Influence of carnitine-containing complex for mineral exchange in quails

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Abstract. To stimulate metabolism and productivity, a multivitamin carnitine-containing complex was introduced into the quail's diet. The first group received the drug at a dose of 0.25 ml/l for 5 consecutive days with a 10-day interval, 2-0.5 ml/l for 5 consecutive days with a 10-day interval; 3 - 0.25 ml/l for 5 consecutive days with a 5-day interval; 4 - 0.5 ml/l for 5 consecutive days at 5-day intervals; 5 - received drinking water. The study of the trace element composition of blood serum was carried out at 13-15, 39-42 and 76-78 days of age on an automatic biochemical analyzer SMT-120 Vet with subsequent statistical data processing. As a result, regardless of the scheme, the applied complex promoted an increase in calcium, normalization of the calcium-phosphorus ratio in accordance with the physiological state of quails, and a decrease in the level of sodium and potassium-sodium ratio. It is most advisable for young animals, taking into account the critical periods of development associated with adaptation to a mixed and exogenous type of nutrition and molting, to drink the drug at a dose of 0.5 ml/l for 5 days in a row with a 10-day interval, and for layers - 0.25 ml/l in for 5 consecutive days at 5-day intervals.

Keywords: quail, macronutrients, multivitamin carnitine-containing complex, application regimen.

Introduction

Raising quails, preparing hens for egg-laying require the utmost attention and providing them with nutrients that are involved in all biochemical reactions in the body. A specific feature of the bird body is its high dependence on mineral supply [6]. Mineral substances play a major role in the formation and construction of body tissues, skeletal bones, maintain the osmotic pressure of cellular and extracellular fluids and acid-base balance, regulate water-salt metabolism, create conditions for the normal course of metabolic processes and energy, actively participate in the formation of proteins and regulate the activity of enzymes. So calcium takes part in the generation of action potential, the initiation of muscle contraction, is a necessary component of the blood coagulation system, increases the reflex excitability of the spinal cord and has a sympathicotropic effect [4]. Ossification, muscle contraction, excretion of metabolic products, and the formation of eggs in birds are carried out only in the presence of phosphoric acid compounds. Phosphorus takes part in the metabolism of carbohydrates, enhances the absorption of glucose in the intestine, enters into the structure of nucleic acids, regulates protein biosynthesis, and participates in fat metabolism [2]. Vitamins A, C, D, F and minerals have a stimulating effect on the level of calcium and phosphorus [8]. Potassium is a part of buffer systems, promotes digestion processes, participates in the synthesis of proteins and glycogen, regulates heart contractions, activates a number of enzymes, and is part of the cells of all tissues [1]. Sodium transports amino acids, sugars, inorganic and organic anions across cell membranes; participates in the transfer of carbon monoxide in the blood, hydration of proteins and dissolution of organic acids, the formation of gastric juice; activates the enzymes of saliva and pancreatic juice, enhances the excretion of various metabolic products by the kidneys. From the literature it follows that in biological objects the ratio of sodium to potassium varies in a wide range from 1:1 to 60:1 and their mutual influence on each other in the determination can be significant [3; 9].

In the poultry industry, feed additives with physiological activity are widely used, which can be considered both from the point of view of medical use and to maintain normal vital activity of the body, giving it any new properties [5]. The introduction of complexes based on vitamins and vitamin-like substances into the diet of poultry is still of great scientific interest [10].

Based on this, the **purpose** of this study was: to establish the effect of a multivitamin carnitine-containing complex on the level of macronutrients in Japanese quail.

Material and research methods

The study was carried out in 2020-2021 at the Department of Obstetrics, Surgery and Non-communicable Animal Diseases. The object was Japanese quail, owned by LLC "Shepilovskaya poultry" farm (Moscow Oblast, urban district of Serpukhov, Shepilovo). The

conditions for keeping quails corresponded to zoo-hygienic standards. Feeding was carried out according to age with combined feed, drinking without restrictions from nipple drinkers.

To achieve the goal of the experiment, 5 groups of quails, 7 thousand each, were formed: the control group received a standard diet, the experimental groups received a multivitamin carnitine-containing complex (MCCC) with water from two days of age until the end of cultivation according to the experimental scheme (tab. 1). MCCC was given from 2 to 80 days of age.

Table 1 – Experiment layout

Group 1 – test	0.25 ml/l for 5 consecutive days at 10-day intervals
Group 2 – test	0.5 ml/l for 5 consecutive days at 10-day intervals
Group 3 – test	0.25 ml/l for 5 consecutive days at 5-day intervals
Group 4 – test	0.5 ml l for 5 consecutive days at 5-day intervals
Group 5 – control	drinking water without restrictions

Blood for the study was obtained in the morning hours before feeding from 10 heads from each group at 13-15, 39-42 and 76-78 days of age. Analysis of blood serum for the content of total calcium, inorganic phosphorus, potassium and sodium was performed on an automatic biochemical analyzer SMT-120 Vet with subsequent statistical data processing.

