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Research Paper

ASSESSING THE WATER QUALITY STATUS OF AMBRAMPALAYAM RIVER, POLLACHI TALUK, TAMILNADU, INDIA WITH REFERENCE TO TRACE METALS

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Abstract

Rivers in Indian continent are considered scared as it provides life sustenance to ecology and environment. But during the last few decades due to increased anthropogenic activities, urbanization and industrialization these rivers are under intimidation of high-water pollution and transformation. Due to advancement in industrial technology and human population safe use of fresh waterbody waters for consumption and other activities is a very big query. In specific metropolitan cities of developing country like India on of the major concern for river pollution is heavy metals which on entering water will get bioaccumulated and biomagnified. So, an attempt has been made to determine the extent of heavy metal pollution in the most important river of Pollachi region. Heavy metal concentration in the water was determined using Atomic Absorption Spectroscopy, (model-analyst 200, PerkinElmer) and the results were compared with standard permissible limits, WHO. The order of the essential heavy metal concentration in the water sample was Fe>Zn>Mn>Cu and the non-essential heavy metals were Cd>Pb>Cr>Hg. On comparing to standard permissible the analytical results of the present study indicates that concentration of heavy metals in the Ambrampalayam river are higher and its presence in water is not safe for aquatic animals and human consumption.

Key words: Fresh water bodies, Heavy metals, Aquatic pollution.

INTRODUCTION

Globally water covers 70.9% of the earth's surface and is literally the source of life on earth. Primarily aquatic ecosystem became the ultimate recipient of almost everything including heavy metals. This has long been recognized as a serious pollution

problem because the quality and the quantity of water is rapidly getting deteriorating globally. In addition, freshwater bodies like river and streams is highly polluted by heavy metals as a result of rapid urbanization, industrialization and population growth [1-5]. [6,7] in their research work too stated that both natural and anthropogenic activities are also responsible for the abundant of heavy metals in the environment. By the year 2025, however, many countries are expected to face water shortages, affecting more than 2.8 billion people i.e. -35% of world's projected population. So, most of the countries however currently are aware of the necessity of fresh water as a requirement for survival so it occupies highest priority, on the international agenda. So, the present investigation of heavy metals in Ambarampalayam river water of Pollachi Taluk, could be used to assess the impacts and risks posed by waste discharges on the riverine ecosystem as it is the main natural fresh water source for many villages and villagers prime activities. Therefore, it is important to measure the concentrations of heavy metals in water of any contaminated riverine ecosystem in and around the inhabitant habitat for better and pure freshwater supply and to provide aesthetic and clean water and water bodies for upcoming generations.

MATERIALS AND METHODS

Study Area

Pollachi is a taluk of Coimbatore Rural district of the Tamil Nadu state of India. It lies in the southern part of the Coimbatore city around 40 kilometres from downtown Coimbatore. This is the second largest town in the District after Corporation of Coimbatore (Plate:1). Owing to the proximity to the Western Ghats, Pollachi has a pleasant climate throughout the year.

Sampling Area

Ambarampalayam village is located in Pollachi Tehsil of Coimbatore district in Tamil Nadu, India (Plate:2). It is situated 8km away from sub-district headquarter Pollachi and 48km away from district headquarter Coimbatore. The total geographical area of village is 426.18 hectares. Ambarampalayam has a total population of 3,794 peoples. There are about 1,052 houses in Ambarampalayam village.

Plate:**1** ***Map showing the study area located taluk***

Plate:2 ***Showing the sampling point***

Water Sampling and analysis

Water samples were collected by direct immersion of polyethylene plastic bottles (1000ml) handled by rope in water sampling point. Sampling container must be tightly sealed either by stopper or cap. Before collection bottles were washed with concentrated nitric acid and distilled water to avoid contamination. Following the standard methods [8] for water sampling and preservation techniques collected sample bottles were preserved using icebox and transported to the laboratory of within 6-9 hrs after sample collection for heavy metal analysis. The water samples were analysed seasonally for heavy metals like Zinc, Copper, Cadmium, Mercury, Lead, Manganese, Chromium, Nickel (Atomic Absorption Spectroscopy, (model-analyst 200, Perkin Elmer)

in accordance with standard methods for examination [8] and [9] at the college central laboratory.

Statistical analysis

The mean and standard deviation of water with regard to heavy metals was calculated using SPSS statistical package-Version-12.

