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The effect of biological supplements of natural origin on metabolism of parent flock hens

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Abstract

The article presents the study results on the effect of a Dahurian larch biologically active preparations—dihydroquercetin as part of the "Ecosimul-2" feed supplement and arabinogalactan as part of the "Lavitol-arabinogalactan" supplement—in poultry diets on metabolic processes in hens of the Hisex Brown parent flock and qualitative composition of hatching eggs. In the research, the authors have established a positive effect of the supplements under study on the morphological composition of blood. The content of red blood cells of hens in the test groups has increased by 17.29 and 22.78%, and the hemoglobin concentration by 7.94 and 8.72%. Hematocrit (HCT) has significantly exceeded the Control by 2.60 and 3.30%. The authors have established that biologically active substances as a part of the studied supplements intensified metabolic processes in the chicken bodies and positively influenced the qualitative composition of hatching eggs.

Key words: biologically active preparations, dihydroquercetin, eggs quality, metabolic processes, parent flock hens.

INTRODUCTION

In the poultry industry, in order to maximally achieve the genetic potential of high-laying chicken crosses, it is necessary to carefully monitor the full value of feeding, since because of extremely intense metabolic processes in the body, nutritional imbalances lead to poor health, reducing the production and period of poultry use.

To solve the problem of increasing nutrient intake, farmers use biologically active feed supplements of natural origin, including bioflavonoids (dihydroquercetin) that have the highest antioxidant and immunostimulating properties and arabinogalactan of immunobiological and hepato- and gastroprotective activities. These are

- "Ecostimul-2" feed supplement that is a Dahurian larch bioflavonoid complex, containing dihydroquercetin as the main ingredient, not less than 70% and
- "Lavitol–arabinogalactan" that is a water-soluble plant polysaccharide that is obtained from Dahurian larch wood and contains galactose and arabinose molecules. Due to prebiotic properties, arabinogalactan maintains a normal microbial balance in the gastrointestinal tract. Being a source of soluble dietary fiber, arabinogalactan improves nutrition, absorption and preservation of a healthy gastrointestinal tract. Moreover, arabinogalactan contributes to the formation of short-chain fatty acids that are extremely important for normal functioning of the body.

The effectiveness of the new supplements was studied while growing broiler chickens for meat and production of edible eggs. However, in the production of hatching eggs in the diets of the parent flock chickens, the EcoStimul-2 feed supplement and the Lavitol-arabinogalactan preparation have not been studied before.

In this regard, in our experiment, we studied the effect of the new feed supplements on productive and reproductive properties of the parent flock hens, as well as on the possible extension of the use periods of chickens while preserving the quality of hatching eggs.

MATERIAL AND METHODS

The experiments were conducted in conditions of a second order Pedigree Reproducer "Svetlyi" farm enterprise of the Vostok agricultural firm in the Volgograd region. The object of the research study was the parent flock chicken of the "Hisex Brown" cross. The age of the poultry was 21-60 weeks; the duration of the experiment lasted 39 weeks.

For the analogue experiment, there were formed 3 groups of poultry: Control, Test I and Test II, 70 heads each. The poultry in Control group was fed with a general ration; in Test group I with general ration + "Lavitol-arabinogalactan" (TU 9325-008-70692152-08) 6.0 mg/kg of body weight; and in Test group II with general ration + "EcoStim-2" feed supplement (TU 9364-010-70692152-2010) 3.6 mg/kg of body weight related to pure dihydroquercetin + Lavitol-arabinogalactan 3.6 mg/kg of body weight. The supplements under study were developed by specialists at AO AMETIS (the Amur region).

The test poultry was kept in the laying-battery cages (produced by Big Dachman, Germany). The poultry was fed with dry complete feed. The nutritional value of the rations for the parent flock hens during the reference period complied with the norms of the Federal Research Center VNITIP of the Russian Academy of Sciences, taking into account the actual nutritional value of raw materials.

