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Heavy Metals Accumulation in Five Commercially Important Fishes of Parangipettai, Southeast Coast of India

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Abstract: Investigations on the accumulation of heavy metals five of the most commercially important fishes in the Parangipettai coastal waters were selected and analyzed for the Zn, Pb, Cr, Co and Cd concentrations in the muscles. The results revealed that the Cr and Zn concentrations were the highest; followed by Pb<Cd<Co being the lowest in the five species of fish tissue. The muscle concentrations of Cr, Zn, Pb, Cd and Co ranged from 0.415±0.27-1.168±1.49, 0.103±0.14-0.807±0.13, 0.114±0.14 and 0.006±0.00-0.014±0.00 ppm respectively. A significant species-specific difference was not found. The *Anchoviella commersonii* contained higher muscle concentrations of Cd, Co and Pb than the other species of fishes. However, the *Upeneus vittatus* contained the highest concentrations of Zn and lowest concentration of most of the metals. The metal concentrations found in this study were similar to the metal levels of the fishes collected from pitchavaram mangroves and mudasalodai landing center. Therefore, no public health problem would be raised in the consumption of the fishes.

Key words: Heavy metals, fishes, muscle and parangipettai

INTRODUCTION

Due to industrialization, the number of factories and population has increased rapidly. Massive amounts of domestic wastewater and industrial effluents are transported by rivers and discharged into the sea, contaminating rivers and coastal waters. Such anthropogenic pollutants are the main sources of heavy metal contaminants in the ocean. These contaminants entering the aquatic ecosystem may not directly damage the organisms; however, they can be deposited into aquatic organisms through the effects of bioconcentration, bioaccumulation and the food chain process and eventually threaten the health of humans by seafood consumption. Metals may occur in the environment as hydrated ionic species or they may form a variety of complexes with inorganic and organic ligands (VanLoon, 1977). Water they occur as complex and diverse mixtures of soluble and insoluble forms such as ionic species, inorganic and organic complexes and/or associated with colloids and suspended particulate matter. Measuring heavy metals in aquatic organisms may be a bioindicator of their impact on organism and ecosystem health (Krishnakumar *et al*., 1994). The natural concentrations of these metals in sea water are very low and hence the risk of contamination in living tissue is high. Industrial effluent is one of the prime sources of metal contamination in coastal waters and the Bay of Bengal is no exception (Mitra and Choudhury, 1993). Lead, Zinc, Copper, are scavenged element with typical residence times and a profile of surface maxima, concentration decreasing with depth. Lead an ubiquitous pollutant finds its way into the sea through industrial waste water, discharged by industries such as printing, dyeing, oil refineries etc These heavy metals, being conservative in nature have the maximum probability of biomagnification, when they are transferred to the human beings through the various members of different trophic levels in the marine food chain. With this background, edible fish samples were collected from Parangipettai in order to evalute the degree of contamination. This surveyed area not only supports a flourishing tourism industry and a few aquacultural farms.

Description of the Study Area: The study area was a coastal town Parangipettai station (Lat. 11º30'N; Long. 79º6' E): This station is situated at the mouth of the Vellar estuary in the marine zone, near Annankoil fishing hamlet. The Vellar Estuary is a highly productive estuary located at Porto novo originated at Servarayan hills in Salem Dist, Tamil Nadu flows over a distance of 480km, forming an excellent estuarine system at Porto novo before it drains into the Bay of Bengal (Fig. 1).

MATERIALS AND METHODS

Five fish species were purchased from local fishermen at the Annancoil landing centre at Parangipettai in April, 2009. In the present study accumulation of metals such as Cobalt, Zinc, Cadmium, Chromium, Lead

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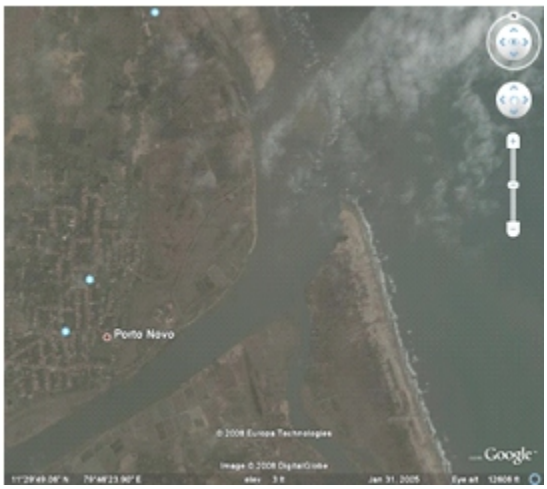

Fig. 1: Showing the study area

were estimated in the tissue of *Upeneus vittatus* (Yellow striped goat fish) *Anchovilla commersonii* (White bait) *Pomadasys maculates* (Spotted grunter) *Lutjanus adetii* (Yellow banded sanpper) *Ambassis commersoni* (Glassy perchlet). After identifying the species, samples were immediately kept in pre cleaned polythene bags, which were sealed and kept in an ice box until further analysis in the laboratory. The soft tissue was removed and dried at 60ºC. The dried tissue was reduced into fine powder in a pestle and mortar and the resulting powder was selected, using a plastic sieve with 0.2 mm opening size and was stored in dessicator for further analysis. To estimate the trace metal content (Co, Zn, Cd, Cr and Pb) samples were digested (1 g) with conc. HNO_3 and conc. $HClO_4$ (4:1) and analysed in optical emission spectrophotometer (optima 2100DV) (Topping, 1973). The values were expressed in ppm.

