UDC 577.38, 577.356; 577.359 https://doi.org/10.33619/2414-2948/106/09
AGRIS Q01

THE ROLE OF WATER IN THE LIFE OF LIVING ORGANISMS

©Mammadov H., *ORCID: 0009-0003-8904-5933, Ph.D., Nakhchivan State University, Nakhchivan, Azerbaijan, hasan_1961@mail.ru*
©Gulamova A., *ORCID: 0000-0002-2086-7408, Nakhchivan Food Safety Institute, Nakhchivan, Azerbaijan, aynurequlamova82@gmail.com*

РОЛЬ ВОДЫ В ЖИЗНИ ЖИВЫХ ОРГАНИЗМОВ

©Маммадов Х., *ORCID: 0009-0003-8904-5933, Нахичеванский государственный университет, канд. экон. наук, Нахичеванский институт продовольственной безопасности, г. Нахичевань, Азербайджан, hasan_1961@mail.ru*
©Гуламова А., *ORCID: 0000-0002-2086-7408, Нахичеванский институт продовольственной безопасности, г. Нахичевань, Азербайджан, aynurequlamova82@gmail.com*

Abstract. The article discusses the biological, physical, and chemical properties of natural drinking and bottled mineral waters and examines their mechanism of effect on human health. It provides information on the criteria that drinking water must meet to be considered safe and offers a comparative analysis of mineral waters. The use of various types of mineral waters in the treatment of specific diseases is investigated. The physical and chemical indicators of mineral waters produced in the Nakhchivan Autonomous Republic and their benefits are described. The research concludes that while proper and effective use of mineral waters is beneficial to human health, improper use without considering their composition can lead to serious safety issues.

Аннотация. В статье рассматриваются биологические, физические и химические свойства натуральных питьевых и бутилированных минеральных вод, а также изучается их механизм воздействия на здоровье человека. Приводится информация о критериях, которым должна соответствовать питьевая вода, чтобы считаться безопасной, и проводится сравнительный анализ минеральных вод. Исследуется использование различных типов минеральных вод в лечении конкретных заболеваний. Описаны физико-химические показатели минеральных вод, производимых в Нахичеванской Автономной Республике, и их преимущества. Исследование приходит к выводу, что правильное и эффективное использование минеральных вод полезно для здоровья человека, однако неправильное использование без учета их состава может привести к серьезным проблемам с безопасностью.

Keywords: mineral waters, hardness, macroelements, microelements, diseases, balneotherapy.

Ключевые слова: минеральные воды, жесткость, макроэлементы, микроэлементы, заболевания, бальнеотерапия.

Water is one of the biological, physical, and chemical elements that plays a crucial role in the life processes of humans and all living organisms. Drinking water is a liquid that can be used safely for long periods without harming health. Water makes up 50-80% of the human body, although this proportion varies at different stages of physical development. Infants' bodies consist of 75% water, children 70%, adults 60%, and elderly individuals 50%. Losing 20% of body water can lead to cell

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https://doi.org/10.33619/2414-2948/106

destruction and death. Even a 1% loss of fluid can cause dehydration. A person can survive without water for 3-5 days.

Prolonged water deficiency can lead to various psychological disorders, muscle cramps, and organ failure. A healthy person should drink 1.5-2 liters of water daily. However, it is important to note that excessive water accumulation in the body is also harmful.

Water is crucial for several reasons. Firstly, it plays a decisive role in ensuring normal metabolic activity due to its solvent properties. It also helps in detoxification, skin hydration, aids kidney function, and supports immune system protection.

Characteristics of Drinking Water

Drinking water should have the following qualities: It must be free of disease-causing microbes, colorless, odorless, transparent, have a temperature below 15°C, be sufficiently soft, and not abrasive. It should not contain undissolved chemical substances like hydrogen sulfide (H_2S), iron (Fe), or manganese (Mn), and should not have any substances that could be toxic or harmful beyond normative indicators.

Packaged drinking water in retail trade networks should be available in sufficient quantities and be reasonably priced for the public. According to the World Health Organization, 80% of health issues are related to drinking water.

