INTERNATIONAL JOURNAL OF PHARMACEUTICS & DRUG ANALYSIS

VOL.6 ISSUE 2, 2018; 302 – 306 ; http://ijpda.com; ISSN: 2348-8948

MEDFOOD'18 [1st February 2018]

National Conference on Phytochemicals in Medicinal Plants and Food

Department of Biochemistry, Bharathidasan University Constituent College for Women, Orathanadu - 614 625, Tamil Nadu, India

Research Article

Heavy Metal Levels In Three Major Carps (*Catla catla, Oreochromis niloticus and Cyprinus carpio* Var.*communis*) From The Lake Of Thanjavur District

K.Karpagam[1*], V.Mariappan[2]

[*1]Department of Biotechnology, Bharathidasan University Constituent College for Women, Orathanadu, Tamil Nadu, India

[2]Department of Botany, Government Arts College, Viruthunagar, Tamil Nadu, India

Date Received: 23rd January 2018; Date accepted: 29th January 2018; Date Published: 21st February 2018

Abstract

The present study was conducted to determine heavy metal (cadmium and chromium) concentrations in gills, liver, skin and muscles of three fish species (*Catla catla, Oreochromis niloticus and Cyprinus carpio var. communis)* from three stations viz. Varan lake, Red lake and Amni lake in Thanjavur District. Heavy metal concentrations varied significantly depending upon the type of fish tissues and locations. The concentrations of cadmium and chromium differed significantly ($P<0.05$) among three fish organs and three sites and non-significantly between the three fish species. Fish liver appeared to have significantly higher tendency for the accumulation of cadmium and chromium (3.27±1.57 and 2.97 ±1.57 μgg^{-1}), while gills had minimum concentrations (1.05±0.53 and0.92±0.088 μgg^{-1}) of these metals. Generally, *Catla catla* showed higher levels of metal concentrations than *Oreochromis niloticus and Cyprinus carpio var. communis*. Metal contamination was highest in Red lake probably due to inclusion of more effluents from sewage water.

Keywords: Major carps, cadmium, chromium and lakes.

Introduction

Pollution of water resources is a serious and growing problem but despite the existence of relevant legislation on pollution of the aquatic environment by toxic chemical pollutants, pollution continues to occur with domestic waste water being the main sources responsible for the contamination of aquatic environments (1).

Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, Mutagenic and Carcinogenic effects in animals (2). Aquatic organisms have the ability to accumulate heavy metals from various sources including sediments, soil erosion and runoff, air depositions of dust and aerosol, and discharges of waste water (3,4). Therefore, accumulation of heavy metals in aquatic organisms can pose a long lasting effect on biogeochemical cycling in the ecosphere. Heavy metals can also adversely affect the growth rate in major carps (5).

Fish are often at the top of aquatic food chain and may concentrate large amounts of some metals from the water [6]. Metal bioaccumulation is largely attributed to differences in update and depuration periods for various metals in different fish species [7]. Multiple factors including season, physical and chemical properties of water [8] can play a significant role in metal accumulation in different fish tissues. The gills are directly in contact with water. Therefore, the concentration of metals in gills reflects their concentration in water where the fish lives, whereas the concentration in liver represents storage of metals [9] .

The present study was planned to investigate heavy metals viz. cadmium and chromium ecotoxicity of the river system with particular reference to fish. Bioaccumulation patterns of these metals in fish body organs were also investigated.

Materirials And Methods

Samples of three fish from each of the three species (*Catla catla, Oreochromis niloticus and Cyprinus carpio var. communis)* were collected from three stations viz. Varan Lake, Red lake and Amni Lake on monthly basis for one year study period. Sample of fish organs viz. gills, liver, skin and muscles were digested, separately with concentrated nitric acid. For this purpose, each sample was taken in a 100ml tube and 10ml concentrated nitric acid was added. Samples in tubes were heated at 100,150,200 and 250°C on hot plate for 30 minutes and 1.0 hour respectively. Finally, 2ml of 1N nitric acid was added to the residue and the solution was evaporated again on hot plate, continuing until sample was completely digested and become colorless.