In the research study, the morphological blood parameters (red blood cells, white blood cells, hemoglobin, hematocrit, MCV and MCHC) of poultry were determined on the URIT-3020 VetPlus automatic hematology analyzer (China). The biochemical composition of blood (total protein, albumin, glucose, total cholesterol, phosphorus, calcium, iron and magnesium) was determined on the URIT-800 Vet semi-automatic biochemical analyzer (China).

The amino acid composition of hatching eggs was determined in a VSTU laboratory on the Aracus amino acid analyzer (Germany). The concentration of chemical elements in hatching eggs was determined by inductively coupled plasma mass spectrometry (MS - ICP) using the Nexion 300D quadrupole mass spectrometer (PerkinElmer, USA).

RESULTS AND DISCUSSION

The effect of the feed supplements in the diets of animals and poultry on metabolic processes in their bodies is seen in the blood composition. The research results proved a positive effect of Dahurian larch supplements (arabinogalactan and hydroquercetin) on the morphological blood composition of the parent flock chickens in the test groups.

The studied blood parameters of the parent flock hens varied within the physiological norm (Table 1).

The red blood cells content of chickens in the test groups exceeded the Control group by 17.29 (P<0.01) and 22.78% (P<0.01), and the hemoglobin concentration increased by 7.94 (7.13%; P<0.05) and 8.72 g/l (7.83%; P<0.05).

The white blood cells level as one of the indicators characterizing the body's immune system exceeded the Control by 1.28 and 1.51%, but the difference was not statistically significant. The tendency of the white blood cells of chickens to increase in the test groups indicated an increase in immunity under the influence of the supplements studied.

The hematocrit (HCT) in blood of hens in the test groups significantly exceeded the Control by 2.60 (P<0.01) and 3.30% (P<0.01). The mean cell volume (MSV) and mean cell hemoglobin concentration (MCHC) in blood of test hens also exceeded the Control by 1.91 (P<0.01) and 2.63% (P<0.01); 1.23 (P<0.05) and 1.85% (P<0.05), respectively. The study results confirmed the red blood dysfunctions being absent in the test poultry.

The experimental data allowed establishing that under the influence of the supplements studied, the protein metabolism in test hens proceeded more intensively than in their control analogues (Table 2).

The total protein content in Test group I increased by 1.21 (P<0.05), in Test group II by 2.45% (P<0.01); the level of the albumin fraction by 4.21 (P<0.05) and 6.23% (P<0.01), respectively. The content of the globulin fraction was at the control level. Considering the values of this indicator, we could conclude that in Test group II, where dihydroquercetin and arabinogalactan were used taken together as part of a premix, chickens had higher intensity of the protein metabolism than those in Test group I, where arabinogalactan was a part of the premix.

Table 1 – The morphological blood composition of chickens (n=5)

Parameters under study	Group		
	Control	Test I	Test II
Red blood cells (RBC), 10^{12}/l	2.37±0.09	2.78±0.08**	2.91±0.09**
Hemoglobin (HGB), g/l	111.32±2.39	119.26±3.04*	120.04±3.15*
White blood cells (WBC), 10^9/l	34.39±0.42	34.83±0.82	34.91±0.79
Hematocrit (HCT), %	26.1±0.48	28.7±0.59**	29.4±0.61**
Mean cell volume (MCV), mkm^3	125.5±0.61	127.9±0.46**	128.8±0.56**
Mean cell hemoglobin concentration (MCHC), g/l	325.0±1.13	329.0±1.52*	331.0±1.39*

Table 2 – Biochemical blood composition of parent flock hens (n=5)

Parameters	Group		
	Control	Test I	Test II
Total protein, g/l	55.45±0.17	56.12±0.12*	56.81±0.41**
Albumins, g/l	24.71±0.27	25.75±0.18*	26.25±0.34**
Comparatives, %	44.56±0.31	45.89±0.53	46.21±0.43
Globulins, g/l	30.74±0.35	30.37±0.29	30.56±0.31
Comparatives, %	55.44±0.49	54.11±0.53	53.79±0.57
Glucose, mmol/l	10.43±0.33	11.37±0.24*	12.04±0.51*
Total cholesterol, mmol/l	6.24±0.40	5.11±0.34*	4.72±0.29**
Iron, µmol/l	126.0±3.15	137.0±2.84*	141.0±4.07**
Magnesium, mmol/l	0.62±0.009	0.68±0.013**	0.71±0.017***
Calcium, mmol/l	4.64±0.12	5.12±0.15*	5.35±0.18**
Phosphorus, mmol/l	2.15±0.05	2.30±0.04*	2.35±0.06*

