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HYDROCHEMICAL AND SANITARY MICROBIOLOGICAL EXAMINATION OF SPRING WATERS OF NAKHUNAO COMMUNITY OF MARTVIL MUNICIPALITY

Abstract: *For the first time, a hydrochemical and sanitary-microbiological examination of the spring waters of Nakhunao community of Martvil municipality was conducted. The content of Mg_2+, Ca_2+, HCO_3 -, Cl- ions and total iron were determined. Oxygen, carbon(IV) content, oxidizability and dry balance were also studied. Relatively simple and fast chemical and physico-chemical methods with good reproducibility were selected for determination. Biogenic substances were determined by the photometric method. Sanitary-microbiological examinations were carried out by the following methods: mesophilic aerobes and facultative anaerobes: MVK, 2.1.4 1184-03, Total coliform bacteria – MVK 4.2. 1018-01 and Escherichia coli – 18963-73. Based on the data of the experiment, it was determined that the waters of the research source are low in mineralization, which is why their reaction is almost neutral. The content of the above-mentioned ions in the studied spring waters is within the norm. In all samples (mesophilic aerobes and facultative anaerobes, common coliform bacteria) a limit concentration of microbiological pollution was determined, which is harmless to human health and its use for drinking and agricultural purposes is within the norm.*

Key words: *spring water, Nakhunao community, Martvili municipality.*
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Introduction

Water is one of the most important irreplaceable resources and priceless wealth of our planet. Water is used widely and in many ways. Since the day of its origin, man has influenced the biosphere, uses its resources, which has caused certain changes in the biosphere. Thus, the problem of environmental protection is very important, especially due to the importance of water. Water is the source of life and it is the building material used by all organisms, water brings the necessary substances into the body and removes everything superfluous. Water is a universal solvent. It is of great importance in the daily life of a person. It has always been considered the source of life.

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

Martvili Municipality is located in the northeastern part of Western Georgia, on the Odishi plain (southern part) and in the foothills of the Egris ridge (central part) and on its southern slopes (northern part). It is bordered by Lentekhi in the north, Khoni and Tsageri in the east, Abasha in the south, Senaki and Chkhorotsku in the west. The southern part of the Martvili territory is occupied by a plain that rises from the southwest to the northeast from 60 to 170 m. The highest point is 3003 meters above sea level. To the south-west of the Martvili area is the massif of the Askhi mountain, which is rich in karst caves, waterfalls, mineral deposits and building stone. Lebarde, "Chegola" and Dviri mountains are rich in healing mineral waters. Beautiful valleys of plants on the shore create wonderful relief formations, small riverside plains and lands, where wonderful gardens are planted on hundred-year-old alluvial soil. On the territory of the municipality of Martvili flow rivers: Tekhuri and Abashi water, which have their origin on the Egris ridge [2].

Magnesium and calcium salts determine the permanent and temporary hardness of water. Calcium and magnesium ions are the leading ions of low-mineralized waters. The increase in mineralization leads to a decrease in the calcium content, which is caused by the 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. The content of magnesium and calcium in groundwater is much higher [4]. The content of magnesium, calcium and iron in fresh waters depends on the type of soil, the water season and the time of day and night [5].

One of the main tasks when investigating the composition of water 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 strong poisons and their presence can make the water unfit for drinking. The ion may not be poisonous, but may worsen the physical and organoleptic properties of water. For example, iron is not a poisonous substance, so the water containing it does not have a toxic effect. 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 domestic purposes. Such water has a dark brown and metallic taste. When snow and rain water gets on the soil, it washes away sand and clay particles, these particles are difficult to dissolve in water and therefore remain in a saturated state. The presence of saturated substances in water prevents its use for drinking and household purposes [1].

Microorganisms are also important in the formation of the chemical composition of water, which use the substances in the water as food, mainly organic, and transform it into mineral substances, therefore, the sanitary-microbiological examination of the source water is of interest, as far as groundwater contaminated with fecal masses, which are used by humans for various purposes, can cause intestinal Infections, damage to the urinary tract and genitals, bacteremia, poisoning and others.

