Assessment of Water Quality in Water Intake Points the City of Grozny by Biotesting Methods

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Abstract. A study of 184 water samples in the water intake areas of the city of Grozny (Goity, Sunzhensky and Chernorechensky) was carried out using generally accepted biotesting methods. Luminescent bacteria E. coli and freshwater crustaceans Daphnia magna Straus were used as test objects. The toxicity of samples from the Sunzha water intake in the summer period during biotesting on bacteria and a different degree of chronic toxicity of water samples during biotesting of water on daphnia, depending on the place of water intake, are shown.

1 Introduction

In the conditions of scientific and technological progress, the demand for water is constantly growing and at the same time the discharge of waste water is increasing. This process is accompanied by a deterioration in the quality of water sources and the limitation of the possibility of their use for industrial needs, irrigation, fish farming, cultural and domestic and especially drinking water use. The problem of providing the population of Grozny with high-quality drinking water is relevant and is associated with a change in the natural properties of water in the main water supply sources under the influence of anthropogenic factors [1]. The main sources of pollution are discharges of household, industrial and storm sewage of varying degrees of pollution. Of the total volume of wastewater, industrial accounts for about 17%, the rest - for the housing and communal complex (State report “On sanitary and epidemiological well-being in the Chechen Republic”, 2010). In this regard, studies of water quality in the places of water intake in the city of Grozny are of particular relevance.

2 Research methodology

In our work, methods of biological testing and indication were used to evaluate the synergistic effect of various ecotoxicants in river water and their biological effects at ultra-low concentrations [2-3]. To assess the quality of water, a system of biotests was used - prokaryotic and eukaryotic organisms. As test objects, luminescent bacteria E. coli (Method for determining the toxicity of water and water extracts ... by changing the intensity of

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bacterial bioluminescence with the Ecolum test system) and freshwater crustaceans Daphnia magna Straus (Method for determining the toxicity of water and water extracts ... by mortality and change in the fertility of Daphnia) [9-10]. Important factors in the selection of this test object are the presence of an aerobic type of metabolism, high reproductive capacity, and genetic homogeneity of individuals during parthenogenetic reproduction.

3 Results and discussions

The toxicity of the studied water samples was assessed by two indicators: the death of individuals of the initial generation and the change in the fertility of surviving females [4]. The criterion for an acute toxic effect on daphnia was the death of 50% or more individuals in 96 hours. In addition to the generally accepted indicators, we assessed the cumulative mutagenic effect of aquatic ecotoxicants on D. magna Str. contained in model reservoirs (with water from different points of the city water intake). In the second generation of daphnia, different types of mutants were identified: sublethal, manifested in an increase in the death of individuals; lethal, manifested in a decrease in their fertility; morphological, manifested in a change in phenotypic traits [5].

D. magna Str.

When assessing the chronic toxicity of water samples on daphnia, as test objects, the manifestations of intoxication were recorded as a violation of reproductive function, embryogenesis and postembryonic development (growth retardation, the occurrence of developmental anomalies in offspring), and a reduction in life expectancy. Based on the obtained results, an analysis of possible genotoxic effects was carried out in comparison with control values [6-7].

Thus, toxic effects were revealed in the analysis of Daphnia of the initial generation; observations of individuals of the first and second generations in model reservoirs made it possible to judge genetic effects. In the period 2009-2011. in different seasons, a study of 184 water samples was carried out in the places of water intake of the city of Grozny (Goity, Sunzhensky and Chernorechensky) [8].

4 Conclusions

When biotesting water on bacteria, the toxicity of samples from the Sunzha water intake in the summer period was detected. In the study of water samples from other water intakes, acute toxicity was not detected. When biotesting all the studied water samples on daphnia, no acute toxic effect was noted. However, a significantly higher mortality of D. magna Str. in samples from the Sunzha water intake in the summer compared to their viability in water samples from other water intakes. Observations on Daphnia of the first and second generations kept in model reservoirs made it possible to identify sublethal mutants in small numbers in the water of the Goitinsky and Chernorechensky water intakes, and in the number of individuals in the water from the Sunzha water intake that significantly differed from the control values. Lethal and morphological mutant forms of D. magna Str. were not marked. The revealed violations of the reproductive function of Daphnia of the initial generation and postembryonic development of individuals of the first generation, manifested in their growth retardation, made it possible to judge the presence of chronic toxicity of the studied water samples. The obtained results indicate a different degree of water quality depending on the place of water intake. The identified toxicity of water samples from the Sunzha water intake in the summer can be explained by contamination with urban wastewater containing significant amounts of ecotoxicants.

The applied methodological approach to the assessment of water quality in urban water intake sites by biotesting on different test objects made it possible to identify genetic and toxic effects induced by various pollutants of the aquatic environment and to carry out an integral assessment of the degree of danger of ecotoxicants located in these objects, according to a set of quantitative indicators. It seems important to determine the pollutants of technogenic origin specific to eukaryotic organisms of the aquatic environment and to quantify their genotoxic activity.

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