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The Effect Of The Treatment With Organic Preparations Of Selenium And Iodine On The Latent Form Of Hypoelementosis Of Quails And Guinea Fowls With Their Breeding In The Biogeochemical Conditions Of The Lower Volga Region.

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ABSTRACT

The article discusses current issues of physiology and biochemistry of acclimatized quails and guinea fowls in the Astrakhan region of Russia and their connection with the biogeochemical situation in the Lower Volga region. Acclimatized poultry brought to the region of the Lower Volga (Astrakhan, Volgograd regions) from the black earth "reference" region (Krasnodar Territory), where there are no endemic diseases, since in the main components of ecosystems there is no shortage of vital macro and microelements for animals and birds. In acclimatized quails and guinea fowls, a sharp decline in productivity functions was observed and growth and development were definitely slowed down. Earlier, low levels of selenium, iodine and cobalt were found in the main components of ecosystems (soil, plants, water, organs and tissues of birds and animals) of the Lower Volga region, which prolongs the presence of hidden forms of combined (Se, I) hypomicroelementoses in acclimatized birds. In the treatment and prevention of the latent form of combined hypomicroelementosis in the birds studied, selenium preparations (DAPS-25) and iodine (YODDAR) increased physiological and biochemical status, the level of TSH in quails from the experimental group decreased by 31.5%, and in guinea fowls - by 54,2% relative to similar results in birds from the control groups ($P<0,05$). In quails from the experimental group, the level of triiodothyronine (T_3) increased by 13.4%, thyroxin (T_4) - by 20%, and in the guinea fowls - respectively: by 11.8% and 57.7% relative to similar control results ($P<0.05$).
Keywords: trace elements, hypomicroelementosis, enzymes, hormones, quail, guinea fow

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INTRODUCTION

Birds, distinguished by a high level of metabolism, are very sensitive to chronic deficiency of physiologically important microelements, and therefore their bodies often exhibit low levels of bio-oxidants, leading to the development of oxidative stress and a hidden form of hypomicroelementoses and to a decrease in productivity and adaptation functions when they are acclimatized to new conditions regions of Russia [5; 2]. In the activation of free radical oxidation, cation radicals of selenium, iodine, manganese, zinc, copper, cobalt, molybdenum and iron-sulfur clusters take part [5]. For example, a low level of selenium in the body reduces the activity of antioxidant enzymes, violates the processes of neutralization of hydroperoxides and lipid peroxides, and this, in turn, prolongs oxidative stress and the development of a latent form of hypomicroelementosis [30]. Permanent iodine deficiency in the environment and feed of farm birds negatively affects the production of thyroid hormones and causes metabolic disturbances in the body. Selenium and iodine are functionally related to each other and with vitamin E [7; 9; 23; 30]. Selenium controls the exchange of iodine, being part of two iodothyronine-deiodinase [29], which catalyze the conversion of inactive thyroxin (T_4) to the more active triiodothyronine (T_3), which is involved in the synthesis of thyroglobulin, which accelerates the conversion of carotene to vitamin A, and also performs other important functions. Therefore, deficiency of selenium and iodine in the environment and the body leads to the development of a latent (asymptomatic) form of hypomicroelementose, which reduces the level of metabolism and entails the impossibility of the full realization of the genetic potential of productivity of farm animals and birds [8; 17; 19; 21; 23; 27]. The molecular and cellular mechanism of the pathogenesis of the latent (asymptomatic) form of avian hypomicroelementosis has been studied very little. Therefore, conducting a comprehensive physiological and biogeochemical study of quails and guinea fowls in order to diagnose, treat, and prevent the latent form of hypomicroelementosis in birds, to maintain homeostasis, increase their integrative functions of adaptation and productivity in the Astrakhan region is an important issue.

Comprehensive diagnostics conducted by us earlier, including the study of the biogeochemical situation of the Astrakhan region of Russia, where Manchurian golden quails and gray-speckled guinea fowls from the “reference” of black earth region (Krasnodar Territory), physiological and biochemical parameters of the blood of birds studied were brought, data of free radical oxidation, activity antioxidant and pituitary-thyroid systems showed that the acclimatized agricultural birds develop a hidden form of the combined (Se, I) hypomicroelementosis and they reduce the integrative functions of productivity by 20% (quail) - 25% (guinea fowl) [2].

