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EFFECT OF THE APPLICATION OF OPOKA ADDITIVE IN FEED ON BLOOD MORPHOLOGICAL AND BIOCHEMICAL PARAMETERS AND ANIMAL HUSBANDRY INDICATORS OF BROILER CHICKEN

WPŁYW ZASTOSOWANIA W PASZY DODATKU OPOKI NA PARAMETRY MORFOLOGICZNE I BIOCHEMICZNE KRWI ORAZ PARAMETRY ZOOTECHNICZNE KURCZĄT BROILERÓW

***Summary**: In the paper, the studies on the effect of the application of 1% additive of opoka on morphological and biochemical parameters of blood and animal husbandry indicators (weight increase and dressing percentage) of chicken broilers ROSS 308 were presented. The experiment was conducted in animal facilities of the Department of Animal Nutrition and Biotechnology, Warsaw University of Life Sciences.*

***Keywords**: opoka, silica-calcite sedimentary rock, broilers, blood morphological and biochemical parameters*

***Streszczenie**: W artykule przedstawiono badania wpływu zastosowania w paszy 1% dodatku opoki na parametry morfologiczne i biochemiczne krwi oraz parametry zootechniczne (przyrosty i wydajność rzeźną) kurcząt broilerów ROS 308. Doświadczenie przeprowadzono w zwierzetarni Katedry Żywienia i Biotechnologii Zwierząt SGGW w Warszawie.*

***Słowa kluczowe**: opoka, krzemionkowo-kalcytowa skała osadowa, broilery, parametry morfologiczne i biochemiczne krwi*

Introduction

Opoka is a silica-calcite sedimentary rock – seabed, composed of the residues coming from marine organisms dating back to the Upper Cretaceous period. It occurs in the area of the North Sea, at the territory of Poland, Lithuania, Ukraine and Russia. Its chemical structure and a high porosity cause that it is an excellent absorber [1]. Until now, there have been conducted the studies on the application of opoka mainly as the sorbent in the treatment of municipal sewage [1 – 3]. Its use in agriculture and gardening with the aim of a slow penetration of the elements to the soil is also well documented [1, 3].

Similar materials, mainly diatomaceous earth (DM), were already earlier used as growth stimulators, natural source of silicon in farm animals, the anti-parasite agent, or mycotoxin absorbents [4, 9]. Bennett et al. (2011) showed that 2% additive of diatomaceous earth to feeds for laying hens had the influence on the evident decrease of the number of eggs of *Capillaria* and *Heterakis* parasites. Besides it, the hens from the experimental group had higher body weight and were characterized by higher laying performance. The studies of Łukasiewicz and Wiewióra [9] indicate that DM addition in feed for the broilers resulted in the higher participation of breast muscles and lower fattening of carcasses in the group, receiving 4% additive of diatomaceous earth as compared to the control group, with the simultaneous lack of the effect on chemical composition of the muscles. Moreover, it was found that femurs (thigh bones) of the animals from the group receiving 4% DM additive were characterized by a significantly higher strength as compared to the chicken from the control group [9].

Due to the similarity in chemical and physical structure, it may be expected that opoka will have the similar properties as DM. In the earlier work, Makarski et al.(2020) [5] demonstrated that 1% addition of opoka had a positive influence on the quality of broiler meat via increase of collagen and ash content and lowering of fat level in leg muscles [5]. According to our knowledge, more experiments where opoka was used as food additive for animals have been not carried out.

The aim of the present study was to evaluate the effect of the application of 1% addition of opoka in the diets on morphological

and biochemical parameters of blood and animal husbandry parameters (live weight gains and dressing percentage) of broilers ROSS 308.

Material and methods

The experiment was conducted in animal facilities of the Department of Animal Nutrition and Biotechnology, Warsaw University of Life Sciences. In the henhouse, the controlled conditions were maintained, i.e. temperature from 32°C for the first 12 days – decline by 1°C per day until reaching 21°C; the range of humidity 64–70%; cycle light/darkness 20/4h for the first 10 days, and then, 20/10h until the end of the experiment. The animals had a free access to water and feed.

One day-old ROSS 308 broilers were classified into 2 groups (control and experimental). The number of the birds was: 12 females and 12 males in each group. The diets, starter (from1 to 14 day of life) and grower (from 15 to 42 day of life) were developed according to NRC requirements (1994). The chicken from the control group were *ad libitum* fed the standard diet. The animals from the experimental group received the standard diet, supplemented with 1% opoka addition, i.e. silica-calcite sedimentary rock, supplied by the Manufacturing Plant of

Table 2. Chemical composition of natural Opoka

Component	Natural Opoka*	
SiO_2	52.10	37.20
CaO	19.30	28.20
MgO	0.69	0.58
Al_2O_3	5.75	3.82
Fe_2O_3	1.80	1.79
K_2O	1.05	0.71
Na_2O	0.13	0.12
TiO_2	0.37	0.24
P_2O_5	0.03	0.04
MnO_2	0.01	0.02