RESULTS AND DISCUSSION

Environmental pollution is the prime universal problem and the most major pollutants are the heavy metals in aquatic network because of their toxicity as they have dreadful effects on the ecological equilibrium and a variety of aquatic entities. These trace metals bio-accumulate in the food chain and cause adverse effects and even death. So, bio-monitoring of trace elements is essential to assess ecosystem health. With this context the current experimental work was carried out at Ambarampalayam river, Pollachi taluk, Tamilnadu, India. The results of heavy metal concentration in water column Ambarampalayam river are presented in Table -1.

Table: 1showing the heavy metals analyzed in the collected samples during the study period from water collected from Ambrapalayam river during the study periodJuly-Dec-2017.

Samples	Water		Permissible Limits			
Seasons			BIS limit	ICMR limit	WHO limit	USEPA limit
Heavy metals	Pre-monsoon	Post-monsoon				
Iron	6.36±0.04	8.25±0.06	0.3	0.3	0.3	0.3
Zinc	3.35±0.06	3.42±0.07	5	.1	3	5
Manganese	3.02±0.04	3.25±0.04	0.1	.1	0.4	0.05
Copper	2.81±0.08	3.02±0.05	.05	.05	2	1.3
Cadmium	1.09±0.049	1.12±0.02	.01	.01	.003	.005
Chromium	0.01±0.049	0.09±0.04	0.05	0.05	0.03	-
Lead	1.01±0.085	1.09±0.80	.05	.05	.01	.015
Mercury	0.01±0.049	0.01±0.085	0.001	0.001	0.001	-

***Values are expressed in µg/g dry weight of tissues and as mean ± SD where, n = 3**

In this present study four essential heavy metals such as zinc, iron, copper, manganese and four non-essential heavy metals lead, cadmium, chromium and mercury in the study selected site of Ambarampalayam river were analyzed for two seasons (Pre-monsoon and Post-monsoon). During Pre monsoon Season at the study site the recorded essential heavy metal values were Iron- 6.36±0.04µg/L; Zinc–3.35±0.06µg/L, Copper-2.81±0.08µg/L, Manganese-3.02±0.04µg/L and the non-essential heavy metal values were Chromium-0.01±0.049µg/L, Lead- 1.01±0.085µg/L, Cadmium-1.09±0.049µg/L and Mercury-0.01±0.049µg/L (Table-1). During Post monsoon Season at the study site the recorded essential heavy metal values were Iron- 8.25±0.06µg/L; Zinc–3.42±0.07µg/L, Copper-3.02±0.05µg/L, Manganese-3.25±0.04µg/L and the non-essential heavy metal values were Chromium-0.09±0.04µg/L, Lead- 1.09±0.80µg/L, Cadmium-1.12±0.02µg/L and Mercury-0.01±0.085µg/L. The order of the essential heavy metal concentration in the water sample was Fe>Zn>Mn>Cu and the non-essential heavy metals were Cd>Pb>Cr>Hg.

[10] and [11] in their experimental analysis stated that the metal pollution of most aquatic ecosystems is increasing due to the effects from urbanization and industrialization. In the present analysis the selected essential and non- essential heavy metals were observed to be maximum during post-monsoon and minimum during pre-monsoon. The minimum values recorded during pre-monsoon season in the water which may be during transportation of heavy metals in the riverine system, it may undergo frequent changes due to dissolution, precipitation and sorption phenomena [12], which affect their performance and bioavailability [13,14] at that particular place at particular season.

The maximum values of essential and non-essential heavy metals in the selected study site during post monsoon season may be due to disposal of urban wastes, untreated effluents from various industries, mixing of agrochemicals in the open water and action of human in washing vehicles, water outlet from electroplating industries and small scale industries, cleaning utensils, washing, runoff from urban and residential areas and fishing. Thus, the selected metals in water showed significant seasonal variation, where Post-monsoon season exhibited higher than Per-monsoon. Moreover, the analysed results levels of lead, cadmium, iron and zinc exceeded their threshold limits (.01, .003, .3 and 3 ppm, respectively) set by the WHO health-based guideline for

drinking water. But the mercury (Hg) concentration were noted be within the permissible limit. In general river water bodies serve the local population for drinking water supply and sundry uses to the rural people. During the present analysis the analysed and recorded essential and non-essential heavy metals values are observed to be more than the permissible limit [15-18].

