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Morphological blood parameters of cyprinid fish in mixed infection with chilodonellosis and trichodinosis, and the effectiveness of anthelmintic drugs

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Abstract. This study analyzed the infestation of carp fish in artificial reservoirs with the ciliates Chilodonella cyprini and Trichodina pediculus, assessing the prevalence of infestations and clinical manifestations. The influence of environmental factors, stress, and weather conditions on the development of parasitic diseases in infected fish was examined. Changes in key hematological parameters were detected, including variations in the number of erythrocytes and metaneutrophils in peripheral blood. The quantitative ratio of eosinophils, pseudoeosinophils, basophils, pseudobasophils, monocytes, and lymphocytes was studied at varying degrees of invasion. It has been determined that parasites affect the gills, skin, fins, and other anatomical structures, causing significant morphofunctional disturbances. Fluctuations in red blood cell counts have been shown to depend on the age, sex, season, and physiological state of the fish, and to be exacerbated by infectious processes. A concept has been developed regarding the relationship between the intensity of infection and the degree of hematological changes in carp fish. The use of antiparasitic drugs is proposed, taking into account their neuroparalytic, metabolic, and microtubule-mediated mechanisms of action against pathogens. An experimental justification for assessing the therapeutic efficacy of drugs based on parasitological studies before and after treatment was developed. The importance of comprehensive hematological analysis in veterinary practice for the diagnosis and monitoring of parasitic diseases in fish was substantiated.

1 Introduction

Along with other branches of animal husbandry, the further development of fisheries and the increasing demand of our people for fish and fish products are increasing. Today, the demand of the world's population for agricultural products, including fish and dietary food products made from it, is increasing year by year. Meeting this demand, creating new jobs,

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and further increasing the volume of fish production are important tasks. "Parasitic diseases in fish cause serious harm to the development of the fisheries sector. In recent years, it has been noted that parasitic diseases of fish, especially ligulyosis and digrammosis, are becoming widespread in water bodies and reservoirs. Accordingly, it is of great scientific importance to study the effects of invasive diseases on the morpho-physiological characteristics of fish organisms in various water bodies. It is of great importance to identify changes in morphological and physiological indicators in the bodies of cyprinid fish infected with cestodes and develop measures to combat them.

In the world fishing industry, great attention is paid to conducting strict parasitological control in order to rationally manage fisheries and increase the productivity of water bodies. As a result of changes in the hydrochemical and gas regime of water bodies under the influence of abiotic, biotic and anthropogenic factors and an increase in the population of intermediate hosts of fish parasites, the incidence of fish infection with cestodes is increasing. Cestodes occur in the form of monoinvasion and associative invasion and are highly pathogenic. Therefore, when assessing the epizootological and epidemiological situation in water bodies, one of the urgent tasks is to conduct scientific research on the main cestodes of cyprinid fish and their impact on the morpho-physiological characteristics of the fish organism.

In our republic, great attention is paid to supporting the fishing industry, increasing the efficiency of fishing and fishing farms, rational and efficient use of land and water resources in this area, and the widespread introduction of intensive technologies. Therefore, it is important to timely identify various diseases occurring in farms, develop measures for their treatment and prevention. Meeting the population's demand for affordable, high-quality and environmentally friendly fish and fish products is directly related to the development of private-owned fishing farms, small businesses and private entrepreneurship. This, in turn, requires increasing the efficiency of artificial ponds, increasing fish stocks in natural reservoirs, creating a solid feed base, improving the quality of service for them, and increasing the amount of product and income through the organization of product processing.

The Resolution of the President of the Republic of Uzbekistan No. PD-2939 “On measures to improve the management system of the fisheries industry” dated May 1, 2017, Resolution No. PD -3657 “On additional measures for the accelerated development of the fisheries industry” dated April 6, 2018, Resolution No. PD -4005 “On additional measures for the further development of the fisheries industry” dated November 6, 2018, and Resolution No. PD -83 “On additional measures for the further development of the fisheries industry” dated January 13, 2022, as well as other regulatory legal acts related to this activity, serve to a certain extent in the implementation of the tasks set forth in the Resolution.

