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**BIOCHEMICAL PARAMETERS OF QUAIL EGGS AND BLOOD WITH FEED ADDITIVES APPLICATION****Poberezhets J.M./Побережець Ю.М.***c.a.s., as. prof. / к.с.-г.н., доц.*

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**Abstract.** *The aim of the experiment was to study the effect of Echinacea pallida phytobiotic additives on the eggs and blood biochemical composition. Echinacea pallida is becoming more widespread in medicine and zoo veterinary as therapeutic and prophylactic medicine and a feed additive of plant origin. It should be noted that it has a mild action, low toxicity and a high content of vital sub-stances affecting the animals` metabolism. Additional consumption of phytobiotic additive by quail increased the fat content by 2.4% ( $p < 0.001$ ) and nitrogen-free extractives by 0.9 % in egg yolks, the protein accumulation by 5.1% ( $p < 0.01$ ) in egg white than control indicator. Additional feeding by Echinacea pallida extract caused increased by 1.6 times calcium content, phosphorus by 3.0% ( $p < 0.001$ ), zinc by 18.6% ( $p < 0.001$ ), manganese by 34.1 % ( $p < 0.001$ ) in the yolks; calcium and phosphorus by 30.4% and 0.3%, iron by 1.4 times ( $p < 0.001$ ), manganese by 18.7% ( $p < 0.01$ ), copper by 14.1% ( $p < 0.001$ ) in egg white; and calcium, iron, manganese and copper by 7.2%, 13.5% ( $p < 0.001$ ), 41.0% ( $p < 0.001$ ) and 78.1% ( $p < 0.001$ ) in the eggshell of quail eggs relative to the control value. Feeding laying hens by plant additive increases the number of essential amino acids such as histidine by 0.43% ( $p < 0.001$ ), arginine by 0.66% ( $p < 0.001$ ), valine by 0 , 15% ( $p < 0.001$ ), methionine by 0.27% ( $p < 0.001$ ), phenylalanine by 0.26% ( $p < 0.001$ ) and the amount of essential amino acids by 1.28% in egg white compared with the control. The Echinacea pallida extract application for laying hens feeding contributed to the vitamin A accumulation by 26.1% ( $p < 0.001$ ), vitamin D<sub>3</sub> by 7.1% ( $p < 0.001$ ) and vitamin E by 6.8 % in egg yolks relative to the control group. The researched supplement application in the quail diet causes a tendency to increase the number of erythrocytes by 0.8%, leukocytes by 3.3%, total blood protein by 15.1%, albumin by 10.5% and globulin by 19.3%, aspartate aminotransferase (AST), compared with the control indicator.*

**Key words:** *quails, phytobiotics, eggs, blood, biochemical parameters, amino acids.*

**Introduction**

Consumer requirements for the biological integrity, safety and taste of livestock products are increasing all over the world every year. Healthy human nutrition is not possible without rational and balanced feeding of animals, including poultry (Podobed L. I., 2007; Podolian Yu. M., 2016).



The issue of meeting the population needs for more environmentally friendly products is rather topical, it led to a ban on antibiotics application in European countries (Shtainer T., 2010; Grashorn M. A., 2010). That's why scientists and practitioners are looking for new feed additives of plant origin containing biologically active substances which increase productivity, strengthen the immune system and improve digestive processes, the inherent mildness and low toxicity also characterize the above-mentioned supplement (Applegate T.J. & Klose V., 2010; Shevchenko, L.V. et al., 2017; Sobolev O. I. et al., 2019).

The phytobiotics are phytocorrectors modifying the work of the digestive glands, providing conditions for competitive growth of beneficial microflora, which stabilizes acidity and enhances the absorption of nutrients (Podolian Yu. N., 2017; Chudak R.A. et al., 2019).

Feed additives of plant origin as a component of farm animals diets increase productivity, improve intestinal microflora, improve the taste of feed, stimulate salivation, secretion of digestive juices due to the rapid passage of feed and absorption of nutrients, and improve the immune system (Pospelov S. V. et al., 2008; Aituan M. A. & Wanyu S. H., 2009).

