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DETERMINATION OF SOME VITAL IONS IN THE SPRING WATERS OF THE VILLAGE OF AKHUTI IN THE CHKHOROTSKU MUNICIPALITY(GEORGIA)

Abstract: *For the first time, a study of the chemical composition of water from some springs in the village of Akhuti in Chkhorotsqu municipality was conducted. The pH, water hardness, magnesium, calcium, total iron, chloride, bromide, hydrocarbonate and sulfate ions, permanganate oxidation, dissolved oxygen, total arsenic, free carbon dioxide, BOD₅, and biogenic substances were determined. Relatively simple and rapid chemical and physico-chemical methods with good reproducibility were selected for the determination. Biogenic substances in the examined waters were studied by photometric method. The content of biogenic substances - NO_2^-, NO_3^-, NH_3, PO_4^3 ions is less than the detection limit and their content is not recorded. The quantitative content of the these ions in the examined springs is within normal limits, it is environmentally friendly, and its use for drinking and economic purposes is recommended.*

Key words: *water; chemical analysis; ions; biogenic substances; spring.*

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Introduction

Jointly with students, the chemical composition of waters from some springs in the village of Akhuti in Chkhorotsku municipality was studied. For this purpose, we studied the springs for: pH, water hardness, Mg^{2+}, Ca^{2+}, total iron, HCO_3^-, SO_4^{2-}, Br^-, total arsenic and Cl^- ions, permanganate oxidation, dissolved oxygen, free carbon dioxide, BOD_5, and biogenic elements content. The relevance of the issue lies in the fact that the content of the above-mentioned ions was determined for the first time in these waters, for which highly sensitive methods were selected. The analyses were conducted in the Iason Moseshvili Hydrochemistry Laboratory of the Chemistry Department of the Faculty of Exact and Natural Sciences at Akaki Tsereteli State University.

Water covers a large part of our planet's surface; water is everywhere around us and in our bodies. Water is a substance essential for life. Water, like carbon, has special importance for living organisms. It is essential for life. It is impossible to overestimate the importance of water for life. Water is unevenly distributed on Earth. Water is found not only on the Earth's surface but also underground and in the air as water vapor. Soil contains water along with other substances. Water has unique properties and is necessary for the existence of vegetation, the animal world, and humans. It is the most important natural resource [1]. In natural conditions, water always contains dissolved salts, gases, and organic substances in varying amounts. If this amazing substance were not so necessary, human rough hands would have dried it up by now. Water is one of the important components of the diet. It participates in the body's metabolism, digestion, excretion of metabolic products with urine, and thermoregulation. The body's demand for water varies. It depends on climate, workload, health condition, diet, and other factors [2].

The content of salts of calcium and magnesium gives natural water its hardness. When CO_2-containing water comes into contact with limestone layers, carbonates are converted to bicarbonates, which dissolve well in water [3].

Water is involved in numerous biochemical processes. Therefore, life depends on water. Substances necessary for an organism's life dissolve well in water; water is involved in numerous biochemical reactions. The most important biochemical reactions are photosynthesis and cellular respiration. All living organisms need water. Life originated in water. In reality, without molecules composed of three simple atoms, life would not exist. The water molecule has positive and negative poles, making it polar. Hydrogen bonds form between water molecules. Pure water is used in many sectors, and its quality control is necessary.

Chkhorotsku district is located on the left bank of the Khobistskali River. The relief is diverse. The territory is within the Colchis Plain. It represents a weakly and dissected plain and foothill. The plain is composed of Quaternary and Tertiary sedimentary formations. The foothill zone is mainly composed of Cretaceous limestones, marls, and sandstones. In the northern half, there is a mountainous relief; to the north rises the Egrisi Range. The climate is humid subtropical, with mild winters in the plain, long hot summers, and maximum precipitation in autumn-winter. In the foothills, winters are moderately cold with long, warm summers. The river network density is high. The territory of the district is crossed throughout its length by the upper and partially middle course of the Khobistskali. Its largest tributary is Ochkhomuri. The rivers are fed by rain, snow, and

groundwater. The soils in the lowlands are subtropical podzolic and alluvial carbonate. In the foothills, there are yellow soils, with some red soils and some podzolized areas.

Akhuti is a village in Georgia, in the Chkhorotsku municipality of the Samegrelo-Zemo Svaneti region, a community center (villages: Akhuti, Mongiri). It is located east of the town of Chkhorotsku, in the valley of Zana and Otskarie. It borders the villages of Nogha and Potskho, as well as Kvemo Chkhorotsku, the town of Chkhorotsku, and Nakiani.