CHEMICAL STANDARDS & PHYSICAL PROPERTIES FOR DRINKING WATER

Chemical Substance	*Normative Amount (mg/l)*	*Physical Property*	*Normative Amount*
pH	6.5-9.5	Turbidity	Clear
Magnesium (Mg)	50	Colour	Colourless
Calcium (Ca)	100-200	Odor	Odorless
Fluoride (F)	1.50	Temperature	4-12°C
Sodium (Na)	200		
Iron (Fe)	0.2-0.3		
Potassium (K)	12		
Nitrate (NO_3)	50		
Nitrite (NO_2)	0.50		
Sulfate (SO_4)	250		

pH is a measure of water's acidity or alkalinity. According to WHO standards, drinking water samples should have a pH between 6.5 and 9.5, magnesium content should be 50 mg/l, and calcium content should be 200 mg/l. Water with a pH below 6.5 is acidic and can corrode metals in network systems and homes, while water with a pH above 9.5 can create taste issues and a slippery feeling. Long-term use of water with high pH can contribute to the formation of stones (gallstones, kidney stones). pH levels can be influenced by industrial pollution and the type of soil through which water flows. The hardness of water depends on the amount of calcium and magnesium salts it contains. Excessive magnesium can damage the eyes, cause diarrhea, and make water taste bitter. Magnesium levels in water are affected by soil composition. Calcium does not directly harm the body, it is beneficial for bone structure; however, excessive amounts can increase the risk of stone formation, while insufficient amounts can be abrasive [1].

Composition and Benefits of Mineral Waters

Mineral water is a natural water containing high amounts of dissolved mineral salts, gases, organic substances, and other beneficial components. Mineral water is distinguished from regular

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drinking water by its special physical and chemical properties and varies based on its origin, composition, temperature, and gas exchange. Mineral waters are classified into underground (formed under pressure and temperature at great depths) and surface (formed at the earth's surface under atmospheric influence). Mineral waters are categorized based on their content into carbonated (containing carbon dioxide), sulfurous (containing hydrogen sulfide), radon (containing radon), iodine-bromine (containing iodine and bromine), and iron-rich waters. They are also classified by their ion content, such as calcium, magnesium, sodium, potassium, chlorides, sulfates, bicarbonates and others. Based on temperature, mineral waters are classified into cold (up to 20°C), warm (20-37°C), and hot (above 37°C). Based on gas content, they are classified into carbonated (containing more gas than the atmosphere), naturally carbonated (same amount of gas as the atmosphere), and non-carbonated (less gas than the atmosphere). Gas exchange in water depends on its source, composition, and temperature.

Mineral water can be classified according to various criteria, but the most common is the classification according to the degree of mineralization, that is, the amount of salt dissolved in 1 liter of water. According to this criterion, mineral waters are divided into: Low mineralization: up to 1 g/l; Medium mineralization: 1-10 g/l; High mineralization: 10-35 g/l; Very high mineralization: above 35 g/l. The mineralization level determines the therapeutic properties and usage of mineral water. The higher mineralization means the higher effect of water, but ıt becomes less drinkable. Low mineral waters can be consumed without restrictions, medium mineral waters with medical advice, and high and very high mineral waters under medical supervision and in small amounts.

There is substantial scientific evidence supporting the effectiveness of mineral water in treating various diseases. Mineral water affects physiological and biochemical processes in the body by normalizing acid-base balance, accelerating metabolism, improving digestion, reducing inflammation, enhancing immunity, detoxifying, improving circulation, relieving spasms and pain, strengthening bones and teeth, and improving skin and hair condition. However, mineral water has many beneficial properties for the human body. But not every mineral water is suitable for the treatment of all kinds of diseases. For the treatment of a particular disease, mineral water can be used depending on its composition, its temperature and method of drinking. In order to get the maximum benefit from Mineral water, it is necessary to pay attention to its type, composition, temperature and method of consumption, these factors must be taken into account in order to choose a suitable mineral water. Waters with bicarbonates, sulfates, chlorides, calcium, magnesium, and sodium are suitable for gastrointestinal diseases. Such water stimulates gastric juice secretion, increases intestinal motility, and helps heal ulcers and erosions. Waters with sulfur, iodine, bromine, fluoride, calcium, and magnesium are suitable for musculoskeletal disorders. They strengthen bone tissue, reduce inflammation and swelling in joints, and improve metabolism between bones and cartilage. Sulfur, iodine, bromine, fluoride, and selenium-rich mineral waters are useful for skin diseases, providing antiseptic and anti-inflammatory effects, and improving skin elasticity and color. Each disease has its optimal mineral water for speeding up recovery. Mineral water is not crucial for all diseases but serves as an additional tool in complex treatment. The use of mineral water in therapy is called balneotherapy. Although balneotherapy is considered an alternative medicine method, it is widely used by doctors due to its effectiveness. Mineral water benefits not only joints but also cartilage, bone, and muscle tissue.

