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Effect of aloe preparation and 5-oxo-1,2,4-triazine on the biochemical parameters of blood of turkey hens subjected to stress

Wpływ preparatu aloesowego i pochodnej 5-okso-1,2,4-triazyny na wskaźniki biochemiczne krwi indyczek poddanych stresowi

Summary. The aim of this study was to determine the influence of the applied additives: aloe preparation (Aloes plus) and a 5-oxo-1,2,4-triazine derivative on chosen biochemical indices of turkey hens blood under conditions of stress. The experiment was carried out on 360 turkey hens allocated at random to 6 groups, 60 birds each. Groups C and C + stress were the control group that did not receive any additive. Birds from groups A and A + stress were administered the Aloes plus preparation in a dose of 0.70 ml/kg body weight (BW)/day. In turn, turkey hens from groups T and T + stress were receiving a derivative of 5-oxo-1,2,4-triazine in a dose of 30 μg/kg BW/day which that was dissolved in a small volume of ethanol (ca. 2 ml). The stress factor in the form of simultaneous crowding and changes in the temperature and lighting conditions did not significantly affect the changes in the level or activity of most analyzed biochemical indices of turkey hens blood (GLU, TP, UA, CHOL, AST, ALT and ALP). Both additives decreased the activity of ALT and ALP in turkey hens blood, independently of the presence or absence of stressors. Also, administration of aloe preparation and a derivative of 5-oxo-1,2,4-triazine under induced stress in turkey hens resulted in reduction of blood lipid indicators both in the birds subjected to stress as well as not subjected to stress.

Key words: turkey hens, aloe, derivative of 5-oxo-1,2,4-triazine, stress, blood, biochemical indices

INTRODUCTION

Homeostasis mechanisms maintaining the constant internal environment in the body thereby keeps the normal physiological function of the birds. A deviation from normal condition is called stress. During industrial, large-scale rearing, animals are exposed to multiple stress factors, like environmental stress that induces disorders of a daily rhythm of hormones secretion, physiological and morphological changes, manifested mainly in changes of blood composition, changes in muscle tissue and formation of meat defects. In a consequence, the exposure to a stress factor elicits deterioration of immunity, decreased production performance, incidence of pathological symptoms, and even death [Siegel 1995, Pijarska *et al.* 2006, Ognik and Sembratowicz 2012b, Lara and Rostagno 2013]. Hence, in poultry production the effective minimization of all stressogenic factors is an element of a successful production process. In order to reduce the adverse effects of stress factors the birds are exposed to in the production process and during pre-slaughter handling, attempts are made to use mineral-vitamin preparations [Wójcik *et al.* 2001], or herbal plants especially these with adaptogenic, immunostimulatory and antioxidative properties [Pandurang *et al.* 2011, Hashemi and Davoodi 2012]. The Aloes plus is a preparation based on the synergistic action of active compounds of aloes, trans-resveratrol (an antioxidant isolated from Japanese knotweed) and vitamin C. Analysis of the content of the mineral elements and vitamin C in the Aloe Plus preparation was presented in paper of Ognik and Sembratowicz [2012a]. The aloe preparations have been used for a long time as biostimulators, positively affecting body weight gain and immunity of animals. The beneficial effects of improving the production indicators and the stimulation of antioxidant and immune mechanisms in turkeys was also found as a result of administration of a newly-synthesized derivative of amidrazones 5-oxo-1,2,4--triazine [Ognik and Sembratowicz 2011, Ognik and Merska 2012]. Taking into account the biological properties of extract from aloe and newly synthesized derivative of 5-oxo--1,2,4-triazine we have attempted use these additives during artificially induced stress in organisms of turkey hens.

The aim of this study was to determine whether the introduction of stressor affects the biochemical blood indices of turkey hens and whether the administration of Aloe plus preparation and derivative of 5-oxo-1,2,4-triazine mitigates the potential adverse changes in examined parameters induced under stress.

