Change of hematological indices from acclimatization period of cattle of milk direction

V V Shishkin, I Yu Tatarenko, E A Shulzhenko and G Yu Shishkina

Far Eastern Research Institute of Mechanization and Electrification of Agriculture, Blagoveshchensk, Russia

E-mail: shishkin-vi@mail.ru, igor.t.2765@bk.ru, jenialight@mail.ru, oskilko-galina@mail.ru

Abstract. The article presents the results of a study of the leukocyte composition dependence of the blood of cows of red-motley breed on their ability to acclimatize. Getting into new climatic conditions, animals undergo profound physiological changes. Acclimatization is one of the stress factors for cows. Determination of the presence of stress in cattle can be determined by establishing the dependence of the leukocyte composition of the blood of cows on their ability to adapt. On this basis, it is possible to carry out productive work to reduce the impact of stress on the animal's body. In the process of research, hematological parameters were studied in dynamics in two groups of animals in the joint-stock company “Luch” in the Ivanovo district of the Amur region. The control group consisted of local cows of the red-motley breed, which are already adapted to the living conditions. An experimental group is a livestock imported from the Krasnoyarsk Territory. The change in blood leukogram indicators from the degree of acclimatization of cattle of the Red-motley breed was reliably established. The obtained research results confirm the possibility of analyzing the degree of adaptation of animals using a comparative analysis of leukograms of imported and local cattle. The results can be the basis for the development of methods for determining the degree of acclimatization and stress in animals. The technique is necessary for research aimed at developing ways and tools to reduce the effects of stress and combat its negative impact on the animal's body. Farm specialists, in the presence of a control group not subject to stress, carried out the study under production conditions.

1. Introduction

When cattle are imported from other areas, animals are transported from areas that differ in climatic conditions from their destination.

The acclimatization factor negatively affects the productivity of animals, their physiological state, and their reproductive properties.

Acclimatization is the adaptation of organisms to new conditions of existence after territorial, artificial, or natural movement with the formation of stable reproducing groups of organisms (populations) [1].

Cows are animals that have gone through a long and complicated process of domestication. With the acclimatization of farm animals, the leading role is played by human assistance. In addition to natural factors, the concept of the environment of domestic animals also includes economic factors. Such factors are the chemical composition of the feed, the level of feeding, maintenance, care, disease prevention, breeding, and more. If the old and new environmental conditions are very contrasting, the acclimatization process takes place with high stress and often fails. Particularly significant difficulties arise in the transportation of valuable factory breeds.
For successful acclimatization of farm animals, it is necessary to take into account the climatic conditions of the new habitat and provide imported animals with appropriate types of feed, nutritious diets, excellent facilities, and create improved conditions. If the imported breeds are poorly acclimatized, crossbreeding them with local breeds is used. At the same time, careful selection of animals is carried out according to health, constitution, and productivity. Manufacturers tested by the ability of offspring to acclimatize are used. For the degeneration preventing, acclimatized animals are crossed with already acclimatized animals of the same breeds, using various forms of selection, as well as using interbreeding. An essential method of overcoming the difficulties of acclimatization is hybridization. The offspring of introduced animals possess broader adaptive capabilities since the adaptation process begins with it at the early stages of development when the body is most plastic [10].

In economic practice, acclimatization is associated with the artificial resettlement of useful wild or farm animals. Experiments on the acclimatization of wild mammals in different countries were carried out on 160 species. In the acclimatization, there is a change in the way animals live and their morphophysiological characteristics. Such characteristics are the resistance of animals to changes in temperature, light regime, humidity, atmospheric pressure, the gas composition of the air, and feed intake increases. Adaptive reactions caused by relatively insignificant changes in living conditions increase the resistance of animals to sharp changes in the environment (for example, keeping some mammals at a temperature of 10 °C increases their resistance to temperatures below –15 °C). The success of acclimatization depends on the choice of objects and the time of its holding. In the new environment, individuals are selected that are most fully adapted to the unusual conditions of existence.

The phenology of animal reproduction and development comes into line with the new rhythm of seasonal and diurnal phenomena. Acclimatization can be considered complete when the species acquires the ability to maintain its abundance in new environmental conditions and restore it after periods of depression. Changes in morphophysiological features during acclimatization are especially pronounced in mammals. At the same time, the productive qualities of animals may change. The release of particularly valuable forms within the species range in order to improve the quality of local animals does not lead to the desired results since the aliens are changing towards the natives. Acclimatization plays a vital role in restoring the original range of animals, which decreased as a result of human activity (re-acclimatization) [2].

Taking into account the ability to acclimatize animals, one must not lose sight of it if it is necessary to relocate the animals to a new homeland for practical purposes. With this kind of relocation, the following points must be kept in mind: a) the slow and gradual movement of animals from one country to another ensures more certain success; b) younger animals more easily acclimatize than older ones; c) when moving animals from wetter climates to drier areas, it is advisable to stick to more watery feeds, and vice versa; d) to avoid generally very sharp differences in climatic conditions of existence during the resettlement of animals; e) keep in mind that animals more easily tolerate relocation when moving along the same isotherm, having a more exceptional ability to successfully move to the north than to the south of it; f) to select extreme and viable organisms for resettlement to a new homeland; g) to take special care in the matter of proper feeding, keeping and raising young animals undergoing the process of acclimatization [5].

