



**RESEARCH ARTICLE**

# Change Of Morphometric Indicators of Erythrocytes of Blood of Pigs in the Conditions of Balantidium Coli Invasion - Candida Spp

**VILKOVA E.A.<sup>1</sup>, ILYINA N.A.<sup>2</sup>, BUGERO N.V.<sup>3</sup>, ALEXANDROVA S.M.<sup>4</sup>**

<sup>1</sup>Candidate of Biological Sciences, Associate Professor, Associate Professor of the Department of Geography and Ecology, Ulyanovsk State Pedagogical University named after I.N. Ulyanov

<sup>2</sup>Doctor of Biological Sciences, Professor, Department of Zoology and Animal Ecology, Pskov State University

<sup>3</sup>Doctor of Biological Sciences, Professor of the Department of Fundamental Medicine and Biochemistry, Pskov State University

<sup>4</sup>PhD in Chemistry, Associate Professor of the Department of Chemistry, Pskov State University

## ABSTRACT

Blood cells quickly react to different physiological and pathological processes in the organisms of pigs. Functional condition of erythrocytes is the most successful biological model for studying the dynamics of changes happening in the organisms of pigs. There has been carried out the analysis of hematological condition which showed that during the experiment in the animals under the condition of diinvasion Balantidium coli-Candida spp. there was a cyclic change of morphometric indexes of erythrocytes of peripheral blood. In the first 20 days there was marked an increase in the number, size, volume of the erythrocytes and the hemoglobin inside of them, which is obviously connected with the compensatory reactions resulting in the intensification of hematopoiesis. On the 30th day and up to the end of the experiment there was marked a reduction of these parameters connected with the change of biochemical processes in the membranes of the erythrocytes and with the reduction of their resistance.

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## KEYWORDS:

morphometric parameters, erythrocyte, simplest Balantidium coli, funguses of the kinds Candida spp., hemoglobin.

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## INTRODUCTION

In modern conditions of intensive industrial development, the ecological situation is aggravated and the balance between the habitat and the body is disturbed, which significantly affects the state of health and the occurrence of various pathological processes in animals, in particular pigs.

Blood cells, are the most important components of the internal environment of the body, react to various physiological and pathological processes in the body, which makes it possible to use blood changes as a differential diagnostic test for a wide

variety of nosological forms [8].

It should be noted that an important function in the body of animals is performed by blood corpuscles, the bulk of which are erythrocytes [1,9]. So, according to Lesnikova L.N. (2006), the functional state of erythrocytes is the most successful biological model for studying the dynamics of many disorders occurring in the body of pigs. Therefore, the diagnostic importance of determining the quantitative and qualitative characteristics of erythrocytes in the blood in pathological processes is highly significant both in theoretical and practical aspects.

In this regard, the aim of the research is to study the morphometric parameters of pig erythrocytes in the case of *Balantidium coli*-*Candida* spp.

## MATERIAL AND RESEARCH METHODS

The object of the study was 196 large white breeding pigs of both sexes (boars and sows). Experimental animals were selected in compliance with the principle of analogs in terms of clinical and physiological state, breed, age, sex and body weight, constituting the groups of control (noninfected by protozoa *Balantidium coli* and fungi of the genus *Candida* spp.) and experimental (with dyneinvasion of *Balantidium coli* - *Candida* spp.) animals.

During the observation, pigs in the control and experimental groups from 240 to 300 days of age were kept on a basic diet balanced in terms of the main indicators in accordance with the norms of the Russian Academy of Agricultural Sciences [2].

The material for laboratory research was blood taken from the tail vein of pigs. To exclude the influence of circadian rhythms on the results of experiments in both experimental and control groups of animals, blood sampling was carried out at the same time of the day, in the morning hours before feeding them with the addition of heparin to the test tubes at the rate of 25 U per 1 ml of blood in a density gradient ficollverografin ( $\rho = 1.007$  g/ml) [3].

In the course of the work, a hematological research method was used.:

- the number and volume of erythrocytes in the peripheral blood were determined on a "PS-4" microparticle counter by "Medikor" [7].

- the size of erythrocytes was determined using an Epiics-C laser flow cytometer at an argon laser wavelength of 488 nm. The distribution of the size of erythrocytes is linear along the channels and, therefore, all measurements were carried out in a linear measurement mode [4].

- to determine the hemoglobin content in erythrocytes, a unified hemoglobincyanide method was used [6]. As a calibration solution of hemoglobincyanide, we used a solution from Reanal (Hungary) with a substance concentration of 59.75 mg/100 mg, which corresponds to a hemoglobin concentration in the blood of 15 g/100 ml, when diluted 25 times.

