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FEATURES OF THE MORPHLOLOGIC COMPOSITION OF BLOOD OF TURKEYS

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ABSTRACT--*Blood morphology is most commonly used to assess the clinical status of birds. The purpose of the work is to study the morphological characteristics of the blood of turkeys of the Broad-Breasted White and Hybrid breeds of different crosses, and their dynamics depending on age. It has been established that morphological and biochemical blood parameters varying within the standard limits during growing in industrial conditions. At the same time the value of blood parameters depends on the age and genotype of the bird, determined both by the breed and the cross. Thus, the number of erythrocytes (by 17.88-20.47%), hemoglobin (by 18.32-40.52%) and ESR (by 26.76-50.25%) increases in the blood of turkeys during their growth, indicating the level of respiratory gas need in life processes and the kinetic stability of red cells. At the same time, the ratio between erythrocytes and hemoglobin, estimated by the size of MGC and color index, has the most optimal value in turkeys of the middle cross Hybrid Grade Maker (Group III) and heavy cross Hybrid Converter (Group IV), which determines the rate of metabolic processes in their organism, interacting with the level of oxygenation. The level of white blood cell count depends on age and cross. According to this indicator birds of medium (group I) and heavy cross of Broad-Breasted White are superior to individuals of medium cross of Hybrid Grade Maker (group III) and heavy cross of Hybrid Converter (group IV) by 3.04-14.47% depending on their age.*

Keywords-- *turkey, blood, erythrocytes, hemoglobin, leukocytes.*

I. INTRODUCTION

Enhancing the productivity of the poultry industry requires improving meat quality, which depends on many factors (Igenbayev et al., 2019; Okuskhanova et al., 2017; Sharipova et al., 2017; Sydykova et al., 2019). Physiological and biochemical status of birds is determined by a set of genetically determined and acquired properties, the ratio of which influences the processes of growth and development; formation of functional,

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metabolic activity of organ and tissue cells; productivity growth, including product quality (Kubinska et al., 2016; Velleman & Nestor, 2004). The nature and orientation of changes in these characteristics during the technological cycle of birds is the result of its adaptation to the technological environment (Chachaj et al., 2019; Dankevych et al., 2020; Derkho et al., 2019).

It is known that the speed of bird growth processes, which determine the quantity and quality of the products obtained, is the consequence of the combination of the properties and functions of the physiological systems, which determine the organism's health and metabolic activity (Ognik et al., 2016; Szarek et al., 2006). The most convenient, accessible, and informative system for characterizing these parameters is blood, through which all vital processes are integrated (Czech et al., 2014; Khabirov et al., 2020; Koncicki et al., 2000). The blood, formed as a special mechanism to combine various functional structures, directly participates in the body's reactions, affecting its resistance and reactivity (Khabirov et al., 2020; Shevchenko et al., 2017). Blood responds to different effects that the body is subjected to over its lifetime and is an important criterion for its condition (Jankowski et al., 2000; Ognik & Wertelecki, 2012). The body's ability to maintain homeostasis is an important characteristic of its ability to realize adaptive capacity in response to the threat of damage to internal resilience (Iakubchak et al., 2017; Szabó et al., 2005).

Blood morphology indicators are most commonly used to assess the clinical status of birds. These indicators are associated with the transport of respiratory gases and thus affect the efficiency of redox reactions in the body, as well as the level of its immunological reactivity (Chachaj et al., 2019).

The purpose of the research was to study the basic characteristics of changes in the blood morphological composition and their dynamics based on age of turkeys of various species of origin and crosses.

II. MATERIALS AND METHODS

For this purpose 4 groups of turkeys (30 head each) at the daily age were selected according to the analogue principle (Table 1).

Table 1: Experimental groups of turkeys

Group	Turkey breed	Slaughter age, days
I	Broad-Breasted White (middle cross)	120
II	Broad-Breasted White (heavy cross)	150
III	Hybrid Grade Maker (middle cross)	120
IV	Hybrid Converter (heavy cross)	150

Blood was tested at ages 30, 60, 90 and 120 days from 5 heads in each group. The erythrocytes sedimentation rate (ESR) was determined using the Westergren method; the number of erythrocytes, leukocytes and hemoglobin content were determined using the DIATRON Abacus automatic hematology analyzer using the approved technique of this device.

