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# Assessment of essential metals in some freshwater fishes in Ayeyawady River, Magway Segment, Myanmar

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## Abstract

*A study was conducted to assess the concentration of essential metals such as iron (Fe), copper (Cu), manganese (Mn) and zinc (Zn) in the muscles of some freshwater fishes (Labeo rohita, Salmostoma sardinella, Clupisoma prateri, Ompok bimaculatus, Wallago attu and Mystus cavasius) from Ayeyawady River, Magway Area during December 2011 to March 2012. Ten samples for each species were used for metal analysis. For sample preparation, acid digestion procedure was used. The concentration of metals was analyzed by Atomic Absorption Spectrophotometry (AAS) (AA-6300). In the muscles of the fishes studied, Fe was the highest accumulated metal (6.031 to 15.64ppm d.w) and Cu the lowest accumulated one (0.176 to 0.281 ppm d.w). The order of metal accumulation in the muscles of the fishes studied was Fe> Zn> Mn> Cu. The level of metals in the fishes studied was lower than the permissible limits of FAO/WHO guidelines except the level of Mn in Salmostoma sardinella but it seems not to be considered. ANOVA test was used to determine the differences of statistical means of the heavy metal concentration among fish species studied. The level of metals among six fishes studied was not statistically significant ($p > 0.05$). It can be concluded that from a public health point of view, fish commonly consumed by the local population in Magway Area do not seem to pose any significant human health risks due to metal exposure.*

**Keywords:** Metals, muscles, permissible limits, health risks, freshwater fishes, Ayeyawady River.

## Introduction

During the past few decades, the pollution of aquatic environment by metals has become a worldwide problem and most of which have toxic effects on living organisms[1]. Metals are of particular concern due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems and in animals including human[2,3].

The trace amount of these metals are naturally occurred in the aquatic environment but their concentration have increased due to domestic, industrial, mining and agricultural activities. Some metals are essential for many biological processes at low levels (e.g., copper, cobalt, zinc, iron and manganese). Other metals have no known critical role in living organisms and are toxic at even low concentrations (e.g., cadmium, mercury and lead)[4]. Even essential metals, their presence higher than the amount essentially required for organisms may become toxicity[5].

Many researchers in all over the World have studied the heavy metal level in fish as an index to assess the level of these metals in the aquatic environment. The biological method to control metal pollution in aquatic environment has been considered to be cost-effective and sensitive way of analysis[3]. Because they are easy to access and investigate the different trophic levels of the aquatic ecosystem[6]. Therefore, fish may accumulate some amount of metals from their aquatic environment. In Myanmar, however, the literature in which the study of heavy metal level in fish species was very limited. The country's extensive river systems have supported the freshwater fisheries resources. It has more than 21.35 million ha (213,500 $km^2$) of freshwater ecosystems. In 2011, ASEAN-SEAFDEC Conference have considered sustaining food supply from inland fisheries for Food Security towards 2020, "Fish for the People 2020"[7,8].

Myanmar is mainly an agricultural based country and therefore a wide variety of pesticides and plant promoting hormones have been extensively used. Traditionally, Myanmar people of various society prefer freshwater fish to marine fish. Ayeyawady River (2,170 km long) is the life artery of Myanmar and serves as an important source of water and fish for the people and supports one of the most productive inland fisheries in the ASEAN[9].

The study site is one of the major landing sites of commercial fisheries in Magway Area. For these intensive considerations, the objectives of the present study are to determine the level of copper, iron, manganese and zinc in six fish species mostly consumed by the local people and to assess the level of these metals in fishes according to International standards.

## Materials and methods

Fishes were directly purchased from local fishermen who were fishing near Myathalun Pagoda, Magway, Myanmar (Figure-1). Fishes were collected during December 2011 to March 2012.


**Figure-1:** Figure showing the fish landing site.

**Sample collection and preparation:** Six species of fish were chosen on the basis of popularity by local market survey. For each sample, about 30g of muscle tissue were collected for large specimen while for small size fishes, ten to fifteen fishes were pooled. Ten samples for each species were used. Then, the samples were sun dried for five days and then ground by blender into small pieces. After that samples were sun dried again, powdered finely by pestle and sieved. Finally, dried fish powder was stored in airtight container until acid digestion.