## RESEARCH RESULTS AND THEIR DISCUSSION

The study of the effect of protozoal-fungal associations on the number of erythrocytes in pigs' blood was carried out at different times from the beginning of observation of the animals at 260, 270, 280, 300 days of life. As follows from table 1, on day 260 from the beginning of the experiment, the number of erythrocytes increased in the animals of the experimental group to  $5.38 \pm 0.09 \cdot 10^9/l$  (in the control group it was  $4.25 \pm 0.22 \cdot 10^9/l$ ).

**Table 1:** Change in the number of erythrocytes in pigs. ( $\cdot 10^9/l$ )

Group of animals	Statistical indicators	Terms of research (days of animals' life)				
		250	260	270	280	300
control group	$M \pm m$	$4.25 \pm 0.22$	$4.25 \pm 0.20$	$4.11 \pm 0.16$	$4.13 \pm 0.06$	$4.13 \pm 0.07$
	n	10		10	10	10
experimental group	$M \pm m$	$4.17 \pm 0.25$	$5.38 \pm 0.09$	$4.23 \pm 0.08$	$3.27 \pm 0.12$	$2.27 \pm 0.11$
	n	10	10	10	10	10
	p	<0.001	<0.001	<0.001	<0.001	<0.001

On day 270, the number of erythrocytes in experimental animals decreased and amounted to  $4.11 \pm 0.16 \cdot 10^9/l$  and  $4.23 \pm 0.08 \cdot 10^9/l$ . The decrease in the number of erythrocytes in animals continued on day 280 -  $3.27 \pm 0.12 \cdot 10^9/l$  (in control animals -  $4.13 \pm 0.06 \cdot 10^9/l$ ). On the 300th day from the beginning of the study, the number of erythrocytes in the experimental animals was only  $2.27 \pm 0.11 \cdot 10^9/l$  (in the pigs of the control group it remained within the same limits).

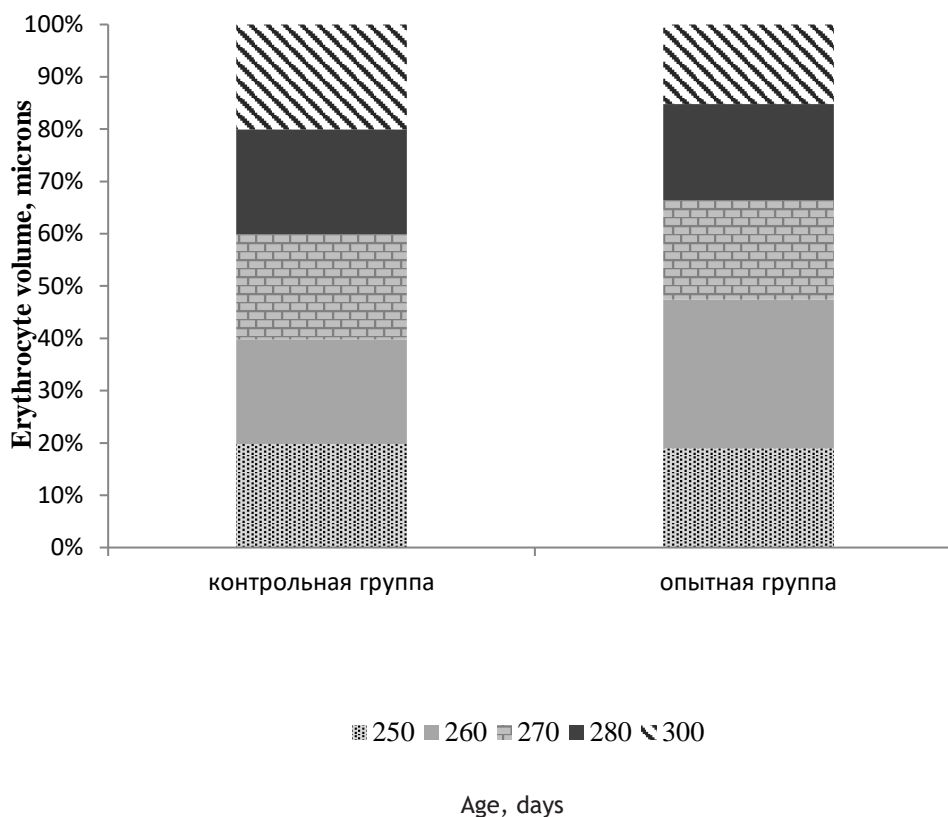
The data obtained indicate sharp changes and cyclicity of quantitative indicators of blood erythrocytes during prolonged vegetation of *Balantidium coli* - *Candida* spp. in the large intestine of pigs.

