TISCIA 28, 53-56

ECOPHYSIOLOGICAL INTERPRETATION OF HEMATOLOGY OF DIFFERENT PERCIDAE SPECIES IN THE RIVER TISZA

A. Ivanc, S. Maletin, N. Djukić and B. Miljanović

Ivanc, A., Maletin, S., Djukić, N. and Miljanović B. (1994): Ecophysiological interpretation of hematology of different Percidae species in the river Tisza. - Tiscia 28, 53-56.

Abstract. Hematological analyses of pikeperch (*Stizostedion lucioperca*) and perch (*Perca fluviatilis*) originated from the River Tisza nearby Novi Becej were performed.
The fish were caught by electrofishing, recovered during 24 hours, and finally heart puncturing was undertaken for blood collection. Number of erythrocytes, erythroblast percentage, haematocrit, hemoglobin concentration, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), number of leukocytes, and differential blood count were determined. Different values for hematological parameters were obtained, in particular hemoglobin concentration, MCHC, and differential blood count. The differences noticed were discussed from the aspect of idioecological specificity of these two Percidae species.

Keywords: erythrocytes, erythroblast, haematocrit, hemoglobin, MCV, MCH, MCHC, leukocytes.

A. Ivanc, S. Maletin, N. Djukić, B. Miljanović, University of Novi Sad, Faculty of Sciences, Institute of Biology, 21000 Novi Sad, Yugoslavia

Introduction

Having fair knowledge of the hematological status of certain fish species is equally useful from the point of view of their physiology and ecology. Hematological state of an organism is defined by the interaction of hereditary and ecological factors. The former determines basic structural and functional features of a species formed during its speciation and adaptation to a given environment. The latter manifests its effects by an immediate influence upon an organism occupying certain habitat. As a response, an organism activates its physiological regulatory mechanisms and/or adaptational mechanisms such as acclimation and acclimatization (Slonim, 1971; Ivanc et al., 1985). Distinction between hereditary and ecological determinants in actual values of certain physiological parameters is essential for a more comprehensive understanding of both physiology and ecology of a species. It could be hardly carry out, however, due to a complex interaction of factors and the fact that actual response on the organismic level is influenced by the state of its internal environment and the faze of its life cycle, such as age, reproductive activity etc. (Speckner et al., 1989). Data on a comparative hematology of freshwater fish are not rare but most frequently such investigations were not carried out in the way enabling the differentiation between hematological adaptation typical of a species and physiological acclimation and/or acclimatization (Hart, 1962).

This paper deals with the hematology of two species of the family Percidae (pikeperch and perch) living in the same habitat under the same basic environmental conditions. To eliminate the environmental influence upon the results of hematological investigations of these two fish species they were analyzed on the same day and therefore the obtained values may be considered as characteristic for species.

Methods

Hematology of two species (*Stizostedion lucioperca* and *Perca fluviatilis*) from the River Tisza was studied. Individuals of both species were caught from the same locality nearby Novi Becej. They were caught by electrofishing and then let to recover for 24 hours in net cages kept in the river.

Blood samples were taken by cardiac puncture, without using anticoagulant. Erythrocyte and leukocyte numbers were counted in Neubaur-chamber following Kekic and Ivanc (1982). Hemoglobin concentration was estimated photometrically by means of hemoglobincyanide method (Blaxhall and Daysley, 1973). Hematocrit was determined by centrifuging blood in heparinized capillary glass tubes at 15000 rpm for 5 minutes. Mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined by calculations based on erythrocyte number, hemoglobin concentration and haematocrit. Differential leukocyte count and erythroblast count were made on blood smears stained according to Pappenheim and Graham-Knoll (Romeis, 1968; Heckner, 1975). Significance of differences in mean values of hematological parameters between the two species were established by Student's "t"-test.

Results and discussion

Number of erythrocytes, hemoglobin concentration, haematocrit, MCV, MCH, MCHC, and number of polychromatic and acidophilic erythroblasts are given in Tab. 1. and leukocyte number and proportions of different white blood cells are given in Tab. 2.

Perch had significantly higher values of hemoglobin concentration, MCH and MCHC than pikeperch, while the values of erythrocyte number, haematocrit and MCV were almost identical in these two species. The leukocyte number had similar values in both perch and pikeperch but individual variation of this parameter was higher in perch, as it is evident from broad range and high standard deviation. As to differential leukocyte counts, perch and pikeperch differed significantly. In the blood of pikeperch immature (myelocyte and metamyelocyte) neutrophils and mature pseudo-eosinophilic granulocytes were present while they were not found in the blood of perch. Perch had higher proportions of nonsegmented and segmented neutrophils and lower proportion of lymphocytes.

