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RESEARCH ARTICLE *UDC636.5.033*

Dynamics of Hematological Indicators of Chickens under Stress-Inducing Influence

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Deviations from optimal environmental conditions, including external conditions of keeping and feeding birds, often lead to so-called technological stresses. The effect of stress affects the cellular composition of the blood. Assessment of baseline blood parameters of chickens before stress-induced exposure in groups I and II showed that they had different gas exchange rates, which reflected on the oxygen supply of the body. Before stress (background) in the blood of two-linear chickens (group I), the number of red blood cells was 3.25 ± 0.06 1012/ , white blood cells 23.10 ± 1.02 109/l, hemoglobin 67.61 ± 2.49 g/l, average erythrocyte hemoglobin content 19.56 ± 0.52 Pg. In group II, the number of red blood cells in the peripheral blood was 3.80 ± 0.06 1012/L, white blood cells 27.10 ± 0.93 109/L, hemoglobin 83.91 ± 1.86 g/L. The effect of the stress factor in the form of a vibrational effect initiated a decrease in the concentration of red blood cells in the bloodstream of chickens, regardless of a series of studies. The cell level in hybrid birds obtained at the poultry farm decreased by 12.36% ($p<0.01$) compared to the background, and by 15.38% imported from Germany. In the body of chickens obtained at the poultry farm, 1 hour after exposure to the stress factor erythropoiesis stimulation was observed, compensating for the loss of red blood cells and increasing the hemoglobin concentration to 101.45 ± 2.83 g/l, as well as the value of SIT. The red blood cells and erythropoiesis organs in the body of chickens obtained at the poultry farm (group II) had a high reactivity, which allowed the body to quickly compensate for the lack of oxygen and metabolic substrates.

Keywords: Chickens; Cross; Blood; Red blood cells; Stress factors

Introduction

To maintain an optimal level of human nutrition, it is necessary to use poultry meat, the qualitative characteristics of which are influenced by many factors of cultivation and production (Okuskhanova et al, 2019; Sharipova et al., 2017; Sydykova et al., 2019). Morphophysiological status, as a combination of morphological and hematological indicators, objectively reflects the physiological state of the body (Capitelli & Crosta, 2013; Gavrilin et al., 2020; Soleimani & Zulkifli, 2010; Sharipova et al., 2017). It changes under the influence of technological factors (Novikova & Lebedeva, 2018; Okuskhanova et al, 2017; Teke, 2019). The effect of stress affects the cellular composition of the blood, including the level of red blood cells (Nikonov et al., 2017). This is due to the fact that red blood cells not only determine the rheological properties of blood and perform respiratory function, but also transport amino acids, cholesterol, glucose, vitamins on their surface, and participate in the humoral regulation of adaptation processes in normal and pathological conditions (Chachaj et al., 2019; Piotrowska et al., 2011). These functions are realized due to the fact that on the erythrocyte membrane there are insulin receptors, growth hormone, acetylcholine, catecholamines, etc., which and determines their participation in the stress response and the formation of the adaptive potential of the animal organism (Gueguinou et al., 2014; Iakubchak et al., 2017; Rath et al., 2009; Rozenboim et al., 2007). Therefore, the characteristics of the respiratory function of blood in the body of chickens of different breeding during the development of a stress reaction were evaluated.

Materials and Methods

The object of the study was 40-day-old chickens (♀) of the cross-country Loman-white. The birds were selected in groups according to the principle of analogues, taking into account origin, live weight, gender and clinical status. Group I chickens of two linear crosses, imported to the poultry farm from Germany by the company LohmannTirtzucht (subjected to prolonged transport stress, including air travel, car transportation, followed by transplantation into the house). Group II - four-line chickens cross-country Loman-white, obtained in a poultry farm.

To determine the morphological parameters, blood smears were made immediately after taking the material, then stained according to the Romanovsky-Giemsa method using standardized methods. The mean erythrocyte hemoglobin content (MCH) was calculated.

Results and Discussion

It was established that before stress (background) in the blood of two-linear chickens (group I), the number of red blood cells was 3.25 ± 0.06 1012/l, white blood cells 23.10 ± 1.02 109/l, hemoglobin 67.61 ± 2.49 g/l, the average hemoglobin content in the red blood cell is 19.56 ± 0.52 Pg. An increase in the degree of hybridity of the bird was reflected in the intensity of the respiratory function of the blood. So, in four-linear chickens (group II), the number of red blood cells in the peripheral blood was 3.80 ± 0.06 1012/l, white blood cells 27.10 ± 0.93 109/l, hemoglobin 83.91 ± 1.86 g/l , which determined the value of SIT, which characterizes the intensity of hemoglobin synthesis and the size of red blood cells (Figure 1).

