

PARASITOLOGICAL SCIENCES

MORPHOLOGICAL AND BIOCHEMICAL INDICATORS OF THE BLOOD OF TURKEYS WITH A MIXED COURSE OF HISTOMONOSIS AND TRICHOMONOSIS

Bogach M.,

doctor of veterinary sciences, professor

ORCID: <https://orcid.org/0000-0002-2763-3663>

Belyi O.

applicant of Ph.D

ORCID: <https://orcid.org/0009-0007-4936-7507>

Odessa Research Station of the National Research Center "Institute of Experimental and Clinical Veterinary Medicine", Ukraine

Abstract

The pathogenesis of histomonosis begins with parasite damage to the cecum, which leads to severe inflammation and necrosis. In chronic parasitic diseases, the hematopoietic, antioxidant and immune systems are primarily affected, as helminths and unicellular parasites cause significant changes not only in the structure of individual organs where they parasitize, but also change metabolic processes through their toxins. During the mixed course of histomonosis and trichomonosis, a decrease in hemoglobin by 13.3%, an increase in leukocytes by 26.0%, and eosinophilia were recorded. In the blood serum of infested turkeys, a decrease in the albumin content by 28.9% was recorded against the background of an increase in β - and γ -globulins by 19.0% and 6.7%, which affected the A/G ratio - 0.6 against 0.9. An increase in the activity of ALT enzymes by 12.7% and AST by 17.8% indicates the severity of the pathological process in the bird's body.

Keywords: turkeys, histomonosis, trichomonosis, morphology, biochemistry, blood.

The immune system of the bird protects the body from various infections. With helminthic and protozoan diseases, the state of the immune system changes and secondary immunodeficiency occurs. Proteins play an extremely important role in the body. They make up the structural and functional basis of all tissues and organs and perform catalytic, energetic, transport, protective and other important functions [1].

In organically raised turkeys, the prevalence of caecal parasites was 45.49% for *Trichomonas gallinarum*, 26.92% for *Eimeria meleagridis*, 23.08% for *Histomonas meleagridis* and 3.08% for *Heterakis gallinarum* [2].

The pathogenesis of histomonosis begins with parasite damage to the cecum, which leads to severe inflammation and necrosis. After the destruction of the intestinal tissue, the parasite enters the blood vessels and reaches the liver through the portal vein. As a result, areas of inflammation and destruction appear in the liver. At the final stage, the disease can become systemic, when the parasite spreads to different organs of the bird [3].

In chronic parasitic diseases, the hematopoietic, antioxidant and immune systems are primarily affected, as helminths and unicellular parasites cause significant changes not only in the structure of individual organs where they parasitize, but also change metabolic processes through their toxins [4].

Indicators for assessing the physiological state of the liver under various pathological conditions are the activity of the peramination enzymes ALT and AST in blood serum. These enzymes participate in the processes of phosphorylation - LDH, GHT and in the processes of oxidation - LF and CF. *Eimeria* and histomonads parasitize in the intestinal mucosa and secrete metabolic products that have a toxic effect on various

systems and tissues of turkeys. They suppress the hematopoietic function of the bone marrow, so the number of erythrocytes decreases and the level of hemoglobin decreases in sick birds [5].

During the spontaneous acute course of histomonosis in turkeys, morphological indicators of blood are characterized by hemoglobinemia, erythropenia with simultaneous leukocytosis, absolute and relative eosinophilia [6].

The age dynamics of erythrocytes in the blood of turkeys is characterized by a 1.3-fold decrease in the number from the third to the 14th day. In 150-day-old turkeys, the number of erythrocytes, compared to 120-day-old turkeys, decreases by 1.26 times. The age-related dynamics of hemoglobin and the total volume of erythrocytes in the blood of turkeys correspond to the general age-related dynamics [7].

The use of vitamin C, in order to correct the natural resistance of the body of turkeys, helped to increase the activity of alkaline phosphatase already on the third day of research [8].

Blood plays an important role in the vital activity of the body. In addition, blood is a means of assessing the clinical condition of turkeys. Under the conditions of experimental eimeriosis of turkeys, the direct and indirect effect of parasites on the body was noted, which was manifested by increased activity of aminotransferase enzymes, damage to microcirculation systems and disruption of metabolic processes [9].

Therefore, it remains relevant to study the influence of the mixed course of histomonosis and trichomonosis on the morphological and biochemical parameters of the blood of turkeys.

The goal of the work. To study changes in the morphological and biochemical parameters of the

blood of turkeys 60-80 days old spontaneously affected by histomonosis and trichomonosis.