The differences in hemoglobin concentration, MCH and MCHC of pikeperch and perch found in this study can hardly be attributed to environmental influences because fish of both species inhabited the

Table 1. Comparative hematology of *Stizostedion lucioperca* and *Perca fluviatilis* - Erythrogram (mean, SD, range, significance of differences between means).

Species	No. of ind.		Body weight g	Total body length cm	RBC count x 10^{12}/l	Hemoglobin concentration g/l	Hct. l/l	MCV fl	MCH pg/l	MCHC gHb/l erc	Number of erythroblasts per1000 erythrocytes polych	acidophil.
Stizostedion lucioperca	7	mean	612.3	31.9	1.735	54.09	0.431	250.50	31.51	126.07	21.1	14.6
		SD	435.2	10.4	0.217	3.78	0.041	25.12	3.36	10.17	14.7	5.4
		Range	128.0	26.5	1.513	49.60	0.379	212.27	25.89	113.36	5.0	5.0
			1258.0	52.0	2.200	60.21	0.488	283.72	35.25	147.70	54.0	25.0
Perca fluviatilis	7	mean	73.1	16.9	1.625	82.68	0.435	269.01	51.12	190.68	20.3	16.7
		SD	58.8	3.7	0.105	6.58	0.043	34.75	5.57	8.77	10.2	6.6
		Range	26.0	13.0	1.467	76.48	0.389	228.83	42.89	174.01	4.0	4.0
			212.0	25.0	1.783	94.38	0.487	317.91	59.92	203.44	34.0	24.0
p					>0.200	<0.001	>0.400	>0.200	<0.001	<0.001	<0.001	>0.400

Table 2. Comparative hematology of *Stizostedion lucioperca* and *Perca fluviatilis* - Leucogram (mean, SD, range, significance of differences between means).

Species	No. of ind.		Leukocytes x 10^9/l	Myelocytes	Metamyelocytes	Neutrophils Nonseg	Seg.	Pseudo-eosinophils	Lymphocytes	Monocytes
Stizostedion lucioperca	7	mean	20.140	0.013	0.019	0.444		0.004	0.429	0.090
		SD	5.276	0.016	0.023	0.124		0.007	0.161	0.065
		Range	13.000	0.000	0.000	0.240		0.000	0.240	0.020
			27.000	0.040	0.060	0.580		0.020	0.660	0.190
Perca fluviatilis	7	mean	25.000			0.813	0.007		0.177	0.004
		SD	10.001			0.063	0.014		0.072	0.007
		Range	9.000			0.690	0.000		0.050	0.000
			43.000			0.910	0.040		0.310	0.020
p			>0.200	>0.050	>0.050	<0.001	>0.200	>0.100	<0.001	<0.010

same microhabitat. Handling of fish, technical and analytical methods were identical and were performed at the same period of day, so that effects of that kind were also similar.

Therefore, the differences observed are due to certain other factors, possibly to perch speciation within which this species was adapted also to waters with lower oxygen concentration (Muus and Dahlström, 1978), at least in certain periods of a year. Within this process, in perch blood a transport system providing satisfactory oxygen supply of tissues, even when its concentration in the environment is low, was developed. This may account for its being widespread in almost all inland waters (Müller, 1987). The fact that in the same microhabitat and at the same physico-chemical features of water perch has evidently different hematological parameters than pikeperch, shows that here indeed operate the physiological adaptation and hereditary characteristics of the species. Similar differences in hematological parameters were reported by Halsband et al. (1981) in two species of the family Cyprinidae (*Carassius auratus* and *Cyprinus carpio*) of which the former better endures unfavourable conditions of environment. Hematological characteristics of such type were also found in other fish species and usually they were explained by differences in habitat quality and activity level. Therefore, in active species considerably higher values of erythrocyte parameter were reported. This phenomenon is explained by a higher metabolic rate, and greater tissue requirements for more efficient oxygen supply. Thus, Romestand et al. (1983) in their study of hematology of a number of sea and freshwater fish observed that the number of erythrocytes is higher in sea fish while they have smaller volume (MCV) and smaller amount of hemoglobin (MCH). The authors stated that an adaptive character was established since at the same total volume (hematocrit) a great number of small erythrocytes is characterized by a greater total surface than a small number of large erythrocytes. This improves gas exchange and breathing in sea water in which oxygen dissolubility is lover. Rambhaskar and Srinivasa Rao (1987) found that more active species of tropical sea fish were characterized by a greater erythrocyte number, higher hemoglobin concentration, and higher MCH and MCHC values, and smaller volume of erythrocytes (MCV) than less active fish species from the same water. They concluded that in fish both the increase of hemoglobin concentration and the decrease in erythrocyte volume appear as adaptive characters but that ratio of these two adaptation aspects differed from one another.

