ARSENIC DETECTION IN HAND PUMP WATER SAMPLES OF DISTRICTS OF PUNJAB (BATHINDA, FARIDKOT AND MOGA)

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ABSTRACT

The aim of the present study was to analyse presence of arsenic in hand pump water samples collected from districts in Punjab (Bathinda, Faridkot and Moga district (Malwa region). Total 40 hand pump water samples were collected from each district. In Bathinda district, value of arsenic ranged from 0.008 to 0.1530 ppm with mean value of 0.0569 ppm. *Similarly, in Faridkot district,value ranges from* 0 to 0.153 ppm with mean value of 0.0156 ppm and in Moga districts ,value ranges from 0 to 0.0137 ppm with mean value of 0.0021 ppm. The study reveals that hand pump water samples collected from these three different districts are not for good quality since some samples *were having increased level of arsenic concentration as recommended by WHO and* USEPA *(0.01 mg/L).*

Keywords : Arsenic, As, water, ICAP-AES

I. INTRODUCTION

Arsenic (As), is the most naturally occurring element which is found throughout earth's crust. It potentially toxic element and can exist in both inorganic or organic form. Inorganic form of arsenic is generally considered more toxic [8]. Arsenic reacts with other elements such as oxygen, hydrogen, chlorine, carbon, and sulphur [9]. Arsenical compounds can be grouped as inorganic, organic, and arsine gas (AsH3), and they are further classified according to their valence states: elemental (0), arsenite (trivalent, +3), and arsenate (pentavalent, +5). Trivalent Arsenic or arsenite compounds, both inorganic and organic, are considered the most toxic as compared to the pentavalent and elemental states [1].

In water, it is most likely to be there as arsenate, with an oxidation state of 5, if the water is oxygenated. However, under reducing conditions, it is more likely to be present as arsenite, with an oxidation state of 3 [2].

ARSENIC IN WATER

Water is the most precious gift of the nature and is vital for sustenance of life [3]. Groundwater is the primary source of drinking water for about 95% of Punjab's population [7]. Contamination of water by toxic elements may be arsenic attracting much attention due to its wide occurrence in many countries including India. This toxic element is unevenly distributed in the earth's crust in soil, rocks, and minerals and ranked twentieth in abundance of elements in the earth's crust. Arsenic enters lakes, rivers, or underground water when mineral deposits or rocks containing arsenic dissolve. Arsenic is then released to soil, surface water, groundwater, and the atmosphere with other metals including Cu, Pb, Ag, and Au. Arsenic is also a by-product of some agricultural and industrial activities such as the burning of waste and fossil fuels (especially coal), gold and base metal mining, or agricultural use of pesticides and feed additives [4].

Worldwide, the main reason for chronic human intoxication with arsenic is intake of contaminated drinking water. The current WHO (1993)/Environmental protection agency permissible limit of arsenic in drinking water is 0.01 ppm (10 ppb). Cancer risk from drinking water containing arsenic at 50ppb may be as high as one in 100.In India, natural exposure of man to arsenic through drinking water of wells, hand pumps and springs in Chandigarh and its surrounding areas was first highlighted in 1976. Arsenic level exceeding WHO permissible limit has been reported in ground water of West Bengal, some areas of Bihar and Madhya Pradesh. Similar results have been reported from other countries also [5]. The most devastating case of chronic As exposure is found in Bangladesh. Since the spatial distribution of As in aquifers of the region is highly variable, the ability to distinguish high and low As wells through rapid and reliable testing in the field is critical [6].

An estimated 65 million Bangladeshis are exposed to poisoning through drinking water, since the ground level arsenic concentration in some locations reaches as high as 2mg/L (2 ppm) (Environmental Health Criteria 224 ,WHO). Arsenite is about 50% of the total arsenic (10-1000 ppb) in the groundwater of many wells in West Bengal (India), whereas As(III) was found to be the dominant form of the total arsenic (400-800 ppb) with a ratio of 2.6:1 over As(V) in Taiwan [4]. In addition, the people in such countries often use this water for crop irrigation resulting in the introduction of arsenic in the food chain through various plants including rice.