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III. RESULTS AND DISCUSSION

The main parameter of red blood is red blood cells, which are directly involved in the transport of oxygen and carbon dioxide, as well as nutrients and biologically active compounds. The number of erythrocytes in the blood of birds of experimental groups, regardless of the cross, increased with age (Table 2). In turkeys of the middle cross of Broad-Breasted White during the period of growing from 30 to 120 days the level of red cells increased from 2.49±0.01 x 1012/l to 2.96±0.14 x 1012/l or by 18.88%, the heavy cross of Broad-Breasted White by 17.88%, the middle cross of Hybrid Grade Maker by 20.27% and the heavy cross of Hybrid Converter by 20.47%. Therefore, the growth and development processes of birds were followed by the strengthening of aerobic processes in their bodies, which increased the proliferative activity of erythropoiesis organs and affected the number of red cells in the bloodstream. The age growth of erythrocytes in middle-class birds of Hybrid Grade Maker and heavy cross Hybrid Converter was more significant, indicating a higher demand for biological functions of cells in their organism.

Meanwhile, the genotype of birds also had an impact on erythrocyte variability in the bloodstream. Thus, at the age of 30 days, the maximum number of cells was found in middle (group I) and heavy (group II) turkeys of Broad-Breasted White, which were 2.49±0.01 and 2.46±0.10 1012/l. They exceeded the level of Group III and Group IV by 12.85-15.66 and 11.79-14.63% respectively. Similar tendency between groups of birds was found also in 60-, 90- and 120-day-old turkeys. It is reasonable to assume that the number of erythrocytes does not yet reflect the degree to which cells perform their biological properties.

To confirm this hypothesis, we determined the concentration of hemoglobin in the blood of turkeys in experimental groups. Hemoglobin in turkeys transports molecular oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs, providing a normal course of energy processes. It is also part of the hemoglobin blood buffer system, taking part in the regulation of acid-alkaline balance.

Table 2: Morphological composition of turkey blood (n=30), X±Sx

Indicator	Age, days	Group			
		I	II	III	IV
ESR, mm/h	30	1.99±0.21	2.12±0.22	2.13±0.25*	2.16±0.22*
	60	2.77±0.28	2.55±0.36	2.41±0.26*	2.70 ±0.34
	90	2.98±0.36	2.58±0.32	2.52±0.41	2.76±0.47
	120	2.99±0.43	3.00±0.41	2.70±0.37	2.79±0.45
Erythrocytes, 10^{12}/l	30	2.49±0.01	2.46±0.10	2.17±0.13*	2.10±0.22*
	60	2.62±0.09	2.63±0.15	2.38±0.13	2.27±0.17
	90	2.85±0.13	2.87±0.14	2.42±0.09	2.36±0.13
	120	2.96±0.14	2.90±0.16	2.61±0.11	2.53±0.16
Hemoglobin, g/l	30	88.11±1.10	85.14±2.20	72.70±3.20*	75.74±2.00*
	60	92.23±2.20	93.26±3.10	85.38±2.50*	82.35±2.40*
	90	99.51±2.30	97.93±2.80	90.13±4.80	96.44±3.20

	120	104.25±3.10	102.08±3.50	102.16±3.20	104.43±3.30
Leukocytes, 10^9/l	30	17.85±0.47	17.63±0.43	17.12±0.20	17.11±0.65
	60	19.36±0.38	18.94±0.48	18.74±0.45	18.13±0.44
	90	20.31±0.43	19.87±0.21	18.53±0.38*	18.25±0.51*
	120	20.14±0.56	20.13±0.18	17.98±0.53*	17.62±0.49*

Note: * - P≤0,05 compare with control. Normal range for turkeys: ESR – 2-4 mm/h; erythrocytes - 2,5-3,5·10^{12}/l; leukocytes – 20 - 40·10^9/l; hemoglobin – 70-110 г/л.

The concentration of hemoglobin in the blood of turkeys increased steadily as they grew and matured, reaching its maximum value at 120 days of age. At the same time, it was within the limits of the norm during the whole growth period. In birds of I experimental group the growth of respiratory protein level in blood was 18,32%, in turkeys of II, III and IV groups - 19,89; 40,52 and 37,88%. Therefore, in middle-cross Hybrid Grade Maker and heavy-cross Hybrid Converter birds, protein was in higher use in life processes than in middle and heavy-cross Broad-Breasted White. This contributed to a better oxygen supply of these crosses with appropriate functional activity of the bone marrow.

The age-specific variation of hemoglobin in turkeys blood in experimental groups was also reflected in the degree of discrepancies at a given age between the animals. Thus, the amount of hemoglobin was maximally high in the 30-day turkeys organism of the experimental group I and was 88.11±1.10 g / l. The birds of the Broad-Breasted White middle cross surpassed their analogs of groups II, III and IV by 3.49, 21.19 and 16.33 per cent (the difference is not significant).

