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Effect of aloe preparation on the level of biochemical indices of blood and tissue composition of female turkeys

Wpływ preparatu aloesowego na poziom wskaźników
biochemicznych krwi oraz skład chemiczny tkanek indyczych

Summary. The aim of this study was to establish the effect of an aloe preparation administered to drinking water for turkey hens on levels of biochemical indices of their blood and chemical composition of their tissues. The study was conducted with 160 turkey hens of medium-heavy BUT 9 type divided into four experimental groups. Each group included 40 turkey hens (two replications, 20 birds each). The birds were kept since the 6^{th} till the 16^{th} weeks of life in pens, on straw litter. Group I served as the control (A-O), where the birds received drinking water without experimental additives. The turkey hens from experimental groups (A-1, A-2, A-3) received an aloe preparation with drinking water. The preparation was dosed as follows: 0.35 ml/kg b.w./day in group A-1, 0.70 ml/kg b.w./day in group A-2, and 1.40 ml/kg b.w./day in group A-3. The analyzed preparation was administered to the birds in drinking water for 28 days. After four weeks of its administration, a two-week break was made in supplementation, during which the turkey hens of all groups received only pure water. After this break, the birds were again administered the aloe preparation in identical doses as at the beginning of the experiment. At the end of weeks 4, 6 and 10 of observation, blood was sampled from the brachial vein of the birds for biochemical analyses that included determinations of: AST, ALT, ALP, TP, GLU, CHOL, HDL, TG, and macroelements (K^{+}, Na^{+}, Ca^{+2}, Mg^{+2}). After completed rearing (16^{th} week of life), the birds were slaughtered and simplified dissection was performed. Chemical composition of meat was determined in samples of breast, thigh, shank muscles and in liver. The obtained results demonstrate that the addition of various doses of the aloe preparation affected a decrease in cholesterol level and activities of AST, ALT and ALP enzymes, and an increase in the HDL fraction of cholesterol in blood of the birds. It additionally resulted in a diminished blood level of phosphorus and an increased calcium concentration in tissues. The applied addition of aloe was also observed to influence the chemical composition of muscles and liver of turkey hens, as it reduced the content of dry matter and protein in leg tissues and the content of fat in liver.

Key words: aloe, turkey hens, blood, tissues, metabolic indices

INTRODUCTION

The elimination of antibiotic growth stimulants from animal feeding has triggered the necessity of searching for new nutritional solutions that would contribute to the improvement in slaughter performance and, most of all, in the nutritive value and sensory characteristics of meat [Charis 2000]. Assumptions of phytotherapy enable speculating that herbs may, to a great extent, substitute for antibiotic growth stimulants, thereby exerting a positive effect on the health status of animals. Knowing the specificity of their action, herbs may be used to stimulate animal production without chemotherapeutics [Gajewska *et al.* 2003, Michalczuk *et al.* 2003, Tipu *et al.* 2008, Szkucik and Pisarski 2010]. Some reports are available indicating that an aqueous extract from aloe may be a phyto-additive to feedstuffs [Białas-Chromiec *et al.* 2000]. In veterinary phytotherapy, preparations made of aloe are applied as cholokinetic agents, laxatives, digestants and orexigenic agents for animals [MacDonald 1998]. "Aloes plus" is a plant preparation containing an aloe extract which stimulates natural defense mechanisms of the body and mechanisms strengthening the immune system, for its advantages include: the excitation of non-specific cellular responses as well as effects on growth and blood morphology [Kołacz *et al.* 1997, Rekiel 1998]. In addition, an aloe preparation is a source of vitamin C exhibiting antioxidative and immunostimulating properties [Kodym 1998b, Białas-Chromiec *et al.* 2000].

The aim of the undertaken study was to establish the effect of an aloe preparation addition to drinking water for turkey hens on levels of selected biochemical indices of their blood and chemical composition of their tissues.