Groundwater is the main source of drinking water for more than 95% of the population in Punjab [7].The main source of irrigation in Punjab is ground water. The quality of irrigation water is poor due to presence of heavy metal. One of the most dangerous trace metals in drinking waters is arsenic (As) being both toxic and cancer causing [8].

II. MATERIALS AND METHOD

A). STUDY REGION

The state is divided into three regions— Majha, the land which is situated between river Ravi and Beas, Doaba which situated between river Sutlej and Beas and Malwa the region which is present on the south of river Sutluj. Our study area is located in Moga district (Malwa region).

B). COLLECTION OF SAMPLES

Water samples were randomly collected from hand pumps located in different areas of Bathinda, Faridkot and Moga districts of Punjab.

Sampling from Hand pump

A piece of paper was burned and kept at the mouth of the hand pump for few seconds. It kills the bacteria present on surface. Hand pump was worked for 3-4 minutes and water was allowed to flow freely for some time. Bottle was filled (80%-90% of the bottle) with sample water and closed tightly, labelled with location, date and time.

Preservation of samples

After collection of sample, pH was observed followed by addition of 1 ml HCl to the sample bottles for the preservation of the samples. Total 40 hand pump water samples were collected from each district and stored in a cool place till further analysis. Samples were then transported to Citrus Estate Hoshiarpur, Soil/Leaf Testing Laboratory.

Determination of Arsenic

Inductively Coupled Argon Plasma-Atomic Emission Spectroscopy (ICAP-AES) of Total Arsenic Estimation in Water Samples:

Arsenic level in water was estimated using ICAP-AES by following the procedure provided by the manufacturer. 100 mL of water sample was taken in glass beaker in which 2 mL of concentrated HNO_3 was added. After addition of HNO_3, the samples were covered with watch-glass and heated in the water bath at 90-95°C till the volume reduces to 20 mL. Beaker was allowed to cool down. Then, the sample was filtered with Whatman Filter Paper (Grade I) in order to remove the insoluble material as well as the silicates. Final volume of 100 mL was made with reagent water and analysed for presence of Arsenic by ICAP-AES.

III. RESULT AND DISCUSSION

Total 40 hand pump water samples were collected from different places of each district (Bathinda, Faridkot and Moga) . After analysis, it was observed that some samples show high range of Arsenic as compared to the recommended permissible limit by WHO and USEPA (0.01 mg/L).

Concentration of Arsenic in Water Samples

From total 40 water samples collected from each district, the samples having increased level of arsenic concentration are marked as (*).