The biological properties of erythrocytes in turkeys were not so much related to their number as to their saturation with hemoglobin. To test this supposition, we calculated the mean hemoglobin content in the erythrocyte (MGC) by the ratio of hemoglobin to erythrocyte quantity.

As can be seen from Figure 1, the value of MGC in the I and II experimental groups of birds did not depend on their age. In turkeys of the middle cross of the Broad-Breasted White (Group I) it varied in the range of 34.91-35.38 pg, and in the heavy cross of the Broad-Breasted White - from 34.12 to 35.46 pg, that is, despite the increase in the number of red blood cells and hemoglobin in the blood of birds, the red cells saturation with respiratory protein remained same. In turkeys of middle cross Hybrid Grade Maker (group III) and heavy cross Hybrid Converter (group IV) the MGC saturation increased gradually during the growing period from 33.50 to 39.14 pg and from 36.06 to 41.27 pg respectively.

Consequently, the rise in the amount of erythrocytes in the bloodstream was preceded by the rise in the content of hemoglobin in birds of these experimental groups. Thus, birds of these crosses were able to carry more respiratory gases, even though they had fewer red cells compared to turkeys of medium and heavy Broad-Breasted White crosses. This, therefore, was reflected on the functional and metabolic status of cells of organs and tissues, determining their organism's speed of growth and development, as well as obtaining high quality food products.

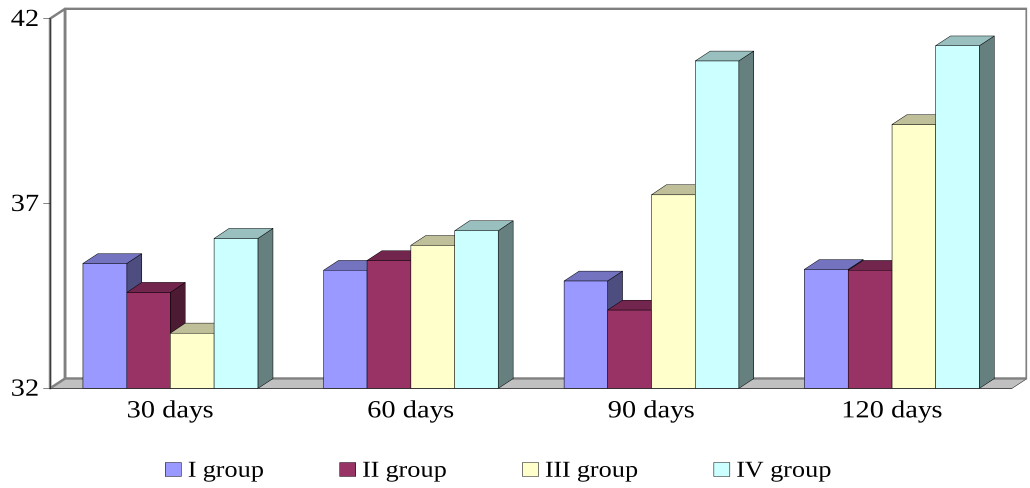

Figure 1: Dynamics of MGC value (pg) in birds of experimental groups.

The results of age-related variability of the mean hemoglobin content in erythrocyte (MSC) are consistent with the variability of the color index value, both in age-related dimensions and in experimental groups (Fig. 2).

