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Physicochemical Analysis of Drinking Water in Kohdasht City Lorestan, Iran

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Abstract: This study consisted of the determination of some physiochemical properties in drinking water samples from the Kohdasht region of the Lorestan, Iran, where drinking water sources are ground water. The purpose was to ascertain the quality of water from these sources. Samples were taken from sixteen sampling points and analyzed for the following parameters, Ca, Na, K, Mg, Mn, NO_3^-, NO^-, SO_4^{2-}, PO_4^{3-}, F^-, Cl^-, TDS, EC, alkalinity, hardness and turbidity using the procedure outline in the standard methods. The data showed the variation of the investigated parameters in samples as follows: pH 7.5-7.76, Electrical Conductivity (EC) 705.67-976 μS cm^{-1}, turbidity 0.1-0.4 NTU, PO_4^{3-} 0.11-0.31 mg L^{-1}, NO_3^- 11.44-41.36 mg L^{-1}, NO_2^- 0.017-0.514 mg L^{-1}, SO_4^{2-} 44-90 mg L^{-1} and Mn 0.002-0.056 mg L^{-1}. The concentrations of most of the investigated parameters in the sources of drinking water samples from Kohdasht region were within the permissible limits of the World Health Organization drinking water quality guidelines.

Key words: Water, WHO, physiochemical, turbidity, anions

INTRODUCTION

Good drinking water quality is essential for the well being of all people. Unfortunately in many countries around the world, some drinking water supplies have become contaminated, which has impacted on the health and economic status of the populations (Anonymous, 1992). Even if no sources of anthropogenic contamination exist, there is potential for natural levels of metals another chemical to be harmful to human health. This was highlighted recently in Bangladesh where natural levels of arsenic in groundwater were found to be causing harmful effects on the population (Anawara *et al*., 2002). Unfortunately, this problem arose because the groundwater was extracted for drinking without a detailed chemical investigation. The natural water analyses for physical and chemical properties are very important for public health studies. These studies are also a main part of pollution studies in the environment (Kot *et al*., 2000; Soylak *et al*., 2002a, b). According to our literature review, there has been no published report concerning possible contaminants in drinking water sources in these communities. A wide range of pollutants such as heavy metals, nitrate and nitrite, chlorinate hydro carbons, phenol, cyanide pesticide, inorganic pollutants, radioactivity and bacteria has been reported by many researchers in different regions (Julia *et al*., 2006; Ekdal *et al*., 2006; Fujikawa *et al*., 2005; Ikem *et al*., 2002; Ahmed and Sulaiman, 2001; Elisabeth *et al*., 2000; Fatta *et al*., 1999; Kjeisen *et al*., 1998).

In this study, concentrations of Mn, Ca, Na, Mg and K ions in drinking water samples from water sources in this community were determined. Some physical and chemical properties of the samples were also determined by using standard analytical methods.

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MATERIALS AND METHODS

Sample Collection

The drinking water samples were collected in prewashed (with detergent, diluted HNO_3 and doubly de-ionized distilled water, respectively) polyethylene bottles. pH and conductivity of the samples were measured while collecting the samples. Each water sample was taken from each any 16 well during March 2006 to March 2007. Determinations of the major ions, physical and other chemical properties of the water samples were performed on the same day of sampling.

The samples were obtained directly from the water pump after allowing the water to run for at least five minutes and each sample bottle and its cap rinsed three times. These samples were subsequently stored at 4°C for as short time as possible before analysis to minimize physicochemical changes (Anonymous, 1996). Because very little particulate matter was present in the sample, filtration was not considered necessary. Each sample was analysis for, Mn, NO_3^-, NO_2^-, SO_4^{2-}, PO_4^{3-} and other parameters- using procedures outline in the standard methods for the examination of water and wastewater (APHA, AWWA, WPCF, 2003) also DR 5000 spec- photometer.

RESULTS AND DISCUSSION

Phosphate (PO_4^{3-}) ranged from 0.11 to 0.31 mg L^{-1}. Fluoride (F-) varied from 0.6 to 0.8 mg L^{-1}. Permissible limit for F concentration is 1-1.5 mg L^{-1} according to WHO (2003). The data revealed that all the sources had lower F-values. Nitrate and nitrite (measured as nitrate and nitrite) in the investigated samples were found to be in a range of 11.44 to 41.36 mg L^{-1} and 0.017 to 0.514 mg L^{-1}, respectively (Table 1). The range of sulphate (SO_4^{2}) in the samples was 44.5 to 90.0 mg L^{-1} at wells throughout the sampling periods. The range of chloride (Cl^-) in the samples was 14.40 to 44.00 mg L^{-1}. Nitrate, nitrite, chloride and sulphate concentrations were all below the WHO permissible limits. The concentrations of the major ions were below the permissible limits given by the WHO.

