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Biological Sensitization of Blood Immune Cells of Rabbits to External Environmental Stress Factors (Temperature And Seasons)

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ABSTRACT:
In this article, the condition and activity of the special immune system index in the blood of Chinchilla and New Zealand rabbits in the extreme climatic conditions of Uzbekistan during the seasons due to temperature fluctuations and nutritional stress are studied. As a result of the study, information on the active physiological state of leukocytes, T-, V-lymphocytes and their subpopulations, helper suppressors and leukocyte-T-lymphocyte ratio in blood is presented.

Keywords: Rabbits, Blood, Ecology, Temperature, Atmosphere, Body Adaptation, Leukocytes, T-, B-Lymphocytes, Immunity, Helpers, Suppressors

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INTRODUCTION

Today, the demand of the world population for high quality and ecologically clean food is increasing. The large-scale use of available meat stocks (cattle, sheep, goats, etc.) as food in the production of meat and meat products leads to a sharp decline in the number of animals. Poultry farming, fisheries and rabbit farming are the main sources of stable supply of high quality meat and meat products to the population. Therefore, one of the most urgent problems of today is to find a positive solution to the problem of meat shortage by identifying the favorable conditions for the care and feeding of rabbits in extreme conditions, developing practical recommendations to increase their productivity and introducing them into production.

Rabbit farming is one of the most economically favourable and profitable sectors of the livestock industry. Factors such as cold, high temperatures, hunger, lack of oxygen in the development of rabbit breeding cause them stress. When rabbits were exposed to high temperatures and bacterial endotoxin, it was found that detoxification of liver function was reduced in heat compared to exposure to endotoxin. The rabbit is one of the most common laboratory animal species used in a number of experimental studies in general biology, medicine, and veterinary medicine. Therefore, we believe it is important to study the effects of temperature on immune cells as a function of season.

The animal organism responds to stimuli (stressors) such as endocrine, nervous, immunological, hematological, and metabolic changes that serve to maintain viability, promote survival, and restore homeostasis (Knowles, Warriss, 2000; Muir, 2004; Ashok Agarwal, 2005). These stressors can increase the concentration of various physiological responses, particularly key mediators (stress-related hormones; glucocorticoids, catecholamines, and beta-endorphins) (von Borell, 2001; Terlouw et al., 2008), which in turn cause biochemical and hematological changes in the components (Nemec Svete et al., 2012). Long-distance transport (migration) of animals causes changes in the composition of blood, electrolytes, hormones, metabolites, and enzymes (Fazio, Ferlazzo, 2003; Minka, Ayo, 2009).

Heat (temperature) stress is one of the main problems commonly encountered in road transport of livestock (Zulkifli et al., 2010). In the scientific literature, differences in the transport processes of rabbits in summer and winter are noted (De la Fuente et al., 2004; Lambertini et al., 2006; Mazzone et al., 2010).

Rabbits were transported in hot, humid tropical conditions, resulting in lymphocytopenia. In addition, the number of white blood cells and red blood cells, hemoglobin concentration, and hematocrit have been significantly increased (Nakyinsige, 2013).

Transporting rabbits often results in dehydration due to factors such as dehydration, increased respiratory rate, and water loss through urine. Dehydration and hemoconcentration of rabbits after transport have been demonstrated by an increase in hemocrit and plasma protein concentration (Nakyinsige, 2013), which is in contrast to Mazzone et al.

Transporting rabbits under hot humid tropical conditions resulted in heat stress regardless of the duration of transport, as the rabbits exhibited hyperglycemia, hypercalcemia, lactic acidemia, lymphocytopenia, dehydration, and increased enzyme activity in the blood (Nakyinsigeb 2013).

Climate change is a long-term imbalance of typical weather conditions such as temperature, radiation, wind and precipitation characteristics of a certain region, perhaps one of the main problems of the current century for humanity (Ganaie et al., 2013).

The observation of climatic changes such as temperature, humidity and radiation is recognized as a potential risk in the development and production of all livestock species. High ambient temperature together with high air humidity causes discomfort and increases the stress level, which leads to depression of physiological and metabolic activity of animals (Ganaie et al., 2013).

In Africa, rabbits have been promoted as a tool for poverty alleviation, food security management, rural-urban migration reduction, entrepreneurial skills, humanitarian services including disaster relief, and gender empowerment (Mutwedu et al., 2020).

