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The influence of immunity on the regulation process of the homeostatic mechanism in animals

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Abstract: This study examines the role of the immune system in regulating the homeostatic mechanisms of animals, particularly in conditions of physiological stress such as pregnancy. The research highlights how deficiencies in essential microelements like zinc, copper, and cobalt can impair immune resistance and disrupt metabolic processes. It was observed that reduced immunity contributes to the weakening of non-specific resistance, especially in newborn calves, leading to primary immunosuppressive conditions. These changes affect the body's ability to maintain homeostasis, resulting in a decline in animal health and economic productivity. The findings emphasize the importance of monitoring immune and metabolic parameters to prevent immunodeficiency-related disorders in livestock.

Keywords: Animal immunity, homeostasis, metabolic disorders, immunosuppression, zinc deficiency, immune resistance, livestock health, physiological stress.

Introduction: It is well known that the growing global population is increasingly making the provision of nutritious food a global issue. To ensure the population is supplied with high-quality meat products, it is necessary to develop a herd of pedigree cattle. In determining the health and adaptability of pedigree cows, homeostatic indicators are considered essential. The immune system of an animal's body depends on the functional activity of growth and development, as well as the level of mineral and vitamin metabolism. Highly productive animals are significantly more demanding in terms of feeding and maintenance conditions compared to those with low or medium productivity.

The essence of the specific features of metabolism in animals lies in the fact that the processes of food intake and milk synthesis are not subordinated to neurohumoral and hormonal regulation [1; pp. 37–39].

Zinc (Zn) is one of the rare essential elements and, in terms of importance, competes with iodine, iron, and magnesium [8; pp. 6–15].

In immunological analyses, neglecting the assessment of zinc levels in the body of high-milk-producing cows leads to intensified metabolic processes and increases the demand for the quality of consumed feed, the organization of complete nutrition, proper storage, and early diagnosis and treatment of metabolic disorders [4; pp. 109–111].

In most cases, the increase in milk productivity in cows is directly related to metabolic disorders and the onset of diseases. This is because highly productive animals react much more quickly even to minor mistakes in feeding, compared to animals with low or medium productivity. These issues are especially observed during pregnancy and postpartum periods.

A lack of micro- and macroelements, inadequate feeding with nutritious food, and insufficient colostrum lead to a decrease in non-specific resistance not only in pedigree cows but also in their offspring. Under modern conditions of livestock intensification, the impact of numerous anthropogenic and stress factors, as well as the widespread use of antimicrobial and biological preparations, leads to a disruption of immune mechanisms.

Immunological monitoring conducted on pedigree cows and their calves allows for the identification of immune deficiencies in newborn calves caused by untimely and insufficient colostrum intake. Calves suffering from gastrointestinal diseases are characterized by decreased levels of total protein and immunoglobulins in their immune status.

The homeostatic mechanism plays an important role in adapting the animal's body to environmental and metabolic changes and regulates immune responses in the animal's body.

METHODS

Currently, the dynamics of non-specific parameters and the decline in immune characteristics in cattle against the background of life-threatening deficiencies caused by a lack of microelements have not been sufficiently studied in pedigree cow systems. Therefore, as one of the most important indicators, we studied non-specific resistance parameters at the "Chortut" breeding cattle farm in the Pastdargom district of Samarkand region.

For the study, 10 head of Holstein breed pedigree cows from German selection were selected and divided into control and experimental groups based on analog principles.

The following were determined in the blood (according to V.I. Georgievsky):

- Hemoglobin – using a Sahli hemometer;
- Erythrocytes and leukocytes – using a Goryaev counting chamber;
- Types of leukocytes – by counting the types of leukocytes in a blood smear using the Goryaev chamber.