2 The level of study of the problem

For the study, blood was taken from the heart of white Amur fish from the fish farm using a syringe. In carp, instead of injection, blood is taken from the junction of the lateral line by drawing a line perpendicular to the anal opening. Blood should be taken from starved fish. Freshly caught fish should be kept in oxygenated water for 10-15 minutes before blood is taken.

3 Results and Discussion

Experiments 1.- According to the data in Table 1, in determining the morphological indicators of the blood of roundhead fish in mixed infection with chilodinillosis and trechodinosis in freshwater bodies, favorable conditions for the parasites that cause these diseases, deterioration of water quality in terms of composition, making it difficult to determine the chemical composition of water and the living conditions of fish, and also having a great importance in the development of *Chilodonella cyprini, Trichodina pediculus* .

Chilodonella cyprini, Trichodina pediculus in fish to be parasitic As a result of the effect on the red blood cells and hemoglobin content in the blood of the roundhead fish, the hemoglobin content in the healthy control fish was 81.1±1.7 g/l, and in the honeyed fish it was It was 79.3±2.13 g/l. In our experiments, the hematocrit level in the healthy control groups of farmed humpback fish was 52.11±1.41 %, and in the honeyed fish it was 52.11±1.41%. 45.11±1.45 %. In our studies, when the erythrocyte count was studied from the morphological indicators of blood, it was 1.93±0.053 10 12 /l in healthy groups , and 1.93±0.053 10 12 /l in honeyed fish. It was found to be 1.99±0.055 10 12 /l and an increase of 0.06 10 12 /l was observed compared to the healthy control group. Chilodonella cyprini, Trichodina pediculus with The average size of erythrocytes in the affected fish was 234.5±5.89 µm , compared to 223.1±7.12 µm in the healthy control group , with a mean difference of 11.3 µm. Hemoglobin in erythrocytes was determined to be 42.17±0.79 pg in the healthy control group and 39.89±1.55 pg in the affected fish.

Chilodonella cyprini, Trichodina with pediculus When the leukogram of the affected fish was studied, it was observed that the imperial form was 1.05±0.34 % in the healthy control group and 1.07±0.11% in the healthy control group, and the interspecific difference was 0.02%. Promyelocytes were 0.91 ± 0.019 % in the healthy control group and 0.71 ±0.02 % in the affected fish (figure 1).

Was 0.89±0.13% in the control group , while it was increased by 1.04±0.012% in the affected group (Table 1.).

The metamyelocyte neutrophil count was found to be increased by 0.69±0.11% in the healthy control group and by 0.79±0.023% in the infected fish.

In the healthy control group, the number of rod-shaped neutrophils was 0.55±0.07%, and in fish infected with protozoa, it increased to 0.69±0.022 %. Segmental neutrophils were also found to be 0.19±0.011%.

a) b)

Fig. 1. A - Saprolegniosis and mixed protozoan infection in silverside fish, B - Susceptibility to saprolegniosis.

The total number of neutrophils in the healthy control group increased by 2.09±0.71%, in the infected fish by 2.73±0.71%, foam cells in the control group by 0.30±0.014%, in the infected fish by 0.41±0.021%, and monocytes in the healthy group by 0.89±0.013%, 1.01±0.071%.

Table 1. Morphological parameters of the blood of the humphead fish in mixed infection with chylodinillosis and trechodinosis

Indicators	Control (healthy)	Sick fish
Hemoglobin, g/l	81.1±1.7	79.3±2.13
Hematocrit, %	52.11±1.41	45.11±1.45
Erythrocyte, 10^{12}/l	1.93±0.053	1.99±0.055
Average size of erythrocytes, µm	223.1±7.12	234.5±5.89
Hemoglobin in erythrocytes, pg	42.17±0.79	39.89±1.55
Leukogram, %		
Imperial form	1.07±0.11	1.05±0.34
Promyelocyte	0.91±0.019	0.71±0.021
Myelocyte neutrophil	0.89±0.13	1.04±0.012
Metamyelocyte neutrophil	0.69±0.11	0.79±0.023
Rod-shaped neutrophil	0.55±0.07	0.69±0.022
Segmented neutrophil	0	0.19±0.011
Total neutrophil count	2.09±0.71	2.73 ±0.71
Eosinophil	0.96±0.21	0.81±0.071
Pseudoeosinophil	2.33±0.21	3.97±0.87
Basophil, pseudobasophil	0.52±0.082	0.19±0.011
Foam cell	0.30±0.014	0.41±0.021
Monocyte	0.89±0.013	1.01±0.071
Lymphocyte	92.10±1.61	87.98±3.32

The eosinophil count increased from 0.96±0.21% to 0.81±0.071%, and the basophil and pseudobasophil count increased from 0.52±0.082% to It was observed that the number of lymphocytes decreased from 92.10±1.61 % to 87.98±3.32% (Table 1).