As we all well known that Fe is an essential metal element for most living organisms and in humans nutrition. The use of iron rich water for domestic purposes, such as drinking and washing, is usually associated with unpleasant metallic tastes and staining of clothes. Hemochromatosis, a genetic disorder, has also been reported to people those who consuming large amounts of iron. [19] reported that excessive intake may damage liver, heart, and endocrine glands and it may change the color of the water; Maximum concentration was observed in the selected site of Ambrampalayam river which may be mainly due to the weathering of deeper materials usually contain higher percentage Fe (silicates, feldspar, and biotite) and, during post monsoon it is owing to the mixing of small scale industrial wastewater and also from the reaction of rainwater and ground waters with siltstone, shale, lime stones, and anthropogenic constructional basis.

Zinc the essential trace element of biological importance for organisms plays an important role in the physiological and metabolic processes of many organisms. But it also has an adverse effect on human being and other organisms when deficient or present in an excessive amount affects most metabolic processes [20]. The desirable limit of Zn in drinking water is specified as 3 ppm [8]. Several studies suggest that excessive amount of Zn (3–5 ppm) can cause neuron death and toxicity resulting in diarrhoea, vomiting and may appear opalescent and develop a greasy film on boiling vessel and produce bitter taste [21].

According to [22] Manganese is a major component of enzymes and core micronutrient that contributes to the regular growth of connective tissues, physiological processes in living organisms and further being needed for respiratory enzymes. [23] reported in their study that Mn concentrations in the range of 0.24-0.35 mg/L can lead to memory lapses, decreased concentration and less attentiveness in children. Following which[24] in his research analysis reported that domestic water if present in

a high concentration it will yield a characteristic metallic taste and staining properties.[25,26] have reported that Mn exposure rivets both psychiatric indication, causing impaired neurological and neuromuscular control and Parkinsonism skin texture by affecting the brain and the central nervous system. High concentration of Mn may lead to mitochondrial fraction of the human kidney, liver, and pancreas, however, high dosage of Mn results in some diseases, including liver damage. The highly recommended value in drinking water is .1 ppm and the samples analysed were not in safe range.

In 2007 [27] reported that copper is an essential part of several enzymes and is necessary for haemoglobin synthesis and human metabolism. Moreover, high intake of copper rich water would undoubtedly cause health hazard as the mineral copper are mostly insoluble hence concentration of copper is should be always lower in natural water. But copper availability in Amabrapalyam river water is excessive which could be due to extensive use of pesticides containing copper compounds for agricultural purpose which was in accordance to [28] water study analysis copper could causes anaemia, disorders of bone, connective tissues and liver damage at excessive level. The ideal intake amount of Cu is 2 mg/day. Water with 3 ppm Cu is associated with gastrointestinal disturbance in adults [29,30]. In the present study the recorded copper value was above the permissible limit of [8]. It presence in aquatic ecosystem indicates contamination. Cd may interfere with the metallothionein's (protein) ability to maintain levels of Zn and Cu in the body. When Cd induces metallothionein's activity, it bridges to Cu and Zn and thus disrupting the homeostasis level [31]. Under the long-term environmental exposure, Cd may cause lung infections and the skeletal structure disorders [32].

Lead (Pb) is both a toxic and non-essential metal having no nutritional value to living organisms. The maximum amount of lead recorded during study season at the selected study site implies that the particular site and or may be from the upstream of river form the agricultural lands near by the usage of pesticides for agricultural activities which contains Pb may be the reason and especially during post monsoon season may be due to influx of more water from the nearby agricultural land due to rain pour. Moreover, it could be found naturally in rocks like galena (PbS), cerussite ($PbCO_3$), minim (Pb_3O_4), and other minerals which may be available in the ground level. Pb in

lower concentration is not harmful but if high levels of Ca are ingested, Pb in bone was replaced, the free Pd in the body system resulting in hypertension, nephrotoxicity, and neurotoxicity [33,34]. Nil amount Pb is considered safe in drinking water. But from the value obtained and from [33] report , higher amount of Pb will lead to impaired functioning of the reproductive and nervous systems, kidney damage, high blood pressure and aneamia. Even at very low concentrations, Pb a threat to public health, because it usually builds up in body. It is essentially harmful to children under the age of six and causes mental and physical retardation.

Thus from the above discussed views the average value of analysed heavy metals from the present study shows that the water samples exceeded the standard specification limit (Table-1) so this could be warning to environment, aquatic organism and health hazards to public in and around the Ambarapalayam river who use the water for drinking , irrigation and for aquaculture practice.