The species of *Echinacea* are excellent plant biostimulants that stimulate immunity of a living organism, increase resistance performing antibacterial, anti-inflammatory, immunostimulatory and adaptogenic effects (Samorodov V. N. & Pospelov S. V., 2013; Chudak R.A. et al., 2020).

Thus, the aim of the experiment was to research the effect of *Echinacea pallida* phytobiotic additives on egg biochemical composition and blood.

### **Material and methods**

Research of the *Echinacea pallida* extract feed additive effectiveness for the quails feeding was conducted at Vinnytsia National Agrarian University research farm according to the general research scheme.

The scientific experiment was conducted on four groups of laying hens of Manchurian Golden quails. The duration of the experiment was 180 days. Four groups-analogues were selected for the experiment, 50 birds in each group. The control group consumed a basic diet (BD). The experimental groups were additionally fed by different doses of *Echinacea pallida* feed additive extract (Table 1) (Ibatullin I. I. et.al., 2017).

The researched phytobiotics was homogeneous, powdered and dry extract of *Echinacea pallida* roots. This was brown powder with a characteristic smell and a specific bitter taste. The manufacturer of the extract from *Echinacea pallida* is LLC Kharkiv Research Plant, Ukraine. The main active biologically substances are polysaccharides, i.e., fructosans, phenolic compounds, hydroxycoric acids having anti-inflammatory, antimicrobial and adaptogenic activities (Pospelov S V. & Samorodov V. N., 2006).

The experimentally obtained data were processed by the method of variational statistics according to the algorithms proposed by Plohinskiy N.A. (1969). Three P-values (\* P <0.05; \*\* P <0.01; \*\*\* P <0.001) of F-test were also used for our research.

Determination of vitamins in egg yolk was carried out by high-performance



liquid chromatography by liquid chromatograph Chromos LC-301. Fatty acid composition of eggs was researched using gas chromatography method (Kulyk M. F. et.al., 2003).

**Table 1. Scheme of experiment**

Group	Number of animals in group, heads	Duration of the experiment, days	Feeding characteristics
1-control	50	180	BD (complete feeds)
2-experimantal	50	180	BD + <i>Echinacea pallida</i> (6 mg per kg of body weight)
3-experimantal	50	180	BD + <i>Echinacea pallida</i> (12 mg per kg of body weight)
4-experimantal	50	180	BD + <i>Echinacea pallida</i> (18 mg per kg of body weight)

\*BD – basic diet

We have researched the egg amino acid composition was determined in the laboratory of the Biochemistry Research Institute named after O.V. Paladin (Kyiv) by TTT 339 automatic analyzer using LG ANB cation exchange resin with SO<sub>3</sub> active group.

Morphological and biochemical parameters of blood were researched at Vinnytsia veterinary regional laboratory.

### Results and discussion

According to our research results, the dry matter content of the 3rd experimental group egg yolk increased by 0.8% (p <0.001). This indicator was 0.4% (p <0.05) in the 4<sup>th</sup> group; it was lower than in the control group (Table 2).

**Table 2. Chemical composition of laying quail eggs, % (M ± m, n = 4)**

(based on air-dry matter)

Indicator	Group			
	1-control	2-experimantal	3- experimental	4- experimental
Yolk				
Dry matter	92.87 ± 0.07	92.91 ± 0.01	93.75± 0.03***	92.42 ± 0.10*
Protein	31.56 ± 0.14	34.12 ± 0.34***	27.98 ± 0.66**	28.48 ± 0.56**
Fat	46.50 ± 0.05	44.99 ± 0.09***	50.83± 0.05***	48.93± 0.01***
Ash	4.18 ± 0.007	3.61±0.07***	3.16 ± 0.04***	3.67±0.02***
NFE	10.75 ± 0.27	10.53 ± 0.52	11.95 ± 0.76	11.73 ± 0.63
Egg white				
Dry matter	94.82±0.03	94.60±0.04**	94.11±0.01***	94.59±0.02***
Protein	58.76 ± 1.12	57.48 ± 0.18	63.76 ± 0.64**	63.84 ± 0.25**
Fat	5.10 ± 0.03	4.39 ± 0.07***	4.35 ± 0.05***	4.64 ± 0.05***
NFE	30.65 ± 1.18	32.92 ± 0.22	26.14 ± 0.68*	26.24 ± 0.30*
Eggshell				
Ash	71.75± 0.09	70.82± 0.08***	77.32± 0.29***	74.60± 0.17***



The second group quails have the yolk protein highest level. It was higher by 2.5 % ( $P < 0.001$ ) in the second group than in control one. This indicator decreased by 3.5% and 3% ( $P < 0.01$ ) respectively in the third and fourth experimental groups.