In the first twenty days from the beginning of the experiment, there seems to be a compensatory increase in the number of erythrocytes, followed by a subsequent decrease in them in

the experimental animals.

In parallel with the study of changes in the number of erythrocytes in pigs, the volume of erythrocytes, that is, their qualitative characteristics, was studied. It should be noted

that the change in the volume of erythrocytes was observed at the same time as the change in their number 10, 20, 30, 40 and 60 days after the start of observation of the animals (Fig. 1).



**Fig. 1:** Change in the volume of pig blood erythrocytes

On the 250th day of life of animals, the volume of erythrocytes in animals of both the experimental and control groups did not undergo changes and amounted to  $6.5 \pm 0.11 \mu\text{m}^3$  and  $6.7 \pm 0.17 \mu\text{m}^3$  respectively. On the 260th day of the animals' life, an increase in the volume of erythrocytes of the animals of the experimental group to  $9.7 \pm 0.08 \mu\text{m}^3$ , and on the 270th day of the animals' life - a decrease to  $6.8 \pm 0.13 \mu\text{m}^3$ . In the subsequent periods, a further decrease in the volume of erythrocytes was observed: by 280 days to  $6.3 \pm 0.11 \mu\text{m}^3$  and 300 to  $5.2 \pm 0.21 \mu\text{m}^3$ .

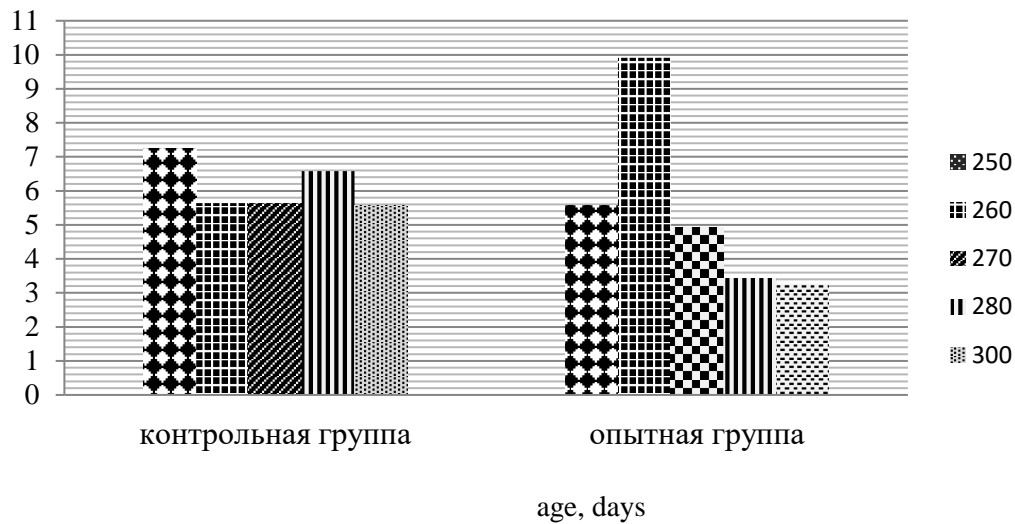
The decrease in the volume of erythrocytes in the animals of the experimental group, from the age of 270 to the end of the experiment, is apparently explained by a change in the biochemical processes in the membranes.

Changes in the size of erythrocytes with lesions of the intestines of animals *Balantidium coli* - *Candida* spp. occurred in pigs in the experimental and control groups after 10, 20, 30,

40 and 60 days from the beginning of the experiment.

From the data shown in Fig. 2 shows that in the animals of the experimental group there was a decrease in the size of erythrocytes on the 250th day of life of the animals ( $5.58 \pm 0.03 \mu\text{m}$ ) in comparison with the size of the erythrocytes of the control animals ( $7.25 \pm 0.04 \mu\text{m}$ ).

After 20 days from the beginning of the experiment, the size of the erythrocytes of the animals of the experimental group increased significantly and on the 260th day of life of the animals reached a maximum ( $9.91 \pm 0.07 \mu\text{m}$ ) compared to the size of the erythrocytes of the control animals ( $5.64 \pm 0.03 \mu\text{m}$ ). By the 30th day, the animals of the experimental group showed a sharp decrease in the size of erythrocytes to  $4.92 \pm 0.08 \mu\text{m}$ . On the 40th day, the size of the erythrocytes of the experimental animals was  $3.44 \pm 0.05 \mu\text{m}$ , on the 60th day it was  $3.25 \pm 0.02 \mu\text{m}$ .



