International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Study of Lead Bioaccumulation in Fish Specimen (*Mystus gulio* HAM.-BUCH.) of Hooghly River Downstream as per Seasons

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Abstract: ***The present study was conducted to detect Pb metal content in sediment and muscle of fish (Mystus gulio Ham. – Buch.) of the of the river Hooghly, West Bengal, India. The study sites were selected at Batanagar (Bt), Budge Budge (Bg) and Birlapur (Br) sites. The samples viz. sediment and muscle of fish were collected and estimated by using atomic absorption spectrophotometer. The Pb content in sediments gradually significantly increasing trend towards downstream in the river Hooghly and winter season observed higher values in all the sites. But the content was found within the prescribed limit. The study sites observed significantly higher level of Pb accumulation in the muscle of the fish specimen (Mystus gulio) during summer compared to winter. The findings pose the risk of accumulation may be lower in fish muscle as per BSAF value. In future, this study may be beneficial to determine the water and sediment quality status in different stations of river Hooghly as well as other metals content in different fish species.***

Keywords: Pb metal, Bioaccumulation; Sediment pollution, Estuarine fish, *Mystus gulio*

1. Introduction

The lower stretch of river Ganga known as river Hooghly, which is a seasonal river, and it was reported that 80% of drainage discharge occurred during the monsoon (July to October) of Southwest Indian monsoon. [1]After reaching Diamond Harbour, it attains a southward direction and is splitting into two streams before reaching the Bay of Bengal. [2, 3]

Several studies have already been reported that the discharges of untreated effluents, inputs of agricultural chemicals, discharge of organic matter and chemicals from aquaculture farms, etc. in the different sites of Ganges. [1, 2, 4, 5] Moreover, these may create water and sediment pollution by the presence of inorganic elements, which ultimately accumulate in the vital organs. [6 - 10]Among several metals, lead (Pb) is well known toxin and genotoxin, causing cancer in different tissues. [11] Many studies have revealed that Pb was accumulated in the vital organs of different fish species [6 - 10] the study is lacking for the bioaccumulation of Pb in *Mystus gulio*, which is consumed by local people as low - cost fish specimen.

The present study attempted to know the Pb bioaccumulation factors for muscle of fish specimens (*Mystus gulio* Ham. – Buch.) inhabited in the downstream of river Hooghly, West Bengal, India.

2. Materials and Methods

Selection of study sites

The study sites were selected at Batanagar (Bt), Budge Budge (Bg) and Birlapur (Br) sites in the downstream of river Hooghly, West Bengal, India as per our earlier study. [12]

Selection of fish specimen

The fish specimen was selected as per earlier study. [12]It is locally known as Gulse tengra, which has been reported to be distributed in India, other parts of Southeast Asia. This fish specimen is an eryphagous feeding behaviour with wide range of food preference. [13]

Sediment sampling

The sediment samples were collected from the three different zones of study sites. After collection, it was transported to the laboratory for analysis of lead (Pb). [12]

Fish muscle sampling

The fish specimens *Mystus gulio* were collected from nearby fish catcher/seller along the bank of river Hooghly. The fish ranged from 17 - 25 cm in length and weighed between 80 - 100 gm. All the fishes were collected just died and muscles were dissected out as per earlier study for Pb analysis. [10, 12]

Pb estimation

The method of Pb analysis in sediment and fish muscle was done as per earlier study by using AAS. [10, 12]

Estimation of bioaccumulation factors

The bioaccumulation factors (BAFs) are derived mainly by the ratio of Pb metal concentration in muscle of fish from the medium viz. sediment, which was determined as Bio sediment accumulation factor (BSAF) as per protocol by Lau et al., [14] Usero et al., [15]Abdel Gawad. [16]The formula of BSAF is as follows:

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$$BWAF = \frac{\text{Pb content in muscle of fish}}{\text{Pb content in Water}}$$

$$BSAF = \frac{\text{Pb content in muscle of fish}}{\text{Pb content in Sediment}}$$

Statistical analysis

For statistical analysis, the comparative data between summer and winter were expressed as means ± standard deviation (M ± SD) for sediment, and muscle to determine bioaccumulation factors. The student 't' test was performed for seasonal variation. All the data were considered the significance level at P<0.05 by using statistical software, PAST PAleontological Statistics) software (version 3.26) developed by Hammer et al. [17]

3. Results

Table 1 explains the content of Pb (Mean ± SD) in the river sediment samples (mg/Kg) of six study sites. Maximum values of about 12.5 ± 2.4 followed by 10.5 ± 0.6 in the study site of Br2 and Br1 followed by the sites of Bt1 (8.2 ± 0.2) and Bt2 (8.2 ± 1.3), respectively and minimum values of about Bg2 (5.5 ± 0.9) and Bg1 (6.4 ± 1.1) during summer season. While in winter season the values were significantly (P<0.001, P<0.01 and P<0.05) decreased (7.2 ± 0.3 and 6.7 ± 0.1 for Bt1 and Bt2, and 9.5 ± 0.2 and 10.1 ± 0.3 for Br 1 and Br2) but did not show significant change for Bg1 and Bg2 (5.2 ± 0.2 and 5.3 ± 0.2) in comparison with summer season. Interestingly, the comparison between the study sites observed significant (P<0.001) difference during summer and winter season separately.

