ASSESSMENT OF GROUNDWATERS' QUALITY WITH DEPTH of 8-60 m IN THE ARBËRIA NEIGHBOURHOOD OF GJILAN MUNICIPALITY, KOSOVO

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Abstract: Gjilan is one of the largest cities in the Republic of Kosovo. Groundwater samples with a depth of 8-60 m have been taken in this neighbourhood Arbëria, where the samples were taken in three different areas. These groundwaters are used as drinking water and to ascertain that these groundwaters comparing with the WHO regulation. Parameters analysed are: nitrites (NO_2-N), nitrates (NO_3-N), ammonia (NH_3-N), chlorides (Cl^-), bicarbonates (HCO_3^-), alkaline (A-HCl), carbonic strength (CS), NTU, pH, and conductivity in water (CW). The results of this study display the quality of these groundwaters based on the WHO regulation. Some groundwaters are not in accordance with WHO water quality regulations. The groundwaters we have analysed in three areas of the Arbëria neighbourhood in Gjilan Municipality, based on the analysis confirm very well, showing that the land of this neighbourhood has strong layers of lime.

Keywords: Groundwater, hydrogenochemical, neighbourhood, WHO.

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INTRODUCTION

The vast majority of groundwater comes from rains and melting of ice. Water fills the spaces between stones and soil forming aquifers (water reservoirs). Groundwater can be considered as one of the hidden resources. Groundwater may contain natural impurities or pollutants regardless of human activity (1). Groundwater is an important water resource and a major factor for maintaining the regional ecological environment, which plays a significant role in ensuring water, food, economic, and ecological security (2). The chemical composition of groundwater is the product of the long-term interaction between groundwater and the surrounding environment. During the evolution of a groundwater system, different hydrogenochemical processes result in groundwaters having different chemical compositions (3).

Well water quality and their suitability for drinking were discussed through physico-chemical parameters. Well water was taken in different depths and analysed for pH, conductivity in water (CW), nephelometric turbidity unit (NTU), bicarbonates (HCO_3^-), carbonic strength (CS), alkaline (A-HCl), chlorides (Cl^-), nitrites (NO_2- N), nitrates (NO_3-N), and ammonia (NH_3-N).

pH is a very important parameter in water quality (4). Turbidity results from the scattering of light in water by organic and inorganic particles; however, high turbidity usually is caused by suspended inorganic particles, particularly sediments (5). Conductivity of water (CW), also, known as specific conductivity, represents the ability of water to convey electricity, and is related to the concentration of ionised substances in water (6).

Ammonia (NH_3-N) is present in groundwater very often. Its presence in water describes its formation as the result of the reduction of organic substances containing nitrogen, deamination of amines, etc. The main source of nitrite ions (NO_2-N), in water is the process of mineralisation of organic matter and nitrification from bacteria. Nitrites are much more toxic than ammonia and nitrates (7). In our case, some groundwater contains high amounts of NO_2 and their values are not in accordance with WHO, *etc*. Concentration of nitrates in groundwater often reaches alarming values. The concentration of NO_3-N higher than 10 mg/L in water is a cause for the methemoglobinemia of children, a disease characterised by cyanosis and blue skin colour. NO_3-N deactivates haemoglobin by transforming into methaemoglobin, a form that cannot make oxygen transport. This illness hits hard babies up to three months after birth. Chlorides are inorganic anions that are most commonly found in natural and contaminated waters and mainly come from natural minerals and industrial pollution. In drinking waters such as groundwater, salty taste is derived from the presence of high amounts of Cl^- (1). Water hardness considers the amount of mineral salts dissolved in water or water capability to form a stone scale. The water hardness indicator is of great importance for determining the use of drinking water and for industrial purposes (4). The largest number of European countries rely more on surface water than on groundwater. In many countries, groundwater is used as the main source of water for public use because such processing and water supply costs are relatively low, while water is of high quality, etc. The parameters analysed in groundwaters are based on WHO criteria.

