DOI: 10.21276/sb.2017.3.1.3

Scholars Bulletin
(A Multidisciplinary Journal)
An Official Publication of "Scholars Middle East Publishers",
Dubai, United Arab Emirates
Website: http://scholarsbulletin.com/

ISSN 2412-9771 (Print)
ISSN 2412-897X (Online)

Seasonal variation study for the accumulation of Cu, Pb and Mn in Kidneys, liver and Muscles of different edible fish from River Jhelum, Punjab, Pakistan.

Iram Inayat [1], Aima Iram Batool [2]*, Muhammad Fayyaz Ur Rehman [3], Naima HumaNaveed [4], Humaira Jabeen [5], Hakim Bibi [6]

[1]Department of Zoology, University of Sargodha
[2]Department of Zoology, University of Sargodha
[3]University of Birmingham, UK
[4] Department of Botany, University of Sargodha
[5]Department of Zoology, University of Sargodha
[6]Department of Zoology, University of Sargodha

***Corresponding Author:**
Aima Iram Batool
Email: aimairam@uos.edu.pk

Abstract: Polluted water inhabitant fishes accumulate metals in their body tissues;mainly accumulation depends upon different factors, like way of uptake, temperature, time of exposure etc. Different metals show different affinities to fish tissues for accumulation. Liver and kidney have relatively high metal accumulation as compare to muscles.The present study was carried out to determine the bioaccumulation of heavy metals into different organs of fish collected from four sampling stations of river Jhelum. Three metals Cu, Pb and Mn were examined by using Shimadzu AA 6200 atomic absorption spectrophotometry and the results were as ug/g dry wt. Seasonal variations regarding metal accumulation in kidney, liver and muscles of edible fishes from river Jhelum was also observed. We observed that seasonal variations affect the bioaccumulation of metals in body tissues. Cu, Pb and Mn were higher in summer season as compared to winter season in kidney of fishes. But in the case of liver concentration had opposite affects and had highest concentrations of these metals during winter. While in muscles Cu was significantly ($P<0.01$) higher in summer,Pb was non significantly higher in summer and Mn was non significantly higher in winter in the case of muscles.
Keywords: bioaccumulation, seasonal variations, liver, kidney, muscles.

INTRODUCTION

The contamination ofrivers with different types of pollutents and wide range of metals has become serious concerning matter fromlast few decades [1-4]. The rivers and fresh water entititiesare being polluted with heavy metals and pollutantsof other types released from industries and anthropogenic activities [5,6].

Contamination caused by heavy metals may have very detrimental effects not only on the ecological balance of recipient environment but also on the living fauna of aquatic environments[7-9].

Among all animal diversity of river, fishes are the inhabitantswhich cannotbe escape from the devastating effects of these contaminants[10 –12]. Fish are used as bioindicator to check the fresh water ecosystem health, because pollutants transfer through food chsain are responsible for damaging and adverse effects on the river ecosystems [13,14].

The prsesnt studies was carried out on various fish organs that how heavy metals effects biochemical parameters and physiological changes in different tissues [15,16] The damaging effects of heavy metals like Cu, Pb and Mn have reviewed, like bioaccumulation [17-21]. Fishes tries to develop a defense against the detrimental effects of both essential andnon-essential xenobiotics that may cause damage like oxidative effects in body[22,23]. Edible fishes in river Jhelum are very popular in the people living around it; different types of edible fishs were selected due their adoption in the most polluted points. The basic purpose of this research was to quantify the amount of heavy metal accumulation in different body tissues of edible fishes from river jhelum.

MATERIALS AND METHODS

River Jhelum famous river flows both in Pakistan and India. It is one of the five rivers and largest river of Punjab. It flows through the Jhelum district as name shows. It is the tributary of Chenab and is about 813km long. It is populated with various types of fish fauna.

There were some basic criteria for selection of fishes as bioindicator, according to Wittig [29] and Markert[30]. It was that particular fish type must be present in large amount all over the sampling stations. And sampling should be easy for these particular types of fishes and must not be problems to identify.

Ediblefishes collected for this research study was collected from the four selected sampling stations of river Jhelum. The selected sites were Khushaab, Muhammad wala, 8.R.D Barrage, and Rasool Barrage. The selected fishes Wallagoattu, Rittaritta and Mystusseenghala are equally present in the selected sites. Samples of fishes are taken from these sites during end December, January 2010 (winter collection) and end May, June 2011 (summer collection).

After sampling wet acid digestion were carried out for all tissues by using Mehra and Juneja [24] after few changes in this method.