Table 1: Mean values ($\mu g g^{-1}$, ±SD) of cadmium and chromium in various body organs of three fish species collected from three stations

1. RED LAKE

	Cadmium					
Factors	Control	*Catla catla*	Control	Oreochromis *niloticus*	Control	*Cyprinus carpio var. communis*
Gills	0.82±0.011	1.05±0.53*	0.82±0.011	0.98±0.041*	0.82±0.011	0.92±0.088*
Liver	2.78±1.12	3.77±1.57**	2.78±1.12	3.43±0.151**	2.78±1.12	3.38±0.166**
Skin	1.98±0.95	2.36±1.12**	1.98±0.95	2.60±0.188**	1.98±0.95	2.44±0.144**
Muscles	1.05±0.65	1.90±0.80**	1.05±0.65	1.41±0.120**	1.05±0.65	1.25±0.101**
Chromium						
Gills	0.72±0.008	0.95±0.53*	0.72±0.008	0.79±0.041*	0.72±0.008	0.92±0.088**
Liver	2.64±09.12	2.97 ±1.57**	2.64±09.12	2.83±0.151**	2.64±09.12	2.80±0.166**
Skin	1.68±0.75	2.06±1.12**	1.68±0.75	2.00±0.188**	1.68±0.75	1.90±0.144**
Muscles	1.00±0.54	1.70±0.80**	1.00±0.54	1.21±0.120**	1.00±0.54	1.02±0.101

2. VARAN LAKE

	Cadmium					
Factors	**Control**	***Catla catla***	**Control**	***Oreochromis niloticus***	**Control**	***Cyprinus carpio var. communis***
Gills	0.73±0.010	0.96±0.51*	0.73±0.010	0.80±0.041*	0.73±0.010	0.92±0.088*
Liver	2.68±1.02	2.75±1.47**	2.68±1.02	2.73±0.150**	2.68±1.02	2.70±0.163**
Skin	1.79±0.85	2.16±1.12**	1.79±0.85	2.00±0.188**	1.79±0.85	1.94±0.140**
Muscles	1.00±0.60	1.70±0.70**	1.00±0.60	1.30±0.120**	1.00±0.60	1.05±0.100**
Chromium						
Gills	0.68±0.010	0.85±0.50**	0.68±0.010	0.64±0.030*	0.68±0.010	0.56±0.080**
Liver	2.57±09.08	2.67 ±1.52*	2.57±09.08	2.62±0.142*	2.57±09.08	2.61±0.131*
Skin	1.62±0.80	1.86±1.02**	1.62±0.80	1.90±0.176*	1.62±0.80	1.81±0.163*
Muscles	1.00±0.45	1.54±0.79 **	1.00±0.45	1.21±0.102**	1.00±0.45	1.00±0.092**

3. AMNI LAKE

	Cadmium					
Factors	Control	*Catla catla*	Control	*Oreochromis niloticus*	Control	*Cyprinus carpio var. communis*
Gills	0.72±0.008	0.92±0.088**	0.72±0.008	0.80 ±0.088**	0.72±0.008	0.74±0.080*
Liver	1.64±09.12	2.00±0.153**	1.64±09.12	1.84 ±0.144**	1.64±09.12	1.75±0.163**
Skin	1.60±0.75	1.75±0.131**	1.60 ±0.75	1.62±0.120**	1.60±0.75	1.73 ±0.122*
Muscles	1.00±0.54	1.30±0.100*	1.00±0.54	1.12±0.080**	1.00±0.54	1.05±0.100**
Chromium						
Gills	0.64±0.005	0.75 ±0.53**	0.64±0.005	0.69±0.041*	0.64±0.005	0.67 ±0.088**
Liver	1.24±09.10	1.97 ±1.57*	1.24±09.10	1.43±0.151*	1.24±09.10	1.63±0.166*
Skin	1.48±0.70	1.70±1.12**	1.48±0.70	1.59±0.188**	1.48±0.70	1.60±0.144**
Muscles	0.90±0.50	1.52±0.80**	0.90±0.50	1.01 ±0.120**	0.90±0.50	1.00 ±0.101**

**Significant $p<0.05$, **Highly Significant $p<0.01$*

The sample was cooled and 10ml of 1N nitric acid was added again. Digested sample was transferred 500ml volumetric flask to make the volume by using the double distilled water. The digested sample volume was filtered through 0.45µm Millipore membrane filter (Type HV). The filtrate was analyzed for cadmium and chromium concentrations according to Steel *et al* [10] on an Atomic Absorption Spectrophotometer. Analysis of variance and Student t-test were applied to find out statistical differences among varies parameters [11].