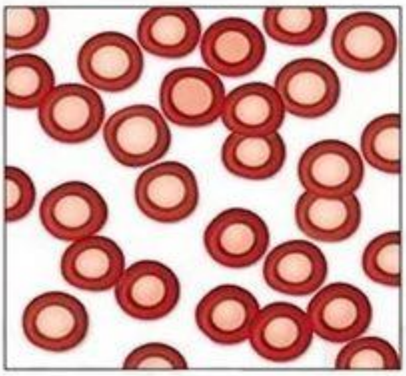
Blood was collected from the jugular vein of 10 cows from each group in the morning before feeding. Morphological examinations were conducted in the veterinary room of the farm, while biochemical analyses were carried out at the immunology laboratory of the Veterinary Scientific and Educational Center of Samarkand region.

RESULT

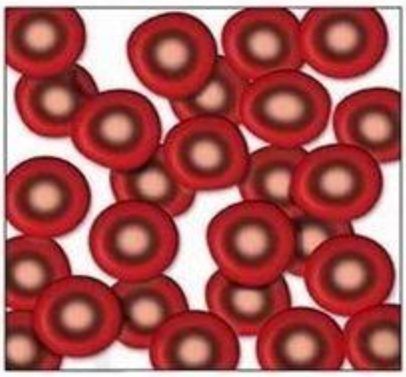
Hematological studies revealed mild leukocytosis in the cows. In the experimental group, leukocyte levels were within 10.16±1.48 x10^9/L (Table 1). The number of erythrocytes was 6.20±0.15 x10^{12}/L, and the hemoglobin level was 90±4.76 g/L, indicating the development of hypochromic anemia.

Figure 1.

In hypochromic anemia, red blood cells with low hemoglobin content appear colorless.



Colorless erythrocytes with low hemoglobin content in hypochromic anemia.



Normal, healthy erythrocytes.

Below is the identified dynamics of morphological blood parameters of cattle in the "cow-calf" system at the "Chortut" cattle breeding farm.

Table 1

Blood test results of pregnant cows and their newborn calves

	Morphological blood indicators:	Pregnant cows	Calves
1.	Erythrocytes, $x10^{12}/L$	6,20±0,15	6,28±0,79*
2	Hemoglobin, g/L	90±4,76	95,09±5,0
3.	Leukocytes, $x10^9/L$	10,16±1,48	8,34±0,9**
4.	Hematocrit, %	30,5±0,89	27,5±2,5**
5.	**Leukocyte formula, %**		
6.	Basophils	0,55±0,10	0,2±0,1*
7.	Eosinophils	8,92±0,95	1,3±0,56*
8.	Young neutrophils	1,22±0,18	10,0±0,18**
9.	Band neutrophils	4,89±0,60	19,2±0,31**
10.	Segmented neutrophils	22,39±1,21	51,2±1,52**
11.	Lymphocytes	57,81±2,27	17,0±1,36**
12.	Monocytes	4,17±0,78	1,0±0,83**

Note: * - P<0.05; ** - P<0.01

When analyzing the morphological blood parameters and leukocyte formula of the calves, they were characterized by a neutrophil profile, which is a physiological feature of the animals on the farm (Table 1). The hemoglobin level was 95.09±5.0 g/L and erythrocytes – $6.28±0.79x10^{12}/L$, which indicates the development of hypochromic anemia.

Table 2

Immunoglobulin levels in the blood serum of cows in the 8th month of pregnancy and their calves

	Immunoglobulin indicators:	Pregnant cows	Calves
1.	Immunoglobulin A, mg/ml	1,1 ± 0,2	1,63±0,18
2	Immunoglobulin G, mg/ml	12,15 ± 0,2	16,75±1,2
3.	Immunoglobulin M, mg/ml	0,98 ±0,1	1,21±0,05

In the experimental cows, a low level of immune resistance was observed.

CONCLUSION

In livestock, deficiency of cobalt, copper, and nutritionally derived zinc is most common and leads to intensive metabolic activity (during pregnancy). Humoral regulation acts as a factor that decreases the level of immunity. A reduction in the parameters of non-specific resistance of the organism contributes to the development of primary immunosuppressive conditions in the offspring. This process, in turn, represents an etiopathogenetic aspect of the development of secondary immune deficiency and leads to disruption of homeostasis. As a result, a decline in the health and economic value of livestock is observed.

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