The medium and maximum doses of *Echinacea pallida* extract increase the fat content in egg yolks by 4.3% and 2.4%, respectively ( $P < 0.001$ ). The minimum dose of *Echinacea pallida* extract decreases the yolks fat content by 1.5 % ( $P < 0.001$ ).

It should be noted that egg yolk ash amount decreased respectively by 0.5%, 1.0% and 0.5% compared to the control ( $P < 0.001$ ).

It should be noted that the nitrogen-free extractives content was higher in the 3<sup>rd</sup> group by 1.2% and 4<sup>th</sup> group by 0.9% compared to the control one.

The researched additive different doses reduce the dry matter content of egg white by 0.2% ( $P < 0.01$ ), 0.7% and 0.2% ( $P < 0.001$ ) respectively compared to the control group.

The protein level of white egg increased by 5% and 5.1% ( $P < 0.01$ ) in the third and fourth groups.

The quails of experimental groups have the lowest amount of ash, respectively by 0.7%, 0.8% and 0.5% ( $P < 0.001$ ) compared to the first group.

The nitrogen-free extractives content decreases by 4.5% and 4.4% ( $P < 0.05$ ) under the action of the medium (third group) and maximum (fourth group) doses of *Echinacea pallida* extract. The nitrogen-free extractives content increases by 2.3% under the action of the minimum (second group). However, no significant difference with control is detected.

The ash accumulation highest level in the eggshell was recorded in the 3<sup>rd</sup> and 4<sup>th</sup> experimental groups, respectively by 5.6% and 2.8% ( $P < 0.001$ ). This indicator decreased by 0.9% ( $P < 0.001$ ) in the 2<sup>nd</sup> group.

Quail eggs are one of the most important dietary foods. They contain such amino acids as lysine, histidine, threonine, glycine, tyrosine, and aspartic acid. That's why we have also studied the amino acid composition of egg white (Table 3).

It was found that the use of the minimum and medium dose of *Echinacea pale* extract increases the content of lysine and threonine in egg protein, respectively, by 0.14%, 1.47% ( $P < 0.001$ ) and 0.25%, 0.26% ( $P < 0.001$ ) compared with the control.

The experimental groups have the higher content of histidine and arginine by 0.49%, 0.41%, 0.43% ( $P < 0.001$ ) and 1.02%, 0.72%, 0.66% ( $P < 0.001$ ) respectively compared with control analogues.

There is an aspartic acid increase in the egg white content in the 2<sup>nd</sup> and 3<sup>rd</sup> groups, by 0.19% and 0.59% ( $P < 0.001$ ), respectively. The above-mentioned indicator decreases by 0.31% ( $P < 0.001$ ) in the 4<sup>th</sup> group.

It should be noted that the content of glutamic acid increased by 0.97%, 0.93%, 0.23% ( $P < 0.001$ ) and serine by 0.67%, 0.58%, 0.34%, respectively ( $P < 0.001$ ) in all experimental groups compared with the control one.

It was found out that there is a probable decrease of proline in the egg white content by 0.15% ( $P < 0.01$ ) and 0.2% ( $P < 0.001$ ) under the action of the minimum and maximum doses of the researched additive.

There was a significant increase of glycine by 0.48%, 0.37% and 0.19% and alanine by 1.48%, 1.21% and 0.93% ( $P < 0.001$ ) respectively in the quail egg white of



the 2<sup>nd</sup>, 3<sup>rd</sup>, and 4<sup>th</sup> experimental groups.

