

CHEMISTRY

HYDROCHEMICAL AND SANITARY MICROBIOLOGICAL RESEARCH OF THE ELENA HILL SPRING WATERS IN THE NAKHUNAO COMMUNITY OF MARTVILI MUNICIPALITY

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ABSTRACT

Hydrochemical and sanitary microbiological research of the Elena Hill spring waters in the Nakhunao community of Martvili Municipality was done for the first time.

The content of Mg^{2+} , Ca^{2+} , Fe^{3+} , HCO_3^- , Cl^- , I^- ions was determined. Relatively simple and quick chemical and physico-chemical methods of good repeatability were selected for determination. Biogenic substances were determined by photometric method.

Carbon dioxide, oxygen BOD_5 and dry remains were also identified. Sanitary-microbiological studies were performed using the following methods: mesophilic aerobes and facultative anaerobes: MYK, 2.1.4 1184-03, common coliform bacteria – MYK 4.2. 1018-01 and Escherichia coli – 18963-73. Based on the experimental data, it was found that the spring water that being researched is low-mineralized, which is why their reaction is almost neutral. The above-mentioned ionic content in the studied spring waters is within the norm, and in some samples (mesophilic aerobes and facultative anaerobes, common coliform bacteria) are established that microbiological, such a marginal concentration of pollution that is harmless for human health and its use in drinking and agricultural terms is within the norm.

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Introduction. Water is the source of life and it is a building material used by all organisms, water brings the necessary substances into the body and takes out everything unnecessary. Water is a universal solvent. It is of great importance in a person's daily life. It is one of the most important unchangeable resources and invaluable wealth of our planet. It has always been considered as the first source of life. Water is used widely and in many ways. From the day of its origin, man has been influencing the biosphere, using its resources, which has led to some changes in the biosphere. Thus the problem of environmental protection is of vital importance, especially by means of the importance of water. Rational use and protection of water resources is crucial.

Chemically pure water does not exist in nature. While moving in the earth's crust, water touches many minerals, dissolves them, and carries them along the entire path of circulation. Natural water is a solution that contains substances of different nature and condition, so the study of natural waters requires knowledge of the basic properties of the solutions [1].

Martvili district is located in the north-eastern part of western Georgia, in the Odisha lowlands (southern part) and in front side of the Egrisi ridge mountain (central part) and its southern slopes (northern part). It is bordered on the north by Lentekhi, on the east by Khoni and Tsageri, on the south by Abasha, on the west by Senaki and Chkhorotsku districts. The southern part of the Martvili area is occupied by a lowland, which rises from 60 to 170 m from southwest to northeast. The highest point is located at 3003 meters above sea level. To the south-west of the Martvili area lies the Askha Mountain Massif, which is rich with karst caves, waterfalls, mineral deposits and building stones. Lebarde's "Chegola" and the Dviri Mountains are rich with healing mineral waters. The beautiful valleys of the plants on the shore create wonderful relief formations, small river plains and table-lands where excellent gardens are cultivated on the alluvial soils of hundred years. The rivers Tekhuri and Abasha, which originate from the Egrisi ridge, flow onto the territory of the municipality [2].

The village of Nakhunao is mountainous, Elena Hill is 150 meters above sea level. Four pure cold springs flow down from Elena Hill. The places where the springs come out from the ground are 900 meters away from each other.

Calcium and magnesium ions are the leading ions in low-mineralized waters. Magnesium and calcium salts determine the constant and temporary hardness of water. An increase in mineralization leads to a decrease in calcium content which is caused by low solubility of CaCO_3 and CaSO_4 . However, the amount of magnesium and calcium in chloride waters increases because MgCO_3 is well soluble in water, unlike calcium carbonate and sulfate [3]. Calcium content in river waters does not exceed 250 mg / l. Magnesium and calcium content in underground water is much higher [4]. The content of magnesium, calcium and iron in fresh water depends on the type of soil, the season and the time of day or night.