For microbiological examination, water samples were taken in a 1L steel vessel, the sample was labeled with the date and time, then we placed it in a special basket that maintains a low temperature, and then they were transported to the laboratory. The analysis was performed no later than 6 hours .

Aim. We aimed to study the hydrochemical composition and sanitary-microbiological indicators of the spring waters of Nakhunao community of Martvili municipality. We consider the importance of magnesium, calcium and iron ions in managing the life processes of human, animal and plant organisms. The aim of our research was to study the content of magnesium and calcium, total iron,

HCO_3^- -is , SO_4^{2-} -is , Cl^- -is , I^- -is , CO_2 ,

oxygen and biogenic elements in the spring waters of Nakhunao community of Martvil district. The relevance of the issue lies in the fact that the above-mentioned ion content and microbiological parameters were determined for the first time in the given waters, for which highly sensitive methods were selected.

Judgment of the experiment. Thus, Mg^{2+}, Ca^{2+}, Fe^{3+}, HCO_3^-, Cl^-, SO_4^{2-}, CO_2^-, permanganate oxidizability, oxygen content, Biochemical demand for oxygen(5), dry balance, biogenic elements were determined for the first time in the spring waters of Nakhunao community of Martvili municipality - 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), which is why their reaction is almost neutral (5.87-6.67). The ion content is variable.

The largest amount of magnesium ion is contained in the source of Merkheuli - 7.76 mg/l. And its content in the ore source is the smallest at 0.65 mg/l. The average content of magnesium ions in Karaman spring is 2.16 mg/l.

The ion content is also variable. Its relatively large amount was observed in the source of Basa at 12.92 mg/l, while its content was less in the source of Agati at 4.16 mg/l. The average content of calcium ions in Maca source is 7.63 mg/l.

Total iron content is high in Karaman spring at 0.054 mg/L, while its content is low in Agati spring at 0.026 mg/L. The average amount of total iron in the Meinj source is 0.045 mg/l.

HCO_3^- ion content is the largest in the Napatarou spring at 2.93 mg/l, the content of hydrocarbonate ions is the smallest in the ore spring at 0.96 mg/l. Its average content is 1.58 mg/l in the Bakho spring.

SO_4^{2-} high ion concentration is recorded in the Meinji spring at 0.0615 mg/l. A small amount of sulfate ions is contained in Agati's water at 0.0065 mg/l. The average amount of sulfate ions in the Napataro spring is 0.0393 mg/l.

Chloride ions are contained in a relatively large amount in the Ivane spring, 0.0070 mg/l. And its mass content is small in Karaman spring at 0.0036 mg/l. The average content of chloride ions was recorded in the ore source and it is equal to 0.0055 mg/l.

The content of carbonic acid gas is the highest in the source of Napatarou at 0.0086 mg/l. Beritsku spring contains a small amount of carbonic acid gas, 0.0028 mg/l. Agati spring contains 1.36 mg/l of carbon black gas.

Permanganate oxidizability is relatively high in Napatarou source 2.86 mg/l, its small amount is recorded in Merkheuli spring 2.14 mg/l. The average value of permanganate oxidation characteristic of the ore source is 2.36 mg/l.

The oxygen content is high in Karaman spring, 12.48 mg/l. A relatively low concentration of oxygen is recorded in the Karaman spring at 10.34 mg/l. Its average value is fixed at 11.68 mg/l in Tekhura spring.

The dry balance is the highest in Beristku spring, 0.84 mg/l. Its content is the smallest in the Basa spring at 0.47 mg/l. Maca source contains 0.64 mg/l of dry matter.

The highest amount of Biochemical demand for oxygen (5) is 11.39 mg/l in the spring of Merkheuli, the lowest is 9.46 mg/l in the water of Ivane spring, the average value of Biochemical demand for oxygen (5) is 10.46 mg/l in the Bakho spring.

The content of biogenic elements - NO_2^-, NO_3^-, NH_3, PO_4^3 – is lower than the detection limit and their replacement is not recorded in the investigated spring water of Nakhunao community of Martvili municipality.

Microbiological indicators were determined in the waters of the Nakhunao spring of the Martvil municipality. The results of the analysis are given in Table 2.