The lowest and the highest levels of these metals detected ranged between 0.002 to 0.056 mg L^{-1} for manganese in the sample from this region (Table 2).

Except well number five, Average manganese levels were found to be in the water samples were below the WHO permitted limit, which is 0.05 mg L^{-1}.

Table 1: The concentration of analyzed anions in the drinking water samples

Well No.*	SO_4^{2-} (mg L^{-1})	Cl^- (mg L^{-1})	PO_4^{3-} (mg L^{-1})	NO_3^- (mg L^{-1})	NO_2^- (mg L^{-1})	F^- (mg L^{-1})
1	44.50	24.50	0.15	20.25	0.025	0.70
5	55.00	34.95	0.28	11.44	0.023	0.60
6	85.00	15.93	0.19	26.40	0.039	0.70
7	79.50	14.40	0.17	14.08	0.023	0.80
9	47.00	42.25	0.12	14.08	0.026	0.70
10	61.50	40.11	0.23	13.20	0.020	0.75
11	65.50	39.75	0.27	11.88	0.017	0.75
12	61.00	35.26	0.25	25.08	0.046	0.70
13	90.00	42.69	0.16	41.36	0.514	0.70
14	90.00	43.75	0.19	14.52	0.092	0.70
15	66.50	17.73	0.31	15.40	0.020	0.70
16	80.00	21.59	0.11	30.36	0.095	0.60
17	90.00	44.00	0.15	13.24	0.023	0.70
18	89.00	29.50	0.18	12.12	0.019	0.70
19	89.00	32.64	0.31	21.25	0.020	0.60
20	87.00	33.38	0.16	13.64	0.020	0.80
Max	90.00	44.00	0.31	41.36	0.514	0.80
Min	44.50	14.40	0.11	11.44	0.017	0.60

*Wells No. 1, 2, 3, 4 and 8 had been out of service

Table 2: The concentration of certain metals ion in the drinking water samples

Well No.	Ca (mg L^{-1})	K (mg L^{-1})	Na (mg L^{-1})	Mg (mg L^{-1})	Mn (mg L^{-1})
1	78.93	0.80	28.0	53.87	0.045
5	96.24	0.90	50.5	54.93	0.056
6	79.50	1.30	25.0	48.00	0.042
7	108.36	1.75	24.5	25.28	0.039
9	94.27	0.95	49.5	59.20	0.031
10	106.18	0.91	47.0	52.80	0.002
11	76.12	0.90	45.0	52.80	0.027
12	70.19	0.60	39.0	60.27	0.018
13	93.55	1.28	37.0	52.80	0.041
14	76.12	0.93	41.5	52.80	0.027
15	64.38	1.20	42.0	21.12	0.040
16	78.11	1.47	29.0	32.00	0.026
17	64.00	0.60	35.0	52.80	0.045
18	75.73	0.70	25.0	35.20	0.041
19	79.13	0.57	29.5	32.00	0.009
20	53.07	0.58	34.5	56.00	0.017
Max.	108.36	1.75	50.5	73.60	0.056
Min.	53.07	0.57	24.5	21.12	0.002

Table 3: The average values of hardness and alkalinity in the drinking water samples

Well No.	Phenol alkalinity (mg L^{-1}) as $CaCO_3$	Methyl alkalinity (mg L^{-1}) as $CaCO_3$	Alkalinity total (mg L^{-1}) as $CaCO_3$	Hardness total (mg L^{-1}) as $CaCO_3$
1	0	293.30	293.30	418.10
5	0	315.80	315.80	435.77
6	0	229.00	229.00	365.03
7	0	203.80	203.80	354.88
9	0	350.00	350.00	433.46
10	0	360.00	360.00	446.69
11	0	363.30	363.30	396.59
12	0	335.00	335.00	427.58
13	0	240.00	240.00	425.64
14	0	400.00	400.00	396.59
15	0	252.50	252.50	258.13
16	0	220.00	220.00	341.32
17	0	345.00	345.00	376.39
18	0	261.70	261.70	333.60
19	0	318.00	318.00	316.36
20	0	336.00	336.00	384.62
Max.	0	400.00	400.00	449.66
Min.	0	203.75	203.75	259.58

Sodium concentrations in the drinking water samples were in the range from a minimum 24.50 to 50.50 mg L^{-1} (concentrations in excess of 200 mg L^{-1} may give rise to unacceptable taste.