Discussion of the experiment:

For the first time in the spring waters of the village of Akhuti in the Chkhorotsku municipality, pH, water hardness, Mg^{2+}, Ca^{2+}, total iron, HCO_3^-, SO_4^{2-}, Br^-, total arsenic and Cl^- ions, permanganate oxidation, dissolved oxygen, free carbon dioxide, BOD_5, and biogenic substances content were determined using chemical and photometric methods. The analysis results are presented in Table1.

Table 1. Hydrochemical Analysis Results of Some Spring Waters in the Village of Akhuti in the Chkhorotsku Municipality

N	Local names of the springs	pH	Mg/l	Mg/l											
			Water hardness	Mg^{2+}	Ca^{2+}	Total iron	Br^-	Cl^-	HCO_3^-	Free CO_2	Dissolved oxygen	BOD (Biochemical Oxygen Demand)	Permanganate oxidation	Total arsenic	SO_4^{2-}
1	Zuriko's	7,51	0,82	0,42	7,64	0,018	0,12	0,48	0.64	1.20	1.55	1,38	0, 82	0,030	0,038
2	Eka's	7,83	1,04	1.21	9,21	0,ოշշ	0,15	0,38	0,42	1.24	1,46	1,28	0,32	0,028	0,033
3	Aliosha's	7,47	1,60	4,45	1,16	0,028	0,08	0,66	0,54	1,36	1,44	1,20	1,68	0,026	0,082
4	Jobia's	7,55	3,68	28,8	8,08	0,026	0,19	0,56	0,64	0.98	1.66	1,28	0,46	0,027	0,045
5	Nukri's	7,35	3,56	36,04	5,69	0,019	0,14	0,52	0,58	1,27	1,50	1,25	0,49	0,024	0,017
6	Miro's	7,28	1,84	9,68	6,62	0,024	0,17	0,54	0,36	0,78	1,79	1,29	1.44	0,019	0,116
7	Paata's	7,05	1,16	4,87	4,87	0,020	0,16	0,62	0,44	0,88	1.77	1,36	1,52	0,022	0,071
8	Tamazi's	7,32	2,76	20,86	6,81	0,027	0.09	0,72	0,74	1,26	1,69	1,31	0,56	0,015	0,062
9	Amalioni's	7,05	1,96	10,08	9,65	0,023	0,11	0,56	0.72	1,00	1,34	1,26	0,96	0.026	0,021
10	Aliko's	7,03	5,40	45.22	8.86	0,025	0,20	0,58	0,62	0,87	1,63	1,39	0.88	0,025	0,049

In the examined spring waters, the pH ranges from 7.03 to 7.51. The water hardness is relatively higher in Nukri's spring at 3.56 mg/L. The hardness is low in Zuriko's spring - 0.82 mg/L. Aliko's spring contains the highest amount of magnesium ion at 45.22 mg/L. Its content is lowest in Zuriko's spring at 0.42 mg/L. The ion content is also variable. A relatively large amount was recorded in Amalioni's spring at 9.65 mg/L, while the content is low in Amalioni's spring at 1.16 mg/L. The total iron content is higher in Aliosha's spring at 0.028 mg/L. Its content is low in Zuriko's spring at 0.019 mg/L. Aliko's spring contains more bromide ions at 0.20 mg/L, while its content is low in Tamazi's spring at 0.09 mg/L. Tamazi's spring contains relatively more chloride ions at 0.72 mg/L, while its mass content is low in Eka's spring at 0.38 mg/L. The ion content is highest in Tamazi's spring at 0.74 mg/L, while the hydrocarbonate ion content is low in Eka's spring at 0.42 mg/L. The content of free carbon dioxide is highest in Aliosha's spring at 1.36 mg/L. Aliko's spring contains a small amount of free carbon dioxide at 0.87 mg/L. The dissolved oxygen content is higher in Miro's spring at 1.79 mg/L. A relatively low concentration of dissolved oxygen is recorded in Amalioni's spring at 1.34 mg/L. BOD_5 is highest in Aliko's spring at 1.39 mg/L, relatively lower in Amalioni's water at 1.20 mg/L. Permanganate

oxidation is relatively high in Aliosha's spring at 1.68 mg/L, with a small amount detected in Eka's spring at 0.32 mg/L. A high concentration of total arsenic is detected in Zuriko's spring at 0.030 mg/L. Tamazi's spring contains a small amount of total arsenic at 0.015 mg/L. The content of SO_4^{2-} ions is relatively higher in Miro's spring at 0.116 mg/L, while Amalioni's spring contains a small amount of sulfate ions at 0.017 mg/L.