Materials and methods. In the conditions of the laboratory of epizootology, parasitology, monitoring of animal diseases of the Odesa research station of the NSC "IEKVM", two groups of turkeys 60-80 days old, 10 heads each, were formed. In the experimental group, turkeys were spontaneously infested with *Histomonas meleagridis* and *Trichomonas gallinae*, in the control group they were not infested.

For the diagnosis of histomonosis and trichomonosis of turkeys, smears were prepared from fresh feces, fixed with ethyl alcohol for 5-10 minutes and stained according to the Romanovsky-Giemza method. In stained smears, the nucleus and flagella of histomonads acquired a red color, the cytoplasm - blue [11].

For morphological and biochemical studies, blood in the amount of 2-3 ml was collected in a 5 ml syringe from the *vena axillaris*. Morphological indicators of blood were determined by generally accepted methods (Kondrakhin I.P. et al., 1985). The number of erythrocytes and the hemoglobin content were determined on FEK-M according to the method of E.S. Gavrilets (1966), a number of leukocytes - using a counting chamber with a Goryaev grid (Chumachenko V.E.,

1991), a leukogram was obtained by counting individual leukocytes in fixed smears stained according to Romanovsky-Giemza, hemoglobin concentration - according to the method of Derviz G.V. and Vorobyova A.G. (1959).

The content of total protein was determined by the biuret reaction, and the fractional composition of proteins was determined by electrophoresis on polyacrylamide gel plates and a photometer on the ARF-1 phorogram decoding apparatus, the content of circulating immune complexes (according to the method of Yu.A. Grynevycha and A.N. Alfeyorova, 1981) and seromucoids (according to Weimer H.E., Moshin R.J., 1952). The activity of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) in blood serum was studied by the spectrophotometric method according to the method of Reitman and Frenkel in the modification of K.G. Kaletanaki [12].

Research results. According to the results of morphological studies in turkeys with a mixed course of histomonosis and trichomonosis, a probable ($p<0.001$) decrease in hemoglobin by 13.3% (100.0 ± 0.2 g/l) was established, compared to the indicators in clinically healthy birds (115.4 ± 0.3 g/l) (Table 1).

Table 1

Morphological parameters of the blood of turkeys 60-80 days old with a mixed course of histomonosis and trichomonosis (n=10, M \pm m)

Parameters	Experimental group	Control group	percentage relative to control
Hemoglobin (g/l)	100.0 \pm 0.2***	115.4 \pm 0.3	-13.3
Erythrocytes (T/l)	2.4 \pm 0.2**	3.1 \pm 0.1	-22.6
Leukocytes (G/l)	25.7 \pm 0.4***	20.4 \pm 0.1	+26.0
Leukogram (%)			
Basophils	—	—	—
Eosinophils	1.5 \pm 0.1*	1.1 \pm 0.1	+36.4
Young neutrophils	—	—	—
Rod-nuclear neutrophils	2.2 \pm 0.2*	1.9 \pm 0.1	+15.8
Segmented neutrophils	62.6 \pm 0.7*	61.1 \pm 1.9	+2.5
Lymphocyte	29.2 \pm 1.1*	31.7 \pm 2.9	-7.9
Monocyte	4.5 \pm 0.2*	4.2 \pm 0.2	+7.1

Note: * - $p<0.05$, ** - $p<0.01$, *** - $p<0.001$ – compared to control

In the experimental group of turkeys, a probable ($p<0.01$) decrease in the number of erythrocytes by 22.6% (2.4 ± 0.2 T/l) was recorded compared to the control (3.1 ± 0.1 T/l).

In the leukogram of turkeys, the number of leukocytes increased by 26% (25.7 ± 0.4 G/l) compared to the control group (20.4 ± 0.1 G/l). In infected turkeys, a significant ($p<0.05$) increase in eosinophils by 36.4% ($1.5\pm0.1\%$), compared to controls ($1.1\pm0.1\%$) and rod- and segmented-nuclear neutrophils by 15.8% and 2.5%, respectively.

During the mixed course of histomonosis and trichomonosis in the experimental group of turkeys, the number of lymphocytes decreased by 7.9% and

amounted to $29.2\pm1.1\%$ against $31.7\pm2.9\%$ in the clinically healthy group. The number of monocytes significantly ($p<0.05$) increased by 7.1% ($4.5\pm0.2\%$), compared to the turkeys of the control group ($4.2\pm0.2\%$).

Such changes in the morphological parameters of the blood of turkeys indicate an immunodeficient state in the body of a sick bird.