As per US Environment Protection Agency (USEPA), the sediment limit for Pb is 40 mg/Kg and the Canadian water quality guidelines for protection of aquatic life (CCME), the Pb should be within the standard of 35 mg/Kg. The present results for Pb content in river sediment within the prescribed in all seasons.

Table 1: Concentration of Pb in river sediment (n = 4 in each site; Mean ± SD)

	Summer	Winter
Study sites	River sediment (mg/Kg)	
Bt1	8.2 ± 0.2	7.2 ± 0.3*
Bt2	8.2 ± 0.2	6.7 ± 0.1*
Bg1	6.4 ± 1.1[a]	5.2 ± 0.2[a]
Bg2	5.5 ± 0.9[a]	5.3 ± 0.2[a]
Br1	10.5 ± 0.6[a]	9.5 ± 0.2**[a]
Br2	12.5 ± 2.4[a]	10.1 ± 0.3***[a]

*[a]P<0.001; **[b]P<0.01; ***P<0.05

Table 2 evaluates the content of Pb (Mean ± SD) in the muscle samples (mg/Kg) of six study sites. Maximum values of about 17.6 ± 6.2 followed by 17.1 ± 6.6 in the study site of Br2 and Br1 followed by the sites of Bt2 (9.5 ± 1.7) and Bt1 (9.4 ± 1.7), respectively and minimum values in Bg1 (8.4 ± 4.2) and Bg2 (8.6 ± 4.2) during summer season. While in winter season the values were decreased (8.6 ± 0.3 and 8.8 ± 0.5 for Bt1 and Bt2, and 6.4 ± 0.5 and 6.3 ± 0.3 for Bg1 and Bg2 and 15.4 ± 0.4 and 15.8 ± 0.2 for Br1 and Br2 without significant change when compared to summer season.

Interestingly, the comparison between the study sites observed significant (P<0.001 and P<0.05) difference during summer and winter season separately.

Table 2: Concentration of Pb in fish muscle (n = 5 in each site; Mean ± SD)

	Summer	Winter
Study sites	Fish muscle (mg/Kg)	
Bt1	9.4 ± 1.7	8.6 ± 0.3
Bt2	9.5 ± 1.7	8.8 ± 0.5
Bg1	8.4 ± 4.2	6.4 ± 0.5
Bg2	8.6 ± 4.2	6.3 ± 0.3
Br1	17.1 ± 6.6[b]	15.4 ± 0.4[a]
Br2	17.6 ± 6.2[b]	15.8 ± 0.2[a]

[a]P<0.001; [a]P<0.05

The bio - sediment accumulation factor (BSAF) was obtained (Table 3). The values of BSAF were increased in the muscle of fish specimens at Br1 and Br2 followed by Bt1 and Bt2 and comparatively lower value in Bg1 and Bg2 for both the seasons (Table 3).

Table 3: Bio sediment accumulation factor for Pb metal for muscle of fish specimens as per seasons

Summer					
BASF					
Bt1	Bt2	Bg1	Bg2	Br1	Br2
1.15	1.17	1.31	1.58	1.64	1.40
Winter					
BASF					
Bt1	Bt2	Bg1	Bg2	Br1	Br2
1.19	1.31	1.21	1.63	1.61	1.56

BSAF = Bio sediment accumulation factor

4. Discussion

Several fish species are inhabiting the river Hooghly that are edible for humans in and around West Bengal. Several investigators have already documented that Pb metal in water and sediment followed by bioaccumulation in the vital organs of fish. [1, 3 - 10]

According to Begum et al., [12]this fish specimen feeds on wide range of foods viz. phytoplankton, zooplankton, insects, and their larvae, etc. Due to bottom feeder, there is a possibility of continuous topical exposure of Pb in the skin, muscle, gills, etc., which is supported by other studies. [6 - 8]Thus, present study was conducted to know the sediment and muscle content of Pb metal in three different sites of Hooghly river. This fish may provide the knowledge of the distribution of metals in sediments and bioaccumulation in fish related to anthropogenic pollution and threat to the aquatic ecosystem. Moreover, the risk of accumulation may be lower in fish muscle as per bio sediment accumulation factor but in earlier study, negative correlation may lead to harmful impact in the study site for sediment. [12]

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5. Conclusions

It is concluded that the Pb content in sediments were gradually increasing trend towards downstream in the river Hooghly and winter season observed higher values in all the sites. But the content was found within the prescribed limit. The study sites observed higher level of Pb accumulation in the muscle of the fish specimen (*Mystus gulio*) during summer compared to winter. This may be due to dilution factor during post - monsoon season especially in winter. In future, this study may be beneficial to detect the sediment quality status in different stations of river Hooghly as well as comparison between other metals content in different fish species as per seasonal variations.

Acknowledgement
The author is thankful to R. V. Briggs Co. Pvt. Ltd. (An analytical Laboratory) for the analysis of lead in sediment and muscle.

Conflict of interest
No conflict of interest in the present study.

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