At room temperature, the average taste thresh Guideline sodium is about 200 mg L^{-1}. No health-based guideline value has been derived (WHO, 2006). Potassium concentrations in the drinking water samples were in the range from a minimum 0.57 to 1.75 mg L^{-1}. Magnesium concentration in the drinking water samples were in the range from a minimum 21.12 to 60.27 mg L^{-1}. Calcium concentration in the drinking water samples were in the range from a minimum 53.07 to 108.36 mg L^{-1}. The importance of the two later cations is in hardness formation. The values of related hardness to these to metal is shown in Table 3. Minimum 258.13 to 446.69 mg L^{-1} as $CaCO_3$. Lower than maximum tolerate consumers 500 mg L^{-1} specified by WHO. In addition, types of Alkalinity shown in Table 3. Phenol alkalinity values is zero in all samples. The entire alkalinity component is bicarbonate.

Turbidity is a measure of the cloudiness of water. It has no health effects. However, turbidity can interfere with disinfection and provide a medium for microbial growth (Table 4). Turbidity may indicate the presence of disease causing organisms. These organisms include bacteria, viruses and

Table 4: The values of turbidity, EC MPN, pH and TDS in the drinking water samples

Well No.	TDS (mg L^{-1})	EC (µS cm^{-1})	pH	MPN/100 cc	Turbidity (NTU)
1	392.0	865.5	7.56	0	0.12
5	456.3	908.0	7.60	0	0.20
6	350.0	705.7	7.73	0	0.20
7	461.7	916.3	7.73	0	0.20
9	460.3	917.0	7.50	0	0.21
10	456.8	949.2	7.53	0	0.30
11	453.6	943.0	7.55	0	0.40
12	447.0	906.3	7.59	0	0.20
13	450.0	937.4	7.62	0	0.35
14	456.6	948.8	7.53	0	0.40
15	381.0	772.0	7.76	0	0.20
16	381.5	796.3	7.68	0	0.10
17	444.8	976.0	7.55	0	0.12
18	326.0	727.0	7.72	0	0.14
19	355.0	712.7	7.61	0	0.12
20	422.3	864.3	7.59	0	0.21
Max	461.7	976.0	7.76	0	0.40
Min	326.0	705.7	7.50	0	0.10

parasites that can cause symptoms such as nausea, cramps, diarrhea and associated headaches (USEPA, 2003). All the samples have turbidity values less than the WHO permissible value of 5 NTU. The pH values (7.5 to 7.76) were within optimum limit. The recommended permissible limit for Electrical Conductivity (EC) is 300 µS cm^{-1}. By analyzing the results all wells showed EC higher than permissible limit. The value for EC ranged from 705.7 to 976.0 µS cm^{-1}.

The MPN test showed no microbial contamination. All the samples were negative.

Ground waters are water source of many communities usually have high soluble solids but low microbial contamination (Muhammad *et al*., 2007; Adnan *et al*., 2005).

Any way the amount of the parameters varies from places of the word. Villages of Haryana have high amounts of fluoride (up to 6.9 mg L^{-1}) in ground waters (Meenakshi *et al*., 2003) and levels as high as 1.5 to 11.6 mg L^{-1} in Ethiopian par of Africa has been reported (Clemens *et al*., 2003). Groundwater in the area of eastern Croatia contains high concentrations of iron, manganese, ammonia, organic substances and arsenic (Mirna *et al*., 2007). Similar study in Greece showed sodium, fluoride, sulphates, nitrates and conductivity were lower than the upper limits by 2% of the total number of samples analyzed (Sotirios *et al*., 2008). Results from a study in Lagos City showed almost high levels of sodium in analyzed samples (Yusuf, 2007).

Their quality varies depend on soil and earth combination and other climate and human activities. Compare to other studies in another part of the word this water has a good property for drinking. Study in Ghana showed low pH in some ground water sources (Akoto and Adiyiah, 2007). Fortunately, with regard to analyzed parameters during this research, nearly all harmful component for human health was in a good state.

CONCLUSION

The concentrations of the investigated major ions and metal ions in the drinking water samples from this community in the Kohdasht region of Lorestan were found at the range of the guidelines for drinking waters given by the World Health Organization (WHO). Further research on other communities in this region of Iran for drinking water analyses is required as levels of contaminants may vary due to different soil types, water chemistry and different human activities.

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