Currently, there is no affordable and straightforward methodology for determining the degree of acclimatization of animals. In this regard, agricultural producers cannot carry out full-fledged work to eliminate or reduce the stress caused by this factor. In the case of excessively intense or inadequately prolonged exposure, the stress reaction can be a source of tissue and organ damage [6].

Physico-chemical properties of blood reflect the state of the whole organism as a whole, as they have a close relationship with its various functions. Activation of the adrenal cortex as a center of stress reactions is accompanied by numerous changes in the composition of the blood (leukocytes, eosinophils, lymphocytes, blood sugar, blood viscosity). Many researchers have adopted these changes as criteria for assessing the stress state of animals. Changes in the blood composition make it possible
to identify the stressful effect of various factors on their body and determine the intensity and duration of the stress state [8].

Uncontrolled acclimatization leads to non-receipt of livestock products, and as a result of a decrease in the economic efficiency of the entire industry. According to our hypothesis, the degree of acclimatization of imported animals can be estimated using dynamic changes in blood parameters (stress leukogram). Measurements can be made in the conditions of the livestock complex, at the lowest cost.

Leukocyte formula is an indicator that includes the definition of 5 main types of white blood cells (neutrophils, eosinophils, basophils, lymphocytes, monocytes). Types of white blood cells perform various functions in the body. It is possible to determine their percentage in the blood of the animal. An increase in the content of certain types of leukocytes is noted for various allergic diseases or as a reaction to parasitic invasion and stress.

When determining the blood formula, the ratio of different types of white blood cells and their morphology is evaluated. This study provides more accurate information about the patient's immune system than determining only the white blood cell count. In total, five main types of leukocytes are distinguished – neutrophils, eosinophils, basophils, lymphocytes, and monocytes. When calculating the blood formula, the percentage of leukocytes of each type is determined. The blood formula reflects the relative amount of each type of white blood cell in the blood. To determine the absolute number of leukocytes of each type, multiply their percentage by the total number of leukocytes [3].

An increase in the content of certain types of leukocytes is noted in various allergic diseases or as a reaction to parasitic invasion and stress [4].

A blood leukogram stress is characterized by neutrophilia (an increase in the absolute number of neutrophils), lymphocytopenia (a decrease in the absolute number of lymphocytes), eosinopenia (a decrease in the absolute number of eosinophils), and sometimes monocytosis (an increase in the absolute number of monocytes).

The term "stress" means the presence of increased cortisol. Cortisol is secreted by the adrenal glands a second time with systemic disease (e.g., diabetic ketoacidosis, renal failure), accompanied by high body temperature, pain, dehydration, or hyperadrenocorticism.

Neutrophilia is due to an increased release of mature neutrophils from the bone marrow storage pool into the circulating blood and a decrease in the movement of neutrophils from the circulating blood into the tissue. Lymphocytopenia is the result of lymphocyte retention in the lymphoid organs and lymphocyte lysis. Eosinopenia is due to a decrease in the eosinophils release from the bone marrow, and their lysis increases.

Lymphocytopenia is a hallmark of stress leukograms. While the degree of neutrophilia may decrease over time, lymphocytopenia and often eosinophilopenia will persist until the concentration of steroid hormones in the plasma is increased.

E.V. Panina and M.V. Sidorova found that large white pigs, duroc and landrace pigs reacted under stress factors with an increase in the content of lymphocytes and monocytes (leukemia and monocytosis), and a decrease in the number of neutrophils and eosinophils (eosin and neutropenia). Under the influence of many internal and external factors, the physiological status of the body often changes. Fluctuations of the physiological status reflect the composition of the blood, closely related to the intensity and direction of metabolic processes [7].

Based on the preceding and because no similar studies have been conducted on cattle to date, the study of stress factors against the background of acclimatization, methods for its diagnosis, and exceptions are relevant.

The subject of the study is to determine the changes patterns in blood leukocyte composition and milk productivity in cattle due to their degree of acclimatization.

The main objectives of the study are:

- Selection of animals in the experimental and control group by the method of pair-analogs;
- A monthly collection of blood samples and determination of its leukocyte composition;
- Systematization and mathematical processing of the data;
• Summarizing the results.

The research aimed to study the influence of the acclimatization factor on the leukocyte composition of blood in cattle in the milk production direction.