MATERIAL AND METHODS

The experiment was conducted with the approval of the Local Ethics Committee [2009]. Turkey hens of medium-heavy BUT-9 type were reared since the 6^{th} to 16^{th} week of life in pens, on straw litter. The bird room temperature, air exchange, and humidity were maintained according to the recommendations for zoo-hygiene for young turkeys. Each day of the experiment, the number of birds in pens was controlled as required by Council Directive 2007/43/EC [European Commision 2007]. In the experimental period, turkey hens from all groups were receiving complete lose feed mixtures (Table 1), in which the content of basic nutrients is consistent with the current recommendations contained in Nutrient Requirements for Poultry [Smulikowska and Rutkowski 2005]. The experiment was carried out on 360 turkey hens allocated at random and evenly to 6 groups, 60 birds each (6 replications × 10 birds). Groups C and C + stress were control groups that did not receive any additive (Table 2). Birds from groups A and A + stress were administered the Aloes plus preparation at a dose of 0.70 ml/kg body weight (BW)/day. In turn, turkey hens from groups T and T + stress were receiving a derivative

Table 1. The composition of diets
Tabela 1. Skład komponentowy mieszanek

Ingredient Składnik	Feeding period (in weeks of life) Okres żywienia (w tygodniach życia)				
	Starter (1–2 wk)	Grower I (3–5 wk)	Grower II (6–9 wk)	Grower III (10–12 wk)	Finisher I (13–15 wk)
Maize meal Mączka kukurydziana (g/kg)	256	274	238	352	474
Wheat/Pszenica (g/kg)	200	250	300	250	250
Rape cake/Makuch rzepakowy (g/kg)	–	–	–	–	–
Wheat bran/Otręby pszenne (g/kg)	30	–	–	–	–
Soybean meal 46% protein Śruta sojowa 46% białka (g/kg)	410	417	388	327	204
Soybean meal 45% protein Śruta sojowa 45% białka (g/kg)	20	–	–	–	–
Fish meal 60% Mączka rybna 60% (g/kg)	35	–	–	–	–
Fodder chalk/Kreda pastewna (g/kg)	12	17	17	14	15
Soybean oil/Olej sojowy (g/kg)	5	10	25	30	30
Cytromix Plus[a] (g/kg)	2	2	2	2	2
Farmix[b] (g/kg)	30	30	30	25	25
Nutritional value/Wartość odżywcza					
Crude protein/Białko surowe (g/kg)	271.0	255.0	245.0	220.0	175.0
Metabolic energy Energia metaboliczna (MJ/kg)	11.45	11.73	12.19	12.58	13.09
Crude fibre/Włókno surowe (g/kg)	28.6	27.7	27.2	27.1	27.0
Lysine/Lizyna (g/kg)	18.1	17.1	15.7	13.8	11.7
Methionine + cysteine (g/kg) Metionina + cysteina (g/kg)	9.8	9.0	8.8	7.9	7.0
Tryptophan/Tryptofan (g/kg)	3.4	2.8	2.7	2.3	1.9
Arginine/Arginina (g/kg)	17.7	15.7	15.0	13.2	9.8
Cal (g/kg)	13.9	12.3	11.7	10.6	9.4
Available P/P przyswajalny (g/kg)	7.7	6.7	5.9	5.7	4.7
Na (g/kg)	1.5	1.6	1.5	1.5	1.5

[a] Cytromix Plus: citric acid, fumaric acid, phosphoric acid (62%)/ Cytromix Plus: kwas cytrynowy. kwas fumarowy. kwasu fosforowy (62%)

[b] Farmix mineral and vitamin premix provided the following per kilogram of feed: 3000000 IU vitamin A; 900000 IU vitamin D_3; 10000 mg vitamin E; 500 mg vitamin K_3; 700 mg vitamin B_1; 2000 mg riboflavin; 1200 mg vitamin B_6; 6 mg vitamin B_{12}; 400 mg folic acid; 72 mg biotin; 15000 mg niacin; 120000 mg of choline; 4200 mg of calcium pantothenicum; 30000 mg Mn; 18000 mg Zn; 12000 mg Fe; 3000 mg Cu; 200 mg I; 60 mg Se; 40 mg Co; 15 g Ca; 15.5 g P/ Farmix premiks mineralno-witaminowy zawierający w kilogramie paszy następujące składniki: 3000000 IU witamina A; 900000 IU witamina D_3; 10000 mg witamina E; 500 mg witamina K_3; 700 mg witamina B_1; 2000 mg ryboflawina; 1200 mg witamina B_6; 6 mg witamina B_{12}; 400 mg kwas foliowy; 72 mg biotyna; 15000 mg niacyna; 120000 mg of cholina; 4200 mg of wapń; 30000 mg Mn; 18000 mg Zn; 12000 mg Fe; 3000 mg Cu; 200 mg I; 60 mg Se; 40 mg Co; 15 g Ca; 15.5 g P