One of the main tasks in the research of water composition is to determine the content of ions, the analysis is based on the specific properties of each ion and determines their concentration. Some ions are highly toxic, and because of their presence, water can be useless for drinking. Ions may not be poisonous, but it may worsen the physical and organoleptic properties of water. For example, iron is not a poisonous substance, so water containing it has no toxic effects. Nevertheless, the presence of iron ions in water is undesirable. If its content exceeds 0.3 mg / l, the water is unsuitable for drinking and household use. Such water has a brownish-brown and metallic taste. When snow and rain water hit the ground, it washes away sand and clay particles, these particles are difficult to be soluble in water and therefore they stay in a floating condition. The presence of floating substances in the water makes it useless for drinking and household use [1].

Important microorganisms in the formation of the chemical composition of water, use mainly organic substances in the water as nutrients and transform them into minerals. Therefore, the sanitary-microbiological research of spring, well and network waters is an interesting thing. As much as underground waters polluted by fecal masses, which are used by humans for various purposes, can cause intestinal infections, damage the urinary tract and genitals, or cause bacteremia, poisoning and much more.

Objective. Our objective was to study hydrochemical and sanitary microbiological research of the Elena Hill spring waters in the Nakhunao community of Martvili Municipality.

Taking into consideration the importance of magnesium, calcium, and iron in leading the vital processes of humans, animals, and plants' organisms, the aim of our study was to research the content of magnesium, calcium, iron, HCO_3^- -is, SO_4^{2-} -is, Cl^- -is, I^- -is, CO_2 , oxygen, BOD_5 and

biogenic elements in the Elena Hill spring waters, in the village of Nakhunao, Martvili district. The actuality of the issue lies in the fact, that the content of the abovementioned ions was analyzed in these waters for the first time, for which highly sensitive methods were selected.

The experimental part. Methodology for determining chemical elements in the water

Analyzes were conducted in Analytical Chemistry Laboratory of Kutaisi Akaki Tsereteli State University. Methods tested in hydrochemical practice have been used for analysis [6].

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

The mercurymetric method was used to determine chlorides (titrant 0,01 $Hg(NO_3)_2$). Indicator diphenyl (carbazole).

Hydrocarbons were determined by the acidimetric method titrant 0.1-0.01 N *HCl* indicator methyl naringerin.

The content of calcium and magnesium, as well as the total hardness of the waters being researched is determined by the complexonometric method (Titrant 0.01N Complexon III.). To determine the magnesium ion content, we used an eriochrome black as an indicator, we created the recommended area with an ammoniacal buffer, and we used merexide as an indicator to determine the calcium ion. Alkaline area was created by 2N sodium alkali.

Sulfate ions were determined by the classical gravimetric method, a precipitating form is presented by $BaSO_4$.

Common iron in the waters are determined by photometric method after preliminary rusting in the alkaline area (photometric reagent sulfosalicylic acid) (photoelectrocolorimeter).

Carbon dioxide gas was determined by the alkalimetric method. Titrant 0.1-0.01N *NaOH*. Indicator Phenolphthaleine

We determined the oxidization by the permanganatometric method (oxidant 0,01 N $KMnO_4$, acidic area. titrant 0,01 N $H_2C_2O_4$).

Oxygen content and BOD₅ were determined by iodometric method (titrant 0,01 N $Na_2S_2O_3$ in an alkaline environment $Mn(OH)_2$ oxidized by oxygen dissolved in water and transferred to a four-valent manganese compound, which is formed in the presence of excess *KI* in the acidized solution I_2).

The dry residue was determined by the classical gravimetric method.

Iodine ion was determined by the Reznikov method [7] (Titrate 0,01N $Na_2S_2O_3$). Oxidized was accompanied by prepared bromine water.

Biogenic substances were determined by photometric method: NO_2^- membrane reactive, NO_3^- sodium salicylate, NH_3 – Nesler's reagent, PO_4^{3-} – ammonium phosphomolybdate. Sanitary-microbiological research of the studied water were carried out in the laboratory of microbiology of Akaki Tsereteli State University of Kutaisi and the examination laboratory in "Microbiology" Ltd. Mesophilic aerobes and facultative anaerobes, common coliform bacteria, and Escherichia coli have been studied by using modern methods.