Table 3 – Chemical composition of hatching eggs, % (n=5)

Parameters	Group		
	Control	Test I	Test II
White of the egg contained			
Dry matter	11.819±0.068	12.117±0.097*	12.210±0.062*
Protein	10.461±0.055	10.698±0.049*	10.787±0.068**
Fat	0.020±0.004	0.021±0.004	0.020±0.003
Carbohydrate	0.825±0.018	0.879±0.009	0.881±0.008
Ash	0.512±0.006	0.519±0.017	0.522±0.038
Yolk contained			
Dry matter	49.885±0.34	51.015±0.32*	51.229±0.27*
Protein	15.512±0.13	16.611±0.16*	16.733±0.12**
Fat	32.199±0.012	32.218±0.028	32.285±0.026
Carbohydrate	1.128±0.004	1.135±0.008	1.152±0.005
Ash	1.046±0.013	1.051±0.017	1.052±0.014

Table 4 – Amino acid composition of hatching eggs, g/100 g (n=5)

Amino acid	Group		
	Control	Test I	Test II
Aspartic acid (Asp)	0.56±0.02	0.60±0.02	0.68±0.02**
Glutamic acid (Glu)	1.49±0.04	1.40±0.04	1.41±0.04
Serine (Ser)	0.73±0.02	0.75±0.02	0.75±0.02
Histidine (His)	0.17±0.005	0.15±0.003	0.14±0.004
Glycine (Gly)	0.23±0.01	0.24±0.01	0.25±0.01
Threonine (Thr)	0.96±0.03	1.00±0.03	0.99±0.03
Arginine (Arg)	0.89±0.03	1.08±0.03**	1.15±0.04***
Alanine (Ala)	0.97±0.03	1.12±0.03**	1.16±0.04**
Tyrosine (Tyr)	0.56±0.02	0.54±0.02	0.54±0.02
Cystine (Cys)	0.13±0.004	0.14±0.004	0.14±0.004
Valine (Val)	0.68±0.02	0.63±0.02	0.62±0.02
Methionine (Met)	0.58±0.02	0.60±0.02	0.62±0.02
Phenylalanine (Phe)	0.60±0.02	0.62±0.02	0.64±0.02
Isoleucine (Jle)	1.08±0.03	1.26±0.04**	1.29±0.04**
Leucine (Leu)	0.78±0.02	0.86±0.03	0.88±0.03*
Lysine (Lys)	0.63±0.02	0.70±0.02*	0.74±0.02**
Proline (Pro)	0.44±0.03	0.53±0.02*	0.57±0.03*
Total	11.48±0.18	12.22±0.17*	12.57±0.25**

In our experiment, the carbohydrate metabolism was noted for the presence of glucose in the blood serum. Its content in the test groups exceeded the Control by 9.01 (P<0.05) and 15.44% (P<0.05), respectively. The level of total cholesterol decreased by 22.11 (P<0.05) in Test group I and by 32.20% (P<0.01) in Test group II related to the Control.

The supplements studied had a significant impact on the mineral metabolism of hens in the test groups. The calcium content in the blood serum of chickens in Test group I was higher than in the Control by 10.34 (P<0.05) and in Test group II by 15.30% (P<0.01); phosphorus by 6.98 (P< 0.05) and 9.30% (P<0.05); iron by 8.73 (P<0.05) and 11.90% (P<0.01); and magnesium by 9.68 (P<0.01) and 14.52% (P<0.001).

The data obtained convincingly indicated that the studied supplements intensified the metabolic processes in the bodies of the parent flock chickens and affected the quality indicators of the hatching eggs (Table 3).

