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# The Levels of Some Selected Metals in Muscle's Tissues of Three Commercially Important Edible Fishes Collected from the Fish Market of Quetta City in Balochistan Province

*[1]Nighat Din, [1]Nima Nazeer, [1]Zubia Masood, [2]Hameed-UR-Rehman and [3]Asim Ullah*

[1]Department of Zoology, SardarBahadur Khan Women University, Quetta, Balochistan (SBKWU), Pakistan
[2]Department of Chemistry, Kohat University of Science and Technology, Kohat, Pakistan
[3]Department of Zoology, Kohat University of Science and Technology, Kohat, Pakistan

**Abstract:** The consumption of highly contaminated foods may prove to be lethal for the human being and can also produce some distressing impact. Therefore, this study is focused on evaluating the trace metal levels in the muscle's tissue of three commercially important edible fishes i.e., catfish (*Sperata seeghala*), mullet fish (*Mugil incilis*) and major carp (*Catla catla*). Fish samples were purchased once a month from the local fish market of Quetta, Balochistan. The levels of some metals like calcium (Ca), potassium (K), Sodium (Na), Iron (Fe), Manganese (Mn) and Chromium (Cr) in the muscle's tissues of the fishes were detected by using atomic absorption spectroscopy. The overall result of the present study revealed that the levels of these six metals in the muscles of our three selected species were found in order, K>Na>Ca>Fe>Cr>Mn, respectively. Furthermore, most metal levels in the muscles of three selected species were found in order, mullet>catfish>carp fishes, respectively. Thus, the results of our present study revealed that these three edible fishes are the rich source of calcium and potassium in human diet.

**Key words:** Muscle Tissues · Metals Detection · Edible Fishes

## INTRODUCTION

Fish play a vital role in providingcheap source of food for the human populationsin various regions of world, becauseit contains large amount of protein (15-20%), and various other essential nutrients that are quiet necessary for growth[1].Group of metals and metalloids which are also known as trace elements, because they occur in very small concentrations in biological systems, however, if they will not built up in cell than such organism face significant health hazard. Among these trace elements, some heavy metals are also the most important toxic pollutants that threaten the environment;hence, the accumulation of these metals in marine ecosystems is of global prominence. These metals generally enter in the aquatic environment through corrosion of geological matrix, atmospheric deposition or due to the anthropogenic activities [2]. The manifestations of anthropogenic effects from metal release into the aquatic environment have provoked disturbances to the hydrosphere stability which further upsets the structure and functions of marine biota. Seafood, especially the marine fish are more susceptible to the effects of chemical contaminants including trace metals that are now bio accumulated in the aquatic food chain [1,3]. These toxic elemental contaminants cause insalubrious effects on fish and are transferred into human metabolism through consumption of contaminated food fish that leads to severe deterioration of human health status [4-6]. The levels of toxic contaminants in fish have now significant attention due to its potential effects not only on the fish themselves, but also on the heath of all those organisms (Especially in human beings) that consume them as food resources [7]. As aquatic foods are the rich sources of essential amino acids, fatty acids, protein, carbohydrates, vitamins and some important trace minerals, therefore, among the other sea foods, fish are most commonly used as food and, hence, are a connecting link for the transfer of toxic metals in human beings that later may also have harmful effect on health [8].

**Corresponding Author:** Zubia Masood, Department of Zoology, Sardar Bahadur Khan Women University, Quetta, Balochistan (SBKWU), Pakistan. E-mail: masoodzubia@gmail.com.

As fishes are major part of the human diet, therefore, it is not surprising that numerous studies have been carried out on metal pollution in different species of edible fish. Primarily, fish toxicological and environmental studies have encouraged interest in the determination of toxic element in seafood [8]. Hence, in this regards, the present study was conducted to determine the concentration of some trace metals in the muscle tissues of three commercially important edible fishes i.e., catfish (*Sperata seeghala*), mullet fish (*Mugil incilis*) and major carp (*Catla catla*)purchased from the local fish market of Quetta, Balochistan inorder to analyzed their impact on human health condition.The basic aim of our study was to detect some useful and harmful metals elements in muscles of these edible fishes collected from the different environments; marine,brackish water and fresh water ecosystems.