However, African rabbit husbandry suffers from a number of problems such as poor reproductive management, predation, uncontrolled breeding practices, inbreeding, adverse selection (Mapara et al., 2012; Mutwedu et al., 2020), and environmental stress (Kumar et al., 2011).

There are several types of stress that affect animals and include physical, nutritional, chemical, psychological and thermal factors (Ngoula et al., 2017).

It occurs when the environmental temperature exceeds the thermoneutrality zone of the animal, otherwise called the "thermal comfort zone", so its productivity decreases (Kumar et al., 2011; Bazarov, Rajamuradov, 2015).

The optimal ambient temperature for rabbits is between 16°C and 21°C (Marai et al., 2007; Khayitov D.G', 2022). Ambient temperatures above this range cause heat stress due to the presence of several sweat glands that help dissipate excess body heat. When exposed to thermal stress for extended periods of time, this leads to an increase in free radicals that cause oxidative stress (Kumar et al., 2011).

Female rabbits are very sensitive to heat stress, which is an important factor affecting their reproduction, fertility and physiological characteristics. Exposure of New Zealand rabbits to a temperature of 41°C led to a decrease in the number of red erythrocytes, hemoglobin and platelets, as well as a decrease in total protein, albumin (Khayitov, Rajamuradov, 2018).

As a homeothermic animal, rabbits can regulate their body heat input and output through physical, morphological, biochemical, and behavioral processes to maintain a normal body temperature (Marai et al., 2007). Unfortunately, the relationship between oxidative stress status, physiological parameters, and heat stress in female rabbits at different temperature ranges is rarely mentioned in the scientific literature. Changes in oxidative stress status and physiological processes in female rabbits exposed to different temperature ranges have been studied (Mutwedu et al., 2020).

MATERIALS AND METHODS

The experimental experiments of the research work were carried out in the scientific laboratory of Vivary (Biophysiological and Biochemical Research) of Samarkand State University named after Sharof Rashidov, at the farm "Tarnov vegetables".

Twenty 3-month-old male homologous chinchillas (control) and imported New Zealand rabbits (experimental) were selected for the experimental trials.

The study areas in 3 regions of the Middle Zarafshan District basin have a continental climate with intense solar radiation, diurnal and seasonal variations, a long hot and dry summer season (30-50^{o}C) and a slightly cold winter (-10-0^{o}C) is described. Atmospheric variability was calculated based on the amount of emissions from stationary and road sources in the designated areas. The dynamics of atmospheric air pollution was studied in cooperation with the Environmental Protection Committee of Samarkand region.

Laboratory animals were fed standard rations in vivarium and farm conditions.

A volume of 2 ml of blood was collected from the lateral ear vein of rabbits in test tubes treated with heparin. General blood analysis was performed using a Mindray BS -5000 automated hematological analyzer (reagent DIFF52-Lyse, LH52-Lyse), and the indicators of immunoglobulins IgA, IgM, and IgG were determined using a Maglum 600 (Snibe) immunochemical fluorescent analyzer.

The difference between the means obtained in the control and the experiments was calculated using Student's t-test, and the reliability of the difference of the values was expressed at the level of $p<0.05$. Statistical processing of the data was performed on the basis of modern programs (OriginPro 8.6, Excel, 2013).

RESULTS AND DISCUSSION

We know that the biological sensitization of immune cells in animals and all other living beings to stress factors from the external environment is of great importance. To assess the functional state of the special immune system of rabbits, indicators of blood content were studied, including: the percentage of lymphocytes, indicators of T and B - cells.

According to the studies conducted, the amount of leukocytes in the blood of chinchilla rabbits was 5.5% lower than in the blood of imported rabbits in the spring season, while it was increased by 22.5% and 7.3% respectively in the other two seasons. Although the amount of leukocytes in the blood of rabbits of the control group did not change significantly in all compared seasons, a tendency to decrease was observed in the animals of the experimental group.