The choice of the drug is due to the property of L-carnitine to donate radicals inside mitochondria to oxidative enzymes, as a result of which those substances that can serve as a source of intramitochondrial acyl-CoA are included in the fatty acid chain [7].

L-carnitine is important for both young birds and during the production period of laying quails.

Results and interpretation

In quails of the control group, no significant changes in the content of calcium, phosphorus, potassium and sodium were found in the blood serum throughout the entire study period (tab. 2). Only at the beginning of oviposition there was a slight tendency to an increase in calcium (42 days) and its end (76 days) to an increase in phosphorus.

In experimental group 1, at the beginning of oviposition (40 days), the concentration of calcium significantly increased by 3.90%, phosphorus - by 10.24%, sodium - by 16.23% ($p \leq 0.05$). By the end of the productive period (78 days), compared with the previous date of the study, laying hens showed a decrease in calcium by 7.92% ($p \leq 0.05$), as well as a tendency to a decrease in sodium and an increase in phosphorus.

In experimental group 2, at the beginning of oviposition (39 days), an increase in phosphorus by 14.29% ($p \leq 0.01$) and sodium by 6.56% ($p \leq 0.05$) was observed and there was a tendency to an increase in calcium (by 2.53%).

By the end of the productive period (78 days), a significant decrease in potassium by 10.28%, calcium by 7.82% and phosphorus by 2.60% ($p \leq 0.05$) occurred in layers relative to the beginning of the productive period.

In experimental group 3, at the beginning of oviposition (41 days), an increase in calcium and phosphorus by 6.14 and 6.90%, respectively ($p \leq 0.05$), was revealed. By the end of the productive period (78 days), there was a decrease in calcium by 5.37% and an increase in sodium by 31.47% ($p \leq 0.05$) relative to the previous indicator.

In the 4th experimental group, at the beginning of oviposition (40 days), a significant increase in phosphorus by 8.98% ($p \leq 0.05$), a tendency to an increase in calcium and a decrease in sodium by 7.75% ($p \leq 0.05$) were found. Compared with these data, by the end of the productive period (77 days), the hens showed a decrease in calcium and sodium by 5.04% and 8.57%, respectively ($p \leq 0.05$).

Table 2 – Dynamics of mineral metabolism in quails participating in the experiment, n=10, M±m, mmol/l

Indicator	Test				Control
	Group 1	Group 2	Group 3	Group 4	Group 5
age 13-15 days					
Total calcium	2.31±0.03	2.37±0.02	2.28±0.01	2.32±0.02	2.06±0.06
Inorganic phosphorus	1.66±0.01	1.68±0.02	1.74±0.02	1.67±0.03	2.03±0.05
Potassium	4.72±0.14	4.58±0.18	5.50±0.16	5.58±0.12	4.87±0.21
Sodium	123.20±12.8	120.40±10.8	125.60±14.3	127.70±13.9	173.50±24.6
age 39-42 days					
Total calcium	2.40±0.02	2.43±0.03	2.42±0.03	2.38±0.01	2.11±0.02
Inorganic phosphorus	1.83±0.01	1.92±0.03	1.86±0.01	1.82±0.01	2.02±0.02
Potassium	4.74±0.07	4.57±0.06	5.60±0.07	5.55±0.03	4.82±0.16
Sodium	143.20±10.4	128.30±11.30	127.10±12.50	117.80±14.70	173.80±16.35
age 76-78 days					
Total calcium	2.21±0.01	2.24±0.02	2.29±0.01	2.26±0.02	2.06±0.03
Inorganic phosphorus	1.86±0.01	1.87±0.02	1.86±0.01	1.84±0.01	2.12±0.02
Potassium	4.70±0.01	4.10±0.04	5.62±0.03	5.50±0.06	4.80±0.06
Sodium	139.5±13.60	128.70±10.50	167.10±7.80	107.7±8.00	173.00±17.30

Having analyzed the ratio in blood serum between the level of total calcium and inorganic phosphorus by 13-15; 39-42 and 76-78 days in 1-4 experimental groups found that the

dependence changed from 1.4:1.0 to 1.3:1.0 and 1.2:1.0. In the 5th group (control) throughout the entire period, the ratio did not fundamentally change, and was at the level of 1.0:1.0.

Naturally, with high productivity in laying quails, there is a decrease in the concentration of calcium in the blood serum, since a significant part of it is spent on the formation of the shell.

Comparing the content of calcium in separate age periods, it was found that in the 2nd group of birds of 13-15 days and 39-42 days of age, its concentration was higher than the same indicator in the other groups by 2.60-15.05% and 0.41-14.70%. 76-78-day-old quails of the 3rd group in terms of calcium content exceeded their analogs from the 1st, 2nd, 4th and 5th groups by 1.33-11.17%.