MATERIAL AND METHODS

The study was conducted with 160 turkey hens of medium-heavy BUT 9 type divided into four experimental groups. Each group included 40 turkey hens (two replications, 20 birds each). Since the 6^{th} till the 16^{th} week of life the birds were kept in pens, on straw litter. They were reared under standard zoohygienic conditions, optimal for fattening of slaughter turkeys [Faruga and Jankowski 2000]. Over the experimental period, turkey hens of all groups were fed full-dose feed mixtures (Tab. 1). Contents of basic nutrients in the feed mixtures corresponded with current recommendations of Poultry Feeding Standards [Normy… 2005]. Group I served as the control (A-O), where the birds were receiving drinking water without experimental additives. The turkey hens from experimental groups were receiving an aloe extract with drinking water, in the following doses: 0.35 ml/kg b.w./day in group A-1, 0.70 ml/kg b.w./day in group A-2, and 1.40 ml/kg b.w./day in group A-3. The analyzed preparation was administered to the birds in drinking water for 28 days. The "Aloes plus" preparation is an aqueous extract prepared on the basis of Krantz aloe (*Aloe arborescens* Mill.) with the addition of *trans* rezveratrol (an antioxidant obtained from Japanese knotweed) and vitamin C. The additives were administered to the birds in drinking water for 28 days. After four weeks of aloe preparation administration, a two-week break was made in supplementation, during which the turkey hens of all groups were receiving only pure water. After this break, the birds were again administered the aloe preparation in identical doses as at the beginning of the experiment.

Table 1. Nutrient content of the standard diets
Tabela 1. Zawartość pokarmowa standardowych mieszanek

Ingredients Składniki	Grower 1 (6–9 week)	Grower 2 (10–13 week)	Finisher 1 (14–17 week)
Corn (%) Kukurydza (%)	25.0	25.0	20.0
Wheat (%) Pszenica (%)	30.6	36.8	56.6
Soybean (%) Soja (%)	33.5	28.0	15.0
Meat and bone meal (%) Mączka mięsno-kostna (%)	5.00	5.00	4.0
Soya oil (%) Loej sojowy (%)	2.00	2.00	1.2
Fodder chalk (%) Kreda pastewna (%)	0.70	0.50	0.50
Cytromix Plus[1] (%)	0.20	0.20	0.20
Farmix[2] (%)	3.00	2.50	2.50
Nutrient composition – Składniki odżywcze			
Crude protein (CP) (%) Białko surowe (%)	23.0	19.5	17.0
ME, kcal kg^{-1}	2900	2950	3000
Lysine (%) Lizyna (%)	1.45	1.25	1.05
Methionine + Cysteine (%) Metionina + cysteina (%)	0.95	0.85	0.75
Tryptophan (%) Tryptofan (%)	0.25	0.21	0.18
Threonine (%) Tronina (%)	0.92	0.79	0.67
Calcium (%) Wapń (%)	1.20	1.15	1.10
Phosphorus (%) Fosfor (%)	0.65	0.55	0.50
Sodium (%) Sód (%)	0.15	0.15	0.15

[1]Cytromix Plus – citric acid, fumaric acid, phosphoric acid (62%)
[2]Farmix – the mineral and vitamin premix provided the following per kilogram of diet – 3 000 000 IU of vitamin A; 900 000 IU of vitamin D_3; 10 000 mg of vitamin E; 500 mg of vitamin K_3; 700 mg of vitamin B_1; 2 000 mg of riboflavin; 1 200 mg of vitamin B_6; 6 mg of vitamin B_{12}; 400 mg of folic acid; 72 mg of biotin; 15 000 mg of niacin; 120 000 mg of choline; 4 200 mg of calcium pantothenicum; 30 000 mg of Mn; 18 000 mg of Zn; 12 000 mg of Fe; 3 000 mg of Cu; 200 mg of I; 60 mg of Se; 40 mg of Co; 15 g of Ca

At the end of week 4, 6 and 10 of observation, blood was sampled from brachial vein of the birds for biochemical analyses. These analyses, conducted with the kinetic method using monotests by Cormay company, included determinations of the activities

of the following enzymes in blood plasma: aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP). Blood samples were analyzed using monotests by Cormay company also for contents of: total protein (TP), glucose (GLU), total cholesterol (CHOL), HDL fraction of cholesterol and triacylglycerols (TG). In addition, blood plasma, meat tissues and liver were determined for contents of selected macroelements (K^+, Na^+, Ca^{+2}, Mg^{+2}) using the technique of flame atomic absorption spectrometry (AAS).

Once the rearing had been completed (16^{th} week of life), the birds were slaughtered after 12-h fasting. Slaughter and simplified dissection were performed following recommendations by Faruga and Jankowski [2000]. The chemical composition was assayed in samples of breast, thigh and shank muscles as well as in liver according to AOAC procedures [2000].

Numerical data achieved were subjected to a statistical analysis using Statistica ver. 5 software, one-way analysis of variance ANOVA, and assuming the level of significance at 0.05.

