Content of Heavy Metals in Some Fish Species from Ayeyawady River Segment between Nandaw Kyun Village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township

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Abstract

Content of heavy metals was determined in the muscle tissues of 11 fish species from Ayeyawady River segment between Nanda Kyun village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township during the cold season of 2019-2020. The fish samples were analyzed in the laboratory of Material Science Research Division, Department of Research and Innovation, Kyaukse. Content of heavy metals in tissue samples was determined by using Shimadzu's ICPE-9820 multitype ICP Emission Spectrometer. The results indicated that the highest concentration of arsenic (As) was found in *Wallago attu* (0.37 ppm) while the mercury (Hg) content was the highest in *Osteobrama belangeri* (0.31 ppm). However, *Ompko bimaculatus* contained the highest concentration of cadmium (Cd) (0.30 ppm), copper (Cu) (1.87 ppm) and lead (Pb) (0.81 ppm) among the fish species studied. The concentrations of heavy metals in the sampled fish are within the permissible limits of FAO/WHO (2011) except for the concentration of lead which some fish species showed beyond the acceptable limits.

Keywords: Heavy metals, Fish, Ayeyawady River

Introduction

Fish species are an important inductor of ecological health. The abundance and health of fish will show the health of water body. Fish species diversity can be used as a biological indicator to show the level of aquatic pollution contributing to environmental quality. Biodiversity affects the capacity of living system to respond to changes in the environment underpins ecosystem function and provide the ecosystem with goods and services that support human well-being. This has led to the development of some management programs to conserve and to increase needs for the freshwater fish population (Zainudin, 2005).

The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms. Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems (Goldstein; cited by Sen *et al.,* 2011). Heavy metals are well known environmental pollutants that cause serious health hazard to human, their effects are not immediate and show up later many years (Boguszewska *et al*., 2004; Jarup, 2003) (cited by Ali *et al*., 2011). Accumulation of heavy metals in an aquatic environment has direct consequences for men and the ecosystem.

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In Myanmar, the Ayeyawady River flows from north to south generally passing through the central area and finally discharges its contents into the sea. It is the country's largest river and most important commercial waterway. Due to holding of huge amount of water body, many aquatic organisms including fish and prawns inhabited in the river and well occupied and established in the different available niches of river ecosystem. However, due to the effects of different anthropogenic activities for their benefits, the water body may be polluted with various toxicants including heavy metals. The portion of Ayeyawady River segment between Nanda Kyun village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township is a flat plain area and has wide water body. In this water body, subpopulation of Irrawaddy dolphin *Orcaella brevirostris* was inhabited and well occupied. Moreover, many freshwater fish species ranging from small size to large size are also thriving very well in this water body.

This research asks whether the water body of Ayeyawady River has been polluted with toxicants including heavy metals during the present day and if polluted whether it can affect the aquatic organisms especially fish which is included in the daily food of Myanmar people with different ways of preparations. This research investigated the heavy metal contents in some fish species from Ayeyawady River.

Materials and Methods

Study Area

The fish samples were taken from the Ayerawady River segment between Nandaw Kyun village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township. The study area lies between 22° 34' 53.08" to 22° 03' 14.20" north latitude and between 95° 57' 39.35" to 96° 01' 01.33" east longitude. (Plate 1)

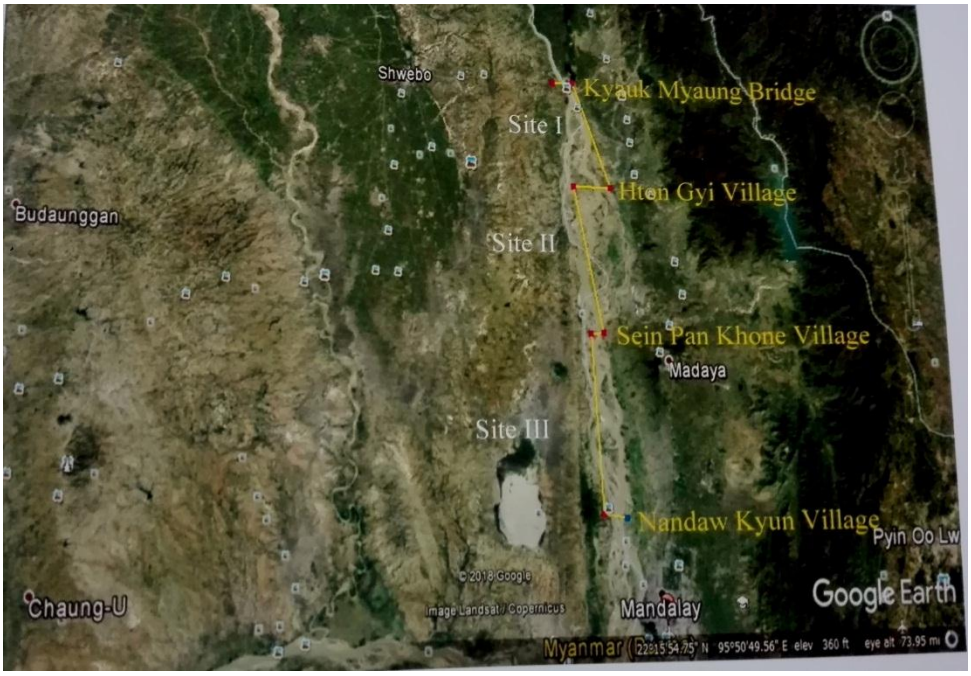

Plate 1 A location map of study area

Study Period

This study was conducted during the winter season of 2019-2020.