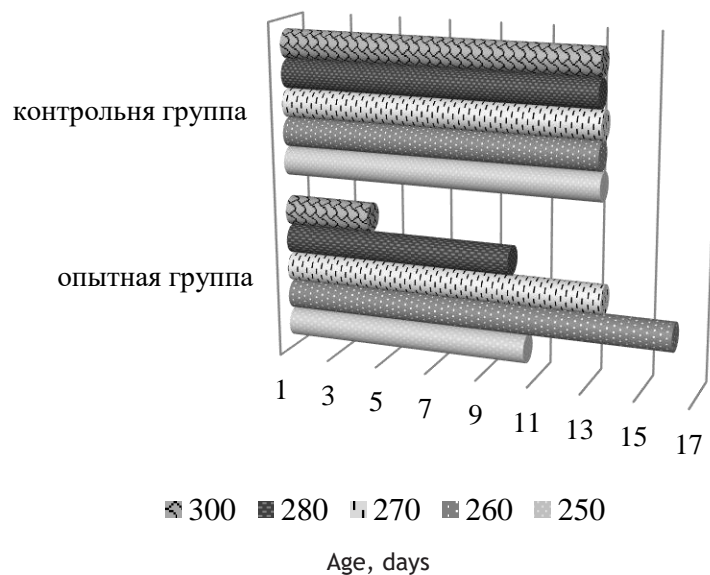
**Fig. 2:** Changing the size of pigs' blood erythrocytes

The sizes of erythrocytes of animals in the control group ranged from  $5.58 \pm 0.03$ - $7.25 \pm 0.04$   $\mu\text{m}$  throughout the experiment.

It is known that an increase in the size of red blood cells when exposed to pathogenic agents occurs as a result of changes in the membranes of red blood cells, which play an important role in the detoxification of toxins, since the membrane is a universal adsorbent. This, apparently, explains the sharp increase in the size of the erythrocytes of the animals of the experimental group on the 20th day. A further decrease in the size of erythrocytes is possibly associated with a change in metabolic processes occurring in them.

Long-term vegetation of the association *Balantidium coli* - *Candida* spp. in the pigs of the experimental group caused a change in the amount of hemoglobin in the erythrocytes of the blood of these animals.

Analysis of the results obtained (Fig. 3) indicates a statistically reliable decrease in hemoglobin on the 250th day of life of animals from the beginning of the experiment in experimental animals compared with control animals ( $10.56 \pm 0.03$  g/% and  $13.38 \pm 0.02$  g/% respectively). However, it should be noted that the amount of hemoglobin in the pigs of the experimental group increased sharply and reached its maximum on day 260 ( $16.11 \pm 0.52$  g/%), while the amount of hemoglobin in the control animals did not change ( $13.31 \pm 0.5$  g/%).



**Fig. 3:** Dynamics of changes in the amount of hemoglobin in pig blood erythrocytes

By 270, the amount of hemoglobin in the experimental animals corresponded to the amount of hemoglobin in the animals of the control group ( $13.49 \pm 0.32$  g/% and  $13.40 \pm 0.68$  g/%, respectively). On the 280th day of the animals' life, the hemoglobin content in the erythrocytes of the experimental

animals decreased to  $9.95 \pm 0.04$  g/% (in the control -  $13.27 \pm 0.120$  g/%). After 60 days from the beginning of the experiment, the amount of hemoglobin in the experimental animals decreased almost 2 times ( $4.37 \pm 0.02$  g/%) both in comparison with the beginning of the experiment and in

relation to the indicators of the control group  $13.32 \pm 0.25$  g/%).

## CONCLUSIONS

Thus, the analysis of the hematological picture showed that during the experiment in animals with di-invasion of *Balantidium coli* - *Candida* spp. there was a cyclical change in the morphometric parameters of peripheral blood erythrocytes.

It should be noted that for the first time 20 days there was an increase in the number, size, volume of erythrocytes and the content of hemoglobin in them, which, apparently, can be explained by compensatory reactions, manifested, in particular, in an increase in hematopoiesis.

The decrease in these parameters, which occurs after 30 days and continues until the end of the experiment, is associated with changes in biochemical processes in the membranes of erythrocytes, as well as a decrease in their resistance.

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