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COMPARISON OF SOME HEAVY METALS IN FISH (*MUGIL CEPHALUS)* AND WATER FROM OIL SPILLED AREA AT ENNORE COSTAL REGION, TAMIL NADU, INDIA

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ABSTRACT

Heavy metals such as mercury (Hg), lead (Pb), cadmium (Cd), arsenic (As), chromium (Cr), copper (cu), nickel (Ni) and selenium (se) were analyzed in water sample of Ennore coastal area and different parts of the marine food fish, *Mugil cephalus*. The samples were collected from oil spilled area near at Ennore, after the ship accident occurred on the month of January 2017. The highest heavy metal concentrations in different parts of the fish were noticed as follows: mercury (0.87 ppm) in liver, lead (2.45 ppm) in fried tissue, cadmium (0.56 ppm) in liver, arsenic (1.22 ppm) in intestine, chromium (1.35ppm) in liver, copper (0.34ppm) in tissue, and selenium (6.32 ppm) in tissue. The water quality parameter in the Ennore coastal area were analyzed and presented in this paper. The present study was compared with the earlier finding of the Ennore coastal area. Based on the results there was much contamination in the water and fish sample and hence the fish is not fit for human consumption.

KEYWORDS: Heavy metals, Concentration, *Mugil cephalus*, Chennai, oil spill.

1.0 INDRODUCTION

Marine pollution is a worldwide environmental problem which mainly involved by human activities directly or indirectly into the coastal area of marine water. The effluent are from point and non-point source of polluted water were discharging in marine ecosystem which create heavy metals accumulation for living animal into the marine ecosystems (Cenci *et all*., 2006; Pote *et all*., 2008). These accumulations of heavy metals in living organism were

transferred to the next trophic level. The accumulated heavy metal becomes toxic when it crosses the permissible limit. (Blackmore and Wang 2003). Heavy metals occur naturally in the ecosystem with larger variations in the concentration. Aquatic pollution started long back, but intensified during the last few decades and now the situation has become alarming especially in India (Girija *et all*., 2007). Even though some of the heavy metals form the part of our daily life activities, they are subjected to potent toxics, contaminating ecosystems. Some essential heavy metals like Iron, Cobalt, Copper, Manganese, Molybdenum, and Zinc are important to the human body to maintain the metabolism, but its excessive levels can be damaging to the organism (Siji Thomas and Abbas Mohaideen, 2015). Copper (Cu) is essential to human life and health but, like all heavy metals, is potentially toxic as well as continued inhalation of Cu containing spray is linked with an increase in lung cancer among exposed worker (Ramesh & Thirumangai, 2014). Lead poisoning has been recognized as an occupational illness for centuries and it is linked with both severe and subtle health damages. Ennore receives pollution through Point and non-point source from North Chennai Thermal Power Plant, Ennore port activities, Manali Petrochemical Industries, other nearby industries and untreated urban wastes from Chennai metropolitan. Exposure to heavy metals can also affect reproduction efficiency of aquatic biota and can lead to gradual extinction of their generations in polluted waters (Sridhara *et all*., 2008). Diffusion of metal to a sink located below the sediment-water interface can occur if dissolved metal concentrations are higher in the water column than in pore waters this can create subsurface peaks in sedimentary metals that could be erroneously attributed to variations in metal deposition (Usha Natesan and Ranga Rama seshan 2009). Ennore estuary was one of highly polluted estuary due to heavy industrialization and the improperly treated effluents ultimately reached through. Ennore bar mouth and finally enter into the Bay of Bengal (Padmini *et all*., 2009). In the present study were assessing that the quality of water and fish sample by analyzing metal concentration in collected sample.

2.0 MATERIALS AND METHODS

Study area: Ennore is situated on a peninsula and is bounded by the Korttalaiyar River, Ennore creek and the Bay of Bengal. The creek separates Ennore from the Ennore Port ($13^0$12’5’N $80^0$18’42”E). Ennore creek carries a high load of heavy metals. The treated effluents of the Madras Refinery Ltd., through the Buckingham canal and the Madras Fertilizers Ltd. 14-16, through the Red Hills surplus channel, reach the Ennore backwater.

Sample collection: Water samples were collected from different sampling stations. The sampling was done during morning hours between 7 am to 9 am using polythene bottle regularly every month interval. After collection, the sample was immediately transferred to laboratory for further analysis of various physico chemical properties, pH and salinity was measured in the time field itself. The remaining parameter such as appearance, Colour, Odour, Turbidity, Conductivity, Total Dissolved Solids, Iron, Total Hardness as Calcium, Non Carbonate Calcium, Alkalinity to Methyl Orange, Alkalinity to Phenopthalein, Magnesium, Sulphate, Chloride, Sodium, Total Suspende Solids, Heavy Metals, Mercury, Chromium, Selenium, Microbial limit tests Copper were analyzed in the laboratory by using standard methods as prescribed by BIS (Bureau of Indian Standard IS 10500, 2012) and APHA (2005).