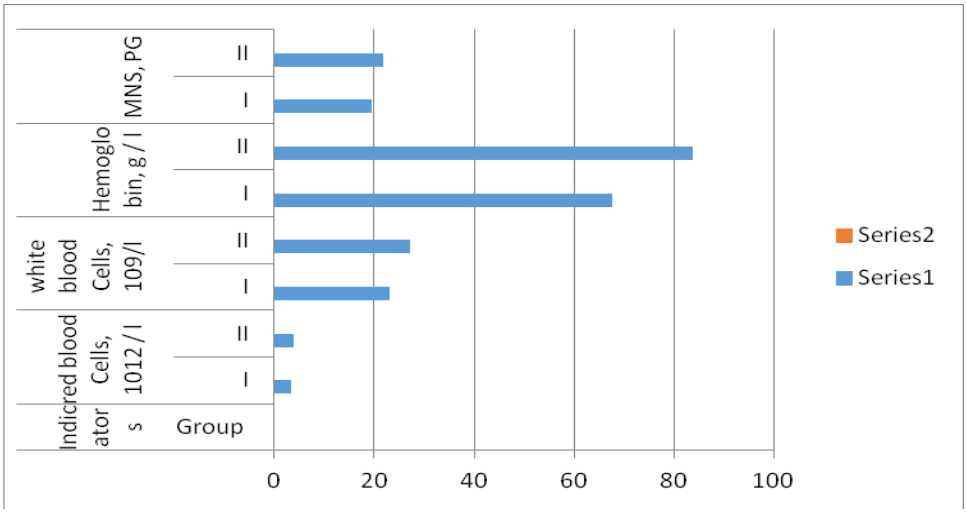

Figure 1. Background morphological indicators of blood.

Assessment of the background blood parameters of chickens in groups I and II testified that they had different gas exchange rates, which reflected on the oxygen supply of the body.

The effect of the stress factor in the form of vibration exposure initiated a decrease in the concentration of red blood cells in the bloodstream of chickens, regardless of a series of studies. The cell level in hybrid birds obtained at the poultry farm decreased by 12.36% ($p<0.01$) compared to the background, and by 15.38% imported from Germany.

The decrease in the number of red blood cells in the peripheral blood of chickens immediately after exposure to the stress factor was reflected in the hemoglobin level (Figure 2). In group I, in two-linear chickens, the amount of Hb decreased by 17.51% ($p<0.001$) compared to the initial value against the background of maintaining the average concentration of hemoglobin in the red blood cell and, as a consequence, its volume. In birds obtained at the poultry farm (group II), the concentration of respiratory pigment decreased by 15.52% ($p<0.001$) compared with the value "before stress", and the value of SIT also remained. Hence, the reaction of erythrocytes and erythropoiesis organs to the effect of a stressor was the same in two- and four-linear chickens: a 2-hour vibrational effect initiated erythrocyte hemolysis, but did not affect the proliferative activity of hematopoietic organs, which is consistent with the data of Rani, MP, Ahmad, NN, Prasad, Prasad, PE, Latha, C.S.

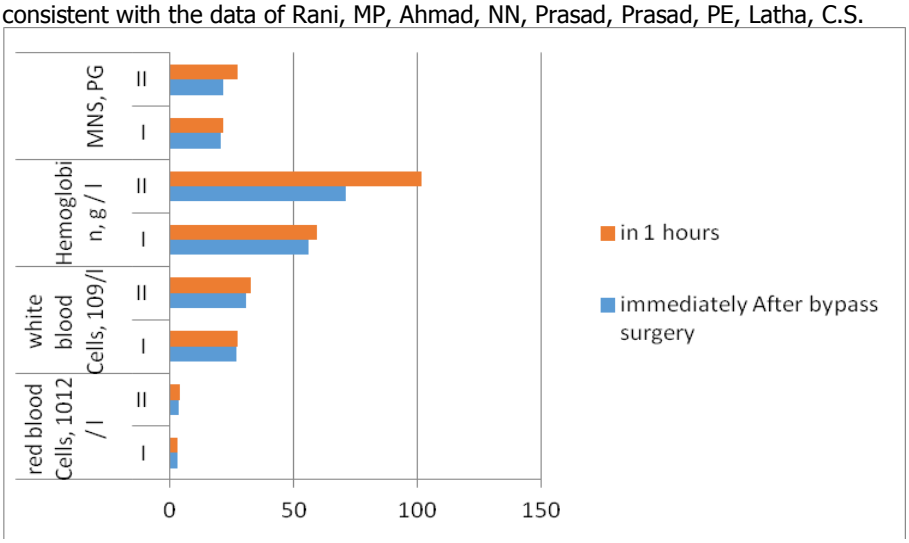

Figure 2. Morphological indicators of blood immediately and an hour after stress.

