

A STUDY ON THE CONCENTRATION OF HEAVY METALS IN THE DRINKING WATER OF SELECTED AREAS OF IMPHAL EAST DISTRICT, MANIPUR (INDIA)Joychandra O¹, Sanjoy Meitei L², Kh. Rakesh³, Joymati O⁴**HOW TO CITE THIS ARTICLE:**

Joychandra O, Sanjoy Meitei L, Kh. Rakesh, Joymati O. "A Study on The Concentration of Heavy Metals in the Drinking Water of Selected Areas of Imphal East District, Manipur (India)". *Journal of Evolution of Medical and Dental Sciences* 2014; Vol. 3, Issue 24, June 16; Page: 6649-6653, DOI: 10.14260/jemds/2014/2797

ABSTRACT: The present study attempts to evaluate the quality of the drinking water (tap) particularly heavy metal concentrations (Fe, Zn, Pb, Cu and Cd) in selected areas of Imphal east district, Manipur. Findings were compared with the Indian Standard (ISI) and Indian Council of Medical Research (ICMR) for drinking water specification. Concentrations of metals such as iron, cadmium and lead are alarming. They crossed the maximum permissible limit for drinking water standards set by ISI and ICMR.

KEYWORDS: Heavy metals, evaluation, medical research, drinking water, Indian standard.

INTRODUCTION: Millions of people particularly in the developing and underdeveloped countries lose their lives due to unavailability of safe drinking water. In this connection, a reference is taken as Manipur, a small state of India. According to the Annual Report, Statistics and Economics Department, Govt. of Manipur (2011)^[1] water supply coverage in urban areas was only 46% and that of rural areas was 30%. Only, 38.6% households had accessed tap water and 48.3% are dependent on other sources like ponds, rivers, lakes, spring etc. and 62% population are yet to get safe drinking water. Inadequate water supply coupled with poor sanitation practices contributes to contamination of water. The most common way of contamination is the leaking of the joints of the pipe and dissolving of joining materials like Pb. The inorganic contaminants – heavy metals like Fe, Mg, Ni, Zn, which are micronutrients of life process and others Cd, Cr, Pb which have no known physiological activities but determinant beyond a certain limits (Bruins et al., 2000).^[2]

Heavy metals when present above the permissible limit act as conservative pollutants because they cannot be degraded biologically and tends to accumulate in the bottom as sediments (Rakesh et al., 2013).^[3] Excessive exposure of heavy metals through nutritional, occupational or environmental can lead to progressive toxicity resulting into serious consequences. The major contributory sources of contaminants are the domestic sewage, solid waste disposal, commercial waste and major industries producing fertilizers and pesticides (Nourie et al., 2008).^[4] This contaminated water is consumed by man and animals for their survival. There are many reports about the relationship of consuming contaminated water and diseases like renal and hepatic diseases, anemia, loss of hair (Johnson, 1998).^[5] The major cause of the disease seems to be a breakdown of the immune and nervous system which open the gateway for all kind of the diseases in the body. Further, the report of the chronic ailments like cancer, birth defect, organ damage, disorder of the nervous system and damage of immune system may also be noted (USGAO, 2000).^[6] Considering the above facts and figures, the present study was carried out with special reference to heavy metal concentrations in drinking water of a few thickly populated areas of Imphal city where the main source is the tap water.

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SELECTION OF THE STUDY AREAS: The areas which are selected are thickly populated areas of Imphal city and also in and around the two big teaching hospitals (Regional Institute of Medical Sciences, Imphal and Jawaharlal Nehru Institute of Medical Sciences, Imphal) in the state. The main source of drinking water in the study area is the tap water. Over and above, there is a report of poor water quality that staining of laundry and sanitary wares, appearance and taste of drinking

MATERIALS AND METHODS: Water samples were collected during April 2013 in well sterilized and cleaned dried polyethylene container from eight different sampling points in the Imphal area viz. point -I (Canchipur treatment plant) designated as CTP; point-II (Canchipur public hydel) 3 km away from the point-I designated as CPH; point-III (Porompat treatment plant) represented as PTP; point -IV (Porompat public hydel) 3kms away from the point-III represented as PPH; point -V (Bamon Leikai treatment plant) designated as BTP; point -VI (Bamon Leikai public hydel) 3 km away from the point-VI designated as BPH; point-VII (Ningthem pukhri treatment plant) represented as NTP and point -VIII (Ningthem pukhri public hydel) designated as NPH, 3 km away from the treatment plant -VII. The water samples were preserved for metal analysis by adding 6 N, HNO₃ (8 ml/L) to get pH <2 as per (APHA-1998)^[7] and brought to the laboratory for analysis. Metals (Fe, Cu, Pb, Cd and Zn) analyses were carried out by using Graphite Furnace Atomic Absorption Spectrophotometer (Analytik Jena Vario-6) as per protocol of APHA, 1998.