It was found that there were differences in the total amount of lymphocytes, which were 8.16% higher during the year in the experimental animals in the spring season and 8.04% higher in the control rabbits in the summer season than in the experimental animals. A gradual increase in temperature in the spring and summer seasons resulted in an adaptation process between animals, so there was no clear difference between seasons and breeds. However, the change of seasons and the decrease of temperature caused changes in lymphocytes of rabbit breeds. Compared with the summer season, a sharp decrease in winter temperature of 2.9-fold was observed in chinchilla rabbits and 2.5-fold in New Zealand rabbits. The differences between breeds in winter season compared to control showed 0.83% hemolymphocytoma in experimental group (Table 1).

Table 1: Quantitative index of leukocyte types in the blood of rabbits (n=10), (M±m)

Indicators	Groups	Seasons		
		Spring	Summer	Winter
Leukocytes, thousand / mm^3	Control	7.3±0.15	7.1±0.14	6.9±0.13
	Experience	7.7±0.57*	5.47±0.33***	6.40±0.50*
Lymphocytes, %	Control	61.66±0.98	61.20±0.73	22.00±0.45
	Experience	53.50±1.56***	53.16±1.68***	21.17±0.48*
B-lymphocytes, %	Control	22.00±0.63	21.80±0.58	22.00±0.45
	Experience	21.50±0.56*	21.67±0.42*	21.33±0.33*

*Explanation: *-P>0.05; *** - P<0.01*

It should be noted that changes in the total amount of lymphocytes were not significantly observed in all seasons of the year in both compared control and experimental groups (changes were at the level of $0.08\text{-}0.10*10^3/\mu l$).

The variability of B lymphocytes as a function of seasons was not clearly evident. We saw that it was wavy in the control group, decreasing slightly by 0.20% in summer, whereas in the experimental group it increased partially in summer. When comparing the control and experimental groups, we found a superiority of the control group in all seasons.

It is known that the function of monocytes is phagocytosis, while that of lymphocytes is the formation of specific immunity. Therefore, the low number of leukocytes and lymphocytes indicates low natural resistance of New Zealand rabbits adapted to extreme conditions in Uzbekistan.

As a result of a sharp change in the ecological environment, there is information about changes in immunological parameters in the direction of immunosuppression. These changes are manifested by a decrease in the absolute and relative amounts of T and B lymphocytes and immunoglobulins IgA, IgM and IgG.

As a result of the tests, differences in the amount of T lymphocytes in the blood of rabbits of the control and experimental groups of cellular immunity were found. The amount of T lymphocytes in the blood of imported New Zealand rabbits was found to be low 0.64 - $0.75*10^9$ / l of Chinchilla rabbits. .

In addition, differences in subpopulations of T-lymphocytes in the blood of imported rabbits were also detected. According to seasons, the number of T-helper, T-suppressor and T-active lymphocytes was 0.35:0.40:0.46, 0.36:0.28:0.29 and $0.47:0.51:0.56*10^9$g / l, respectively, was observed to be lower than in the control group (Fig. 1).

The ratio of helper-suppressor lymphocyte subpopulations, reflecting the functional state of immunogenesis in the body, is important in evaluating the specific immune system (Table 2).

According to the statistical analysis carried out to determine the ratio of helper-suppressor subpopulations of lymphocytes in the blood of rabbits in the control group, it was found to be -1.5 times less in spring, -1.12 times in summer, and -1.17 times in winter than in the experimental group.

