HYGIENIC ASSESSMENT OF DRINKING WATER QUALITY IN THE KHOREZM REGION

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Relevance. Ensuring access to safe and high-quality drinking water is one of the key prerequisites for protecting public health. Compliance of drinking water with sanitary and hygienic requirements is essential for preventing communicable and non-communicable diseases, improving quality of life, and increasing life expectancy. Therefore, regular hygienic assessment of drinking water quality and measures to ensure its safety remain important scientific and practical priorities worldwide.

The natural, geographical, and hydrogeological characteristics of the Khorezm Region, its sharply continental climate, strong dependence on the water resources of the Amu Darya, and limited water availability are among the main factors shaping drinking water quality. In addition, intensive agricultural development, the use of mineral fertilizers and pesticides, high soil salinity, and the impact of domestic and industrial wastewater on water sources may adversely affect the sanitary-chemical and microbiological characteristics of drinking water.

Objective. To conduct a comprehensive hygienic assessment of the organoleptic, sanitary-chemical, and microbiological characteristics of drinking water supplied through the centralized water supply system of the Khorezm Region, to determine their compliance with current sanitary standards and regulations, and to identify the major risk factors affecting drinking water quality in order to develop evidence-based recommendations for ensuring a safe drinking water supply.

Materials and Methods. The study was conducted to evaluate the hygienic quality of drinking water supplied through centralized water supply systems in the Khorezm Region. Water samples collected from the centralized distribution network in urban and rural districts of the region served as the study material. Sampling was performed in accordance with current sanitary regulations and national standards. Samples were collected from water intake facilities, water treatment plants, and different points within the distribution network supplying consumers.

A comprehensive assessment of organoleptic, sanitary-chemical, and microbiological parameters was performed. Organoleptic evaluation included the determination of water color, odor, taste, and turbidity. Sanitary-chemical analysis comprised measurements of pH, total mineralization, total hardness, total dissolved solids (TDS), nitrates, nitrites, ammonium, chlorides, sulfates, iron, manganese, residual free chlorine, and other hygienically significant parameters.

Statistical analysis was performed using Microsoft Excel and IBM SPSS Statistics software. Quantitative variables were expressed as the mean (M), standard deviation (SD), and 95% confidence interval (95% CI).

Results and Discussion. The study demonstrated that microbiological and organoleptic parameters were the most informative indicators for assessing the sanitary condition of drinking water. During the study period, total coliform bacteria were detected in 7.6% of the analyzed samples, while thermotolerant coliform bacteria were identified in 3.1%. Most cases of microbiological contamination occurred between May and October, when the proportion of positive samples was 2.8 times higher than during the winter season ($p < 0.01$).

Analysis of organoleptic characteristics showed that the mean water color was 16.8 ± 2.4 degrees, whereas the mean turbidity reached 1.21 ± 0.18 mg/L. Between May and September, water color increased to 21.4 ± 2.8 degrees and turbidity to 1.56 ± 0.21 mg/L, reflecting seasonal intensification of hydrobiological processes in the source waters.

Sanitary-chemical analysis showed a mean pH of 7.28 ± 0.14. The average iron concentration was 0.46 ± 0.08 mg/L, and the mean manganese concentration was 0.09 ± 0.02 mg/L. Iron concentrations exceeding 1.0 mg/L were detected in 9.4% of the samples. Such conditions may impair the organoleptic quality of drinking water and increase the likelihood of skin irritation, dryness, and allergic reactions among consumers.

Analysis of trace elements revealed a mean fluoride concentration of 0.28 ± 0.05 mg/L, which was 44.0% below the recommended physiological level (0.5 mg/L). The concentrations of iodine and selenium in all samples remained below the analytical detection limits, preventing their quantitative determination.

Analysis of seasonal variation showed that microbiological indicators reached their highest levels between June and August. During this period, the total microbial count (TMC) averaged 38 ± 6 CFU/mL, whereas from November to February it declined to 17 ± 4 CFU/mL ($p < 0.001$). This seasonal pattern is likely associated with increased water temperature and the formation of biofilms within the water distribution network.

Conclusion. The findings indicate that although the epidemiological safety of drinking water supplied through the centralized water supply system in the Khorezm Region is generally maintained, certain concerns regarding its physiological adequacy remain. In particular, insufficient concentrations of calcium, magnesium, fluoride, iodine, and selenium, together with seasonal deterioration of microbiological water quality during the summer period, support the need for continuous water quality monitoring and the implementation of appropriate water conditioning technologies to ensure a safe and physiologically balanced drinking water supply.

Keywords: drinking water; drinking water quality; hygienic assessment; centralized water supply; sanitary-chemical indicators; microbiological indicators; trace elements; water quality monitoring; water conditioning; public health.