RESULTS AND DISCUSSION:

Copper: Copper is widely distributed and is an essential metal required by all living organisms in some of enzyme systems, but at higher concentration it acts as pollutant. Higher concentrations of Cu cause fishy, fatty and oily taste (Sharma & Kaur, 1997).^[8] Higher concentrations of Cu in drinking water are toxic; the ISI^[9] & ICMR^[10] desirable limit (0.05 mg/L) and maximum permissible limit (1.5 mg/L) in drinking water is set. Beyond this limit caused astringent taste, discoloration and corrosion of pipes, fitting and utensils. Municipal waste and sewage, corrosion of copper containing pipelines or fitting are the principal anthropogenic sources of copper in the water. Copper concentrations in all the sampling points were above the desirable limit but did not cross the maximum permissible limit for drinking water guidelines prescribed by ISI & ICMR (Fig. 1). The low value of Cu indicates there is no significant source of copper pollution in all the sampling point.

Iron: Iron is one of the most abundant metals in the earth crust and is essential for human beings. But excess iron in drinking water produces inky taste and muddy smelling (Sharma & Kaur, 1997). Desirable and permissible limits (in the absence of alternate source) set by ISI & ICMR is 0.30 ppm and 1.0 ppm. Beyond this limit taste, appearance is affected and has adverse effect on domestic uses and water supply structures, and promotes iron bacteria. Sling coating on pipes occurs due to oxidation of ferrous to ferric iron. Concentration of iron levels in all the sampling points varied from 1.59 mg/L to 4.68 and has crossed the maximum permissible limit (Fig. 1). At level above 0.3 mg/L iron stains laundry and plumbing fixture. When the comparison of Fe concentrations was made between water from treatment plant and public hydel, hydel always showed higher concentrations than plants in all the sampling station except in BPH. Probable reason may be because of old structures in these areas.

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Lead: Lead is one of the widely used metals by man. The main sources of lead are paints, solder, pipes, plumbing process, building materials, PVC, discarded battery and leaded petrol. Atmospheric fallout is usually the most important source of lead in the fresh water. Main source of water in tap water is from household plumbing system containing lead in pipes, solders, fitting or service connection to homes and depends on pH, hardness, standing time and water acidification. Lead in water may be present either in colloidal/particulates/soluble form.

In fresh water at pH 6, Pb is mainly in the form of an inorganic, non-colloidal, non-asv-labile species whereas at the higher pH values, Pb is more likely to be associated with colloidal matter. According to the ISI & ICMR drinking water standards, the desirable and maximum permissible limit for lead is 0.05 mg/L. Concentrations of lead in sampling points - CTP, BPH, NTP and NPH were felt between desirable limit whereas, samples from CPH, PTP, PPH and BTP were slightly greater than the maximum permissible limit for drinking water standard as shown in figure 1.

Acute exposure to lead may cause kidney damage while chronic exposure may lead to interstitial nephritis. The major biochemical effect of Pb is its interference with heme synthesis, which leads to disruption of the synthesis of haemoglobin as well as other respiratory pigments such as cytochrome, which require heme. At higher levels of Pb in the blood (>0.8 ppm) there will be symptoms of anemia, kidney dysfunction and finally brain damage. Placental transfer of Lead occurs 12 weeks of pregnancy and continues throughout the development. Young absorbs lead 4-5 times as much as adults. Lead interferes with calcium metabolism directly or indirectly affecting vitamin D metabolism thereby producing toxicity to central and peripheral nervous system and skeletal system also.

Cadmium: Of various heavy metals present in the aquatic environment, cadmium pollution is particularly a problem because it is not only highly toxic to the organisms but its toxicity is also cumulative. The contamination of cadmium in drinking water may be caused by impurities in the Zinc of galvanized metal fitting. It enters the aquatic environment from electroplating, pigments works, vinyl plastics, metallic pipes, sewage and sludge etc. It causes toxicity because of its higher affinity for thiol (sulphydryl) groups of essential enzymes in human physiology.

At high levels, Cd causes kidney problems, anemia and bone marrow disorders. When excessive amounts of Cd are ingested, it replaces Zn at key enzymatic sites, causing metabolic disorders. Cd induces hypertension and cirrhosis of liver. It has also been linked with pulmonary emphysema and lung cancer. Presence of higher concentrations of Zn in water inhibits cadmium toxicity (Omkar, 1994).^[11]

It is clearly observed from the figure that the concentration level of Cd in all the sampling points were several time greater than the permissible limit of 0.01 mg/L as set by both the regulatory agency, ISI and ICMR. Therefore considering the Cadmium concentrations, it may be concluded that the water quality of present study area are not suitable for drinking purposes because of its highly toxic and traces are responsible for adverse renal arterial changes in kidneys in man (www.alternative-doctor-radio.com).^[12]

