Study of the effect of feed zeolites supplements of the Kholinsky deposit on hematological parameters of representatives of the Leporidae family

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Abstract. The article presents the results of an analysis of the influence of natural zeolite minerals of the Kholinsky deposit on hematological blood parameters of rabbits. Activation of erythropoiesis and an increase in the amount of hemoglobin are associated with sufficient oxygen supply to the tissues and an increase in metabolic processes in the animal body. A decrease in white blood cell count is a result of an increase in immune status in rabbits.

1. Introduction

Minerals play an important role in animals and humans. They affect energy, nitrogen, carbohydrate and lipid metabolism; are the structural material of organs and tissues; are part of organic substances; support the protective functions of the body, participating in the processes of neutralization of toxic substances [1].

Zeolites are natural minerals that have adsorption activity and ion-exchange properties. The effect of zeolites on the metabolic processes and productivity of cattle was established [2], and their positive effect on the metabolic processes and productivity of piglets was noted [2, 3]. They contribute to an increase in body weight gain, increasing the average growth by 9-11% [2, 4, 5].

Zeolites to some extent stimulate erythropoiesis, affect the optimization of protein, carbohydrate, mineral, lipid and enzyme metabolism, have a positive effect on the growth energy and productivity of animals [2].

Experiments on therapeutic and preventive measures of yersiniosis infection in animals show that zeolites in combination with antibacterial drugs are quite effective [5].

Zeolites are able to absorb and remove toxins, radioactive substances and heavy metals from the body, reduce the concentration of triglycerides and cholesterol in the blood [6], have a detrimental effect on microorganisms, adhere to the surface of bacteria, and are also able to change the sensitivity of microorganisms to certain antibacterial drugs [7].

It is well known that biologically active substances (BAS) are necessary to maintain metabolic processes in the body of warm-blooded animals. However, biologically active substances are not synthesized in the body, and therefore must be supplied with food in sufficient quantities [5].

In solving the problems of normalizing mineral metabolism and increasing the resistance of animals, an important role is given to natural minerals - zeolites [3, 4].
Thus, the use of zeolites for therapeutic and prophylactic purposes determine the dynamic increase in the indicators of the general resistance of the animal organism [8].

The study of blood composition is an important part of scientific research, since it reflects physiological processes and is one of the sensitive indicators of changes in the body [9].

It is known that all cells and tissues are washed by blood, tissue fluid and lymph, forming in turn the internal environment of the body. The processes that occur in the body can be judged by the blood picture: to determine the physiological state of the animal, which occurs under the influence of conditions of feeding and feeding, as well as to obtain data on the general fitness of the body to environmental conditions [10, 11].

It is well known that blood performs vital functions, including trophic, protective, thermoregulatory, respiratory, etc. Blood consists of two parts: a liquid medium - plasma and formed elements (red blood cells, white blood cells and platelets). The number of blood cells can vary with various pathological conditions of the body [12].

The content of red blood cells in the first month of life is much lower than normal, however, by the 4th month it rises and returns to normal [2].

The main part of red blood cells is occupied by hemoglobin, which is a respiratory enzyme and, accordingly, carries out the respiratory function of the blood.

Thus, the blood composition is one of the important indicators of the physiological state of the animal organism, and the analysis of morphological and biochemical blood parameters is an important link in the study of blood composition.

In this regard, at the first stage of our experiments, we set a goal - to study the effect of feeding a mineral supplement based on zeolites of the Kholinsky deposit on the main biochemical and morphological blood parameters of warm-blooded animals using the example of a gray giant rabbit.

2. Materials and methods of research
For the experiments, two groups of gray giant rabbits were formed, 3 animals in each group (one control group and one experimental group). During the first 10 days, an equalization period was carried out. Animals were selected by the principle of analogues. The animals were 5 months old, with an average live weight of 2.93 ± 0.25 kg.

The feeding scheme for the animals was as follows: rabbits of the first (control) group received the main diet. The main diet included alfalfa hay, barley, wheat, corn, and sunflower cake.

Rabbits of the experimental group for a month in addition to the main diet were fed with a mineral supplement based on zeolites, at the rate of 3% per 1 kg of feed. The food was carefully altered before distribution to the animals.

In the experiment, zeolites of the Kholinsky deposit were used (scientific and production company "Nov"). Rabbits of the control group did not receive zeolites. The experimental scheme is shown in figure 1.

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![Experimental scheme](image)

Figure 1. Scheme of the experiments.

3. Research results
Rabbits of both groups were fed ad libitum. The research material was rabbit blood samples. An injection needle punctured the marginal ear vein of rabbits. Blood was collected in hematological tubes (figure 2). Then, the morphological and biochemical composition of the blood was studied according to generally accepted methods.

Figures 3 and 4 show data from a clinical analysis of rabbit blood.
The research results explain the positive effect of the zeolite mineral supplement on the morphological picture of the blood.

