Application scheme influence of carnitine-containing composition on quails’ metabolism

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Abstract. The development of quail farming in Russia stimulated the search for environmentally friendly micronutrient preparations that ensure the safety, health and high productivity of birds. Evaluation of the effect of a complex carnitine-containing composition on metabolic parameters was assessed using an automatic biochemical analyzer Biochemical Analyzer SMT-120 Vet with subsequent mathematical data processing. The composition was applied to quails from 2 to 80 days of age. The introduction of the composition at a dose of 0.25 ml/l for 5 days with a 10-day interval in 76-78-day-old quails significantly increased the protein coefficient by 17.14 and creatinine by 22.59%, decreased urea by 5.09%, total bilirubin by 15.45%, glucose by 51.00%. The use of the composition at a dose of 0.5 ml/l for 5 days with a 10-day interval significantly increased the protein coefficient by 18.29%, decreased the concentration of uric acid by 16.38, urea by 6.58 and glucose by 55.16%. The use of the composition at a dose of 0.25 ml/l for 5 days with a 5-day interval contributed to an increase in albumin by 67.68%, normalization of the protein coefficient, a decrease in uric acid by 9.91, urea by 5.34, total bilirubin by 22.22 and glucose by 45.03%. Integration of the composition into the diet at a dose of 0.5 ml/l for 5 days with a 5-day interval led to a decrease in uric acid by 7.33, total bilirubin by 29.33 and glucose by 54.89%, an increase in creatinine by 11.57%. The carnitine-containing composition was a universal regulator of metabolic processes, with a pronounced hepatoprotective effect, had a beneficial effect on protein metabolism and improved the energy status of quails. Its most effective use is at a dose of 0.25 ml/l for 5 days with a 5-day interval throughout the entire growing period.

1. Introduction
In modern Russia, the agricultural sector is well developed, where poultry farming rightfully takes the leading place. Domestic poultry enterprises in terms of technological equipment, production culture, financial and economic indicators are not inferior to European ones. According to experts, in the next 5 years, the production of poultry meat in Russia will reach 5.5 million tons, and the volume of exports of poultry products will exceed 630 thousand tons [1]. At the same time, the key concepts of the industry are efficiency and biosafety. In parallel, there is an increase in consumer demand for environmentally friendly, hypoallergenic, dietary products, complete in amino acid and protein composition [2]. In modern economic conditions, the solution to this problem is based on the development and implementation of new resource-saving technologies, the production of local alternative feed and products with a given chemical property and biological activity [3, 4, 5].

Recently, quail farming has been intensively developing in the country as a source of dietary and gourmet products [6]. Quails have a number of significant productive and economic advantages over...
other bird species. So, quails have a five times higher growth rate than chickens, an early onset of egg production (at 5-6 weeks of age). In quail eggs, in comparison with chicken eggs, the content of potassium, phosphorus, iron, vitamins A, PP, K, B1, B2 is several times higher, eggs have antiallergic and antimicrobial properties, stimulate hematopoiesis [7]. In recent years, doctors have recommended quail eggs as an indispensable product in the diet of children and in complex therapy for patients with bronchial asthma, chronic pneumonia, tuberculosis [8], which in turn stimulates the demand for quail eggs.

The productivity of laying hens directly depends on the completeness of the diet and strict adherence to the feeding regime. To maintain metabolic processes at an optimal level, productive longevity and product quality, it is advisable to use micronutrients. Thanks to the development of biotechnology, fodder products and biologically active additives with new properties that can increase resistance, antioxidant status, and the function of internal organs and body systems have appeared [9; 10; 11; 12; 13]. The health status of birds and the metabolic rate can be assessed by examining hematological and biochemical blood parameters [14, 15, 16, 17].

2. Purpose of the study
The purpose of this study is due to the assessment of the effect of a complex carnitine-containing composition on metabolic parameters in quails.

3. Material and research methods
Analytical studies were carried out at the Department of Obstetrics, Surgery and Non-communicable Animal Diseases. The object was Japanese quail, owned by “Shepilovskaya poultry farm” (Moscow region, Serpukhov urban district, village Shepilovo).

The conditions for keeping the 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 from one parent flock, according to the recommendations of ARSRVIP, in compliance with the principle of analogues, 5 groups of quails, 7 thousand each, were formed. The control group received a standard diet, the experimental groups received a composition containing carnitine in its base from 2 days of age until the end of growing (80 days) with water (table 1).

| Quail groups     | Drug administration scheme                                      |
|------------------|-----------------------------------------------------------------|
| Group 1 - control| drinking water without restrictions                              |
| Group 2 - experimental| 0.25 ml/l for 5 days with a 10-day interval                    |
| Group 3 - experimental| 0.5 ml/l for 5 days with a 10-day interval                    |
| Group 4 - experimental| 0.25 ml/l for 5 consecutive days with a 5-day interval |
| Group 5 - experimental| 0.5 ml/l for 5 consecutive days with a 5-day interval |

The subject for the study was blood serum, for this blood was obtained from the axillary vein in 10 heads from each group at 13-15, 39-42 and 76-78 days of age in the morning hours before feeding, the study was performed on an automatic biochemical analyzer Biochemical Analyzer SMT-120 Vet. Biometric processing of the results was carried out using an Excel spreadsheet processor.