Concentrations of heavy metals are analyzed by using atomic absorption spectrophotometer (Model# AA.6300 SHIMADZU "Japan" AAS flame type).

RESULTS

Seasonal Variations for the accumulation of metals among four sampling stations for Kidney in Fresh water Fishes.

- **Seasonal variations regardingCopper (Cu) Concentration.**

Overall mean value of copper in summer seasons remained as 29.11±29.76 ug/g. While overall mean value of Copper during winter seasons remained19.90±13.70 ug/g. During summer seasons accumulation of Copper in kidney was higher.

- **Seasonal variations regarding Lead (Pb)Concentration.**

Concentration of lead was none significantly higher in kidneys of Fresh water fishes in summer as compared to winter seasons at all sampling stations. Overall lead mean value of lead in summer remained as 21.08±32.32 ug/g.

- **Seasonal variations regarding Manganese (Mn) Concentration.**

Concentration of Manganese (Mn)was non significantly higher in summer seasons samples at all sampling stations on overall basis in kidneys of fresh water fishes.

Table-1: Comparison between Summer and Winter regarding different minerals for Kidney.

Mineral	Season	n	Mean	SD	SE	t-value	Prob.
Cu	Summer	36	29.11	29.76	4.96	1.69^{NS}	0.096
	Winter	36	19.90	13.70	2.28		
Pb	Summer	36	21.08	32.32	5.39	1.63^{NS}	0.108
	Winter	36	11.69	12.26	2.04		
Mn	Summer	36	27.73	39.12	6.52	1.61^{NS}	0.111
	Winter	36	16.21	17.40	2.90		

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

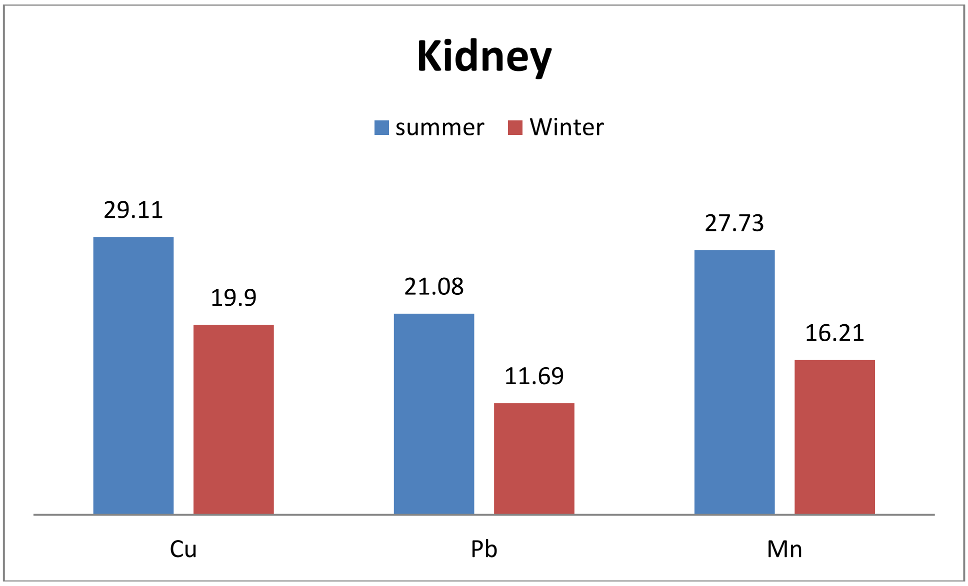

Fig-1:Comparison between Summer and Winter regarding different minerals for Kidney

Seasonal Variations for the accumulation of metals among four sampling stations for Liver in Fresh water Fishes.

- **Seasonal variations regarding Copper (Cu) Concentration.**

Seasons exerted significant effect on copper accumulation in liver. It remained higher during summer than winter.

- **Seasonal variations regarding Lead (Pb) Concentration.**

Concentration of lead was significantly higher in liver of Fresh water fishes in winter as compared to summer seasons at all sampling stations. Overall mean value of lead in winter remained as 19.52±18.20 ug/g.

- **Seasonal variations regarding Manganese (Mn) Concentration.**

Concentration of Manganese (Mn)was significantly higher in winter seasons samples at all sampling stations on overall basis in livers of fresh water fishes.

Table-2: Comparison between summer and Winter regarding different minerals for Liver.

