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Evaluation of Arsenic, Magnesium and Calcium in Drinking Water of Ghouri-Goul Region in Tabriz

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Abstract: Drinking of the Arsenic contaminated water has harmful effects on digestive tract, cardiovascular system and central nervous system. Also, presences of calcium and magnesium metals in potable water prevent cardiovascular and cerebrovascular diseases. However, high amounts of recent compounds have some difficulties for watering, industrial and home using. So, in order to evaluating of water quality in Ghouri-Goul region, thirty six samples were taken during a year in order to determination of cited metals by means of atomic absorption spectrometry. ANOVA and one sample T-test were used for analyzing of data. In according with present study, mean of the arsenic calcium and magnesium were 0.0067, 30.97 and 12.75 mg L^{-1}, respectively. The results of present study show that there is no significant difference in aqueous concentration of Arsenic, Calcium and magnesium during a year ($p>0.005$) and they have acceptable amount, accordance of Iranian standards.

Key words: Water, atomic absorption, arsenic, magnesium, calcium, Ghouri-Goul

INTRODUCTION

Problems due to arsenic persistence in water are widespread. Arsenic is a carcinogen element and drinking of contaminated water to this element may have harmful effects on digestive tract, heart, vascular system and central nervous system. For its poisonous effects on human health, recently United States Environmental Protection Agency (USEPA) has decreased the maximum allowance limit of arsenic in water from 50-10 μg L^{-1} (Kumar *et al*., 2004; Wilson *et al*., 2004).

Calcium salts almost can be found in form of mineral compounds in natural waters and they influence the water resources through three ways: Calcic stones, chalk and calcium chloride. Calcic stones can be solute in water up to 13 ppm. If there has been soluble CO_2 in water, solubility of it can reach to 1000 ppm. Chalk ($CaSO_4$) dissolves utmost up to 2000 ppm in water and Calcium Chloride ($CaCl_2$) is very soluble in water and it makes water, no drinkable before saturation (Babbitt *et al*., 1962). Persistence of high amount of magnesium in drinking water has a laxative effect (Babbitt *et al*., 1962). According to the effect of calcium and magnesium concentrations on water quality, these metals were measured and they didn't show significant difference during a year ($p>0.05$).

Also, the lack of magnesium in drinking water causes the complications such as high blood pressure, heart arrhythmia, acute heart infarction, eclampsia in pregnant women and possibly type 2 diabetes and osteoporosis (Yang *et al*., 2000; Sherer *et al*., 2001; Sauvant and Pepin, 2002; Saris *et al*., 2000; Rubenowitz *et al*., 2000; Innerarity, 2000; Guillemant *et al*., 2000). Therefore, the minimum required amounts of magnesium and calcium in drinking water are 10 and 20 mg L^{-1}, respectively and the desired amounts of magnesium and calcium are 30-20 mg L^{-1} and 80-40 mg L^{-1}, respectively that these are studied for confirmation of drinking water quality (Kozisek, 2003).

Entry ways of arsenic to the body of human are water, soil and food. Inhalation of dust containing arsenic causes its entree to the lung. Contact of arsenic contaminated soils with skin causes the low values entree of arsenic to the body (Edwards *et al*., 1998). If human body exposures to arsenic the liver converts some of it into a low loss organic form. The human body can excrete both of organic and mineral forms through the urine in a few days. But in some cases, it may remain in the body for several months or more. The As (III) has a tendency to be stored in tissues of body while As (V) quickly and almost completely is excreted through the kidneys (Wilson *et al*., 2004). Since, the old, the mineral arsenic is well-known as

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a toxin for human and overdoses of it (60 mg L^{-1}) in food or water can lead to death (Public Health Statement for Arsenic, 2007). However, lethal amount of arsenic in the form of arsenic tree oxide (As_2O_3) is mentioned 180-70 mg in some sources (Wilson *et al*., 2004). Also, swallowing of less arsenic values (the range of 0.3 -30 mg L^{-1}) can cause stomach and intestinal stimulation with signs such as pain, queasiness, vomiting and diarrhea. Reduction of red and white blood cells production is another effect of mineral arsenic that it can lead to fatigue, heart rate arrhythmia, blood vessels damaging and bruising. Consumption of mineral arsenic for long period will cause skin changes. This effect appears as being dark skin and emersion of wart and corn on palm and other parts of body and a low numbers of corns eventually lead to skin cancer (Naidu *et al*., 2006; Public Health Statement for Arsenic, 2007; Wilson *et al*., 2004).