of 5-oxo-1,2,4-triazine at a dose of 30 μg/kg BW/day that was dissolved in a small volume of ethanol (ca. 2 ml). The additives were administered to the birds in drinking water for 28 days (36th–63rd day of birds life) (Table 2). In order to determine the dose of additives per kg of body weight data on average values of performance parameters (body weight, daily gains turkey hens BUT 9) presented in BUT 9 the producers quide were used. The experimental additives were administered every morning to drinking troughs in about 1–2 liters of water, which was guarantee total intake of additives. Then according to demand of birds clean drinking water was provided. Then, a two-week break was made in additives administration when the birds drunk water without additives. After the break, the birds were again receiving the additives for another 28 days (78th–105th day of birds life). On day 61st–63rd and 103rd–105th day of life an experimental factor in the form of stress stimuli was introduced in groups: C + stress, A + stress and T + stress for 1 hour a day. The stress stimuli included simultaneous crowding and change of temperature and lighting. The birds were put into plastic containers 85 × 50 × 35 cm in size (crowding), used for the transport of birds. Into the one container were placed maximum 3 birds. The containers had holes that provided the access of cool fresh air when the birds were moved outdoor (to a place not shielded from wind) in order to induce a rapid change of lighting conditions from artificial light to daylight and a decrease of temperature by ca. 20–30°C, as in the study months (November–January) the temperature of air ranged from +5°C to –10°C. The above treatments were conducted in daytime, always at the same time of the day. Experimental conditions were adjusted so as to resemble the conditions of the production process, especially during intensive rearing at large production farms.

Table 2. Experimental design
Tabela 2. Układ doświadczenia

Day of life Dzień życia	Control Grupy kontrolne		Experimental groups Grupy doświadczalne			
	C	C + stress	A	A + stress	T	T + stress
36–63	–	–	Aloes plus (0.70 ml/kg BW/day)	Aloes plus (0.70 ml/kg BW/day)	derivative of 5-oxo-1,2,4--triazine (30 μg/kg BW/day)	derivative of 5-oxo-1,2,4--triazine (30 μg/kg BW/day)
61–63	–	+ stress	–	+ stress	–	+ stress
64–77	–	–	–	–	–	–
78–105	–	–	Aloes plus (0.70 ml/kg BW/day)	Aloes plus (0.70 ml/kg BW/day)	derivative of 5-oxo-1,2,4--triazine (30 μg/kg BW/day)	derivative of 5-oxo-1,2,4--triazine (30 μg/kg BW/day)
103–105	–	+ stress	–	+ stress	–	+ stress

Derivative of 5-oxo-1,2,4-triazine/ Pochodna 5-okso-1,2,4-triazyny.

Table 3. Biochemical parameters of blood plasma of turkey hens
Table 3. Wskaźniki biochemiczne osocza krwi indyczek

Experimental factors Wskaźniki doświadczalne		TP (g dl^{-1})				GLU (mmol l^{-1})				UA (mmol l^{-1})			
		9	11	15	$\bar{x}$	9	11	15	$\bar{x}$	9	11	15	$\bar{x}$
C	(–) stress	4.43	6.32^{a}	5.65	5.47	12.8	13.2	15.1	13.7	0.26	0.50	0.35	0.37
A		3.81	6.01^{ab}	5.30	5.04	12.2	12.7	14.4	13.1	0.34	0.48	0.36	0.39
T		4.03	4.57^{b}	5.56	4.72	12.3	12.9	14.4	13.2	0.27	0.52	0.34	0.38
C	(+) stress	4.06	5.35^{ab}	5.23	4.88	11.9	13.7	15.4	13.6	0.27	0.46	0.44	0.39
A		4.18	4.55^{b}	5.29	4.67	12.3	13.3	14.5	13.4	0.24	0.50	0.41	0.38
T		4.55	4.93^{b}	4.96	4.81	12.4	13.5	15.0	13.6	0.25	0.51	0.36	0.37
Additive effect (D)	C	4.25	5.84^{a}	5.44	5.18	12.3	13.4	15.2	13.6	0.27	0.48	0.40	0.38
	A	4.25	5.84^{a}	5.44	5.18	12.3	13.4	15.2	13.6	0.27	0.48	0.40	0.38
	T	4.29	4.75^{b}	5.26	4.765	12.3	13.2	14.7	13.4	0.26	0.52	0.35	0.38
Stress effect (S)	(–) stress	4.09	5.63	5.50	5.08	12.4	12.9	14.6	13.3	0.29	0.50	0.35	0.38
	(+) stress	4.26	4.94	5.16	4.79	12.2	13.5	14.9	13.5	0.25	0.49	0.40	0.38
D effect		n.s.	**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s	n.s.	n.s.	n.s	n.s.
S effect		n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s	n.s	n.s.
D × S interaction		n.s.	**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