RESULTS AND DISCUSSION

Data referring to analyses of biochemical indices of blood plasma of turkey hens were collated in Tab. 2. Results obtained for contents of total protein, glucose, cholesterol, HDL fraction of cholesterol, uric acid, triglycerides, aspartate aminotransferase, alanine aminotransferase and alkaline phosphatase correspond with results of investigations conducted with turkeys [Krasnodębska-Depta and Koncicki 2000, Sembratowicz *et al.* 2004, Ognik *et al.* 2004]. The application of various doses of the aloe preparation did not affect the level of glucose (GLU) nor triglycerides (TG) in blood plasma of the turkey hens examined. The analysis of results achieved for cholesterol content demonstrated that as early as in the 9^{th} week of birds life significant differences appeared between groups receiving the aloe preparation in a dose of 0.35 ml/kg b.w./day (A-1) and 0.70 ml/kg b.w./day (A-2). The level of cholesterol in blood plasma of those birds was significantly lower than in the control group by respectively 13% and 14%. The total cholesterol is the major constituent of cell membranes. Together with plasma it is transported between liver and peripheral tissues. Its excess in blood results in cholesterol deposition in blood vessels, which predisposes for the development of atherosclerosis and coronary heart disease [Jakubowski *et al.* 1993]. Likewise, the reduced level of cholesterol was observed by Faruga *et al.* [2002] who were administering various doses of a herbal preparation Biostrong-500 to slaughter turkey hens. As reported by Majewska *et al.* [2007], plant and herbal additives (e.g. extract from garlic) may diminish cholesterol level and, what is more, affect a better health status. In the turkey hens receiving the addition of the aloe preparation in the dose of 1.40 ml/kg b.w./day (A-3), analyses demonstrated an increased level of the HDL fraction of cholesterol, i.e. by over 20% when compared to the control group. The HDL takes part in the primary transport of cholesterol to liver and constitutes 40% of total cholesterol concentration [Winnicka 2008]. In turn, when administering beta-glucan and nettle to turkey hens, Truchliński *et al.* [2005] noted a decrease in the level of this cholesterol fraction.

Table 2. Level of biochemical markers in blood of turkey hens receiving the addition aloe preparation
Tabela 2. Poziom wskaźników biochemicznych we krwi indyczek otrzymujących dodatek aloesu

