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Research Article

### METHOD FOR OPTIMIZING MORPHOLOGICAL AND BIOCHEMICAL COMPOSITION OF BLOOD AND BROILER PRODUCTIVITY BY DETOXICATION OF HEAVY METALS

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#### Abstract:

*The broiler meat production currently involves the production of ecologically safe products. The research aims to study the effect of different doses of antioxidant and adsorbent ferrocene (when excessive content of heavy metals) as feed additives in broilers' diets based on corn, wheat and rape to increase productivity and prevention of metabolic disorders. Research methods. The objects of the study were broilers of cross "Smena-7". Day-old chicks by analogue scale and due to their age, live weight and clinical state were divided into 4 groups of 100 birds each. Research results. During the first experiment mixed feed of the experimental birds was safe in the content of heavy metals. In their composition, different dosages of antioxidant selenopyran were tested. At this, selenopyran at a dose of 0,25 mg/kg feed is characterized by the best effect on the flock safety, due to which birds of the second test group exceeded the control by 5,5%. As for live weight gain, birds of the second test group exceeded the control by 7,6%. Different doses of adsorbent ferrocene supplementation in diets with excess content of zinc, lead and cadmium were used during the second experiment. Broilers of the second test group, which were fed ferrocene at a dose of 0,3% of feed weight and having surpassed the control counterparts by 6,6% had a higher level of the flock safety. Due to this stimulating factor broilers of the second test group had, respectively,  $0,73 \times 10^{12}/l$  and 3,3 g/l more content of erythrocytes and hemoglobin in their blood. Broilers of the second test group had in samples of their blood, liver and pectorals a decrease in concentration of zinc by 1,79; 1,62 and 2,90 times; lead – by 2,44; 2,20 and 2,91 times; and cadmium – by 2,73; 2,48 and 3,60 times respectively.*

**Keywords:** broilers, heavy metals, antioxidant, adsorbent, detoxification, morphological and biochemical composition of blood.

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**INTRODUCTION:**

**The relevance of the topic.** The toxic effect of heavy metals is explained by the fact that they form insoluble compounds with proteins, changing properties and inactivating a number of vital enzymes [1, 2].

The environmental pollution by lead, zinc and cadmium of industrial origin is of particular concern. Over past few years, these elements, in the context of continuing industrial pollution, have become the most common toxicants in the group of heavy metals. Heavy metals during intoxication can cause serious harm to the health and productivity of farm animals and poultry [3, 4, 5].

Substances that reduce the absorption of lead, zinc and cadmium are well known. They are iron, calcium, magnesium, phosphates, and others. Recently there appeared publications on reducing the content of heavy metals in the body when using adsorbents [6, 7].

**The research aims** to study the effect of different doses of antioxidant and adsorbent ferrocene (when excessive content of heavy metals) as feed additives in broilers' diets based on corn, wheat and rape to increase productivity and prevention of metabolic disorders.

**Research material and methods.** The experimental part of the work was carried out in the agricultural-production cooperative "Polyakov" in RNO – Alania. The objects of the study were broilers of cross "Smena-7".

In accordance with the scheme of two scientific experiments (table 1), day-old chicks by analogue scale and due to their age, live weight and clinical state were divided into 4 groups of 100 birds each. To do this birds of the same brood batch, same cross, moving, with tightly pressed to the body wings, responded well to light were selected.

Table 1- Scheme of scientific experiments n=100

Group	Feeding habits
I <sup>st</sup> experiment	
Control	Basic diet of corn, wheat and rape without excessive heavy metal content (BD <sub>1</sub> )
1 test	BD <sub>1</sub> + selenopyran at a dose of 0,25 mg/kg feed
2 test	BD <sub>1</sub> + selenopyran at a dose of 0,3 mg/kg feed
3 test	BD <sub>1</sub> + ferrocene at a dose of 0,35 mg/kg feed
II <sup>nd</sup> experiment	
Control	Basic diet of corn, wheat and rape with excessive heavy metal content (BD <sub>2</sub> )
1 test	BD <sub>2</sub> + ferrocene at a dose of 0,1 % of feed weight
2 test	BD <sub>2</sub> + ferrocene at a dose of 0,3 % of feed weight
3 test	BD <sub>2</sub> + ferrocene at a dose of 0,5 % of feed weight

Experimental broilers were kept on the grid floor in triple-deck cages, with due regard to the flock density. The duration of the experimental poultry breeding was 42 days.

Morphological and biochemical indexes of experimental chickens' blood were determined by common methods.

The experimental material was processed statistically by the Student's t-test using the mathematical analysis software package "Microsoft Excel".

**Research results.** The basic diet (BD) of the experimental birds was represented by complete dry mixed feed based on corn, wheat and rape.

In the process of broilers growing during the first scientific experiment the mixed feed of the experimental birds was safe in the content of heavy metals. In their composition different doses of antioxidant selenopyran were tested.

During the second experiment different doses of adsorbent ferrocene supplementation in diets with excess content of zinc (MPC excess by 35,6%), lead (MPC excess by 36,6%) and cadmium (MPC excess by 30,6%) were used to study the detoxifying properties.