Explanation of the experiment. Thus, Mg^{2+} , Ca^{2+} , Fe^{3+} , HCO_3^- , Cl^- , SO_4^{2-} , CO_3^{2-} were determined for the first time in Elena Hill spring waters in the Nakhunao community of Martvili Municipality, oxidizability, Oxygen content BOD₅ dry residue biogenic elements and I^- ion by chemical and photometric methods. The results of the analysis are given in Table 1.

The spring waters studied by us are low-mineralized (0.02-0.65 mg / L), so their reaction is almost neutral (5.91-6.28). The ion content is variable.

The largest amount of magnesium ions is found in the northern spring water 0.1000 mg / l. While the least amount is found in the eastern spring water 0.0024 mg / l.

The content of Ca^{2+} ion is variable as well. A relatively large amount was found in the northern spring water 0.0074 mg / l, and its content is small in the western spring water 0,0016 mg/l.

Fe^{3+} ion content is big in the western spring water 0,04 mg/l, and its content is small in the northern spring water 0,02 mg/l.

HCO_3^- ion content is the biggest in the eastern spring water 0,0098 mg/l, the content of hydrocarbon ions is small in the northern spring water 0,0060 mg/l.

SO_4^{2-} ion high concentration is fixed in the eastern spring water 0,0453 mg/l. A small amount of sulfate ions are contained in the northern spring water 0,0206 mg/l.

Eastern spring water contains a relatively large number of chloride ions 0,0064 mg/l. And its content is less in the southern spring water 0,0046 mg/l.

The highest carbon dioxide content is in the northern spring water 0.0118 mg / l. A small amount of carbon dioxide is contained in the southern spring water 0.0053 mg / l.

Water oxidation is relatively high in the western spring water 2.32 mg / L, its small amount is found in the northern spring water 2.16 mg / l.

Oxygen content is high in the western spring water 14.69 mg / l. A relatively small concentration of oxygen is found in the northern spring water 9.79 mg / L.

BOD₅ is 61 mg/l in the eastern spring water, and it is – 8,16 mg/l in the northern spring water.

The dry residue is the highest in the eastern spring water 0.65 mg / l. Its content is the lowest 0.21 mg / l.

The content of biogenic elements NO_2^- , NO_3^- , NH_3 , PO_4^{3-} at the detection margin is smaller. I^- ion content is also variable. I^- is high in the western spring water 4,185 mcg/l. A small amount of iodide ion contains a northern spring water 2,538 mcg / l.

Table 1. Results of hydrochemical analysis of Elena Hill spring waters in village Nakhunao of Martvili region

#	Spring waters	pH	Mg^{2+}	Ca^{2+}	Common iron	HCO_3^-	SO_4^{2-}	Cl^-	CO_2	oxidization	Oxygen content	BOD ₅	Dry residue	NO_2^-	NO_3^-	NH_3	PO_4^{3-}	I^-
1	East spring water	6,62	0,0024	0,0016	0,03	0,0098	0,0453	0,0064	0,0066	2,24	12,24	10,61	0,65	-	-	-	-	3,1725
2	West spring water	5,91	0,0030	0,0046	0,04	0,0070	0,0247	0,0052	0,0062	2,32	14,69	9,95	0,21	-	-	-	-	4,185
3	North spring water	6,28	0,1000	0,0074	0,02	0,0060	0,0206	0,0054	0,0118	2,16	9,79	8,16	0,33	-	-	-	-	2,538
4	South spring water	6,54	0,0036	0,0068	0,038	0,0082	0,034	0,0046	0,0053	2,26	12,98	10,12	0,47					3,496

Results of microbiological analysis are given in table 2.

Table 2. Results of microbiological analysis of Elena Hill spring waters in village Nakhunao of Martvili region

#	Microbiological indicators	unit of measurement	Standard not more than	Result of examination
1	Mesophilic aerobes and facultative anaerobes	Ktse/ml 37°C 22°C	20 100	32 105
2	Common coliform bacteria	300 ml	Not allowed	Was found
3	Escherchia coli	300 ml	Not allowed	Was not found

Conclusions. The ion content in the above-mentioned studied waters is within the norm and its use for drinking and agricultural purposes is acceptable. The main microbiological indicators in the samples of water being researched are within the norm, only in some samples microbiological pollution is established.

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