## MATERIALS AND METHODS

**Fish Sampling:** Three commercially important and commonly consumed marine and fresh water fish species were used in this study. The studyfocused on evaluating the trace metal levels in tissues of fish species samples catfish (*Sperata seeghala*) mullet fish (*Mugil incilis*) and major carp (*Catla catla*). A total of 30 Fish samples (10 samples of each species) were collected from the different supermarkets of Quetta city of Balochistan province, Pakistan. Obtained samples were than kept in ice box for further analysis.

**Sample Preparation:** In laboratory, for the isolation of the muscle samples, fishes were washed and de-scaled before dissection. Precautions were taken during dissection of the internal organs to avoid any indemnities and metal contaminations of the muscle samples by using stainless steel dissecting kits. Muscles were then subjected to oven drying at 180°C for 6 hours.

**Instrumentation:** Flame Atomic Absorption Spectrophotometer (Perkin Elmer model AS 3100 double beam mode, USA) with multi element hollow cathode lamp was used for the analysis of trace elements (Ca, Cr, Na, Fe, Mn, K) present in the muscle tissue extracts obtained from the three different species of edible fishes. Air-acetylene was used as fuel for flame. Metals concentrations of manganese (Mn), calcium (Ca), chromium (Cr), sodium (Na), Iron (Fe) and potassium (K) in the muscle tissue of each sample was analyzed. The results were presented as mg/kg of fish muscles.

**Metal Extraction from the Muscle Tissues of Fish:** For the analysis of metals, digestion of muscle tissues obtained from three species was carried out. Tissue samples were thawed, rinsed in distilled water and blotted with blotting paper. Then shifted to 100 ml volumetric flasks already washed with distilled water and dried in oven at 60 °C for a few minutes. Known weight (2.0 grams) of each tissue was shifted to volumetric flasks. Samples were digested according to the methods described by Van Loon [9] and Due-Freez and Steyn [10]. At the time of digestion to each flask, add 10 ml nitric acid (55%) and 5 ml perchloric acid (70%). The flasks were then placed on hot plate and allowed to digest at 200 to 250 °C until transparent and clear solutions of three muscle samples were obtained. The dense white fume from the flasks after brown fumes was an indication of completion of digestion. By this method digestion was completed in 2 to 4 hours as stated by Van Loon [9]. After digestion, samples were cooled. The digests were diluted to 10ml with Nano pure distilled water appropriately in the range of standards that were prepared from stock standard solution for the detection of the metals as followed by Iram *et al.* [11].

**Statistical Analysis:** All statistical analysis was carried out by using MS excel and Minitab statistical software 17.0 version.

**Coefficient of Correlations and Covariances:** Coefficient of correlations (r) at 5% significant level ($p>0.05$) and covariances (C.V) also calculated in order to measure the strength of relationship between metal contents in the muscle tissues among the three selected species of this study. The highest value of correlation coefficient (r) showed the strong relationship in the metal contents among the two fish species. The highest value of covariances (C.V) was showing the highest degree of variation in the metal contents in the muscles of any two fish species.