EXPERIMENTAL

Chemicals

Some of the reagents used for groundwater analysis: Nitri Ver 3 (HACH®), Nitra Ver 5 (HACH®), 0.01 M HCl, K_2CrO_4 0.257 mol/L, $AgNO_3$ 0.01 M, methyl orange, phenolphthalein, 0.1 M HCl, Ammonia Salicylate reagent (HACH®), Ammonia Cyanurate reagent (HACH®).

Physico – Chemical parameters and methods analysis

Absorption spectrophotometry in the ultraviolet and visible region is based on the electromagnetic radiation absorption of molecules in the UV spectra of 160–400 nm and Vis 400–780 nm range. UV-Vis radiation absorption causes the excitation of the electrons of chemical bonds by passing the molecules to higher energy levels (8). The absorption of UV-Vis radiation from complex molecules and inorganic salts of transitional metals, as well as of lanthanides and actinides, causes the molecule to move from its basal to its excited state (9). The HACH® Model DR/2010 Spectrophotometer is a microprocessor-controlled single-beam instrument for colorimetric testing in the laboratory or in the field. The instrument is precalibrated for over 120 different colorimetric measurements and allows convenient calibrations for user-entered and future HACH® methods (10).

The pH and CW are defined in the groundwater sampling areas so that the results are as accurate and realistic as those waters. The pH is determined with a WTW 3010 type instrument, while CW is determined with WTW Cond 3110 at μS/cm. NTU results were obtained in labs shortly after laboratory sampling. The instrument used was the 2100N ISC Turbidimeter HACH® (*ISO Method 7027*).

In aquatic environments, total ammonia exists in two chemical forms, unionised ammonia and ionised ammonium (NH_3-N). Nowadays, there is increasing attention and a significant number of studies that are focusing on nitrogen to gain more knowledge about the factors that are influencing its different transformation pathways (11).

NH_3-N concentration was determined using in first step Ammonia Salicylate reagent and in second step using Ammonia Cyanurate reagent (Nitrogen Ammonia Test 0 – 0.50 mg/L, *Method 8155*) and the absorbance level was then measured using a spectrophotometer (HACH® DR/ 2010, USA) at λ = 655 nm.

NO_2-N concentration was determined using Nitri Ver 3 reagent (Nitrite Test 2 - 150 mg/L, *Method 8153*) and the absorbance level was then measured using a spectrophotometer (HACH® DR 900, USA). Nitrate (NO_3-N) concentration was determined using Nitra Ver 5 reagent (Nitrate Test 0-30 mg/L, *Method 8039*) and the absorbance level was then measured using a spectrophotometer (HACH® DR / 2010, USA) at λ = 500 nm.

The water sample alkalinity is the measurement of its capacity to neutralise the acids. Water accumulation is mainly due to weak acid salts. We took 100 mL of the analysed sample, added 4 drops of phenolphthalein and if the 100 mL solution gets purple, then water has bases as a result of pH above 8.3, and if it does not get purple, then 2 to 3 drops of methyl orange is added, which gives yellow colour. It is titrated with 0.01 M HCl until the solution gets orange and the amount of titre used is written (7).

The determination of chlorides was carried out in an Erlenmeyer flask containing 100 mL of water sample (adjust pH 7–10 if necessary). With the addition of 1 mL of (K_2CrO_4 (C= 0.257 mol/L)) the sample turned to a yellowish colour. Titration was done with silver nitrate ($AgNO_3$ (C = 0.01 mol/L)) and it stopped at the moment when the solution gets light red colour. The value of the chlorides in the sample was calculated according to Eq. 1 (12):

$$Cl^- \text{ mg/L} = 35.453 \cdot M \cdot \frac{(V_1 - V_2)}{Vs} \quad (1)$$

where V_1 is the volume of the titre for the sample (mL), V_2 is the volume of the titre for blank sample (mL), M is molarity of $AgNO_3$ 0.01 M, and V_s is the volume of the sample used (100 mL in our case).