Mineral water is beneficial for individuals suffering from arthritis, spondylosis, osteoarthritis, gout, and consequences of bone, tendon, and muscle injuries, as well as rheumatism and osteochondrosis. Magnesium-rich mineral water reduces the risk of coronary heart disease, heart attack, and stroke. Radon-rich water alleviates osteochondrosis, arthritis, and chronic pain related to nerves. Gout patients should include alkaline mineral water in their diet. Alkaline water also

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normalizes stomach function and is used in gastritis treatment, typically consumed 1.5-2 hours before meals.

Systematic consumption of mineral water has been proven beneficial for joint osteoarthritis. Dehydration affects cartilage, joint tissue, and tendons, making them less elastic and more brittle. Calcium deficiency leads to bone tissue deformation and brittleness. Mineral water positively affects spinal ligaments. Iodine-rich water is particularly beneficial for joints, reducing pain, inflammation, and muscle tension while improving tissue nourishment and recovery. Alkaline, iodine-bromine, sodium, and complex mineral waters are suitable for preventing and treating musculoskeletal disorders, especially joint pathologies. Mineral water can be stored in plastic bottles at temperatures up to 20°C for 3 to 18 months. After opening, the water should be kept in the refrigerator and consumed within a few days. The key factor in using mineral waters is their composition, and contraindications arise depending on the water's content. Table waters are generally considered safe for consumption [2].

Drinking any mineral water for extended periods can be harmful, particularly for individuals with acute or chronic conditions. For example, chlorinated water is risky for patients with gallstones and hypertension, while sulfate-rich water should be avoided by adolescents, as their skeletal system is still developing, and by those with calcium deficiencies (osteoporosis, etc.). Magnesium-rich water can be dangerous for people with small stones in the gallbladder or kidneys due to its choleretic and diuretic effects, which might cause stones to move.

The U.S. Food and Drug Administration (FDA) has conducted studies on plastic containers used for food and drink, highlighting their potential hazards [3]. These studies raised awareness about the environmental impact of plastic bottles and the dangers of bisphenol A ($C_{15}H_{16}O_2$), a key component of plastic. It has been proven that when food is heated or if proper storage guidelines for plastic-wrapped water are not followed, bisphenol A can leach into the food, leading to serious food poisoning and disrupting hormonal functions. It is recommended to use water packaged in glass bottles for optimal health safety.

Materials and Methods

The majority of the population in the Nakhchivan Autonomous Republic uses bottled sparkling and still waters from various factories and plants for drinking. We collected samples of both plastic and glass bottled waters available in the Nakhchivan AR and analyzed them primarily for pH, permanent and temporary hardness at the Central Food Testing Laboratory of the Nakhchivan Food Safety Institute. The quantities of Ca2+ and Mg2+ cations, as well as other macro and microelements, were also examined.

Results and Discussion

Results 5-liter plastic bottled still Sirab water analyzed at the Central Food Testing Laboratory of the Nakhchivan Food Safety Institute showed a total mineralization degree of 14 mg/l, with Na^+ and K^+ at 10 mg/dm³, Mg^{2+} at 3.0 mg/dm³, Ca^{2+} at 6.2 mg/dm³, and a pH of 7.1. For 1-liter plastic bottled carbonated Sirab water, the total mineralization degree was 820 mg/l, with Na^+ and K^+ at 130 mg/dm³, Mg^{2+} at 45 mg/dm³, Ca^{2+} at 220 mg/dm³, and a pH of 5.99.

Conducted research has indicated that Sirab water is recommended for individuals with metabolic disorders, respiratory illnesses, urinary system diseases, gastrointestinal tract diseases, and liver diseases [1].