Parameter Cecha	Week of life Tydzień życia	Experimental groups – Grupy doświadczalne				SEM
		A-0	A-1	A-2	A-3	
TP g dl^{-1}	9	4.30 ±0.5	4.17 ±0.59	4.70 ±0.65	4.20 ±0.51	0.12
	11	5.35 ±0.75	5.43 ±0.74	5.37 ±0.79	5.22 ±0.32	0.14
	15	6.16 ±0.82	5.04 ±0.71	5.94 ±0.53	6.05 ±0.61	0.15
	$\bar{x}$	5.27 ±0.69	4.81 ±0.56	5.33 ±0.65	5.15 ±0.48	0.14
GLU mmol l^{-1}	9	12.7 ±0.65	12.8 ±1.00	12.3 ±0.70	12.6 ±0.87	0.19
	11	13.2 ±1.05	13.7 ±0.98	13.2 ±0.61	13.3 ±0.44	0.21
	15	15.4 ±0.85	14.8 ±0.83	14.4 ±0.95	14.6 ±0.82	0.22
	$\bar{x}$	13.76 ±0.85	13.76 ±0.93	13.3 ±0.75	13.50 ±0.71	0.20
TG mmol l^{-1}	9	1.01 ±0.14	0.99 ±0.15	0.99 ±0.15	0.89 ±0.14	0.03
	11	1.39 ±0.18	1.43 ±0.18	1.46 ±0.16	1.41 ±0.14	0.03
	15	1.34 ±0.14	1.43 ±0.20	1.46 ±0.17	1.55 ±0.23	0.04
	$\bar{x}$	1.24 ±0.15	1.28 ±0.17	1.30 ±0.16	1.28 ±0.17	0.03
CHOL mmol l^{-1}	9	3.29^{a} ±0.39	2.86^{b} ±0.14	2.82^{b} ±0.16	2.91^{ab} ±0.18	0.07
	11	3.35 ±0.35	3.26 ±0.50	3.37 ±0.54	3.29 ±0.31	0.06
	15	3.43 ±0.56	3.32 ±0.39	3.22 ±0.49	3.24 ±0.38	0.09
	$\bar{x}$	3.35 ±0.43	3.14 ±0.34	3.13 ±0.39	3.14 ±0.29	0.07
HDL mmol l^{-1}	9	1.64^{b} ±0.25	1.75^{ab} ±0.24	1.92^{ab} ±0.21	1.99^{a} ±0.11	0.09
	11	1.78 ±0.19	1.69 ±0.13	1.76 ±0.13	1.77 ±0.15	0.03
	15	1.77 ±0.17	1.70 ±0.17	1.84 ±0.12	1.86 ±0.13	0.03
	$\bar{x}$	1.73 ±0.20	1.71 ±0.18	1.84 ±0.15	1.87 ±0.13	0.05
UA mmol l^{-1}	9	0.35 ±0.03	0.34 ±0.02	0.33 ±0.05	0.33 ±0.06	0.01
	11	0.47±0.04	0.48 ±0.05	0.50 ±0.05	0.49 ±0.03	0.009
	15	0.45 ±0.05	0.42 ±0.05	0.42 ±0.06	0.41 ±0.06	0.01
	$\bar{x}$	0.42 ±0.04	0.41 ±0.04	0.41 ±0.05	0.41 ±0.05	0.009
AST U l^{-1}	9	190.2 ±19.7	186.7 ±25.3	174.8 ±22.6	187 ±24.6	4.94
	11	186.3 ±10.9	183.1 ±14.7	182.2 ±20.0	191.6 ±21.3	3.59
	15	190.1^{a} ±4.7	184.4^{ab} ±17.5	164.0^{b} ±14.8	167.6^{bc} ±6.31	3.82
	$\bar{x}$	188.8^{a} ±15.1	184.7^{a} ±19.2	173.6^{b} ±19.1	180.1^{ab} ±17.4	4.11
ALT U l^{-1}	9	5.42 ±0.9	5.49 ±1.06	5.34 ±0.78	5.36 ±0.83	0.18
	11	5.35 ±0.72	5.47 ±0.74	5.65 ±0.69	5.57 ±0.60	0.14
	15	6.21^{a} ±0.61	5.99^{ab} ±0.73	5.34^{b} ±0.61	5.45^{ab} ±0.66	0.16
	$\bar{x}$	5.66 ±0.74	5.65 ±0.84	5.44 ± 0.69	5.46 ±0.69	0.16
ALP U l^{-1}	9	1218 ±116	1143.3 ±101.9	1086.3 ± 109.3	1121.2 ±100.1	24.4
	11	1271.1^{ab} ±107.4	1280.4^{a} ±86.8	1176.9^{ab} ±97.1	1156.1^{b} ±62.5	22.4
	15	1173.3^{a} ±78.7	1115.7^{a} ±98.7	1068.5^{ab} ±96.2	992.7^{b} ±75.3	23.5
	$\bar{x}$	1220.7^{a} ±100.7	1179.8^{a} ±95.8	1110.6^{ab} ±100.8	1090^{b} ±79.3	23.4

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$ – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$
control – A-0 – kontrola

A-1 – 0.35 ml/kg b.w./day – dawka 0,35 ml/kg m.c./dzień
A-2 – 0.70 ml/kg b.w./day – dawka 0,70 ml/kg m.c./dzień
A-3 – 1.40 ml/kg b.w./day – dawka 1,40 ml/kg m.c./dzień
TP – total protein – białko ogólne TP
GLU – glucose – glukoza
TG – triglicerydy – triglycerides
CHOL – cholesterol – cholesterol
UA – uric acid – kwas moczowy
AST – asparagine aminotransferase – aminotransferaza asparaginianowa
ALT – alanine aminotransferase – aminotransferaza alaninowa
ALP – alkaline phosphatase – fosfataza zasadowa

Table 3. Content of macroelements in blood plasma of turkey hens
Tabela 3. Zawartość makroelementów w osoczu krwi indyczek