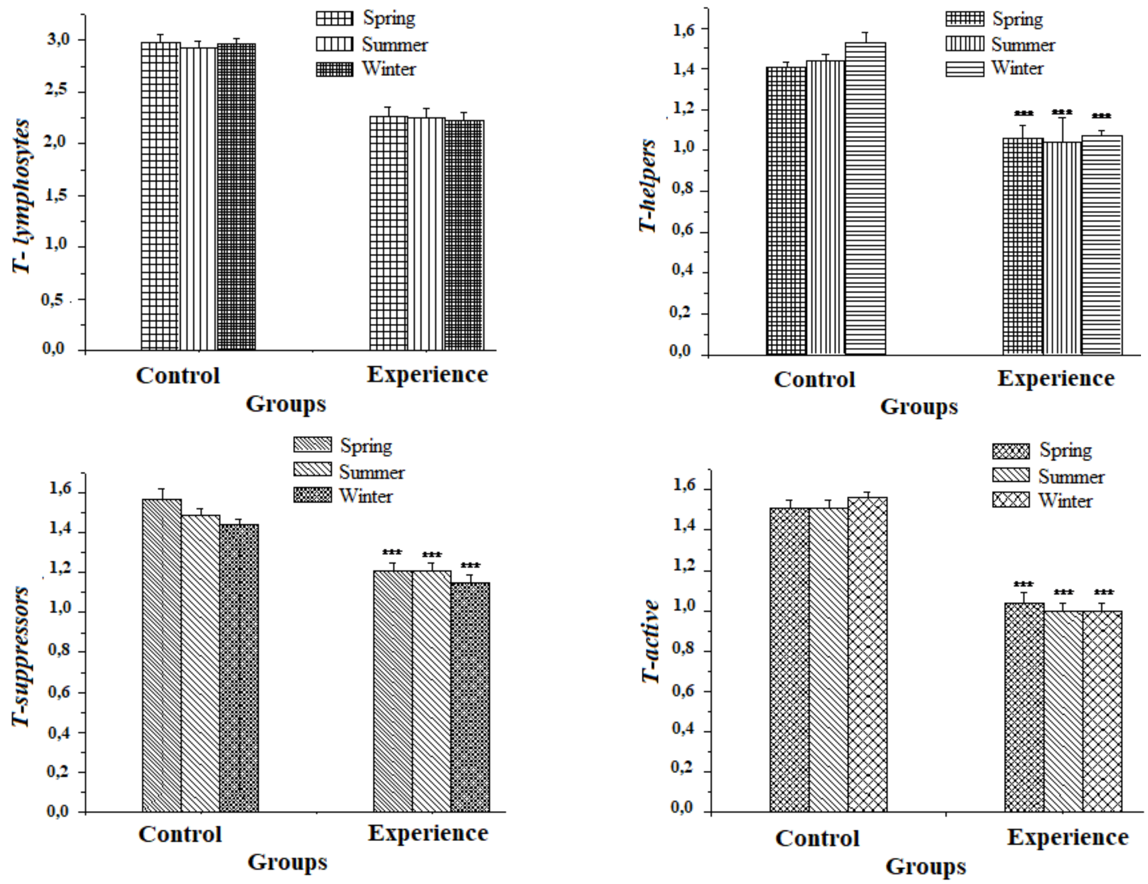

Figure 1: Seasonal variation of immune system cellular indicators in rabbit blood

The analysis of the leukocyte-T-lymphocyte index showed that the ratio of leukocytes to T-lymphocytes in the blood of rabbits of the experimental group was 1.2-1.3 times higher than that of rabbits of the control group.

According to the data obtained, the level of immune class IgM in New Zealand rabbits in spring was 0.36±0.03g/l, and we found a difference of 0.02g/l in the blood of chinchilla rabbits. An advantage over 0.01g/l was observed (Table 2).

Table 2: Seasonal variation of immune system cell indicators in rabbit blood (n=10), (M±m)

Indicators	Groups	Seasons		
		Spring	Summer	Winter
IgM g/l	Control	0.34±0.04	0.34±0.03	0.35±0.06
	Experience	0.36±0.03*	0.33±0.09*	0.34±0.01*
Th/Ts	Control	2.90±0.13	3.56±0.16	4.36±0.15
	Experience	4.46±0.18*	4.04±0.15*	5.18±0.15*
L/Tl	Control	2.82±0.22	2.70±0.17	2.56±0.12
	Experience	3.48±0.16*	3.28±0.13*	3.1±0.08 *

*Explanation *-P>0.05; *** - P<0.01;*

Analyzing the ratio of T-helpers (Th) and T-suppressors (Ts) in the blood of both breeds of rabbits, we can observe that the indicators in the blood increase with the decrease of temperature. Analyzing the ratio of Th/Ts by rabbit breeds, we can find that the experimental group shows quantitative superiority in the given seasons, which means that the adaptation process is observed in the New Zealand rabbit breed. Also, the total and T-lymphocyte variability ratios repeated the above data.

CONCLUSIONS

Thus, the amount of T and B lymphocytes and their subpopulations in the blood of rabbits imported from abroad is lower than that of the control group, indicating that the cellular and humoral immunity in their blood is not fully functional and the specific immune system is at a low level.

Normal feeding of chinchilla rabbits adapted to the local conditions of our country shows that the condition and activity of the specific immune system are at a high level. indicates the active physiological state of the ratio.

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