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HYGIENIC ASSESSMENT OF THE CHEMICAL COMPOSITION OF WATER

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Abstract. This article describes the chemical composition of drinking water, its effect on the human body and public health, and the main criteria for the hygienic assessment of water quality. The hygienic significance of mineral substances, macro- and microelements, toxic chemical compounds, heavy metals, nitrates, nitrites, fluoride, chlorides, sulfates and other components is analyzed. The study shows the importance of comparing the results of laboratory tests with sanitary norms and health-based limit values when assessing the chemical safety of drinking water. The dependence of the chemical composition of water on the geological structure of the region, industry, agriculture and water treatment processes is also described. The World Health Organization recommends an approach to assessing drinking-water quality based on the identification and monitoring of chemical hazards and on risk management from the source to the consumer. The work is based on a theoretical analysis; no original laboratory measurements are presented.

Keywords: drinking water; chemical composition; hygienic assessment; minerals; trace elements; nitrates; nitrites; fluoride; heavy metals; water quality; sanitation; toxic substances.

1. Introduction

Water is one of the most important natural factors that sustain human life and health. The normal functioning of the human body, metabolism, thermoregulation, digestion, blood circulation and the biochemical processes in cells are closely connected with water. Therefore, providing the population with high-quality and safe drinking water is one of the key issues of sanitation, hygiene and public health [3].

The quality of drinking water is determined by its physical, chemical, microbiological and organoleptic properties. The chemical composition is of special importance in assessing the hygienic safety of water, because some chemical substances occur in water naturally, while others enter water sources as a result of human activity. When their amounts exceed the norm, they may have a negative effect on the human body [1, 3].

The current guidelines of the World Health Organization (WHO) indicate health-based targets, the use of water safety plans and independent monitoring as important tools for ensuring drinking-water safety.

The aim of this article is to describe the chemical composition of drinking water, to explain the hygienic significance of its main components and to outline the principles of hygienic assessment of its chemical safety.

2. Materials and Methods

2.1. Study design

This work is a descriptive analytical review of the principles of hygienic assessment of the chemical composition of water. The main theoretical provisions of water hygiene and the approach recommended by the WHO were used. No original laboratory measurements were carried out, and no new numerical data were generated.

2.2. Procedure for hygienic assessment of chemical composition

The hygienic assessment of the chemical composition of water is carried out on the basis of special laboratory tests and includes the following stages.

1. Sampling. The water sample is taken according to established rules and delivered to the laboratory. Errors made during sampling may affect the reliability of subsequent analysis results.

2. Laboratory analysis. In the laboratory, indicators such as pH, total mineralization, hardness, chlorides, sulfates, hydrocarbonates, calcium, magnesium, sodium, iron, manganese, fluoride, ammonium, nitrates and nitrites can be determined.

3. Additional tests. If there is a hazard in a particular region or water source, additional tests are carried out for heavy metals, pesticides and other chemical pollutants.

4. Comparison with norms. The results are compared with the sanitary norms and health-based limit values in force, and a conclusion is made on the suitability of the water for human consumption, in line with the general principle of hygienic evaluation [6, 7].

3. Results

The theoretical analysis shows that the chemical composition of water is formed under the influence of many factors, and each of its main components has its own hygienic significance. The main components are summarized in Table 1.

3.1. Formation of the chemical composition of water

Natural water is never completely pure chemically. During its movement and contact with the natural environment, water dissolves various mineral substances from the atmosphere, soil and rocks. Therefore, the chemical composition of water differs significantly depending on its source, geographical location, geological structure, climatic conditions and anthropogenic activity [2]. Groundwater is usually rich in minerals because it is in contact with rocks for a long time. The chemical composition of surface water bodies may change under the influence of precipitation, substances washed from the soil, agricultural runoff, industrial waste and domestic wastewater.

The basic chemical composition of water consists of calcium, magnesium, sodium, potassium, hydrocarbonate, carbonate, sulfate and chloride ions. In addition, trace elements such as iron, manganese, fluoride, copper and zinc, as well as nitrates, nitrites, ammonium compounds and various organic substances, may be present in water. In some cases, toxic elements such as lead, arsenic, cadmium, mercury and chromium also enter the water. Their amounts may increase as a result of natural geological processes or human activity. Therefore, in the hygienic assessment of the chemical composition of water, not only the presence of a substance but also its concentration, its effect on the human body and the duration of water use are taken into account.