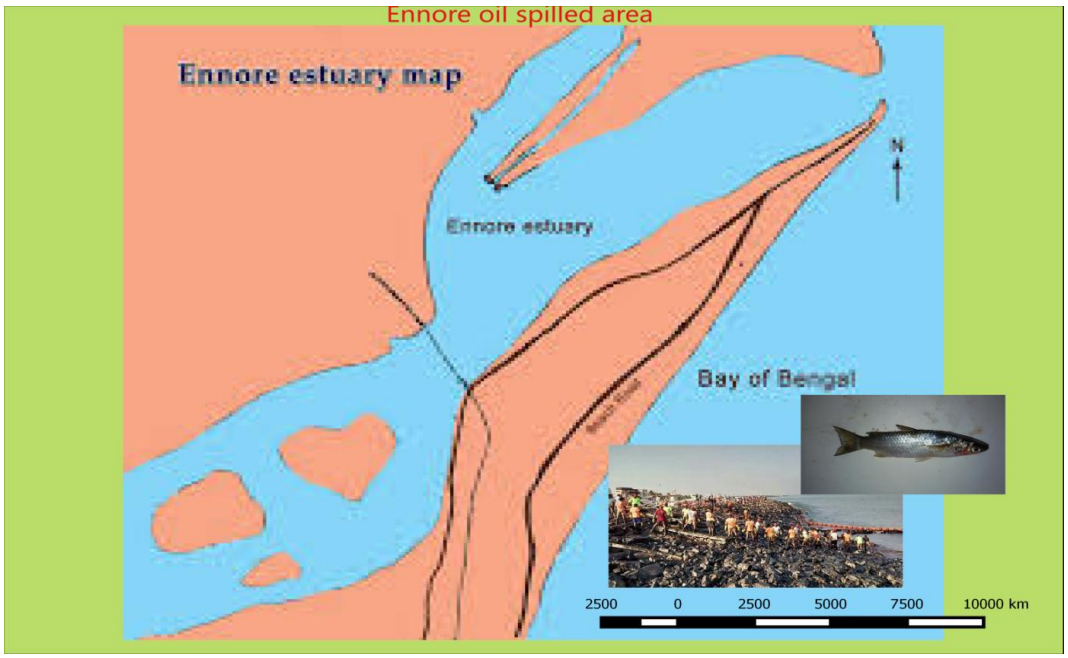

Figure 1: Location of sample collection.

Sample collection for heavy metal: Fish samples of *Mugil cephalus* were collected from oil spilled area. Samples were frozen well until used. After reaching the laboratory, total length and weight were measured for each fish and classified into groups. Fish was dissected out and separated the fish organs (muscle, liver, gills, and intestines) and from each organ 2 g were taken as analytic sample and digested by HNO3 inside closed teflon crucible and a hot plate with thermostatic control according to Oregioni and Aston (1984). The digested tissues were dissolved in a known volume of metal free distilled water and preserved in acid-clean PVC

bottles for analysis. Concentrations of the metals (Fe, Mn, Cu, Zn and Cd) were determined using a Perkin Elmer 28301 flame atomic absorption Spectrophotorneter (USP, 2012).

RESULTS AND DISCUSION

Water analysis: To find out the quality of water and fish sample from oil spill collided area (Bharathi Nagar near at Ennore estuary) the water sample and fish sample were collected and transported to the laboratory. There the physico- chemico parameter including heavy metal range were measured such as Colour (colourless), pH (7.91), Odour (Odourless), Turbidity (5NTU), Conductivity (51.6 macro Siemens), Total Dissolved Solids (25,555ppm), Iron (140.5 ppm), Total Hardness as Calcium (235.7ppm), Non Carbonate Calcium (1350.8ppm), Alkalinity to Methyl Orange (0.4 ml of 0.1M Naoh is required), Alkalinity to Phenopthalein (0.5 ml of 0.1M Naoh is required), Magnesium (1567.8ppm), Sulphate (4563.7ppm), Chloride (6704.8ppm), Sodium (880.45ppm), Total Suspended Solids (245.6ppm), and Heavy Metals are, Mercury (0.45ppm), Chromium (2.32ppm), Selenium (9.17ppm), Copper (0.03ppm). Out of the derived parameter result elucidated that the concentration of chloride level was high 6,704 ppm, and TDS 25,555 in collected water sample from oil spilled area. The chloride and TDS level shows that water become polluted due to some anthropogenic activity was continuing in the near coastal area.

