WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 7.523
Volume 7, Issue 1, 600-606. Research Article ISSN 2277– 7105

SEASONAL VARIATIONS OF MERCURY IN EDIBLE TISSUES OF LABIO ROHITA AND CATLA CATLA

Geeta Singh*

School of Chemical Sciences, Department of Chemistry, St. John's College, Agra.

Article Received on
30 October 2017,
Revised on 20 Nov. 2017,
Accepted on 10 Dec. 2017
DOI: 10.20959/wjpr20181-10358

***Corresponding Author**
Geeta Singh
School of Chemical Sciences, Department of Chemistry, St. John's College, Agra.

ABSTRACT

Mercury is a toxic heavy metal which is widely dispersed in nature. Fish are a valuable source of high-grade protein and nutritious component of the human diet and occupy an important position in the socio-economic conditions of south Asian countries. Fishes have a natural tendency to concentrate mercury in their bodies, often in the form of methyl mercury, a highly toxic organic compound of mercury. The two most commercially important fresh water fish species namely; Labio *rohita* and Catla *catla* were collected from different fish markets of Agra city and analyzed for the Mercury concentration. The present study is undertaken to gauge the accumulation of Mercury in tissues of Labio *rohita* and Catla *catla* seasonally. The metal concentration was evaluated using a Perkin Elmer AA analyst 100 atomic absorption spectrophotometer. Wet digestion method was used for analysis of metals with nitric acid and sulfuric acid. The heavy metal concentrations ranges of Hg detected in Labio *rohita* and Catla *catla* were 0.01-32.0 and 0.01-23.0 μg kg^{-1}respectively. The frequency of heavy metal contamination was higher in Labio *rohita* followed by Catla *catla*. Similar trend of seasonal variation in metal concentrations were observed in both the species. The highest concentrations were observed in summer followed by winter and rainy seasons. The present study showed that the levels of mercury are different in both the fish species but within the maximum residue levels recommended at National and International standards.

KEYWORDS: Heavy metals, mercury, Seasonal variation, fish.

INTRODUCTION

Fishes are valuable source of high-grade protein, form nutritious component of the human diet and occupy an important position in the socio-economic conditions of South Asian

countries. Heavy metals from natural and anthropogenic sources like atmospheric precipitation, wastewater, industrial discharge are released into aquatic ecosystems, where they pose a serious threat to living beings because of its toxicity, long persistence, bioaccumulation and biomagnifications in the food chain (Kucykbay and Orun 2003; Pourang et al. 2005). A lot of studies have been published on the heavy metal levels in the aquatic environment (Rashed 2001; Canli and Atli 2003; Demirak et al. 2006; Farkas et al. 2003; Karadede et al. 2004; Velcheva 2006; Yilmaz, 2006). Mercury is globally well-distributed environmental heavy metal pollutant released from natural and anthropogenic sources. Once they are released into the environment, they circulate between air, water, soil, and biota in various forms. When deposited in the biota, mercury undergoes biotransformation, in which inorganic mercury may convert into organic mercury (methyl mercury). (Altindag and Yigit, 2005). Episodes such as Minamata have been linked to mercury poisoning in human with the consumption of fish. Environmental pollution by heavy metals as a result of rapid industrialization has been reported by researchers in different part of India and world (Chakraborty R, 2003). Considering the importance of fish in the human diet, consumption of significant amounts of contaminated fish could pose a significant threat to human health. Hence, the present study was proposed to monitor the seasonal variations of mercury in edible tissues of two fresh water fish species namly, Labio *rohita* and Catla *catla* of Agra region, keeping in view of public health significance of metal residues, safety of consumers and legal restrictions on export.

MATERIAL AND METHOD

The study was conducted in Agra, the city of Taj, one of the seven wonders, (latitude 27^0 10′ N and longitude 78^0 5′ E) which is located in the North central part of India. Information available from different fish dealers indicates that fresh water fishes available in Agra markets are brought from river Yamuna and its tributaries.

Wet digestion method was used for the analysis. All reagents like Sulfuric Acid (H_2SO_4), Nitric acid (HNO_3) and Hydrogen peroxide used were of analytical grade purchased from E. Merck (India) Ltd, India. Certified reference material of mercury procured from the National Physical Laboratory, New Delhi. Fresh samples were purchased from commercial fishery market of Agra. 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 oven dried to remove moisture and was crushed

with a mortar and pestle to fine powdery form. To estimate the metal content 5g.±0.1 of samples were digested with conc. HNO_3 and conc. H_2SO_4 (1:1). The completely digested sample were allowed to cool to room temperature, filtered with a Whatman filter paper (No.-1) and made up to 50 ml with double distilled water. The elemental analysis was carried out in a Perkin Elmer AA analyst 100 atomic absorption spectrophotometer as per standard conditions (Table-1).

Table 1: Working conditions for the analysis by atomic absorption spectrophotometer.

