JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

A Preliminary approach on the assessment of Heavy Metal contamination in Water, Sediments and Fishes from Pamba River Basin, Pathanamthitta, Kerala, South India.

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Abstract- The Heavy metals, encompass under the emerging environmental contaminant categorization, with density greater than 4.5g/cm ^{3}. Beyond their highly toxic nature, they manifest non-degradable disposition. The river Pamba is the third longest river in Kerala, (southern Ganga). One of the most important vital riverine systems, as a source of food, water and pilgrim activities. The river is peculiarized, because one of the famous pilgrimage centres in south India, the Sabarimala is located on the bank of this river. The present study involves field study and laboratory analysis for the distribution and abundance of heavy metals (Cd, Pb and Hg) in water, sediment and fish species from the river basin. From the study it is evident that the sediment sample, the lead contamination was much more than the admissible level, whereas levels of Cadmium and Mercury was below detectable level both in water and sediment samples. Fish organs like muscle and liver also shows toxic level of Lead. From the study, it can be concluded that river Pamba is polluted with heavy metal like Lead mainly due to anthropogenic activities. Analysis of different season's samples may reveal the correct picture of the riverine pollution with heavy metals.

Key words - Heavy Metals, Pamba River, Water, Sediments, Fish species.

1. INTRODUCTION

Heavy metals are the highly toxic emerging environmental contaminants, they are known as the elements with metallic properties. They are specially characterized based on their high density, atomic number, atomic weight and high relative gravity. The heavy metals have a density usually greater than 4.5 g/cm^3 and atomic weight ranges from 63-200.6 g/mol. These metals are highly toxic to human beings and to other living organisms in high concentration. But some of them are poisonous even in the low concentration also[1]. Along with the toxic nature of heavy metals another important feature is that they are non-degradable in nature. So that

they can persist in various ecosystems for a long time and thereby they can generate several toxic impacts, so they are also known as Conservative pollutants. The heavy metals are thought to be highly absorbed and adsorbed by numerous materials present in nature. They show physical properties such as high melting point, good conduction of heat and electricity and can be drawn them out into thin wires. Beyond the emerging environmental contaminant categorization, the heavy metals are described as globally distributed pollutants. These are the metallic substance that shows harmful effects due to their persistence in the soils and sediments i.e. also referred as Chemical time bombs. The heavy metals are naturally occurring particles so they are present in the environment, and they perform some vital functions, but if they are accumulated in the environment then it became poisonous and alter the health of different ecosystem. In the form of trace elements some heavy metals such as copper, selenium, zinc, are essential to maintain the metabolism of organisms. They are concerned as essential elements in humans, animals as well as in plants. Required for many actions like enzymatic activities, for chlorophyll and seed production, growth and development in plants[2]. Usually the aquatic organisms are more prominent in bio accumulation; the reason is that they can absorb the heavy metal particles from water rapidly than they excrete[3]. From these organisms the heavy metal particles can reach to other organisms by bio magnification through food chain, remarkably to human beings also. Other than this the bacteria and other micro-organism are also responsible for the bio accumulation these metals. The heavy metals reported to transport through various other means such as water, air, etc.

The objective of the present study is to analysis the presence of heavy metal pollutants in Pamba River from water as well as sediment samples. Also to investigate the presence of heavy metals in edible and inedible parts of the pelagic food fishes sold for human consumption.

LITERATURE REVIEW

The Heavy metal concentration in Water, Sediments and their bioaccumulations in some freshwater fishes and mussle in Dhaleswari River was recorded by Ahmed *et al*, in 2009. The health risk assessment of metal contamination through the consumption of fish Amirah *et al.*, in 2013. was studied by The accumulation of heavy metals in selected benthic organisms and fishes of Vemband Lake ecosystem were analyzed by Jayasooryan K. K, in 2015. The Seasonal Variation in Heavy Metal pollution at Palluruthy, a converging Point of Pamba and Vembanad Lake, Kerala was analyzed by Rani *et al.*, in 2015. Alkesh et al in 2017 provided an overview about the heavy metal impact on aquatic life and human health. The Bioaccumulation and potential sources of heavy metal contamination in fish species in River Ganga basin and the possible human health risk evaluation was investigated by Pradip Kumar *et al*, in 2019. Shahbaa in 2021 give a detailed review on some heavy metal toxicity in fresh water fishes. Assessment of heavy metal pollution in water, sediment and fish of river Ganga at Varanasi was studied by Anupma *et al.*, in 2021. Saranya et al in 2023 studied a Review on heavy metal contaminants in freshwater fish in South India: current situation and future perspective.