Mesophilic aerobes are the most in Beritsku spring at 18 Colony-forming unit in ml at 370 C. And its content is smaller than that of Ivela in the waters of Ivane and Kosta springs and is equal to 11 Colony-forming unit in ml. Mesophilic aerobes are contained in an average quantity of Bakho spring in 14 Colony-forming unit in ml.

Facultative anaerobes at 220 C contain the highest amount of Napatarou spring at 82 Colony-forming unit in ml, while its content is small in Maca spring water at 39 Colony-forming unit in ml. The average concentration of facultative anaerobes in the Merkheuli spring is 64 Colony-forming unit in ml.

Common coliform bacteria and Escherchia coli were not found in the investigated spring waters.

Experimental Part. Methodology for Determination of Chemical Elements in Water

The analyzes were carried out in the Analytical Chemistry Laboratory of Akaki Tsereteli State University. The methods tested in hydrochemical practice were used for the analysis [6].

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

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

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

The content of calcium and magnesium, as well as the total hardness of the water under investigation,

was determined by the complexonometric method (titrant 0.01N Complexon III. To determine the magnesium ion content, we used eriochrome as an indicator, we created the recommended area with an ammonia buffer, and to determine the calcium ion, Merexide was used as an indicator. We created an alkaline area with 2N sodium alkali).

Total iron in water is determined by the photometric method after preliminary oxidation in the alkaline zone (photometric reagent sulfosalicylic acid) (photoelectrocolorimeter).

Sulfate ions were determined by the classical gravimetric method, representing a precipitated form of $BaSO_4$.

Carbonic acid gas was determined by the alkalimetric method. Titrant 0.1-0.01N $NaOH$. Indicator - Phenophthalein.

Oxidability was determined by the permanganatometric method (oxidizing agent 0.01 N $KMnO_4$, in acidic area. 0,01 N $H_2C_2O_4$).

The oxygen content was determined by the iodometric method (titrant 0,01 N $Na_2S_2O_3$. In an alkaline environment, $Mn(OH)_2$ is oxidized by oxygen dissolved in water and transferred to a tetravalent manganese compound, which is formed by acidifying the solution in excess KI).

The dry weight was determined by the classical gravimetric method.

Biogenic substances were determined by photometric method: NO_2^- shell reagent, NO_3^- sodium salicylate, NH4+ - Nessler's reagent, PO_4^{3-} - ammonium phosphorolybdate.

Photometric determination of NO_2^- using Gries's reagent in the acid zone is based on the reaction of formation of a reddish-brick-colored azo dye as a result of the interaction of sulfanilic acid, nitrite ion and alpha-naphthylamine.

Determination of NO_3^- was conducted by 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 coloration is directly proportional to the nitrate ion concentration.

The determination of NH4+ is based on the interaction between the ammonium ion and Nessler's reagent (mercury tetra iodide) in the alkaline zone, during which the resulting yellow coloration is directly proportional to the concentration of the ammonium ion.

Determination of PO_4^{3-} was conducted by the photocolorimetric method, which is based on the interaction of orthophosphoric acid and ammonium molybdate in the acid zone, during which the blue color formed is directly proportional to the concentration of phosphate.

Sanitary-microbiological examinations of the research water were carried out at the microbiology laboratory of Akaki Tsereteli State University of Kutaisi and the testing laboratory of "Microbiologist" LLC. Mesophilic aerobes and facultative anaerobes, common coliform bacteria and Escherichia coli were investigated using modern methods.

Table 1. Results of hydrochemical analysis of spring waters of Nakhunao community of Martvili municipality

