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STUDY OF HEAVY METALS CONCENTRATION IN GROUND WATER SAMPLES COLLECTED FROM BIKANER CITY, RAJASTHAN

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ABSTRACT:
The present study was focused on quantitative analysis of 84 samples of ground water collected from seven different locations of Bikaner city for seven heavy metals (Fe, Zn, Mn, Ni, Cu, Pb and Cd). The results revealed that the average heavy metal contamination with respect to sampling sites was found in the order of Jorbeed > Beechwal > Shiv bari > Udasar > Natthusar > JNV colony > Pawanpuri. The concentration of these heavy metals in some water samples was found above the critical toxic level prescribed by WHO and BIS. Zn (80.95%), Fe (52.38%) and Cu (34.52%) were three most abundant heavy metals reported in the ground water samples studied for the present investigation. However, the concentration of these heavy metals was found under the maximum permissible limits. A large population is using ground water as drinking purpose; hence they are at the high risk of heavy metal toxicity. Therefore, continuous monitoring of heavy metals in ground water must be ensured to aware the consumers to mitigate the health related problems occurred from heavy metals.

KEY WORDS: Heavy metals, Quantitative analysis, ground water samples.

INTRODUCTION:

Rapid industrialization has geared-up the heavy metal toxicity in ground water due to indiscriminate dumping of industrial wastes. Heavy metals are chemical elements with a specific gravity that is at least five times the specific gravity of water. Heavy metal toxicity problem is the major universal dilemma of the present time with its degree and at variance from region to region, country to country and place to place, depending upon physico-chemical properties of soil and water. Although, some metals are very essential for proper functioning of enzymatic activities in plants and animals, but high level of exposure of these metals may be lethal to the life (Howard, 2002). They may cause strong toxicity even at low concentrations (Marcovecchio et al., 2007). Toxic heavy metals in different components of the environment are a severe threat to civilization. There are hundreds of sources of heavy metal pollution including industrial waste dumping, burning of fossil fuel, chlor-alkali industries, pulp and paper industries etc. Sources may include mining and smelting of ores, electroplating operations, fungicides and pesticides, sewage and sludge from treatment plant etc. These metals may enter into the human body through food, water, air or absorption through the skin when they come in contact with humans in agriculture and in manufacturing, pharmaceutical, industrial or residential settings. Industrial exposure accounts for a common route of exposure for adults. Ingestion is the most common route of exposure in children. Heavy metals become toxic when they are not metabolized by the body and accumulate in the soft tissues. Toxic effects from chronic exposure to heavy metals are far more common than acute poisonings. Heavy metals may cause profound action on living matter, affecting the growth, metabolism, morphology of cells. The metal ions interact with

ionized moieties of amino acids in the polypeptide chain and disrupt the non-covalent polar and ionic interactions which stabilize the secondary or higher order structure of the protein (Horvath, 2011).
Bikaner is situated in the core area of the Thar desert of western Rajasthan, where water scarcity is a general feature. The Indira Gandhi Canal is a life line of the region, as it serves as a major source of water for irrigation as well as for drinking purpose. However, over-exploration of ground water to meet the need of increased industrial activities and domestic uses is continuing. In Bikaner city, there are more than 500 industrial units are working. Many of these industries releases wastes as effluent without any treatment, containing objectionable concentration of different heavy metals. These metals may percolate to the water table and contaminate the invaluable ground water resource. Therefore, the aim of this study was to investigate the quality of the ground water of Bikaner city of western Rajasthan.

MATERIALS AND METHOD:

STUDY AREA:

The present study was confined to the ground water analysis form heavy metal contamination point of view, collected from seven different locations of Bikaner city (Fig. 1). The selection criteria of sampling sites was based on density of hand-pumps and tube wells, density of population, location of industrial zones, discharge of industrial waste and location of industrial waste dumping etc. The seven sites for collection of ground water samples were Natthusar, Udasar, Beechwal, Shiv bari, Pawanpuri, Jorbeed and JNV colony.

SAMPLE COLLECTION:

Total 84 samples of ground water were collected from seven selected sampling sites in Bikaner city during July 2012 to December 2012 for the present investigation. For ground water analyses, water samples from hand pumps and tube wells were collected by first running of water for at least 10 minutes so that the precipitates already formed in the pipelines due to the drying of material, are washed away and prevented from contamination of samples. Ground water samples were collected at the interval of 15 days and taken in 1 liter labeled glass bottles and stored at 4°C prior to analyses in the laboratory.