The aim of the study was to determine the effect of organic preparations of selenium (DAPS-25) and iodine (YODDAR) on the content of trace elements in organs and tissues of birds, products of the antioxidant system and physiological and biochemical status to solve the problem of treatment and prevention of the latent form of combined hypomicroelementosis in agricultural birds to improve metabolic processes and integrative functions of the productivity of quails and guinea fowls acclimatized in the biogeochemical conditions of the Lower Volga region.

MATERIALS AND METHODS

Manchurian golden quail - Coturnix japonica (Temminck and Schlegel, 1849) and gray-speckled guinea fowl - Numida meleagris (Linnaeus, 1758) were taken as objects of research.The materials for the thesis (soil, water, plants, bird feed, organs and tissues of quails and guinea fowls) were selected for analyzes in 2015-2018. In the Kamyzyaksky, Ikryaninsky and Limansky districts of the Astrakhan region and the Labinsky district of the Krasnodar region, from where quails and guinea fowls were brought to the peasant farm of the Astrakhan region in 2015. For the analysis of the trace elements content, were selected 36 soil samples, 31 species of plants and vegetable feed, 15 water samples, 186 organs and tissues of quails and guinea fowls from regions of the Astrakhan region and black farms of the “reference” Krasnodar region (Labinsky district).

In the experiment, conducted in the farm "Maryin Dvor" of the Astrakhan region for 4 months (May-August) in 2017 on females of 4 months quail and on 10 months guinea fowls, for 6 months, the effect of organic preparations of selenium (DAPS-25) and iodine (YODDAR) as a therapeutic and prophylactic agent for the latent form of combined hypomicroelementosis of birds. A control group of 50 similar quails received the basic ration (BR) according to the norms of VNITIP. An experimental group of quails similar in age and weight (50 birds) received an (BR) with the addition of DAPS-25 (1.5-diphenyl-3-selenopentadion), approved by the

veterinary council of the Department of Veterinary Medicine of the Russian Federation, registration number of TAC 2.04.0185-96 at dose 1,6 mg / kg feed. At the same time, besides selenium, iodine was added to the (BR) as an organic drug YODDAR (Opinion of the Nutrition Research Institute No. 721E-9023 / 6-06 of August 26, 2006, certificate No. 77.99.3.U.9536 of September 27, 2006), in a dose of 50 g/t feed. 1 gram of YODDAR contains 33 μg of bound iodine. Guinea fowls in the first control group (25 similar females) were given the basic ration (BR) according to the VNITIP standards, and in the second experimental group (28 similar females) the birds received a similar BR with DAFS-25 in a dose of 1,6 mg/kg of feed and YODDAR at a dose of 50 g/t feed.

Experiment and analysis are carried out in accordance with the norms of human treatment of animals, set out in the directive of the European Community (86/609 / EEC) and the Helsinki Declaration. The blood of the birds was obtained in vivo by puncture from the brachial vein in all the experiments performed before feeding. The hematological parameters (the number of erythrocytes, leukocytes, hemoglobin, glucose, alkaline reserve, total protein, and total lipids) of birds total Ca and inorganic P were investigated according to generally accepted methods. The amount of vitamin E in the serum was investigated by the method of Emery-Engel in the reaction with a reactive gel and using liquid chromatography on a "Minichrom" chromatograph with a scanning UV detector. The content of vitamin A was studied by the Carr-Price color reaction with antimony chloride. The level of diene conjugates (DC) in the serum of the studied birds was assessed spectrometrically by UV spectra, and malonic dialdehyde (MDA) was determined by V.S. Buzlama et al. (1997). Catalase activity was investigated according to M.A. Korolyuku (1988), superoxide dismutase (SOD) was determined by its ability to compete with nitro blue tetrazolium for superoxide anions, and the activity of glutathione peroxidase (GPO) according to R. Paglian and J. Valentine (1967). The endocrine status of birds was investigated by the level of activity of thyroid-stimulating hormone (TSH), total thyroxin (T_4) and total triiodothyronine (T_3) in the blood by an enzyme immunoassay method using the "Uniplan" analyzer and test systems (ELISA AT-T) and tests “Biomerica. ACTH ELISA”. Trace elements (Cu, Mn, Zn, Co, Cr) in the collected samples were determined by atomic absorption analysis using a "SHITACHI" 180-50 spectrophotometer. The research results were processed statistically using computer programs Microsoft Excel 97 Pro, Statistica. To determine the degree of reliability of the average values of the studied parameters of the physiological state of the birds, t-test was used, with a significance level of $P<0.05$.