## RESULTS AND DISCUSSIONS

**Metal Concentrations:** The levels of some selected metals (mg/Kg) in the muscle tissues of three commercially important edible fish species were presented in Table 1 and Figure 1. At present study, six metals including sodium (Na), chromium (Cr), calcium (Ca), potassium (K), manganese (Mn) and iron (Fe) were investigated in the muscle tissue of two fresh water fishes (major carp and catfishes) and a marine water fish species (mullet fishes)

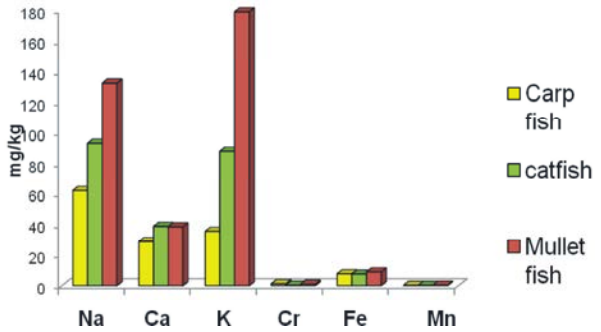


Fig. 1: Metals concentrations in the muscles of three commercially important edible fishes of Quetta

Table 1: The levels of some selected metals in the muscle tissues of three commercially important edible fishes

| | Metal Concentration (mg/kg) | | |
|---|---|---|---|
| | Sample A | Sample B | Sample C |
| Metals | Carp fish | catfish | Mullet fish |
| Na | 61.8 | 93.0 | 132.5* |
| Ca | 28.7 | 38.7* | 38.5 |
| K | 35.5 | 87.9 | 179.0* |
| Cr | 1.2* | 0.3 | 0.9 |
| Fe | 7.7 | 7.5 | 9.0* |
| Mn | 0.2 | 0.2 | 0.3* |

Note: * shows the highest concentration of metal.

that are most commonly use as edible fishes in Balochistan province. Among them, mullet fish mostly showed a highest concentration of sodium, potassium, iron and manganese in its muscle tissue than the carp and cat fishes, as shown in Table 1 and Figure 1, respectively. Hence, in the present study, most metal levels in the muscles of three selected species were found in order, mullet>catfish>carp fishes, respectively. This might be due to differences in metal concentrations and chemical characteristics of water in which fish lived or because of some other factors such as, ecological needs, metabolism and feeding patterns of fishes that may also have some effects on the metal concentrations in the bodies of fishes. In the river, fish are often at the top of the food chain and have the great tendency to concentrate metals from the water [12]. Therefore, bioaccumulation of metals in fish can be considered as an index of metal pollution in the aquatic bodies that could be a useful tool to study the biological role of metals present at higher concentrations in fish [13-17]. Thence, mullet fishes were marine/brackish water species that showed higher accumulation of metals in their bodies than the two exclusively fresh water fisheslike catfish and major carps of the present study, however, the response of these three fish species for the accumulation of metals in their bodies did not vary considerably. Further, the overall result of our present study revealed that in general, the levels of these six metals in the muscles of our three selected species were found in order, K>Na>Ca>Fe>Cr>Mn, respectively. Hence, the concentration of some metals i.e., sodium, potassium and calcium were found to be highest as compare to the iron, chromium and manganese (Table 1 and Figure 1). Thus, the muscle tissues of our three selected edible fish species could be considered as the rich sources for some useful metals like potassium and calcium in human diet that later quiet valuable especially for the growth of bones and make them strong during the developmental stage.

In the present study, the carp fish showed higher accumulation of chromium (Cr) in their bodies than other two species, while calcium (Ca) in catfish, respectively. The concentration of potassium was also highest in mullets >catfishes>carp fishes. Rauf *et al*. [17] and Javed [18] reported that the major carps at BalokiHeadworks accumulated significantly highest amounts of calcium (Ca) and chromium (Cr) in their bodies than those captured from Sidhnai Barrage, however, the difference for the toxicity of chromium was statistically significant in carp fishes among three sampling stations.

In order to measure the strength of relationships between the metal contents in the muscle tissues of three fish species, coefficient of correlations (r) and covariances (C.V) were calculated and recorded in the Table 2. Highly significant correlations (p>0.05) exist between the metal contents of the muscle tissues of three selected fish species i.e., catfish (*Sperata seeghala*), mullet fish (*Mugil incilis*) and major carp (*Catla catla*), respectively.

