On the issue of the thermal adaptation of the larvae caucasian brown frog *Rana macrocnemis* Boulenger, 1885 (Amphibia, Ranidae) to low-temperature environmental conditions

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Abstract. The results of the study of hematological parameters of the blood of the larvae caucasian brown frog Rana macrocnemis and the total activity of catalase compared with adults and at different temperature conditions: at 23°C and after five days of hypothermia at 5°C. Differences in the blood formula were revealed in different periods of ontogenesis and under the influence of artificial hypothermia. The number of erythrocytes in tadpoles at the 28–30 stage of development according to Gosner is 2 times less than in adult frogs, a lymphocytic profile is noted in the blood of larvae and adults. The content of lymphocytes is slightly higher at the larval stage, and eosinophils, basophils and monocytes – in adults. With hypothermia in the blood of tadpoles, a decrease in eosinophils and neutrophils was noted against the background of an increase in the level of immunocompetent cells. With low-temperature exposure, catalase activity in the body of tadpoles decreased by 2 times at the 34th stage, and by 1.3 times at the 40th stage, that is, before metamorphosis, antioxidant protection decreases. The dependence of catalase activity on temperature in adult frogs with hypothermia has not been noted, which allows us to conclude that the enzyme's tolerance to temperature changes increases as it develops in ontogenesis. The revealed changes in the studied parameters are adaptive in nature.

Keywords: Amphibians, *Rana macrocnemis*, erythrocytes, differential white blood cells count, catalase, hypothermia, ontogenesis

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REFERENCES

Akulenko N. M. Seasonal dynamics of erythropoiesis and its topographic distribution in the lake frog. *Bulletin of the Zaporozhye National University*, 2008, no. 2, pp. 5–10 (in Russian).

Berman D. I., Bulakhova N. A., Meshcheryakova E. N. Adaptive strategies of brown frogs (Amphibia, Anura, *Rana*) in relation to winter temperatures in the north of the Palearctic. *Zoologicheskii zhurnal*, 2017, vol. 96, no. 11. pp. 1392–1403 (in Russian). https://doi.org/10.7868/S0044513417110034

Vershinin V. L. Hematopoiesis of tailless amphibians – specificity of adaptationogenesis of species in modern ecosystems. *Zoologicheskii zhurnal*, 2004, vol. 83, no. 11, pp. 1367–1374 (in Russian).

Korolyuk M. A., Ivanova L. I., Mayorova I. G., Tokarev V. E. Method for determining catalase activity. *Laboratornoe delo*, 1988, no. 1, pp. 16–19 (in Russian).

Litvinov N. A., Chetanov N. A., Ganshchuk S. V. Principles of evaluation of thermoadaptation abilities of reptiles. *Tambov University Reports. Series: Natural and Technical Sciences*, 2013, vol. 18, iss. 6, pp. 3035–3038 (in Russian).

Menshikov V. V., Delektorskaya, L. N., Zolotnitskaya R. P., Andreeva Z. M., Ankirskaya A. S., Balakhovsky I. S., Belokrinitsky D. V., Voropaeva S. D., Garanina E. N., Lukicheva T. I., Pletneva N. G., Smolyanitsky A. I. *Laboratornye metody issledovaniya v klinike* [Laboratory Methods of a Research in the Clinic]. Moscow, Meditsina, 1987. 368 p. (in Russian).

Mechnikov I. I. *Lektsii o sravnitel'noj patologii vospalenija* [Lectures on the Comparative Pathology of Inflammation]. Saint Petersburg, Adamant Media Corporation, 2001. 160 p. (in Russian).

Mineeva O. V., Mineev A. K. Violations of the leukocyte formula of the blood of the lake frog of the Saratov reservoir. *Vestnik of Lobachevsky University of Nizhni Novgorod*, 2011, no. 2, pp. 94–97 (in Russian).

Peskova T. Yu. *Adaptation Variability of Amphibians in Anthropogenically Polluted Environment*. Thesis Diss. Dr. Sci. (Biol.). Togliatti, 2004. 36 p. (in Russian).

Romavova E. B., Shapovalova K. V. Myelograms of marsh (*Pelophylax ridibundus*) and gress frogs (*Rana temporaria*) of the Nizhny Novgorod region. *Modern Problems of Science and Education*, 2016, no. 2, pp. 1–9 (in Russian).

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Romanova E. B., Lukonina S. A., Ryabinina E. S., Plotnikova V. D. Ecological and physiological analysis of immune reactions of *Pelophylax ridibundus* and *P. lessonae* (Amphibia: Ranidae) in anthropogeneously transformed territories. *Povolzhskiy Journal of Ecology*, 2023, no. 1, pp. 77–96 (in Russian). https://doi.org/10.35885/1684-7318-2023-1-77-96

Skorkina M. Yu., Lipunova E. A. The blood system as a screening test of the ecological state of the environment. *Regional Environmental Issues*, 2009, no. 1, pp. 147–150 (in Russian).

Slonim A. D. *Ehvolyutsiya termoregulyatsii* [Evolution of Thermoregulation]. Saint Petersburg, Nauka, 1986. 86 p. (in Russian).

White A., Handler F., Smith E., Hill R., Lehman I. *Principles of Biochemistry*: in 3 volumes. Moscow, Mir, 1981, vol. 1. 539 p. (in Russian).

Hochachka P., Somero G. *Biochemical Adaptation*. Moscow, Mir, 1988. 567 p. (in Russian).

Emirbekov E. Z., Magomedova N. G., Mirskaya R. O., Meilanov I. S., Emirbekova A. A. Investigation of catalase activity in the weaving of the ridibund lake wound frog in hypothermia and self-preservation. *Bulletin of Higher Education Institutes. North Caucasus Region. Natural Sciences*, 2004, no. 6, pp. 55–60 (in Russian).

Angiletta M. J. Thermal adaptation: A theoretical and empirical analisis. *Integrative and Comparative Biology*, 2010, vol. 50, iss. 2, pp. 253–254.

Coico R., Sunshine G., Benjamini E. *Immunology. A Short Course*. Hoboken, Wiley-Liss Publications, 2003, pp. 237.

Gosner K. L. A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica*, 1960, vol. 16, pp. 183–190.

Nano R., Griffini P., Barni S. Morphohistochemical changes of the blood cells in the Hibernating frog (*Rana esculenta* L.). *Comparative Haemotalogy International*, 1991, vol. 1, iss. 4, pp. 220–223.