Carbonate strength (CS) is defined as the alkalinity to methyl orange. A volume of 100 mL water sample was transferred to a 500 mL Erlenmeyer flask and 2–3 drops of methylene chloride were added. The titration was performed with standard HCl solution (C = 0.01 mol/L) until the colour changed to orange. The analysis results were calculated in German degrees (°dH) water hardness scale according to E. 2 (12):

$$CS\ (°dH) = 2.8 \cdot V_{HCl} \cdot C_{HCl} \quad (2)$$

2.8 is a constant, V_{HCl} is the consumed volume of HCl, and the concentration of HCl is 0.1 mol/L.

RESULTS AND DISCUSSION

The location of the analysed samples

To analyse a large-scale neighbourhood is a challenge. We have analysed 15 groundwaters in the Arbëria neighbourhood in municipality of Gjilan, where the distance from one sample to the other sample is about 100-200 m and the depth of the groundwaters are 8 to 60 m. Before sampling the waters, sampling planning has been carried out to divide into three sampling areas such as Area 1, Area 2 and Area 3, see Figure 1.

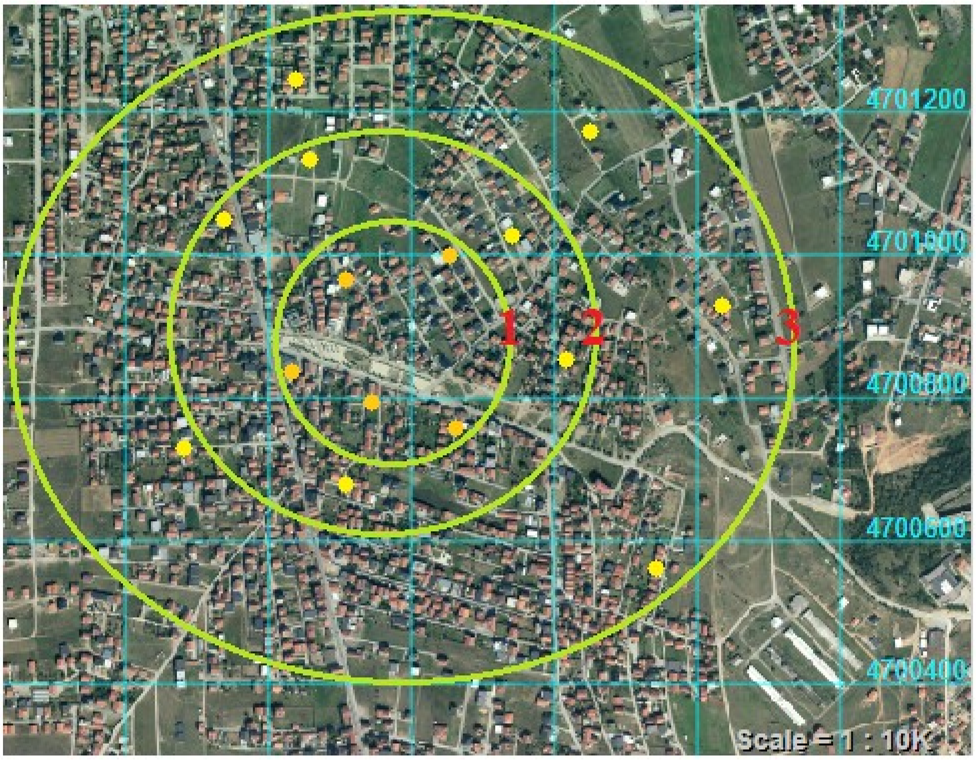

Figure 1. Research areas of groundwaters within the depth of 8-60 m in neighbourhood Arbëria in municipality of Gjilan.

Transporting samples to the laboratory

First, we have cleaned the glass bottles and sterilised them well in order to be in a level of purity, then started collecting 1000 mL water samples and in each area were taken 5 samples in deep wells of 8-60 m. The water samples were transported from 15 locations to a laboratory with a temperature of 4-5 °C. The water is taken from taps that have been connected with groundwater and before the samples are taken, the water flow should be within a 15-minute time interval. The samples were taken according to EPA / 600 / R-94/205.