Tables (1) shows presence of high arsenic concentration

TABLE 1:- HIGH ARSENIC CONCENTRATION (*) IN HANP PUMP WATER SAMPLES OF BATHINDA, FARIDKOT AND MOGA

Sample No.		Quantity Of Elements in Analysed Water (HAND PUMP)					
	MOGA	As(PPM)	FARIDKOT	As(PPM)	BATHINDA	As(PPM)	
	VILLAGE		VILLAGE		VILLAGE		
1	kalie wala	0.0010	Machaki Mal Singh	0.0068	chathawala	0.0012	
2	kalie wala	0.0000	Machaki Mal Singh	0.0059	chathawala	0.0013	
3	mahesari	0.0000	ratti rori	0.0111*	jewan singhwala	0.0009	
4	mahesari	0.0090	ratti rori	0.0099	jewan singhwala	0.0148*	
5	darapur	0.0000	sargo romana	0.0062	kotshmear	0.0009	
6	darapur	0.0000	sargo romana	0.0096	kotshmear	Trace	
7	kukhrana	0.0012	dago romana	0.0135*	shearghar	0.0086	
8	kukhrana	0.0000	dago romana	0.0153*	shearghar	0.0023	
9	jogewal	0.0000	hariewala	0.0076	nasibpura	0.0008	
10	jogewal	0.0030	hariewala	0.0039	nasibpura	0.0031	
11	kahnsingh wala	0.0014	sukhanwala	0.0084	bhagiwander	0.0011	
12	kahnsingh wala	0.0000	sukhanwala	0.0068	bhagiwander	Trace	
13	daulatpur niwan	0.0000	qila nan	0.0078	mehta	0.0008	
14	daulatpur niwan	0.0000	qila nan	0.0095	mehta	Trace	
15	sadasingh wala	0.0013	chet singh wala	0.0136*	gurusar jagga	0.0055	
16	sadasingh wala	0.0102	chet singh wala	0.0102	gurusar jagga	0.0013	
17	salena	0.0000	sher singh wala	0.0082	bhawan kaur singh	0.0028	
18	salena	0.0000	sher singh wala	0.0088	bhawan kaur singh	0.0026	
19	atari	0.0000	dhab	0.0066	sheekhpura	0.0036	
20	atari	0.0006	dhab	0.0066	sheekhpura	0.0012	
21	balkandi	0.0000	bhilewala	0.0990	fethaghar nauabad	0.0005	
22	balkandi	0.0020	bhilewala	0.0020	fethaghar nauabad	0.0005	
23	churh chak	0.0096	mehmoana	0.0096	manuayana	0.0005	
24	churh chak	0.0000	mehmoana	0.0137*	manuayana	0.0004	
25	wada singh wala	0.0000	jandwala	0.153*	talwandi sabo	0.096*	
26	wada singh	0.0000	jandwala	0.0000	talwandi sabo	0.135*	

	wala						
27	umri ana	0.0000	sadhwala	0.0000	bhaghwanghar	0.153*	
28	umri ana	0.0008	sadhwala	0.084*	bhaghwanghar	0.0076	
29	daulatpur ucha	0.0018	midu mann	0.0182*	masana	0.1028*	
30	daulatpur ucha	0.0088	midu mann	0.0088	masana	0.26*	
31	daroli pai	0.0056	jhotiwala	0.0066	bangi raghu	0.36*	
32	daroli pai	0.0000	jhotiwala	0.0066	bangi raghu	0.012*	
33	nathowala	0.0000	ghugiana	0.0000	malwaha	0.523*	
34	nathowala	0.0020	ghugiana	0.0020	malwaha	0.084*	
35	lande ke	0.0060	machaki khurd	0.0196*	sukhladi	0.058*	
36	lande ke	0.0137*	machaki khurd	0.0137*	sukhladi	0.079*	
37	bhinder kalan	0.0000	machaki kalan	0.0000	bangi deepa	0.016*	
38	bhinder kalan	0.0012	machaki kalan	0.0020	bangi deepa	0.136*	
39	kothe rajpura	0.0030	pehlu wala	0.0090	jajjal	0.02*	
40	kothe rajpura	0	pehlu wala	0	jajjal	0.0082	

Present study gives information about high arsenic concentration in drinking water and its exposure to individuals. The concentration of arsenic was observed in a range of 0.008 to 0.1530 ppm with mean value of 0.0569 ppm in Bathinda district. *Similarly, in Faridkot district,value ranges from* 0 to 0.153 ppm with mean value of 0.0156 ppm and in Moga districts ,value ranges from 0 to 0.0137 ppm with mean value of 0.0021 ppm. The study reveals that some hand pump water samples collected from these three different districts are not of good quality as they *were having increased level of arsenic concentration as recommended by WHO and* USEPA *(0.01 mg/L or* 0.01ppm)

IV. CONCLUSION

High arsenic concentration in some water samples indicates further analysis and health impact of arsenic exposure. The findings of the study are expected to be useful to take appropriate steps for justifying the present arsenic crisis pattern and improvement.

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