Also, Arsenic consumption increases the risk of liver, bladder, kidney, prostate and lunges cancers. Department of Health and Human Services (DHHS) has introduced the mineral arsenic as a cancer agent. Also, International Agency for Research on Cancer (IARC) has nominated the arsenic as a carcinogen agent (Naidu *et al*., 2006; Public Health Statement for Arsenic, 2007; Wilson *et al*., 2004).

Although, there is not a certain treatment for diseases due to consumption of arsenic contaminated waters, but we can say that replacing of arsenic contaminated water source with a safe water source makes the above-mentioned symptoms gradually disappeared and the infected person improves (Public Health Statement for Arsenic, 2007).

Although, presence of low to moderate amounts of calcium and magnesium salts in drinking waters in terms of health prevents incidence of cardiovascular disease and cerebrovascular disease, but theirs high values may create some problems for domestic, industrial and watering uses (Babbitt *et al*., 1962). Also, the magnesium salts have laxative effect for those who are not addicted for its presence in water. Carbonate compounds and Calcium and magnesium bicarbonates naturally due to the severe effectiveness on the base behavior and hardness of water are important because in addition to being effective on the taste of drinking water, they have Corrosion effects on thermal systems and they effect on dissolving ability of materials in industries such as soft drink making (Kozisek, 2003).

It is proven that waters of the Kurdistan region are as a part of the arsenic contaminated regions in Iran (Mosaferi *et al*., 2003). Water resources usually are contaminated by natural processes like erosion and dissolution of minerals and soils containing arsenic and it occurs due to human activities such as not controlled industrial production of Metallurgy and Mineral Industries and pesticides containing arsenic.

In accordance with Act of Institute of Standards and Industrial Research of Iran, the maximum permissible concentration for arsenic in potable mineral water is 0.05 and for calcium and especially, magnesium are 200 mg L^{-1}it and 150 mg L^{-1}, respectively (Institute of Standards and Industrial Research of Iran, 1383d).

In recent years, surveys show that the construction demand of mineral water producer units has been increased in the Ghouri-Goul region of Tabriz city. Identification and analysis of Azerbaijan mineral waters from viewpoint of potability is among the research priorities of Tabriz University of Medical Sciences, therefore, investigation for the quality of mineral waters of Ghouri-Goul region were studied. In this study, because of harmful effects of arsenic, it is the main goal of research. Also, the two calcium and magnesium metals, due to their effects on water quality, were measured.

MATERIALS AND METHODS

All solutions, used in this research, including the standard solutions of metals for analysis, were purchased from the Merck Company (Germany). Referring to the Ghouri-Goul region of Tabriz and in accordance with standard methods No. 2348 and 2347 and 1055 36 , water samples (samples with a length of 10 days) were transferred to the food control , drink, cosmetics and health laboratory of Tabriz Medical Sciences University during a year. Samples were kept in laboratory temperature and away from direct sun light. In order to measuring the concentration of calcium and magnesium the flame atomic absorption spectrometry (Shimadzu model AA 6650) was used. For this purpose, solutions with concentrations of 10, 20, 40 and 60 mg L^{-1} of calcium and 5, 10, 15 and 20 mg L^{-1}s of magnesium were prepared and absorbing diagram against concentration for each of them was drew by the Software of atomic absorption device. In order to determination of the unknown solutions concentration, absorption of each solution was measured by experimental device and the concentrations of unknown solutions were obtained by relevant diagram (Institute of Standards and Industrial Research of Iran, 1383a-c).

For measuring of total arsenic [As (III) + As (V)] in samples, the Hydride production method and Atomic absorption spectroscopy were used. The device used for this purpose was Varian spectroscope (Model: 240FS) equipped with Hydride producing system. Regarding to the primary tests and determination of low concentrations

of arsenic in the samples, arsenic concentrations of 0.001, 0.003, 0.006 and 0.010 mg L^{-1} were prepared from 1000 ppm standard solution. For preparing of solutions, we used diluted thick solution with no ion water, that it was produced by water purification system (Millipore, USA).

