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Determination of Trace Elements in the Drinking Water of Mardan District KPK, Pakistan

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Abstract: Water is an important component for living organisms especially for human. The current study of Mardan area gave a lot of information about quality of the drinking water. The present paper showed the concentration of trace elements (Ni, Pb, Cr, Cd, Zn, Cu) and cations like (Na, K, Ca, Mg) in the drinking water of district mardan. the magnesium level was found very high 292.6 mg/l then the WHO recommend level is 150 mg/l.it means that mardan district drinking water showed hardness and hardness caused cardiovascular disease mortality in human body. The analysis of date gave normal concentration of heavy metals water of Mardan tube well is fit for drinking after Mg is removed by boiling

Key words: Water Quality · Trace Elements · Drinking Water · Cations

INTRODUCTION

Water is the most essential substance for living things and it supports the life processes and without water it would not have been possible to sustain life on this planet. The total quantity of water on earth is approximately 1.4 trillion cubic meters [1]. Heavy metals are sometimes called trace elements of the periodic table. Heavy metals have become of particular interest in recent two decades and within framework of environmental investigations. Heavy metals are among the most persistent pollutants in aquatic ecosystem because of their resistance to decomposition in natural conditions [2]. High concentration of these metals can be released into the aquatic environment as a result of leaching from bed rocks atmospheric decomposition, water drainage run off from riverbanks and discharges off urban and industrial wastewaters [3]. The toxicity of an element depends on the dose of the chemical form, route of exposure, bio-availability, and distribution in the body and storage and excretion parameters.

In recent years, considerable interest has been focused on assessing the human health risk posed by metals, metalloids, and trace elements. It has long been recognized that large areas of the globe contain human population characterized by having trace elements deficiency, or excess including chronic poising [4].

The two main sources of potable water are surface water and ground water. Rivers and streams are the important surface water sources, while springs, deep and shallow wells are the common sources of ground water. The main sources of ground water are precipitation (snow, rain, dew etc) and underground (phreatic) water [5].

The quality of water should be necessarily checked from time to time in order to have a check upon the level of inorganic, organic, microbial and bacterial pollutants.

Bottom sediments are important sources of inorganic and organic matter in streams, fresh water, estuaries and oceans. Sediments and suspended particles are also important repositories for trace metals, e.g. Cr, Cu, Mo, Ni, Co and Mn. Metals differ from other toxic substances because they are neither created nor destroyed by humans. There are at least two ways by which human utilization influences the potential for health effects; first by environmental transport, that is by humans as anthropogenic contributions to air, water, soil and food, second by altering the speciation or biochemical form of the element [6].

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Naturally metals are redistributed in the environment by the geologic and biologic cycles. Rocks and ores are dissolved in rain water and then rain water physically transport material to streams and rivers, adding and detecting from the adjacent soil and finally to the oceans which are then precipitated as sediments or taken up in rain water to be relocated elsewhere on earth.

According to " PCRWR" Pakistan ground water was almost free from any heavy metals pollution and all the analyses were found to be within the permissible limits except the Mg level [7].

The present study aimed at determining heavy metals concentration in Mardan distracts drinking water and also the level of sodium, potassium, calcium and magnesium.

MATERIALS AND METHODS

Sixteen tube well drinking water samples were collected from different localities of Mardan division, Pakistan. The sample were examined for the Ca^{2+}, Mg^{2+}, Na^{1+}, K^{1+} ion with help of flame photo meter while the heavy metals including Pb, Ni, Mn, Cr, Cd, Zn, Cu were determined by the standard literature method using Atomic Absorption spectrophotometer [8].

RESULTS AND DISCUSSION

Table 1 shows the standard value of trace metals in potable water and table 2 shows the trace metals values in drinking water.

Table 1: WHO standards for heavy metals in potable water [13]

Metal	Symbol	Prescribed Limit (mg/l)
Arsenic	As	0.05
Cadmium	Cd	0.005
Chromium	Cr	0.05
Copper	Cu	0.05
Iron	Fe	0.3
Lead	Pb	0.05
Manganese	Mn	0.1
Mercury	Hg	0.001
Nickel	Ni	-
Zinc	Zn	5.0

The amount of lead present in water samples was given in table 2 (Column 2). According to WHO standards, the permissible limit for lead in drinking water is 0.05mg/l [9]. Lead concentration in all the water samples was within the permissible limit and ranged from 0-0.03mg/l. The Nickel concentration in water samples ranged from 0-0.10mg/l as shown in table 2 (column 3). According to WHO standards, the permissible limit for Mn is 0-0.1ppm [10]. The concentration of manganese in water samples was calculated and the water of Mardan water was free from this metal.

The Chromium concentration in samples ranged from 0-0.02mg/l. The permissible limit for chromium is 0.05mg/l, so, chromium was found within the limit recommended by WHO[11]. The permissible limit for cadmium is 0.005mg/l [12]. However, the water of Mardan was free from cadmium. The permissible limit for zinc in drinking water is 5mg/l [13].The concentration of zinc lied between 0 and 0.16mg/l. So it is not hazardous for human health.