2. Methods and materials
Six blood samples were taken from red-motley cattle to determine the dependence of changes in hematological parameters on the period of adaptation of animals. The studies were carried out in the conditions of the joint-stock company "Luch" in the Ivanovo district of the Amur region, starting in November 2018 with an interval of one month. The experimental group – heifers imported from the Krasnoyarsk Territory at the end of 2018 (non-acclimatized). Five animals were selected in each group; the feeding and keeping conditions were identical; the animals were one year old, the animals were selected using the analog-steam method. Blood sampling was carried out according to the general procedure into vacuum tubes with anticoagulant dilution by specialists of the Far Eastern Research Institute of Mechanization and Electrification of Agriculture and Luch Joint-Stock Company. Blood sampling was carried out individually for each animal. Determination of hematological parameters was carried out at the Federal State Budget Scientific Institution "Far Eastern Zonal Scientific Research Veterinary Institute." Erythrocytes and leukocytes were counted in a Goryaev's chamber. Hemoglobin level was determined using a StatFax 1904 + R biochemical photometer, Vital reagent. Differential counting leukocytes were carried out visually in dry, fixed, stained blood smears (staining of blood smears using the Pappenheim method) carried out according to the methodology of R.Z. Siraziev "Statistical analysis of mathematical data in biology" [9].

3. Results
The average indicators for groups and months are shown in Table 1. The results are shown in Figure 1. As a result of the mathematical processing of the obtained data, their reliability was established. So from Table 1, it can be seen that in heifers imported from the Krasnoyarsk Territory the number of stab and segmented white blood cells is significantly higher in November, December, and February than in the local ones, by 34.6, 45.5, 25 % and 23.8, 22.1, 7.47 %, respectively. In January 2019, routine vaccination of the local livestock against rabies was carried out. Vaccination was reflected in the leukogram and caused a sharp jump in the growth of stab and segmented white blood cells. In this regard, data for this month are not taken into account. In March and April, leukogram indices of the heifers of local and imported livestock are equalized and have slight deviations. In this regard, data for this month are not taken into account. In March and April, leukogram indices of the heifers of local and imported livestock are equalized and have slight deviations. In this regard, it can be argued that the animals went through the process of adaptation (acclimatization) and no longer experience the associated stress factor. Therefore, the change in blood leukogram indicators from the degree of adaptation (acclimatization) of cattle of the Red-motley breed was reliably established. In addition, acclimatization is one of the stress factors. Therefore, this approach can be used for the determination of the stress presence state in cattle and to conduct sufficient work to reduce its effect on the animal's body.

4. Conclusion
In general, the obtained research results confirm the possibility of analyzing the degree of acclimatization of animals employing a comparative analysis of leukograms of imported and local cattle. The results of the study can be the basis for the development of methods for determining the degree of acclimatization and stress in animals. This methodology can be used in studies aimed at developing methods and tools to reduce the effects of stress on animals. The study contributes to the fight against the harmful effects of stress in the production environment, which is carried out by farm specialists in the presence of a control group not subject to stress.
Table 1. Changes in hematological parameters from the period of Adaptation (Acclimatization) of cattle of the dairy direction of productivity

| No. | Indicators                     | Leukogram, % Neutrophils | Lymphocytes | Monocytes |
|-----|--------------------------------|--------------------------|-------------|-----------|
|     |                                | nuclear wand             | segmented nuclear |          |
| 1   | Experienced group              | 2.75±0.34*               | 36.75±2.73*  | 57.25 2   |
|     | Control group                  | 1.8±0.85*                | 28±5.83*     | 62.6 2.4  |
|     | Difference of indicators       | 0.95                     | 8.75         | –5.35 –0.4|
| 2   | Experienced group              | 2.2±1.78**               | 27.2±3.38*   | 67.2 2.6  |
|     | Control group                  | 1.2±1.30**               | 21.2±5.63*   | 75.2 1.8  |
|     | Difference of indicators       | 1.0                      | 6            | –8 0.8   |
| 3   | Blood test results from 07.11.2018 |                      |             |           |
|     | Experienced group              | 2.2±0.83                 | 31.2±3.44**  | 61.8 4   |
|     | Control group                  | 2.4±1.14                 | 29.2±2.53**  | 60.8 7.2 |
|     | Difference of indicators       | –0.2                     | 2.0          | 1.0 –3.2 |
| 4   | Blood test results from 06.12.2018 |                      |             |           |
|     | Experienced group              | 1.6±1.34***              | 26.8±1.71*   | 68.8 0.6 |
|     | Control group                  | 1.2±0.24***              | 24.8±1.67*   | 72.6 0.2 |
|     | Difference of indicators       | 0.4                      | 2.0          | –3.8 0.4 |
| 5   | Blood test results from 01.01.2019 |                      |             |           |
|     | Experienced group              | 0.2±0.34**               | 20.4±1.16    | 72.6 1.8 |
|     | Control group                  | 0.6±0.50**               | 22±3.53      | 69.8 0.1 |
|     | Difference of indicators       | –0.4                     | –1.6         | 2.8 1.7  |
| 6   | Blood test results from 14.03.2019 |                      |             |           |
|     | Experienced group              | 0.4±0.24*                | 12.2±1.42*   | 84.2 1.4 |
|     | Control group                  | 1.5±1.28*                | 26±4.31*     | 67.25 3.5 |
|     | Difference of indicators       | –1.1                     | –13.8        | 16.95 –2.1|

P≥0.001 * P≥0.01 ** P≥0.05 ***

Figure 1. Comparative leukograms of imported and local cows

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