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CONTENT OF METALS IN DRINKING WATER OF SEVEN DISTRICTS OF SINDH PROVINCE

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Abstract

An analysis of the quality of drinking water actually being used by local inhabitants of the districts Hyderabad, Mirpukhas, NawabShah, Sanghar, Badin, Noushero Feroz and Khairpur was performed. Median and range values for the metals Na, k, Ca, Mg, Fe and Mn were computed. In all cases, the median values for these metals were well below the WHO upper limit recommendations. The Interrelationship of the parameters studied is examined from district and/or source of water viewpoints.

Introduction

There is an increasing interest in the quality of drinking water throughout the world. A large number of population with no access to safe, clean water has been a matter of deep concern in the developing countries, especially in rural areas. Both, surface and underground water may be contaminated at the source, between the source and storage points or in the storage tanks {1]. The basic type of contamination in surface water is caused by the discharge of untreated or inadequately treated waste water into rivers, lakes and reservoirs. The increased use of manure and fertilizers in agriculture has increased the risk of contamination of under ground water, practically, all natural waters contain dissolved minerals that exert significant effect not only on potability and palatability of drinking water but they also affect human health, since many diseases in man have been associated with either an excess or deficiency of these metals in body fluid [2-5]. Therefore, it is vital to know the concerntrations of these in drinking waters in order to evaluate the risks, if any, to consumers of such waters. In the present study, an attempt is made to provide the basic data on the levels of Na, K, Ca, Mg, Fe and Mn drinking waters which were sampled from different places of seven districts of Sindh Province. The data thus gathered has been compared with WHO standards for drinking water quality.

Materials and Method

Hand pump (24) and tap water (32) sample were collected at random from various locations of seven district (Hyderabad, Mirpurkhas, Nawab Shah,

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Sanghar, Badin, Noushero Feroz and Khairpur) of Sindh Province according to WHO criteria [6]. The water source selected were actually being used by the inhabitants of that area. In case of sampling from tap water, the taps were run at their maximum flow rate for at least 2-3 minutes before collection. All the sample were collected in day time in 1 litre screw cap dried plastic bottles, sequentially cleaned according to Meranger *et al*, [7], that is a deteregent (Zip) wash followd by doubly distilled deionised water rinse, soaking in a 1% (v/v) nitric acid solution for 24 hours, high purity water rinses (12 times) and drying in dust free air in up down position.

Estimation for sodium, potassium, calcium, magnesium, iron and manganese were made within one month of collection. However, in order to avoid the loss of metals, high purity nitric acid (5 ml) was added to each water sample [8] and transferred to 100 ml polyethylene bottles (for storage in the refrigaerator at 4c°) until analysed. The concerntrations of sodium and potassium were determined by using conventional flame photometric methodology and, for the levels of calcium, magnesium, iron an manganese, direct flame atomic absorption method as described in "Standard methods for the examination of water and waste water" [9] was followed.

Results

The operating and analytical parameters used for the determination of calcium, magnesium, iron and manganeses by flame atomic absorption sepectrometry are shown in Table 1. In general, the waters, especially from tap, contained manganese at or below the detection limit. The metal analyses data for 24 hand pumps and 32 tap water samples collected from different places of seven districts of Sindh Province are gicen in tables 2A and 2B respectively. The data shows that majority of the hand pump (84.37%) and tap water (79, 17%) samples had iron higher than 1.5 mg/L. Like wise, sodium greater than 150 mg/L and potassium greater than 20 mg/L were detected in 6 (18.75%) and 4 (12.50%) hand pump water samples respectively. However, with expection to iron, the median values for all other metals were found to be well below the WHO upper limit recommendations [6]. After excluding the outliers from the data, the mean and normal range values (mean $\pm$ 2 S. D) for hand pump and tap water sample were calculated separateluy (table 3). The comparison of the mean values for hand pump and tap water sample (table 4) revealed that the waters from the two sources differed significantly in the amounts of sodium ($p < 0.001$), potassium ($p < 0.001$) magnesium ($p < 0.001$) and manganese ($p < 0.001$), all being higher in had pump waters than in the tap.

Dicussion

The importance of metals and the levels of these in human up takes has received the attention of many reseacrch workers world wide [2, 5, 10]. In the present study, an attempt has been made to provide the basic data on the levels

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of Na, K, Ca, Mg, Fe and Mn in drinking waters collected from various places of seven districts of Sindh Province. The individual metals which have been determined are discussed below:

Sodium

In drinking water excess of sodium may be harmful to patients afflicted with cardiac, renal and circulatory diseases [11]. The maximum permissible level for sodium in drinking water is 150 mg/L [6]. In the present study, all the tap water sample and 18 of the 24 hand pump waters were found to be satisfactory with respect to sodium cantents. The six hand pump water samples (two each from Hyderabad and Khairpur districts and on each from Badin and Sanghar districts) were found to caontain over 200 mg/L sodium, thus, rendering these waters to be unfit human consumption.