2. Materials and Methods

2.1 Study area

The Pamba River has a total length of about 176 km. The river (Lat.9.500 and long. 76.416, Elevation- 1650 m) flows through four districts in Kerala, India. The samples were collected from the site named *"Ranni"*. The site was coming under the section of middle zone of Pamba River. The study area was a highly populated region.

Fig.1- Map showing the Study area

2.2 Materials

For the present study, two water samples from two different sites were collected using pre-cleaned polypropylene bottles from the Pamba River, as mentioned in the study area. In addition to the water samples, two sediment samples were also collected from the same site, where the water samples were collected for the heavy metal analysis using a stainless steel shovel in cleaned polyethylene bags.

Fig. 2 - Sampling site

The Fish species were collected with the help of fishermen from two different sites. The edible fishes of commercial importance were selected for the analysis.

Figure 3- *Puntius chola*

Figure 4- *Pseudetroplus maculatus*

After collecting the water samples, the basic parameters such as temperature, pH, and conductivity are tested in the laboratory. Then the water samples were treated with concentrated HNO_3 for acidifying the samples. The analysis for heavy metals (Cd, Pb and Hg) were done by following the U S EPA Method 200.8 version with the help of ICP OES.

The sediment samples were first oven dried then powdered to fine powders. After sieving the fine powdered sediment samples were analyzed for the presence of heavy metals.

After analyzing the morphometric parameters, the Gills and muscles were dissected from each species. Then each organ was oven dried and powdered. By using the powdered samples quantification of heavy metals were carried out by following AOAC Method 2015.01.

2.3 Methodology

This analysis was conducted by digesting the samples using a Microwave digester. The microwave digestion procedure was performed using the methods described by (Chen & Ma, 2001; Sreenivasa et al., 2014). A sample weighing approximately 0.1g was combined with 8 ml of nitric acid (Trace Metal TM Grade) and 2ml of sulphuric acid (Trace Metal TM Grade) in a Teflon tube. Following a 30-minute open digestion, the closed digestion was performed using a microwave digestion device (Anton Paar). The sample took around 2 hours to fully digest. After completing the digestion process, the digestion containers were cooled briefly in the microwave and then in a water bath. Following the cooling process, the digested liquid underwent filtration using Whatman no. 42 filters. The filtered liquid was thereafter poured into a 25-ml standard flask and filled using deionized distilled water. This process was carried out under identical conditions as the calibration standards. A blank digest was conducted using the same methodology.

2.4 Analysis of Heavy metal content

Heavy metal and other mineral content were analysed by Inductively Coupled Plasma-Mass Spectrometry, ICP-MS, (iCAP Q, Thermo Fisher). The ICP-MS working conditions are provided in Table 1. Standardization was done with the ICP multielement

standard VI made by Merk.

3. Result and discussion

Heavy metal concentration in the water and sediment samples are indicated through the table.

Table 1: Concentration of Heavy metals in Water and Sediment

Heavy Metal Concentration	Concentration (ppm)			
		Cd	Pb	Hg
Water	Sample 1	ND	BLQ	ND
	Sample 2	ND	BLQ	ND
Sediment	Sample 1	ND	7.06	ND
	Sample 2	BLQ	10.35	ND

Graphical representation of Heavy Metal Contamination in different organs of Fish collected from Sampling site.

