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Assessment of Heavy Metal Contamination in Fish Gill Tissue From Ambattur Lake And Pulicat Lake, Tamilnadu India

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ABSTRACT

The study of the trace metals and heavy metals present in the freshwater ecosystem plays an essential role in determining the amount of pollution in the study area. In the present study, totally 8 species were recorded in the Ambattur and Pulicat lakes based on abundance. Among 8 species of fishes, the family Cichlidae predominates followed by Cyprinidae. The higher level of heavy metals in the gill tissue, shows the high potential of fish to concentrate heavy metals like Cr, Hg, Pb and Cd for which the observed concentrations are above the permissible limits except Cu and Zn whose level were within the permissible limits. Based on these results, it is inferred that there is serious heavy metal pollution in the freshwater ecosystem of these lakes. There is an urgent need to control the industrial pollution and save the above water bodies for the welfare of the present and future generations.

KEYWORDS: Ambattur Lake, Pulicat Lake, heavy metals, fishes.

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INTRODUCTION

Lakes are inland depressions containing standing water. Lakes are socio economically and bio aesthetically important aquatic ecosystem**.** The lakes of Pulicat and Ambattur are the important water bodies which aids the Chennai city in their water supply. They are famous for their rich biodiversity and they are quite a few inhabitants in its surrounding areas. Now the main threats to these lakes are due to the pollution by the agricultural wastes, domestic sewage, hospital and Industrial discharges. There is no much investigation so far on the water Quality parameters and heavy metals' content of these lakes.

Heavy metals are one of the key groups of poisonous environmental contaminants based on their toxicity, persistence and bioaccumulative properties[1,2]. Heavy metals are a significant category of pollutants and impose main detrimental effects on human and environmental health[3]. Heavy metals are considered to be potential pollutants in aquatic ecosystems because of their adsorption in bottom sediments even at low concentrations, environmental persistence, their toxicity at low concentration and their ability to get incorporated into food chain and concentrate in aquatic organisms[4].

The aquatic organisms of runoff water tend to accumulate heavy metals in their body but fishes are more commonly affected than other species[5,6] . Studies carried out in different fish species have revealed that both essential and non-essential metals can produce toxic effects in fish by disturbing their growth, physiological biochemical, reproduction activities, and mortality[7,8]. The studies on bioaccumulation of heavy metals in fishes are considered as one of the best indicator of heavy metal contamination in coastal environment[9,10]. Hence, the aim of the present study is evaluate the level of heavy metal contamination in commonly available fish species, which appears to have great economic and ecological importance in the above freshwater ecosystems.

MATERIALS AND METHODS

Study area:

Ambattur lake: Located in Ambattur municipality of Thiruvallur district, Tamilnadu.

Pulicat lake: Second largest coastal lake in India, located in 40km North of Chennai, Tamilnadu.

Fish sample collection: The fish specimens were collected by using cast nets and local contrivances. The collected fish samples were preserved in 10% formalin. The identification of the specimen has sent to Zoological Survey of India (ZSI), Southern regional centre, Chennai.

Heavy metal analysis*:* Heavy metal concentrations cadmium, zinc, lead, arsenic, aluminium, nickel, chromium and lithium were measured using a flame atomic absorption spectrophotometer

(Perkin-Elmer AA700) equipped with a deuterium background corrector. Suitable internal chemical standards (Merck Chemicals, Germany) were used to calibrate the instrument. All the reagents used were analytical grade of high purity. The results of the heavy metal concentrations were determined on a dry weight basis ppm g-1.

RESULTS AND DISCUSSION

Totally 8 species were recorded in the above lakes based on abundance. Among 8 species of fishes, the family Cichlidae was the most dominant in the assemblage composition with 37.5% followed by Cyprinidae with 25.0% and other families of Gobiidae, Channidae and Schilbeidae each with 12.5 % respectively (Table 1). The present results get support from other workers[11,12,13] like Wakid and Biswas, 2005, Venkatshwarlu *et al*, 2007 and Thirumala *et al*., 2011.

A family wise comparison reveals that in Cichlidae among the three species that were recorded, the *Oreochromis mossambicus* and *Etroplus maculates* were present in both station, but *Oreochromis niloticus* was not present in Pulicat Lake. Among two species of Cyprinidae, the *Puntius sophore* was present in both stations, but the species of *A. microlepis* was absent in Pulicat Lake. Other fishes like *Glossogobius giuris* was present in both stations, but *Channa punctatus* and *Pachypterus atherinoides* were absent in Pulicat Lake.