Potassium

It is reported that excess of potassium in drinking water acts as cathartic. Although, the concentration of potassium in drinking water seldom increases beyond 20 mg/L. However 4 hand pump water sample (2 from Khairpur district and each from Hyderabad and Sanghar districts) were seen to contain greater amounts of this metal, thus indicating a possible risk factor.

Calcium

Calcium is important for the biological productivitu of waters. Calcium in water can be used by the body as a supplement to the calcium supplied in the diet. An inverse correlation between the calcium content of waters and cardiovascular diseases as well as urolithiasis has been reported by many investigators [12-16]. The upper recommended limit for calcium is 200 mg/L in the present study of all of the water samples were seen to contain calcium with in the limits set by WHO [6].

Magnesium

Magnesium mainly comes from the leaching of igneous and carbonate rocks, and in areas where these sources are common, magnesium concentration in water mostly ranges from 5 to 50 mg/L. At higher concentrations magnesium may cause undesirable taste and gastro intestinal irritations. Moreover, several research workers gave noted an inverse relationship between the magnesium of drinking water and cardiovascular mortality [16, 17]. The maximum permissible level for magnesium is 150 mg/L in the present study, non of the waters contained magnesium greater than 78.12 mg/L.

Iron and Manganese

Iron and Mangnanese are both essential for optimum health. Their intake through drinking water is normally an insignificant part of the total body

requirement. The presence of iron and manganese above the recommended upper limits, is objectionable because oxides or hydroxides of these metals form precipitates and stains on laundry, sanitary articles and plumbing fixtures [8, 18]. Although, iron at concentrations above 0/5 mg/L produces an unpleasant taste, its concentrations over 1/5 mg/L in drinking water may have a protective role against renal stone formation [19].

Conlusion

The present study has shown that, in general, the hand pump and tap water sample used as sources of drinking water seven districts of Sindh Province are satisfactory and meet the drinking water standards set by the World Health Organization.

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Table-1

OPTIMIZED PARAMETERS FOR THE DETERMINATION OF Ca, Mg, Fe & Mn BY FLAME ATOMIC ABSORPTION SPECTROMETRY

PARAMETERS	METALS			
	Ca	Mg	Fe	Mn
Line, nm	223.1	285.2	248.3	279.5
Slit, nm	0.2	0.5	0.2	0.2
Linear working range, mg/l	10-40	0.1-0.4	2.5-10.0	1-4
Lamp Current, m A	10	3.5	5	0.5
Flame	Air Acet:	Air Acet:	Air Acet:	Air Acet:

Table-2A

METAL CONTENT DATA ON HAND PUMP WATER SAMPLES FROM SEVEN DISTRICTS OF SINDH PROVINCE.

SAMPLE No.	DISTRICT	SAMPLING POINT	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Fe (mg/l)	Mn (mg/l)
1	Hyd.	Tando M.Khan	095.91	001.95	084.35	23.57	1.8	0.3
2		Tando M.Khan	033.35	004.30	032.80	47.14	1.5	0.2
3		Hoosri	091.77	006.26	090.85	28.93	1.6	0.1
4		Khawaja Colony	058.42	007.08	116.95	23.57	1.9	0.4
5		Tando Jam	049.91	014.47	073.00	25.71	1.7	0.1
6		Khisana Mori	049.91	006.26	054.25	19.29	1.6	0.2
7		Tando Allahyar	066.70	012.51	069.80	30.00	1.8	0.4
8		Shaikh Bhirkyo	054.28	006.26	051.05	27.86	1.7	0.2
9		Matiari	608.33	027.76	080.55	34.58	1.9	0.3
10		Hala	641.67	012.51	099.30	32.14	1.7	0.3
11	M.Khas	Mirpurkhas	058.42	004.30	055.35	30.00	2.1	0.1
12		Mirpurkhas	058.42	006.26	029.95	18.21	1.5	0.0
13		Mirpurkhas	054.28	007.43	062.85	40.71	1.9	0.3
14	N.Shah	Nawab Shah	058.42	007.43	052.32	15.00	1.9	0.0
15		Nawab Shah	066.70	006.26	054.25	19.29	1.6	0.2
16		Sakrand	074.98	004.30	058.15	30.00	1.8	0.0
17		Sakrand	091.77	008.21	069.80	23.57	1.7	0.2
18		Doulatpur	070.84	003.13	073.00	18.21	1.5	0.0
19	Sanghar	Khipro	175.02	028.54	070.50	45.00	1.9	0.0
20		Sanghar	059.56	010.56	090.85	32.14	1.8	0.0
21		Phuliyonn	066.70	008.21	062.85	25.71	1.5	0.0
22	Badin	Badin	049.91	014.47	071.10	32.14	1.6	0.1
23		Badin	095.91	007.43	102.55	16.07	1.7	0.1
24		Talhar	433.30	005.08	032.55	21.43	1.6	0.0
25	N.Feroz	Moro	074.98	004.30	058.15	30.00	1.6	0.0
26		Bhiria	141.67	014.47	031.95	27.86	1.5	0.2
27		Padidan	091.77	010.56	062.85	27.86	1.7	0.0
28	K.Mirs	Bhangu	416.74	133.72	032.20	78.12	1.9	0.1
29		Jalalji	525.07	007.43	101.90	27.86	1.8	0,0
30		Faiz Ganj	025.07	004.30	042.00	16.07	1.7	0.0
31		Ali Nawaz	029.21	136.85	035.70	07.50	1.9	0.1
32		Mirwah	133.39	003.13	020.55	19.29	1.7	0.0