a, b, c Means in the same column without common superscripts differ significantly at ** $p \le 0.05$; n.s. $p > 0.05$.
a, b, c Średnie w tej samej kolumnie, bez wspólnych indeksów górnych różnią się istotnie przy ** $p \le 0{,}05$; r.n. $p > 0{,}05$.
TP – total protein/ białko ogólne; GLU – glucose/glukoza; UA – uric acid/kwas moczowy;
(–) stress – without stress/brak stresu; (+) stress – with stress/obecny stress;
additive effect/ wpływ dodatku; stress effect/wpływ stresu; D × S interaction/interakcja D × S.

At the end of the 9th, 11th and 15th week of turkey hens life, blood was sampled (by a veterinarian) from the wing vain of 10 birds of each group. Blood samples was taken after 8-hour fasting with free access to drinking water. In blood plasma, using monotests by Cormay company, spectrophotometric analyses will be carried out in order to determine contents of selected biochemical markers, i.e. total protein (TP), glucose (Glu), uric acid (UA), urea, total cholesterol (CHOL), triacylglycerols (TG), HDL cholesterol fraction and the activities of aspartate aminotransferaze (AST), alanine aminotransferaze (ALT), alkaline phosphatase (ALP). Data achieved were analyzed using the STATISTICA software package version 6.0 [StatSoft 2003]. A two-way repeated measures ANOVA was applied to assess the effect of main factors: stress (S), additives (D) and their interactions (S × D). If the analysis revealed a significant interaction or that both factors had a significant influence, the differences among the individual groups were then analyzed using Tukeys multiple range post hoc test. Data had been checked for normality before the statistical analysis was performed. Differences were considered to be significant at $P \le 0.01$ and $P \le 0.05$.

RESULTS AND DISCUSSION

The values of blood biochemical indices of birds constitute a valuable information regarding the proper course of metabolic processes. They are in fact a reflection of changes in response to an environmental stimuli system, disease, or the application of experimental factor [Fitko 1983, Krasnodębska-Depta and Koncicki 2000]. At stress, the demand for energy increases even several times and the preferred energetic substrate is glucose. Hence, a temporary increase in blood level of glucose (hyperglycemia) has been observed [Ognik and Sembratowicz 2012b]. An increase in the quantity of corticoids circulating in blood occurring under stress conditions is the cause of suppressed synthesis of systemic proteins and enhanced proteolysis, because these hormones exert mainly catabolic effects. Degradation of proteins is supposed to provide the availability of amino acids, as gluconeogenic substrates, for glucose synthesis. As is clear from the data presented in Table 3, the stress did not contributed to significant changes in the level of glucose, total protein and uric acid, which is the final product of protein catabolism in birds. The additives used in a preparation of aloe, and the 5-oxo-1,2,4-triazine does not significantly affect the level of these indicators, with the exception of total protein (TP), which in the groups treated with a derivative of 5-oxo-1,2,4-triazine was significantly ($P \leq 0.05$) lower than in the control group (C). However, it was found only in the 11th week of rearing. The results of Ognik and Merska [2011] also showed lower concentrations of TP in turkey hens administered this supplement.

The results depicting activity of aminotransferases: alanine (ALT) and aspartate (AST) and alkaline phosphatase (ALP) (Table 4) indicate that the stress factors had no significant effect on it. Only in the 9th week of birds life was recorded significant ($P \leq 0.05$) increase in AST activity in stress-treated groups compared to birds without stress. As shown by investigations conducted by Krasnodębska-Depta and Koncicki [2002] and Pijarska *et al.* [2006], no significant differences were observed in ALT activity in blood plasma of birds exposed to stress, the differences referred only to the activity of AST. Our research shows significant ($P \leq 0.05$) decrease in activity of ALT and ALP under the influence of both tested additives, especially aloe vera preparation. Similar results of decrease activity of these enzymes under the influence of this preparation has been found in the study of Ognik and Merska [2012]. In turn, Krauze [2007] giving turkeys derivative of amidrazones, ie the derivative of 1,2,4-triasole recorded a significant increase in activity of AST and ALT.

