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HEAVY METALS PRESENT IN THE PONDS OF RAIPUR CITY (CHHATTISGARH, INDIA), - AN ALARMING SITUATION

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ABSTRACT

Raipur is the capital town of the newly formed state of Chhattisgarh. There are several ponds situated in the city area out of which seven ponds (1) Raja Talab (2) Dumaratarai Talab (3) Telibandha Talab (4) Naraharadeo Talab (5) Maharajabandh Talab (6) Karabala Talab and (7) Budha Talab have been selected for present study. Water samples were collected once in a season from these ponds in year 2006-2007 for present study. The heavy metal concentration such as Copper (Cu), Iron (Fe), Manganese (Mn), Cadmium (Cd), Chromium (Cr), Nickel (Ni) and Lead (Pb) was studied during present investigation. Cu, Ni and Pb were not detected in any season, while Iron (Fe), Manganese (Mn), Cadmium (Cd) and Chromium (Cr) were found in miscellaneous concentration assortments.

INTRODUCTION

Ponds define as a body of standing water, smaller than a lake either natural occurring or made by human beings. This is fact that the essential ingredient to any viable civilization is easily access to water. Civilization in Chhattisgarh (Raipur) has also flourished around tanks and ponds owing to its geographical location (hilly area). People in India (as well as in Raipur) have partially dependence upon the freshwater bodies for their entire water requirement such as domestic need, irrigation and industrial need to recreation. But with time and development, freshwater bodies of the region are being modified by human influence because dense human settlements are present in the catchment area of these ponds. Due to lake of awareness and water treatment plants generally untreated water effluents from various industries, agricultural, sewage and residential wastewater, human and animal faeces are released or disposed of directly in nearby water body causes serious environmental problems. Currently, only few water bodies are in immaculate condition in Raipur city.

The term heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations. These metals can be introduced in to aquatic systems through effluent discharges from various sources and runoff water. Contamination of freshwater ecosystem with heavy metals is a major environmental problem all over the world due to their pervasiveness and persistence (Gavrilesca, 2004; Malik, 2004; Srivastava and Thakur, 2006). The pollution caused by heavy metals is long-term, non- reversible and are not biodegradable (McGrath *et al.* 2000; Vijendra Singh and Chandel, 2006). Heavy metals are dangerous because the met-

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als increase in concentration at every level of food chain and are passed onto the next higher level-a phenomenon called bio-magnification (Lokeshwari and Chandrappa, 2006; Paknikar *et al.* 2003). Many of these metals can be bio-accumulated by aquatic organisms, and chances of their entrance in food chain, causing serious health and environmental concerns even at low concentration (Anderson and Nilsson, 1973; Trivady and Joag, 2000). The toxicity of metal ion is owing to their ability to bind with protein molecules and prevent replication of DNA and thus subsequent cell division (Kar *et al.* 1992).

MATERIAL AND METHODS

General description of Raipur city - Raipur is situated between 22° 33'N to 21°14'N Latitude and 82°6'E to 81°38'E Longitude. The temperature of Raipur city is extremely hot, ranging between 29°C-45°C (±2°C) and dry in summer season (March to June), hot and humid in rainy season (July to October) and moderate cool; temperature ranging between 08°C-25°C (±2°C) in winter season (November to February). The city receives about 1300 mm (51 inches) of rain, mostly in the monsoon season from late June to early October.

Study Sites (ponds) - Historians claim that Raipur town itself had more than 100 ponds. At present there are about 30 such water bodies within Raipur municipal area. Out of which, for present investigation seven ponds i.e. (1) Raja Talab (2) Dumaratarai Talab (3) Telibandha Talab (4) Naraharadeo Talab (5) Maharajabandh Talab (6) Karabala Talab and (7) Budha Talab have been chosen.

Collection of Water Samples - The water samples were collected between 9:30 a.m to 1:30 p.m from the surface water in a pre-sterilized bottle one to two meters away from the bank once in a season (April in summer season, July in rainy season and December in winter season in year 2006) for heavy metals analysis.

RESULTS AND DISCUSSION

The results of heavy metal concentration of different pond water samples are given in Table 1. Source and probable causes of contaminations, as well as significance of contamination have also been mentioned. Pond no. 4 (Naraharadeo Talab) and Pond no. 6 (Karabala Talab) were free from heavy metal contamination. The metals such as Copper (Cu), Iron (Fe), Manganese (Mn), Cadmium (Cd), Chromium (Cr), Nickel (Ni) and Lead (Pb) were analyzed by Atomic Absorption Spectrophotometer. During present investigation Cu, Ni and Pb were not detected from Pond no. 1-7 in any season. Which means all water sample of study area is free from Cu, Ni and Pb contamination. While Iron (Fe) Manganese (Mn) Cadmium (Cd) and Chromium (Cr) were found in miscellaneous concentration assortments.

Iron (Fe)

Source and probable causes - It gets dissolved in water from most rocks and soils. It may also be derived from iron pipes, pumps, and other equipment.