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Table-2B

METAL CONTENT DATA ON TAP WATER SAMPLES FROM SEVEN DISTRICTS OF SINDH PROVINCE

SAMPLE No.	DISTRICT	SAMPLING POINT	Na (mg/l)	K (mg/l)	Ca (mg/l)	Mg (mg/l)	Fe (mg/l)
01	Hyd.	Usman Shah	025.07	5.08	25.35	07.50	2.0
02		Hussainabad	009.89	3.52	32.80	05.08	1.8
03		Wahdat Colony	004.14	1.95	10.55	21.43	2.2
04		Pathan Colony	100.04	6.26	59.85	03.75	2.1
05		Latifabad	011.27	3.24	14.95	07.50	1.9
06		Matiari	033.35	6.26	31.60	10.00	2.0
07	M.Khas	Digri	041.63	5.08	32.60	10.00	3.6
08		Digri	008.28	5.08	24.95	07.50	1.5
09		Mirpurkhas	145.81	6.26	47.90	32.14	1.6
10		Tando Jan Mohd	136.17	4.30	39.65	08.40	1.9
11	N.Shah	Nawab Shah	041.63	6.26	29.60	07.50	1.4
12		Sakrand	033.35	3.52	31.60	05.08	1.8
13	Sanghar	Hingorno	029.20	7.69	27.20	07.69	1.3
14		Mirwah	025.07	3.24	29.05	08.40	1.9
15		Phuliyonn	027.05	5.63	50.60	07.69	2.2
16		Khipro	030.25	5.08	22.45	08.40	1.8
17	Badin	Badin	016.56	6.26	30.80	07.50	1.7
18		Badin (stored)	012.42	4.30	24.40	05.08	1.4
19		Matli	029.21	6.26	34.60	07.50	1.7
20		Matli (stored)	025.07	6.26	33.70	07.50	1.7
21	N.Feroz	Kandiaro	016.56	5.08	36.46	08.40	1.6
22		Bhiria City	045.26	7.69	39.65	05.08	1.5
23	K.Mirs	Khairpur	008.28	3.24	47.90	21.43	1.8
24		Ranipur	008.57	3.52	52.03	23.12	1.9

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Table-3

NORMAL RANGE (MEAN ± 2 S.D) VALUES FOR METALS IN HAND PUMP AND TAP WATER SAMPLES.

METAL (mg/L)	NORMAL RANGE FOR HAND PUMP WATER	NORMAL RANGE FOR TAP WATER
Na	24.37-102.89 (24)	0.00-47.31 (21)
K	0.27- 14.51 (28)	2.48-07.88 (23)
Ca	16.95-106.11 (31)	14.97-52.29 (22)
Mg	13.75- 36.35 (27)	4.58-10.34 (19)
Fe	1.43- 1.99 (31)	1.29-02.25 (23)
Mn	0.01- 0.42 (19)	0.00-00.10 (09)

Number in parentheses refer to No. of samples

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Table-4

COMPARISON OF METAL CONTENTS (mg/l) IN HAND PUMP AND TAP WATER SAMPLES.

METAL	HAND PUMP SAMPLES (N) MEAN ± S.D	TAP WATER SAMPLES (N) MEAN ± S.D	T VALUE & LEVEL OF SIGNIFICANCE
Na	(24) 63.63 ± 19.63	(21) 22.01 ± 12.65	8.13, p< 0.001
K	(28) 07.39 ± 03.56	(23) 05.18 ± 01.35	2.76, p< 0.01
Ca	(31) 61.53 ± 22.29	(22) 33.63 ± 09.33	5.40, p< 0.001
Mg	(27) 25.05 ± 05.65	(19) 07.46 ± 01.44	12.96, p< 0.001
Fe	(31) 01.71 ± 00.14	(23) 01.77 ± 00.24	00.22, N.S.
Mn	(19) 00.21 ± 00.10	(09) 00.10 ± 00.00	p< 0.00

N.S. refer to not significant.

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