Short communication

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Organization of blood oxygen transport system for cottoid fishes of Lake Baikal

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ABSTRACT. The blood of cottoid fishes has the lowest parameters that characterize the ability of heamoglobin to bind oxygen. Environmental characteristics of the species determine the morphological parameters of red blood cells and the structure of haemoglobins. In red blood cells of the Baikal yellowfin sculpin under the exposure of phenol, we revealed the damage of intracellular structures and a decrease in the number of active mitochondria by 60%.

Keywords: cottoid fish, Lake Baikal, ecological group, red blood cells, haemoglobins

Red blood cells (RBC) and haemoglobin (Hb) protein are the main chain in the system of oxygen transport in fish. The composition and morphology of RBC in fish are genetically determined and species-specific. Morphological parameters of RBC are variables that correlate with all aspects of the body's vital activity, characteristics of habitat and its changes (Yakhnenko et al., 2016; Lahnsteiner, 2020). However, little is known about the role of various factors and the degree of their impact on the blood system in fish. This is relevant for cottoid fishes of Lake Baikal.

This study aims to assess the quantitative and qualitative features of RBC as well as the structure of haemoglobins in members of cottoid fishes from Lake Baikal belonging to different ecological groups.

Materials and methods

The peripheral blood from 17 sculpin fish species (*Cottoidei*) was studied. In the family *Cottidae*, there were benthopelagic species of the genus *Cottocomephorus*, bentho-coastal species of the genera *Paracottus* and *Leocottus*, benthic abyssal species of the genus *Procottus*, bentho-coastal, bathypelagic and benthic abyssal species of the genus *Batrachocottus*. In the family *Comephoridae*, there were pelagic species of the genus *Comephorus*, and in the family *Abyssocottidae* – benthic abyssal species of the genera *Abyssocottus Asprocottus* and *Limnocottus*.

Standard procedures of hematologic (Yakhnenko et al., 2016) and ultrastructural (Weakley, 1975) analysis were used. Erythrocyte size was measured using Image Pro Plus 6.0 computer software. Studies of the Hb structure were carried out using the isoelectric focusing method (Righetti, 1983). The experiments were carried out on the effect of phenol (concentration 3 mg/l, control, 24 hours, and four days of exposure) on the blood parameters and the structure of RBC of the Baikal yellowfin sculpin.

Results

The peripheral blood of the studied fishes had mature RBC (up to 90%) and erythroblasts (immature forms of RBC). In the cytoplasm of mature RBC, we detected ribosomes, endoplasmic reticulum and mitochondria. In comparison with other Baikal fishes, the blood of cottoid fishes has the lowest Hb concentration as ell as the lowest parameters of the number of RBC per unit of blood volume, oxygen carrying capacity of blood and the Hb concentration in RBC (Yakhnenko et al., 2016). Bentho-coastal species and pelagic species, except for golomyankas, have the highest RBC concentration, and ellipsoid degree of RBC, and benthic abyssal species – the lowest one. Abyssal fishes have the highest cytometric parameters of RBC and their nuclei. Hb in golomyankas is reliably higher, but the erythropoiesis level is lower compared to other pelagic species. In contrast to big golomyanka, RBC in small golomyanka are larger, and the ellipsoid degree is lower.

In coastal pelagic species, cathodic fractions prevail in the Hb structure. Abyssal species and golomyankas have both cathodic and anodic fractions, which at low temperatures allows Hb to bind with a high degree of saturation.

Experiments on the effect of phenol on the composition and structure of blood cells of the Baikal

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yellowfin sculpin have revealed that, in addition to the damage of intracellular structures, vacuolization of mitochondria and damage to mitochondrial cristae, the number of active mitochondria decreases by 60%.

Therefore, at present, we have not revealed any deteriorations in the structure and morphology of RBC in the Baikal cottoid fishes from different ecological groups.

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