Table 2: Pearson correlation (r) and covariance's (C.V)between the levels of some selected metals in the muscle tissues of three commercially important edible fish species

| | Pearson correlation coefficient (r) at p>0.05 | | | Covariance's (C.V) | | |
|---|---|---|---|---|---|---|
| Metals concentrations | Samples A and B | Samples A and C | Samples B and C | Samples A and B | Samples A and C | Samples B and C |
| | 0.92* | 0.82* | 0.96* | 982.4 | 1521.5 | 3190.2 |

Note: * Shows the highly significant correlations between the metal contents of muscles tissues of edible fishes.

**Significance of Metal Analysis:** Metals generally regarded as essential for human health in trace amounts because they form an integral part of one or more enzymes involved in a metabolic or biochemical process. In the present study six metals are studied in the muscles tissues of three edible fish species. All these metals have different essential role in human body such as;

**Sodium:** Sodium helps control blood pressure and regulates the function of muscles and nerves, which is why sodium concentrations are carefully controlled by the body. However, most people consume far more sodium than their bodies need. Sodium also plays a special role in controlling the heartbeat by helping in its origin and maintenance. Daily requirement of sodiumin adults is about 2-3 grams. It is absorbed nearly completely from diet in the intestinal tract.

**Calcium:** The human body is 2 percent calcium and fish is one of the major sources of calcium.Calcium works with magnesium in its functions in the blood, nerves, muscles and tissues, particularly in regulating heart and muscle contraction and nerve conduction. In the result of the current study we find anexcessive range in all the three fish muscles which can count of the edibility of these fishes.

**Potassium:** Potassium is a very significant body mineral, important to both cellular and electrical functions. It is one of the main blood minerals called "Electrolytes" (The others are sodium and chloride) which means it carries a tiny electrical charge (Potential). Potassium is the primary positive ion (Cation) found within the cells, where 98 percent of the 120 grams of potassium contained in the body is found. The blood serum contains about 4-5 g (Per 100 ml.) of the total potassium; the red blood cells contain 420 mg, which is why a red-blood-cell level is a better indication of an individual's potassium status than the commonly used serum level. With respect to this need of potassium to the human body we can say that mullet is very good source of potassium. Same like that catfish and carp fish also count is source of this essential element.

**Chromium:** Chromium is a mineral our bodies use in small amounts for normal body functions, such as digesting food. It also helps to control blood sugar level and may play a role in management type 2-diabetes. Daily recommended chromium for adult men and women is 50-200µg/day [19]. But taking excessive chromium may leads to some problems like kidney damage and hyperglycemia. The required chromium normal range is studied in the muscles of the above discussed three fishes.

**Iron:** Iron is an essential element for most life on Earth, including human beings. Iron is required for the production of red blood cells (A process known as haematopoiesis) but it's also part of hemoglobin (That is the pigment of the red blood cells) binding to the oxygen and thus facilitating its transport from the lungs via the arteries to all cells throughout the body. Males of average height have about 4 grams of iron in their body and females about 3.5 grams while children will usually have 3 grams or less. These 3-4 grams are distributed throughout the body in hemoglobin, tissues, muscles, bone marrow, blood proteins, enzymes, ferritin, hemosiderin and transport in plasma. Hence, these three fishes can contribute the required rates of iron to the human body.

**Manganese:** It has been determined that each adult has about 15-20 mg of manganese stored in his or her body. Low intake of manganese are associated with poor bone formation. Manganese is a required co-factor for an enzyme called prolidase, which is in turn necessary to make collagen as a structural component of skin. This amount of manganese can easily get from the above listed fishes [20].

