efekty produkcyjne, wydajność rzeźną tusz oraz poziom wskaźników biochemicznych krwi. Doświadczenie przeprowadzono na 120 indyczkach typu ciężkiego Big-6. Ptaki utrzymywano od 6 do 16 tygodnia życia przy stałym dostępie do paszy i wody. Grupa I stanowiła grupę kontrolną, otrzymującą standardowe mieszanki. Ptakom należącym do grupy II podawano mieszanekę paszową z dodatkiem przeciwutleniacza L100 (BHT, galusan propylu, etoksyquin, kwas cytrynowy). Podczas doświadczenia rejestrowano masy ciała indyczek, przeżywalność oraz spożycie paszy, a także wyliczono wartość WEO. Krew do badań pobrano pod koniec 9, 13 i 16 tygodnia życia ptaków. W próbkach krwi indyczek oznaczono zawartość TP, GLU, CHOL, frakcji HDL oraz LDL-cholesterolu i TG. Po zakończonym odchowcie przeprowadzono ubój i uproszczoną dysekcję. Wyliczono wydajność poubojową oraz procentową zawartość w tuszce mięśni piersiowych, mięśni nóg, tłuszczu sadelkowego oraz podrobów jadalnych. Zastosowanie mieszaniny syntetycznych przeciwutleniaczy do paszy dla indyczek nie wpłynęło znacząco na poprawę efektów produkcyjnych. Wyniki przeprowadzonych analiz krwi wskazują jednak, że dodatek do paszy mieszaniny syntetycznych przeciwutleniaczy przyczynił się do poprawy wskaźników profilu lipidowego krwi indyczek.

Słowa kluczowe: indyczki, antyoksydanty, efekty odchowu, krew