Significance - The desirable concentration of dissolved Fe for Class SW-III waters (surface waters) is 500µg/L or less according to primary water quality criteria. The permissible concentration of iron in drinking water is 300µg/L as per the Indian Standards (Awashthi, S.K. 2000). On exposure to air, iron in ground water oxidizes to reddish brown sediment. More than about 0.3 mg/L stains laundry and utensils reddish brown. Iron cause unpleasant taste and favor growth of iron bacteria but do not endanger health. A greater concentration causes rapid increase in pulse rates, congestion of blood vessels and drowsiness.

Status of Iron (Fe) in studied area - Concentration of iron was found 0.324 mg/L in Pond no. 1 (Raja Talab) both in summer and winter season. This is slightly above the maximum recommended limit. In Pond no. 2 (Dumaratarai Talab) concentration of iron was 0.27 mg/L in summer and 0.1 mg/L in winter. Other ponds samples did not contain iron (Table 1).

Manganese (Mn)

Source and probable causes - Manganese leached from the soil and rock gets into the ground and surface water. An often-high concentration is associated with high iron content and with acid waters.

Significance - Same objectionable features as iron is found. It causes dark brown or black stain. For taste and aesthetic reasons, iron and manganese together should not exceed 0.3 mg/L. Inhalation or contact causes damage to central nervous system (Hima *et al.* 2007).

Status of Manganese (Mn) in studied area - Except in pond no. 4 (Naraharadeo Talab) and pond no. 6 (Karabala Talab) Manganese was present in all ponds. Concentration of Manganese (Mn) ranged between 0.01 mg/L (pond no. 5 and 7) - 0.08 mg/L (pond no. 2) in winter and 0.016 mg/L (pond no. 7) - 0.183 mg/L (pond no. 1 and 2) in summer and was not harmful as

Table 1. Seasonal variation of heavy metal concentration present in pond water

Sr.no	Study sites	Seasons	Metal						
			Copper Cu (ppm)	Iron Fe (ppm)	Manganese Mn (ppm)	Cadmium Cd (ppm)	Chromium Cr (ppm)	Nickel Ni (ppm)	Lead Pb) (ppm
(1)	Raja Talab	Summer	NIL	0.324	0.183	NIL	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	0.324	0.05	NIL	NIL	NIL	NIL
(2)	Dumaratarai Talab	Summer	NIL	0.27	0.183	NIL	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	0.1	0.08	NIL	NIL	NIL	NIL
(3)	Telibandha Talab	Summer	NIL	NIL	0.066	0.0168	0.818	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	NIL	0.06	0.01	0.52	NIL	NIL
(4)	Naraharadeo Talab	Summer	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	NIL	NIL	NIL	NIL	NIL	NIL
(5)	Maharajabandh Talab	Summer	NIL	NIL	0.083	0.028	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	NIL	0.01	0.01	NIL	NIL	NIL
(6)	Karabala Talab	Summer	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	NIL	NIL	NIL	NIL	NIL	NIL
(7)	Budha Talab	Summer	NIL	NIL	0.016	NIL	NIL	NIL	NIL
		Rainy	NIL	NIL	NIL	NIL	NIL	NIL	NIL
		Winter	NIL	NIL	0.01	NIL	NIL	NIL	NIL

the concentration is marginal and well within the recommended limit (Table 1).

Cadmium (Cd)

Source and probable causes - Effluents from electroplating industries, textile printing and chemical industries contributes cadmium to water.

Significance -Cadmium in surface and drinking water should not exceed 0.01 mg/L5. Cadmium has high toxic potential and minute quantities of cadmium are responsible for adverse renal arterial changes in human kidneys. Higher concentration of cadmium causes kidney damage, bronchitis, gastrointestinal disorder and cancer ((Hima *et al.* 2007).

Status of Cadmium (Cd) in studied area - Pond no. 3 (Telibandha Talab) and 5 (Maharajabandh Talab) show 0.0168 and 0.028 mg/L concentration of Cadmium (Cd) respectively in summer season which is higher than permissible range. It was limited to 0.01 mg/L in both the ponds (Pond no. 3 and 5) during winter season, which is marginal and well within the permissible limit (Table 1). Other pond samples don't show the presence of cadmium (Table 1).

Chromium (Cr)

Sources and probable causes - Industrial effluents contribute chromium to water.

Significance - Chromium in drinking and surface water should not exceed 0.05 mg/L. Swallowing of larger amounts of chromium cause stomach upsets and ulcers, convulsions, kidney and liver damage and even death. Although chromium in small amounts are an important nutrient needed by the body. Soluble chromium substances can be irritating to the eyes and skin. Ingestion may affect kidney and liver functions (Abdul, 2006; Siegel, 1990). Anna and George reported that Chromium is a human carcinogen, as determined by the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC, 1990), the U.S. Environmental Protection Agency (U.S. EPA, 1998) and Office of environmental health hazard assessment (OEHHA) (Anna and George, 1999; IARC, 1990; USEPA, 1998).