In the fight against chylodinyliasis of cyprinid fish A granular feed containing an anthelmintic agent was prepared. For this In farm conditions, 1 kg of anthelmintic drug was dissolved in 10-15 liters of water and mixed with 1.0 ton of concentrated feed (2 kg of alben alone was added to 1 ton of feed). One kilogram of the prepared treatment granules was poured into ponds containing 100 fish each twice for 24 hours, based on 25.0 kg of fish body weight (0.42 grams of active substance per kg of body weight). The effectiveness of the control measures was determined based on parasitological examinations before and after the granules were poured. The experimental results are given in Table 2.

Table 2. Cyprinids The effectiveness of anthelmintic drugs used against chylidiniosis.

No.	Brug used name	Number of fish examined, pcs.	Inspection results				Event effectiveness, IE relative % on account of
			Experience at the beginning		14 days after disinfection		
			IE, %	II, copy	IE, %	II, copy	
1	Albendazole suspension, 10%, 0.10 g/kg	50	11	10	11	14	0
2	Albendazole suspension, 10%, 0.20 g/kg	50	11	13	3	7	63.64
3	Ivermectin, 22%, 0.2 g/kg	50	12	16	7	2	41.67
4	Ivermectin, 22%, 0.4 g/kg	50	12	3	0	0	100
5	Metsalbin, 10%, 0.10 g/kg	50	9	10	8	5	88.89

6	Metsalbin, 10%, 0.20 g/kg	50	9	5	2	1	77.78
7	Praziever suspension, 0.10 ml/kg	50	12	13	9	1	91.67
8	Praziever suspension, 0,20 ml/kg	50	12	9	0	0	100
9	Emicon, 0.2 g/kg	50	11	11	9	1	90.9
10	Emicon, 0.4 g/kg	50	11	8	0	0	100
Control		100	50	50	2	22	3

As can be seen from the data in Table 2, in group I, the invasion extensiveness (IE) before deworming was 22%, and the invasion intensity (II) was 10 copies when examined by the microscopic hanging drop method. When Albendazole suspension (10%) was used in an amount of 0.10 ml/kg for deworming, the IE was 11%, II was 14 copies, i.e. the effectiveness was 0%.

In the control group, the IE and II indicators was observed to increase accordingly.

Such a positive anthelmintic and therapeutic effect observed in the experimental groups can be explained by the neuroparalytic, metabolic, and microtubular effects of the drugs on the parasite.

It should also be noted that the results of the experiment conducted will help to improve the control measures against *chylodinilloiasis and trechodinosis.* showed that it is advisable to conduct it in June and October on unhealthy farms (Fig. 2).

Hematological parameters of the blood of unicellular (fingerling) cyprinid fish in the experiment affected by chylodonellosis were determined during laboratory studies of blood samples.

Fig. 2. A- Initial signs of chilodinellosis, B- Fish that died from mixed chilodinellosis and saprolegniosis.

In particular, in fish affected by chylodonellosis, the hemoglobin content in the blood was 98.10±3.1 g / l, the hemotacrit index was 48.10±2.12%, the number of red blood cells in the blood was 1.71±0.07 1012/l, and the erythrocyte sedimentation rate was 2.10±0.75 mm/h. In healthy fish of the control group, these parameters corresponded to the hemoglobin content of 95.7±4.8 g / l, the hemotacrit index of 48.25±1.40%, the number of red blood cells in the blood of 1.63±0.05 1012/l, the erythrocyte sedimentation rate of 1.45±0.15 mm/h (Table 3).

Table 3. Hematological indications of unicellular (fingerling) carp affected by xylodonellosis.