**Table 3. Amino acid composition of experimental poultry egg white, % (M ± m, n= 4) (100 mg)**

(of the total number of amino acids)

Amino acid	Group			
	1-control	2-experimental	3- experimental	4- experimental
Lysine	6.49 ± 0.015	6.63 ± 0.005***	7.96 ± 0.007***	6.04 ± 0.002***
Histidine	2.49 ± 0.004	2.98±0.002***	2.90 ± 0.003***	2.92±0.003***
Arginine	5.02 ± 0.004	6.04 ± 0.007***	5.74±0.009***	5.68 ± 0.007***
Aspartic acid	5.89 ± 0.005	6.08±0.005***	6.48±0.002***	5.58 ± 0.002***
Threonine	5.26 ± 0.018	5.51±0.002***	5.52±0.002***	5.27±0.003
Serine	6.09 ± 0.004	6.76±0.003***	6.67±0.004***	6.43±0.003***
Glutamic acid	12.78 ± 0.007	13.75±0.015***	13.71±0.007***	13.01±0.021***
Proline	3.60 ± 0.027	3.45 ± 0.011**	3.57 ± 0.011	3.40 ± 0.008***
Glycine	3.59 ± 0.002	4.07±0.004***	3.96 ± 0.002***	3.78 ± 0.003***
Alanine	4.62 ± 0.002	6.10 ± 0.004***	5.83 ± 0.004***	5.55 ± 0.003***
Cystine	5.13 ± 0.007	2.10±0.004***	1.87±0.011***	4.51 ± 0.017***
Valine	6.24 ± 0.009	7.06±0.004***	6.84±0.002***	6.39 ± 0.006***
Methionine	3.99 ± 0.004	4.42±0.005***	4.34 ± 0.004***	4.26 ± 0.005***
Isoleucine	4.82 ± 0.004	5.17 ± 0.007***	5.04 ± 0.004***	4.77 ± 0.004***
Leucine	9.25 ± 0.002	9.61±0.003***	9.55±0.002***	9.25 ± 0.007
Tyrosine	8.18 ± 0.014	3.53±0.004***	3.13±0.009***	6.32 ± 0.004***
Phenylalanine	6.52 ± 0.017	6.68±0.002***	6.82±0.007***	6.78 ± 0.004***
Essential acids amount	50.08	54.10	54.71	51.36
Substitutable acids amount	49.88	45.84	45.22	48.58

The cystine and tyrosine content decreases when quails consumed compound feeds with different doses of *Echinacea pallida* extract by 3.03%, 3.26%, 0.62% and 4.65%, 5.05%, 1.86%, respectively (P < 0.001).

It should be noted that the laying hens of the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups have increased content of such essential amino acids as valine by 0.82%, 0.6%, 0.15% (P < 0.001); methionine by 0.43%, 0.35%, 0.27% (P < 0.001), and phenylalanine by 0.16%, 0.3%, 0.26% (p < 0.001) in the egg white.

There is a probable increase of isoleucine by 0.35%, 0.22% (P < 0.001) and leucine by 0.36%, 0.3% (p < 0.001) in the 2<sup>nd</sup> and 3<sup>rd</sup> experimental poultry groups. However, the isoleucine content decreases by 0.05% (P < 0.001) in the 4<sup>th</sup> experimental group; the leucine content is on the same level with the 1<sup>st</sup> group.

Thus, the *Echinacea pallida* extract application for quails feeding cause increasing of essential amino acids amount by 4.02%, 4.63% and 1.28%, respectively, in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> experimental groups. However, control group quails have greater amount of substituted amino acids, it was higher by 49.88% than other experimental quails.

The mineral composition of the main parts of the eggs of laying quails varied depending on the additional feeding by different doses of *Echinacea pallida* extract



(Table 4).