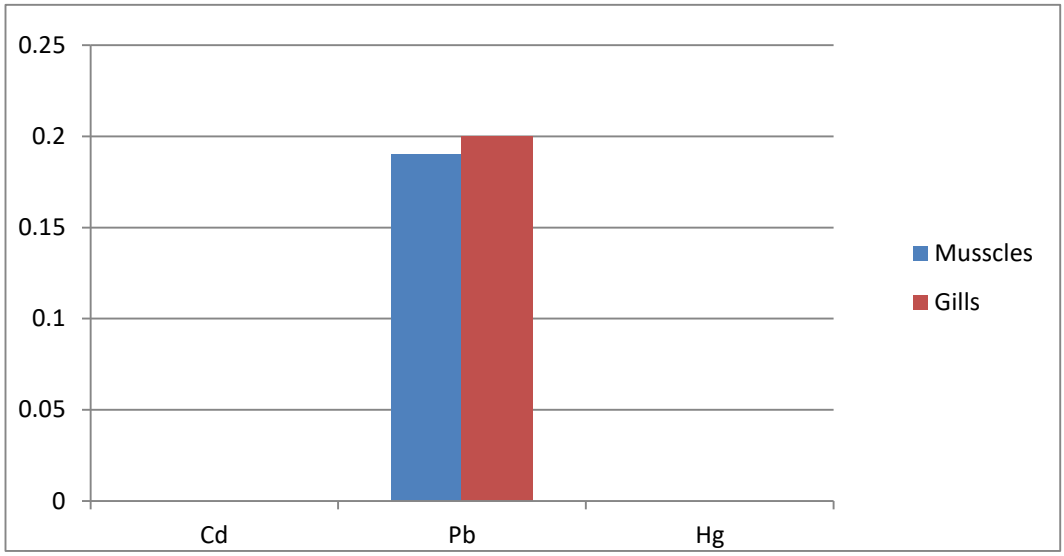

Figure 5- Concentration Heavy metal (Pb) in *Puntius chola*

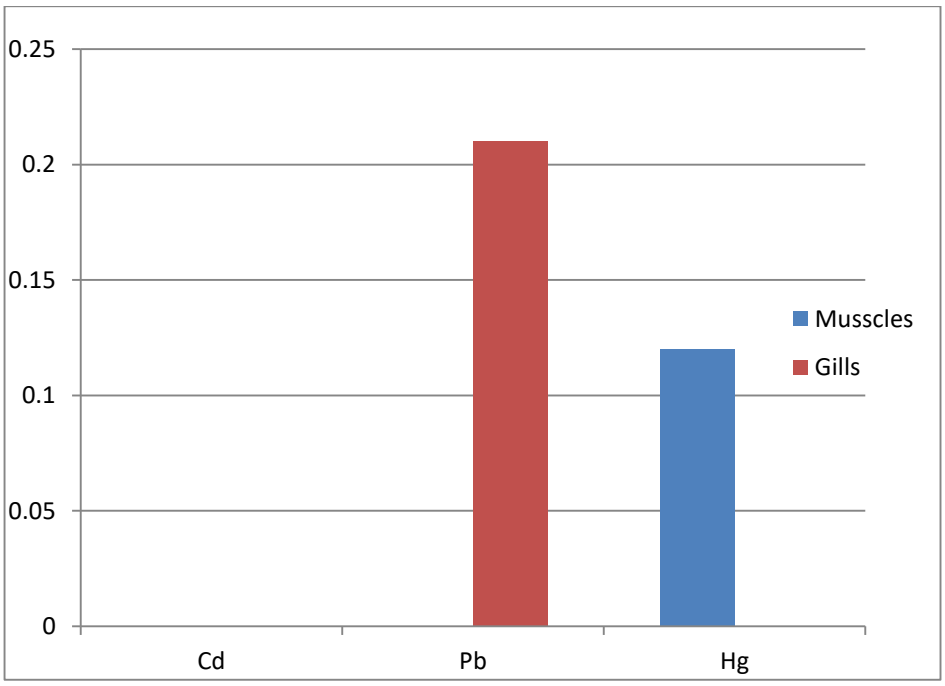

Figure 6- Concentration Heavy metals (Pb and Hg) in *Pseudetroplus maculatus*

From the analysis, it was noted that the Concentrations of heavy metals (Pb, Cd and Hg) in the water samples from the two samples are below the detective limit. In the sediment samples Cd and Hg are below detective level, but the Pb is present in the concentration of 7.06ppm and 10.35ppm in the first and second sample respectively. In the case of fish species, Pb was present both in gills and muscles of *P. chola* whereas in *P. maculatus*, lead was present only in the gills and Hg was present in the muscles.

4. Conclusion

From the present study it is evident that in the water samples the concentration of heavy metals such as Cd, Pb and Hg were below toxic level. But both the sediment as well as different organs of the fish species show toxic levels of metals like Pb and Hg, which were cumulative toxic substances that leads to many health effects to human beings through food chain. Among that the mercury (Hg) is the most volatile of all metals. which the only

common metal that exists in liquid form at ordinary temperatures. It occurred in the earth's crust naturally. And they are highly toxic in their vapor form (Sharma *et al.*, 2005). The liquid mercury itself is not highly toxic form, most of them ingested by organisms are excreted. They can cause several health effects in organisms as well as in the ecosystems. In the aquatic ecosystems, the acidic surface waters also contain significant amounts of mercury. The mercury concentrations in the water will increase due to the varying pH and movement of mercury from the ground (Mitra *et al.,* 2022)

Lead (Pb) is found in the environment in various forms, organic and inorganic compounds (Mitra *et al.,* 2022). The inorganic forms are fewer toxic ones, has no physiological role in the biological systems. Foods such as fruit, vegetables, meats, grain, seafood, soft drinks and wine may contain significant amounts of lead. Cigarette smoke also contains small amounts of lead. Lead can enter a foetus through the placenta of the mother (Briffa *et al.*, 2020). Because of this it can cause serious damage to the nervous system and the brains of unborn children. The children are at greater risk for lead absorption than adults, and it is depending on several factors such as physical state of lead and nutritional status of the person. Lead accumulates in the bodies of water organisms and soil organisms also. So ultimately the lead pollution can influence global balances (Sharma *et al.,* 2005).

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