During laboratory tests, it was found that the mineralization level of 5 liters of non-carbonated Badamlı water is 41 mg/l. The amounts of Na+ and K+ are 13 mg/dm³, Mg^{2+} is 2.8 mg/dm³, Ca^{2+} is 5.7 mg/dm³, and the pH is 7.5. In contrast, 1 liter of carbonated Badamlı water, packaged in a

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https://doi.org/10.33619/2414-2948/106

plastic bottle, has a mineralization level of 400 mg/l. The amounts of Na+ and K+ are 102 mg/dm³, Mg^{2+} is 29 mg/dm³, Ca^{2+} is 83 mg/dm³, and the pH is 5.6. Badamlı water is bicarbonate, magnesium, calcium, and sodium-rich, with a mineralization level ranging from 0.7 to 7.4 g/l. The pH is 7.5, with calcium at 83 mg/l and magnesium at 45 mg/l. Badamlı water is recommended for use in digestive system disorders, certain liver diseases, and urinary tract conditions.

Figure. Bottled sparkling and still waters from various factories and plants (https://lyl.su/Ouc1)

The mineralization level of 1 liter of carbonated Darıdağ mineral water, packaged in plastic bottles, is 825 mg/l. The amounts of Na+ and K+ are 312 mg/dm³, Mg^{2+} is 52 mg/dm³, Ca^{2+} is 210 mg/dm³, and the pH is 5.80. Darıdağ water is a type of mineral water that has therapeutic significance for conditions such as myocardial dystrophy, joint pain, metabolic disorders, and gynecological diseases.

Conclusion.

Based on numerous studies, the increase in cardiovascular diseases and the occurrence of muscle and nerve spasms are associated with magnesium deficiency in the body. Additionally, some research has demonstrated that the reduction in calcium and magnesium levels in softened waters contributes to an increased risk of vascular diseases. Studies examining overall calcium and magnesium levels indicate a correlation between magnesium levels and cardiovascular diseases. A lack of sufficient magnesium in the body may lead to the rapid onset of symptoms associated with cardiovascular diseases.

According to the World Health Organization, it is crucial to consider every detail, including the determination of the minimum allowable levels of calcium and magnesium in drinking water, in regions with significant deficiencies of these elements in the diet. Research shows that magnesium intake is linked to reduced risk of heart disease and cancer, as well as lower cholesterol levels and stress. Conversely, magnesium deficiency can lead to decreased bacterial counts in the intestines and an increased risk of gastric ulcers. The human body obtains 10-20% of its required calcium from drinking water. Deficiency in this element can result in pathological conditions such as musculoskeletal disorders, brittle nails, thinning of the scalp, and chronic fatigue [4].

Based on our laboratory analyses, it can be concluded that the use of carbonated sodium-calcium Sirab water produced in the Nakhchivan Autonomous Republic is recommended for patients with gastritis. However, due to its acidic nature, the consumption of carbonated mineral waters such as Sirab, Badamlı, and Darıdağ is not advisable for individuals with gout. Similarly, these waters could have serious health implications for people with gallbladder and kidney stone diseases. The research has identified that in the autonomous republic, the amounts of calcium and magnesium ions in non-carbonated mineral waters are significantly reduced during filtration. People commonly use non-carbonated waters in 5, 10, and 20-liter volumes for regular consumption, which

disrupts the calcium and magnesium balance in the body. To maintain this balance, it is recommended to consume 0.5-1.0 liters of highly mineralized carbonated water daily. It is important to note that there is a direct correlation between life expectancy and the total amount of calcium and magnesium in the diet. Given the above, it can be stated that if the population uses the mineral waters sold in the autonomous republic according to their intended purpose, it can be beneficial from a safety perspective.

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Работа поступила
в редакцию 16.08.2024 г.

Принята к публикации
22.08.2024 г.

Ссылка для цитирования:

Mammadov H., Gulamova A. The Role of Water in the Life of Living Organisms // Бюллетень науки и практики. 2024. Т. 10. №9. С. 90-95. https://doi.org/10.33619/2414-2948/106/09

Cite as (APA):

Mammadov, H. & Gulamova, A. (2024). The Role of Water in the Life of Living Organisms. *Bulletin of Science and Practice, 10*(9), 90-95. https://doi.org/10.33619/2414-2948/106/09