As it can be seen from the data presented in figure 3, the number of leukocytes in the blood of rabbits of the experimental group was within normal limits and was 49.2% higher than in rabbits of the control group.

Figure 2. Blood sampling from the marginal ear vein of rabbits.

White blood cells are directly involved in the body's immune responses. Their main function is to recognize foreign substances, phagocytosis and the recording of information about microorganisms. In adult rabbits, the norm of erythrocyte content is 4.7-7.5 million in 1 mm³, white blood cells - 5.5-10 thousand in 1 mm³, ESR 1.5 mm / h, and hematocrit - within 35-45% [14]. If we talk about the number of red blood cells in rabbits of the experimental group, then this indicator was 24.3% higher than in animals of the control group, but, nevertheless, remained within the physiological norm.

Figure 3. Results of laboratory analysis of hematological parameters (leukocytes, erythrocytes, ESR).
Some scientists attribute the increase in red blood cell count to a positive formation of the immune status [15].

The ability of red blood cells to settle to the bottom of the vessel and to remain in a non-coagulable state is called the erythrocyte sedimentation rate (ESR) - a non-specific indicator of the state of blood in animals and primarily depends on the content of globulins in the plasma (large molecular blood plasma proteins).

In the animals of the experimental group, the ESR value was 1.28±0.29 mm/h, which corresponded to the physiological norm, and in the rabbits of the control group, the ESR was 2.26 ± 0.23 mm/h, which is 13% more than the upper limits of the physiological norm.

As it is known, red blood cells perform the function of oxygen transfer from the lungs to organs and tissues. This is due to the iron-containing protein - hemoglobin, which is found in red blood cells. Hemoglobin performs an important function in the body - it carries oxygen to organs and tissues.

If we talk about the amount of hemoglobin in rabbits of the experimental group that received 3% zeolites, this indicator was 17.3% higher than in animals of the control group, but, nevertheless, remained within the physiological norm. In rabbits of the control group, the hemoglobin content was slightly underestimated and amounted to 76.1 ± 5.39 g/l (figure 4).

Hematocrit is the volume ratio of blood cells (red blood cells, white blood cells, platelets) and plasma. Red blood cells make up more than 98% of blood cells. The hematocrit value indicates how much of the total amount of blood the red blood cells occupy and determines the ability of the blood to transport oxygen molecules. Therefore, a decrease in hematocrit may indicate anemia. In rabbits of the experimental group, the hematocrit value was higher than in the control by 31.1% and corresponded to the norm.

![Figure 4. Results of laboratory analysis of hematological parameters (hemoglobin, hematocrit).](image)

Data on an increase in the content of red blood cells and hemoglobin indicate an improvement in the supply of oxygen to the rabbits and, consequently, an increase in metabolic processes in animals. Our results of clinical blood tests are consistent with the data of researchers [2, 5].

Blood biochemical parameters reflecting the quality of the body's metabolic processes are presented in table 1.
Table 1. The results of the laboratory analysis of some biochemical parameters of rabbit blood.

| Indicators               | Control group | Experimental group |
|-------------------------|---------------|--------------------|
|                         | before experiments | after experiments | before experiments | after experiments |
| Total protein, g%       | 6.0-8.0       | 5.26±0.15         | 5.8±0.17         | 5.39±0.23         | 6.95±0.35*       |
| Total calcium, mg%      | 8.5-10.50     | 8.91±0.56         | 9.70±0.68       | 8.68±0.32         | 10.45±0.19*      |
| Inorganic phosphorus, mg%| 2.5-3.5      | 2.53±0.21         | 2.58±0.12       | 2.52±0.11         | 2.75±0.48*       |

*P<0.05

Proteins are the main plastic material that provides the construction of cells and tissues of the body. Therefore, the concentration of total protein is an important indicator characterizing the effect of nutrition on the state of the body [12].

The data of a biochemical analysis of rabbit blood indicate a significant increase in the amount of total serum protein by 19% in the second experimental group compared to the control. It was also noted that the amount of total calcium in the blood serum of rabbits of the experimental group exceeded the control by 7.7%, and the content of inorganic phosphorus by 6.5%, respectively. It should be noted that all blood parameters were within the physiological norm, while the biochemical blood parameters of the rabbits of the control group remained practically unchanged.

4. Conclusions
The results of clinical blood tests of experimental rabbits show that the addition of a biologically active mineral supplement, in this case, natural zeolite, to the main diet of animals positively affects the physiological state of the rabbit's body, i.e., the clinical status and metabolic processes in the rabbit's body.

Hematological blood tests revealed an increase in hemoglobin, total protein, and calcium.

In rabbits of the experimental group, the activation of erythropoiesis and an increase in the amount of total protein were noted. An increase in the amount of calcium and phosphorus in the rabbit's body is an important indicator characterizing the effect of nutrition on the state of the body [12].

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