RESULTS AND DISCUSSION

Comprehensive diagnostics of hypomicroelementoses in poultry should take into account the biogeochemical situation of their breeding area. It was established that various types of soils of the Astrakhan region are poorly provided with gross forms of iodine - 0.32 ± 0.06 mg / kg, selenium (0.34 ± 0.03 mg / kg) and cobalt (7.9 ± 0.57 mg / kg). In the Volga water, the level of iron, manganese, selenium, cobalt, copper, zinc and iodine is, respectively: 0.32 ± 0.007; 0.15 ± 0.009; 0.02 ± 0.007; 0.01 ± 0.003; 0.19 ± 0.007; 0.03 ± 0.003 and 0.004 ± 0.0003 mg / l. It is established that the level of trace elements Co, Mn, Zn, Cu, I and Se in physiologically important for the body directly depends on their content in the soil (r = +0.61), the nature of the mobility of chemical elements (r = +0.59) , pH, plant species and their physiological state. Plants and feeds produced from them have a low level of provision with selenium (from 0.03 to 0.12 mg / kg), cobalt (from 0.01 to 6 mg / kg) and iodine (from 0.01 to 0.07 mg / kg). Analyzing the above data of the microelement picture of soils, various plant species, vegetable feed and water in the Astrakhan region and comparing them with similar data in the “reference” of black earth province of Russia and literary indicators, we can conclude that the soil, water and plants in the Astrakhan region are weak are provided with selenium, iodine and cobalt, which predetermines the development of oxidative stress, prolonged development of the latent form of hypomicroelementosis in the quails and guinea fowls under study.

Considering that selenium and iodine are important adaptogens of the animal world, and peroxides and hydroperoxides are actively summed up in the blood during the period of chronic deficiency of selenium and iodine in soils, plants, feed, organs and tissues, forming a state of oxidative stress, turning into a latent form of combined hypomicroelementoses birds, the use of selenium and iodine in the form of organic preparations, which are lacking in the environment and feed, contributes to a better adaptation of imported quails and guinea fowls. The addition of selenium and iodine to the food of quails and guinea fowl seems to increase (expands) the boundaries of the established adaptation zone and helps the body relatively safe to exist in conditions of intensified oxidative processes caused by low levels of selenium, iodine and cobalt in the main components of terrestrial ecosystems of the Astrakhan region.

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For the purpose of therapy and prevention of the latent form of hypomicroelementosis in quails and guinea fowls brought to the Astrakhan region, which we have previously established [5], an experiment was conducted with the enrichment of feed for birds in the experimental groups with selenium and iodine preparations. At the end of the experiment, we studied the microelement status of quails and guinea fowls from the experimental and control groups. Thus, the content of selenium in the blood of quails from the experimental group increased by 58.8%, in guinea fowls - by 61%, the level of iodine in quails increased in blood by 61%, in guinea fowls - by 44% compared to similar control data ($P<0.05$). We found a significant ($P<0.05$) increase in the content of zinc, manganese and copper in the organs and tissues of the studied birds from the experimental groups relative to similar indicators of control. The addition of missing selenium and iodine to the food of the experimental groups had a favorable effect on the microelement status of quails and guinea fowls from the experimental groups, which became very similar in trace-elements content in organs and tissues of quails and guinea fowls to similar birds from the Krasnodar Territory and reached physiological indices of selenium and iodine.

