CHANGES IN COPPER METABOLISM UNDER THE INFLUENCE OF HELMINTHS

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Abstract: *The article provides information about the changes in copper metabolism that occur under the influence of helminths and their consequences.*

Keywords: *Microelements, vitamin, helminthiasis, cytochrome, oxidative stress, antioxidant system, hematopoiesis.*

Objective: *To study and analyze the changes in copper metabolism that occur in living organisms under the influence of various helminths and their consequences.*

Relevance of the Topic: Microelements, like vitamins, possess high biological activity and are capable of exerting a strong influence on the regulation of various physiological functions in the organism even in very small doses. The high activity of microelements is due to their close interaction with biologically important and active organic substances.

It is known that copper participates in oxidation and hematopoietic processes, and by converting iron into an organically bound form, it plays an active role in the formation of the primary respiratory pigment—hemoglobin—and increases oxygen consumption by tissues.

Materials and Methods of Research: The experiments were conducted on Karakul lambs of the "Qarnab" factory type. To study the changes in copper metabolism during the periods of helminthic invasion in cases of experimental marshallagiosis, nematodiosis, and habertiosis, 20 Karakul lambs aged 3-4 months were selected and divided into 4 groups.

All the lambs used in the experiment were separated and reared under conditions where they were not naturally infected with helminths, and were free from other infectious and non-infectious diseases, having passed a veterinary examination. Initially, the clinical, hematological, and biochemical parameters of all the control and experimental lambs were determined twice. Following this, the lambs selected for the experiment were infected by direct administration into the abdominal cavity of a pure culture of invasive strongylate (marshallagia) larvae using a rubber probe. A sample of 5,000 invasive larvae was used for each organism.

Before the invasive infection with parasites, blood was taken from the jugular vein of all experimental and control lambs, and the initial parameters were determined. Subsequent parameters were measured and analyzed on the 5th, 15th, 35th, 55th, and 70th days after the invasive infection. The concentration of copper ions in the blood was determined by ion-selective (Ostroushko A.A., Sennikov M.Yu.) and atomic absorption spectrometric (AAS) methods.

Before the experimental infection, the average copper content in the blood of the experimental and control lambs was within the normal range, at 1.07±0.06 mg/l. Starting from the 10th day after the invasive infection with marshallagiosis, the copper content in the blood began to decrease significantly, reaching 0.97±0.02 mg/l, and by the 15th day, it had dropped to 0.81±0.04 mg/l, which is a significant reduction from the initial level. In the following days of the disease, the concentration of copper in the blood continued to decrease sharply, and by the end of the observation period (on the 50th day of invasion), its content had halved from the initial and control levels, reaching 0.51±0.01 mg/l.

In experimental nematodiosis, the copper levels in the lambs' blood were almost identical to those in experimental marshallagiosis. That is, starting from the 10th day of invasion, the decrease in blood copper began, reaching 0.92±0.04 mg/l. This decrease became more pronounced from the 20th day and remained at a very low concentration until the 65th day of the invasion (Figure 1).

In habertiosis, the copper levels in the lambs' blood significantly decreased as early as the first days of the invasion, reaching 0.67±0.05 mg/l on the 10th day. However, unlike marshallagiosis and nematodiosis, the copper levels in the blood decreased gradually, without a sharp decline, and throughout the course of the disease, it differed significantly from the initial and control levels. Based on the above, we can conclude that the hematological and clinical changes caused by helminth infections are directly related to changes in blood copper concentration. Additionally, as the copper concentration in the blood decreases, the lambs exhibit shortness of breath, initially hyperemia followed by anemia, weakness, diarrhea, discoloration of the wool, and hematologically, a decrease in the number of erythrocytes and hemoglobin content.

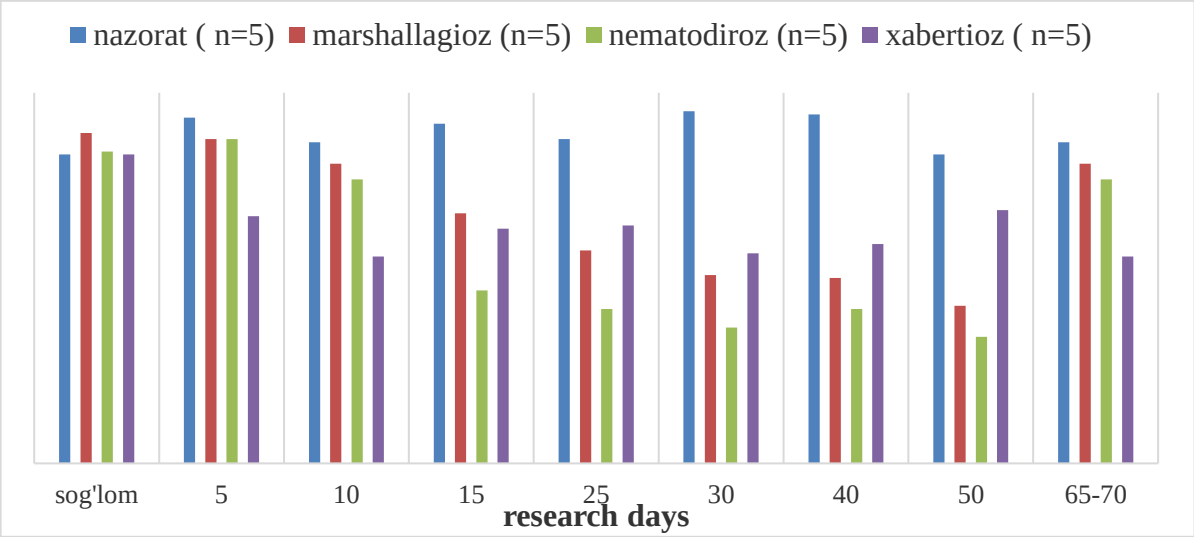

Figure 1. Copper levels in the blood of Karakul lambs (mg/l), M±m (n=5).

Some physiological and clinical signs that occur before death—such as disturbances in movement coordination, paresis, and paralysis of the limb muscles—are likely related to the decrease in copper levels in the blood. Helminths, during their feeding process in the host organism, also absorb copper. For instance, parasites in the

gastrointestinal tract directly absorb copper, which can lead to copper deficiency in the host organism.

Helminths affect the host's immune system, causing the production of various cytokines and other immunological factors that influence copper metabolism. Some cytokines can lead to the redistribution of copper and its accumulation in tissues.

Disruption of Antioxidant Defense and Oxidative Stress: Helminths induce oxidative stress in the host organism, which increases the demand for copper. Oxidative stress reduces the efficiency of antioxidant systems, thereby increasing the need for copper. Several enzymes in the body require stable copper function. Helminths may directly or indirectly affect the activity of these enzymes. For example, enzymes like cytochrome c oxidase play a crucial role in energy production, and infection with helminths can disrupt this process.

The consequences of copper deficiency due to helminth infection can vary. Copper plays an essential role in hemoglobin synthesis. Helminth infection can lead to copper deficiency, resulting in anemia (a condition of low hemoglobin). Copper is also vital for the immune system. Deficiency can weaken the immune system, reducing resistance to diseases. Copper is important for growth and development. A deficiency can disrupt normal growth and developmental processes in children and adolescents.

Conclusion : Helminth infections have a significant impact on copper metabolism in the body. These effects negatively influence various physiological processes, potentially leading to a decline in health. The theoretical and practical study of copper metabolism is crucial for the prevention and effective treatment of parasitic helminth infections.

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