According to the results of biochemical indicators in the blood serum of infested turkeys, a probable decrease ($p<0.001$) in the content of total protein by 10.6% (52.4 ± 0.2 g/l) was recorded, compared to the control (58.6 ± 0.3 g/l) and albumin content by 28.9% (19.5 ± 1.2 g/l), compared to the control (27.4 ± 0.1 g/l) (Table 2).

Table 2

Biochemical and immunological indicators of blood serum of turkeys 60-80 days old with a mixed course of histomonos and trichomonos (n=10, M±m)

Parameters	Experimental group	Control group	percentage relative to control
Total protein (g/l)	52.4±0.2***	58.6 ±0.3	-10.6
Albumins (g/l)	19.5±1.2**	27.4±0,1	-28.9
Globulins (g/l)	32.9±0.5**	31.2±0.1	+5.1
α-globulins (g/l)	12.4±0,1*	12.9±0,9	-3.9
β-globulins (g/l)	9.4±0,6*	7.9±0,1	+19.0
γ-globulins (g/l)	11.1±0.1***	10.4±0.1	+6.7
Albumin-globulin ratio	0.6	0.9	-33.3
CIC (mg/cm ³)	0.3±0.1*	0.2±0.1	+50.0
Seromucoids (mg/cm ³)	0.2±0.1*	0.1±0.1	+100
ALT (U/I)	8.9±0.1*	7.9±0.4	+12.7
AST (U/I)	126.0±0.6***	107.0±0.2	+17.8
Total calcium (mg/%)	14.7±2.2*	22.5±2.2	-34.7
Inorganic phosphorus (mg/%)	6.5±1.8*	6.2±1.8	+4.8
Calcium / phosphorus	2.3	3.6	-36.1
Vitamin E (μg/cm ³)	3.3±0.2*	4.6±1.0	-28.3
Vitamin A (μg/cm ³)	1.1±0.1*	1.6±0.9	-31.3
Carotenoids (μg/cm ³)	0.5±0.1*	0.6±0.1	-16.7

Note: * - p<0.05, ** - p<0.01, *** - p<0.001 – compared to control

In the experimental group of turkeys, the content of β- and γ-globulins increased significantly (p<0.05) by 19.0% (9.4±0.6 g/l) and 6.7% (11.1±0, 1 g/l), compared to the control group (7.9±0.1 g/l and 10.4±0.1 g/l, respectively).

The albumin-globulin ratio in the control group of turkeys was 0.9, while in the experimental group of turkeys it was only 0.6, which is 34.1% less. A decrease in the coefficient indicates pathological changes in the body of a sick bird and a decrease in protein synthesis by the liver.

In the experimental group of turkeys, a probable (p<0.05) increase in the concentration of circulating immune complexes by 50% (0.3±0.1 mg/cm³) was recorded, compared to the control (0.2±0.1 mg/cm³) and seromucoids by 100% (0.2±0.1 mg/cm³) compared to the control (0.1±0.1 mg/cm³).

In turkeys, a significant (p<0.05) increase in the activity of AlAT enzymes by 12.7% (8.9±0.1 Units/l) was recorded, compared to the indicators of the control group (7.9±0.4 Units/l) and AsAT by 17.8% (126.0±0.6 U/l) compared to the control (107.0±0.2 U/l). Changes in the activity of enzymes are an indicator of the development of a pathological process in the body of turkeys.

The level of total calcium in the experimental group of turkeys significantly (p<0.05) decreased by 34.7% (14.7±2.2 mg/%) compared to the control (22.5±2.2 mg/%), while the level inorganic phosphorus in the experimental group significantly (p<0.05) increased by 4.8% (6.5±1.8 mg/%) compared to the control (6.2±1.8 mg/%). The ratio of calcium to phosphorus in infested turkeys was 36.1% lower than in clinically healthy ones. These changes indicate a violation

of mineral metabolism and possible structural and functional changes in the body of turkeys during the invasion.

The level of vitamin E in the experimental group decreased significantly (p<0.05) by 28.3% (3.3±0.2 μg/cm³), compared to 4.6±1 μg/cm³ in the control group. The level of vitamin A decreased by 31.3%, and the level of carotenoids by 16.7%.

Conclusions.

1. During the mixed course of histomonosis and trichomonosis in turkeys, a decrease in hemoglobin by 13.3%, an increase in leukocytes by 26.0%, and eosinophilia were recorded.

2. In the blood serum of infested turkeys, a decrease in albumin content by 28.9% was recorded against the background of an increase in β- and γ-globulins by 19.0% and 6.7%, which affected the A/G ratio - 0.6 against 0,9.

