Original Article

RFP Journal of Biochemistry and Biophysics
Volume 5 Number 2, July– December 2020

Impact of Pollutants in the River Water Ecosystem

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How to cite this article:
P Jasmin Lena, S Maneemegalai, Impact of Pollutants in the River Water Ecosystem, RFP Journal of Biochemistry and Biophysics. 2020;5(2):35–38..

Abstract

Water is the foremost necessity of all living beings. The components which are dissolved in water determines the water quality for the growth of plants and animals. The requirement of adequate nutrients, pleasant and healthy environment is necessary for the growth of aquatic organisms. The productivity of the organisms present in water depends on the physicochemical characters.

The productivity is at its maximum by the presence of optimum levels of physico chemical parameters. Water quality of Varahanadhi River was assessed in the study at different locations for an annual year by measuring the various physico chemical parameters with the standard certified methods. Three different regions such as upstream, midstream and downstream and three different seasons were chosen for the present study.Downstream region was found to be polluted with heavy metals that might have adverse effects on the humans who consume the fishes from the river.

Keywords: River; seasons; pollution; water.

Introduction

Environmental pollution is a worldwide problem as heavy metals belong to the most important pollutants. Heavy metals are toxic at low concentration and cannot be easily destroyed, possess high density; found in earth's crust. Geochemical structure,waste from industries, have increased their levels (Sprocati *et al.*, 2006). The progress of industries has led to increased emission of pollutants into ecosystems (Saleh *et al*., 2010). The absorption of heavy metals can be absorbed from various biological tissues exposed to pollutants is (Won *et al*., 2013).

The biochemical reactions taking place in water are influenced by the physico chemical parameters. The changing conditions of water are reflected by the changing parameters. Various researches was done by the scientists (Singh *et al*., 2004) to explore the variation between different seasons and the physico chemical parameters of rivers. Fishes such as (Catla (*Catla catla*), Mrigal (*Cirrhinus mrigala*), Rohu (*Labeo rohita*) Tilapia (*Oreochromis niloticus*) are the inhabitants of the river. Heavy metals are naturally occurring elements, and are present in varying concentrations in all ecosystems. Various types of heavy metals exist in different forms and it is because of the human activities an imbalance in them exists. Their accumulation and distribution

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in soil, water and environment are increasing at an alarming rate causing deposition and sedimentation in water reservoirs and affects aquatic organisms as well (Hobbelen *et al*., 2004; Okafor and Opuene, 2007; Mohiuddin *et al*., 2010). Heavy metals like chromium, lead, cadmium, arsenic, etc. exhibit extreme toxicity even at trace quantities.

Heavy metals during their transport, undergo numerous changes due to precipitation, absorption and complexation phenomena (Abdel-Ghani and Elchaghaby, 2007) which affect their behavior and bioavailability (Nouri *et al* 2011). Hence they serve as the best bioindicators for assessing the environment. Geochemical distribution results have also been used as an aid in predicting potential contaminant mobility and bioavailability (Pueyo *et al*., 2003).

Materials and methods:

Varahanadhi River

Varahanadhi river basin is located in parts of Villupuram district in Tamil Nadu. It lays 12.04′ N latitude and 79.34′ E longitude. It covers a total area of 798ha. Varahanadhi River has 21 Km of catchment area. Varahanadhi basin is surrounded in east by Bay of Bengal, in north by Palar basin and Nallavur sub basin in south and west by Ponnaiyar basin.

The sampling point includes the upstream (US), midstream (MS) and downstream (DS) regions. Site A (upstream) which is situated in Gingee town and has its source at the hills of Melmalayanur in the South Arcot District of Tamil Nadu, site B (midstream) is the branch of the river that flows through Villupuram District and site C (downstream) part of the river called Sankaraparani that drains into Bay of Bengal. The three region selected was sampled in monsoon (June – September), pre-monsoon (January – May) and post-monsoon (October – December) seasons to study the variations due to contents present and the seasonal effect over the water body and the present study was carried out for a year in different sites.

Heavy Metals Quantification in Water:

Metal digestion was done using the Milestone Acid digestion method.