Results for the pH

pH is a very important parameter in groundwaters, surface waters, and atmospheric waters. In our case, the pH does not express any degradation as a parametre and is in accordance with the WHO regulation. In area 1, pH ranges from 7.1-7.45 in depths of 8-60 m, see Table 1. In Area 2, pH in groundwaters with depth of 8-30 m is 7.39-7.81, while in area 3 pH in groundwaters with depth of 25-40 m is 7.2-7.8, see Table 1. pH in area 2 is slightly higher compared to Areas 1 and 3.

Results for the conductivity water (CW)

Electrical conductivity in water, also known as specific conductivity, is the ability of water to convey electricity, and is related to the concentration of ionised substances in water (7). If the electrical conductivity in the water is too high, then this indicates that in that sample the water contains many minerals. In the CW water chemistry is an important parameter that is carried out at the place where the samples are taken. CW in groundwaters where we have obtained values in the deposits in the three areas is not presented as a problem in the three areas analysed (Figure 1). In Area 1, where the sampling depth was 8-60 m, which CW is 867-1673 µS/cm as seen in Table 3. In a groundwater with a depth of 18 m, the CW is slightly high and is not in compliance with WHO allowed values. see Table 1. Groundwaters in area 2 with a depth of 8-30 m, CW value is from 471-1448 µS/cm and these groundwaters are in accordance with WHO, see Table 1, also in Area 3 where groundwater with depth of 25-40 m CW included in 920-1400 µS/cm, see Table 1. Meaning that even in Area 3 conductivity is in accordance with WHO rules. Groundwaters have always been found to possess a higher conductivity than surface water (lakes, rivers etc).

Results for Nephelometric turbidity unit (NTU)

Turbidity is a measurement of the influence of suspended solids on an aqueous solution's ability to transmit light (13). In the groundwaters from the evidence of scientific research it has concluded that in the groundwaters it is difficult to achieve a high turbidity, eventually if there is extreme contamination near an underground water, etc. In Area 1 of groundwaters with depth of 8-60 m, the value of NTU is not high which is 0.75-3.54 and is in accordance with the WHO regulation, while in area 2 (Figure 1), where groundwaters with depth 8-30 m, the NTU are from 0.44 to 0.65, these NTU values that are analysed are in accordance with WHO. In Area 3, NTU in groundwaters with depth of 25-40 m is 0.5-3.1, see Table 1. NTU values in the three areas analysed are in accordance with WHO.

Results for chlorides (Cl^-)

Chlorides (Cl^-) are present in both fresh and salty water, and are essential elements of life. High chloride concentrations in fresh water can harm aquatic organisms by interfering with osmoregulation, the biological process by which they maintain the proper concentration of salt and other solutes in their bodily fluids (14). Chlorides in groundwaters often are higher than surface water because water is always in contact with the various layers of soil which may contain different ions. Groundwaters in Area 1 with depth of 8-60 m, there is no high concentration of chlorides is 26.2-55 mg/L, see Table 1. In Area 2, groundwaters with depth of 8-30 m, the concentration of Cl^- in this area is 12.6-49.4 mg/ L. In Area 3, the concentration of Cl^- in groundwaters with depth of 25 -60 m is 22-60 mg/L, see Table 1. In Area 3 (Figure 1) the concentration of Cl^- is higher compared to Area 2 and Area 1, see Table 1. In all groundwater samples, the concentration of Cl^- is in accordance with WHO.

Results for Alkalinity

Alkalinity is determined by volume through class titrations or potentiometric titrations (6). The alkaline in these waters are in accordance with the WHO regulation and this appearance a positivity in these groundwaters that we have analysed. In Area 1, the amount of alkalinity in groundwaters with depth of 8-60 m is 6.39-8.57 HCl/ mL, while in area 2 the amount of alkalinity is 4.2-8.6 HCl/mL in the groundwaters' depths of 8-30 m, see Table 1. In Area 3, groundwaters with a depth of 25-40 m, the amount of alkalinity is 4.73-8.46 HCl/mL, see Table 1. In the three areas analysed (Figure 1), all values obtained in this groundwater are in accordance with the WHO regulation for this parameter, see Table 1.