For Comparing of the mean concentrations of above metals during the months of year, we used ANOVA statistical test and to compare them with the permissible limit of standard, statistical test of T-test was used.

RESULTS AND DISCUSSION

The results of this study showed that the mean concentrations of magnesium and calcium are 97.30 and 75.12 mg L^{-1} it during a year, respectively (Table 1). But, the statistical analysis of these results indicates a significant difference between the permissible values of the examined elements and obtained mean value ($p<0.005$). So that none of the examined metals concentrations weren't higher than permissible value of Iran standard office.

Also, calculation of the mean concentration of examined metals showed variations in separate months of a year that comparing of these variations during the months of a year did not show significant difference separately ($p>0.005$). In other words, despite the increasing of some elements concentration in several months of a year, so their concentration in examined water was under the standard level (Fig. 1-3).

Arsenic can be found in water in forms of organic and mineral (Fields *et al*., 2000). But, the amount of arsenic in mineral waters is more (Edwards *et al*., 1998). Capacity and mineral arsenic types in water are dependent on the oxidation- reduction condition and pH of water (Edwards *et al*., 1998). As a rule, arsenic in forms of As (V) or Arsenate (As4O10) is more in surface waters and it is found in groundwaters in form of As (III) or Arsenite (As4O6); However, these two forms are always together (Kumar *et al*., 2004). Although, several methods such as titration, spectrophotometry and electrochemical method can be used for measuring of various arsenic types, but regarding to the poor amounts of this element in analyzed waters, the mentioned methods have not desirable accuracy in these concentrations. Hence, we analyzed the values of total arsenic by atomic absorption method with Hydride generator in this research.

Analysis of data indicates this fact that arsenic concentration was very low and almost constant during this period. These variations probably attributes to the amount of rainfall and genus of soil. The results of this study show that there aren't significant variations in arsenic concentrations in waters of this region during four seasons ($p>0.05$) and the amount of arsenic never has been exceeded from the standard limit of Iran. Therefore, waters in this area of Azerbaijan can be called as clean waters from arsenic.

Table 1: Mean concentrations of calcium, magnesium and arsenic at mg L^{-1} during 1384 years

	Descriptive statistics			
Metals	N	Min.	Max.	Mean±SD
CA	36	15.000	50.000	30.9722±7.6513
MG	36	8.000	16.000	12.7500±1.9766
AS	36	0.005	0.008	6.78E-03±1.045E-03
Valid N (list wise)	36			

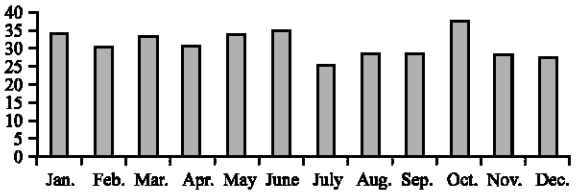

Fig. 1: The mean concentrations of calcium at mg L^{-1} during the months of 1384 years

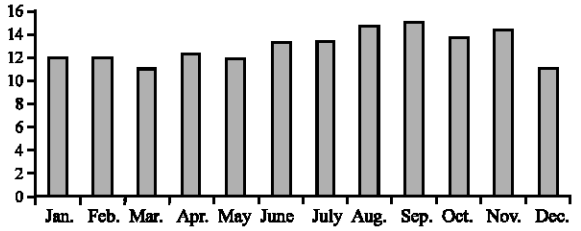

Fig. 2: The mean concentrations of magnesium at mg L^{-1} during the months of 1384 years

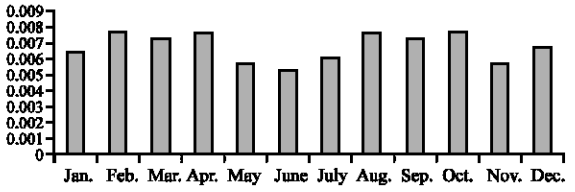

Fig. 3: The mean concentrations of arsenic at mg L^{-1} during the months of 1384

CONCLUSION

With a quick review of the results and considering of permissible standard amounts, it can be concluded that waters of Ghouri-Goul region in the East Azarbaijan province are clean waters from arsenic and regarding to the value of calcium and magnesium waters of this region are standard.

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