The studies showed that in eggs obtained from laying hens in the test groups, the protein content was observed to increase by 0.24 (P<0.05) and 0.33% (P<0.01) in the white of eggs and by 1.10 (P<0.05) and 1.22% (P<0.01) in the yolk.

The fat content was almost at the control level in the white and exceeded the control by 0.019% and 0.086% in the yolk.

The content of amino acids in eggs (white+yolk) in the test groups was within the physiological norm (Table 4).

Having considered the values of various amino acids in the test groups, we came to ambiguous conclusions. So, in Test group I, where the poultry was fed with arabinogalactan, there was observed a significant increase in a number of amino acids compared with the control, i.e., arginine by 21.35 (P<0.01), alanine by 15.46 (P<0.01), isoleucine by 16.67 (P<0.01), lysine by 11.10 (P<0.05) and proline by 18.18% (P<0.05). In Test group II, where the poultry received arabinogalactan in combination with dihydroquercetin, there was a more significant increase in the content of the amino acids with respect to the Control, i.e., aspartic acid by 21.42 (P<0.01), arginine by 29.21 (P<0.001), alanine by 19.59 (P<0.01), isoleucine by 19.44 (P<0.01), leucine by 12.82 (P<0.05), lysine by 17.46 (P<0.01) and proline by 29.54% (P<0.05).

It should be noted that in the test groups there was a tendency of the sulfur-containing amino acids (cystine and methionine), as well as glycine and threonine to increase. Along with the increase in the level of the amino acids listed, there was a slight decrease in glutamic acid, histidine, tyrosine and valine in eggs of the test groups.

Table 5 – Concentration of chemical elements in hatching eggs, μg/g (n=5)

Element	Group		
	Control	Test I	Test II
Aluminum (Al)	0.38±0.046	0.37±0.044	0.28±0.034
Arsenic (AS)	0.006±0.0012	0.003±0.0006	0.003±0.0007
Bor (B)	0.19±0.023	0.20±0.030	0.19±0.027
Calcium (Ca)	410.0±9.15	443.0±10.43*	477.0±12.15**
Cadmium (Cd)	<0.00048	<0.00048	<0.00048
Cobalt (Co)	0.003±0.0009	0.003±0.0007	0.003±0.0008
Chrome (Cr)	0.04±0.006	0.02±0.002*	0.02±0.002*
Copper (Cu)	0.52±0.056	0.50±0.062	0.52±0.063
Iron (Fe)	21.59±0.86	24.34±0.79*	25.49±0.66**
Mercury (Hg)	<0.0036	<0.0036	<0.0036
Iodine (I)	0.50±0.045	0.69±0.058*	0.76±0.071*
Potassium (K)	1177.0±25.19	1272.0±31.23*	1330.0±37.24**
Lithium (Li)	0.02±0.003	0.03±0.004	0.03±0.003
Magnesium (Mg)	138.0±1.68	143.0±2.41	144.0±1.98
Manganese (Mn)	0.41±0.042	0.45±0.042	0.47±0.046
Sodium (Na)	1151.0±21.17	1248.0±19.85**	1295.0±24.21**
Nickel (Ni)	0.03±0.004	0.03±0.003	0.02±0.005
Phosphorus (P)	1948.0±20.63	2025.0±22.11*	2089.0±33.09**
Lead (Pb)	0.002±0.0004	0.002±0.0002	0.002±0.0004
Selenium (Se)	0.28±0.034	0.29±0.035	0.32±0.038
Silicon (Si)	8.16±0.26	8.48±0.23	8.94±0.32*
Tin (Sn)	0.006±0.002	0.006±0.002	0.006±0.002
Strontium (Sr)	2.85±0.17	2.45±0.12	2.53±0.13
Vanadium (V)	0.03±0.004	0.04±0.004	0.04±0.005
Zinc (Zn)	10.76±0.28	12.06±0.17**	12.67±0.27**

The total of the amino acids in eggs of the test groups significantly exceeded the Control by 6.44 (P<0.05) and 9.49% (P<0.01). The data obtained indicated that the studied supplements intensified the metabolic processes in the bodies of the parent flock chickens and positively influenced the quality indicators of hatching eggs, in particular, their amino acid composition.