Numerous publications indicate that stress factors may significantly modify lipid metabolism in poultry. Depending on the type of stressor changes in lipid indicators of blood may vary over in different directions. As is apparent from the data presented in Table 5, the combination of crowding, the change of light and temperature reduction (C + stress group) resulted in an increased level of triglycerides versus controls not subjected to stress (C – stress). Significant ($P \leq 0.01$) increase of this parameter was observed in 15th week of turkey hens life, after the first application of stress. The content of total cholesterol in stressed birds and non-stressed and was similar, but the stress contributed to a decrease in beneficial cholesterol fraction – HDL. It is involved in the primary active transport of cholesterol to the liver and represents 40% of concentration of plasma total cholesterol [Winnicka 2008].

Table 4. Activity of enzymes of turkey hens blood plasma
Tabela 4. Aktywność enzymów w osoczu krwi indyczek

Experimental factors Wskaźniki doświadczalne		AST U l^{-1}				ALT U l^{-1}				ALP U l^{-1}			
		9	11	15	$\bar{x}$	9	11	15	$\bar{x}$	9	11	15	$\bar{x}$
C	(–) stress	203.4	184.4	191.7	193.1	6.10^{a}	5.55^{a}	5.45^{ab}	5.70^{a}	1323.1^{a}	1371.7^{a}	1115.9^{a}	1270.2^{a}
A		188.0	185.5	170.1	181.2	4.86^{b}	4.53^{b}	3.81^{b}	4.40^{b}	818.2^{c}	963.1^{b}	937.3^{b}	906.2^{c}
T		184.8	173.6	172.6	177.0	4.71^{b}	4.27^{b}	3.92^{b}	4.30^{b}	1192.3^{b}	1210.1^{ab}	1088.5^{ab}	1163.6^{b}
C	(+) stress	223.9	172.3	178.4	191.5	5.20^{ab}	5.46^{a}	6.10^{a}	5.50^{a}	1295^{ab}	1328.8^{a}	1132.1^{a}	1252.1^{a}
A		209.1	174.1	166.5	183.2	3.95^{b}	4.58^{b}	4.51^{b}	4.34^{b}	863.8^{c}	989.8^{b}	969.7^{b}	941.1^{c}
T		243.5	183.7	184.3	209.8	4.68^{b}	4.35^{b}	4.50^{b}	4.51^{b}	1283.1^{ab}	1291.1^{ab}	1124.7^{a}	1232.9^{ab}
Additive	C	213.6	178.3	185.1	192.3	5.65^{a}	5.51^{a}	5.78^{a}	5.6^{a}	1323.1^{a}	1350.2^{a}	1124^{a}	1261.1^{a}
effect (D)	A	198.5	179.8	168.3	182.2	4.40^{b}	4.56^{b}	4.16^{b}	4.37^{b}	841.0^{c}	976.45^{c}	953.5^{b}	923.6^{b}
	T	214.2	178.6	178.4	193.4	4.69^{b}	4.31^{b}	4.21^{b}	4.41^{b}	1237.7^{b}	1250.6^{b}	1106.6^{ab}	1198.3^{ab}
Stress	(–) stress	192.1^{b}	181.2	178.1	183.8	5.22	4.78	4.39	4.80	1111.2	1181.6	1047.2	1113.3
effect (S)	(+) stress	225.5^{a}	176.7	176.4	194.8	4.61	4.80	5.04	4.78	1073.4	1203.2	1075.5	1142.0
D effect		n.s.	n.s.	n.s.	n.s.	*	*	*	*	**	*	*	**
S effect		**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
D × S interaction		**	n.s.	n.s.	n.s.	**	**	*	**	*	**	n.s.	n.s.

$^{a, b, c}$ means in the same column without common superscripts differ significantly at * $p \le 0.01$; ** $p \le 0.05$; ns $p > 0.05$.
$^{a, b, c}$ średnie w tej samej kolumnie, bez wspólnych indeksów górnych różnią się istotnie przy * $p \le 0{,}01$; ** $p \le 0{,}05$; r.n. $p > 0{,}05$.
AST – asparagine aminotransferase/ aminotransferaza asparaginianowa; ALT – alanine aminotransferase/ aminotransferaza alaninowa; ALP – alkaline phosphatase/ fosfataza zasadowa; (–)stress/ without stress/ brak stresu; (+)stress – with stress/ obecny stress Additive effect/ wpływ dodatku; stress effect/ wpływ stresu, D × S interaction/ interakcja D × S.