** Brogowski, Renman 2004*

Table 1. Components of feeds

Commercial component diet[1]	Control group		Experimental group	
	Starter	Grower	Starter	Grower
	%			
Wheat	10	10	10	10
Maize	48.7	49.7	47.9	48.7
Soy bean meal 46%	32.6	31	32.7	31.4
Soy bean oil	3.5	3.82	3.5	3.85
DL-methionine 98%	0.2	0.1	0.2	0.05
L- Lysine 99%	0.2	0.34	0.2	0.35
Threonine 98.5%	0.1	0.1	0.1	0.1
Limestone	1	1	0.7	0.7
Monocalcium phosphate	2.4	2,6	2.4	2.6
Sodium chloride	0.34	0.34	0.34	0.34
Premix [2]	1	1	1	1
Opoka	0	0	1	1
Metabolizable energy MJ/kg [3]	12.2	12.35	12.1	12.26
Crude protein g/kg [3]	210.0	210.0	200.0	200.0
Calcium *	10.5	10.4	10.6	10.9
Phosphorus *	4.7	5.01	4.7	5.02

[1] *NRC (1994)*
[2] *In 1 kg of premix diets: vitamin A 15 000 IU; vitamin D 3000 IU; vitamin E 20 mg; vitamin K_3 2.7 mg, vitamin B_1 2.5 mg; vitamin B_6 0.4 mg; vitamin B_{12} 0.015 mg, nicotinic acid 25 mg; pantothenic acid 8 mg; folic acid 1.2 mg; Choline chloride 450 mg; DL-methionine 1.0 mg; Mn 74 mg; Fe 30 mg, Zn 45 mg; Cu 4 mg; Co 0.4 mg; I 0.3 mg*
[3] *Calculated*
** Experimental feeds were corrected for Ca content from $CaCO_3$ contained in the rock (169.8 g Ca per 1 kg of rock) or Ca value corrected for opoka $CaCO_3$ content (169.8 g Ca per 1 kg of rock); Brogowski and Renman, (2004)*

Feeds and Concentrates in Kcynia (Poland). The components of feeds have been presented in detail in Table 1. Opoka used in the experiment came from Polish beds and was ground to consistency of flour. Its content has been presented in Table 2.

Mortality, feed intake and individual body weights were currently monitored. Slaughter was carried out in 42th day of life.

During the slaughter, the peripheral blood samples were collected.

Carcasses were chilled by the air method at temperature of 4°C for 24 h. Then, the dissection was performed following the methodology, described by Ziołecki and Doruchowski (1989). **Dressing percentage**, i.e. the content of muscles and the content of giblets, in relation of the body weight before slaughter was calculated. The collected breast and leg muscles were weighed, protected and left for further analyses.

Neubauer's haematological chamber was used for Red blood cell (RBC) and white blood cell (WBC) determination, with Natt and Herrick's solution used as a solvent. The remaining blood parameters were studies in the commercial veterinary analyzers.

The obtained results were statistically processed by two-way ANOVA and Duncan's multiple range tests using the Statgraphic 4.1 Plus software package (StatPoint, Inc., USA). The differences with $P<0.05$ were considered significant.

Results and discussion

The assessment of physiological state of poultry is based, to a great extent, on haematological and biochemical indicators of blood which are the invaluable tools, helping the vets to understand the health state of the birds.

The results of the haematological parameters of blood are given in Table 3. The application of opoka affected significantly the increase of the haemoglobin level in red cells (MCHC), the mentioned values did not however exceed the typical readouts for ROSS broilers in the discussed period of their life [6]. Haemoglobin plays the important role in support of metabolic activity of the chicken. It seems that the increased MCHC coefficient, as a result of supplementation with opoka, may be the answer of the chicken organism to better oxidation of the cells [7].

The results indicate that Opoka may possibly have an immunostimulating effect. Previously studied mineral materials, particularly aluminosilicates, have also been shown to enhance the immunity of chickens [6]. Other hematological parameters remained unchanged following the Opoka introduction to the feed mixture. This suggests that the use of Opoka as a feed additive does not negatively impact the hematological parameters of the blood.

Biochemical parameters of blood are given in Table 4. Any significant changes in the experimental groups as compared to the control one have not been found. The results indicate that the application of opoka as feed additive does not affect the biochemical blood parameters.

The addition of opoka has not also affected significantly the final body weight, feed conversion rate and mortality of the chicken broilers (Table 5).