Results for bicarbonates (HCO_3^-)

The amount of bicarbonate (HCO_3^-) often expresses great concern in groundwaters, because limestone layers can be found in the interior, *etc*. In Area 1, the concentration of HCO_3^- in groundwaters with depth of 8 - 60 m is 390.4 -523.2 mg/L, so in two groundwaters of this area are not in accordance with the WHO regulation. In area 2, groundwaters with a depth of 8-30 m of HCO_3^- is 256.2-524.6 mg/L. In Area 3, groundwaters with a depth of 25-40 m of HCO_3^- is within 289-516.5 mg/L, see Table 1. The concentration of HCO_3^- in those groundwaters that is not accordance with WHO:

(i). In groundwater with a depth of 8 m in Area 1, the concentration of HCO_3^- is 523.2 mg/L. This concentration indicates that it is not in accordance with the WHO regulation because it is more than 23.2 mg/L, see Table 1. In addition, in this area there is another groundwater that is not in accordance with the WHO regulation, which is in depth of 9 m, where the concentration of HCO_3^- is 518.5 mg/L. This indicates that the concentration of 18.5 mg/L is more than the WHO allowed regulation, see Table 1.

(ii). In Area 2, there is only a groundwater that is not in accordance with the WHO. The depth of this groundwater reaches up to 12 m where the concentration of HCO_3^- is 524.6 mg/L, so according to this value, the concentration of 24.6 mg/L is above the WHO allowed value, see Table 1.

(iii). Also, in Area 3, groundwater with a depth of 30 m and other groundwater with a depth of 40 m are not in accordance with WHO. In groundwater with a depth of 30 m, the concentration of HCO_3^- is 516.5 mg/L, so according to this concentration in this groundwater there are more than 16.5 mg/L HCO_3^-, see Table 1. In groundwater with a depth of 40 m, the concentration of HCO_3^- is 501.9 mg/ L, see Table 1 and compare with WHO criteria for these parametres that have been analysed in three areas.

Results for nitrites (NO_2- N) and nitrates (NO_3- N)

Nitrates (NO_3^-) and nitrites (NO_2^-) are frequently present in plants, soils and waters; since their chemistries are practically indissociable, one rarely is found without the other. If in excessive levels, these ions can have an adverse impact on public health and ecological systems. NO_3^- is the foremost toxic agent, but the fairly inert nitrate is easily reduced to nitrite by bacterial action in the soil or within the digestive system (15). With the development of agriculture, the use of artificial fertilisers increases, which means that the consumption of nitrates increases, while the phosphate consumption remains the same. There is a risk of NO_3^-, because approximately 10% of fertilisers and pesticides are removed from the soil surface (16). In Area 1, the concentration of NO_3-N in groundwaters with a depth of 8-60 m does not contain a high concentration, where values are within 3-7.1 mg/L, while in Area 2 the concentration of NO_3-N is within 1.9-35 mg/L in groundwaters with depth of 8-30 m, see Table 1. In Area 3, groundwaters with depth of 25-40 m does not display a high concentration of NO_3-N, where values are within 1.9-8.9 mg/L. The concentration of NO_3-N which is not in accordance with WHO regulation:

(i). In Area 2, groundwater with a depth of 8 m (Figure 1) possesses a very high concentration of nitrate up to 35 mg/L, see Table 1. This concentration is too high for a groundwater, containing more than 25 mg/L as compared to WHO regulation. This groundwater is not in accordance with WHO, see Table 1.

Nitrites (NO_2-N) usually display many complications in groundwater, where these waters are open in the ex-agricultural land, as in our study.

The nitrites in our case in the groundwater with a depth of up to 60 m have been proved to be present in most groundwaters, the concentration of NO_2-N in some groundwaters is not in accordance with WHO. In Area 1, NO_2-N in groundwaters with depth of 8 - 60 m, the concentration of NO_2-N is 0.001-0.008 mg/L, see Table 1. In Area 2, in groundwaters with depth of 8 - 30 m, the concentration of NO_2-N is 0.003-0.008 mg/L, while in Area 3, the NO_2-N quantity is within 0.002-0.009 mg/L, see Table 1. The concentration of NO_2-N in groundwaters in the Arbëria neighbourhood that are not in accordance with the WHO regulation:

(i). In Area 1, groundwater with a depth of 8 m, NO_2-N is 0.008 mg/L, see Table 1 and this concentration is high compared to WHO, see Table 1. In this groundwater NO_2-N is more than 0.003 mg/L compare to the permissibility up to 0.005 mg/L.