There is no publications, which tested the effect analogous stressors to discuss the similar parameters. Reduction in the quantity of lipids (total cholesterol and TG) are observed most frequently in the fasting [Rajman *et al.* 2006], and in reduced temperature of air in order to generate stress [Sahin *et al.* 2006], as well as during transport [Keller 1990, Vosmerova *et al*. 2010]. Results of own research indicate that introduction of both tested additives in stressed birds (A + stress, T + stress) resulted in tendency to decrease in TG level relatively to the control group (C + stress). A significant ($P \le 0.05$) decrease in the concentration of triglycerides was observed as a result of administration of the 5-oxo-1,2,4-triazine (9th week of life birds). Aloe preparation used in the birds treated with stress and non-stressed contributed to reduce the level of total cholesterol and a slight increase in the beneficial, antiatherogenic HDL cholesterol fraction (but only in 15th week of birds life). The results of Lim *et al.* [2003] and Akinmoladun and Akinloye [2004] show that aloe extracts have a hypocholesterolemic effect. The use of a derivative of 5-oxo-1,2,4-triazine did not affect the level of total cholesterol, although in case of the aloe preparation, contributed to an increase in HDL cholesterol fraction.

Table 5. Lipids parameters of blood plasma of turkey hens
Tabela 5. Wskaźniki lipidowe w osoczu krwi indyczek

Experimental factors		TG (mmol l^{-1})				CHOL (mmol l^{-1})				HDL (mmol l^{-1})			
		9	11	15	$\bar{x}$	9	11	15	$\bar{x}$	9	11	15	$\bar{x}$
C	(–) stress	1.41^{bc}	1.81	1.90^{ab}	1.70^{ab}	3.20^{a}	3.36^{a}	3.37^{a}	3.31^{a}	1.70^{a}	1.63^{a}	1.53^{ab}	1.62^{a}
A		1.45^{b}	1.83	1.56^{b}	1.61^{ab}	2.76^{b}	2.79^{b}	2.86^{b}	2.80^{b}	1.54^{ab}	1.64^{a}	1.77^{a}	1.65^{a}
T		1.03^{c}	1.75	1.82^{ab}	1.53^{b}	3.0^{ab}	3.26^{a}	3.28^{ab}	3.18^{ab}	1.27^{ab}	1.66^{a}	1.67^{ab}	1.53^{ab}
C	(+) stress	1.66^{a}	1.86	2.04^{a}	1.85^{a}	3.20^{a}	3.28^{a}	3.41^{a}	3.29^{a}	1.08^{b}	1.36^{b}	1.38^{b}	1.27^{c}
A		1.50^{ab}	1.91	1.79^{ab}	1.73^{ab}	2.81^{b}	2.84^{b}	2.91^{b}	2.85^{b}	1.15^{b}	1.57^{ab}	1.60^{ab}	1.44^{b}
T		1.15^{c}	1.93	1.86^{ab}	1.65^{ab}	3.10^{ab}	3.31^{a}	3.34^{a}	3.25^{b}	1.06^{b}	1.49^{ab}	1.58^{ab}	1.37^{bc}
Additive effect (D)	C	1.54^{a}	1.84	1.97^{a}	1.78^{a}	3.20^{a}	3.32^{a}	3.39^{a}	3.30^{a}	1.39^{a}	1.49	1.46^{b}	1.45
	A	1.48^{ab}	1.87	1.68^{b}	1.67^{ab}	2.79^{b}	2.82^{b}	2.89^{b}	2.83^{b}	1.35^{a}	1.61	1.69^{a}	1.55
	T	1.09^{b}	1.84	1.84^{ab}	1.59^{b}	3.05^{ab}	3.29^{a}	3.31^{a}	3.22^{a}	1.17^{b}	1.58	1.63^{ab}	1.45
Stress effect (S)	(–) stress	1.30	1.80	1.76^{b}	1.61	2.99	3.14	3.17	3.10	1.50^{a}	1.64^{a}	1.66	1.60^{a}
	(+) stress	1.44	1.90	1.90^{a}	1.74	3.04	3.14	3.22	3.13	1.10^{b}	1.47^{b}	1.52	1.36^{b}
D effect		*	n.s.	**	**	**	**	**	**	**	n.s.	**	n.s.
S effect		n.s.	n.s.	**	n.s.	n.s.	n.s.	ns	n.s.	**	*	n.s.	**
D × S interaction		n.s.	n.s.	**	n.s.	n.s.	n.s.	n.s.	**	**	**	**	**