Parameter Cecha	Week of life Tydzień życia	Experimental groups – Grupy doświadczalne				SEM
		A-0	A-1	A-2	A-3	
Na mmol l^{-1}	9	119.6 ±3.51	119.3 ±5.08	117.8 ±4.61	115.5 ±2.30	0.99
	11	124.5 ±10.4	117.5 ±8.91	119.4 ±5.39	117.9 ±5.39	1.97
	15	114.4 ±3.05	119.9 ±9.91	116.7 ±8.74	113.7 ±12.5	2.16
	$\bar{x}$	119.5 ±5.65	118.9 ±7.97	117.9 ±6.24	115.7 ±6.73	1.70
K mmol l^{-1}	9	3.66 ±0.25	3.63 ±0.21	3.53 ±0.22	3.58 ±0.20	0.05
	11	3.94^{a} ±0.23	3.97^{a} ±0.37	3.58^{ab} ±0.37	3.35^{b} ±0.47	0.09
	15	3.91 ±0.38	4.07 ±0.46	4.04 ±0.22	4.17 ±0.23	0.08
	$\bar{x}$	3.83 ±0.28	3.89 ±0.35	3.71 ±0.27	3.70 ±0.30	0.07
Ca mmol l^{-1}	9	3.77 ±0.32	3.80 ±0.48	3.87 ±0.30	3.82 ±0.31	0.08
	11	3.05^{b} ±0.36	3.47^{a} ±0.36	3.68^{a} ±0.31	3.65^{a} ±0.42	0.10
	15	3.52 ±0.19	3.62 ±0.43	3.60 ±0.22	3.72 ±0.15	0.06
	$\bar{x}$	3.44 ±0.28	3.63 ±0.42	3.72 ±0.28	3.73 ±0.29	0.08
Mg mmol l^{-1}	9	0.71 ±0.20	0.73 ±0.14	0.80 ±0.15	0.76 ±0.05	0.03
	11	0.78 ±0.05	0.77 ±0.09	0.79 ±0.03	0.80 ±0.02	0.01
	15	0.74 ±0.05	0.77 ±0.08	0.80 ±0.07	0.73 ±0.05	0.01
	$\bar{x}$	0.74 ±0.10	0.76 ±0.10	0.79 ±0.08	0.76 ±0.04	0.02

a, b – values in the same rows with different letters differ significantly at $p \leq 0.05$ – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$
A-0 – control – kontrola
A-1 – 0.35 ml/kg b.w./day – dawka 0,35 ml/kg m.c./dzień
A-2 – 0.70 ml/kg b.w./day – dawka 0,70 ml/kg m.c./dzień
A-3 – 1.40 ml/kg b.w./day – dawka 1,40 ml/kg m.c./dzień

The activity of aspartate aminotransferase (AST) in particular groups both in the 9th and the 11th week of life was quite similar. Whereas, in the 15th week of birds life, the activity of this enzyme in groups A-2 (164.0 U l^{-1}) and A-3 (167.6 U l^{-1}) turned out to be significantly lower than in the control group (190.1 U l^{-1}). AST is an intracellular enzyme that participates in the metabolism of amino acids and hydrocarbons [Murray *et al.* 1995]. As shown by Murray *et al.* [1995], the reduced activity of AST may accompany

deficiency of B_6 vitamin and kidney failure. Likewise in the case of aspartate aminotransferase, in the same period no differences were reported between the groups of birds in the activity of alanine aminotransferase (ALT). The lowest activity of ALT compared to the control group was noted in blood plasma of 15-week-old turkey hens receiving the aloe additive in a dose of 0.70 ml/kg b.w./day. In the case of alkaline phosphatase (ALP), a significantly lower activity of this enzyme was determined in the plasma of turkey hens administered the aloe preparation in a dose of 1.40 ml/kg b.w./day (A-3), i.e. 1156.1 U l^{-1} in week 11 and 992.7 U l^{-1} in week 15 of birds life. When feeding poultry with herbal additives, Schleicher *et al.* [1998] and Faruga *et al.* [2002] did not report any effect of those preparations on the activities of aminotransferases and alkaline phosphatase.

Table 4. Content of macroelements in tissues of turkey hens
Tabela 4. Zawartość makroelementów w tkankach indyczek