In the course of the research, the influence of the tested preparations on the indicators of the flock safety, live weight gain and feed consumption per 1 kg gain was studied (table 2).

Table 2 – Indicators of the flock safety, of live weight gain and feed consumption per 1 kg gain n = 100

Indicator	Group			
	control	1 test	2 test	3 test
I <sup>st</sup> experiment				
Safety, %	91	93	96	95
Live weight per 1 bird, g.				
At the beginning of the experiment	39,2 ± 0,11	39,8 ± 0,15	40,1 ± 0,07	40,9 ± 0,10
At the end of the experiment	2231,8 ± 13	2357,3 ± 13*	2399,9 ± 18*	2368,4 ± 16*
Body weight gain, g:				
absolute	2192,6 ± 16	2317,5 ± 17	2359,8 ± 13*	2327,5 ± 14
averagedaily	52,20 ± 0,09	55,17 ± 0,16	56,19 ± 0,12*	55,42 ± 0,13
In % to the control	100,0	105,7	107,6	106,2
II <sup>nd</sup> experiment				
Safety, %	91	94	97	95
Live weight per 1 bird, g.				
At the beginning of the experiment	39,9 ± 0,15	40,5 ± 0,18	41,0 ± 0,17	40,6 ± 0,13
At the end of the experiment	2222,1 ± 13	2359,3 ± 14*	2391,7 ± 11*	2369,5 ± 17*
Body weight gain, g:				
absolute	2182,2 ± 12	2318,8 ± 10*	2350,7 ± 15*	2328,9 ± 13*
averagedaily	51,96 ± 0,10	55,21 ± 0,19*	55,97 ± 0,18*	55,33 ± 0,22*
In % to the control	100,0	106,3	107,7	106,7

\* P<0,05

In the course of the first scientific experiment, selenopyran at a dose of 0,25 mg/kg feed is characterized by the best effect on the flock safety, due to which birds of the second test group exceeded the control by 5,5%. As for live weight gain, birds of the second test group significantly (P<0,05) exceeded the control by 7,6%.

Following the results broilers of the second test group, which were fed ferrocene at a dose of 0,3% of feed weight with the excess of heavy metal background in the feed and having surpassed the

control counterparts by 6,6% had a higher level of the flock safety. During the experiment, higher body weight gain had chickens of the second test group that significantly (P<0,05) exceeded their control counterparts on this indicator by 7,7%.

To assess the effect of feeding conditions during two scientific experiments on hematopoietic functions in the body of experimental broilers, morphological studies of peripheral blood were conducted, the results of which are presented in table 3.

Table 3 – Morphological composition of blood in the experimental birds

n = 5

Indicator	Group			
	control	1 test	2 test	3 test
I <sup>st</sup> experiment				
Hemoglobin, g/l	80,3±3,5	82,7±3,9	83,9±4,1	83,1±3,2
Erythrocytes, 10 <sup>12</sup> /l	3,25±0,45	3,46±0,30	3,84±0,29	3,52±0,36
Leucocytes, 10 <sup>9</sup> /l	8,84±0,42	8,88±0,46	8,90±0,38	8,89±0,51
II <sup>nd</sup> experiment				
Hemoglobin, g/l	81,2±2,2	82,1±4,1	84,5±3,3	83,6±1,6*
Erythrocytes, 10 <sup>12</sup> /l	3,26±0,12	3,65±0,36	3,99±0,27	3,87±0,16*
Leucocytes, 10 <sup>9</sup> /l	8,72±0,25	8,85±0,49	8,92±0,36	8,89±0,41

\*P&lt;0,05

Based on the results of the first scientific experiment in the comparative evaluation of the physiological effect in different doses of antioxidant selenopyran statistically significant (P>0,05) differences on the hemoglobin and erythrocytes level in broilers of the control group, on the one hand, and test groups, on the other hand, were not found.

The results of hematological studies in the course of the second experiment showed that higher hemopoietic properties had birds' bodies in the second test group due to the heavy metal elimination by means of adsorbent ferrocene at a dose of 0,3% by

the feed weight. Due to this stimulating factor broilers of the second test group compared to the control had, respectively, 0,73×10<sup>12</sup>/l (P<0,05) and 3,3 g/l (P<0,05) more content of erythrocytes and hemoglobin in their blood.

During all scientific experiments there were no significant (P>0,05) differences by leukocytes count in blood of broilers from the compared groups.

In the course of performing the experimental part of this work some biochemical blood indicators in the experimental birds shown in table 4 were studied.