Zinc: Unlike Cd, Pb and Cu, Zinc is an essential trace element which plays a vital role in physiological and metabolic processes of many organisms but toxic at higher concentration. The major sources of water contamination of Zn are from industrial wastes, deterioration of galvanized iron and

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dezincification of brass etc. Zinc sulphates containing fertilizers are also responsible for higher values of Zn in water (Wu et al. 2008).^[13] According to the regulatory authority (ISI & ICMR) standard limits for zinc in drinking water are 15 mg/L and 10 mg/L respectively. Beyond these limits cause astringent taste and opalescence in water. Figure 1 shows the concentration profile for Zn in different sampling points. It reveals that the Zn concentrations in water collected from all the sampling points fall well within the safe limit for drinking purpose, thus water of present study area are posing no threat of Zn as pollutant for drinking purposes.

CONCLUSION: From the present investigation, it can be said that the water qualities of the present study areas are not an immediate threat to human beings though the concentrations of some metals such as iron, cadmium and lead are alarming. They crossed the maximum permissible limit for drinking water standards set by ISI and ICMR thus requiring treatment for safe human consumption. If proper monitoring and remedial measures are not taken up as soon as possible, the danger and health risk of heavy metals could be prevalent in the study areas. Hence, adoption of suitable remedial measures is the prime solution to protect the consumers from metal contamination. However, it is further suggested that treatment plants and tap water needs careful monitoring both spatially and temporally.

Metals	CTP	CPH	PTP	PPH	BTP	BPH	NTP	NPH	ISI		ICMR	
									Desirable limit	Permissible limit	Desirable limit	Permissible limit
Fe	3.918	4.680	3.349	4.235	1.956	1.591	2.233	2.456	0.3	1.0	0.1	1.0
Zn	2.071	2.180	1.840	1.390	0.746	0.911	1.100	2.020	5.0	15	5.0	10
Pb	0.048	0.059	0.062	0.060	0.168	0.042	0.029	0.028	0.05	0.05	0.05	0.05
Cu	0.167	0.161	0.180	0.188	0.165	0.132	0.173	0.189	0.05	1.5	0.05	1.5
Cd	0.192	0.186	0.085	0.083	0.230	0.480	0.130	0.146	0.01	0.05	0.01	0.01

Table 1: Comparison of heavy metal concentrations in drinking water of the study areas with that of Indian standard

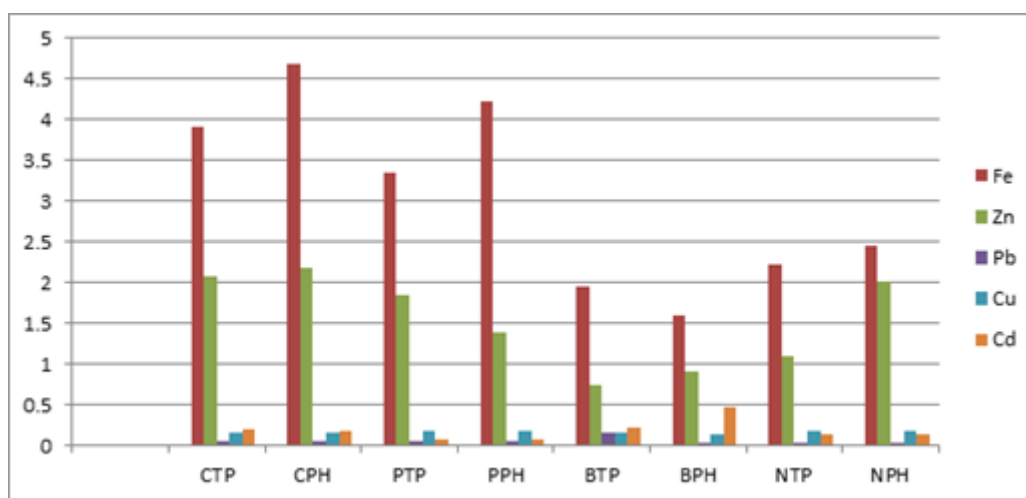


Fig. 1: Heavy metal concentration profile of different sampling points

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AUTHORS:

1. Joychandra O.
2. Sanjoy Meitei L.
3. Kh. Rakesh
4. Joymati O.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Pharmacology, Jawaharlal Nehru Institute of Medical Sciences, Imphal.
2. Assistant Professor, Department of Environmental Science, D.M. College of Science, Imphal.
3. Scientific Officer, Manipur Science and Technology Council, Imphal.

4. P.G. Student, Regional Institute of Medical Sciences, Imphal.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Rakesh Kh,
 Scientific Officer,
 Manipur Science and Technology Council,
 Central Jail Road,
 Imphal.
 E-mail: khakesh1@rediffmail.com

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