SAMPLE PREPARATION:

Each sample of ground water was filtered through Whatmann No.42 filter paper. 100 ml filtered sample was taken into a dried 250 ml beaker and was digested with a mixture of (3:1 v/v) of concentrated HNO3 and concentrated HCl. The mixture was covered with watch glasses and heated on hot plate to near boiling for one hour, until a clear solution was obtained. It was filtered and made up to mark with distilled water in 100ml volumetric flask. The residue was washed with warm distilled water and the solution made up to mark with distilled water. Fresh working standards were prepared as needed. Each of standard stock solution was diluted to levels appropriate to the operating range of the instrument using the appropriate acid diluents. The single element hollow cathode lamp was used for preparation of calibration curve. Concentrations of different heavy metals were determined using Atomic absorption spectrophotometer. The targeted heavy metals have been analyzed using atomic absorption spectrometer (ECL-AAS-4141) as per the standard method (APHA, 1998).The instrument was calibrated initially before preparation of calibration graph.

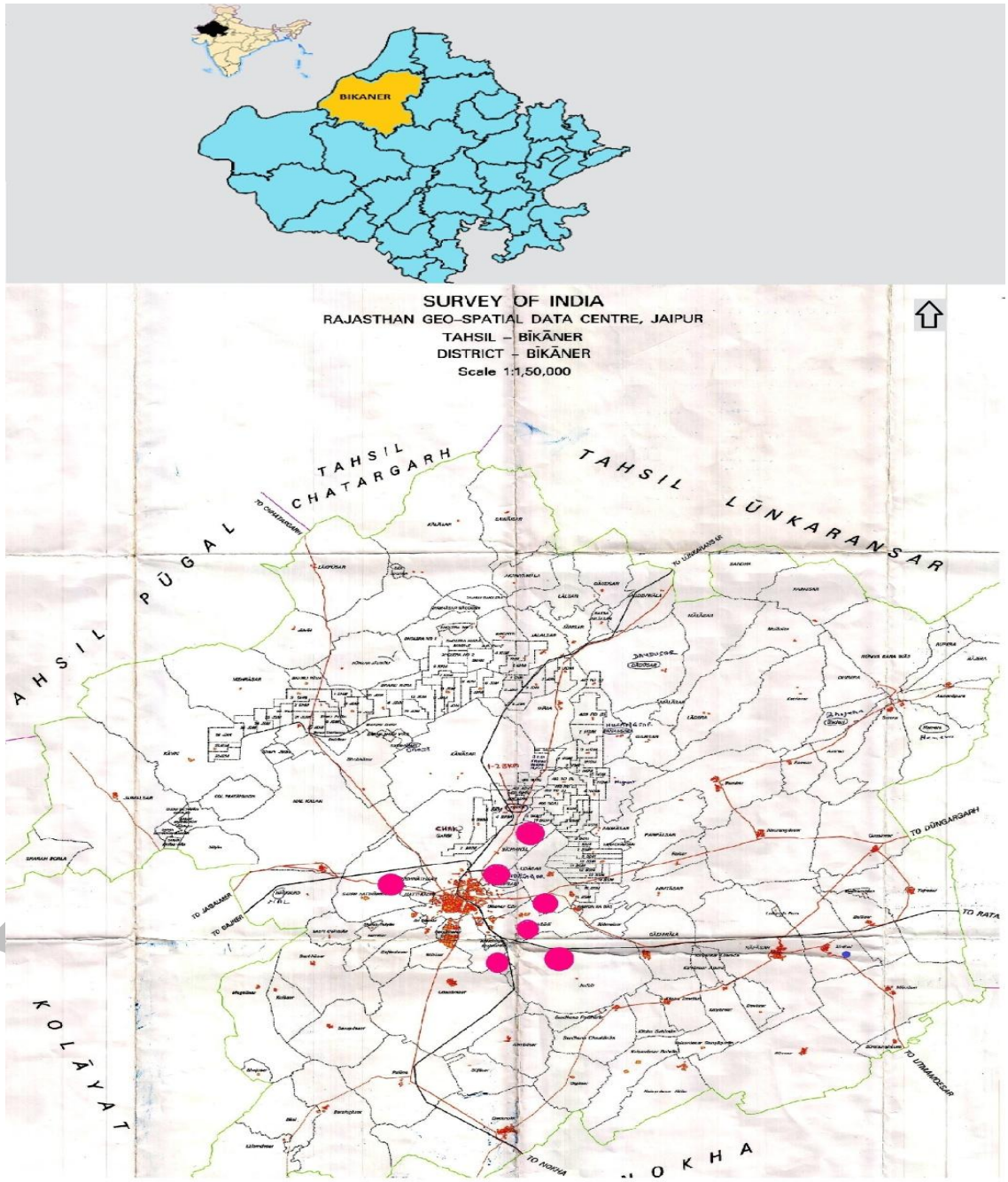

Fig.1: Location of Bikaner city and sampling sites

RESULTS AND DISCUSSION:

The present research was carried out for the assessment of seven heavy metals viz. (Fe, Zn, Mn, Ni, Cu, Pb and Cd) in ground water samples collected from seven selected sampling sites in Bikaner city during July 2012 to December 2012. Total 84 samples of ground water were assessed for the present investigation. Comparative assessment of various heavy metals at different sites was made (Table 1). The results revealed that the average heavy metal contamination with respect to sampling sites was found in the order of Jorbeed > Beechwal > Shiv bari > Udasar > Natthusar > JNV colony > Pawanpuri. The region behind most of contamination of heavy metals in the samples collected from Jorbeed may be correlated with the waste water released from Rani Bazar industrial area. The Rani bazzar industrial area is having about 191 sub-units of industries based on ceramics, woolen industries, food industries etc. The results of the present findings are in

