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Research paper

Assessing Heavy Metal Bioaccumulation in Freshwater Fish at the Gingee River in Puducherry, India

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A R T I C l E I N F O

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A B S T R A C T

Heavy metal bioaccumulation was investigated in fish from the Gingee river in Vadamangalam and Ariankuppam in the Puducherry area, including mercury (Hg), zinc (Zn), and copper (Cu) (Cu). According to the study, heavy metal concentrations in sediments were more significant than in water. Depending on the season, the amount of heavy metal played at each location changes. Heavy metal bioaccumulation was seen in river fish. Metal concentrations have been detected in the following order: sediment > fishes > water.

Introduction

India ranks tenth among all nations with cultivable freshwater and brackish water resources, suggesting that aquaculture has enormous potential to expand into a significant sector (Sukumaran and Ashmawy 2001). In the past three decades, there has been an increasing worldwide concern about the toxicological dangers posed by industrial effluents to humans, animals, and the environment. Most aquatic systems have been heavily polluted due to increased industrialization, urbanization, and other developmental activities (Sarode, Joshi et al. 1992, Tirupurasundary and Ramamoorthy 2009).

Fish is an indicator organism for heavy metal contamination in water, and it may become unsafe for human eating as a result. Fish are a good indication of heavy metal enrichment since they are the final consumers in the aquatic food chain. Fish muscle has been studied more than other organs since it is a technique to determine the number of heavy metals entering the human body via food chain enrichment (Brown, Shaw et al. 1974).

In 2003, the total global fisheries product output was 132.2 million tons, with aquaculture accounting for 41.9 million tons or around 31% of

total global production. Global aquaculture is quickly increasing (> 10% per year for most species), whereas wild fisheries' proportion of total catch has been broadly stable over the previous decade (Piedrahita 2003).

Heavy metals such as Mn, Hg, Cu, and Zn are plentiful in the experimental region. Heavy metals in organisms are affected by physiologic parameters such as salinity and temperature (Colby 1963, Forstner and Wittmann 1979, Gautam 1995). The main goals of the research were to examine how heavy metals (mercury, zinc, and manganese) accumulated in different fish species, water, and sediment throughout the post-monsoon and pre-summer seasons.

Materials and Methods

The Puducherry area is located between 11°372' and 12°302' north latitude on the Coromandel coast. Important Reminders: Bioaccumulation is a musical genre characterized by heavy metal. Fish that live in a body of water are known as freshwater fish. Risks of toxicity The longitudes of the Gingee River are 79°372' and 79°532' east. The area was bounded on three sides by the south district's lands: the Bay of Bengal on the east and the Cuddalore district of Tamilnadu State on the west. The area is bordered on three sides by the land of the South Arcot district and on the east by the Bay of Bengal. The physiographic map of the region depicts a mostly flat landscape. In this location, there are no hills or woods. This area's most common soil types are red ferrallitic black clayey and coastal alluvial soils. The Gingee River, which runs diagonally from northwest to southeast, and the Pennaiyar River, which defines the district's southern boundary, are the two essential drainage basins. Puducherry is a popular tourist destination in India.

Along the Gingee River, test sites were strewn around. The stream has been contaminated by industrial waste. Mercury, copper, zinc, and iron pollution were identified at Vadamangalam, site-1, and Ariankuppam, site-2. Vadamangalam, in the northern section of the Puducherry territory, is one of the chosen locations. Private organizations formed the majority of Vadamangalam's small and large-scale companies. Chemicals such as hydrochloric acid, plastics, soap, oil, paper, cosmetics, batteries, and other pollutants are discharged since the river is near these enterprises.

The other research location was Ariankuppam, located on the southern outskirts of Puducherry. River water meets saltwater at this location. Water, sediment, and fish samples were collected and analyzed at the Agriculture and Environmental Monitoring System in Auroville, Puducherry. The materials were tested for heavy metals using an Atomic Absorption Spectrometer (AAS) type 220-varian. After digestion of sediment samples, sample preparation for heavy metal assays such as Pb, Zn, Cu, Fe, and Mn was done. Fish samples were digested, and correct calculations were made after standardization, sample analysis, and sample analysis.

Results and Discussion

Heavy metal mercury concentrations were highest in Mystus aor muscle (1. 868 and 1. 703 ppb) in both seasons (December 2003 and March 2004), followed by Tilapia mossambica (1.637 and 1.713 ppb), Ophiocephalus gachuva (0.982 and 1.086 ppb), Ophiocephalus striatus (1.261 and 1.086 ppb), and Borus puntius (1.261 and (0.862 and 0.613 ppb). These results are consistent with Forstner & Wittman (1983), who discovered an average total mercury content of 88.9% in fish musculature in Ariankuppam and Vadamangalam. (As seen in Table 1)

During the post-monsoon season (December 2003), water samples from research sites I and II (Vadamangalam and Ariankuppam) exhibited greater mercury, copper, zinc, and manganese concentrations than during the pre-summer period (March 2004). Because heavy metal concentrations correlated well with the amount of material discharged during the summer, mercury, copper, zinc, and manganese concentrations in water samples from the research region were higher during the post-monsoon period (December 2003) than during the pre-monsoon period (July 2003). (March 2004).

According to the study, heavy metal accumulation in various fish species relies on their presence in water and sediments, suggesting the presence of localized pollution. Multiple mechanisms repeatedly pushed through the biological chain in watery environments where fish are giant predators at the end of the food chain allowed heavy metals to reach people and maybe fish species. The order in which metal concentrations were detected is as follows: sediment > fishes > water.