Table 3. Haematological parameters of blood of broilers fed the standard (control) and experimental (with addition of 1% of opoka) diets

Parameters	Group		SD	p-Value
	control	opoka		
RBCx 10^{12}/l	2.56542	2.64125	0.4570	0.5710
Ht%	23.8333	23.9583	2.4077	0.8595
Hb g/dl	7.48708	7.18167	1.2791	0.4140
MCV um^3	94.2083	93.0167	16.1354	0.8012
MCH pg	29.4292	27.75	5.7554	0.3174
MCHC g/dl	31.6042 b	**35.7292 a**	3.91078	0.0001
WBC x 109/l	19402.1	20240.0	4477.37	0.6296
OB. mm/60min	4.70833	3.47917	2.2730	0.0602
Lymphocytes	55.75	53.125	10.4003	0.3877
Heterophils	37.75	38.5417	10.5608	0.7983
Eosinophils	1.70833 b	**2.95833 a**	2.0035	0.0291
Basophils	3.83333	4.41667	2.2181	0.3679
Monocytes	0.958333	0.958333	1.1101	1.0000
H/L	0.719583	0.865833	0.5717	0.3813

Means within a column with different superscripts are significantly different: a, b at P ≤0.05

Table 4. Biochemical parameters of the chicken fed the standard (control) and experimental (with addition of 1% of opoka) diets

Parameters	Group		SD	p-Value
	control	opoka		
ASPAT (IU/l)	506.73	457.65	126.6690	0.2024
ALAT (IU/l)	14.88	15.40	4.9180	0.7312
Glucose. (mg/dl)	191.19	188.94	22.8632	0.7483
Uric acid (mg/dl)	2.30	2.60	0.9062	0.2700
Urea (mg/dl)	5.10	5.27	1.2051	0.6489
Total protein (g/l)	23.31	23.18	2.7797	0.8730
Alb. (g/l)	15.31	15.27	1.4719	0.9198
Cholesterol (mg/dl)	150.02	139.80	20.4629	0.0980
TG (mg/dl)	32.09	34.85	9.8749	0.3586
VLDL (mg/dl)	6.42	6.97	1.9656	0.3555
HDL (mg/dl)	110.98	105.33	14.9025	0.2124
LDL (mg/dl)	40.11	38.94	8.9918	0.3951
Ca (mg/dl)	6.79	6.81	1.1435	0.9484
P (mg/dl)	6.64	7.01	1.2743	0.3451
Mg (mg/dl)	2.43	2.44	0.2773	0.9064

Table 5. Growth performance of broilers

Parameters	Group		SD	p-Value
	control	opoka		
Body weight (g)	3102.21	3050.17	279.279	0.5244
Feed conversion ratio (kg)	1.46	1.50	0.0186	0.1778
Mortality (%)	0	0	0	0

In relation to the analyzed parameters, significant differences were demonstrated in dressing percentage – its highest value was recorded in the control group, whereas the lowest one was found in the opoka group (Table 6). The application of opoka in the diet for broiler chickens reared until 42nd day of age had not a significant effect on the contribution of breast and leg muscles in carcasses. A higher share of giblets was found in the opoka group, but this difference was not statistically significant. The analyses demonstrated significantly lower abdominal fat content after the diet with 1% of opoka. In their studies, the other authors [9] obtained a similar result in respect of dressing percentage and the decreased percentage participation of muscles of the particular body parts, especially of the leg muscles. The addition of opoka to the feed may affect positively the musculature of the legs as compared to the diatomite earth (DM), employed by other authors. The addition of opoka to the diet has also a positive effect on the quantity of giblets obtained from the chicken in the discussed experiment. Their participation in the carcass weight was considerably higher than in the case of the similar experiment of other authors [9]. A special attention should be paid to the lowered level of depot (abdominal) fat in the birds from the experimental group. It confirms the earlier results where the lower fat content was found in the breast muscle of broilers after the application of opoka additive in the feed [5].

Table 6. The mean results of the slaughter analysis of broiler chicken (%)

Parameters		Group		SD	p-Value
		control	opoka		
Dressing percentage		76.23 a	75.02 b	0.2975	0.0101
Muscles	breast	29.19	28.03	0.6058	0.1907
	legs	20.42	20.41	0.7805	0.9914
Giblets	gizzard	1.38	1.49	0.0650	0.2776
	heart	0.67	0.67	0.9853	0.0378
	liver	2.11	2.26	0.0783	0.1955
Abdominal fat		0.53 a	0.49 b	0.0266	0.0301

Means within a column with different superscripts are significantly different: a, b at P ≤0.05

Summing up

In summing up, we may state that 1% addition of opoka to the standard diet for broilers – did not have a negative effect on biochemical and hematological parameters of broilers. The increase of the level of eosinophils and the earlier studies of the similar materials suggest that opoka may have the immune-modulating properties. Moreover, the application of opoka has decreased the final amount of fat tissue and dressing percentage, without any impact on the quantity of muscles and giblets in the carcasses.

The results of the studies indicate that opoka is a safe material for the chicken. There is a necessity of conducting the further studies with the aim to confirm the immune-modulating properties.

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