Indications	Summer		Winter	
	sick	healthy	sick	healthy
Hemoglobin, g/l	98.10±3.1	95.7±4.8	102.9±5.8	94.8±4.3
Hematocrit, %	48.10±2.12	48.25±1.40	43.11±2.12	48.30±1.34
Erythrocyte, 10^{12}/l	1.71±0.07	1.63±0.05	1.69±0.11	1.48±0.09
Specific weight, mm/h	2.10±0.75	1.45±0.15	1.83±0.60	1.67±0.38
Neutrophil myelocytes	17.12±1.2	5.9±2.1	2.55±0.61	3.69±1.1
Neutrophil metamyelocytes	13.14±1.3	3.13±0.7	0.83±0.08	1.85±0.7
Alackaday neutrophil	6.5±0.61	3.1±0.78	0.42±0.012	1.52±0.62
Segmented neutrophil	13.1±1.1	3.5±0.12	0.43±0.065	2.61±0.89
Total number of neutrophils	56.1±1.75	16.1±1.1	4.3±0.89	8.95±2.5
Eosinophils, foam cells	2.41±0.38	2.1±0.22	3.38±0.81	3.51±1.2
Pseudosinella	3.81±1.5	3.18±1.3	0.99±0.1	1.71±0.81
Monocyte	6.3±0.61	1.65±0.15	2.49±0.87	3.31±1.5
Lymphocyte	29.8±2.2	77.5±3.1	89.23±2.3	83.9±3.45

In addition, studies conducted in the summer also showed that fish infected with chylodonellosis have certain types of white blood cells in their blood.

Based on the conducted experiments, it was found that the total number of neutrophils in the affected fish is 56.1±1.75, including myelocyte neutrophil 17.12±1.2, metamyelocyte neutrophil 13.14±1.3, rod neutrophil 6.5±0.61, segmented neutrophil 13.1±1.1, other types of leukocytes namely eosinophils, foam cell 2.41±0.38, pseudoeosinophils 3.81monocyte was found to be 6.3 ±0.61, and lymphocyte was found to be 29.8±2.2.

In healthy fish of the control group, the total number of neutrophils is 16.1±1.1, of which myelocyte neutrophil is 5.9±2.1, metamyelocyte neutrophil is 3.13±0.7, rod neutrophil is 3.1±0.78, segmented neutrophil is 3.5±0.12, and in healthy fish of the control group, other types of leukocytes are eosinophils, foam cells 2.1±0.22, pseudoeosinophils 3.18±1.3, monocyte was found to be 1.65±0.15, and lymphocyte was found to be 77.5±3.1.

In a winter study of the morphological parameters of the blood of a carp fingerling affected by chylodonellosis, the hemoglobin content in the blood is 102.9±5.8 g/l, the hemotacrit index is 43.11±2.12 %, the number of red blood cells in the blood is 11.69±0.11 1012/l, and the erythrocyte sedimentation rate is 1.83±0.60 mm/l. CH made up these indicators in a healthy in the control group, respectively, the hemoglobin content was 94.8±4.3 g/l, the hemotacrit index was 48.30±1.34%, the number of red blood cells in the blood was 1.48±0.09 1012/l, and the erythrocyte sedimentation rate was 1.67±0.38 mm / h.

In addition, in Fish affected by xylodonellosis, when determining the number of certain types of leukocytes in the blood, the total number of neutrophils in the blood is 4.3±0.89, myelocytic neutrophil is 2.55±0.61, metamyelocytic neutrophil is 0.83±0.08, rod neutrophil is 0.42±0.012, segmentonuclear observing that the neutrophil is 0.43±0.065, other types of white blood cells, and It is eosinophils, foam cell is 3.38 It was found that pseudoeosinophils are contained in the amount of ±0.81, pseudoeosinophils-0.99±0.1, monocytes-2.49±0.87, lymphocytes-89.23±2.3 (figure 2).

In the healthy control group of fish examined in winter, the total number of neutrophils was 8.95±2.5, including myelocyte neutrophil-3.69±1.1, metamyelocyte neutrophil-1.85±0.7, rod neutrophil-1.52±0.62, segmented neutrophil-2.61±0.89, other types of eicocytes-eosinophils, foam cells-3.51±1.2, pseudoeosinophils-1.71±0.81, monocytes were foundto be 3.31±1.5, lymphocyte 83.9±3.45 (Table 3).