Table 1: Effect of DAPS-25 and YODDAR on hematological parameters of quails and guinea fowls in scientific and economic experiment

Indicators	Quails, age 6 months		Guinea fowls, age 10 months	
	control group, n = 10	experimental group, n = 10	control group, n = 10	experimental group, n = 10
RBCs, mln / µl• 10^{12} / l	5,76±0,04	3,29±0,06*	5,51±0,06	3,74±0,16*
hemoglobin, g / l	122±3,26	137±6,10*	99,5±3,34	115,1±3,48*
leukocytes, thousand / µl• 10^{9} / l	13,8±2,19	9,51±2,02*	14,3±1,98	10,6±3,52*
total protein, g / l	49,8±1,35	53,1±2,17	53,11±2,04	61,4±2,02*
total lipids, g / l	7,01±0,34	6,52±0,08	7,34±0,31	7,03±0,21
glucose, mmol / l	5,01±0,04	4,61±0,05*	4,1±0,09	3,96±0,05*
urea, mmol / l	1,76±0,03	2,66±0,01*	3,15±0,75	3,31±0,09
uric acid, mmol / l	0,35±0,15	0,43±0,03*	0,39±0,02	0,50±0,03*
potassium, mmol / l	11,82±0,93	9,37±0,05*	12,33±1,05	8,63±0,51*
calcium, mmol / l	3,97±0,27	3,22±0,08*	3,73±1,05	3,35±0,51*
total phosphorus, mmol / l	1,93±0,02	1,27±0,02*	1,73±0,08	1,31±0,04*

* - $P<0.05$ relative to control

The number of erythrocytes in quails from the experimental group at the end of the experiment decreased by 43%, leukocytes - by 31.1%, and in guinea fowls from the experimental group - respectively: by 32.2% and 26% and reached the limits of the physiological norms. The glucose level in quails and guinea fowls from the experimental groups decreased, respectively: by 8% and 3.4% compared to similar data in birds from the control groups ($P<0.05$). The uric acid content in the blood of quails from the experimental groups increased by 22.9% relative to the control, and in guinea fowls, respectively: by 28.2%, indicating an increase in the protein metabolism level in the studied birds (Table 1) and was accompanied by a decrease in the blood of quails K by 20.7%, Ca - by 19% and P - by 34.2%, which is explained by the conversion of minerals into eggshell and is accompanied by an increase in egg production of quails and guinea fowls from the experimental groups relative to the control.

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Table 2: Effect of DAPS-25 and YODDAR on the level of POL and the activity of AOS of the studied agricultural birds in biogeochemical conditions of the Astrakhan region

Indicators	Quails		Guinea Fowls	
	control, n=10	experimental, n=10	control, n=10	experimental, n=10
vitamin E, µmol / l	0,005±0,0003	0,009±0,0006*	0,004±0,0004	0,005±0,0002
vitamin A, µmol / l	0,82±0,04	0,97±0,003*	0,81±0,007	0,92±0,005*
vitamin C, mg%	1,02±0,003	1,04±0,002	1,02±0,006	1,07±0,004
calcium, µmol / l	3,99±0,006	3,23±0,016	3,78±0,015	3,36±0,02*
diene conjugates, unit.opt./mg lipids	0,371±0,04	0,222±0,015*	0,354±0,016	0,311±0,003
malonic dialdehyde, µmol / l	1,74±0,03	1,22±0,018*	1,51±0,06	1,22±0,007*
catalase, µmol H_2O_2 l / min	49,55±2,12	56,7±1,09*	33,8±1,07	44,2±1,05*
superoxide dismutase, u / min	110,2±1,22	121,4±3,19*	107±1,23	118±1,65*
glutathione peroxidase, µmol G-SH l / min• 10^3	7,17±0,06	7,83±0,09*	7,64±0,04	8,15±0,09*
selenium, mg / l	0,035±0,006	0,06±0,002*	0,027±0,002	0,042±0,001*

* - P<0.05 relative to control data

We found (Table 2) that the level of antioxidant vitamin E in the blood at the end of the experiment was higher in quails from the experimental group by 80% and by 25% in experimental guinea fowls, vitamin A by 18.29% and guinea fowls - by 13.58 % (P<0.05), and vitamin C in quails - by 1.93% and guinea fowls - by 4.9% relative to similar indicators of control, which indicates a better biological availability for the birds from the experimental groups of antioxidant vitamins E and A from the feed. The level of diene conjugates in the blood of quails from the experimental group decreased by 40.25%, and MDA - by 29.89% and in guinea fowls - by 12.2% and 19.2% relative to the similar parameters of birds from the control groups (P<0,05). The activity of catalase in the blood of quails from the experimental group increased by 14.43%, superoxide dismutase (SOD) - by 10.16% and glutathione peroxidase - (GAP) - by 9.21%, and the activity of enzymes in guinea fowls from the experimental group increased - respectively : by 30.76%, by 10.28% and by 6.67% relative to similar data of birds from the control groups (P<0.05), which is confirmed by the data of Swiss researchers [16; 17] and others [9; 14; 22; 25; 28].