N	Dialectal name of spring waters	pH	Mg/l										
			Total iron content	SO_4^{2-}	Ca^{2+}	Mg^+	HCO_3^-	Cl^-	Dissolved oxygen	Biochemicaldemand for oxygen 5	Oxidizability	CO_2	Dry Balance
1	Beritsku	**6,12**	**0,038**	**0.0472**	**11,6**	**4,21**	**2,56**	**0,0056**	**12.24**	**10,15**	**2,28**	**0,0028**	**0,84**
2	Napatarou	**6,23**	**0,036**	**0.0393**	**8,92**	**1,88**	**2,93**	**0,0043**	**12,46**	**10,46**	**2,86**	**0,0086**	**0.68**
3	Basa	**6.08**	**0,039**	**0,0314**	**12,92**	**4,12**	**2.42**	**0,0044**	**11.28**	**9,78**	**2,46**	**0,0044**	**0.47**
4	Maka	**6, 38**	**0,028**	**0,0578**	**7,63**	**3,48**	**1,28**	**0,0038**	**10,34**	**9,98**	**2,18**	**0,0077**	**0,64**
5	Meinji	**6,45**	**0,045**	**0,0615**	**8,96**	**6,23**	**1,83**	**0,0042**	**11,38**	**11,02**	**2,29**	**0,0076**	**0,58**
6	Agathia	**6, 72**	**0,026**	**0,0065**	**4,16**	**1,16**	**1,36**	**0,0066**	**12,42**	**10,68**	**2,38**	**0,0064**	**0,54**
7	Bakho	**6,36**	**0,034**	**0,0405**	**12,12**	**5,52**	**1,58**	**0,0048**	**11,30**	**10,46**	**2,49**	**0,0058**	**0,52**

8	Madeni	**5,98**	**0,042**	**0,1377**	**6,56**	**0,65**	**0,96**	**0,0055**	**10,43**	**11,08**	**2,36**	**0,0054**	**0.56**
9	Merkheuli	**6,67**	**0,044**	**0,0346**	**8,68**	**7,76**	**1,68**	**0,0069**	**10,88**	**11,39**	**2,14**	**0,0042**	**0.82**
10	Ivane	**6.28**	**0,048**	**0,0101**	**8,76**	**4,41**	**1,12**	**0,0070**	**12,18**	**9,46**	**2,16**	**0.0046**	**0,76**
11	Karaman	**5,86**	**0,054**	**0,0133**	**9,44**	**2,16**	**1,41**	**0.0036**	**12,48**	**9.98**	**2,22**	**0,0056**	**0,68**
12	Antrisa	**5, 94**	**0,039**	**0,0164**	**7,82**	**2,32**	**1,34**	**0,0062**	**12.19**	**10,67**	**2,37**	**0.0048**	**0,61**
13	Tekhura	**6.18**	**0,046**	**0,0065**	**4,28**	**2,64**	**0,72**	**0,0052**	**11,68**	**10,16**	**2,48**	**0.0068**	**0,46**
14	Kosta	**6,68**	**0,028**	**0,0067**	**5,76**	**4,24**	**0,36**	**0,0068**	**11,35**	**9,58**	**2,40**	**0.0062**	**0,81**

The results of microbiological examination are given in Table 2

Table 2. Results of Microbiological Analysis of Spring Waters of Nakhunao Community of Martvili Municipality

N	Dialectal name of spring waters	Microbiological indicators			
		Mesophilic aerobes	Facultative anaerobes	Total coliform bacteria	Escherchia coli
		Measurement unit			
		Colony-forming unit in ml		In 300 mg	In 300 mg
		37^0C	22^0C		
		Normative			
		20	100	Not allowed	Not allowed
1	Beritsku	18	74	Could not be found	Could not be found
2	Napatarou	14	82	-	-
3	Basa	12	80	-	-
4	Maka	10	39	-	-
5	Meinji	16	85	-	-
6	Agathia	13	86	-	-
7	Bakho	14	72	-	-
8	Madeni	12	64	-	-
9	Merkheuli	15	60	-	-
10	Ivane	11	58	-	-
11	Karaman	16	56	-	-
12	Antrisa	11	65	-	-
13	Tekhura	17	48	-	-
14	Kosta	11	78	-	-

Conclusion

In the studied spring waters of Nakhunao community of Martvili municipality, the content of $Mg^{2+}, Ca^{2+}, Fe^{3+}, HCO_3^-, Cl^-, SO_4^{2-}, CO_2^-$, permanganate oxidizability, oxygen and dry balance is within the norm and its use for drinking and from the economic point of view is appropriate. The main microbiological indicators in the samples of the analyzed water are within the norm and no microbiological contamination is detected in the tested samples.

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