In terms of phosphorus content, the control group exceeded the analogs by 5.21-22.29% throughout the entire study period.

Having considered the dependence of potassium and sodium in the blood serum of quails in the control group, it was found that the proportion was 1.0:36.0 and did not change throughout the experiment. In 1 experimental group for 13-15; 39-42 and 76-78 days, the ratio of ions corresponded to 1.0:26.0; 1.0:30.0 and 1.0:29.0 in group 2 - 1.0:26.0; 1.0:28.0 and 1.0:31.0; in group 3 - 1.0:23.0; 1.0:23.0 and 1.0:30.0; in group 4 - 1.0:23.0; 1.0:21.0 and 1.0:20.0.

The highest content of potassium ions at 13-15 days of age of quails was noted in group 4, the indicator was higher than that of analogues by 1.45-21.83%. At 39-42 and 76-78 days of age, in terms of potassium content, quail 3 groups exceeded the rest by 0.90-22.54% and 2.18-37.07%, respectively.

A high concentration of sodium ions was recorded in quails of the control, group 5. Throughout the entire research period, the sodium level in quails of this group was 3.53-60.63% higher than in the experimental groups.

Conclusion

Regardless of the regimen of application, the multivitamin carnitine-containing complex promoted an increase in serum calcium, normalization of the calcium-phosphorus ratio in accordance with the physiological state of quails, and a decrease in sodium and potassium-sodium ratio.

Nevertheless, it is most advisable for young animals, taking into account the critical periods of development associated with adaptation to a mixed and exogenous type of feeding, to give MCCC at a dose of 0.5 ml/l for 5 days in a row with a 10-day interval, and for layers - 0.25 ml/l for 5 consecutive days at 5-day intervals.

The multivitamin carnitine-containing complex promotes a more complete assimilation of feed macronutrients, their deposition in bones, muscles and internal organs, stimulates earlier egg-laying and the duration of the productive period.

References:

1. Andrianova E.N. Potassium carbonate granulated in feeding broiler chickens / E.N. Andrianova, I.A. Egorov, E.N. Grigorieva, L.V. Krivopishina, D.N. Efimov, A.R. Grigorchuk // Poultry and poultry products. 2019. №1. P. 33-35.
2. Kosolapov V.M., Chuikov V.A., Khudyakova Kh.K., Kosolapova V.G. Mineral elements in feed and methods of their analysis: monograph. – Moscow: LLC "Ugreshskaya Printing House", 2019. – 272 P.
3. Maznyak N.V., Verkhoturova A.P., Loseva V.N., Zamay T.N. Determination of sodium and potassium in biological objects by atomic absorption and atomic emission spectroscopy // Journal of the Siberian Federal University. Series: Chemistry. 2012. Volume 5. №3. P. 320-330.
4. Medvedsky V.A., Bazylev M.V., Bolshakova L.P., Munayar H.F. Biological bases of mineral nutrition of agricultural poultry // Scientific review. Biological Sciences. 2016. № 2. P. 93-108.
5. Nikulin V.N., Kotkova T.V. Biologically active substances and additives in poultry farming. – Orenburg: OGAU publishing center, 2016. – 202 P.
6. Rusakova E.A., Korolev V.L., Zaveryukha A.Kh., Kharlamov A.V. The effect of phytase on the elemental status of broiler chickens at different levels of metabolic energy in the diet // Bulletin of the Orenburg State University. 2012. №10. P.122-125.
7. Savchenko A.A. Vitamins as the basis of immunometabolic therapy / A.A. Savchenko, E.N. Anisimova, A.G. Borisov, A.E. Kondakov. – Krasnoyarsk: KrasSMU Publishing House, 2011. – 213 P.
8. Tarmaeva I.Yu., Boeva A.V. Minerals, vitamins: their role in the body. Micronutrient Deficiency Problems. – Irkutsk: ISMU, 2014 – 89 P.
9. Tsyganenko A.Ya., Zhukov V.I., Myasoedov V.V., Zavgorodniy I.V. Clinical biochemistry. M.: Triada – X, 2002. – 504 P.
10. Yakimenko N.N. Dynamics of live weight and internal organs in quails against the background of the use of carnitine-containing feed additive / N.N. Yakimenko, M.S. Mannova, V.A. Ponomarev, L.V. Kletikova, A.A. Burnus // Collection of materials of the All-Russian scientific and practical conference: "Agrarian science in the conditions of modernization and innovative development of the agro-industrial complex of Russia", dedicated to the 90th anniversary of the FSBEI HE Ivanovo State Agricultural Academy named after D.K. Belyaev"in 2 volumes (Ivanovo, 11/30/2020). – Ivanovo State Academy of Agriculture, 2020. – V. 1. – P.517-519.