Status of Chromium (Cr) in studied area -Chromium was present only in pond no. 3 (Telibandha Talab). In this pond the concentration of chromium was 0.818mg/L in summer and 0.52 mg/L in winter. This result is far above the maximum recommended limit.

DISCUSSION AND CONCLUSION

The concentration of metals in the pond water was

varied considerably in different season because water level of pond is highly affected by seasonal changes (Ali *et al*.1999). In the present study it was found that the maximum concentration of heavy metals was found to or sometime exceed the limit during the summer season. Water level of ponds decreases due to prolonged dry season and high temperatures during summer season because pond receives direct sun-light throughout the day, which result in increase of dissolved chemical constituents. In the present study it was found that heavy metals were not found during rainy season in any water samples of these ponds. The dilution of pond water during the rainy seasons since, the major source of water for filling and maintaining water levels in ponds are catchments surface runoff, which is affected by rainfall is probably responsible for the absent of heavy metals.

Raipur, famous for his water bodies in ancient times, has now become a city of big buildings, which stands on the graveyard of old ponds. Human interference plays a crucial role in the variation of quality of water bodies. Much of the world is currently suffering due to a lack of clean water. The quality of water is of vital concern for mankind as it is directly linked with human health and living. The observed high concentration of some heavy metals in the test water (higher than the maximum permissible concentration recommended by WHO) may constitute a health risk to persons dependent on the water for their domestic activities.

REFERENCES

Abdul, G. 2006. Removal and stabilization of chromium metal ions from industrial effluents. *Electronic Journal of Environment Agriculture Food Chemistry*. pp. 1286-1295.

Ali, M.B., Tripathi, R.D., Rai, U.N., Pal, A. and Singh, S.P. 1999. Physico-chemical characteristics and pollution level of Lake Nainital (U.P., India): role of macrophytes and phytoplankton in biomonitoring and phytoremediation of toxic metal ions. *Chemosphere*. 39 (12) : 2171-2182.

Anderson, A. and Nilsson, K.O. 1973. Enrichment of trace elements from sewage sludge fertilizers in soils and plants. *Ambio*. 1 : 176-179.

Anna, M. Fan and George, V. Alexeeff, 1999. Public Health Goal for Chromium in Drinking Water, Thesis.

Awashthi, S.K. 2000. Prevention of food adulteration Act no.37 of 1954, Central and State rules as amended for 1999, Edition 3, Ashoka Law House, New Delhi

Gavrilesca, M. 2004. Removal of heavy metals from the environment by biosorption. *Engineering in Life Sciences*. 4 (3) : 219-232.

Hima, K.A., Srinivasa, R.R., Vijaya, S.S., Jayakumar, S.B., Suryanarayana, V. and Venkateshwar, 2007. Biosorption: An eco-friendly alternative for heavy metal removal. *African Journal of Biotechnology*. 6 (25) : 2924-2931.

IARC, 1990.International Agency for Research on Cancer, IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans; Chromium, Nickel, and Welding, Vol. 49, International Agency for Research on Cancer, World Health Organization, Lyon, France.

Kar, R.N., Sahoo, B.N. and Sukla, C.B. 1992. Removal of heavy metals from pure water using sulphate reducing bacteria (SRB). *Pollut. Res*. 11: 1- 13 ()

Lokeshwari, H. and Chandrappa, G.T. 2006. Heavy Metals Content in Water, Water Hyacinth and Sediments of Lalbagh Tank, Bangalore (India). *Journal of Environmental Science and Engineering*. 48 (3) : 183-188.

Malik, A. 2004. Metal bioremediation through growing cells. *Environmental International*. 30 : 261-278.

Mc Grath, S.P., Dunham, S.J. and Correll, R.L. 2000. Potential for phytoextraction of zinc and cadmium from soils using hyperacumulator plants, Pages 109-128, In Terry, N. and Banuelos, G. (Editors), *Phytoremediation of Contaminated Soil and Water*. Lewis Publishers, Boea Raton.

Paknikar, K.M., Pethkar, A.V. and Puranik, P.R. 2003. Bioremediation of metalliferous wastes and products using inactivated microbial biomass. *Indian Journal of Biotechnology*. 2 : 426-443.

Siegel, D.M. 1990. Carcinogenicity of chromium via ingestion. Memo to Standards/Criteria Workgroup members, August 7.

Srivastava, S. and Thakur, I.S. 2006. Biosorption potency of Aspergillus niger for removal of chromium (VI). *Current Microbiology*. 53 : 232-237.

Trivady, R.K. and Joag, G.A. 2000. Treatment of industrial waste water-by-water hyacinth application. *Journal in Pollution Management in Industries*. 10 :295-313.

USEPA, United States Environmental Protection Agency, Chromium VI. Integrated Risk Information System (IRIS) (1998) (http//www.epa.gov/iris).

Vijendra Singh and CP Singh Chandel, Analytical study of heavy metals of industrial effluents at Jaipur, Rajasthan (India). *Journal of Environmental Science and Engineering*. 48 (2) : 103 -108.