**Acid digestion:** Acid digestion procedure was used following after Agemian *et al*. with slight modifications[10]. About two gram of sample (dry weight) was added to polyethylene glass test tube. Two ml of concentrated nitric acid ($HNO_3$, 65%) and then two ml of concentrated sulfuric acid ($H_2SO_4$, 80%) were added into the sample. The reaction was allowed to proceed and the test tubes were placed at room temperature overnight. Next day, the test tubes were heated by water bath up to the temperature of 80˚C for about two hours. After the samples were totally dissolved, the tubes were allowed to cool. After cooling, about two ml of hydrogen peroxide ($H_2O_2$, 80%) was added and heated again by water bath up to about 98˚C for one and half hours until the sample was clear. And then the samples were cooled at room temperature and strained with filter paper. Finally, the volume of the filtrate was adjusted with deionized water up to ten ml of solution.

**Metal analysis:** The samples prepared were sent to Universities' Research Centre (URC), Yangon, Myanmar for analysis of metals. The concentration of metals in the samples was analyzed by Atomic Absorption Spectrophotometry (AAS) (AA-6300). This method is reliable for determination of trace metals in aqueous solution. The value of mean metal concentration was expressed as milligram per litre (mg/l) or part per million (ppm, dry weight). The samples were examined for three times to get more accurate results.

**Data analysis:** All the data will be managed in MS excel spreadsheet and SPSS software will be used for data analysis. ANOVA test was used to determine the difference ($p<0.05$) of statistical means of the heavy metal concentration among fish species studied.

## Results and discussion

**Accumulation of metals in the fishes studied:** In the present study, Cu, Fe, Mn and Zn level in some freshwater fishes commonly consumed by the local residents was analyzed and used as an index to assess these metal level in the river water of Ayeyawady River Segment, Magway. The accumulation of Cu, Fe, Mn and Zn in the muscles of six fresh water fishes viz., *Labeo rohita* (local name, Nga gyin myet san ni), *Salmostomasardinella* (Nga yin baung za), *Clupisomaprateri* (Nga myin), *Ompokbimaculatus* (Nga nu than), *Wallago attu* (Nga but) and *Mystus cavasius* (Nga zin yaing) from the Ayeyawady River was presented in Table-1 and Figure-2. The concentration of Fe, Zn, Mn and Cu in the muscle tissue of fishes studied was assessed with FAO/WHO guidelines (Figure-3)[11,12].

Even in mild polluted condition of the aquatic environment, metals accumulated in the muscle tissue of fish were probably high, especially those at the top of aquatic food chain and great importance because of human health concern[13]. Moreover, fish are unable to excrete some extent of metal burden in their body and remain almost constant throughout their life time[6]. Khin Myint Mar reported that the accumulation of metals in the fish depends on location, feeding behavior, trophic position, size, and duration of exposure to metals of fish[14]. Information of metal level in fish is important to manage because of the main reason such as human consumption of fish[15].

The metals selected to determine are essentials and occur in most natural diet in sufficient quantities to satisfy the metabolic requirements of fishes[16]. During the study period, Fe was the most accumulated metal in muscle of fishes, Zn was the second abundant metal, followed by Mn and Cu, the least accumulated metal. Mn and Cu were also important in metabolism of living organisms[16,17]. Cu also functions in the formation of hemoglobin together with Fe and occurs in nature at low level. Although these metals are essentials, their excess presence will give toxic effects on living organisms[18].