Heavy metal in fish sample: The heavy metal ranges was anaylsed in different parts of mullet fish from selected sampling area. The level of mercury in fish organ was in wet liver 0.867ppm > gill (0.423 ppm) > wet muscle (0.350 ppm) > fried muscle (0.340 ppm) > intestine (0.147 ppm). Led concentration in fish parts were 2.447 ppm > 1.317 ppm> 0.463 ppm > 0.337 ppm > 0.193 ppm in fried muscle, liver, intestine, gill and tissue respectively. The range of cadmium concentration were 0.533 > 0.430 ppm> 0.317 ppm > 0.223 ppm > 0.150 ppm in gill, fried tissue, intestine and wet tissue respectively. The arsenic range was 1.22 ppm > 1.030 ppm > 0.863 ppm > 0.373 ppm > 0.313 ppm in intestine, fried tissue, wet tissue, liver and gill respectively. The chromium range was 1.333 ppm > 0.660 ppm > 0.557 ppm > 0.540 ppm > 0.307 ppm in liver, intestine fried tissue, gill, and tissue respectively. The copper range was 0.327 ppm > 0.243 ppm > 0.227 ppm > 0.153 ppm > 0.130 ppm, in tissue, fried tissue, intestine, liver, and gill respectively. The nickel range was in nil in all fish organs. The selenium range was 6.550 ppm and 5.850 ppm in wet tissue and fried tissue remaining metal was unidentified.

Table 1: Physico –chemicao parameter in selected sampling area at Bharathi nagar coast near at Ennore port.

S.No	Colour	Colorless
1.	pH	7.91
2.	Odour	Colorless
3.	Turbidity NTU	5
4.	Conductivity macro siemens	51.6
5.	Total Dissolved Solids ppm	25,555
6.	Iron ppm	140.5
7.	Total Hardness as Calcium ppm	235.7
8.	Non Carbonate Calcium ppm	1350.8
9.	Alkalinity to Methyl Orange	0.4 ml of 0.1M Naoh is required
10.	Alkalinity to Phenopthalein	0.5 ml of 0.1M Naoh is required
11.	Magnesium ppm	1567.8
12.	Sulphate ppm	4563.7
13.	Chloride ppm	6704.8
14.	Sodium ppm	880.45
15.	Total Suspende Solids ppm	245.6
16.	Heavy Metals ppm	
17.	Mercury ppm	0.45
18.	Chromium ppm	2.32
19.	Selenium ppm	9.17
20.	Microbial limit tests ppm	
21.	Copper	0.03

Table 2: Concentrations of Heavy Metal in fish caught from different locations (mg/Kg).

Metals USEPA	Liver	Intestine	Gill	Tissue	Fried Tissue
Mercury(Hg)	**$0.867\pm0.045_a$**	$0.147\pm0.031_d$	$0.423\pm0.025_b$	$0.350\pm0.030_c$	$0.340\pm0.030_c$
Lead (Pb)	$1.317\pm0.025_b$	$0.463\pm0.031_c$	$0.337\pm0.025_d$	$0.193\pm0.025_c$	**2.447±0.015a**
Cadmium(Cd)	**$0.533\pm0.025_a$**	$0.223\pm0.015_d$	$0.430\pm0.020_b$	$0.150\pm0.010_e$	$0.317\pm0.015_c$
Arsenic(As)	$0.373\pm0.015_d$	**$1.220\pm0.020_a$**	$0.313\pm0.025_e$	$0.863\pm0.025_c$	$1.030\pm0.020_b$
Chromium (Cr)	**$1.333\pm0.021_a$**	$0.660\pm0.020_b$	$0.540\pm0.020_c$	$0.307\pm0.015_d$	$0.557\pm0.032_c$
Copper (Cu)	$0.153\pm0.015_c$	$0.227\pm0.015_b$	$0.130\pm0.020_c$	**$0.327\pm0.015_a$**	$0.243\pm0.021_b$
Nickel (Ni)	0.000±0.000	0.000±0.000	0.000±0.000	0.000±0.000	0.000±0.000
Selenium (Se)	0.000±0.000	0.000±0.000	0.000±0.000	**$6.550\pm0.599_a$**	$5.850\pm0.382_b$