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Sample Collection and Identification

The fish samples were collected from the fishermen at the landing site. The external morphology of fish was examined and the photographic records of fish were taken in the fresh state. The fish collected were kept in the ice box and brought to the department of Zoology, University of Mandalay for further analysis. In the laboratory, the taxonomic characters of fish samples were noted down. The fish were identified using the key characters described in the reference literatures available. The fish were identified following Talwar and Jhingram (1991), Jayaram (2013) and Fishbase (2018).

Preparation of Samples

In the laboratory, the fish samples collected were washed thoroughly with tap water and then with distilled water to remove the adherent materials and contaminants. They were dissected out to remove the muscles. The muscles removed were kept in the petri-dish and labeled. The muscles were cut into small pieces. The fish muscle samples were dried in the oven at 120° C till the constant weight of dry samples was obtained. Then the dried muscle samples were crushed and powdered. The powdered samples were weighed by digital balance and kept in the airtight container. The samples were sent to Material Science Research Division, Department of Research and Innovation, Dattaw, Kyaukse Township for analysis of heavy metals.

Analysis of Heavy Metal Contents

The concentrations of arsenic (As), cadmium (Cd), copper (Cu), mercury (Hg) and lead (Pb) in the muscles of sampled fish were determined by using Shimadzu's ICPE-9820 multitype ICP Emission Spectrometer. The measured values were expressed as milligram per litre (mg/L) or parts per million (ppm).

Results

A total of 11 fish species from the study area was analyzed for the content of heavy metals. (Table 1)

Heavy Metal Contents

Arsenic (As)

Among the 11 fish species analyzed, the highest concentration of arsenic (As) was found in *Wallago attu* (0.37 ppm), followed by *Osteobrama belangeri* (0.31 ppm), *Sperata aor* (0.25 ppm), *Ompok bimaculatus* and *Notopterus notopterus* (0.21 ppm each), *Labeo calbasu*, *Eutropiichthys vacha* and *Labeo boga* (0.15 ppm each), *L. stoliczkae* (0.12 ppm), *Cirrhinus mrigala* (0.09 ppm) and *Channa striatus* (0.05 ppm) (Table 2).

Cadmium (Cd)

In the case of cadmium (Cd) analyzed in the 11 fish species, the highest concentration was found in *Ompok bimaculatus* (0.30 ppm), followed by *Osteobrama belangeri* (0.03 ppm), and *Sperata aor* (0.01 ppm). The remaining species concerned in this study showed no trace amount of cadmium content (Table 2).

Copper (Cu)

Regarding the copper (Cu) content in the 11 fish species analyzed, the highest concentration was found in *Ompok bimaculatus* (1.87 ppm), followed by *Labeo boga* (1.83 ppm), *Labeo calbasu* (1.78 ppm), *Eutropiichthys vacha* (1.70 ppm), *Osteobrama belangeri* (1.64 ppm), *Sperata aor* (1.53 ppm), *Wallago attu* (0.78 ppm), *Cirrhinus mrigala* and *Notopterus notopterus* (0.68 ppm each) and *L. stoliczkae* and *Channa striatus* (0.54 ppm each) (Table 2).

Mercury (Hg)

Concerning the mercury (Hg) content in the 11 fish species analyzed, the highest concentration was found in *Osteobrama belangeri* (0.31 ppm), followed by *Sperata aor* (0.29 ppm), *Labeo boga* (0.26 ppm), *Ompok bimaculatus* (0.14 ppm), *Notopterus notopterus* (0.11 ppm), *Channa striatus* (0.09 ppm), *Labeo calbasu* (0.06 ppm), *Cirrhinus mrigala* (0.05 ppm) and *Wallago attu* (0.03 ppm). The remaining two species revealed to be no trace amount of mercury content in their muscle tissues (Table 2).

Lead (Pb)

When consideration was made on the lead (Pb) content of 11 fish species analyzed, the highest concentration was found in *Ompok bimaculatus* (0.81 ppm), followed by *Sperata aor* (0.59 ppm), *Notopterus notopterus* (0.51 ppm), *Osteobrama belangeri* (0.43 ppm), *Eutropiichthys vacha* (0.42 ppm), *Labeo calbasu* (0.36 ppm), *Wallago attu* (0.31 ppm), *Labeo stoliczkae* (0.26 ppm), *L boga* (0.22 ppm), *Cirrhinus mrigala* (0.15 ppm) and *Channa striatus* (0.01 ppm) (Table 2).