3.2. Calcium, magnesium and water hardness

The mineral composition of water has a great influence on its physiological and hygienic properties. Calcium and magnesium are mineral elements necessary for the human body; they participate in the formation of bones and teeth, in neuromuscular activity and in enzymatic processes. The amount of calcium and magnesium in water determines its hardness, and hard water contains a high amount of calcium and magnesium salts. When such water is used in households, scale may form in heating devices and soap consumption may increase. However, hardness is not assessed only as a negative phenomenon, because calcium and magnesium are essential elements. Therefore, water hardness is assessed from a hygienic point of view together with its other chemical indicators.

3.3. Sodium, chlorides and sulfates

Sodium and chlorides are also important chemical components of water. Sodium takes part in water-salt metabolism, osmotic pressure and the transmission of nerve impulses in the body. Chloride ions are important in the formation of hydrochloric acid in gastric juice. However, when their amount in water becomes excessive, the taste of water deteriorates and total mineralization increases. Sulfates are also among the main anions of natural waters, and their amount is related to

the geological features of the water source. A high concentration of sulfates may change the organoleptic properties of water and, in some conditions, affect bowel function.

3.4. Fluoride

Fluoride is of special importance in assessing the chemical composition of drinking water. It is a trace element that participates in the mineral metabolism of dental and bone tissues. A sufficient amount of fluoride in water may help to prevent dental caries. At the same time, when its amount increases, pathological changes may develop in tooth enamel and bone tissue. Long-term consumption of high amounts of fluoride may lead to dental and skeletal fluorosis. Therefore, sanitary and hygienic control of the fluoride content of drinking water is one of the important preventive measures, especially in areas where the fluoride content of natural water sources is high or low.

3.5. Iron and manganese

Iron and manganese in water are also taken into account in hygienic assessment. Iron may enter water naturally through rocks and underground layers. In addition, corrosion of metal pipes in the water supply system increases the iron content of water. A high concentration of iron may worsen the color, taste and other organoleptic properties of water. Manganese also occurs in natural water, and when its amount increases it may negatively affect the organoleptic properties of water. Therefore, the amounts of these elements are regularly monitored by laboratory control.

3.6. Nitrogen compounds

Nitrogen compounds are another chemical indicator of sanitary importance for drinking water. Ammonium, nitrites and nitrates are formed during the decomposition of organic substances and may also come from fertilizers and sewage; their presence therefore reflects possible contamination of the water source. Nitrates and nitrites are of particular concern for health: when present in excess, they can interfere with the oxygen-carrying function of blood, and infants are most vulnerable. Therefore, determining such substances in drinking water and controlling their amount is one of the important areas of water hygiene.

3.7. Toxic elements

The presence of lead, arsenic, cadmium, mercury and other toxic components in drinking water requires special control from the point of view of chemical safety. These substances are harmful to health even at low concentrations if consumed for a long time: for example, lead affects the nervous system, especially in children, arsenic is associated with skin lesions and an increased cancer risk, and cadmium and mercury affect the kidneys and nervous system [1].

3.8. Anthropogenic factors

Anthropogenic factors also greatly influence the chemical composition of water. Untreated or insufficiently treated wastewater of industrial enterprises may contain various mineral and organic substances [3, 5]. Through the use of mineral fertilizers and pesticides in agriculture, their residues may pass from the soil into water sources. Domestic waste, faulty sewage systems and improper waste management can also change the chemical composition of water. Therefore, in order to ensure the hygienic safety of drinking water, it is important not only to treat the water but also to protect water sources from pollution.

Table 1. Main chemical components of drinking water and their hygienic significance

Component	Role and origin	Hygienic significance
Calcium and magnesium (hardness)	Essential minerals; derived mainly from rocks and soil	Needed for bones, teeth and neuromuscular function; high hardness causes scale and higher soap consumption
Sodium and chlorides	Water-salt balance; gastric hydrochloric acid	Excess worsens taste and increases total mineralization
Sulfates	Major natural anions; linked to geology of the source	High levels change organoleptic properties and may affect bowel function
Fluoride	Trace element of teeth and bone	Adequate level helps prevent caries; excess may cause dental and skeletal fluorosis
Iron and manganese	Natural, or from corrosion of metal pipes	Worsen color and taste of water
Nitrates, nitrites, ammonium	Nitrogen compounds; fertilizers, sewage, organic decomposition	Sanitary indicators; require control in drinking water
Lead, arsenic, cadmium, mercury, chromium	Toxic elements; geological processes or human activity	Presence requires special chemical-safety control

4. Discussion

The assessment of drinking-water quality cannot be limited to determining the amounts of individual chemical components. It requires a complex analysis of their mutual ratios, their source, their transformation in the aquatic environment and the degree to which they enter the human body.