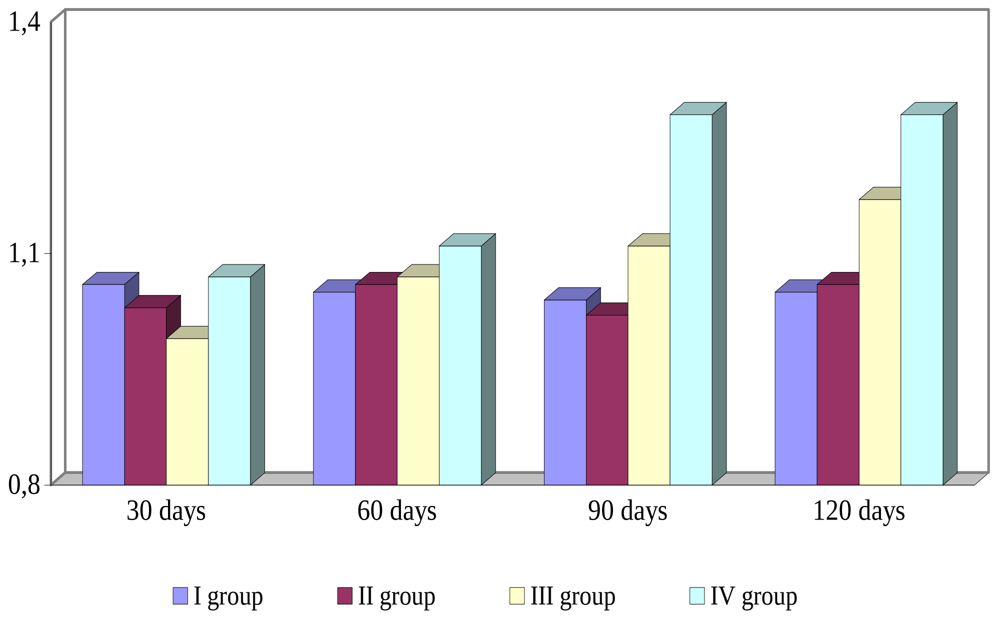

Figure 2: Dynamics of color indicator (unit) in birds of experimental groups

The saturation of erythrocytes with hemoglobin was reflected in the erythrocyte sedimentation rate (ESR), which characterizes the aggregate and sedimentary stability of cells in the bloodstream. Normally, in turkeys, ESR ranges between 2-4 mm/h and is due to their ability to adsorb various particles of low and high molecular weight substances on their surface, the amount of which determines the rate of their sedimentation.

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The value of ESR in turkeys during the growing period was within the standard limits, but systematically increased as their organism grew and developed. Age growth of SER in individuals of I, II, III and IV groups was 50,25; 41,51; 26,76 and 29,17% (Table 2). The smallest variability of the parameter was typical for birds of middle cross Hybrid Grade Maker (group III) and heavy cross Hybrid Converter (group IV). It means that in birds of these groups the erythrocyte size and volume were the most optimal in all periods of research, determining not only the speed of their circulation in the bloodstream, but also their gas transport capacity.

The variability in the size of the ESR is also influenced by the genotype of the turkey. At the age of 30 days, the minimum value of the ESR was typical for turkeys of experimental group I (1.99±0.21 mm/h). It differed from the value of birds of groups II, III and IV by 6.53-8.54% ($P<0.05$). However, starting from 60 days of age, the rate of erythrocyte sedimentation in birds of the control group exceeded the values of their counterparts from other groups by 2.59-18.25%. Consequently, in the organism of birds of the middle cross of the Broad-Breasted White the ratio between erythrocyte number and hemoglobin initiated the presence of cells in the bloodstream with such an aggregate and sedimentation resistance, at which they possessed lower biological efficiency, and this, in its turn, affected the speed of their growth and development.

IV. CONCLUSION

Thus, the value of basic (erythrocytes, hemoglobin, SCE) and additional (average content of hemoglobin in the erythrocyte, color) hematological indicators, while being within the limits of physiological norm, but differed depending on the breed and cross of turkeys, growing period (age). Morphological composition of blood of birds of experimental groups depends on their age and genotype, determining the exchange processes in their bodies during the growing period. This is directly influences the quality of the products. Thus, the studies indicated that there is a direct relationship between the number of form elements in the blood and the productivity of birds.

Evaluation of the physiological status of turkeys on the variation of morphological and biochemical parameters of the blood during growth in industrial conditions showed that they all differed within the standard limits. At the same time the value of blood parameters depends on the age and genotype of the bird, determined by both breed and cross. Thus, the number of erythrocytes (by 17.88-20.47%), hemoglobin (by 18.32-40.52%) and ESR (by 26.76-50.25%) increases in the blood of turkeys during their growth, reflecting the importance of respiratory gases in life processes and the kinetic stability of red cells.

The number of leukocytes in the blood of birds was steadily increased during the industrial growth of birds, however, it was uncertain (Table 2). The increase of cell level in turkeys of medium cross of Broad-Breasted White (group I) and heavy cross of Broad-Breasted White (group II) from 30 to 120 days was 12,83 and 14,18%. At the same time, the number of leukocytes in the Middle Cross Hybrid Grade Maker (Group III) and Heavy Cross Hybrid Converter (Group IV) was hardly age-independent and varied between 17.12-18.74 and 17.11-18.25 10^9/L.

Therefore, the age of the turkeys had an impact on leukocyte levels. At the same time, the ratio between erythrocytes and hemoglobin, estimated by the size of MGC and color indicator, is the most optimal value in turkeys of the middle cross Hybrid Grade Maker (Group III) and heavy cross Hybrid Converter (Group IV), which determines the rate of metabolic processes in their bodies, associated with the level of oxygenation. The number of leukocytes in the blood depends on the age and the cross. According to this indicator birds of medium (group I) and heavy cross of Broad-Breasted White are superior to individuals of medium cross of Hybrid Grade Maker (group III) and heavy cross of Hybrid Converter (group IV) by 3.04-14.47% depending on their age.

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