In concerning with Fe, the range of Fe in the muscles of the fishes studied was from 6.03 to 15.64ppm d.w. The accumulation of Fe in the muscle tissue of fishes studied was the highest in *Mystus cavasius* (15.64ppm) and the lowest in *Labeo rohita* (6.03ppm). Kumar *et al*. reported the concentration of Fe was16.52ppm (dry weight) in the muscles of

freshwater fish in aquaculture ponds of east Kolkata[19]. The Fe level of present study is in accordance with the results of Kumar *et al*[19]. However, Yosef and Gomaa recorded the Fe level in fresh mullet fish from El-Burullus Lake of Egypt was 31.815ppm[15]. Nwani *et al.* published the Fe level in the muscle of *Clarias anguillaris* from the fresh water ecosystem at Afikpo, Nigeria was 186ppm[20]. The Fe level of present finding are lower than the reports of the above two authors. Besides, the concentration of Fe in the muscles of the species studied was far from the permissible limit (100ppm d.w) set down by FAO/WHO guidelines. The bioaccumulation pattern of Fe in muscle tissue of six fish species from Ayeyawady River of Magway Area was observed as *Mystus cavasius*>*Salmostoma sardinella*>*Clupiso*ma *prateri*>*Ompok bimaculatus*>*Wallago attu*>*Labeo rohita*.

**Table-1:** Concentration of metals in muscle tissues of fish species collected from Ayeyawady River, Magway Area (n=10).

| Scientific Name | Local Name | Fe (ppm) | Zn (ppm) | Mn (ppm) | Cu (ppm) |
|---|---|---|---|---|---|
| *Labeo rohita* | Nga-gyin-myet-san -ni | 6.031±0.014 | 3.859±0.019 | 0.55± 0.004 | 0.20± 0.005 |
| *Salmostoma sardinella* | Nga-yin-boung-za | 14.41±0.01 | 7.57±0.03 | 1.24 ± 0.01 | 0.19±0.01 |
| *Mystus cavasius* | Nga-zin-yaing | 15.64±0.08 | 6.62 ± 0.01 | 0.79± 0.01 | 0.18 ± 0.001 |
| *Ompok bimaculatus* | Nga-nu-than | 9.59±0.05 | 6.078 ± 0.03 | 0.91 ± 0.01 | 0.28 ± 0.03 |
| *Wallago attu* | Nga-but | 6.48±0.01 | 5.333± 0.01 | 0.52± 0.01 | 0.19 ± 0.003 |
| *Clupisoma prateri* | Nga-myin | 13.10±0.23 | 6.27 ± 0.01 | 0.85± 0.02 | 0.22 ± 0.01 |
| FAO/WHO guidelines | | 100 | 100 | 1 | 30 |