Heavy metal concentrations, such as Mg, Cu, Zn, and Mn, varied with species and season (Figs. 1 and 2). Heavy metal concentrations were more significant in the post-monsoon season than in the summer. The muscles of Mystus aor, Tilapia mossambica, Ophiocephalus gachuva, Ophiocephalus striatus, Etruplus muculatus, and Barbus puntius had the highest mercury in both seasons. In both seasons, Cu concentrations were most significant in the muscle of Tilapia mossambica (Fig. 4). In both seasons, the muscles of Mystus aor had tremendous quantities of zinc (Fig. 5), whereas the muscles of Ophiocephalus gachuva had the highest concentrations of Mn (Fig. 6).

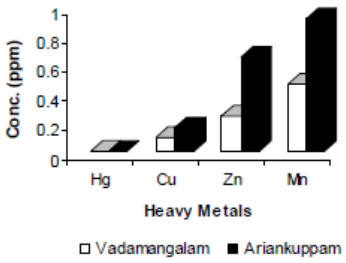

Fig. 1: Mean concentrations (ppm) of selected heavy metals in river, water collected from both the areas.

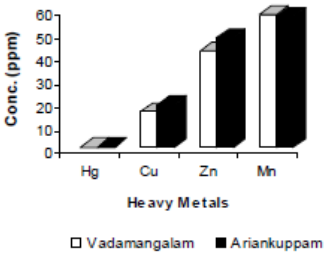

Fig. 2: Mean concentrations (ppm) of selected heavy metals in sediments collected from both the areas.

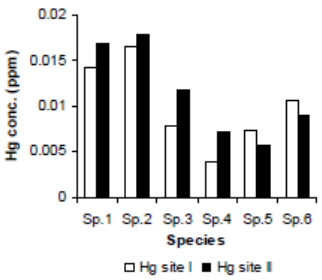

Fig. 3: Mean concentration of Hg in two sites.

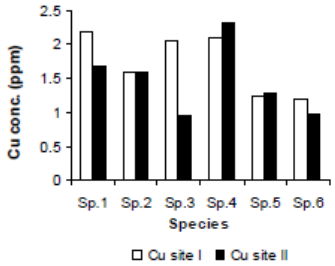

Fig. 4: Mean concentration of Cu in two sites.

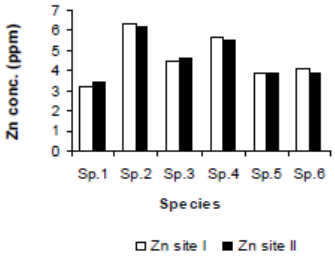

Fig. 5: Mean concentration of Zn in two sites.

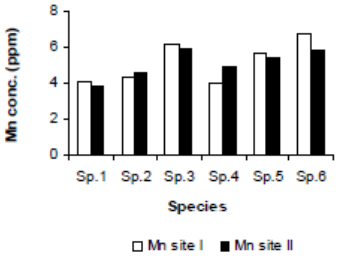

Fig. 6: Mean concentration of Mn in two sites.

Heavy metal concentrations in water and sediment samples from both study locations were more significant during the post-monsoon period in December 2003 than during the pre-summer period in March 2004 because heavy metal concentrations were connected to removing discharge items.

Table 1: Mean seasonal concentrations of selected heavy metals in some freshwater fishes from the study area.

Species	Seasons	Hg (ppb)	Cu (ppm)	Zn (ppm)	Mn (ppm)
Tilapia	Post-Monsoon	1.631	1.786	3.612	3.908
mossambica	Pre-Summer	1.713	1.58	3.198	3.812
Mystus aor	Post-Monsoon	1.868	1.608	6.193	4.597
	Pre-Summer	1.703	1.593	6.226	4.601
Ophiocephalus	Post-Monsoon	1.261	0.812	7.671	5.972
striatus	Pre-Summer	1.086	1.108	7.608	5.896
Barbus puntius	Post-Monsoon	0.862	2.612	5.576	4.971
	Pre-Summer	0.613	2.064	5.489	5.002
Etruplus	Post-Monsoon	0.67	1.286	3.901	5.301
muculatus	Pre-Summer	0.492	1.261	3.896	5.567
Ophiocephalus	Post-Monsoon	0.982	1.087	3.886	5.982
gachuva	Pre-Summer	0.786	0.87	3.802	5.614
Tilapia	Post-Monsoon	1.482	2.121	3.405	4.126
mossambica	Pre-Summer	1.361	2.262	3.046	4.085
Mystus aor	Post-Monsoon	1.701	1.602	6.529	4.637
	Pre-Summer	1.672	1.583	6.138	4.108
Ophiocephalus	Post-Monsoon	0.852	2.258	4.516	6.164
striatus	Pre-Summer	0.716	1.873	4.487	6.076
Barbus puntius	Post-Monsoon	0.483	2.116	5.684	4.108
	Pre-Summer	0.328	2.108	5.601	3.816
Etruplus	Post-Monsoon	0.766	1.261	3.876	5.674
muculatus	Pre-Summer	0.712	1.212	3.782	5.621
Ophiocephalus	Post-Monsoon	1.087	1.27	4.364	6.801
gachuva	Pre-Summer	1.016	1.118	3.986	6.678

Conclusion

Due to industrialization and urbanization, heavy metal pollution is predicted to reach dangerous levels in the Puducherry area. The great majority of enterprises dump their waste into the environment with little consideration for environmental protection. As a result, harmful industrial effluents are stored and monitored in a secure environment. Regular maintenance is required to maintain the environment clean in all areas. The importance of focusing on significant indicator species like top carnivore fish or mammals cannot be overstated.

Conflict of interest

The authors declare that they have no conflict of interest.

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