Heavy Metals	Wavelength (nm)	Slit (nm)	Detection Limit (mg/1)	Sensitivity (mg/1)	Linear Range	Gas	Support	Mode
Hg	253.7	0.7	0.001	0.077	5.0	Acetylene	Air	Absorption

Homogenized samples (5.0 ± 0.5 g) were spiked with three different concentrations (Table 2) of mercury for determination of recovery, each run in triplicate and blanks were carried through the whole procedure described above and recovery was found 94% to 103%.

Table 2: Recovery (%) of Hg residues obtained in fishes.

Sample wt. (g)	Spiked concentration mg/kg	Recovery concentration mg/kg	Recovery (%)
5.0±0.1	0.05	0.047	94
5.0±0.1	0.1	0.097	97
5.0±0.1	0.2	0.206	103

RESULTS AND DISCUSSION

Knowledge about heavy metal concentration in fish is important both with respect to nature management and human consumption. The mean values and standard deviations of mercury concentrations detected in the edible portion of the selected species of fish are shown in Table 3. To study the seasonal variation, sampling was carried out during winter, summer and rainy seasons. In the present study, mercury was observed high in both the fish species in summer followed by winter and rainy season.

Table 3: Concentration of Hg residues obtained in fresh water fishes (μg kg^{-1}).

Fish Species	Winter Season	Summer Season	Rainy Season
Labeo rohita	ND – 28.0 (11.0 ± 3.5)	ND – 32.0 (9.0 ± 4.5)	ND – 12.0 (7.0 ± 3.5)
Catla catla	ND – 11.0 (5.0 ± 3.1)	ND – 23.0 (11.0 ± 6.3)	ND – 13.0 0± 4.1)

- Metal Residues (μg kg^{-1})
- ND - Non detected
- Figures in parenthesis denote mean and standard deviation (SD)

- MRL of Hg –0.5 mg kg^{-1} (PFA)

In India, various researchers have determined the presence of toxic metals in Indian rivers. Prebha and Selvapathy (1997) have studied the status and trend of river water pollution and also Priyadarshani (1998) has reported the presence of zinc, copper, nickel, cadmium, lead, manganese, mercury, cobalt and iron in the Safi River. A monitoring study of fish and fish products from Ganga river (CIFT, 2006) showed that Yamuna have comparatively higher metal concentration in the Agra stretch of the river, due to heavy discharge of industrial effluents. In present study, Hg was detected below the tolerance limits recommended by National and International standard, the same result has been reported by Batvari et al (2007). The level of heavy metals in fishes varies with respect to different species depends upon its feeding habit, age, size and length of the fish and their habitats and different aquatic environments. Moreover, the affinity for metal absorption from contaminated water and food may differ in relation to ecological needs, metabolism and the contamination gradients of water, food and sediment, as well as other factors such as salinity, temperature and interacting agents. Ayyadurai and Krishnasamy (1989) reported mercury level ranged between 0.05 to 0.27 μg kg^{-1} in fish from the swamp contaminated with sewage and hospital wastewater at Madras, India, whereas Paul (1987) reported a mercury level of 0.13 to 0.20 μg kg^{-1} in 10 common edible fish species from the Stanley reservoir at Tamil Nadu, India. These data are similar to the range of mercury found in our study. When the results were compared with the findings of studies conducted abroad in the area of an uncontaminated environment, Mirlean et al. (2005) and Viana et al. (2005) reported similar patterns of mercury content (0.041– 0.117 μg kg^{-1} and 0.054–0.183 μg kg^{-1}, respectively) in fish.

Seasonal variation in metal has been well- documented in different studies from fresh water marine environment (Foster et al., 2000; Kargin et al., 2001; Eastwood and Couture. 2002). Seasonal variation was reported due to varying seasonal growth rate, reproductive cycle, water salinity and temperature. In present study, high metal concentration was observed during summer month in comparison to winter and rainy season, similar trend were observed in Mediterranean shrimp and Mediterranean fish (Alliot and Frenet- Piron, 1990). This can be explained by the fact that in the summer seasons, when the fresh water inflow in the estuary is largely anoxic, dissolved metal concentrations tend to be very low and the metal partitioning in those conditions favours adsorption to suspended particles and the sediments (Mubiana et al. 2005).

CONCLUSION

Present study provides information on the accumulation of mercury and its seasonal variations in fish species from Agra region. The concentration of Hg was found to be higher during summer than the winter and rainy and none of the fish samples exceeded the maximum residue levels (MRL) of mercury in any season prescribed by regulatory authorities of India. ***Hence, these fresh water fish varieties are safe for human consumption. In view of the fact that fish is a highly nutritious food, which constitutes a major dietary component of the people of the Agra region so its rejection from the regular diet is neither possible nor advisable.***

ACKNOWLEDGMENTS

Authors are indebted to Prof. F.M. Prasad, Principal, St. John's College, Agra, Dr. Ashok Kumar, head of the Department, School of Chemical Sciences for providing infrastructure facilities for this present work.