[a, b, c] Means in the same column without common superscripts differ significantly at * $p \le 0.01$; ** $p \le 0.05$; n.s. $p > 0.05$.
[a, b, c] Średnie w tej samej kolumnie, bez wspólnych indeksów górnych różnią się istotnie przy * $p \le 0,01$; ** $p \le 0,05$; r.n. $p > 0,05$.
TG – triglycerides/triglicerydy; CHOL – cholesterol/cholesterol; HDL – high density lipoprotein fraction/frakcja lipoproteinowa cholesterolu o wysokiej gęstości;
(–) stress – without stress/ brak stresu; (+) stress – with stress/obecny stress;
Additive effect/wpływ dodatku; stress effect/ wpływ stresu;D × S interaction/interakcja D × S

CONCLUSIONS

1. The applied stress factors did not contribute to significant changes in the level or activity of the most analyzed biochemical indices of turkey hens blood (GLU, TP, UA, CHOL, AST, ALT and ALP). They contributed significantly only to increase the concentration of triglycerides and decrease in HDL cholesterol fraction.

2. The application of both tested additives, i.e. aloe preparation and derivative of 5-oxo-1,2,4-triazine under induced stress in turkey hens resulted in reduction of the adverse modification of blood lipid indicators. Furthermore the addition of aloe preparation caused a significant reduction in levels of total cholesterol both in the birds subjected to stress, as well as treated with no stress.

3. The administration of the tested additives resulted in decrease of activity of alanine aminotransferase and alkaline phosphatase in the blood, independently of the presence or absence of stressors.

REFERENCES

Akinmoladun A.C., Akinloye O., 2004. Effect of *Aloe barbadensis* on the lipid profile and fasting blood sugar concentration of rabbits fed high cholesterol diet. Global. J. Pure Appl. Sci. 10, 139–142.

European Commision, 2007. Council Directive 2007/43/EC of 28 June 2007 laying down minimum rules for the protection of chickens kept for meat production. O.J. EU, 182, 19–28.

Fitko R., 1983. Współczesne poglądy na mechanizmy i następstwa stresu u zwierząt. Med. Weter. 9, 515–519.

Hashemi S.R., Davoodi H., 2012. Herbal plants as new immuno-stimulator in poultry industry: A review. Asian J. Anim. Vet. Adv. 7, 105 –116.

Keller., 1990. Einfluss von transport und wartezeit auf physiologische parametr bei schlachtputen. Dtsch. Geflügelwirstch. Schweineprod 44, 1305–1306.

Krasnodębska-Depta A, Koncicki A., 2002. Wpływ krótkotrwałego stresu cieplnego na wybrane wskaźniki biochemiczne krwi indyków. Med. Weter. 58, 223–226.

Krasnodębska-Depta A., Koncicki A., 2000. Fizjologiczne wartości wybranych wskaźników biochemicznych w surowicy krwi kurcząt brojlerów. Med. Weter. 56, 7, 456–460.

Krauze M., 2007. Influence of differential rations of 1,2,4-triasole derivative on the level of chosen blood indicators and rearing efficiency of slaughter turkey-hens. Annales UMCS, sec. DD, Medicina Veterinaria 62, 1, 8–14.

Lara L.J., Rostagno M.H., 2013. Impact of Heat Stress on Poultry Production. Animals 3, 356–361.

Lim B.O., Seong N.S., Choue R.W., Kim J.D., Lee H.Y., Kim S.Y., 2003. Efficacy of dietary aloe vera supplementation on hepatic cholesterol and oxidative status in aged rats. J Nutr. Sci. Vitaminol. (Tokyo) 49, 292–296.

Local Ethics Committee, 2009. Zezwolenie na przeprowadzenie doświadczeń na zwierzętach.

Ognik K., Merska M., 2011. Influence of 5-oxo-1,2,4-triazine derivative addition on the level of biochemical blood markers and chemical composition of turkey hens tissues. Annales UMCS, sec. EE, Zootechnica 29 (3), 35–46.

Ognik K., Merska M., 2012. Effect of aloe preparation on the level of biochemical indices of blood and tissue composition of female turkeys. Annales UMCS, sec. EE, Zootechnica 30 (1), 33–45.

Ognik K., Sembratowicz I., 2011. Influence of a newly-synthesized 5-oxo-1,2,4-triazyne derivative on antioxidant indices of blood and performance of turkey hens. S. Afr. J. Anim. Sci. 41, 403–412.

Ognik K., Sembratowicz I. 2012a. Effect of Aloe plus preparation supplement on hematological and immunological blood parameters of and performance of turkey hens. Turk. J. Vet. Anim. Sci. 36 (1), 1–8.