Parameter Cecha	Group Grupa	Macroelements – Makroelementy			
		Na g kg^{-1}	K g kg^{-1}	Ca g kg^{-1}	Mg g kg^{-1}
Breast muscles Mięśnie piersiowe	A-0	0.90 ±0.08	1.71 ±0.30	0.14^{b} ±0.01	17.8 ±0.98
	A-1	1.63 ±0.18	1.90 ±0.17	0.39^{a} ±0.04	18.8 ±1.24
	A-2	1.68 ±0.20	1.89 ±0.16	0.36^{a} ±0.10	18.01 ±1.14
	A-3	1.66 ±0.19	1.87 ±0.10	0.35^{a} ±0.07	17.1 ±1.31
	SEM	0.043	0.051	0.005	0.44
Thigh muscles Mięśnie udowe	A-0	1.78 ±0.12	1.67 ±0.16	0.16^{b} ±0.03	15.0 ±1.12
	A-1	1.38 ±0.25	1.63 ±0.20	0.76^{a} ±0.08	15.3 ±0.95
	A-2	1.59 ±0.33	1.59 ±0.16	0.79^{a} ±0.12	14.7 ±0.67
	A-3	1.57 ±0.31	1.64 ±0.12	0.88^{a} ±0.10	15.8 ±1.06
	SEM	0.054	0.045	0.005	0.21
Shank muscles Mięśnie podudzia	A-0	1.69 ±0.14	1.80 ±0.21	0.32 ±0.09	14.6 ±0.47
	A-1	1.55 ±0.19	1.80 ±0.27	0.35 ±0.09	16.1 ±0.85
	A-2	1.56 ±0.19	1.81 ±0.24	0.37 ±0.04	16.4 ±0.92
	A-3	1.60 ±0.25	1.73 ±0.23	0.41 ±0.07	14.4 ±0.91
	SEM	0.029	0.037	0.009	0.20
Liver Wątroba	A-0	1.72 ±0.14	1.87 ±0.28	0.19^{b} ±0.01	16.9 ±1.31
	A-1	1.69 ±0.18	1.79 ±0.15	0.32^{a} ±0.06	16.2 ±0.54
	A-2	1.74 ±0.15	1.76 ±0.21	0.39^{a} ±0.12	15.8 ±1.02
	A-3	1.76 ±0.20	1.69 ±0.12	0.33^{a} ±0.06	15.6 ±1.33
	SEM	0.043	0.053	0.007	0.31

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-0 – control – kontrola
A-1 – 0.35 ml/kg b.w./day – dawka 0,35 ml/kg m.c./dzień
A-2 – 0.70 ml/kg b.w./day – dawka 0,70 ml/kg m.c./dzień
A-3 – 1.40 ml/kg b.w./day – dawka 1,40 ml/kg m.c./dzień

Table 5. Rearing performance and chemical composition of meat of turkey hens receiving the addition aloe preparation

Tabela 5. Wydajność rzeźna i skład chemiczny mięśni indyczek otrzymujących dodatek preparatu aloesowego

Tissue Tkanka	Experimental groups – Grupy doświadczalne				SEM
	A-0	A-1	A-2	A-3	
Body weight gains (kg) – Przyrosty masy ciała (kg)					
5–9 week 5–9 tydzień	1.82	1.83	1.95	1.99	0.025
9–11 week 9–11 tydzień	1.25	1.35	1.76	1.41	0.065
11–15 week 11–15 tydzień	3.01	2.74	2.40	2.80	0.085
5–15 week 5–15 tydzień	6.08	5.92	6.11	6.20	0.04
Dry matter (%) – Sucha masa (%)					
Breast muscles Mięśnie piersiowe	26.4 ±0.96	26.2 ±0.92	26.2 ±0.95	25.9 ±0.69	0.21
Thigh muscles Mięśnie udowe	24.9^{a} ±0.48	24.4^{a} ±0.54	23.0^{b} ±0.19	22.7^{b} ±0.68	0.26
Shank muscles Mięśnie podudzia	24.2^{a} ±0.45	24.1^{a} ±0.72	23.1^{b} ±0.24	23.2^{b} ±0.25	0.16
Liver – Wątroba	31.3^{a} ±0.90	29.9^{a} ±0.72	26.5^{b} ±0.83	25.9^{b} ±0.80	0.36
Crude protein (%) – Białko surowe (%)					
Breast muscles Mięśnie piersiowe	25.8^{a} ±0.56	25.1^{ab} ±0.73	24.5^{ab} ±0.89	24.1^{b} ±1.31	0.26
Thigh muscles Mięśnie udowe	22.6^{a} ±0.62	21.1^{b} ±0.70	21.0^{b} ±1.12	20.5^{b} ±0.70	0.27
Shank muscles Mięśnie podudzia	22.0^{a} ±0.74	22.1^{a} ±0.26	20.8^{b} ±0.93	20.3^{b} ±0.79	0.26
Liver – Wątroba	17.7^{b} ±0.92	18.4^{ab} ±0.93	19.8^{a} ±0.95	19.2^{ab} ±1.26	0.30
Crude fat (%) – Tłuszcz surowy (%)					
Breast muscles Mięśnie piersiowe	0.92 ±0.04	0.87 ±0.07	0.88 ±0.14	0.90 ±0.03	0.027
Thigh muscles Mięśnie udowe	1.72 ±0.20	1.59 ±0.30	1.60 ±0.33	1.74 ±0.19	0.062
Shank muscles Mięśnie podudzia	2.40 ±0.23	2.83 ±0.32	2.81 ±0.34	2.68 ±0.33	0.096
Liver – Wątroba	3.70^{a} ±0.28	3.59^{ab} ±0.09	3.25^{c} ±0.12	3.37^{bc} ±0.24	0.063
Ash (%) – Popiół (%)					
Mięśnie piersiowe	3.06 ±0.29	2.80 ±0.27	2.76 ±0.34	3.16 ±0.62	0.10
Thigh muscles Mięśnie udowe	2.00 ±0.34	1.84 ±0.24	2.02 ±0.18	1.85 ±0.30	0.065
Shank muscles Mięśnie podudzia	1.96 ±0.58	1.88 ±0.65	1.70 ±0.39	1.99 ±0.30	0.11
Liver – Wątroba	6.14 ±0.17	4.31 ±0.93	6.06 ±0.57	6.17 ±0.73	0.15