Table 4 – Some biochemical blood indicators of experimental birds n = 5

Indicator	Group			
	control	1 test	2 test	3 test
I <sup>st</sup> experiment				
Calcium, mmol/l	23,06 ± 0,34	24,19± 0,23*	25,45±0,13*	24,41±0,16*
Phosphorus, mmol/l	5,71 ± 0,06	5,83 ± 0,08	5,95 ± 0,04*	5,90 ± 0,05*
Reservealkalinity, mg/%	368 ± 7,65	370 ± 8,12	388 ± 7,33	372 ± 8,02
II <sup>nd</sup> experiment				
Calcium, mmol/l	23,91 ± 0,15	24,24±0,06*	25,72±0,02*	24,54±0,10*
Phosphorus, mmol/l	5,84 ± 0,04	5,87 ± 0,07	6,04 ± 0,02	5,95 ± 0,03*
Reservealkalinity, mg/%	370 ± 8,41	375 ± 7,25	390 ± 7,65	384 ± 7,82

\*P&lt;0,05

It is found that during the first and second scientific experiments reserve alkalinity in chickens' blood of the compared groups was within the physiological standard. Thus there were no significant (P>0,05) differences on this indicator between the birds of the compared groups in the process of heavy metal detoxification.

During the first experiment, the highest content of these elements was in the blood serum of broilers in the second test group – 25,45 mmol/l and 5,95 mmol/l, respectively. The inclusion of selenopyran at

a dose of 0,25 mg/kg feed into the diets had the most favorable effect on mineral metabolism in the birds of this group, which allowed them relatively the control to increase significantly (P<0,05) the concentration of calcium by 2,39 mmol/l and inorganic phosphorus by 0,24 mmol/l.

It is found that in the course of the second scientific experiment the highest content of calcium and inorganic phosphorus in the blood serum of the birds in the second test group was provided with adsorbent ferrocene supplementation at a dose of 0,3% by the

feed weight. This allowed the broilers of this group to significantly ( $P<0,05$ ) exceed the control on these blood indicators by 1,81 and 0,2 mmol/l, respectively.

Therefore, results of hematological studies show that when feeding corn-wheat-rape-based mixed feed, under the effect of antioxidant selenopyran and adsorbent ferrocene intermediate broilers' metabolism is optimized.

Among heavy metals lead, zinc and cadmium top a number of pollutants due to high rates of their industrial accumulation in the environment. They are

very toxic elements and are listed as priority pollutants (global ecotoxics) by a number of international organizations. The toxic effect is caused by the fact that they form insoluble compounds with proteins, changing properties and inactivating a number of vital enzymes.

After the completion of the second experiment during the control slaughter of broilers from the compared groups, average samples of blood, liver and pectoral, which contained heavy metals, were taken to study the detoxification properties of the tested preparation ferrocene in different doses (table 5).

Table 5 – Heavy metal content in organs and tissues of chickens, mg/kg n = 5

Element	Group				MPC
	control	1 test	2 test	3 test	
Blood contains					
Zinc	95,8±0,18	65,5±0,28*	65,3±0,38*	53,6±0,40*	70,0
Lead	0,83±0,02	0,45±0,02*	0,46±0,03*	0,34±0,03*	0,5
Cadmium	0,082±0,003	0,042±0,002*	0,040±0,003*	0,030±0,004*	0,05
Liver contains					
Zinc	100,1±0,19	68,1±0,19*	68,8±0,40*	61,8±0,44*	70,0
Lead	0,88±0,03	0,50±0,02*	0,49±0,02*	0,40±0,03*	0,5
Cadmium	0,087±0,001	0,048±0,002*	0,047±0,003*	0,035±0,004*	0,05
Pectoral contains					
Zinc	68,23±0,24	43,92±0,31*	41,05±0,21*	23,01±0,27*	70,0
Lead	0,50±0,02	0,31±0,03*	0,32±0,03*	0,17±0,02*	0,5
Cadmium	0,048±0,04	0,027±0,03*	0,025±0,04*	0,013±0,05*	0,05

\*  $P<0,05$

The research results showed that during the second scientific experiment the use of the tested adsorbent ferrocene in the mixed feed of corn-wheat-rape type provided the detoxification of these xenobiotics, whereby the content of zinc, lead and cadmium in no case did not exceed the MPC in the analyzed samples of organs and tissues of birds in all test groups.

The highest detoxification effect was provided with the adsorbent ferrocene supplementation to the basic diet at a dose of 0,3% by the feed weight. At this broilers of the second test group compared to their control counterparts had in samples of their blood, liver and pectorals a significant ( $P<0,05$ ) decrease in concentration of zinc by 1,79; 1,62 and 2,90 times;

lead – by 2,44; 2,20 and 2,91 times; and cadmium – by 2,73; 2,48 and 3,60 times respectively. At the same time, the elimination of heavy metals was higher in the pectoral muscle than in the blood and liver samples of the experimental bird.

### CONCLUSIONS:

1) To increase economic-useful qualities and optimize morphological and biochemical blood composition it is necessary to include antioxidant selenopyran at a dose of 0,25 mg/kg feed into broilers' mixed feed of corn-wheat-rape type and safein heavy metals.

2) To improve the economic-useful qualities and

optimize morphological and biochemical blood composition it is necessary to include adsorbent ferrocene at a dose of 0,3% by the feed weight into the broilers' mixed feed of corn-wheat-rape type with excessive content of heavy metals.

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