Table 1 List of fish species used for the analysis of heavy metals content in the study area

Sr no	Order	Family	Species	Common name	Local name
1	Osteoglosssiformes	Notopteridae	*Notopterus notopterus* (Pallas, 1769)	Bronze Featherback	Nga-phe, Nga-pya
2	Cypriniformes	Cyprinidae	*Osteobrama belangeri* (Valenciennes, 1844)	Manipur	Nga-phant-ma
3			*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	Nga-gyin-phyu
4			*Labeo boga* (Hamilton, 1822)	Boga-labeo	Nga-lu
5			*L. calbasu* (Hamilton, 1822)	Kalbasu black rohee	Nga-net-pyar
6			*L. stoliczkae* Steindachner, 1870	Moulmein labeo	Nga-lae
7	Siluriformes	Bagridae	*Sperata aor* (Hamilton, 1822)	Long-whiskered catfish	Nga-gyaung
8		Siluridae	*Ompok bimaculatus* (Bloch, 1794)	Indian Butter catfish	Nga-nu-than
9			*Wallago attu* (Bloch & Schneider, 1801)	Boal freshwater shark	Nga-but
10		Schilbidae	*Eutropiichthys vacha* (Hamilton, 1822)	Batchwa vacha	Nga-myin-kun-mar
11	Perciformes	Channidae	*Channa striata* (Bloch, 1793)	Striped snake head	Nga-yant-auk

Table 1 Content of heavy metals in some fish species from Ayeyawady River segment between Nandaw Kyun village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township

Sr no	Name of fish species	Concentration (ppm)				
		As	Cd	Cu	Hg	Pb
1	*Notopterus notopterus*	0.21	ND	0.68	0.11	0.51
2	*Osteobrama belangeri*	0.31	0.03	1.64	0.31	0.43
3	*Cirrhinus mrigala*	0.09	ND	0.68	0.05	0.15
4	*Labeo boga*	0.15	ND	1.83	0.26	0.22
5	*L. calbasu*	0.15	ND	1.78	0.06	0.36
6	*L. stoliczkae*	0.12	ND	0.54	ND	0.26
7	*Sperata aor*	0.25	0.01	1.53	0.29	0.59
8	*Ompok bimaculatus*	0.21	0.30	1.87	0.14	0.81
9	*Wallago attu*	0.37	ND	0.78	0.03	0.31
10	*Eutropiichthys vacha*	0.15	ND	1.70	ND	0.42
11	*Channa striatus*	0.05	ND	0.34	0.09	0.01
	Permissible limit	0.5 (FAO, 2011)	0.5 (FAO, 2011)	3 (WHO, 1985/FEPA, 2003)	0.5 (FAO, 2011)	0.3 (FAO, 2011)

Discussion

Heavy metals such as arsenic (As), cadmium (Cd), copper (Cu), mercury (Hg) and lead (Pb) contents in the muscle tissues of 11 fish species from Ayeyawady River segment between Nanda Kyun village, Patheingyi Township and Kyauk Myaung Bridge, Sintgu Township were determined by using Shimadzu's ICPE-9820 multitype ICP Emission Spectrometer during cold season of 2019-2020.

Among the sampled fish, the highest concentration of arsenic (As) was found in *Wallago attu* (0.37 ppm) and the mercury (Hg) content was the highest in *Osteobrama belangeri* (0.31 ppm). However, *Ompko bimaculatus* contained the highest concentration of cadmium (Cd) (0.30 ppm), copper (Cu) (1.87 ppm) and lead (Pb) (0.81 ppm) among the fish species studied. The concentrations of heavy metals in the sampled fish are within the permissible limits of FAO/WHO (2011) except the concentration of lead in which some fish species showed beyond the acceptable limits.

Lead is non-essential and toxic metals which are distributed and released into the aquatic environment by the use of phosphate fertilizers and gasoline containing lead that leaks from fisher boats (Pascoe and Mattery, 1977). The source of lead in the aquatic environment was made available to the organisms. During the non-flooded dry season, some ground portions of the river may be available for the growing of particular crops. The farmers would use many kinds of fertilizers to grow their crops and the residues of fertilizers would drain and accumulate into the river together with the runoff water.

The content of heavy metals in an organism can be caused by several factors, including differences in growth rate, speed of metabolism, the level of sensitivity to the inclusion of certain heavy metals and physiological needs for metals (Leung, *et al.,* 2001). It is also influenced by gender, age, size, eating habits, and environment (Zhao, *et al.*, 2012). Heavy

metals in general have toxic and dangerous properties for living organisms, although they are in low concentrations (Supriatno, 2009). (Cited from Budijono, *et al.*, 2020)

Heavy metals are toxic and even the trace amount can affect the well-being of organisms especially human beings. Therefore, it is required to practise the proper use of elements especially handling the materials containing heavy metals because it finally affects the people.

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