**Table 4. Mineral composition of the experimental quail eggs, ( $M \pm m$ ,  $n = 4$ )**  
(based on absolutely dry matter)

Trace element	Group			
	1-control	2-experimental	3-experimental	4-experimental
Yolk				
Calcium, g / kg	1.33 ± 0.05	1.91 ± 0.40	2.06 ± 0.38	2.14 ± 0.44
Phosphorus, g / kg	9.57 ± 0.007	8.93±0.009***	10.05 ±0.01***	9.86±0.01***
Iron, mg / kg	138.8 ±1.24	171.6±0.62***	117.0 ±1.03***	121.4±3.78**
Zink, mg / kg	58.1 ±1.39	66.5 ±0.64**	75.5 ±0.01***	68.9±0.04***
Manganese, g / kg	4.71 ±0.02	3.01 ±0.09***	1.40 ±0.03***	3.10±0.04***
Copper, mg / kg	6.76 ±0.10	8.88 ±0.07***	8.05 ±0.06***	6.44 ±0.04*
Egg white				
Calcium, g / kg	1.25 ±0.06	1.94 ±0.40	1.98 ±0.29*	1.63 ±0.20
Phosphorus, g / kg	3.49 ±0.009	4.49 ±0.02***	3.57 ±0.02*	3.50 ±0.05
Iron, mg / kg	30.8 ±0.86	67.7 ±0.05***	40.9 ±0.28***	45.0±0.78***
Zink, mg / kg	14.5 ±0.14	29.9 ±0.64***	15.5 ±0.59	14.4 ±0.02
Manganese, g / kg	2.45 ±0.11	2.01 ±0.06*	2.28 ±0.02	2.91 ±0.04**
Copper, mg / kg	6.74 ±0.10	5.41 ±0.10***	6.42 ±0.02**	7.69±0.02***
Eggshell				
Calcium, g / kg	290.4±14.35	322.8±10.35	344.5±11.82*	311.2±11.14
Phosphorus, g / kg	32.92 ± 0.23	39.01±0.25***	38.21±0.67***	37.36±0.25***
Iron, mg / kg	20.09 ± 0.27	13.44±0.61***	16.03 ±0.71**	17.58±0.58**
Zink, mg / kg	7.17 ± 0.01	8.12 ±0.04***	9.39 ±0.24***	10.11±0.15***
Manganese, g / kg	4.44 ± 0.04	6.26 ±0.17***	7.98 ±0.02***	7.91±0.04***

Poultry of the experimental groups better accumulate calcium in egg yolks, respectively, by 43.6%, 54.9% and 60.9% than the control group poultry.

The phosphorus amount increased by 5.0 % and 3.0 % ( $P < 0.001$ ), respectively in the 3<sup>rd</sup> and 4<sup>th</sup> experimental groups. The level of above-mentioned element accumulation decreased by 6.7 % in the 2<sup>nd</sup> group than in the control one.

It should be noted that quails fed by the minimum dose of the researched additive have increased iron content in egg yolks by 23.6% ( $P < 0.001$ ), and quails fed by the medium and maximum doses have decreased iron content in egg yolks by 15.7% ( $P < 0.001$ ) and 12.5% ( $P < 0,01$ ) compared with control analogues.

The experimental quails have the highest level of zinc accumulation in egg yolks, it was higher by 14.4% ( $P < 0.01$ ), 29.9% and 18.6% ( $P < 0.001$ ) than the control indicator.

It should be noted that the application of *Echinacea pallida* extracts different doses significantly reduced the manganese amount in egg yolks by 36%, 70.2% and 34.1% ( $P < 0.001$ ) compared to the control.

However, in the second and third groups the yolk copper content increased by 31.3% and 19.1% ( $P < 0.001$ ), in the fourth group it decreased by 4.7% ( $P < 0.05$ ).



The level of calcium and phosphorus accumulation in egg white was quite high in all experimental groups; it was by 55.2%, 58.4% ( $P < 0.05$ ), 30.4% and 28.6% ( $P < 0.001$ ), 2.3% ( $P < 0.05$ ), 0.3% more than in the first group.

It was found that the iron content of eggs white increases by 36.9 mg / kg in the 2<sup>nd</sup> poultry group, by 10.1 mg / kg in the 3<sup>rd</sup> poultry group and by 14.2 mg / kg ( $P < 0.001$ ) in the 4<sup>th</sup> poultry group compared to the control indicator.

It is known that the processes of cellular respiration, growth and development, protein metabolism, increased phagocytosis, and increased immunity are dependent on the zinc content in the body.

According to the obtained data, the content of the above-mentioned trace element increased by 15.4 mg / kg in the 2<sup>nd</sup> experimental group.