From a hygienic point of view, it is important that macro- and microelements in water are present in physiologically optimal concentrations. Calcium, magnesium, sodium, potassium and other mineral components take part in the water-salt metabolism, enzymatic processes, neuromuscular activity and mineral homeostasis of the body, whereas both deficiency and excess of trace elements such as fluoride may cause certain functional and pathological changes. At the same time, the presence of nitrates, nitrites, lead, arsenic, cadmium, mercury and other toxic components in drinking water requires special control from the point of view of chemical safety.

Laboratory monitoring is an important diagnostic and preventive tool in assessing the chemical safety of water. By determining pH, total mineralization, hardness, chlorides, sulfates, nitrates, nitrites, ammonium compounds, iron, manganese, fluoride and toxic elements, a well-founded conclusion can be made on the sanitary and hygienic condition of water. Comparing the obtained results with the established norms allows an objective assessment of the suitability of water for human consumption.

It must also be taken into account that the chemical indicators of water quality vary over time and space. A single analysis may not fully reflect the long-term safety of water. Therefore, in the modern hygienic approach, the priority tasks are regular, systematic and risk-oriented monitoring, protection of water sources in sanitary protection zones, prevention of anthropogenic pollution and, where necessary, the use of effective water treatment and conditioning technologies. In line with the WHO approach, this means managing chemical risks from the source to the consumer. The training of specialists in hygiene is also important for the competent application of these principles [4].

A limitation of this work is that it is based on a theoretical review and does not include original measurements. The norms and limit values depend on the regulatory documents in force and may differ between countries; further studies with data from specific water sources would allow the described approach to be tested in practice.

5. Conclusion

The hygienic assessment of the chemical composition of water is of fundamental importance in ensuring drinking-water safety, protecting public health and reducing water-related ecological and sanitary risks. The chemical composition of water is formed under the influence of natural geological features, hydrogeochemical processes, anthropogenic load and water treatment technologies.

Laboratory monitoring of pH, total mineralization, hardness, chlorides, sulfates, nitrates, nitrites, ammonium compounds, iron, manganese, fluoride and toxic elements, and comparison of the results with the established norms, make it possible to evaluate objectively whether water is suitable for human consumption. Because a single analysis may not reflect long-term safety, regular, systematic and risk-oriented monitoring, protection of water sources and, when necessary, effective treatment are priority tasks.

REFERENCES

1. Gadaev, A., Ismoilov, D., Ruziyev, O., Razakova, R., & Toshboev, F. (2025). Assessing the Impact of Environmental Chemicals on the Development of Neurodegenerative Diseases Across Biological Systems. Journal of Animal Environment, 17(3), 889-900.
2. Tavakkalovich, I. D. (2026). SHAHAR SHOVQINING AHOLI SALOMATLIGIGA TA ‘SIRI VA UNING HUDUDIY XUSUSIYATLARI. ACTIVIST SCIENCE, 3(3).
3. Tavakkalovich, I. D. (2026). SUV RESURSLARINING KIMYOVIY VA SANOAT CHIQINDILARI BILAN IFLOSLANISHI SANITARIYA-GIGIYENIK TAHLIL VA NORMATIV TALABLAR. ACTIVIST SCIENCE, 3(3).
4. Ashurova, M. D., Mo’ydinova, Y., Atadjanova, D., Muhammadova, G., & Ismoilov, D. (2023). Pedagogical efficiency of integrated learning in the organization of hygiene classes in medical universities. In BIO Web of Conferences (Vol. 65, p. 10016). EDP Sciences.
5. Umaralievich, A. R., Ugli, I. D. T., Qizi, U. F. U., & Ugli, U. H. N. (2021). Hygienic assessment of working conditions and environmental protection at glass production plants.
6. Tavakkalovich, I. D. (2026). HYGIENIC ASSESSMENT OF FOOD PRODUCT QUALITY. BG pulse journal, 2(10), 310-312.
7. Tavakkalovich, I. D. (2026). METHODS FOR TESTING AND EVALUATING ARTIFICIAL LIGHTING PARAMETERS IN ROOMS. BG pulse journal, 2(10), 306-309.