linearity with the findings of Dutta et al., (2009) who reported heavy metals in water samples collected from Anasagar lake of Ajmer, Rajasthan. The average concentration of each heavy metal at all the selected sites was also compared. The results showed that Zn (7.94 ppm) was in highest concentration, followed by Cu (1.19 ppm), Fe (0.57 ppm), Mn (0.18 ppm) and Pb (0.01 ppm). It was observed that out of 84 ground water samples, highest 68 samples were found contaminated with Zn, followed by Fe (44), Cu (29), Mn (17) and Pb (8), respectively while, no any sample was found detected with contamination of Ni and Cd (Fig. 2). The results of present investigation were compared with the BIS (1998) standards and WHO (1998) standards for heavy metals (Table 2). It was noticed that the average concentration of Fe was exceeded from its maximum permissible limits (1.0 ppm) in water samples collected from Beechwal (1.25 ppm) and Jorbeed (1.11 ppm). Similarly, the average concentrations of Zn (16.2 ppm) and Cu (1.55 ppm) were also found above the excessive limits in samples collected from Jorbeed and Beechwal, respectively. However, rest of the samples was detected under the maximum permissible limits prescribed by BIS and WHO. The present study has shown resemblance with the finding of Lokeshwari and Chandrappa (2006), who did research on impact of heavy metals contamination of Belladur lake on soil and cultivated vegetables. The results of the investigation support the finding of Alshikh (2011), who studied heavy metals and organic pollutants of ground water samples of south Saudi. However, continuous dumping of untreated waste from industrials sectors and other sources may accelerate the heavy metal toxicity in ground water of Bikaner.

Table- 1: Average concentration of heavy metals in ground water of Bikaner

S.No.	Sampling site	Average concentration of different Heavy metals (ppm)							Average	SD
		Fe	Zn	Mn	Ni	Cu	Pb	Cd		
1	Natthusar	0.35	5.3	0.12	ND	1.28	ND	ND	1.01	1.95
2	Udasar	0.29	5.5	0.11	ND	1.35	ND	ND	1.04	2.03
3	Beechwal	1.25	11	0.29	ND	1.55	0.03	ND	2.02	4.01
4	Shiv bari	0.41	6.6	0.14	ND	1.05	ND	ND	1.17	2.42
5	Pawanpuri	0.31	5.4	0.14	ND	0.97	ND	ND	0.97	1.98
6	Jorbeed	1.11	16.2	0.28	ND	1.22	0.03	ND	2.69	5.98
7	JNV Colony	0.3	5.6	0.17	ND	0.93	ND	ND	1.00	2.06

ND= Not Detected

Table- 2: Standards for different heavy metals in drinking water (ppm)