It should be noted that there was a manganese content decrease by 17.9% ( $P < 0.05$ ) in the 2<sup>nd</sup> group and by 6.9% in the 3<sup>rd</sup> group fed by the minimum and medium doses of phytobiotics respectively. When quails were fed by the highest dose, we observed this trace element increase by 18.7% ( $P < 0.01$ ) in the 4<sup>th</sup> experimental group.

According to our research data, there is a decrease in copper amount decrease in egg white in the 2<sup>nd</sup> and 3<sup>rd</sup> experimental groups by 19.7% ( $P < 0.001$ ) and 4.7% ( $P < 0.01$ ) respectively. The copper level increased by 14.1% ( $P < 0.001$ ) in the 4<sup>th</sup> group.

It should be noted that the calcium amount in the quail eggshell increased by 11.1 %, 18.6 % ( $P < 0.05$ ) and 7.2 % in all experimental groups than the control indicator. Its composition is similar to human teeth and bones because it consists of 90% calcium carbonate. Eggshell is well absorbed by the body, stimulates the hematopoietic function of the bone marrow, and also contains all the essential trace elements.

The quails of the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups have increased content of trace elements in eggshell iron by 18.5%, 16.1% and 13.5% ( $P < 0.001$ ), manganese by 13.2 %, 30.9 % and 41 % ( $P < 0.001$ ), and copper by 40.9 %, 79.7 % and 78.1 % ( $P < 0.001$ ) compared to the control group.

The lowest zinc amount in quail eggshell was recorded in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> groups, it was lower by 33.1% ( $P < 0.001$ ), 20.2% and 12.5% ( $P < 0.01$ ) than the control analogues.

Thus, the aim of scientific research was to study the effect of different doses of *Echinacea pallida* extract on the fat-soluble vitamins content in the quail egg yolks (Table 5).

According to Table 5 data, the vitamin A content of egg yolk probably increases by 6.6% ( $P < 0.05$ ) in the 2<sup>nd</sup> quail group, by 15.4% in the 3<sup>rd</sup> quail group and by 26.1% ( $P < 0.001$ ) in the 4<sup>th</sup> quail group than the 1<sup>st</sup> quail group.

It was found that researched additive minimum dose added to the laying hens diet increases the vitamin D<sub>3</sub> content in egg yolk by 7.1% ( $P < 0.001$ ). However, medium and maximum doses decrease this figure by 16.7 % and 11.6% ( $P < 0.001$ ).

It should be noted that the vitamin E content in egg yolk increased by 6.8%, 1.9% and 4.9% in the experimental groups compared with the control group.

Thus, we can conclude that different doses of *Echinacea pallida* extract had a positive effect on egg quality, accumulation of fat-soluble vitamins in yolks, which



are extremely important for normal functioning and development of the human body.

**Table 5. Fat-soluble vitamins content in experimental poultry egg yolks, (M±m, n=4)**

(based on absolutely dry matter)

Indicator	Group			
	1-control	2-experimental	3-experimental	4-experimental
Vitamin A, mg/kg	3.18±0.05	3.39±0.03*	3.67±0.04***	4.01±0.04***
Vitamin D <sub>3</sub> , mg/kg	1.55±0.01	1.66±0.008***	1.29±0.007***	1.37±0.009***
Vitamin E, mg/kg	1.02±0.05	1.09±0.10	1.04±0.01	1.07±0.14

According to quail blood morphological parameters, the *Echinacea pallida* extract influences on them in different ways; blood morphological parameters are presented in table 6.

**Table 6. Morphological indicators of laying hen blood, M ± m, n=4**

Indicator	Group			
	1-control	2-experimental	3-experimental	4-experimental
Hemoglobin, g / l	122.0 ± 7.93	115.2 ± 5.74	120.2 ± 7.28	113.0±4.78
Erythrocytes, T / l	2.53 ± 0.26	2.31 ± 0.08	2.55 ± 0.17	2.32 ± 0.05
Leukocytes, G / l	29.9 ± 2.40	27.4 ± 3.75	30.9 ± 2.59	29.2 ± 1.85
ESR, mm/hour	1.75 ± 0.86	1.50 ± 0.33	1.75 ± 0.55	2.0 ± 0.81

The addition of an average dose of *Echinacea pallida* extract to compound feed increases the erythrocytes content by 0.8% and leukocytes content by 3.3%. However, no significant difference was recorded.