Results

Cadmium: Among various body organs, the liver of all the three fish species sampled from three sampling stations showed significantly higher (P<0.01) concentration (3.27±1.57 $\mu g g^{-1}$) of cadmium followed by that of skin, muscles and gills (Table 1). Gills appeared as an organ that had minimum cadmium concentration (1.05±0.53 $\mu g g^{-1}$). Among the three fish species, *Catla catla* showed higher ability to accumulate cadmium than that of *Oreochromis niloticus* and *Cyprinus carpio var. communis* the difference was significant (Table 1). Among the three sampling stations, the fish at Red lake showed the higher concentrations of cadmium in their bodies (P<0.05) compared to those at Varan lake and Amni Lake, while the difference between the latter two stations was significant.

Chromium

The highest concentration of chromium (2.97 ±1.57$\mu g g^{-1}$) was observed in the liver of all the three fish species (P<0.05). The minimum concentration of chromium (0.95±0.53$\mu g g^{-1}$) was found in the gills (Table 1). Among the three species the maximum concentration of chromium was observed in *Catla catla*, followed by *Cyprinus Carpio Var. Commumnis* and Oreochromis *Niloticus*, the difference was significant. Among the three sampling stations, the fish *Catla catla* accumulated highest chromium concentration in Red Lake, while the lowest value was recorded at Amni Lake. However, there was significant difference among the sampling station for the accumulation of chromium.

Discussion

Knowledge of heavy metal concentrations in fish is important with respect to nature of management and human consumption of fish. In the literature, heavy metal concentrations in the tissue of freshwater fish vary considerably among different studies [5,12,13], possibly due to differences in metal concentrations and chemical characteristics of water from which fish were sampled, ecological needs, metabolism and feeding patterns of fish and also the season in which studies were carried out. In the river, fish are often at the top of the food chain and have the tendency to concentrate heavy metals from water [6]. Therefore, bioaccumulation of metals in fish can be considered as an index of metal pollution in the aquatic bodies [5, 7, 12, 14] that could be a useful tool to study the biological role of metals present at higher concentrations in fish [15].

In the present study, the red lake showed higher accumulation of cadmium in their bodies than other two stations, while the difference for the toxicity of chromium was statistically non-significa*nt among three sampling stations. The fish (Catla catla,* *Cyprinus Carpio Var. Communis* and Oreochromis *Niloticus)* at Red Lake accumulated significantly higher quantities of iron and nickel in their bodies than those captured from Amni Lake (12); however, the response of three fish species, for the accumulation of metals in their bodies did not vary significantly.

Metal accumulation in fish bodies appear as site specific, corresponding with the metallic toxicity of three aquatic components viz. water, plankton and sediments (12). Fish liver exhibited highest tendency to accumulate both the metals. The accumulation of both cadmium and chromium were the minimum in the fish gills. Dural *et al.* and Ploetz et al. (15,16) reported highest levels of cadmium, lead, copper, zinc and iron in the liver and gills of fish species viz. *Sparus aurata, Dicentrachus labrax, Mugil cephalus and Scomberomorus cavalla*. Yilmaz *et al.* (17) reported that in *Leuciscus cephalus and Lepornis gibbosus*, cadmium, cobalt and copper accumulations in the liver and gills wee maximum, while these accumulations were least in the fish muscle. Canli and kalay (18) determined the concentrations of cadmium and chromium in the gills, liver and muscles of C*yprinus carpio*, *Barbus capito* and *Chondrostoma regium* caught at 5 stations on the Seyhan river system. Liver and gills tissues showed higher metal concentrations than muscles tissue. Thus, heavy metals when discharged into the river enter the food chain and accumulate in the fish body as determined during this investigation.

Conclusions

The results of this study supply valuable information on the metal contents in fish from different sampling stations of the lakes. Fish liver exhibited highest tendency to accumulate both cadmium and chromium, while the accumulation of both the metals was minimum in fish gills.