According to modern data, iodine and selenium deficiency in the environment and feed can lead to disruption of the metabolism of thyroid hormones [10; 13; 15]. The enzyme, triiodothyronine deiodinase, regulates the conversion of T4 to 3,3,5-triiodothyronine and has selenium in its molecule [11; 12; 18; 19; 20]. The authors claim that deficiency of selenium in feed exacerbates iodine deficiency in animals. By the end of the experiment, the level of thyroid-stimulating hormone of the pituitary gland (TSH) in the blood of experimental quails decreased (Table 3) relative to the control by 31.5% (P<0.05), and in guinea fowls - by 54.2% (P<0.05) . At the same time, the level of total thyroxin ($_{T4}$) in quails from the experimental group increased by 20%, total triiodothyronine (T_3) - by 13.4%, and in guinea fowls from the experimental group - respectively: 57% and 11.8% compared to similar indicators of quails and guinea fowls from the control groups (P<0.05). It should be said that all the parameters of the hormonal activity of the pituitary-thyroid system in quails and guinea fowls from the experimental groups at the end of the experiment did not go beyond the physiological norms.

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Table 3: Effect of DAPS-25 and YODDAR on the hormonal activity of the pituitary-thyroid system of acclimatized birds

Name	Quails (females)		Guinea fowls (females)	
	control, n=10	experimental, n=10	control, n=25	experimental, n=28
TSH, μMU / ml	0,54±0,02	0,37±0,02*	0,48±0,04	0,22±0,01*
total thyroxin (T_4), nmol / l	7,78±1,13	9,33±1,08*	5,06±1,14	7,96±1,03*
total triiodothyronine (T_3), nmol / l	2,39±0,09	2,71±0,09*	2,45±0,06	2,74±0,07*

* - P<0.05 relative to control values

It is known that the egg production is determined by the homeostasis of the thyrotropic function of the pituitary gland with varying levels of thyroid hormones and, especially, T_4, which undergoes constant peripheral deiodination to T_3, ensuring its level in the blood, and the rate of deiodination gradually increases during egg-laying [5].

Under the influence of exogenous and internal causes, the organism of quails and guinea fowls adapt to changing environmental conditions within the norms of reaction. Consequently, the adaptation processes in quails and guinea fowls brought to the Astrakhan region will always have a certain price (metabolic, energy, etc.). The value of the price of adaptation of quails and guinea fowls imported from the “reference” of black earth region of Russia to the biogeochemical conditions of Se and I deficiency in the environment and in birds is manifested in a decrease in egg production of quails and guinea fowls from the control groups, which dictates the need to use organic selenium and iodine preparations for therapy and prevention the latent form of combined hypomicroelementosis in the studied birds, which negatively affects their productivity, which confirms the results of other scientists [6; 26].

Organic preparations of selenium and iodine, of course, had a positive therapeutic effect on the latent form of combined hypomicroelementosis in birds. They not only increased the adaptation reactions and the physiological status of acclimatizing birds, but also increased the egg production rate of quails from the experimental group during the period of scientific and economic experiment by 7.76% (P<0.05), and also increased the mass of their eggs by an average of 8, 88% (P<0.05), relative to the control (23.21 ± 0.96 eggs per month with a mass and 13.62 ± 1.06 g). In quail eggs from the experimental group, the amount of protein increased by 3.06% (P>0.5) and the level of yolk increased significantly by 21.64% (P<0.05), relative to the control (4.25 ± 0.01).

In guinea fowls, egg production of females from the experimental group increased relative to control by 6.58% (P<0.05). DAPS-25 and YODDAR increased the weight of the hen's eggs by 4.98% (P<0.05), as well as the mass of yolk, which increased by 7.58% (P<0.05) and the thickness of the egg shell by 3.8% (P<0.05), relative to similar indicators of control (46.1 ± 0.98 g; 13.9 ± 0.23 g and 0.53 ± 0.006 mm.).

The clinical parameters (TOC, pulse rate and respiration rate) of the studied Manchurian golden quails and speckled guinea fowls in the control and experimental groups at the end of the experiment were quite close, their differences were statistically unreliable (P>0.5) and fit into the physiological norms.