In the organism of chickens obtained at the poultry farm, stimulation of erythropoiesis was observed already 1 hour after exposure to the stress factor, compensating for the loss of red blood cells and increasing the concentration of hemoglobin to 101.45 ± 2.83 g / l, as well as the value of MCH. The level of values exceeded the background value, respectively, by 20.90 ($p<0.001$) and 25.13% ($p<0.01$). Consequently, red blood cells-macrocytes appeared in the bloodstream. Similar changes were observed 4 hours after exposure to the stress factor (Figure 3).

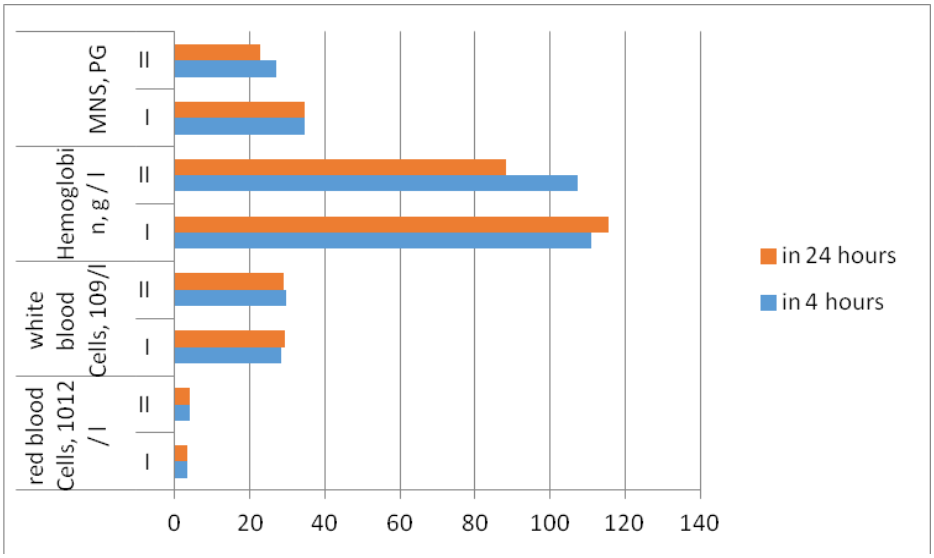

Figure 3. Morphological indicators of blood in 4 and 24 hours after stress.

In the blood of four-linear birds, 24 hours after juggling, the level of erythrocytes, hemoglobin, and MCH did not significantly differ from background values (Figure 3). In group I, in the body of chickens imported from Germany, 1 hour after exposure to the stress factor, signs of interstitial hemolysis of erythrocytes remained without stimulation of proliferative activity of the blood-forming organs, as immediately after vibration exposure. Only after 4 hours of the experiment was an intensification of blood formation processes observed due to which the level of red blood cells was restored in the bloodstream, and hemoglobin and MCH increased. A similar picture persisted 24 hours after exposure to the stress factor in the form of vibration exposure.

Discussion

The results of our studies showed that erythrocytes and erythropoiesis organs, as well as leukocytes and leukopoiesis organs in the body of two- and four-line chickens, were highly reactive. Moreover, oxygen deficiency was the result of hemolysis cells already during the exposure to the stress factor, which determined the subsequent activation of erythropoiesis and the mobilization of red cells into the bloodstream. However, red cells with a large volume (macrocytes) appeared in the blood, which allowed them to contain an increased amount of hemoglobin and provide the body with oxygen requirements. The results of our studies are consistent with the data of Rani, M.P., Ahmad, N.N., Prasad, P.E., Latha, C.S., according to which stimulation of erythropoiesis in the post-stress period is a mechanism to compensate erythrocyte loss with low membrane resistance. Similar data were obtained by Bueno, J.P.R., Nascimento, M.R.B.M., Martins, J.M.S. and others. In their work, the authors also noted an increase in the volume of red blood cells in the process of adaptation of animals to the effects of extreme and toxic stress factors.

Conclusion

Therefore, the impact of stress factors is associated with the urgent mobilization of all components of the red blood, which characterizes the tension of the adaptive reactions of the body and, as a result, its adaptive potential. Based on this situation, it can be argued that the red blood cells and erythropoiesis organs in the body of chickens obtained at the poultry farm (group II) had a high reactivity, which allowed the body to quickly compensate for the lack of oxygen and metabolic substrates, and thereby restore the state homeostasis. In chickens imported from Germany, the reactivity of the blood-forming organs was reduced. We believe that this was a consequence not so much of the linearity of the cross as the presence of transportation at the age of one day.

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