Analyzing the data obtained, it should be noted that statistically significant differences in hematological parameters were observed between the experimental and control groups of fish. In particular, parameters such as hemoglobin concentration, red blood cell count, and erythrocyte sedimentation rate were elevated in infected fish during both summer and winter.

Major changes in the total neutrophil count were observed mainly during the peak of the disease. In particular, we observed a 40% increase in fish morbidity in the summer compared to the control group.

Figure 3. Hematological examination process.

Accordingly, it was observed that other types of white blood cells were higher in Fish infected with xylodonellosis in the summer than in healthy ones, which, of course, indicates that the total number of white blood cells also increased. In all other cases, the amount of red and white blood was slightly different and was within the normal range characteristic of the species (Table 3).

The test and experimental process included the study of morphophysiological features of the body of cyprinid fish, the correct construction of an artificial reservoir, the pH of water on average ranged from 6.5 to 7.4, the oxygen content (O2)-4-10 mg / l, depending on the density of fish in the pool, the volume of water exchange and sanitary condition. Morphophysiological parameters of fish were studied by organoleptic, clinical, morphophysiological and hematological methods in carp caught at the dormonsoy balyklari fish farm Nizhne-Dargomyzhsky district of Samarkand region, and carp caught from the reservoir of Kattakurgan district.In our studies, a sharp differentiation of morphophysiological and hematological parameters was observed in the comparative study of physiologically healthy carp and carp fish (Table 4).

Table 4. Main hematological indicators of healthy fish crucian and carp.

Pointers	Karas			Carp		
	Minimal	Average	Maximum	Minimal	Average	Maximum
Red blood cell,$^{10-12}$/l	1.42	1.63	1.95	2.55	2.68	2.71
Hemoglobin, g / l	79.1	89.3	92.4	76.9	97.3	98.4
Hemotokrit, %	22.9	23.1	25.2	26.10	27.12	28.15
White blood cells,10^{109}/l	50.6	51.8	53.3	42.20	43.16	44.17
Leucogram, %.						
Total neutrophil count	15.12			6.5		
Rod-shaped neutrophil	6.11			3.3		
Lymphocyte	76.38			88.71		
Monocyte	3.1			3.2		

The percentage ratio of white blood cell types to each other, which is the main indicator of fish blood, is reflected on the leukogram neutrophils the total amount in the blood of carp was 15.12 neutrophils with rod nuclei 6.11 lymphocytes 76.38 monocytes 3.1. Healthy carp brought from the farm was reflected in the blood of fish on the sheep leukogram neutrophils 6.5 core neutrophils 3.3 lymphocytes 88.71 monocytes 3.2.

4 Conclusion

Incorrect fertilization of water bodies, insufficient natural feed, and changes in water pH can reduce fish appetite. These factors, combined with infections by Chilodonella cyprini and Trichodina pediculus, are considered major contributors to fish health decline.

During the experiment, the morphological characteristics of the fish organism, the amount of hemoglobin in the blood of fish kept under hydrochemistry of water and bioecological conditions, (g/l) , the number of erythrocytes (x 10 /l) and the number of leukocytes (x10 9 /l), and leucoformula It was observed during our experiments that their indicators differed from each other.

Summing up, we can say that xylodonellosis is a common disease in different countries outside the regions of our country, so early detection and timely diagnosis of the disease are important for reducing economic damage.

In hematological studies in Fish, the transverse-longitudinal diameter of red blood cells is of great importance. Knowing these data, you can determine the intensity of erythropoiesis in fish, and with infection and toxicosis, you can observe the breakdown of red blood cells, blood parasites. The number of red blood cells in different fish species is different and varies significantly depending on age, gender, seasons, physiological state of organisms, diseases and other causes.

The number of white blood cells in fish varies and depends on many factors (age, gender, breed). The main function of white blood cells is protection, and they are a component of the immune system of fish. Consequently, in infectious diseases, the number of white blood cells increases, which is an intense protective reaction of the body.development of the fish network in veterinary practice, the study of hematological data related to fish species is becoming very important.

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