4. Results and their interpretation
The most valuable information about all the processes occurring in the body of quails is given by blood proteins, which are closely related to tissue proteins, as a result of which they subtly react to fluctuations in chemical and physicochemical processes occurring in the body. Due to the properties of
serum proteins, blood is a specialized tissue in which the metabolic processes of the body are integrated [18].

Throughout the experiment, the concentration of total protein in 1, control, group was in the range of 22.70-24.80 g/l, which was 34.68-41.40% less than in quails 2, 4 and 5 of the experimental groups; 42.74-51.10% and 10.08-19.38%, respectively (p≤0.05). More pronounced changes in the protein coefficient and, accordingly, in the concentration of albumin and globulins were recorded in quails of 13-15 days of age in group 4 (figure 1). In quails of groups 3 and 5, the dynamics of protein fractions is not expressed. However, scientists have found that birds with high egg production accumulate significantly more globulins than birds with low productivity [19], which is probably due to the higher content of globulins in quails of groups 2 and 4.

Figure 1. The content of albumin and globulins in quails’ blood serum participating in the experiment, g/l.

The end products of protein metabolism in birds are: uric acid, a small amount of urea, creatine, ammonia, guanine. These substances are excreted in the urine.

In a healthy bird, 90% of uric acid is excreted from the body through the kidneys [20]. The serum uric acid content depends not only on the species and cross of birds, but also on their age. For young animals, the uric acid limit is 240.00–480.00 µmol/L, for the adult livestock it is 320.00–750.00 µmol/L [21].

In group 3 of quails, the highest concentration of uric acid was recorded in comparison with groups 1-5 (table 2).

During the observation period, quails of the 1st group showed a significant increase in the concentration of uric acid by 17.32 and 31.76% at 39-42 and 76-78 days of age, respectively. In group 2, the change in the level of uric acid is insignificant. In groups 3, 4 and 5, the content of uric acid in the blood serum of laying quails decreased by 8.36 at 39-42 days of age; 9.01 and 6.47%, at 76-78 days of age by 16.37; 9.91 and 7.33%, respectively (p≤0.05).

To assess the level of catabolism, it is necessary to know the level of urea [22]. In the control, the first group of quails, an insignificant change in urea was noted. In groups 2 and 3, there was a decrease in urea by 5.08% and 6.58% (p≤0.05) at 39-42 days of age and subsequent stabilization of its concentration. In group 4, 39-42-day-old quails showed a tendency to decrease in urea and by the end of the period of exploitation of birds, its concentration decreased by 5.33% (p≤0.05). In group 5, there
were no significant changes in the level of urea, which is probably associated with a stable level of total protein and albumin.

Another important metabolic indicator with high metabolic activity is creatinine. Quails of the 1st group are distinguished by the highest concentration of creatinine, which indicates a high heat exchange. In this group, an increase in creatinine by 10.00% is recorded at 39-42 days of age, followed by a decrease by 7.45% (p≤0.05). With the age of quails, an increase in serum creatinine is observed, so in group 2 its increase was noted on days 39-42 by 21.73%, in group 5 on days 39-42 and 76-78 by 5.30 and 5.95%, respectively (p≤0.05), in groups 3 and 4 there was only a tendency to increase the indicator (0.30-2.57%).

Bilirubin is a blood pigment, one of the main components of bile in the body. It reflects the activity of the liver enzyme system. The concentration of bilirubin in the blood serum of quails did not exceed the physiological level, nevertheless, its higher content was recorded in birds of the 1st group at 13-15, 39-42 and 76-78 days of age by 31.25-71.88%, 26.47-69.49% and 28.19-72.97%, respectively, compared with analogs from the experimental groups (p≤0.01). The minimum content of this metabolite was found in quails of groups 3 and 4 at the age of 76-78 days.