It was found that *Echinacea pallida* extract different doses application has a positive effect on the biochemical parameters of the quail blood (Table 7).

**Table 7. Biochemical parameters of laying hen blood, (M ± m, n=4)**

Indicator	Group			
	1-control	2-experimental	3-experimental	4-experimental
Total protein, g / l	39.7 ± 6.28	40.2 ± 4.01	43.7 ± 2.23	45.7 ± 2.76
Albumins, g / l	19.0 ± 3.02	18.8 ± 2.23	20.8 ± 1.19	21.0 ± 1.41
Globulins, g / l	20.7 ± 3.28	21.5 ± 1.79	23.0 ± 1.05	24.7 ± 1.52
ALAT, IU/L	2.7 ± 0.55	2.7 ± 0.72	5.0 ± 1.94	1.7 ± 0.28
AST, IU/L	207.5 ± 28.72	220.7 ± 21.55	210.2 ± 19.00	220.2 ± 28.32
Total bilirubin, µmol / l	3.65 ± 1.05	4.32 ± 0.99	4.30 ± 0.82	4.67 ± 0.66
Alkaline phosphatase, IU/L	1115.5±156.30	1193.7±161.37	1189.7 ±185.81	1236.2±176.40
Cholesterol, µmol / l	5.51 ± 0.66	4.45 ± 0.64	4.46 ± 0.52	4.76 ± 0.72
Triglycerides, µmol / l	4.02 ± 0.54	3.32 ± 0.28	3.50 ± 0.23	3.80 ± 0.35
Glucose, µmol / l	5.70 ± 1.02	5.97 ± 1.06	5.90 ± 0.53	6.72 ± 0.56
Creatinine, µmol / l	5.0 ± 1.41	6.75 ± 3.11	4.50 ± 3.28	3.25 ± 1.28
Urea, µmol / l	1.8 ± 0.47	1.6 ± 0.28	2.2 ± 0.20	1.1 ± 0.14
Calcium, µmol / l	2.15 ± 0.20	2.07 ± 0.22	2.06 ± 0.15	1.98 ± 0.20





The level of total blood protein increased by 15.1 %, its fractions increased similarly, i.e. albumin by 10.5% and globulin by 19.3% 4<sup>th</sup> experimental poultry group compared with the control one.

Feeding laying-hens by *Echinacea pallida* extract different doses increased the activity of aspartate aminotransferase (AST) by 6.3%; 1.3% and 6.1% in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> experimental groups respectively.

The poultry of the 4<sup>th</sup> experimental group had a higher activity of alkaline phosphatase and total bilirubin by 10.8% and 27.9% respectively compared with the first control group.

It should be noted that the cholesterol and triglycerides amount in quail blood decreases by 19.2%, 19.0%, 13.6% and 17.4%, 12.9%, 5.4% in the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> experimental quail groups compared to the control indicator.

Poultry fed additionally by the minimum, average and maximum doses of the researched supplement had an increased glucose level compared to control analogues.

According to research data, the 4<sup>th</sup> group poultry had a tendency to decrease creatinine, urea and calcium in the blood by 35%, 38.8% and 7.9%, respectively, compared to the bird of the control group.

Thus, the *Echinacea pallida* extract had no negative effect on a poultry organism, and no essential changes of blood indicators were noted.

### Conclusions

The quail diets enrichment by phytobiotic additive increased the fat content by 2.4%, nitrogen-free extractives by 0.9% in egg yolks, the level of protein accumulation by 5.1% in egg white compared to control. The *Echinacea pallida* extract increased content of amino acids and minerals in quail eggs compared with the control group. The application of phytobiotics to feed of laying hens increased vitamin A accumulation by 26.1%, vitamin D<sub>3</sub> by 7.1% and vitamin E by 6.8% in egg yolks.

The researched supplement application in the quail diet increase the number of erythrocytes, leukocytes, total blood protein, albumin and globulins compared with the control indicator.

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