Mineral	Season	n	Mean	SD	SE	t-value	Prob.
Cu	Summer	33	20.55	23.09	4.02	-0.01^{NS}	0.992
	Winter	36	20.60	16.05	2.68		
Pb	Summer	33	10.61	5.30	0.92	-2.71**	0.009
	Winter	36	19.52	18.20	3.03		
Mn	Summer	33	7.70	11.03	1.92	-4.53**	0.000
	Winter	36	24.78	18.87	3.14		

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

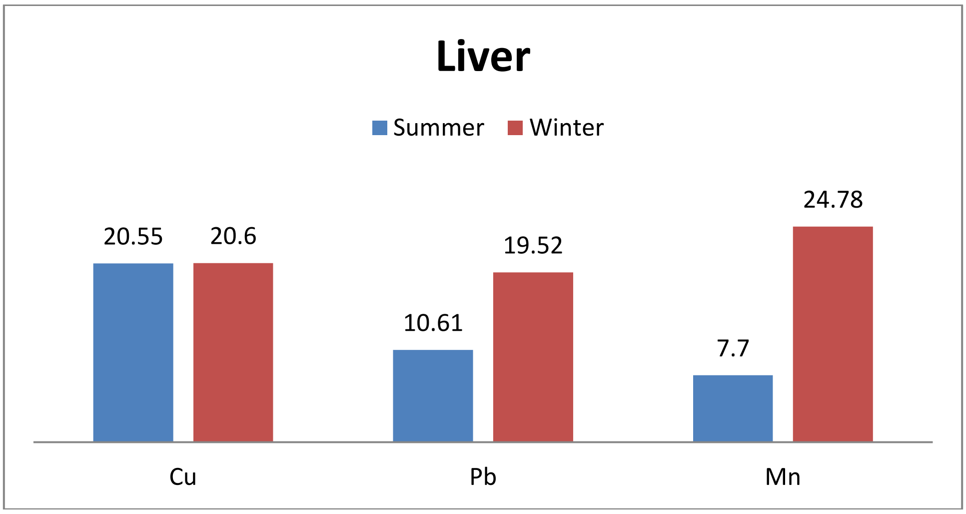

Fig-2:Comparison between summer and Winter regarding different minerals for Liver

Seasonal Variations for the accumulation of metals among four sampling stations for Muscles tissues of Fresh water Fishes.

- **Seasonal variations regarding Copper (Cu) Concentration.**

Muscles of fishes accumulated more copper during summer allegorized to winter during summer it remained as 27.92±22.29 ug/g and during winter it was 15.64±12.02 ug/g of cadmium.

- **Seasonal variations regarding Lead (Pb) Concentration.**

Seasons did not exert any effect on the accumulation of lead in fish muscles.

- **Seasonal variations regarding Manganese (Mn) Concentration.**

Accumulation of Manganese (Mn)was none significantly higher in summer seasons samples at all sampling stations in muscles of fishes.

Table-3: Comparison between Summer and Winter regarding different minerals for Muscles.

Mineral	Season	n	Mean	SD	SE	t-value	Prob.
Cu	Summer	36	27.92	22.29	3.72	2.91**	0.005
	Winter	36	15.64	12.02	2.00		
Pb	Summer	36	9.82	5.64	0.94	-1.15^{NS}	0.256
	Winter	36	12.65	13.67	2.28		
Mn	Summer	36	22.71	30.95	5.16	0.20^{NS}	0.845
	Winter	36	21.55	16.85	2.81		

NS = Non-significant (P>0.05); * = Significant (P<0.05); ** = Highly significant (P<0.01)