Mean ±SD

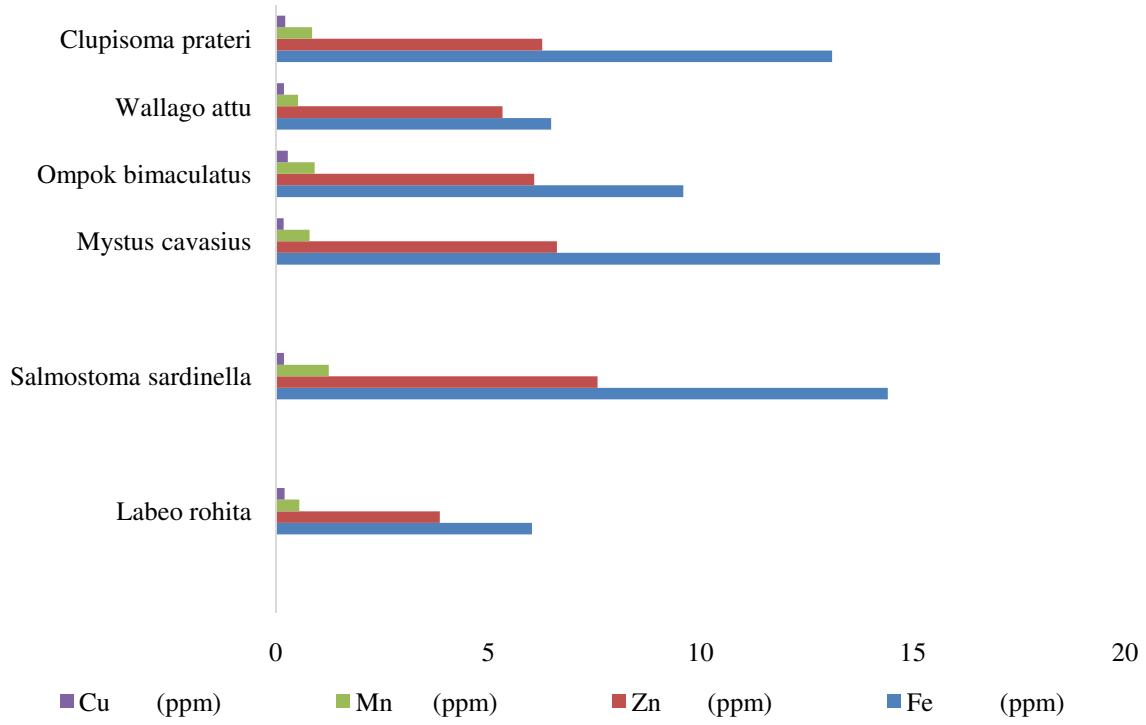


**Figure-2:** Metal accumulation in fish species studied.

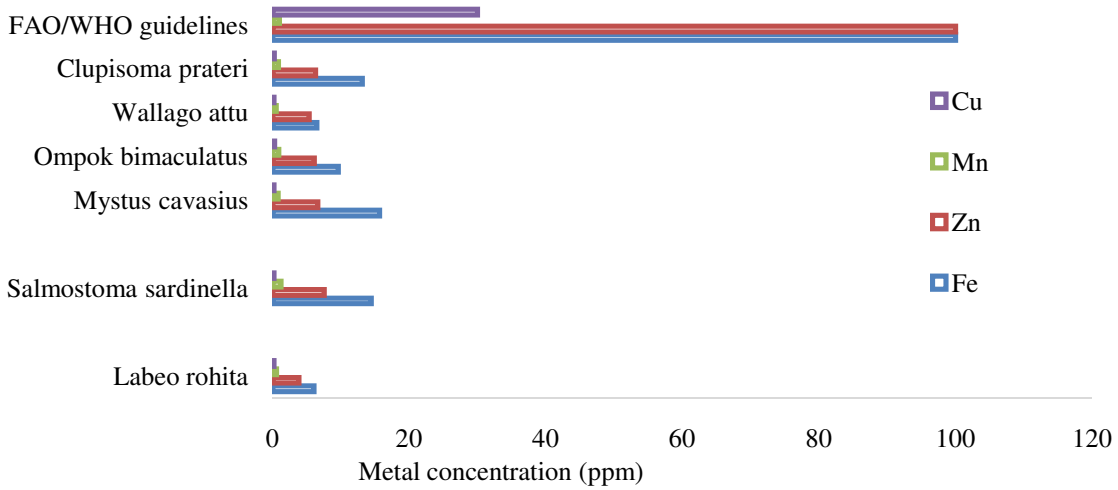


**Figure-3:** Metal concentration in the species studied compared with FAO/WHO guidelines.

Concerning to Zn, it was the second highest accumulated metal in the muscles of the fishes studied that ranged from 3.86 to 7.57ppm d.w. The maximum concentration of Zn was found in the muscle of *Salmostoma sardinella* while minimum concentration in *Labeo rohita*. Nwani *et al*. described the Zn in the muscle of *Clarias nigrodigitatus* was 7.75 ppm from lotic freshwater ecosystem at Afikpo, Nigeria[20]. The Zn level of present study was agreed with the results of Nwani *et al*. However, Jonathan and Maina stated that Zn level (186.19ppm) was found in the muscle of *Mastacembalus armatus* from India and Nawaz *et al.* described Zn level (37.85ppm) in some fresh water fish of Pakistan[21,22]. The Zn level of present study was much lower than the results of the above two authors. Moreover, the concentration of Zn in the muscles of the species studied was very much less than the prescribed limit (100ppm d.w) set down by FAO/WHO guidelines. The bioaccumulation pattern of zinc in muscle tissue of six fish species from Ayeyawady River of Magway Area was observed as *Salmostoma sardinella* >*Mystus cavasius* >*Clupisoma prateri*>*Ompok bimaculatus* >*Wallago attu* >*Labeo rohita*.