Table 2: Trace metals levels in the examined potable water samples

Sample ID	Pb	Ni	Mn	Cr	Cd	Zn	Cu
1	0.01	0.10	00	0.01	00	0.04	0.01
2	00	00	00	00	00	00	00
3	00	0.01	00	00	00	0.01	00
4	0.01	00	00	0.02	00	0.02	00
5	00	00	00	00	00	00	0.01
6	0.02	00	00	00	00	00	00
7	00	00	00	00	00	0.07	0.01
8	0.01	0.01	00	00	00	00	0.01
9	00	0.03	00	00	00	00	0.01
10	0.01	00	00	00	00	0.02	00
11	00	00	00	00	00	00	00
12	00	00	00	00	00	00	0.01
13	00	0.03	00	00	00	0.02	00
14	0.03	0.01	00	0.01	00	00	0.01
15	00	0.04	00	00	00	0.16	0.01
16	0.01	0.01	00	00	00	00	0.01

Table 3: Cations concentrations of examined potable water samples

Sample ID	Na^+ (ppm)	K^+ (ppm)	Ca^{2+}(mg/l)	Mg^{2+}(mg/l)
1	140	4.8	62.4	158.4
2	97	3.5	38.4	115.2
3	49	3.9	57.6	182.39
4	70.5	4.9	91.2	148.8
5	68.5	5.9	187.2	144
6	64.5	3.8	67.2	144
7	66.5	4.3	86.4	206.4
8	24.5	5.8	110.4	211.2
9	42	5.1	105.6	244.8
10	53.2	5.2	134.4	292.8
11	36	4.8	144	283.2
12	43.6	4.6	134.4	220.8
13	46.4	4.5	115.2	211.2
14	54.8	4.5	91.2	244.8
15	60.4	4.7	100.8	211.2
16	63.6	4.7	86.4	196.8

The copper concentration ranged from 0-0.01mg/l in water samples. The permissible limit for copper is 0.05mg/l according to the WHO standards [14].The results showed that there is no high value of trace metals in Mardan district tube well drinking water. All the values were under WHO standards.

Abbreviation

Sample ID: Area name
WHO: World Health Organization
PCRWR: Pakistan Council of Research and Water Resources
G.P.G.C: Government Post Graduate College

Table 3 shows the level of cations in water. Sodium is present in most natural waters, and may be found in fairly high concentrations when water is softened by a process in which Ca and Mg is exchanged for Na. The values of sodium were given in table 3 (column 2) showing the range between 24.5 and 140 ppm. The WHO permissible limit for sodium is 200 ppm [14]. The calculated values of all the samples were below the permissible limit but the magnesium and calcium values are higher than permissible limits.

The maximum tolerable limit of K for drinking purpose is 10ppm. In comparison to Na content the samples under investigation had relatively low concentration of K which ranged from 3.5-5.9ppm (Table 3). According to WHO the permissible limit for K is 75 ppm [15]. The values of Ca concentrations were given in table 3 (column 4). The table shows that the Ca concentration of water samples ranged from 38.4 -187.2mg/l, that were below the WHO maximum permissible level of Ca (250 mg/l) [16]. However, majority of the samples obtained from Jana bad, Sheikh maltoon town, Labour colony, Sarwarabad, Dang baba, Eidgah, G.P.G.C and old Bijlighar (1, 2, 3, 4, 6, 7, 14, and 16, respectively) had very low Ca concentration i.e. below 100mg/l. The concentration of Mg in the samples was given in table 3 (column 5), which shows that these values were ranging from 115.2-292.6mg/l, indicating high concentrations of Mg in most of the samples. Sheikh maltoon, Bagh colony and Dang Baba were the areas, which had Mg concentration within the limits. All the samples, except sample No. 2, 5 and 6 had Mg level above the WHO maximum permissible level (150 mg/l) for potable water [17]. Majority of the samples had dangerously high levels of Mg. Water is a good solvent and picks up impurities easily. Increased Mg level shows hardness of water and also causes cardiovascular disease mortality in human body [18]. The increased Mg concentration also causes several other problems.

In Pakistan especially in Mardan where asses to safe drinking water has not fully guaranteed for a majority of population, the drinking water of mardan district was free from trace elements. The levels of cations were normal except magnesium. The magnesium level was very high (292.6mg/l) compared to the WHO standard value (150mg/l). It is important to improve the quality of tube well water for drinking purpose especially for magnesium.

CONCLUSIONS

The present study aimed to determined heavy metals concentration in Mardan distracts drinking water and also the level of sodium, potassium, calcium and magnesium but the water of mardan division was free from any heavy metals pollution and all the analyses were found to be within the permissible limits except the Mg level.the magnesium level was found very high 292.6 mg/l then the WHO recommend level is 150 mg/l.it means that mardan district drinking water showed hardness and hardness causes cardiovascular disease mortality in human body.

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