CONCLUSION

From the above obtained results, the selected fresh water aquatic source is gradually getting degraded due to bulk discharge of organic and inorganic toxins, unprocessed pollutants, chemical fertilizers and domestic sewages which will cause deleterious effect by bringing impairment in metabolic, physiological and structural system of both biotic and abiotic organisms of the Ambarampalayam river. This present status may which in turn significantly distress the icthyofaunal diversity too. Therefore, the present study facilitates the need of conservation status and help plan policies for suitable conservation of natural bodies and biotic communities for better productivity and aesthetic nature of such natural freshwater bodies for future generations.

REFERENCES

[1]Sekabira, K., H. Oryem Origa, T.A. Basamba, G.Mutumba, E. Kakudidi., 2010. Assessment of heavy metal pollution in the urban stream sediments and its tributaries. *Int. J. Environ. Sci. Technol*. 7 (4), 435-446.

[2] Zhang C., Q. Qiao, J.D.A. Piper, B. Huang., 2011. Assessment of heavy metal pollution from a Fe-smelting plant in urban river sediments using environmental magnetic and geochemical methods. *Environ. Pollut*. 159, 3057-3070.

[3] Grigoratos T., C. Samara, D. Voutsa, E.Manoli, A. Kouras., 2014. Chemical composition and mass closure of ambient coarse particles at traffic and urban background sites in Thessaloniki, Greece. *Environ. Sci. Pollut. Res*. 2,7708-7722.

[4] Staley, C., Johnson, D., Gould, T.J., Wang, P., Phillips, J., Cotner, J.B., Sadowsky, M.J., 2015. Frequencies of heavy metal resistance are associated with land cover type in the Upper Mississippi River. *Sci. Total Environ*. 511, 461–468.

[5] Nguyen, T.T.H., Zhang, W.G., Li, Z., Li, J., Ge, C., Liu, J.Y., Bai, X.X., Feng, H., Yu, L.Z., 2016.Magnetic properties of sediments of the Red River, Vietnam: effect of sorting on the source-to-sink pathway and its implications for environmental reconstruction. *Geochem*. *Geophys*. *Geosyst*. 172.

[6] Sanchez-Chardi A., M.J. Lopez-Fuster, J.Nadal., 2007. Bioaccumulation of lead, mercury, and cadmium in the greater white-toothed shrew, *Crocidura russula*, from the Ebro Delta (NE Spain): Sex- and age-dependent variation. *Environ. Pollut*. 145,7-14.

[7] Khan S. , Q. Cao, Y.M. Zheng, Y.Z. Huang, Y.G. Zhu., 2008.Health risks of heavy metals in contaminated soils and food crops irrigated with wastewater in Beijing, China. *Environ*. *Pollut*. 152,686-692.

[8] APHA. 2012. Standard Methods for the Examination of Water and Wastewater. American Public Health Association, Washington DC.

[9] Trivedy, R.K. and Goe1, P.K., 1986. Chemical and Biological Methods for Water Pollution Studies. Environmental Publications, Karad, India.

[10]Bai J. , R. Xiao, B. Cui, K. Zhang, Q. Wang, X. Liu, H.Gao, L. Huang., 2011.Assessment of heavy metal pollution in wetland soils from the young and old reclaimed regions in the Pearl River Estuary, South China. *Environ. Pollut*., 159, 817-824.

[11] Martin J.A.R. , C.D. Arana, J.J. Ramos-Miras, C. Gil, R. Boluda., 2015. Impact of 70 years urban growth associated with heavy metal pollution. *Environ. Pollut*., 196, pp. 156-163.

[12] Abdel-Ghani N. T., and G. A. Elchaghaby., 2007. Influence of operating conditions on the removal of Cu, Zn, Cd and Pb ions from wastewater by adsorption. *Int. J. Environ. Sci. Tech*., 4 (4): 451-456.

[13] Nicolau R., C.A. Galera, Y. Lucas., (2006). Transfer of nutrients and labile metals from the continent to the sea by a small Mediterranean river. *Chemosphere*, 63, 469-476.

[14] Nouri J., B. Lorestani, N. Yousefi, N. Khorasani, A.H. Hasani, S. Seif, M. Cheraghi., 2011. Phytoremediation potential of native plants grown in the vicinity of Ahangaran lead–zinc mine (Hamedan, Iran). *Environ. Earth Sci*., 62, 639-644.