a, b, c – values in the same rows with different letters differ significantly at $p \leq 0.05$ – wartości w wierszach oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$

A-0 – control – kontrola

A-1 – 0.35 ml/kg b.w./day – dawka 0,35 ml/kg m.c./dzień

A-2 – 0.70 ml/kg b.w./day – dawka 0,70 ml/kg m.c./dzień

A-3 – 1.40 ml/kg b.w./day – dawka 1,40 ml/kg m.c./dzień

Cations present in body fluids serve a number of functions significant to an organism. Macroelements (Na, K, Ca, Mg) may occur in blood as ionized salts or as more biochemically-active and not always ionized metal-organic compounds with proteins (albumins, globulins). They are electrolytes responsible for the water-electrolyte balance in the body [Kodym 1998a]. Ample studies have shown that herbs, herbal extracts and preparations made of them may successfully supplement diet with some valuable macro- and microelements, Ca and Mg in particular, as well as with vitamins [Błoniarz *et. al.* 2003, Ognik *et al.* 2004, Sembratowicz *et al.* 2003]. Data referring to contents of minerals in blood of the turkey hens examined were presented in Tab. 3. No statistically significant differences were found in the experiment between groups in respect of sodium content. Its concentration fitted within the range of 113.7–124.5 mmol l^{-1}. In turn, the lowest concentration of potassium (3.35 mmol l^{-1}) was noted in the 11-week old turkey hens from group A-3 that were receiving the highest dose of the aloe additive. In analyzing results achieved for calcium content, its significant increase was observed in all experimental groups (A-1, A-2, A-3) in the 11-week old birds, i.e. by 14%, 19% and 20%, respectively. The high level of calcium noted in the plasma of the birds administered the aloe extract may suggest that vitamin C occurring in the extract had no negative impact on the absorption of this element in intestines. Lechowski *et al.* [1996] observed the effect of diminished calcium absorption in chickens in the presence of ascorbic acid. In contrast, Krauze *et al.* [2007] who were administering garlic and coneflower to drinking water for turkey hens, demonstrated an increased level of calcium, which may point to the beneficial influence of the herbs.

Investigations carried out on turkeys [Makarski and Polonis 2001, Sembratowicz *et al.* 2004], calves [Bombik *et al.* 2001, Saba *et al.* 2000] and fatteners [Czech *et al.* 2009] demonstrate that the addition of herbs or herbal preparations may facilitate the absorption of selected elements in the alimentary tract and increase their retention in tissues. Tab. 4 collates data concerning contents of the analyzed elements in meat tissues and in liver of the investigated slaughter turkey hens. No statistically differences were noted between the groups in contents of macroelements. The aloe additive caused increased retention of macroelements in all examined groups compared to the control group. Only in the case of calcium content in liver, a significant increase was noted in its concentration in all groups receiving the aloe preparation (A-1, A-2, A-3) compared to the control group.

Natural herbal additives to feedstuffs may exert a positive effect on the improvement of production performance parameters but also on the quality of raw material, including improvement of its dietetic and flavor properties [Czaja and Gornowicz 2004, Wenk 2002]. It has also been demonstrated that turkey meat is characterized by the highest nutritive and dietetic value amongst commercially-reared poultry species [Pudyszak *et al.* 2005]. However, as reported by Zięba [2005], the addition of herbs and herbal preparations to feedstuffs may differently modify the chemical composition of chickens muscles, especially in respect of protein and fat contents. In the reported experiment, the administration of various doses of the aloe preparation was found to affect the percentage content of dry matter and crude protein in the analyzed tissues (Tab. 5). The lowest content of those components was noted in the turkey hens receiving the higher doses of the aloe preparation, i.e. 0.70 ml/kg b.w./day (group A-2) and 1.40 ml/kg b.w./day (group A-3). Czaja and Gornowicz [2004], when feeding broiler chickens a diet with