With regard to Mn, it was the third highest accumulated metal in the muscle tissue of fishes studied ranged from 0.516 to 1.237 ppm d.w. The highest concentration was found in *Salmostoma sardinella* while the lowest in *Wallago attu*. The present finding of Mn concentration was agreedwith the findings of Jonathan and Maina who reported Mn level in *Clarias anguillaris* and *Heterotis niloticus* from Lake Geriyo Yola in Nigeria but lower than the result of Kumar *et al.* who reported Mn level of some freshwater fishes from India was 4.24ppm d.w[19,21]. The Mn level of the present study was found not to be high except that in *Salmostoma sardinella* which has slightly higher level than FAO/WHO guidelines (1ppm d.w). The bioaccumulation pattern of manganese in muscle tissue of six fish species from Ayeyawady River of Magway Area was observed as *Salmostoma sardinella* >*Ompok bimaculatus* >*Clupisoma prateri* >*Mystus cavasius* >*Labeo rohita* >*Wallago attu*. An excess of Mn causes toxic effect and large amount inpair the central nervous system and immunological functions of fish[3,4]. However, the Mn level in the *Salmostoma sardinella* is slightly higher than permissible limits of FAO/WHO. Nevertheless, it was suggested that this level of Mn seems not to be considered.

Cu, the least accumulated metal, in the muscles of fishes studied was ranged from 0.176 to 0.281ppm d.w. The highest level of Cu was found in *Ompok bimaculatus* while the lowest in *Mystus cavasius*. The present findings were lower than that of Ambedkar *et al*. who reported that the Cu in the muscle of *Mystus vittatus* from India was 0.62ppm dry weight[23]. Moreover, Cu in the muscles of the fishes studied was lower than the prescribed limit (30ppm d.w) of FAO/WHO. The bioaccumulation pattern of Cu in muscle tissue of six fish species from Ayeyawady River of Magway Area was observed as *Ompok bimaculatus* >*Clupisoma prateri* >*Labeo rohita* >*Wallago attu* >*Salmostoma sardinella* >*Mystus cavasius*.The results from the data obtained showed that the level of metals among six fishes studied was not statistically significant($p > 0.05$).

## Conclusion

This study is concluded that order of metal accumulation in the present study was Fe > Zn > Mn > Cu. This order may be due to the different uptake, metabolism and excretion of metals in fish. The level of metals in the fishes studied from Ayeyawady River of Magway Area was lower than the permissible limits of FAO/WHO guidelines. All the parameters are within the prescribed limits of FAO/WHO guideline except slightly higher level of Mn in the sample of *Salmostoma sardinella*. From which it was suggested the presence of Mn in the river water is in considerable amount. However, it seems not to be hazard to fish and fish consumers.

**Recommendation:** The study suggests that metal concentration should be monitored for identifying the source of possible contamination and it should be carried out to improve the water quality. Although the number of samples was small in the present study, it is likely to be used basic knowledge for future study and to be informed to the local people. From a public health point of view, fish commonly consumed by the local people in Magway Area do not seem to pose any significant human health risks due to metal exposure.

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## References

**1.** MacFarlane G.R. and Burchett M. (2000). Cellular distribution of copper, lead and zinc in the grey mangrove, Avicennia (Forsk.) Vierh. *Aquatic Botany,* 68, 45-59.

**2.** Censi P., Spoto S.E., Saiano F., Sprovieri M., Mzzola S., Nardone G. and Si Di Gerinimo R. (2006). Heavy metals in costal water systems. A case study from the north western Gulf of Thailand. *Chemosphere,* 64(7), 1167-1176.

**3.** Rauf A., Javed M. and Ubaidullah M. (2009). Heavy metal level in three major carps (*Catla catla*, *Labeo rohita* and *Cirrhina mrigala*) from the three River Ravi, Pakistan. *Pakistan Vet. J*., 29(1), 24-26.

**4.** Sofia (2005). Metal contamination in commercially important fish and shrimp species collected from Aceh (Indonesia), Penang and Perak (Malaysia). *M.Sc Thesis.* University Sains Malaysia.

**5.** Al-Weher S.M. (2008). Levels of Heavy Metal Cd, Cu and Zn in Three Fish Species collected from the Northern Jordan Valley, Jordan. *Jordan Journal of Biological Sciences,* 1(1), 41-46.

