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Responses of unionid mussels (Unionidae) to new types of water pollutants. Potential use of mussels in pollution early warning systems

Abstract

Bivalves of the family Unionidae are an essential component of aquatic ecosystems. In the process of feeding, they filter bioseston and abioseston from the water table, and thus participate in the process of natural purification of surface water. Regrettably, these organisms are vulnerable to various environmental disturbances and are among the most endangered groups of aquatic animals. Bivalves are frequently utilized as bioindicators of water pollution, including in pollution early warning systems.

The aim of the study was to evaluate the response of selected species of Unionidae bivalves to new types of pollutants and to assess the possibility of using the bivalves to detect these substances as part of pollution early warning systems.

Pharmaceuticals were the first group of tested substances. In recent years, aquatic ecosystems have seen an increase in the presence of active pharmaceutical ingredients. The growing number of pharmaceuticals on the market, as well as their increasing consumption contribute to this trend. The dissertation studied the behavioral response of mussels to the popular non-steroidal anti-inflammatory drugs diclofenac, ibuprofen and the analgesic and antipyretic paracetamol. The responses of two species of native bivalves, *Anodonta anatina* and *Unio tumidus*, and the invasive species *Sinanodonta woodiana*, to different doses of these pharmaceuticals were studied. Test procedures used concentrations corresponding to values found in the environment and their multiplications. The results of the study indicate the low suitability of the test species for detecting water contamination with these substances in early warning systems. With prolonged exposure to high doses, a reduction in the filtration activity of the species was observed, indicating the potential negative impact of this type of pollution on the bivalve population.

Another study focused on the effects of iron coagulant ($FeCl_3$) on mussels. The use of this chemical is one of the methods used in lake reclamation. Coagulant dosing is designed to precipitate phosphorus from the water table. This method is relatively cheap and effective, but the side effects of the delivery of this substance to the aquatic environment have not been recognized in detail. In the present study, the effects of iron coagulant on filtration behavior,

chemical stoichiometry and biochemical disorders (oxidative stress) in two species of native mussels *Anodonta cygnea* and *Unio tumidus* exposed to varying (used in reclamation practice) concentrations of iron coagulant were analyzed. Significant and concentration-dependent effects of the coagulant on reducing the filtration activity of the bivalves were observed, as well as disturbances in the chemical stoichiometry of the individuals an increase in iron concentration with a reduction in the concentration of phosphorus in the mussles.

Another study analyzed filtration behavioral disorders and oxidative stress levels in *U. tumidus* and *A. anatina* mussels exposed to different concentrations of the pesticide Roundup 360 PLUS, whose active compound is glyphosate. The use of glyphosate-based products raises a number of concerns both in terms of human health and impacts on aquatic and terrestrial environments. The study tested the reactions of mussels to concentrations of the herbicide corresponding to concentrations recorded in aquatic ecosystems and their multiplications. The study showed that the mussel species tested reduced filtration activity already after exposure to low-environmental concentrations of the pesticide. However, this response was short-lived and not intense enough to reach levels customarily considered alarming in pollution early warning systems. Exposure of the clams to higher concentrations resulted in a rapid and prolonged reduction in filtration activity, showing that the chemical can pose a serious threat to native malacofauna. The results show that Unionidae bivalves can be a bioindicator of incidental water pollution with high doses of Roundup and also that the presence of this pesticide in the waters negatively affects bivalve populations. Analysis of the biochemical response showed an increase in oxidative stress, but the differences were not statistically significant.