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TRACE METAL CONCENTRATIONS IN CERTAIN FISHES FROM THE NAGAPPATTINAM COAST OF TAMIL NADU

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ABSTRACT

Bioaccumulation pattern of metals (iron, zinc, copper, lead and cadmium) in the muscles of certain fishes [*Tilapia mossambica* (F1), *Sardinella brachysoma* (F2) and *Mugil cephalus* (F3)] were studied and it were collected from the landing centre of Nagappttinam, Tamil Nadu was studied during May and June months 2015. These metal concentrations were measured by Atomic Absorption Spectrometer (AAS) in order to find the source of pollution. The average trace metal levels in fish are follows. In the May, the mean metal concentrations such as Cd, Cr, Cu, Fe, Ne Pb and Zn were 0.15, BDL, 0.32, 2.32, 0.03, 0.15 and 1.25 mg l^{-1} while in the June season, mean Cd, Cr, Cu, Fe, Ne Pb and Zn concentrations were 0.12, BDL, 0.25, 1.76, 0.02, 0.12 and 1.27 g kg^{-1}, respectively. The metal accumulation in the fishes were higher (1-5 folds) in the May month than the June month samples. The level of trace metal decreased orders were: *Sardinella brachysoma* (F2) > *Tilapia mossambica* (F1) > *Mugil cephalus* (F3). A competent monitoring programme is an essential adjunct to any attempt of managing the coastal areas in an ecologically sound and sustainable manner.

KEY WORDS: *Sardinella brachysoma,* Trace metals, Nagappttinam, Bioaccumulation.

INTRODUCTION

The health status and the biological diversity of the Indian coastal ecosystems are deteriorating day by day through man-made activities and dumping of enormous quantities of sewage into the coast has drastically reduced the population of the aquatic biota. Heavy metals are considered to be the hazardous inorganic and organic pollutants in the coastal environment. Heavy metals may enter an aquatic environment from different natural and anthropogenic sources, including industrial or domestic sewage, storm runoff, leaching from landfills, shipping and harbor activities and atmospheric deposits. Bioaccumulation of heavy metals in tissues of marine organisms has been identified as an indirect measure of the abundance and availability of metals in the marine environment (Kucuksezgin et al., 2006). The trace metals has also caused considerable ecological imbalance and resulted in the large-scale disappearance of their flora and fauna. Further, introduction of untreated municipal waste-water, industrial effluents into these water bodies leads to serious water pollution including heavy metal pollution, which gets biomagnified and reaches man through food-chain implications (Arunkumar and Hema achyuthan, 2007).

Heavy metals can be accumulated by marine organisms through a variety of pathways, including respiration, adsorption and ingestion (Turkmen et al., 2008). Seafood especially marine fish are vulnerable to the effects of chemical contaminants including heavy metals which bioaccumulate and biomagnifies along the aquatic food chain (Agusa et al., 2007). These toxic elemental contaminants cause unhealthy effects to the fish and are transferred into human metabolism through consumption of contaminated fish that leads to serious deterioration of human health status (Alinnor and Obiji, 2010). The Indian shore line was highly vulnerable and it was highly contaminated by various human activities. In which, the Tamil Nadu state’s 216,000 tonne of marine landings in 1980’s constituted about 15% of India’s total marine catch and 57% of the state’s total (376,000 tonne) fish landings from both inland and marine sources. The proportions of pelagic and demersal fish in the marine landings are nearly equal (DSSF-BBP, 1983). About 1 million people earn their livelihood directly from fisheries. Fish is the principal source of animal protein. Tamil Nadu is India’s third largest fish exporting state (Vignesh et al., 2012a).

The primary objectives of this research is to study the concentration of trace metal levels in an edible fishes from Nagappattinam coastal region in two months and create the awareness against the improper discharges of waste to the coastal regions without any sort of treatment.

MATERIALS AND METHODS

Sampling and processing

The marine edible fish samples [*Tilapia mossambica* (F1), *Sardinella brachysoma* (F2) and *Mugil cephalus* (F3)] were collected from Nagappattinam coast of southern India in May and June 2015. The Nagappattinam station was choosed for its severe anthropogenic impacts on coastal regions like fishing, harbor activities, pilgrims and regular visit/ recreational purposes (Vignesh et al., 2014, 2015). And also Nagappattinam is one of an important fishing harbor in the Cauvery delta regions (Vignesh et al., 2012a). The Tamil Nadu coastal regions were highly congested and received more waste from the coastal slum (Vignesh et al., 2012b). The Cauvery delta regions were affected by severe anthropogenic activities (Vignesh et al., 2013). All the samples were kept in iceboxes and transported to laboratory immediately. Marine fish samples were cut into small pieces and air-dried properly. Thereafter, the dried fish samples were crushed by agate mortar and pestle. The one gram of each fish samples were treated with aqua-regia mixture (i.e. HCl: HNO_3= 3:1) in Teflon bomb separately and were incubated at 140 °C for 2-3 days. After incubation, the reaction mixture was filtered with Whatman No.1 filter paper. The trace metals in the sea water, sea sediment and crab samples were determined by the atomic absorption spectrophotometry (GBC SensAA - AAS, Australia) in flame mode.