1–2% addition of a herbal mixture, achieved opposite results showing an increased content of protein in tissues of the birds receiving the highest dose of herbs. In liver of the experimental turkey hens from groups A-2 and A-3 analyses demonstrated also the lowest content of crude fat. Results of a low fat content in muscles of chickens reared with ecological methods were also described by Gornowicz and Lewko [2010]. As reported by Pietrzak *et al.* [2009], the reduced level of fat correlated with an increased level of protein in the breast tissue of poultry is a beneficial effect from the dietetic point of view. Hence, the reduced level of protein noted upon aloe preparation administration may be found an unfavorable outcome. Discussion of results obtained in the reported experiment is rendered difficult owing to a lack of works in the available literature referring to the effect of this type of feed additive on the quality of meat expressed by chemical composition. It shall, however, be emphasized that all results noted for basic dietary constituents in turkey hens tissues correspond with findings reported by Faruga *et al.* [1988], Lipiński *et al.* [2011] and Pietrzak *et al.* [2009].

CONCLUSIONS

1. Addition of the aloe preparation to drinking water for turkey hens affected a decrease in the level of total cholesterol and activities of AST, ALT and ALP enzymes, and an increase in the HDL fraction of cholesterol.

2. Application of the highest dose of the aloe preparation decreased potassium concentration in blood plasma of 11-week olds turkey hens. In turn, all doses of the preparation caused an increase in plasma level of calcium.

3. All doses of the aloe preparation resulted in a significant increase in calcium concentration, especially in the thigh muscles of the turkey hens.

4. Addition of the aloe preparation influenced a reduction in the content of dry matter and protein in leg muscles and liver, and of fat content in liver of the turkey hens examined.

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Streszczenie. Celem podjętych badań było określenie wpływu preparatu aloesowego dodawanego do wody pitnej dla indyczek na poziom wskaźników biochemicznych krwi oraz skład chemiczny tkanek. Badania przeprowadzono na 160 indyczkach typu średniociężkiego BUT 9, podzielonych na cztery grupy doświadczalne. Każda grupa liczyła po 40 indyczek (dwa powtórzenia, w każdym po 20 sztuk). Ptaki utrzymywano od 6 do 16 tygodnia życia w kojcach, na ściółce ze słomy. Grupa I stano-

wiła grupę kontrolną (A-O), otrzymującą do picia wodę bez dodatków doświadczalnych. Indyczkom z grup A-1, A-2, A-3 dodawano do wody wyciąg z aloesu. W doświadczaniu zastosowano następujący sposób dawkowania preparatu: 0,35 ml/kg m.c./dzień dla grupy A-1, 0,70 ml/kg m.c./dzień dla grupy A-2 oraz 1,40 ml/kg m.c./dzień dla grupy A-3. Preparat aplikowano zwierzętom do wody pitnej przez 28 dni. Potem nastąpiła dwutygodniowa przerwa w suplementacji, podczas której indyczki wszystkich grup otrzymywały jedynie czystą wodę. Po przerwie zwierzęta ponownie dostawały wodę z preparatem aloesowym w identycznych dawkach jak na początku eksperymentu. Pod koniec 4, 6 i 10 tygodnia obserwacji z żyły skrzydłowej ptaków pobrano krew do badań biochemicznych i oznaczono: AST, ALT, ALP, TP, GLU, CHOL, HDL, TG, makroelementy (K^+, Na^+, Ca^{+2}, Mg^{+2}). Po zakończonym odchowie (16 tydzień życia) przeprowadzono ubój i uproszczoną dysekcję. Określono skład chemiczny mięsa w próbkach mięśni piersiowych, udowych, podudzia i w wątrobie. Rezultaty badań wskazują, iż dodatek różnych dawek preparatu z aloesu wpłynął na obniżenie poziomu cholesterolu, aktywności enzymów AST, ALT i ALP oraz zwiększenie udziału frakcji HDL cholesterolu we krwi ptaków. Spowodował spadek zawartości potasu we krwi oraz zwiększenie koncentracji wapnia w tkankach oraz wpłynął na skład chemiczny mięśni i wątroby indyczek, powodując zmniejszenie zawartości suchej masy, białka w tkankach nóg oraz tłuszczu w wątrobie.

Słowa kluczowe: aloes, indyczki, krew, tkanki, wskaźniki metaboliczne