Table 2. The content of end metabolites in the blood serum of quails participating in the experiment, n = 10, M ± m.

| Group       | Uric acid mcmol/l | Creatinine mcmol/l | Urea mcmol/l | Total bilirubin mcmol/l |
|-------------|------------------|-------------------|--------------|-------------------------|
| a) age 13-15 days |                  |                   |              |                         |
| 1 control   | 179.00±21.90     | 10.00±0.68        | 1.94±0.08    | 3.20±0.22               |
| 2 experimental | 181.00±17.30     | 8.10±0.14         | 1.77±0.04    | 2.20±0.06               |
| 3 experimental | 287.00±23.20     | 9.70±0.16         | 1.52±0.04    | 0.95±0.02               |
| 4 experimental | 222.00±16.70     | 9.60±0.11         | 1.50±0.03    | 0.90±0.02               |
| 5 experimental | 232.00±12.40     | 8.30±0.08         | 1.27±0.02    | 1.50±0.04               |
| b) age 39-42 days |                  |                   |              |                         |
| 1 control   | 210.00±23.42     | 11.00±0.34        | 1.95±0.03    | 2.72±0.11               |
| 2 experimental | 183.00±13.05     | 9.86±0.27         | 1.68±0.04    | 2.00±0.15               |
| 3 experimental | 263.00±16.73     | 9.73±0.18         | 1.42±0.02    | 0.96±0.08               |
| 4 experimental | 202.00±14.85     | 9.67±0.12         | 1.45±0.02    | 0.83±0.04               |
| 5 experimental | 217.00±18.37     | 8.74±0.24         | 1.26±0.03    | 1.26±0.12               |
| c) age 76-78 days |                  |                   |              |                         |
| 1 control   | 235.85±26.45     | 10.18±0.65        | 1.98±0.04    | 2.59±0.13               |
| 2 experimental | 187.00±18.32     | 9.93±0.41         | 1.68±0.03    | 1.86±0.05               |
| 3 experimental | 240.00±21.50     | 9.98±0.32         | 1.42±0.03    | 0.92±0.03               |
| 4 experimental | 200.00±16.24     | 9.78±0.26         | 1.42±0.02    | 0.70±0.04               |
| 5 experimental | 215.00±18.33     | 9.26±0.37         | 1.26±0.01    | 1.06±0.06               |

Carbohydrate metabolism in quails can be assessed by the content of glucose in blood serum, since it is this glucose that is the main energy substrate. Birds are high in glucose, unlike other animal species.

In 13-15-day-old quails of 1 group, the concentration of glucose in the blood serum exceeded the same indicator in groups 2-5 by 5.94-35.38% (p≤0.05) (figure 2). In all groups of quails, on days 39-42, the glucose content decreased, and the most significant changes were noted in quails of groups 2 and 5 - the glucose level dropped by 31.40 and 34.30%, respectively (p≤0.01). In 76-78-day-old quails of the 1st group, the concentration of glucose in the blood serum was 12.15 mmol/l, which is 41.36%
less than the initial indicator \((p \leq 0.05)\). In quails of 2-5 groups, the indicator was at around 7.36-9.58 mmol/l. The lowest glucose content was found in birds of the 4th group, its concentration decreased by 45.03\% relative to the initial indicator \((p \leq 0.01)\).

![Figure 2. The glucose content in quails’ blood serum participating in the experiment, mmol/l.](image)

It is known that in laying quails, characterized by an early onset of oviposition and high productivity, an intensive formation of reactive oxygen species occurs, leading to the accumulation of under-oxidized products in the muscles, disruption of the integrity of cell membranes, an increase in the level of cortisol and glucose in the blood serum, and metabolic disorders. The inclusion in the diet of dietary supplements, in particular carnitine-based, allows to level the symptoms of oxidative stress, prevent inflammatory reactions, apoptosis, improve myocardial function, eliminate mitochondrial membrane dysfunctions [23, 24, 25].

Taking into account the individual characteristics of postembryonic development and growth of quails, analyzing the data obtained, it can be noted that the composition based on carnitine had a positive effect on metabolic processes, in particular, it improved protein metabolism, reduced the amount of intermediate metabolites, including uric acid, reduced the concentration of glucose in the blood serum.

**5. Conclusion**

In our work, it has been experimentally proved that a complex feed carnitine-containing composition is a universal regulator of metabolic processes, has a hepatoprotective effect, has a beneficial effect on protein metabolism and improves the energy status of quails.

During the entire observation period, the studied indicators were within the reference values. Applying various schemes for introducing the carnitine-containing complex into the diet of quails, in our opinion, the most effective scheme introduced in group 4, where the dose of the drug was 0.25 ml/l, while the drug was drunk for 5 days, followed by a 5-day break starting from 2 days of age to 80 days of age. As a result, the protein coefficient was 0.91, the level of glucose 7.36 mmol/L, urea 1.42 mmol/L, uric acid 200.00 mmol/L, creatinine 9.78 mmol/L, total bilirubin 0.70 mmol/L.
Thus, the experience of nutriom formation and the practical use of specialized multifunctional supplements in the prevention of metabolic disorders allows us to recommend carnitine-containing compositions for growing quail.

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