S. No.	Heavy metal	WHO (1998) Standards		BIS (1998) Standards	
		Permissible limit	Excessive limit	Permissible limit	Excessive limit
1	Cd	0.01	0.01	0.01	0.01
2	Cu	0.05	1.00	0.05	1.50
3	Fe	0.30	1.0	0.30	1.0
4	Mn	0.10	0.30	0.10	0.30
5	Ni	-	-	-	-
6	Pb	0.05	0.05	0.05	0.05
7	Zn	-	15.0	5.0	15.0

(Source: Siddaramu et. al., 2009)

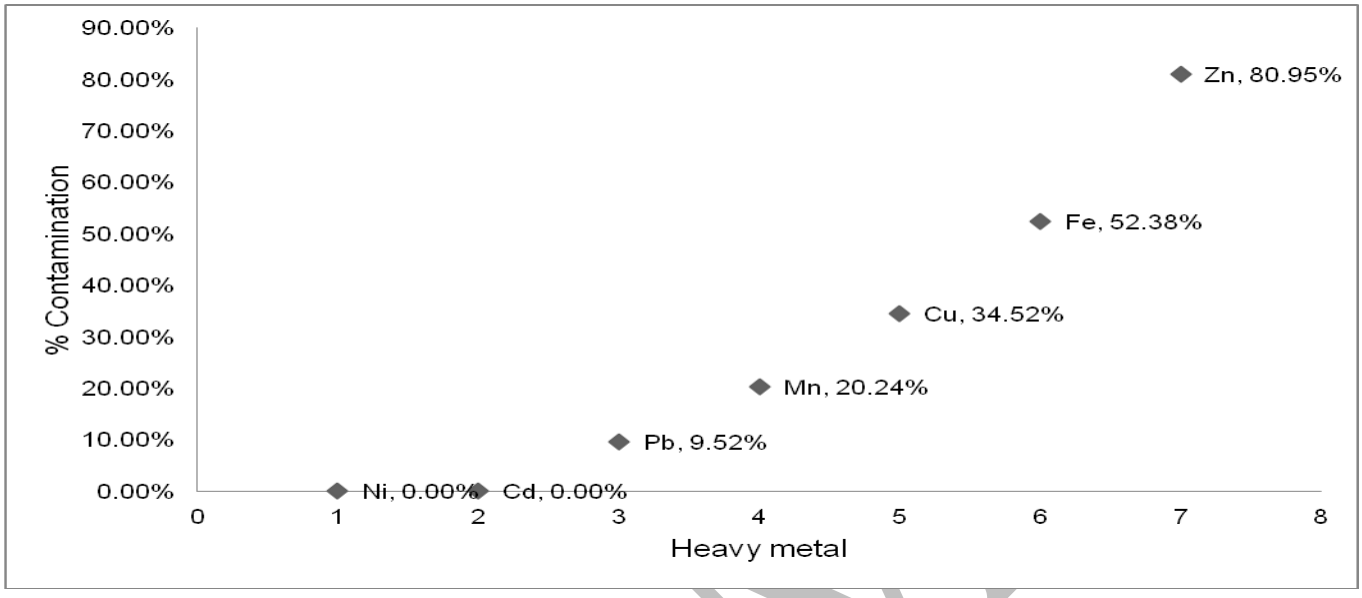

Fig.2: Percentage of contamination of heavy metals in ground water samples

CONCLUSIONS:

It was concluded that most of the ground water samples collected from Bikaner city were found under the safe limits for consumption with respect to heavy metal toxicity. Although, in some of the samples, Fe, Zn and Cu level were found higher than the permissible limit for daily intake through drinking water. The indiscriminate dumping of industrial and domestic wastes may accelerate the heavy metal toxicity in ground water of that area, which may lead to severe health related problems to the consumers. It is reported by UNESCO that water related diseases are responsible for 80% of all illnesses/deaths in developing countries, which kills more than 5 million people every year (Alshikh, 2011). The acute exposure of some heavy metals can cause cardiac disorder, vascular shock, dyspeptic nausea, vomiting, pancreatic disorder, diarrhea and damage of hepatic parenchyma. Therefore, continuous monitoring of water samples must be done. The local administration and policy makers must be aware through such monitoring programs to mitigate heavy metal toxicity in water resources.

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