Knowledge of the metal levels in muscles of fish is important with respect to nature of management and human consumption of fish. Even the metal concentrations in the tissue of same freshwater fish species was found to be varied considerably among the different locations throughout the world [17, 21, 22], this might be because of the variations in their environmental conditions in which they lived. Muscle is the major tissue of concern under routine monitoring of metal contamination in aquatic environment because of the edible nature of fish white muscle. Hence, it is quite important and valuable to examine the fish muscle for the deposition of some metals causing different health threats for the human beings and other aquatic organisms, while consuming fish as a food. Fish muscle was previously studied by several workers throughout the world for recoding the level of some metals even in smallest amount can produce fresh water and riverine pollution across the aquatic ecosystems that later accumulated in the bodies of aquatic biota found there [2, 11, 23-27].

## CONCLUSION

From the obtained results it could be concludedthat the studied fishes contain all the essential metals within the range of the human body requirement, that's why these fishes are use as food source to get the precious elements for the different functions of the human body. Furthermore, this research work will help all those who concern with these fishes to use as food or make research on them.

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## REFERENCES

1. Nor Hasyimah, A.K., V. James-Noik, Y.Y. Teh, C.Y. Lee and H.C. Pearline, 2011. Assessment of cadmium (Cd) and lead (Pb) levels in commercial marine fish organs between wet markets and supermarkets in Klang Valley, Malaysia. Int. Food Res. J., 18: 795-802.
2. Zubia, M., Asim-Ullah, F. Neelam, T.M. Sidra, M. Laila, Sajeela-Naz, S. Zaman, W. Ahmad, Fahim-Ullah and Hameed-Ur-Rehman, 2014. Heavy Metals Detection of a Carp Species, *Bariliusbendelisis* (Family Cyprinidae) Collected from the Shnebaye Stream of District Karak, Khyber Pakhtunkhwa Province, Pakistan. Int. J. Pharm. Sci. Rev. Res., 28(2): 216-219.
3. Agusa, T., T. Kunito, A. Sudaryanto, I. Monirith, S. Kan-Atireklap, H. Iwata, I. Ahmad, J. Sanguansin, M. Muchtar, T.S. Tana and S. Tanabe, 2007. Exposure assessment for trace elements from consumption of marine fish in Southeast Asia. Environ. Pollut., 145: 766-777.
4. Virtanen, J.K., T.H. Rissanen, S. Voutilainen and T.P. Tuomainen, 2007. Mercury as a risk factor for cardiovascular diseases. J. Nutr. Biochem., 18(2): 75-85.
5. Raja, P., S. Veerasingam, G. Suresh, G. Marichamy and R. Venkatachalapathy, 2009. Heavy metals concentration in four commercially valuable marine edible fish species from Parangipettai Coast, South East Coast of India. Int. J. Anim. Veter. Adv., 1(1): 10-14.
6. Alinnor, I.J. and I.A. Obiji, 2010. Assessment of trace metal composition in fish samples from NworieRiver. Pak. J. Nutr., 9(1): 81-85.
7. Burger, J., A.H. Stern, C. Dixon, C. Jeitner, S. Shukla, S. Burke and M. Gochfeld, 2004. Fish availability in supermarkets and fish markets in New Jersey. Sci. Total Environ., 333: 89-97.
8. Indrajit-Sen, Ajay-Shandil and V.S. Shrivastava, 2011. Study for Determination of HeavyMetals in Fish Species of the River Yamuna (Delhi) by Inductively Coupled Plasma-Optical Emission Spectroscopy (ICPOES). Adv. Appl. Sci. Res., 2(2): 161-166.
9. Van Loon, 1980. Analytical atomic absorption spectroscopy. Selected methods. Academic press, New York, pp: 337.
10. Due-Freez, H.H. and G.J. Steyn, 1992. A preliminary investigation of the concentration of selected metals in the tissues and organs of the tiger fish (*Hydrocynusvittatus*) from the Olifants River, Kruger National Park, South Africa. Water, 18: 131-136.
11. Irum, S.A., A.A. Sthanadar, M. Shah, P. Asmat, M. Yousaf, A. Muhammad and M. Zahid, 2013. White muscle as a bio-indicator of cadmium (Cd) pollution across Kalpani River Mardan, Khyber Pakhtunkhwa Pakistan. Int. J. Biosci., 3: 105-116.
12. Mansour, S.A. and M.M. Sidky, 2002. Ecotoxicological Studies: 3. Heavy metals contaminating water and fish from Fayoum Governorate, Egypt. Food Chem., 78: 15-22.
13. Javed, M. and S. Hayat, 1998. Fish as a bio-indicator of freshwater contamination by metals. Pak. J. Agri. Sci., 35: 11-15.
14. Dural, M., M.Z.L. Goksu and A.A. Ozak, 2007. Investigation of heavy metal levels in economically important fish species captured from the TuzlaLagoon. Food Chem., 102: 415-421.
15. Tawari-Fufeyin, P. and S.A. Ekaye, 2007. Fish species diversity as indicator of pollution in IkpobaRiver, Benin City, Nigeria. Rev. Fish Biol. Fisheries, 17: 21-30.