(ii). In Area 2, groundwater with a depth of 12 m displays an obstacle in this water because the concentration of NO_2-N is 0.008 mg/L, this concentration of NO_2-N is not in accordance with the WHO. So, in this groundwater the concentration of NO_2-N is more than 0.003 mg/L compare to the permissible concentration up to 0.005 mg/L, see Table 1.

(iii). In Area 3, groundwater with depths of 30 m, 32 m and 40 m, the value of NO_2-N is high, see Table 2. In groundwater with a depth of 30 m the concentration of NO_2-N is 0.007 mg/L and this value display in one consistent with the WHO regulation and this indicates that it is not in accordance, see Table 1. In groundwater with a depth of 30 m, the concentration of NO_2-N is 0.006 mg/L, this value is not in accordance with the WHO because in this water is more than 0.001 mg/L, while in groundwater with a depth of 40 m, the concentration of NO_2-N is 0.009 mg/L, this value is out of regulation or better to say it is not in accordance with the WHO regulation, because it contains more than 0.004 mg/L, see Table 1.

Results for ammonia (NH_3-N)

Nowadays, there is increasing attention and a significant number of studies that are focusing on nitrogen to gain more knowledge about the factors that are influencing its different transformation pathways (7). Amount of ammonia (NH_3-N) in groundwater with depth of 8-60 m reaches the concentration of 0-0.09 mg/L in Area 1, see Table 1. These concentrations are in accordance with WHO. In Area 2, in groundwater with a depth of 8-30 m, NH_3-N is 0-0.08 mg/L, this chemical parameter in this area is in accordance with the WHO, see Table 1. Area 3 (Figure 1), in groundwater with depths of 25-30 m, NH_3-N quantities is 0-0.03 mg/L and these values do not indicate any risk, see Table 1. In Area 3, all results obtained in this groundwaters are in accordance with WHO, see Table 1. In Area 1, NH_3-N is present with a higher concentration compared to Areas 2 and 3.

Results for carbonic strength

Water hardness is considered to be a disadvantageous parameter in the use of water for urban purposes and factories (due to the formation of lacquer layers in the steam pipes). But it should be said that drinking water should have a moderate hardness value because in these cases the solubility of the toxic metals is lower and the water represents a higher buffering effect on acidic compounds. In addition, medium-medium water presents a better taste as well as evidence that it is better for health in particular in reducing cases of some heart disease (6). Natural water which has a high amount of soluble calcium and magnesium salts is called strong water (17).

The carbonic strength (CS) in the groundwaters we have analysed in three different areas (Figure 1) is a bit high, but this creates a benefit for reason that reduces heart disease, also the third toxic metals. In Area 1, groundwaters with a depth of 8-60 m, the amount of CS is 21.67-40.02 °dH, see Table 1. In Area 2, the amount of CS is 12.53-37.07 °dH in the groundwaters with depth of 8-30 m, while in Area 3 in groundwaters with depth of 25-40 m, the amount of CS includes values 20.64-36.47 °dH. Carbonic strength (CS) in groundwaters with depths of 8-60 m which are not in accordance with the WHO regulation:

(i). In Area 1, all groundwaters entered the category of strong water according to WHO, while the very high CS value in this area is at a depth of 18 m which reaches up to 40.02 °dH. This value is not in accordance with WHO, see Table 1.

(ii). In Area 2, all groundwaters entered the category of strong water according to the German °dH degree. In groundwater with a depth of 30 m, the value of CS is 37.07 °dH, this value is not in tune because this groundwater entered the category of very strong water, see Table 1.

(iii). Also, in area 3, groundwaters entered the category of strong waters. In groundwater with a depth of 32 m, where the value of CS is 36.47 °dH, as well as in groundwater with a depth of 40 m value of CS is 31.2 °dH, see Table 1. In these two high groundwaters mentioned in area 3, they entered the category of groundwater with high hardness according to the German scale and this two groundwaters are not in accordance with WHO, see Table 1.