References

1. Elaxton, L. D. Houk, and Huglas, T.J. 1998. Genotoxicity of industrial wastes and effluents. Mutat Res., 410: 237243.
2. More, T .G., R. A. Rajpuut and N.N Bandela, 2003.Impact of heavy metals on DNA content in the whole body of freshwater bivalve , *Lamelleiden marginalis* .Environ. Sci. Pollut. Res., 22: 605-616.
3. Labonne, M., D.B. Othaman and J.M.Luck, 2001. Lead isotopes in muscles as tracers of metal sources and Water movements in a Logoon (Thau Basin, S.France).Chem. Geology, 181; 181-191.
4. Hayat, S., M. Javed and S.Razzaq, 2007. Growth performance of metal stressed major carps viz. *Catla catla, Labeo rohita and Cirrhina mrigala* reared under semi-intensive culture system. Pakistan Vet. J., 27(1): 8-12.
5. Goodwin, T. H., A. R. Young M. G. R. Holmes, G. H. Old, N. Hewitt, G. J. L. Leeks, J. C. Packman and B. P. G. Smith, 2003. The temporal and spatial variability of sediment transport and yields within the Bradford Beck catchment, West Yorkshire. Sci. Total Environ. 314-316: 475-494.
6. Tawari-Fufeyin, P. and S.A .Ekaye, 2007. Fish species diversity as indictor of pollution in Ikpoba River, Benin city, Nigeria. Rev. Fish Biol. Fisheries, 17:21-30.
7. Kargin F. Seasonal changes in levels of heavy metals in tissues of Mullus *barbatus and Sparus aurata* collected from Iskenderun Gulf (Turkey).Water, Air Soil Pollut., 1996;90; 557-562.
8. Romeo M, Y. Siau, Z. Sidoumou and M. GnassiaBarelli, 1999. Heavy metal distribution in different fish species from the Mauritania coast. Sci. Total Environ, 232:169-175.
9. APHA, 1998. Standard Methods for the Examination of Water and Wastewater. 20th Ed., American Public Health Association, New York, USA.
10. Steel, R. G. D., J. H. Torrie and D.A. Dinkey, 1996. Principls and Procedures of Statistics, 2nd Ed., McGraw Hill Book Co., Singapore.
11. Javed, M., 2005 Heavy metal contamination of freshwater fish and bed sediments in the river Ravi stretch and related tributaries. Pakistan J. Biol. Sci., 8(10): 1337-1341.
12. Chattopadhyay, B., A. Chatterj and S. K. Mukhopadhyay, 2002. Bioaccumulation of metals in the East Calcutta wetland ecosystem. Aquat. Ecosys. Health Manag., 5(2) 191-203.
13. Mansour,S.A. and M.M. Sidky ,2002. Ecotoxicological studis. 3: Heavy metals contaminating water and fish from Fayoum Governorate, Egypt. Food Chem., 78; 15-22.

14. Karadede-Akin, H. and E. Unlu, 2007. Heavy metal concentrations in water, sediments, fish and some benthic organisms from Tigris River, Turkey. Environ. Monit . Assess. 131:323-337.
15. Dural, M., M. Z. L. Goksu and A. A. Ozak, 2007. Investigation of heavy metal levels in economically important fish species captured from the Tuzla Lagoon. Food Chem., 102: 415-421.
16. Ploetz, D. M., B. E. Fitts and T. M. Rice, 2007. Differential accumulation of heavy metals in muscles and liver of a marine fish (King Mackerel, *Scomberomorus cavalla,* Cuvier) from the Northen Gulf of Mexico, USA.Bull. Environ. Contam . Toxicol., 78:134-137.
17. Yilmaz, F.,N. Ozdemir , A Demirak and A.L. Tuna, 2007.Heavy metal levels in two fish species *Leuciscus cephalus* and *Lepomis gibbosus* . Food Chem., 100: 830-835.
18. Canli, M. and M. Kalay, 1998. Levels of heavy metals (Cd, Pb, Cu, Cr and Ni) in tissue of *Cyprinus capio, Barbus capito and Chondrostoma regium* from the Seyhan river, Turkey. Turkish J.Zool.22:149-157.