5 ml of water sample was pipetted into 20ml teflon tube. 6 ml of nitric acid (HNO3, 65%), 3 ml of hydrochloric acid (HCl, 37%) and 0.25ml hydrogen peroxide (H2O2) were added to each sample. 6ml HNO3 (65%), 3ml of HCl (37%) and 0.25ml H2O2 served as the blank. Water samples were processed by microwave digestion for thirty minutes. The samples were allowed to cool to room temperature after digestion and the solutions were diluted to 20 ml using distilled water. The liquid extract was then used for the determination of arsenic, chromium, cadmium and lead.

Heavy metals like chromium (Cr), lead (Pb), cadmium (Cd) and arsenic (As) in acidified water samples were analyzed using Inductively coupled plasma-atomic emission spectroscopy (ICP-AES). For the determination of total heavy metals, the extraction was carried out in Teflon containers, using strong acid mixtures, as described by Tessier et al., (1979). The reagents and chemicals used were of analytical reagent grade suitable for ultra-trace analysis.

Table 1: Heavy metal content analysis in the Varahanadhi river water sample

Values are expressed as mean values of samples taken in triplicates.

Parameters (WHO value)	Site	Pre Monsoon	Monsoon	Post Monsoon
Chromium (0.05mg/dl)	Upstream	0.06	0.05	0.04
	Midstream	0.06	0.04	0.07
	Downstream	0.10	0.11	0.13
Lead (0.05 mg/dl)	Upstream	0.03	0.04	0.06
	Midstream	0.04	0.02	0.05
	Downstream	0.13	0.12	0.15
Cadmium (0.005 mg/l)	Upstream	0.03	0.02	0.04
	Midstream	0.06	0.05	0.05
	Downstream	0.13	0.16	0.12
Arsenic (0.05 mg/l)	Upstream	0.06	0.02	0.04
	Midstream	0.03	0.03	0.06
	Downstream	0.15	0.13	0.14

Table 1 presented the heavy metals chromium, lead, cadmium and arsenic in water samples of pre monsoon, monsoon and post monsoon seasons, collected at different sites (upstream, midstream and downstream) of Varahanadhi River.

Results and Discussion:

A significant rise in the high level of all heavy metals in downstream site was observed in all seasons. Notable variations was also observed in the heavy metal contents between the upstream

and downstream regions of all seasons. Compared to the standard WHO values of heavy metals in water, significantly high level of heavy metals were observed in the downstream site of all seasons.

Cadmium is the most toxic element, is not essential for biological systems and not beneficial to the ecosystem and is found to cause harm. In the human population cadmium toxicity causes renal dysfunction and lung cancer, osteomalacia and hypertension.

Chromium has been found to be is used in the rubber manufacture, wood and leather industries. High levels of exposure cause hepatic and nephrotic damage, ulcers in skin and affects central nervous system and remove related disorders. It is also associated with the toxic effects on hematological problems and immune response in freshwater fish.

Human exposure to lead causes severe toxicity. Higher doses of lead may damage the fetus and is toxic to the central nervous system and gastrointestinal tract. Lead toxicity might disrupt hemoglobin synthesis and affect the kidneys and reproductive systems.(Ferner et al 2001). Airborne lead may cause the poisoning of agricultural food by the deposition on fruits, soils and water.

Arsenic toxicity symptoms depend on the chemical form ingested (Holum, 1983; Ferner, 2001). Arsenic has the ability to precipitate proteins, complex formation with coenzymes and inhibition of of adenosine triphosphate (ATP) production during respiration (INECAR, 2000). It is carcinogenic in all its oxidation states and severe exposure cause death (Ogwuegbu and Ijioma, 2003; USDOL, 2004).

Conclusion:

The toxic elements enter the body mainly through water, food and air. Cosmetics, dentistry, pharmaceuticals, particularly Ayurvedic and Unani drugs also contribute. These changes might be due to the adverse effect of discharge of pollutants such as sewage, industrial waste, heavy metals and anthropogenic sources in Varahanadhi River that the fishes inhabit. Collectively the pollutants that get accumulated in the downstream site of the Varahanadhi river results in detrimental effects in fishes. More research is needed to investigate which of these metals affect human health. Public awareness should be created. There should be monitoring and control over the concentration of these in cosmetics and anthropogenic activities.

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