Table 1: Fish diversity in two different freshwater ecosystem of Chennai

Taxa	Ambattur	Pulicat
Etroplus maculates (Bloch, 1795)	+	+
Oreochromis mossambicus (Peters, 1852)	+	-
Oreochromis niloticus (Linnaeus, 1758)	+	-
Glossogobius giuris (Hamilton, 1822)	+	+
Channa punctatus (Bloch, 1793)	+	-
Amblypharyngodon microlepis (Bleeker, 1853)	+	+
Puntius sophore (Hamilton, 1822)	+	+
Pachypterus atherinoides or *Pseudeutropius alterinoides* (Bloch, 1794)	+	-

Abbreviations: + = Present; - = absent;

Table 2 and 3 shows the heavy metal concentrations in Gill tissues of both the species under study. The heavy metals concentrations in fishes were detected almost all the samples and the highest concentration was detected in the following sequential order, in Ambattur lake samples, Cd (13.60±0.63 ±0.40ppm/g) > Zn (10.83±0.04 ppm/g) > Cr (10.30±0.23 ppm/g) > Hg (09.82±0.46 ppm/g) > Cu (6.86±0.10 ppm/g) > Pb (5.92±0.25ppm/g) / *E. maculates* > *A. microlepis* > *P. atherinoides* > *G. giuris* > *O. mossambicus* > *P. atherinoides* (Fig 1).

In Pulicat lake, Cd (12.40±0.27 ppm/g) > Zn (9.54±0.17 ppm/g) > Cr (9.21±0.09 ppm/g) > Hg (8.13±0.06 ppm/g) > Cu (6.56±0.07 ppm/g) > Pb (5.86±0.50 ppm/g) / *Siganus javus* > *Chanos Chanos* > *Arius Sp.* > *Siganus javus* > *Arius Sp.*> *Siganus javus.* In gills Cd (15.60±0.63 ppm/g) > Hg (10.82±0.46 ppm/g) > Zn (10.82±0.04 ppm/g) > Cr (10.31±0.02 ppm/g) > Cu (6.80±0.10 ppm/g) > Pb (5.90±0.03 ppm/g) / *Liza melanoptera* > *Oreochromis Mossambica* > *Arius* sp. > *Siganus javus* > *Arius* sp.> *Arius* sp (Fig 2).

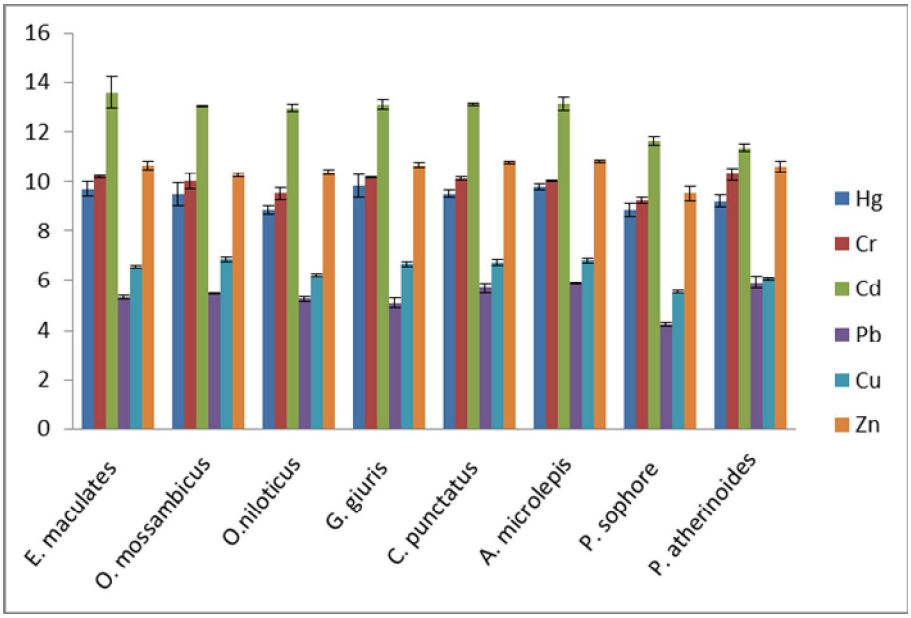

Fig 1: Bioaccumulation of heavy metals (Hg, Cr, Cd, Pb, Cu & Zn) (ppm) in Gills of commercial fish species from Ambattur ecosystem.

Table 2: Bioaccumulation of heavy metals (Hg, Cr, Cd, Pb, Cu & Zn) (ppm) in Gills of commercial fish species from Ambattur ecosystem.