[15] World Health Organization.,2008. *Guidelines for drinking water quality*. Water Sanitation and Health. Retrieved from http://www.who.int/water_sanitation_health/dwq/guigelines/en.

[16] BIS.,2003. Indian Standard Drinking Water Specifications IS 105001991, Edition 2.2 (2003-2009). Bureau of Indian Standards, New Delhi.

[17] Indian Council of Medical Research (ICMR).,1975. Manual of Standards of Quality for Drinking Water Supplies. Special Report Series No. 44. New Delhi: Indian Council of Medical Research.

[18] USEPA—United States Environmental Protection Agency., 2009. Quality Criteria for Water. United States Environmental Protection Agency office of Water Regulations and Standards, Washington DC, 20460.

[19] Mansouri B., R. Baramaki, and M. Ebrahimpour.,2012. Acute toxicity bioassay of mercury and silver on *Capoeta fusca* (black fish). *Toxicology and Industrial Health*, 28(5), 393–398.

[20] Nriagu, J. O.,1989. A global assessment of natural sources of atmospheric trace metals, Nature, 338(6210), 47 – 49.

[21]Atapour,H.,2012.Geochemical baseline of major anions and heavy metals in groundwaters and drinking waters around the urban areas of Kerman city, South Eastern Iran. *Environ Earth Sci*. 67(7):2063–2076.

[22] Crossgrove, J. and Zheng, W.,2004.Manganese toxicity upon overexposure. NMR in Biomedicine, 17(8), 544-553.

[23] Woolf, A., Wright, R., Amarasiriwardena, C., Bellinger, D. A., 2002. Child with chronic manganese exposure from drinking water. *Environ. Health Perspect*.110, 613–616

[24] Karin Ljung and Marie Vahter., 2007. Time to Re-evaluate the Guideline Value for Manganese in Drinking Water? *Environ Health Perspect*. 115(11): 1533–1538.

[25] A.W. Dobson, K.M. Erikson, M. Aschner., 2004. Manganese neurotoxicity. *Ann. N. Y. Acad. Sci*., 1012,115-128

[26] Sehar, S., Naz, I., Ali, M. I., & Ahmed, S.,2011. Monitoring of physicochemical and microbiological analysis of underground water samples of district Kallar Syedan, Rawalpindi-Pakistan. *Research Journal of Chemical Sciences*, 1, 24–30.

[27] Sivaperumal, P., Sankar, T. V. and Viswanathan N., 2007. Heavy metal concentration in fish, selfish and fish products from internal markets of India vis-à-vis International standards. *Food Chemistry* .102:612-620.

[28] Al-Weher, M.,2008. Levels of heavy metal Cd, Cu and Zn in three fish species collected from the Northern Jordan Valley. *Jordan Journal of Biological Sciences*; 1: 41-46.

[29] Chung, P. L., Chung, C. Y., Liao, S. W., and Miaw, C. L. 2009. Assessment of the school drinking water supply and the water quality in Pingtung County. Taiwan. *Environmental Monitoring and Assessment*,159, 207–216. doi:10.1007/s10661-008-0623-9.

[30] Saleshrani, K., and Prabhahar, C., 2013. Seasonal variations of heavy metals distribution in the sediments of Kaduvaiyar estuary, Nagapattinam coastal area, Tamilnadu, India. *International Journal of Recent Scientific Research*, 4, 19–22.

[31] Nduka, J. K., and Orisakwe, O. E.,2011. Water-quality issues in the Niger delta of Nigeria: A look at heavy metal levels and some physicochemical properties. *Environmental Science and Pollution Research*, 18, 237–246.

[32] Rajappa, B., Manjappa, S., & Puttaiah, E. T.,2010. Monitoring of heavy metal concentration in groundwater of Hakinaka Taluk, India. *Contemporary Engineering Sciences*, 3, 183–190.

[33] Lewis, J. A., & Cohen, S. M., 2004. Addressing lead toxicity: Complexation of lead II with thopyrone and hydroxypridine-O, S-mixed chelators. *Inorganic Chemistry*, 43, 6534–6546.

[34] Osmond, D. L., Line, D. E., Gale, J. A., Gannon, R. W., Knott, C. B., Barthenhagen, K. A.,Lehning, D. W.,1995. WATERSHEDDS: Water, soil and hydro-environmental decision support system. Bristol. http://h2osparc.wq.ncsu.edu.