References

1. Khariv I., Gutiy B., Dadakova V. Effect of milk thistle fruits on the protein synthesizing function of the liver in turkeys. Materials of the scientific and practical online conference "Safety and quality of food products in the concept of "One Health". Lviv, June 1–2. 2023. 92-93. <https://doi.org/10.32718/konf.1-2.06.2023> [Published in Ukrainian]
2. Cuta L., Baums C.G., Cramer K., Harzer M., Hauptmann J., Heenemann K., Krautwald-Junghanns M.-E., Stegmaier I., Vahlenkamp T.W., Schmidt V. An Explorative Study of the Causal Pathogenesis of Green Liver Discoloration in Organically Reared Female Bronze Turkeys (*Meleagris gallopavo*) Considering the

Infectious Risk Factors. *Animals*. 2023. 13. 918. <https://doi.org/10.3390/ani13050918>

3. Grabensteiner E., Liebhart D., Weissenböck H., Hess M. Broad dissemination of *Histomonas meleagridis* determined by the detection of nucleic acid in different organs after experimental infection of turkeys and specified pathogen-free chickens using a mono-eukaryotic culture of the parasite. *Parasitology International*, 2006. 55. 317-322. <https://www.doi.org/10.1016/j.parint.2006.07.004>

4. Bogach M.V., Stoyanova V.Yu. The effect of acute and chronic davenosis on biochemical indicators of blood serum of chickens. *Veterinary biotechnology*. 2019. 35. 15-21. <http://vetbiotech.kiev.ua/volumes/JRN35/4.pdf> [Published in Ukrainian]

5. Khariv I.I. Indicators of proteinsynthesis function of the liver and activity of enzymes in the blood serum of turkeys with *Eimeria-histomonosis* infestation. *Scientific bulletin of SZ Gzhitsky Lviv National University of Veterinary Medicine and Biotechnology* 2011. 13. 2(48). 289-292. <https://cyberleninka.ru/article/n/pokazniki-biloksintezuvalnoyi-funktsiyi-pechinki-ta-aktivnist-fermentiv-u-sirovattsi-krovi-indikiv-za-eymeriozo-gistomonoznoyi/viewer> [Published in Ukrainian]

6. Yanak O.M., Bogach M.V. Morphological indicators of blood of turkeys during the acute course of histomonosis. *Agrarian Bulletin of the Black Sea Littoral*. 2017. 83. 286-288. <http://lib.osau.edu.ua/jspui/bitstream/123456789/1570/3/Янак.pdf> [Published in Ukrainian]

7. Kambur M.D., Livoshchenko E.M., Livoshchenko L.P. and others. Hematology of the blood

of turkeys in the age aspect. *Bulletin of SNAU. "Veterinary Medicine" series*. 2010. 3(26). 82-86. <https://repo.snau.edu.ua/xmlui/handle/123456789/228> [Published in Ukrainian]

8. Kambur M.D., Livoshchenko E.M., Livoshchenko L.P. Correction of alkaline phosphatase activity in turkeys with vitamin C. *Bulletin of SNAU. "Veterinary Medicine" series*. 2017. 1(40). 23-26. http://nbuv.gov.ua/UJRN/Vsna_vet_2017_1_6 [Published in Ukrainian]

9. Mazur I. Ya. Effect of Robenkox preparation on biochemical indicators of blood of turkeys with experimental eimeriosis. *Veterinary medicine*. 2017. 103. 392-396. <https://www.jvm.kharkov.ua/sbornik/103/ru-brika8.php> [Published in Ukrainian]

10. Anderson N.L., Grahn R.A., Van-Hoosier K., Bondurant R.H. Studies of trichomonal protozoa in free ranging songbirds: Prevalence of *Trichomonas gallinae* in house finches (*Carpodacus mexicanus*) and corvids and a novel trichomonad in mockingbirds (*Mimus polyglottos*). *Veterinary Parasitology*. 2009. 161(3-4). 178-186. <https://www.doi.org/10.1016/j.vetpar.2009.01.023>

11. Bogach M.V., Berezovsky A.V., Taranenko I.L. Invasive diseases of poultry. Kyiv: Vetinform. 2007. 224. [Published in Ukrainian]

12. Vlizlo V.V., Fedoruk R.S., Ratych I.B. et al. Laboratory research methods in biology, animal husbandry and veterinary medicine. Handbook: under the editorship. Vlizlo V.V. Lviv: Spolom. 2012. 764 <https://www.inenbiol.com/index.php/63-diyalnist-publikacii/knyhy/349-laboratorni-metody-doslidzen-u-biolohii-tvarynyystvi-ta-veterynarii-medycyni> [Published in Ukrainian]