REFERENCES

1. Altindag A, Yigit S, Assessment of heavy metal concentrations in the food web of lake Beysehir, Turkey. Chemosphere, 2005; 60: 552–556.
2. Ayyadurai K, Krishnasamy V. Total mercury concentration in fresh water, sediment, and fish. J Environ Biol., 1989; 10: 165–171.
3. Batvari, B.P.D., S. Kamala-Kannan, K. Shanthi, R. Krishnamoorthy, K.J. Lee and M. Jayaprakash. Heavy metals in two fish species (Carangoidel malabaricus and Belone stronglurus) from Pulicat Lake, North of Chennai, Southeast Coast of India. Environ. Monit. Assess, 2007; 145: 167-175.
4. Canli M, Atli G .The relationships between heavy metal (Cd, Cr, Cu, Fe, Pb, Zn) levels and the size of six Mediterranean fish species. Environ Pollut, 2003; 121: 129–136.
5. Chakraborty, R., Dey, S., Dkhar, P.S., Ghosh, D., Singh, S., Sharma, D.K. and Myrboh, B. Accumulation of Heavy metals in Some Fresh Water Fishes from eastern India and its possible impact on human health., Enviromedia, 2003; 22(3): 353-358.
6. CIFT. National risk assessment programme for fish and fish products for domestic and international markets, Final Consolidated Report. December, 2006.
7. Demirak, A., Yılmaz, F., Tuna, A. L., & Özdemir, N. Heavy metals in water, sediment and tissues of Leuciscus cephalus from a stream in southwestern Turkey. Chemosphere, 2006; 63: 1451–1458.

8. Eastwood, S. and Couture, P. 'Seasonal variations in condition and liver metal concentrations of yellow perch (Perca flavescens) from a metal-contaminated environment,' Aquat Toxicol., 2002; 58: 43–56.
9. Farkas, A., Salánki, J., & Specziár, A. Age-and size specific of heavy metals in the organs of freshwater fish Abramis brama L. populating a low-contaminated site. Water Research, 2003; 37: 959–964.
10. Foster, E. P., Drake, D. L. and Di Domenico, G 'Seasonal changes and tissue distribution of mercury in largemouth bass (Micropterus salmoides) from Drena Reservoir, Oregon,' Arch. Environ. Contam. Toxicol, 2000; 38: 78–82.
11. Karadede, H., Oymak, S. A., & Ünlü, E. Heavy metals in mullet, Liza abu, and catfish, Silurus triostegus, from the Atatürk Dam Lake (Euphrates), Turkey. Environment International, 2004; 30: 183–188.
12. Kargin F, Donmez A, Cogun H Y, Distri. ución of heavy metals in different tissues of the shrimp Panaeus semiculatus & Metapenaeus monocerus from the Iskenderun gulf, Turkey: Seasonal variations. Bull. Environ Contam Toxicol, 2001; 66: 102-109.
13. Kucykbay FZ, Orun I. Copper and zinc accumulation in tissues of the freshwater fish Cyprinus carpio L 1758 collected from the Karakaya dam lake, Malatya (Turkey). Fresenius Environ Bull, 2003; 12: 62–66.
14. Mirlean N, Larned ST, Nikora V, Kutter VT. Mercury in lakes and lake fishes on a conservation–industry gradient in Brazil. Chemosphere, 2005; 60: 226–236
15. Mubiana, VK, Qadah, D., Meys J. & Blust R. Temporal and spatial trends in heavy metal concentration in the marine mussel Mytilius edulis from the Western Scheldt estuary (The Netherlands). Hydrobiologia, 2005; 540: 169-180.
16. Pourang N, Tanabe S, Rezvani S, Dennis JH. Trace element accumulation in edible tissues of five sturgeon species from the Caspian Sea. Environ Monit Assess, 2005; 100: 89–108. doi: 10.1007/s10661-005-7054-7.
17. Prabha, S., and Selvapathy, P. Heavy metal pollution in Indian Rivers., Indian J. Environ. Prot., 1997; 17(6): 641-649.
18. Priyadarshani, N. Trace elements in the sediments of the Safi river in Bachra area of north Karanpura coal fields of Hazaribagh Dist. Ind. J. Environ. Port., 1998; 18: 511-515.
19. Rashed MN. Monitoring of environmental heavy metals in fish from Nasser Lake. Environ Int, 2001; 27: 27–33. doi:10.1016/S0160-4120 (01)00050-2.
20. Velcheva, I. G. Zinc content in the organs and tissues of freshwater fish from the Kardjali and Studen Kladenets Dam Lakes in Bulgaria. Turkish Journal of Zoology, 2006; 30: 1–7.

21. Viana F, Huertas R, Danulat E. Heavy metal levels in fish from coastal waters of Uruguay. Arch Environ Contam Toxicol., 2005; 48: 530–537.
22. Yılmaz, F. Bioaccumulation of heavy metals in water, sediment, aquatic plants and tissues of Cyprinus carpio from Kızılırmak, Turkey. Fresenius Environmental Bulletin, 2006; 15(5): 360–369.