Ognik K., Sembratowicz I., 2012b. Stress as a factor modifying the metabolism in poultry. Annales UMCS, sec. EE, Zootechnica 30 (2), 34–43.

Pandurang L.T; Kulkarni G.B; More P.R; Ravikanth K., Maini S.; Deshmukh V.V., Yeotikar P.V., 2011. Overcrowding stress management in broiler chicken with herbal antistressor. Iran. J. Appl. Anim. Sci. 1, 49–55.

Pijarska I., Czech A., Malec H., Tymczyna L., 2006. Effects of road transportation of chicks on blood biochemical indices and productive results of broilers. Med. Weter. 62, 408–410.

Rajman M., Jurani M., Lamoova D., Maeajova M., Sedlaekova M., Kotal L., Jeova D., Vyboh P., 2006. The effects of feed restriction on plasma biochemistry in growing meat type chickens (*Gallus gallus*). Comp. Biochem. Physiol. A. 145, 363–371.

Sahin, N., Sahin K., Onderci M., Karatepe M., Smith M.O., Kucuk O., 2006. Effects of dietary lycopene and vitamin E on egg production, antioxidant status and cholesterol levels in Japanese Quail. Asian-Aust. J. Anim. Sci. 19 (2), 224–230.

Siegel H.S., 1995. Stress, strains, and resistance. Br. Poult. Sci., 36, 3–20.

Smulikowska S., Rutkowski A. (eds), 2005. Normy żywienia drobiu. Omnitech Press, 4th edn. Instytut Fizjologii i Żywienia Zwierząt im. Jana Kielanowskiego PAN, Jabłonna.

Statsoft, 2003. Statistica. Data analysis software system, version 6.0, www.statsoft.com.

Vosmerova P., Chloupek J., Bedanova I., Chloupek P., Kruzikova K., Blahova J. Vecerek V., 2010. Changes in selected biochemical indices related to transport of broilers to slaughterhouse under different ambient temperatures. Poult. Sci. 89, 2719–2725.

Winnicka A., 2008. Wartości referencyjne podstawowych badań laboratoryjnych w weterynarii. Wyd. SGGW, Warszawa.

Wójcik A., Sowińska J., Iwańczuk-Czernik K., 2001. Zastosowanie u indyków średniociężkich witaminy E i selenu przed obrotem przedubojowym w celu łagodzenia stresu transportowego. Folia Univ. Agric. Stetin., Zootechnica 42, 169–174.

Streszczenie. Celem podjętych badań było stwierdzenie, czy wprowadzenie czynnika stresowego wpłynęło na wskaźniki biochemiczne indyczek, oraz czy zastosowane łącznie ze stresem dodatki, w postaci Aloesu plus oraz pochodnej 5-okso-1,2,4-triazyny, spowodowały złagodzenie ewentualnych niekorzystnych zmian badanych parametrów. Doświadczenie przeprowadzono na 360 sztukach indyczek podzielonych losowo i równomiernie na 6 grup liczących po 60 indyczek. Grupy C oraz C + stres stanowiły grupy kontrolne i nie otrzymywały żadnego dodatku. Ptakom z grup A oraz A + stres aplikowano preparat Aloes plus w ilości 0,70 ml/kg m.c./dzień. Indyczki z grup T oraz T + stres otrzymywały rozpuszczoną w niewielkiej ilości etanolu (ok. 2 ml) pochodną 5-okso--1,2,4-triazyny w dawce 30 µg/kg m.c./dzień. Czynnik stresowy w postaci jednoczesnego stłoczenia, zmiany temperatury oraz oświetlenia nie wpłynął istotnie na zmianę poziomu lub aktywności większości analizowanych wskaźników biochemicznych krwi indyczek (GLU, TP, UA, CHOL, AST, ALT i ALP). Zastosowane dodatki spowodowały zmniejszenie aktywności ALT i ALP we krwi indyczek, niezależnie od obecności czy też braku czynników stresowych. Dodatek preparatu aloesowego oraz pochodnej 5-okso-1,2,4-triazyny w trakcie indukowanego stresu u indyczek skutkował zmniejszeniem wskaźników lipidowych krwi, zarówno u ptaków poddawanych, jak i niepoddawanych stresowi.

Słowa kluczowe: indyczki, aloes, pochodna 5-okso-1,2,4-triazyny, stres, krew, wskaźniki biochemiczne