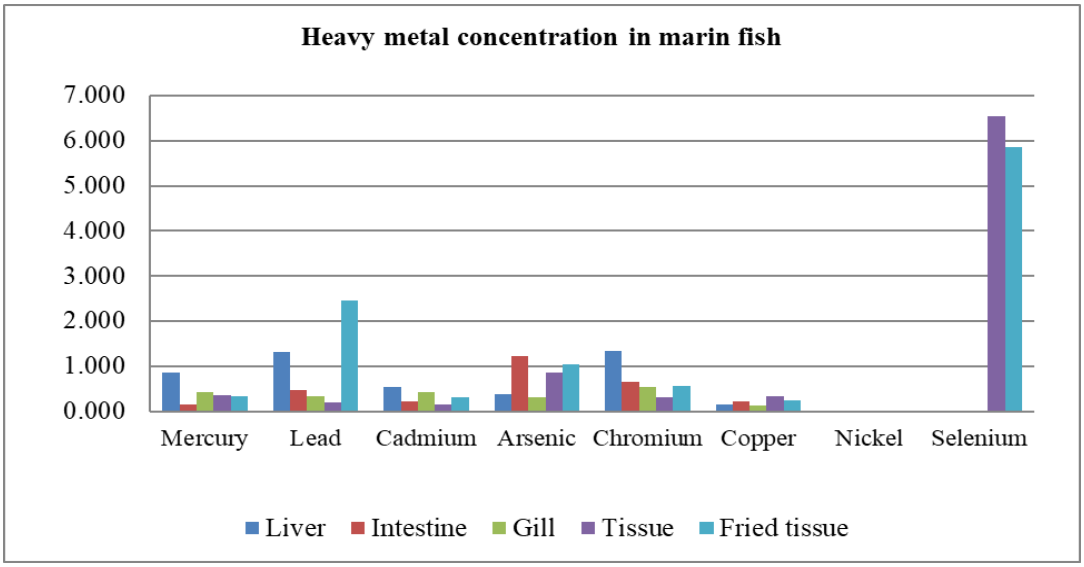

Fig. 1: Heavy metal concentration in fish organ *Mugil cephalus.*

Table 3: Heavy metal concentrations in certified reference material (IAEA 407 and IAEA 436 in fish tissue) from the International Atomic Energy Agency, Vienna, Austria.

Elements	IAEA 407Certified value(µg/g)	IAEA 436Certified value(µg/g)	Present level
Cd	0.19	0.05	0.150-0.533
Cr	0.73	0.19	0.307-1.33
Cu	3.3	1.7	0.130-0.327
Fe	146	89	-
Hg	0.22	4.2	0.340-0.867
Ni	0.60	0.07	BDL
Pb	0.12		0.193-2.447
Zn	67	19	-
As		3.5 (Canadian Food Inspection Agency)	0.313-1.220
Se		2(FAO)	5.850-6.550

Among the different parts of fish organ the metal range was differed based on adsorption capacity of fish and source available in marine water. The accumulation of heavy metals in fish species varies with the species of different aquatic environments (Shanthi and Ramanibai, 2011). The highest level of mercury (0.867) were seen in liver, lead (2.447) in fried tissue, cadmium (0.533) in liver, arsenic (1.220) in intestine, chromium (1.333) in liver, copper (0.327) in tissue, nickel unidentified, selenium (6.55) in tissue. High level of mercury, cadmium chromium, and lead, copper selenium were seen in liver and tissue respectively. High accumulation of metals in liver portion may also be due to the difference in physiological functions of muscle and liver. Thus, the liver is often recommended as a target

tissue in aquatic environments (Unlu *et al*., 1996). Overview of derived result shows that all the metals are above the permissible limit based on IAEA (International Atomic Energy Agency) report. Jebitta *et all*., (2014) reported that higher concentration of Cr presented at the Ennore estuaries are mainly due to the industrial effluents, domestic waste, iron and steel industries which contains large amount of organic particles. Also in previous report the heavy metal range in sediment of Ennore estuary was within permissible limit such as Zn Cu Ni Cr Pb except Cd. (Chitrarasu *et al*., 2013). Earlier studies by Rajkumar et al., 2008 had revealed the concentrations of Cd, Cu, Zn and Pb above the permissible limits in the Ennore estuary. Ramanibai *et al*., 2012 has also recorded a higher concentration of Pb, Cd, Zn, Ni, Co and Cu in Ennore. The maximum concentration of Arsenic (0.034 mg/l), and Chromium (0.063 mg/l) were observed in water sample from Ennore estuary (Siji Thomas and Mohaideen. 2014).

CONCLUSION

Heavy metals of anthropogenic origin are generally introduced into the environment as inorganic complexes or hydrated ions, which are easily adsorbed on surfaces of sediment particles through relatively weak physical and chemical bonds (Forstner 1989; Horowitz, 1985). Based on the review reference and current result shows that fish organ such as liver have been affected with more concentration of heavy metal may be due to industrial effluent surrounded by Ennore Coast region. So these fishes are may not be fit for human consumption. And further treatment is required to avoid the untreated water released in marine source.

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