Differences in proportions of leukocytes between pikeperch and perch obtained in our study may be probably attributed to adaptation of these fish species to different ecological niches. In other words, in waters inhabited by perch greater amount of organic matter and facultative pathogenic microorganisms are present. They were showed to be the reason of an increase in proportion of phagocytic leukocytes in other fish species (Alvarez-Pellitero and Pinto, 1987; Siwicki and Studnicka, 1987; Hine and Wain, 1988; Ivanc et al., 1993).

References

Alvarez-Pellitero, P. and Pinto, R.M. (1978): Some blood parameters in sea bass, *Dicentrachus labarax*, infected by bacteria, virus and parasites. - J. Fish. Biol. 31 (Suppl. A), 259-261.

Blaxhall, P.C. and Daisley, K.W. (1973): Routine hematological methods for use with fish blood. - J. Fish. Biol. 5, 771-781.

Halsband, E., Halsband, I., Knezevic, B., Maric, D., Prochnow, F.H. and Radujkovic, B. (1981): Angewandte methoden zur Früherkennung von Krankheitsbildern an verschiedenen Fischarten des Skadarsees. Bundesforschungsanstalt für Fischerei. - Veröff. Inst. Küst.- u. Binnenfisch. Hamburg 74, 1-12.

Hart, J.S. (1962): Seasonal acclimatization in four species of wild birds. - Physiol. Zool. 35, 220-224.

Heckner, F. (1975): Praktikum der mikroskopischen Hämatologie. - Urban und Schwarzenberg, München, Wien, Baltimore.

Hine, P.M. and Wain, J.M. (1988): Characterization of inflammatory neutrophils induced by bacterial endotoxin in the blood of eels, *Anguilla australis*. - J. Fish. Biol. 32, 579-592.

Ivanc, A., Pavlović, V., Kekić, H., Gvozdenović, O., Pejić, K. and Mijatović, N. (1985): Differential blood count in *Thymallus thymallus* from different populations in various seasons. - Iugoslav. Physiol. Pharmacol. Acta 21, Suppl. 4, 97-98.

Ivanc, A., Maletin, S., Kojčić, K., Djukić, N. and Pujin, V. (1993): Leukocitarna formula riba kao pokazatelj uticaja organskog opterecenja vode kanala Hidrosistema DTD kod Vrbas (Differential count of fish blood leukocytes as indicator of organic water load in Hydrosystem DTD near Vrbas.) - Zbor. rad. "Zastita voda" 93, 240-245.

Kekić, H. and Ivanc, A. (1982): A new direct method for counting fish blood cells. - Ichthyologia 14, 55-59.

Muus, B.J. and Dahlström, P. (1978): Die Süswasserfische. - BLV Verlagsgesellschaft, München, Bern, Wien.

Müller, H. (1987): Fische Europas. - Neuman Verlag, Leipzig, Radebeul.

Rambhaskar, B. and Srinivasa Rao, K. (1987): Comparative hematology of ten species of marine fish from Visakhapatnam coast. - J. Fish. Biol. 30, 59-66.

Romeis, B. (1968): Mikroskopische Technik. - Oldenburg, München, Wien.

Romestadt, B., Halsband, E., Bragoni, G., Knezevic, B., Maric, D. and Prochnow, F., (1983): Etude hematologique comparee des constantes erythrocytaires de quelques poissons marins et d'euax douces. - Rev. Trav. Inst. Pech. Marit. 46, 147-156.

Siwicki, A. and Studnicka, M. (1987): The phagocytic ability of neutrophils and serum lysozyme activity in experimentally infected carp, *Cyprinus carpio* L. - J. Fish. Biol. 31, (Suppl. A) 57-60.

Slonim, A.D. (1971): Ekologitcheskaya fisiologia zhivotnych. - Vyschchaya shkola, Moskva.
Speckner, W., Schindler, J.F. and Albers, C. (1989): Age dependent changes in volume and haemoglobin content of erythrocytes in the carp (*Cyprinus carpio* L.). - J. Exp. Biol. 141, 133-149.