RESULT AND DISCUSSION

The study of heavy metal concentrations in fishes was important with respect to human consumption of fish. Fish is among the dominant bio indicator species used for acute toxicity assay of pollutants such as heavy metals since much attention has been drawn due to the wide occurrence of metal pollution in aquatic system. The average trace metal levels in fish are follows. In the May, the mean metal concentrations such as Cd, Cr, Cu, Fe, Ne Pb and Zn were 0.15, BDL, 0.32, 2.32, 0.03, 0.15 and 1.25 mg l^{-1} (Figure 1) while in the June season, mean Cd, Cr, Cu, Fe, Ne Pb and Zn concentrations were 0.12, BDL, 0.25, 1.76, 0.02, 0.12 and 1.27 g kg^{-1}, respectively (Figure 2). In this study, the level of all metal concentration is high in May month than June month. Interestingly, the nil Chromium (Cr) level was observed in all the fishes at both months. Similar results was observed in the case of Nickel except F1 in both month. The mean concentrations of heavy metals analyzed in the muscle of the flying fishes were well below the maximum permitted concentrations proposed by FAO (1983). Food and Agricultural Organization limits, 0.5 mg/kg for Cd and Pb, 30 mg/kg for Cu and Zn (FAO, 1983 and for Fe 100 µg/g (WHO, 1989). For an average adult (60 kg body weight), the provisional tolerable daily intake (PTDI) for Pb, Fe, Cu and Zn are 214 µg, 48, 3 and 60 mg, respectively (Jayaprabha et al., 2014). In the present study, the level of few trace metals were crossed the standard level in both months at all the three samples.

In May month, the Cd and Pb level in F1, F2 and F3 samples were 0.15, 0.18 and 0.12, and 0.18, 0.12 and 0.16 g/kg respectively. Cd and Pb are among the aquatic metal pollutants which usually present at significant level in water system which may pose high toxicities on the aquatic organisms (Agusa et al., 2007). Fe, Zn and Pb levels in the fishes collected from Cuddalore was higher than the levels reported by Thiyagarajan *et al.* (2012), 0.24 ± 0.42, 1.83 ± 0.44 and 0.07 ± 0.01 respectively, but Cd and Cu levels are lower than the reported level (0.35 ± 0.71 and 3.26 ± 0.87). The present results are also indicate the Tamil Nadu coastal zone were severely affected by different contaminants. The nutritive values of fish depend upon their biochemical composition, such as protein, amino acids, lipid, fatty acids, carbohydrate, vitamins and minerals. Due to the accumulation of toxic metals on the fish muscle, the nutrition level has gradually reduced (Turkmen et al., 2008). This will be transferred from one marine animal to other through several ways. This study has enlightened the fact the persistent pollutants like metals should be regularly monitored and any variation from the normal distributional pattern can furnish an idea about the proper management of the coastal area.

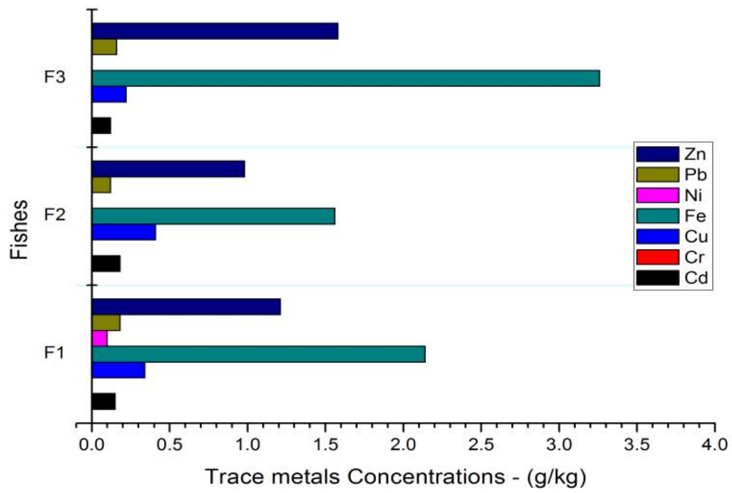

Figure 1. Trace metal concentrations on certain fishes at May month in Nagappattinam coast.