Sampling Locations	Heavy metals Concentration in ppm/g					
	Hg	Cr	Cd	Pb	Cu	Zn
E. maculates	09.70±0.28	10.21±0.06	13.60±0.63	5.32±0.06	6.54±0.05	10.65±0.17
O. mossambicus	09.50±0.45	10.03±0.31	13.05±0.02	5.47±0.02	6.86±0.10	10.26±0.06
O.niloticus	08.86±0.17	09.53±0.25	12.95±0.14	5.24±0.12	6.20±0.04	10.39±0.08
G. giuris	09.82±0.46	10.16±0.02	13.10±0.19	5.08±0.20	6.65±0.08	10.68±0.10
C. punctatus	09.50±0.14	10.14±0.08	13.12±0.04	5.68±0.20	6.72±0.10	10.79±0.04
A. microlepis	09.80±0.12	10.02±0.04	13.14±0.27	5.89±0.03	6.81±0.10	10.83±0.04
P. sophore	8.87±0.27	9.25±0.14	11.63±0.17	4.24±0.06	5.52±0.04	9.52±0.28
P. atherinoides	9.22±0.26	10.30±0.23	11.36±0.15	5.92±0.25	6.08±0.04	10.60±0.23

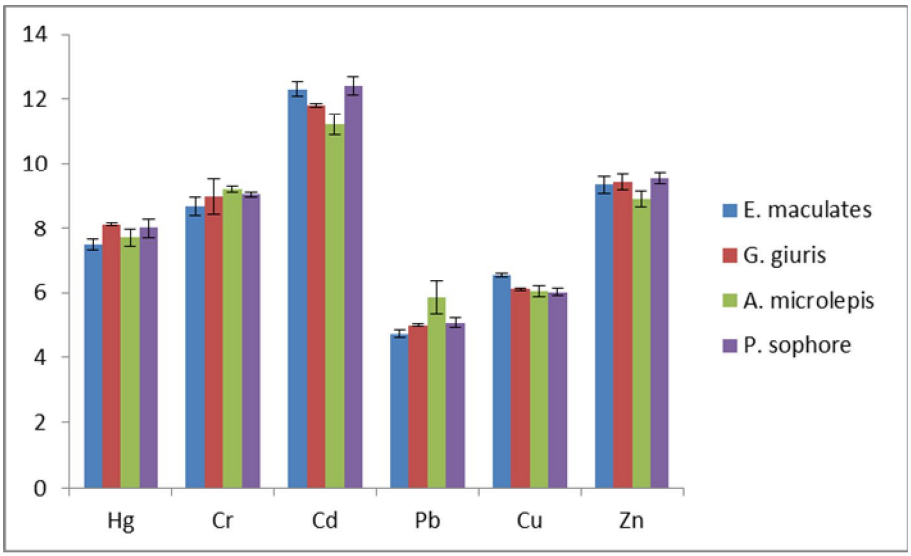

Figure 2: Bioaccumulation of heavy metals (Hg, Cr, Cd, Pb, Cu & Zn) (ppm) in Gills of commercial fish species from Pulicat ecosystem

Table 3: Bioaccumulation of heavy metals (Hg, Cr, Cd, Pb, Cu & Zn) (ppm) in Gills of commercial fish species from Pulicat ecosystem

Sampling Locations	Heavy metals Concentration in ppm/g					
	Hg	Cr	Cd	Pb	Cu	Zn
E. maculates	7.50±0.16	8.67±0.28	12.30±0.22	4.74±0.13	6.56±0.07	9.34±0.26
G. giuris	8.13±0.06	8.98±0.55	11.80±0.05	5.01±0.04	6.10±0.04	9.42±0.24
A. microlepis	7.71±0.26	9.21±0.09	11.21±0.33	5.86±0.50	6.04±0.17	8.90±0.25
P. sophore	8.01±0.30	9.04±0.08	12.40±0.27	5.08±0.15	6.02±0.11	9.54±0.17

The high concentration of metals depending upon the anthropogenic sources such as waste incineration, vehicle operations, combustible consumption, fertilizer use, which likely come from the upper basin of the lotic system that flow in to the wetland and there is no correlation between the metals from the present data[14]. This study shows that the water, sediments and selected fish species, has a high potential to concentrate heavy metals though the observed concentrations are above the recommendation limits of FAO guidelines[15].

CONCLUSION

In the present study results, showed the presence of higher level of heavy metal concentration in the fish Gill tissues has a high potential to concentrate heavy metals like Cd, Hg, Pb and Cr though the observed concentrations are above the permissible limits except two metals (Cu and Zn) are within the permissible limits. Based on these results there is serious heavy metal pollution in the Ambattur and Pulicat ecosystem. These two ecosystems are heavily contaminated by pollutants from rapid urbanization and industrialization to release untreated industrial effluents and domestic sewages to this ecosystem. However urgently need the regular biological monitoring of water and fish for safety in seafood consumption from these areas. So avoid such kind of problem in these two

ecosystems to practicing safe disposal mechanism of industrial effluents and domestic sewages. Also, there must be continuous environmental pollution monitoring and check heavy metals hazard by state and central Government to take remedial measure for protection of Ambattur and Pulicat ecosystem.

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