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The content of biogenic substance ions is below the detection limit and is not detected in the examined spring waters of the village of Akhuti in the Chkhorotsku municipality

Experimental Part: Methodology for Determining Chemical Elements in Water

The analyses were conducted in the Analytical Chemistry Laboratory of the Kutaisi Akaki Tsereteli State University. Methods approved in hydrochemical practice were used for the analysis [4, 5, 6, 7].

The acidity index was measured by the potentiometric method (potentiometer pH 673-M).

The content of calcium and magnesium, as well as the total hardness of water in the investigated waters, was determined by the complexometric method (titrant 0.01N Complexon III. For the determination of magnesium ion content, we used Eriochrome Black as an indicator, creating the recommended environment with an ammonia buffer, while for the determination of calcium ion, Murexide was used as an indicator. The alkaline environment was created with 2N sodium hydroxide.

Total iron in waters was determined by the spectrophotometric method after preliminary oxidation in an alkaline environment (photometric reagent sulfosalicylic acid) (UN-5100B UV/VIS SPECTROPHOTOMETER).

Hydrocarbonates were determined by the acidimetric method (titrant 0.1-0.01 N, indicator - methyl orange).

Sulfate ions were determined by the classical gravimetric method, with the precipitating form being $BaSO_4$.

The mercurimetric method was used to determine chlorides (titrant 0.01 $Hg(NO_3)_2$, indicator diphenylcarbazone).

Total arsenic was determined by the iodimetric method, titrant 0.05 N iodine solution, indicator - starch.

Free carbon dioxide was determined by the alkalimetric method. Titrant 0.1-0.01N NaOH. A small amount of Seignette salt and indicator phenolphthalein were added to the water to be titrated.

Oxidation was determined by the permanganate method (oxidizer 0.01 N $KMnO_4$ in acidic environment, titrant 0.01 N $Na_2S_2O_3$).

Oxygen content and BOD_5 were determined by the iodometric method (titrant 0.01 N $Na_2S_2O_3$). In an alkaline environment, Mn^{2+} is oxidized by dissolved oxygen in water and converted into a tetravalent manganese compound, which is formed upon acidification of the solution in the presence of excess KI [5].

Bromide ions were determined by the iodometric method. (Sodium hydrogen phosphate, sodium hypochlorite, and sodium formate were added to the analytical water, the analytical mixture was heated, then cooled. Potassium iodide, sulfuric acid, and ammonium molybdate were added. Titrant 0.01 N $Na_2S_2O_3$, indicator starch). Bromide ions are oxidized by sodium hypochlorite to bromate ions.

Biogenic substances were determined by the photometric method: NO_2^- with Griess reagent, NO_3^- with sodium salicylate, NH_4^+ with Nessler's reagent, PO_4^{3-} with ammonium phosphomolybdate.

The photometric determination of NO_2^- was based on the reaction of sulfanilic acid, nitrite ion, and alpha-naphthylamine using Griess reagent in an acidic

environment, resulting in the formation of a reddish-brick-colored azo dye.

The determination of NO_3^- was carried out by the photocolorimetric method using sodium salicylate. The method is based on the interaction between nitrate ions and sodium salicylate ions in the presence of sulfuric acid, during which the resulting yellow color is directly proportional to the nitrate ion concentration.

The determination of NH_4^+ is based on the interaction between ammonium ion and Nessler's reagent (mercury tetraiodide) in an alkaline environment, during which the resulting yellow color is directly proportional to the ammonium ion concentration.

The determination of PO_4^{3-} was carried out by the photocolorimetric method, which is based on the interaction of orthophosphoric acid and ammonium molybdate in an acidic environment, during which the resulting blue color is directly proportional to the phosphate concentration [6].

Conclusion:

The analysis of the waters shows that the magnesium, calcium, hydrocarbonate and chloride ions, free carbon dioxide, permanganate oxidation, oxygen, and BOD_5 in the spring waters of the village of Akhuti comply with the requirements for drinking water in Georgia. As for the elements important for life, especially calcium, magnesium, and iron, they are present in the spring waters we studied in the amounts necessary for the normal functioning of living organisms. The content of Ca^{2+} ions is high in the water of Amalioni's spring, while Mg^{2+} ions are high in Aliko's spring. Although the content of total iron is within normal limits, it is high in Aliosha's spring and low in Zuriko's spring. Toxic ions have not been detected in the spring waters we examined. There are no industrial facilities or farms located near the village. The examined waters are suitable for drinking and household use.

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