If the water contains large amounts of bicarbonate, this will determine the hardness of the CS rather than the general hardness (GH). In this case, after determining the total hardness (GH), it equals the carbonate strength.

The health side effects that may have some underground water in the three study areas of the Arbëria neighbourhood

One current challenge in geochemistry is determining the genesis and particularly the geochemical processes controlling the chemical compositions of mineral waters, which are often generated in complex hydrogeological systems (18).

Arterial hypertension, affecting about one billion people worldwide, is the most prevalent modifiable risk factor for cardiovascular diseases and related disability (19). In many cases, groundwater has caused many health problems due to the scarcity of chemical knowledge. In our case, some groundwaters containing HCO_3^- that are not in accordance with WHO and can cause health problems (Figure 2) due to the formation of alkalosis.

Normal arterial blood pH is restricted to a very narrow range of 7.35 to 7.45. A person who has a blood pH below 7.35 is considered to be in acidosis (actually, "physiological acidosis," because blood is not truly acidic until its pH drops below 7), and a continuous blood pH below 7.0 can prove fatal. Acidosis has several symptoms, including headache and confusion, and the individual can become lethargic and easily fatigued. A person who has a blood pH above 7.45 is considered to be in alkalosis, and a pH above 7.8 is fatal. Some symptoms of alkalosis include cognitive impairment (which can progress to unconsciousness), tingling or numbness in the extremities, muscle twitching and spasm, nausea, and vomiting. Both acidosis and alkalosis can be caused by either metabolic or respiratory disorders. Metabolic alkalosis is the opposite of metabolic acidosis. It occurs when the blood is too alkaline (pH above 7.45) due to too much bicarbonate (called primary bicarbonate excess), see Table 2. A transient excess of bicarbonate in the blood can follow ingestion of excessive amounts of bicarbonate, citrate, or antacids for conditions such as stomach acid reflux—known as heartburn. Cushing's disease, which is the chronic hypersecretion of adrenocorticotrophic hormone (ACTH) by the anterior pituitary gland, can cause chronic metabolic alkalosis. The over secretion of ACTH results in elevated aldosterone levels and an increased loss of potassium by urinary excretion. Other causes of metabolic alkalosis include the loss of hydrochloric acid from the stomach through vomiting, potassium depletion due to the use of diuretics for hypertension, and the excessive use of laxatives (20).

Nitrogen compounds are formed in the air by lightning or discharged into it from industrial processes, motor vehicles, and intensive agriculture (21). Nitrites in the water supply system can also reach due to their frequent use as a corrosion inhibitor during industry water processing. When the nitrite ions reach the stomach, the high concentration of hydrochloric acid in the stomach turns nitrite into nitrous acid (HNO_2) which reacts with secondary amines from the digestive tract and forms *N*-nitrosoamine. *N*-nitrosoamines are known as carcinogenic substances (1).

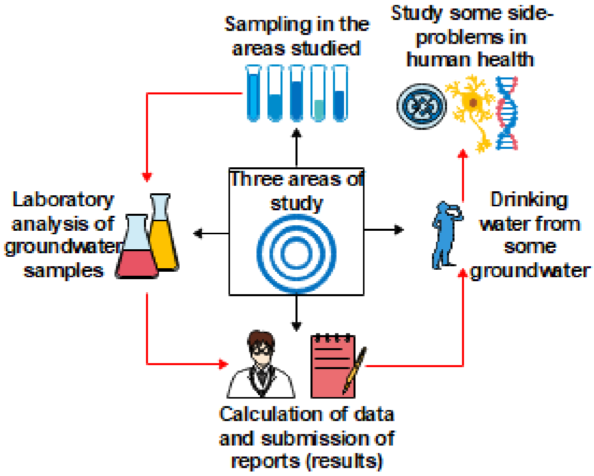

Figure 2. Scientific description of chemical problems in groundwaters with depths of (8-60) m in Arbëria neighbourhood in municipality of Gjilan.