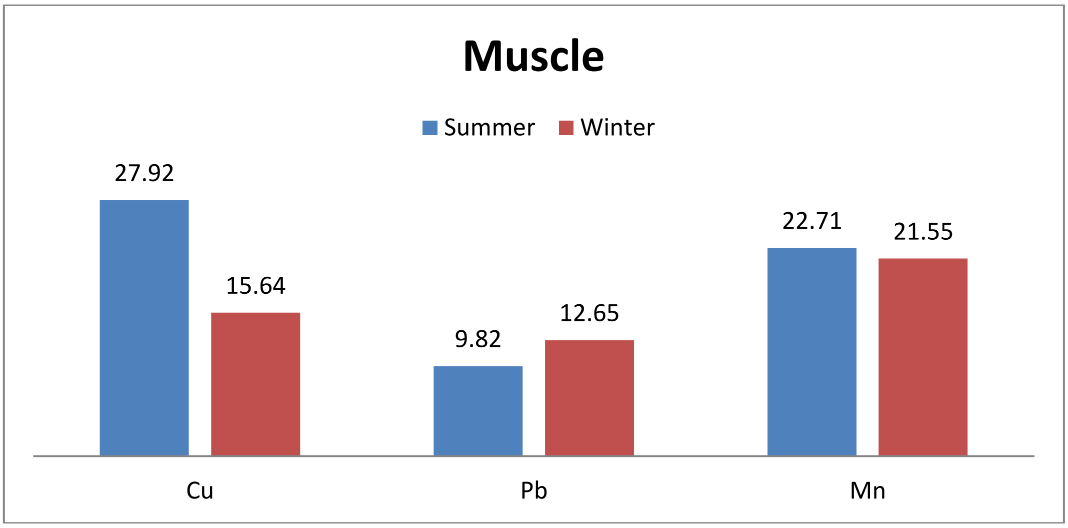

Fig-3:Comparison between Summer and Winter regarding different minerals for Muscles

DISCUSSION

Present study was carried out to assess the metallic ions toxicity in various tissues of edible fishes of River Jhelum stretch from Muhammedwala to Rasool barrage. We have taken the following organs from these edible fishes kidney, liver and fish muscles, among 4 sampling stations.In our studies we observed seasonal variations for the accumulation of heavy metals for different body tissues of fishes collected from four sampling stations. In our studies seasons affect bioaccumulation of metals in body tissues. Over all bases these three metals Cu, Pb and Mn were higher in summer season as compared to winter season. The reason could be Deposition of these metals into the body tissues of fishes increase during summer. The levels of metals were nearly equal across seasons according to Nwude1 andAnthony [25]. So our results disagreed with Nwude1 andAnthony [25].

The mechanisms by which temperature affects accumulation and toxicity of metals are not yet fully understood. May be increase in water temperatures results in increasing gill ventilation rates and to higher oxygen demand for metabolic activities and decreasing oxygen dissolved in the water [26-28].

During winter elimination from the excretory organs increase the uptake of metals, leading to decreasing metal concentrations in liver and kidney [31].

For all these three organs all heavy metals were present highest in amount in kidneys of fishes.The reason may be the major detoxifying organ it is.

Kidney showed highest concentration of Copper (Cu) than both of other organs like liver and muscles. And it showed Non-significant (P>0.05) difference for the accumulation of copper during summer season. Similarly Lead (Pb) and Manganese (Mn) were greatest in kidney during summer. Above results indicate heavy metals like Cu, Mn and Pbdefinitely effects in the river fauna of fishes. Hence scientific method to detoxify these metals is very essential to improve the health of these edible fishes.

REFERENCES

1. Vutukuru. S. S., (2005). Acute effects of Hexavalent chromium on survival, oxygen consumption, hematological parameters and some biochemical profiles of the Indian Major carp, Labeorohita. Int. J. Environ. Res. Public Health. 2 (3), 456- 462.
2. Dirilgen, N., (2001). Accumulation of heavy metals in freshwater organisms: Assessment of toxic interactions. Turk. J. Chem., 25 (3)**,** 173-179.
3. Voegborlo, R. B.; Methnani, A. M. E.; Abedin, M. Z., (1999). Mercury, cadmium and lead content of canned Tuna fish. Food Chem., 67 (4), 341 – 345.
4. Canli, M.; Ay, O.; Kalay, M., (1998). Levels of heavy metals (Cd, Pb, Cu, and Ni) in tissue of CyprinusCarpio, BarbusCapito and Chondrostomaregium from the Seyhanriver. Turk. J. Zool., 22 (3), 149-157.
5. Velez, D.; Montoro, R., (1998). Arsenic speciation in manufactured seafood products: a review. J. food. Protect. 61 (9), 1240-1245.
6. Conacher, H. B.; Page, B. D.; Ryan, J. J., (1993). Industrial chemical contamination of foods [Review]. Food Addit. Contam., 10 (1), 129-143.
7. Farombi, E. O.; Adelowo, O. A.; Ajimoko. Y. R., (2007). Biomarkers of oxidative stress and heavy metal levels as indicators of environmental pollution in African Cat fish (*Clariasgariepinus*) from Nigeria ogun river. Int. J. Environ. Res. Public Health. 4 (2), 158-165.