16. Karadede, H.I., S.A. Oymak and E. Unlu, 2004. Heavy metals in mullet, *Liza abu* and catfish, *Silurustriostegus*, from the Ataturk Dam Lake (Euphrates), Turkey. Environ. Int., 30: 183-188.
17. Rauf, A., M. Javed and M. Ubaidullah, 2009. Heavy metal levels in three major carps (*Catla catla*, *Labeo rohita* and *Cirrhina mrigala*) from the river Ravi, Pakistan. Pakistan Vet. J., 29(1): 24-26.
18. 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.
19. Cefalu, W.T. MD. and F.B.P. MD. Hu, 2004. Role of Chromium in Human Health and in Diabetes. Diabetes care, 27(11): 2741-2751.
20. http://www.whfoods.com/genpage.php?tname=nutrient and dbid=77.
21. Chattopadhyay, B., A. Chatterjee and S.K. Mukhopadhyay, 2002. Bioaccumulation of metals in the East Calcutta wetland ecosystem. Aquat. Ecosys. Health Manag., 5(2): 191-203.
22. Papagiannis, I., I. Kagalou, J. Leonardos, D. Petridis and V. Kalfakaou, 2004. Copper and zinc in four freshwater fish species from Lake Pamvotis (Greece). Environ. Int., 30: 357-362.
23. IUCN (International union for conservation of nature), 1994. Pollution and the Kabul River, an analysis and action plan. Environmental Planning and Development Department, NWFP, Pakistan.
24. Khan, A.R., M. Akif, M. Khan and M. Riaz, 1999. Impact of industrial discharges on the quality of Kabul River water at Aman Gar, Nowshera, Pakistan. J. Chem. Soc. Pak., 21: 97-105.
25. Akif, M., A.R. Khan, M.K. Sok, Z. Hussain, M. Abrar and A. Muhammad, 2002. Textile effluents and their contribution towards aquatic pollution in the Kabul River (Pakistan). J. chem. Soc. Pak., 24(2): 106-111.
26. Yousafzai, A.M. and A.R. Shakoori, 2009. Fish White Muscle as Biomarker for Riverine Pollution. Pak. J. Zool., 41(3): 179-188.
27. Yousafzai, A.M., M. Siraj, H. Ahmed and D.P. Chivers, 2012. Bioaccumulations of heavy metals in common carp: Implications for human health. Pak. J. Zool., 44(2): 489-494.
28. Abah, J., S.T. Ubwa, D.I. Onyejefu and S.A. Nomor, 2013. Assessment of the levels of some heavy metals in mudfish (*Clariasanguillaris*) from River Okpokwu, Apa, Benue State, Nigeria. Int. J. Biosci., 3: 142-150.
29. Tanee, T., A. Chaveerach, C. Narong, M. Pimjai, P. Punsombut and R. Sudmoon, 2013. Bioaccumulation of heavy metals in fish from the Chi River, MahaSarakham Province, Thailand. Int. J. Biosci., 3: 159-167.