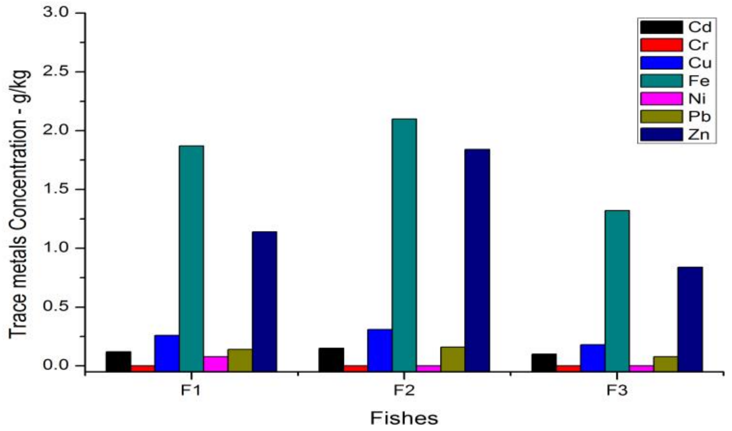

Figure 1. Trace metal concentrations on certain fishes at June month in Nagappattinam coast.

CONCLUSION

Health risk analysis of heavy metals in the edible parts of the fish indicated safe levels for human consumption and concentrations in the muscles are generally accepted by the international legislation limits. The excess levels of heavy metals cause severe toxicity. In this study, some of the metals were crossing the limits and the level of all metal concentration were high in May month than June season. Among the three fishes, *Sardinella brachysoma* (F2) observed high level of trace metals from the marine sources than the other fishes. The high bioaccumulation of trace metals is indicated that the sampling station drained rigorous anthropogenic input of bioaccumulative contaminants into the aquatic environment.

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REFERENCES

1. Agusa, T., Kunito, T., Sudaryanto, A., Monirith, I., Kan Atireklap, S., Iwata, H., Ahmad, I., Sanguansin, J., Muchtar, M., Tana, T. S. and Tanabe, S. Exposure assessment for trace elements from consumption of marine fish in Southeast Asia. Environment Pollution, 2007; 145: 766-777.
2. Alinnor, I. J. and Obiji, I. A. Assessment of trace metal composition in fish samples from Nworie river. Pakistan Journal of Nutrition, 2010; 9(1): 81-85.

3. Arunkumar, K. and Hema achyuthan, Heavy metal accumulation in certain marine animals along the East Coast of Chennai, Tamil Nadu, India. Journal of Enviornmental Biology, 2007; 28(3): 637-643.
4. Development of small-scale fisheries (DSSF). Marine small-scale fisheries of Tamil Nadu: A general description. Publisher - Bay of Bengal Programme (BBP), FAO, 91, St. Mary's road, Abhiramapuram, Chennai - 600 018, India. Amra press, 1983; Chennai – 600 041: 1–53.
5. FAO. Compilation of legal limits for hazardous substances in fish and fishery products. FAO Fisheries Circular, 1983; 464: 5-100.
6. Jayaprabha, N., Balakrishnan, S., Purusothaman, S., Indira, K., Srinivasan, M. and Anantharaman, P. Bioaccumulation of heavy metals in flying fishes along southeast coast of India. International Food Research Journal, 2014; 21(4): 1381-1386.
7. Kucuksezgin, F.A., O. Kontas, E. Altay and D. E. Uluturhan, Assessment of marine pollution in Izmir Bay; Nutrient heavy metal and total hydrocarbon concentrations. Environ. Int, 2006; 32: 41-51.
8. Thiyagarajan, D., Dhaneesh, K. V., Aijthkumar, T. T., Kumaresan, S. and Balasubramanian, T. Metals in Fish along the Southeast Coast of India. Bulletin of Environmental Contamination and Toxicology, 2012; 88: 582-588.
9. Turkmen, A., Tepe, Y. and Turkmen, M. Metal levels in tissues of the European anchovy, Engraulis encrasicolus L., 1758, and picarel, Spicara smaris L., 1758, from Black, Marmara and Aegean Seas. Bulletin of Environmental Contamination and Toxicology, 2008; 80(6): 521-525.
10. Vignesh S, Hans-Uwe Dahms, Kumarasamy P, Rajendran A, Arthur James R. Microbial effects on geochemical parameters in a tropical perennial river basin. Environmental Processes, 2015; 2: 125-144.
11. Vignesh S, Hans-Uwe Dahms, Muthukumar K, Santhosh Gokul M, Emmanuel KV, Arthur James R. Physicochemical parameters aid microbial community? A case study from marine recreational beaches, southern India. Environmental Monitoring and Assessment, 2014; 186(3): 1875–1887.
12. Vignesh S, Muthukumar K and Arthur James R. Antibiotic resistant pathogens versus human impacts: a study from three eco-regions of the Chennai coast, southern India. Marine pollution bulletin, 2012; 64: 790–800.

13. Vignesh S, Muthukumar K, Santhosh Gokul M and Arthur James R. Microbial pollution indicators in Cauvery river, southern India. Springer: On a sustainable future of the earth's natural resources, 2013; 363–376.
14. Vignesh S. 2012a. Human impacts on coastal environment in southeast coast of India. Ph.D. Thesis submitted to Bharathidasan University, Tiruchirappalli.
15. WHO, 1989. Heavy metals environmental aspects, Environment Health Criteria No. 85. Geneva, Switzerland.