Table 1. Physico-chemical results of groundwaters with depth 8-60 m in the Arbëria neighbourhood in Gjilan Municipality.

Area	**Depth (m)**	**pH**	**NTU**	**CW μS/cm**	**Cl^- mg/L**	**A^- mL HCl 0.1**	**HCO_3^- mg/L**	**CS °dH**	**NO_2-N mg/L**	**NO_3-N mg/L**	**NH_3-N mg/L**
Area 1	8	7.19	3.54	1400	55	8.57	523.2	23.21	0.008	7.1	0.05
	9	7.45	0.75	1076	46	8.5	518.5	21.67	0.002	5.6	0.06
	12	7.32	1.62	867	26.2	6.39	390.4	21.79	0.002	5.9	0.02
	18	7.4	1.15	1693	55	7.1	433.1	40.02	0.004	4	0.09
	60	7.1	1.66	1037	28	8.1	494.1	26.27	0.001	3	0
Area 2	8	7.57	0.65	920	39	5.6	341.6	23.08	0.003	5	0.04
	12	7.74	4.52	1170	45.2	8.6	524.6	29.35	0.008	5	0.06
	18	7.51	0.44	978	65	7.78	292	25.27	0.003	6.9	0
	30	7.39	0.45	471	49.4	4.26	260.1	12.53	0.004	1.9	0.01
	30	7.81	0.51	1448	12.6	4.2	256.2	37.07	0.003	3.4	0.08
Area 3	25	7.3	1.5	920	43	4.73	289	24.08	0.002	7.3	0.03
	30	7.31	3.1	1230	29	8.46	516.5	20.64	0.007	8.7	0
	30	7.12	2.99	1310	22	7.05	430.1	21.94	0.004	8.1	0
	32	7.2	0.45	1295	60	6.54	399.1	36.47	0.006	1.9	0
	40	7.8	0.5	1400	59	8.22	501.9	31.2	0.009	8.9	0.01
WHO reference values		7.2 to 7.8	5	1500	250	10.5	250 to 500	18 to 30	0.005	10 (Method 8039)	0.5

Table 2. Types of Acidosis and Alkalosis

	pH	**PCO_2**	**HCO_3^-**
Metabolic acidosis	↓	N, then ↓	↓
Respiratory acidosis	↓	↑	N, then ↑
Metabolic alkalosis	↑	N, then↑	↑
Respiratory alkalosis	↑	↓	N, then ↓

Reference values (arterial): pH: 7.35–7.45; pCO_2: male: 35–48 mm Hg, female: 32–45 mm Hg; total venous bicarbonate: 22–29 mM. N denotes normal; ↑ denotes a rising or increased value; and ↓ denotes a falling or decreased value.

CONCLUSION

The quality and quantity of water for human during history has been a vital factor in determining the welfare. The results obtained on the basis of laboratory analysis conclude that in the neighbourhood Arbëria the water is not of good quality in some areas due to the high concentrations of NO_2-N and HCO_3^- ions and these values of these ions send us in a direction that the waters in this neighbourhood are included a high CS at the German °dH scale. During the analysis we have concluded that there is a high carbonic strength (CS) in the three research areas, and this happened when the water comes into contact with the underground lime layers by dissolving them. In conclusion we can say that water quality is not very good due to the carbon strength exceeding the allowed drinking norm and this is dangerous for direct consumption and for use in the field of industry. The reason why these waters are not suitable for human organs is that these waters after use will cause problems over time in the digestive system, cardiovascular problems etc. NO_2-N in these groundwaters express a great concern because nitrites are very toxic. After receiving the results, we immediately informed the users of these groundwater where their parameters were not in accordance with the WHO regulation. In some groundwaters of the three analysed areas it is proved that those parameters that are not in accordance can cause major problems of normal metabolism.

List of symbols and abbreviations

CW – conductivity water, NTU – nephelometric turbidity unit, CS – carbonic strength, EDTA – ethylenediaminetetraacetic acid, GH – general hardness, WHO – World Health Organisation, A - Alkalinity, ACTH - adrenocorticotrophic hormone.

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