Thus, the use of selenium and iodine in the form of organic preparations (DAPS-25 and YODDAR), which are lacking in the medium and feed, in feed to birds entails an increase in the level of metabolic processes, hematological parameters, microelement status, a decrease in POL, an increase in AOC activity and activation the pituitary-thyroid system, which predetermined the improvement in the general physiological status of quails and guinea fowls in the experimental groups and thereby increased the integrative functions of productivity (egg production) of the studied agricultural birds. All the above unequivocally indicates that the drugs introduced into the feed (DAPS-25 and YODDAR) have a good therapeutic effect on the latent form of combined hypomicroelementosis in acclimatized quails and guinea fowls and prevent the decrease in the integrative functions of the productivity of the studied birds in the biogeochemical conditions of the peasant farms in Astrakhan region. As a result of the use of organic preparations of selenium and iodine, in birds from

experimental groups, egg production increased and profits from product sales increased, in quails - by 7.7%, and in guinea fowls - by 14.6%, relative to similar control results.

CONCLUSIONS

1. Organs and tissues acclimatized in biogeochemical conditions of the Astrakhan region of quails and guinea fowls with a hidden form of hypomicroelementosis have a low level of selenium and iodine, which is correlated with a low amount of these elements in the soil (r=+0.63) and in plants (r=+0,69) of Astrakhan region of the Russian Federation and significantly (P<0.05) lower than the content of Se and I in the organs and tissues of birds from the "reference" of black earth region (Krasnodar region of the Russian Federation), which predetermines the development of the latent combined hypomicroelementoses in the studied birds.
2. Therapy and prevention of the latent form of combined hypoelementosis with selenium and iodine preparations in the studied birds from the experimental groups with DAPS-25 and YODDAR reduced the number of erythrocytes by 43%, leukocytes - by 31.1% and in the guinea fowls from the experimental group - respectively: 32, 1% and 25.9%, while the hemoglobin level in the blood of quails increased by 12.3%, in guinea fowls - by 15.7%, the amount of total protein in quails increased by 6.6%, and in guinea fowls - by 15.6 % relative to similar indicators in birds from the control groups (P<0.05). At the same time, the amount of glucose in the blood of quails from the experimental group decreased by 8%, total lipids - by 7.3%, the uric acid content increased by 23% in the guinea fowls from the experimental group - respectively: by 3.4%, by 4.3% and by - 28%. The level of DC in quails of the experimental group decreased by 40.2% and MDA - by 29.9%, and in guinea fowls - respectively: by 12.2% and 19.3%, and the activity of catalase, SOD and GPO increased in quails - respectively : by 14.4%, 10.2% and 9.2%, and in guinea fowls - by 30.8%; 10.3% and 6.7%, the level of TSH in quails from the experimental group decreased by 31.5%, in guinea fowls - by 54.2%, and the level of triiodothyronine (T_3) in quails increased by 13.4%, thyroxin (T_4) - by 20%, and in the guinea fowls - respectively: by 11.8% and 57.7% relative to similar control results (P<0.05).
3. The effect of DAPS-25 and YODDAR on quails and guinea fowls in the latent form of combined hypomicroelementose increased (relative to control) in the blood of birds from the experimental groups not only the selenium content in quails by 58.8%, and in guinea fowls - by 61%, iodine - respectively: 61% and 44%, and also vitamin E in quails by 80.1%, in guinea fowls by 25%, vitamin A in quails by 18.3% and guinea fowls by 13.6% and vitamin C in quails - by 1.93% and guinea fowls - by 4.9%.
4. The use of organic selenium compounds (DAPS-25) and iodine (YODDAR) increased in Manchurian golden quails from the experimental group egg production by 7.76%, the weight of one egg increased by 8.88%, the amount of protein in one egg increased by 3, 06%, and the level of yolk - by 21.6% relative to similar control data (P<0.05). In gray-speckled guinea fowls from the experimental group, egg production increased on average by 6.58%, egg weight increased by 4.9%, yolk weight by 7.6% and the shell thickness by 3.8% compared to similar data of birds from control group (P<0.05). The profit from the sale of eggs from quails from the experimental group, relative to the control birds, increased by 7.7%, while in experimental guinea fowls increased by 14.6% (P<0.05).

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