Balanced content of certain macro- and micronutrients in the hatching eggs ensured normal development of embryos during the incubation process and high yield of healthy young birds.

In our experiment, the concentration of chemical elements in hatching eggs was within the physiological norm (Table 5).

The research found that the supplements under study in the diets of the parent flock chickens caused the calcium concentration in hatching eggs in the test groups to increase compared with the control by 8.05 (P<0.05) and 16.34% (P<0.01) and phosphorus by 3.95 (P<0.05) and 7.24% (P<0.01). The Ca/P ratio increased to 0.22-0.23 against 0.21 in the Control.

The content of iron, potassium, sodium, silicon and zinc also increased in eggs from chickens in the test groups as compared with the Control by 12.74 (P<0.05) and 18.06% (P<0.01); 8.07 (P<0.05) and 12.99% (P<0.01); 8.43 (P<0.01) and 12.51% (P<0.01); 3.92 and 9.56% (P<0.05); and 12.08 (P<0.01) and 17.75% (P<0.01). The level of iodine concentration significantly exceeded the Control by 38.0 (P<0.05) and 52.0% (P<0.05).

The analysis made it possible to establish that the content of heavy metals such as arsenic, cadmium and mercury decreased or was at the level of acceptable values. The level of chromium decreased 2 times at (P<0.05). So, it was concluded that the arabinogalactan and dihydroquercetin supplements under study normalized the mineral metabolism in the bodies of chickens and positively influenced the quality of hatching eggs.

CONCLUSIONS

The biologically active substances contained in the "EcoStimul-2" feed supplement and "Lavitol-arabinogalactan" preparation in the diets of the "Hisex Brown" parent flock chickens intensified metabolic processes in their bodies and improved the qualitative composition of hatching eggs.

REFERENCES

1. I.F. Gorlov, Z.B. Komarova, A.N. Struk, S.M. Ivanov and V.G. Frisen The impact of new feed additive on the reproduction of poultry *Bulletin of Russian agricultural science*. 2016. *6*, 73-75.
2. I.A. Yegorov, E.N. Andrianova, E.N. Grigorieva and A.V. Xenophontov Use of dihydroquercithin and arabinogalactan in compound feeds for laying hens. *Poultry and poultry products*, 2018, *1*,. 12-15.
3. I. Egorov and O. Demidova Betafin in the diet of laying hens. *Poultry farming*, 2003, *4*, 9-10.
4. I.I. Kocsis, D.A. Suprunov and N.V. Oleinik. Problems and development trends of the poultry industry. *Veterinary, Zootechny and Biotechnology*, 2017, *9*, 87-90.
5. I.I. Kochish, M.G. Petrash and S.B. Smirnov *Poultry farming* Moscow, Kolos 2004.
6. V.F. Lysov, V.I. Maximov *Features of functional systems and the basis of poultry ethology*. Moscow, Agrokonsalt 2003.
7. Okolelova T. A. Grachev and N. Markelova Biochemical indices of the "Hisex" crosses their productivity and quality of eggs *Poultry farming*, 2010, *1*, 33-34.
8. V. Fisinin and I. Egorov Modern approaches to poultry feeding *Poultry farming* 2011, *3*, 7-9.
9. Makarenko, M.S. [et. all] The impact of Bacillus subtilis KATMIRA1933 supplementation on telomere length and mitochondrial DNA damage of laying hens *Probiotics and Antimicrobial Proteins,* 2018, *10,* P. 1-6.
10. Mazanko M.S. [et. all] Bacillus Probiotic Supplementations Improve Laying Performance, Egg Quality, Hatching of Laying Hens and Sperm Quality of Roosters *Probiotics & Antimicro. Prot.* 2018, 1-7. https://doi.org/10.1007/s12602-017-9369-4.
11. Mazanko M.S. [et. all] Products of solid-phase probiotic bacilli fermentation increase food conversion efficiency and stimulate chicken *American Journal of Biochemistry and Biotechnology*, 2018, *4*, 262-271.