RESULTS AND DISCUSSION

India's extensive coastline of about 7515 km is a potentially unique fishery resource that currently contributes to about 90% of total annual marine fish landings of the country. However due to rapid industrialization and urbanization of the adjacent cities and towns, a negative impact is often exerted on this highly productive ecosystem (Mitra, 1998). Heavy metals have the tendency to accumulate in various organs of marine organisms, especially fish, which in turn may enter into the human metabolism through consumption causing serious health hazards (Puel *et al*., 1987).

Hence the present study was undertaken to evaluate the metal concentrations in the fish samples. The analysis of the selected metals in the present study revealed an order of Cr<Zn<Pb<Cd<Co in almost all the species. Accumulation of metal in different species is the function of their respective membrane permeability and enzyme system, which is highly species specifics and because of this fact different metals accumulated in different orders in different fish samples (Table 1).

Zinc in the fish samples accumulated in the order *Upeneus vittatus* < *Pomadasys maculates* < *Ambassis commersoni*< *Lutjanus adetii* < *Anchoviella commersonii.* The high concentration of zinc in the muscles of the fish samples is mainly due to the presence of a large number of fishing vessels and trawlers which use galvanized metal coatings to prevent rusting, that ultimately find it's way into the ambient media through leaching. The high Zn concentration in gonads was because Zn is a necessary element for embryo development and is important to reproductive organs (Carpene *et al*., 1994).

Lead accumulated in the order *Anchoviella commersonii* < *Ambassis commersoni*< *Pomadasys maculates* < *Lutjanus adetii* < *Upeneus vittatus.* The extremely high values of lead in the samples indicate that the environment is highly stressed with respect to lead.

Chromium accumulation showed the order as *Pomadasys maculates*<*Anchoviella commersonii* < *Ambassis commersoni*< *Lutjanus adetii* < *Upeneus vittatus.*

Cadmium accumulatedin the order of *Anchoviella commersonii* < *Ambassis commersoni*< *Upeneus vittatus* < *Pomadasys maculates* < *Lutjanus adetii*. Although Cd is a toxic element that would deposit in human body and is danger to human health (Pourang, 1995). The concentration in fish meats in the study were far lower than the consumption safety tolerance in fish set by countries elsewhere. The daily intake (<0.315 µg/g) was lower than the acceptable daily intake set by WHO/FAO (1989).

Cobalt in the samples was in the order of *Anchoviella commersonii* < *Upeneus vittatus* < *Pomadasys maculates* < *Lutjanus adetii* < *Ambassis commersoni*. The profile of Cadmium, Zinc and lead in tissues of finfishes were studied in the inshore waters of cochin and found that cadmium (0.58 ppm), Zinc (35 ppm) and Lead (0.62 ppm) and it is higher than the present study (Kaladharan *et al*., 2005). Nine species of the most commonly found fishes in the Ann-Ping coastal waters, were selected and analyzed for the Zn, Cd concentrations in the muscles.

Table 1: Trace metal concentrations and related statistical parameter for various samples of fish # Mean ± SD

S/no.	Metals	*Upeneus vittatus*	*Anchovilla commersonii*	*Pomadasys maculates*	*Lutjanus adetii*	*Ambassis commersoni*
1	Cd	0.008±0.00	0.114±0.14	0.006±0.00	0.004±0.00	0.012±0.01
2	Co	0.009±0.00	0.014±0.00	0.008±0.00	0.008±0.00	0.006±0.00
3	Cr	0.415±0.27	1.168±1.49	1.562±1.56	0.467±0.14	1.146±1.25
4	Zn	0.807±0.13	0.103±0.14	0.282±0.12	0.225±0.14	0.245±0.16
5	Pb	0.062±0.00	1.569±1.41	1.066±1.49	0.861±0.14	1.264±1.48

The muscle concentrations of Zn, Cd ranged 4.00-7.28, 0.20-0.83 μg/g wet weight respectively and the present study showed slightly lower accumulation (Chen and Chen, 2001). Tuna fish caught by commercial vessels from the coasts of the Kingdom of Saudi Arabia were analysed for Pb, Cd and Cr concentrations. The mean recoveries for Pb, Cd and Cr were 98.8, 99.2 and 98.6% respectively (Ashraf, 2006).

CONCLUSION

The run-off from the adjacent landmasses during monsoon is also an important factor behind high metal levels in the fish tissues Sea fishes being one of the major exportable items need constant monitoring with respect to heavy metal concentrations in order to maintain a standard quality. The Zn, and Chromium concentrations in some fish species were higher than the limitations set by some countries; however, since muscle was the major consuming portion, and that massive internal organs were rarely consumed, there should not be any health threat to the public resulting from the consumption of fish meat.

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