8. Vosyliene, M. Z.; Jankaite, A., (2006). Effect of heavy metal model mixture on rainbow trout biological parameters. Ekologija., 4, 12-17.
9. Ashraj, W., (2005). Accumulation of heavy metals in kidney and heart tissues of Epinephelusmicrodon fish from the Arabian Gulf. Environ. Monit. Assess. 101 (1-3)**,** 311-316.
10. Olaifa, F. G.; Olaifa, A. K.; Onwude, T. E., (2004). Lethal and sublethal effects of copper to the African Cat fish (*Clariasgariepnus*). Afr. J. Biomed. Res., 7, 65-70.
11. Clarkson, T. W., (1998). Human toxicology of mercury. J. Trace. Elem. Exp. Med., 11 (2-3), 303-317.
12. Dickman, M. D.; Leung, K. M., (1998). Mercury and organo chlorine exposure from fish consumption in Hong Kong. Chemosphere, 37 (5), 991-1015.
13. Farkas, A., Salanki, J.; Specziar, A., (2002). Relation between growth and the heavy metal concentration in organs of bream Abramisbrama L. populating Lake Balaton. Arch. Environ. Contam. Toxicol., 43 (2), 236-243.
14. Yousuf, M. H. A.; El-Shahawi., (1999). Trace metals in Lethrinuslentjan fish from Arabian Gulf: Metal accumulation in Kidney and Heart Tissues. Bull. Environ. Contam. Toxicol., 62 (3)**,** 293-300.
15. Basa, Siraj, P.; Usha Rani, A., (2003). Cadmium induced antioxidant defense mechanism in freshwater teleost Oreochromismossambicus (Tilapia). Eco. Toxicol. Environ. Saf., 56 (2), 218 – 221.
16. Tort, L.; Torres, P., (1988). The effects of sub lethal concentration of cadmium on hematological parameters in the dog fish, ScyliorhinusCaniccula. J. Fish. Biol., 32 (2), 277-282.
17. Waqar, A., (2006). Levels of selected heavy metals in Tuna fish. Arab. J. Sci. Eng., 31 (1A), 89–92.
18. Adami, G. M.; Barbieri, P.; Fabiani, M.; Piselli, S.; Predonzani, S.; Reisenhofer, E., (2002). Levels of cadmium and zinc in hepatopancreas of reared Mytilusgalloprovincialis from the Gulf of Trieste (Italy). Chemosphere, 48 (7), 671 – 677.
19. Rasmussen, A. D.; Anderson, O., (2000). Effects on cadmium exposure on volume regulation in the lugworm, Arenicola marina. Aquat. Toxicol., 48, 151-164.
20. Usha Rani, A., (2000). Cadmium induced bioaccumulation in tissue of freshwater teleost Oreochromismossambicus. Ann. N.Y. Acad., 919 (1), 318-320.
21. Aucoin, J.; Blanchand, R.; Billiot, C., (1999). Trace metals in fish and sediments from lake Boeuf, South Eastern Louisiana. Micro. Chem. J., 62 (2), 299-307.
22. Abou EL-Naga, E. H.; EL-Moselhy, K. M.; Hamed, M. A., (2005). Toxicity of cadmium and copper and their effect on some biochemical parameters of marine fish *Mugilseheli*. Egyptian. J. Aquat. Res., 31 (2), 60-71.
23. Filipovic, V.; Raspor, B., (2003). Metallothionein and metal levels in cytosol of liver, kidney and brain in relation to growth parameters of Mullussurmuletus and Liza aurata. From the eastern Adriatic Sea. Water Res., 37 (13), 3253-3262.
24. Mehra, R and Juneja, M, (2005). Fingernails as biological indices of metal exposure; *J. Biosci*. 30 253–257.
25. Nwudel, Patrice-Anthony C. Davies., O, Okoye, Joshua, O and Babayemi (2010), Assessment of accumulation of heavy metals in the kidney of Cattle as a function of seasonal variation. Afri. J. Anim. Biomed. Sci., 5(3):1-8.
26. Heath, A. G., (1987) Water pollution and Fish physiology. *CRC Press*, Florida. 13.
27. Douben, P.E.T., (1990). Amathematical model for cadmium in the stone loach (*Noemacheilusbarbatulus L.*) from the River Ecclesbourne, Derbyshire. *Ecotoxicol. Environ. Saf.* 19: 160-183.
28. Nimmi, A.J. 1987. Biological half –lives of chemicals in fishes, *Rev. Enviorn. Contam. Toxicol*.99: 1-46.
29. Wittig, M. (1993). One is not born a woman. *The lesbian and gay studies reader*, 103-109.
30. Markert, B. (1993). *Plant as biomonitors-Indicators for heavy metals in the terrestrial environment*(Vol. 298). Weinheim, Germany: VCH VerlagsgesellschaftmbH.
31. Köck, G., Triendl, M., & Hofer, R. (1996). Seasonal patterns of metal accumulation in Arctic char (Salvelinusalpinus) from an oligotrophic Alpine lake related to temperature. *Canadian Journal of Fisheries and Aquatic Sciences*, *53*(4), 780-786.