**6.** Nawaz S., Nagra S.A., Saleem Y. and Priydarshi A. (2010). Determination of heavy metals in freshwater fish species of the River Ravi, Pakistan compared to farmed fish varieties. *Environ. Monit. Assess*., 167, 461-471.

**7.** DoF (2010). Inland Fisheries of Myanmar. Department of Fisheries of Myanmar, Yangon.

**8.** Win Oo (2011). Inland fisheries of Myanmar (internet accessed 15 December 2011). Available from: http://www.inlandfishes.

**9.** Mya Than Tun (2007). Efforts to Preserve a Fishery Cultural Heritage in Myanmar: The "cooperative fishing" with Irrawaddy Dolphins. *In*: Fish for the People, 5(3), 35-38.

**10.** Agemian H., Sturtevant D.P. and Austen K.D. (1980). Simultaneous acid extraction of six trace metals from fish tissue by hot-block digestion and determination by atomic-absorption spectrometry. *Analyst*, 105(1247), 125-130.

**11.** FAO (1983). Food and Agriculture Organization. *FAO Fishery Circular,* 464, 5-100.

**12.** WHO (1989). Guidelines for drinking water quality. Health Criteria. Vol.1, 2nd ed., Geneva, Switzerland.

**13.** Karadede-Akin H. and Unlu E. (2007). Heavy metal concentrations in water, sediment and fish and some benthic organisms from Tigris River, Turkey. *Environ. Monit. Assess*., 131, 323-337.

**14.** Mar Khin Myint (2011). Uptake of heavy metals and relationship to feeding habit of selected fish species from Ayeyawady River, Mandalay and Magway Segments. *PhD Thesis*, University of Mandalay, Myanmar.

**15.** Yosef T.A. and Gomaa G.M. (2011). Assessment of some heavy metal contents fresh and salted Mullet fish collected from El-Burullus Lake, Egypt. *Journal of American Science*, 7(10), 137-144.

**16.** Partridge G.J. and Lymbery A.J. (2009). Effects of manganese in juvenile mulloway (*Argyrosomus japonicus*) cultured in water with varying salinity- Implications for inland mariculture. *Aquacture*, 290(3-4), 311-316.

**17.** Ye, C.X., Tian, L.X., Yang, H.G., Liang, J. J. Niu, J. and Liu, Y.J. (2009). Growth performance and tissue mineral content of juvenile grouper (*Epinephelus coioides*) fed diet supplemented with various levels of manganese. *Aquacult. Nutr*., 15(6), 608-614.

**18.** Lagler K.F., Bardach J.E. and Miller R.R. (1962). ICHTHYOLOGY. Toppon Co. Ltd., Japan.

**19.** Kumar B., Mukherjee D.P., Kumar S., Mishra M., Prakash D., Singh S.K. and Sharma C.S. (2011). Bioaccumulation of heavy metals in muscle tissue of fishes from selected aquaculture ponds in east Kolkata wetlands. *Annals of Biological Research*, 2(5), 125-134.

**20.** Nwani C.D., Nwachi D.A.,Okogwu O.I., Ude E.F. and Odoh G.E. (2010). Heavy metals in fish species from lotic freshwater ecosystem at Afikpo in Nigeria. *Journal of Environmental Biology*, 31(5), 595-601.

**21.** Jonathan B.Y. and Maina H.M. (2009). Accumulation of some heavy metals in *Clarias anguillaris* and *Heterotis niloticus* from Lake Geriyo Yola, Nigeria. *Nature and Science*, 40-43.

**22.** Nawaz S., Nagra S.A., Saleem Y. and Priydarshi A. (2010). Determination of heavy metals in freshwater fish species of the River Ravi, Pakistan compared to farmed fish varieties. *Environ. Monit. Assess*., 167, 461-471.

**23.** Ambedkar G. and Muniyan M. (2011). Bioaccumulation of some heavy metals in the selected five fresh water fish from Kollidam River, Tamilnada, India. *Adv. Appl. Sci. Res*., 2(5), 221-225.