

Date: 7th August-2026

**HYGIENIC RATIONALE FOR OPTIMIZING THE INTEGRATED
ASSESSMENT OF DRINKING WATER QUALITY BASED ON THE WATER
QUALITY INDEX**

Niyazmetov Murodbek Atabayevich

Candidate of Medical Sciences, Head of the Department of Medical and Biological
Sciences, Urgench RANCH University of Technology, Urgench, Uzbekistan

ORCID: [0009-0002-8327-819X](https://orcid.org/0009-0002-8327-819X);

E-mail: muradbek9547@gmail.com

Relevance. At the current stage of environmental hygiene development in Uzbekistan, one of the priority research areas is the development and application of methods for the integrated assessment of drinking water quality. According to the hygienic requirements currently in force in the country, “drinking water shall be epidemiologically and radiologically safe, harmless in terms of its chemical composition, and possess acceptable organoleptic properties” (O‘zMSt 133:2024. *Drinking Water. Hygienic Requirements for the Quality of Water Supplied through Centralized Drinking Water Supply Systems. Quality Control*). In accordance with this classical definition, drinking water quality is determined by four major hygienic criteria: microbiological, radiological, sanitary-toxicological, and organoleptic indicators.

Objective. To improve the Water Quality Index by integrating the sanitary and hygienic indicators of drinking water into a unified assessment system, to develop the hygienic principles for its optimization, and to determine its applicability in drinking water safety assessment.

Materials and Methods. The study was based on the results of laboratory analyses of sanitary-chemical, microbiological, and organoleptic parameters to provide a comprehensive hygienic assessment of drinking water quality. Water samples collected from a centralized drinking water supply system served as the study material. Sampling was performed in accordance with the current sanitary regulations and national standards. The collection, transportation, storage, and laboratory examination of the samples complied with the sanitary requirements of the Republic of Uzbekistan and relevant international standards.

Organoleptic assessment included the determination of odor, taste, color, and turbidity. Sanitary-chemical analysis comprised the evaluation of pH, total mineralization, total dissolved solids (TDS), total hardness, nitrates, nitrites, ammonium ions, chlorides, sulfates, iron, manganese, residual free chlorine, and other hygienically significant parameters. Microbiological examination included the determination of the total microbial count, total coliform bacteria, thermotolerant coliform bacteria, and the presence of *Escherichia coli*. Statistical analysis of the obtained data was performed using Microsoft Excel and SPSS Statistics software.

Results and Discussion. Within the framework of the study, organoleptic, sanitary-chemical, and microbiological parameters of water samples collected from a centralized

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drinking water supply system were comprehensively analyzed and integrally assessed using the Water Quality Index (WQI). The findings demonstrated that the measured values of all investigated parameters complied with the current hygienic standards and did not exceed the established permissible limits.

The mean pH was 7.38 ± 0.12 , total mineralization 356 ± 24 mg/L, total hardness 4.6 ± 0.5 meq/L, nitrate concentration 14.8 ± 2.1 mg/L, nitrite 0.018 ± 0.004 mg/L, ammonium 0.11 ± 0.03 mg/L, iron 0.07 ± 0.02 mg/L, manganese 0.018 ± 0.005 mg/L, chlorides 52.4 ± 6.8 mg/L, sulfates 74.6 ± 8.3 mg/L, and residual free chlorine 0.34 ± 0.05 mg/L. For all parameters, the C/PL ratio (measured concentration/permissible limit) remained below 1.0, ranging from 0.06 to 0.74.

Microbiological analysis revealed no detectable total coliforms, thermotolerant coliform bacteria, coliphages, sulfite-reducing *Clostridium* spores, or *Giardia* cysts. The total microbial count (TMC) was 18 ± 5 CFU/mL, which was 2.8-fold lower than the maximum permissible hygienic limit of 50 CFU/mL. Priority indicators were classified into four hygienic categories: organoleptic, sanitary-chemical, sanitary-toxicological, and microbiological. For each parameter, the relative quality rating (Q_i) and weighting factor (W_i) were calculated. The analysis showed that sanitary-toxicological parameters contributed 41.8% to the overall Water Quality Index (WQI), followed by microbiological parameters (29.6%), sanitary-chemical parameters (18.7%), and organoleptic parameters (9.9%).

The calculated integrated Water Quality Index (WQI) was 38.4. According to the adopted classification criteria (0–50 – excellent; 51–100 – good; 101–200 – satisfactory; 201–300 – poor; >300 – unsuitable for drinking), this value classified the water as excellent. Analysis of the WQI components demonstrated that sanitary-toxicological parameters and the total microbial count made the greatest contribution to the overall index.

Correlation analysis revealed a strong positive association between the WQI and sanitary-toxicological parameters ($r = 0.81$; $p < 0.001$), as well as with microbiological parameters ($r = 0.74$; $p < 0.01$). A moderate positive correlation was observed between the WQI and organoleptic parameters ($r = 0.43$; $p < 0.05$).

Conclusion. The results of the integrated assessment confirmed that the Water Quality Index is a reliable and informative tool for the comprehensive hygienic evaluation of drinking water quality. It enables monitoring of temporal changes in water quality and provides an effective basis for comparative assessment of the performance of drinking water supply systems.

Keywords: drinking water; Water Quality Index (WQI); integrated assessment; hygienic assessment; drinking water safety; environmental hygiene.

