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Estimation Of Heavy Metals In Mudskippers (*Periopthalmus novemradiatus*) From Palghar coast Maharashtra

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ABSTRACT

Coastal pollution has been increasing significantly over the recent years and found expanding environmental problems in many developing countries. Samples of mudskipper (*Periopthalmus novemradiatus)* were collected from various locations within the Palghar area and analyzed for heavy metal content using Calorimeter. The study was conducted from June 2021 to January 2022. The concentrations of key heavy metals, including lead (Pb), copper (Cu), chromium (Cr), were determined in different tissues of the mudskipper.The results revealed varying levels of heavy metal contamination in the mudskipper (muscles, liver and gills) from different sampling sites. Highest concentrations of lead, copper and chromium were estimated in mudskipper from different body and and different sites. Higher copper level in muscles 0.6843 gm/kg, chromium in liver 0.5625 gm/kg and lead 0.9734 gm/kg recorded in muscles from Mahim prawn culture farm. Even those were below than permissible values recommended by USFDA, FAO and WHO,

KEY WORDS – Mudskipper, heavy metals, permissible values

INTRODUCTION

Coastal pollution has been increasing significantly over the recent years and found expanding environmental problems in many developing countries. Pollution of water is one of the areas of major concern to coastal and estuary environments. There are several forms of disturbance, among which chemical pollution associated with industrial production and high levels of urbanization are both major concerns (Bu-Olayan and Thomas, 2008). In the mangrove area, many different animals have developed various ways of protection from hanging environmental conditions and pollution. This indicates that a variety of fish species can use mangrove areas for foraging, i.e. feed on amphipods, isopods, crabs, snails, insects, spiders, copepods, shrimp, and organic matter (Sasekumar, *et al.*1992). Mudskippers are one of the fish which live on the mudflats associated with mangrove shores (Sasekumar,*et*

*al.*1992). Mudskippers value for ecotoxicological studies and it's recognized as a potential bio-indicator in environmental monitoring and assessments of coastal waters and tropical or subtropical soft-bottom intertidal systems (Ansari *et al*. 2014).

Mudskippers can absorb heavy metals via various types of exposures, such as direct contact, ingestion, drinking, and inhalation (Barbee *et al*., 2014). Heavy metal hazardous in biological systems could stimulate excessive production of reactive oxygen species (ROS), leading to abnormalities in cellular metabolic processes resulting in oxidative stress (Basirun *et* al., 2019 and Gavrić et al., 2019). As a result of this kind of stress, an antioxidant defense mechanism isdeveloped and could be used as a biomarker in bio-monitoring programs for pollution risk assessment (van der Oost *et al.,* 2003). Heavy metals could also cause imbalances in cellular redox reactions, leading to lipid and protein lysis, DNA damage, as well as carcinogenic and immunosuppressive effects (Gao *et al*., 2019; Lee *et al*., 2019 and Sinha *et al*., 2020). Intensive studies were conducted to develop biomarkers on mudskippers for bio-monitoring heavy metal pollution in coastal wetland ecosystems. Oxidative stress, genotoxicity, and immunotoxicity biomarkers could be used as early warning systems in the bio-monitoring programs (Radwan *et al.,* 2020). Biomarker diagnostic techniques have already been developed in aqua-toxicological studies, for the early identification of heavy metal pollution in fish, because they are reliable, precise, eco-friendly, and cost-effective. This study aims to provide a comprehensive review on the potential of using mudskipper as a bio-indicator species by assessing the response of biomarkers to heavy metal pollutants. Hence, to evaluate pollution in the coastal wetland environment and which heavy metals are more amount present in Mudskippers . Also to understand it will harmful or not for human diet as fish.

MATERIALS AND METHOD

STUDY SITES

Palghar is a town in the Konkan division of Maharashtra state, India and a municipal council. It is in the Mumbai Metropolitan Region, and since 2014 it has been the administrative capital of the Palghar district. Mahim is the small village in palghar district which is aproximetly 10 km away from Palghar station.

Datiware is a village in the state of Maharashtra (Palghar taluk, Palghar district) in India on the northern bank of Datiware creek at the mouth of the river Vaitarna (Latitude

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19° 17' N, Longitude 72° 50' E). The area also has numerous mudskippers and other species of fish. The study was conducted from June 2021 to January 2022.

SAMPLES COLLECTION AND METHOLOGY

The study was conducted from June 2021 to January 2022. Three sites were selected for the samples collection of mudskippers. This study sites were Mahim (fortune Prawns culture farm), Dativare and Palghar fish market respectively from Palghar district. Handpicking method was adopted for the collection of the samples. The samples were transported to the laboratory in plastic bottles or plastic jar for heavy metal test. Salinity was measured by refractometer and pH with ph paper and reconfirmed by pH meter in the lab.

Image 1. mudskipper collection from field

Image 2 freshly catch mudskipper

Image 3. mudskipper for process

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HEAVY METAL TEST :

For heavy metal test - The fish samples were collected from a three different location and the fish samples were stored at -4°C until analysis. Before sampling the fish was weighed. Then tissues of fish were dried at 65°C in a laboratory oven until the fish attained a constant weight. Nitric-Perchloric acid digestion (HNO3-HCIO4) This was performed according to the method recommended by AOAC (1990). A sample of 1.0 g was taken into a 250 ml beaker and 10 ml of concentrated HNO3 acid was added. The mixture was boiled for 45 min to remove all oxidizable matter. After cooling, 5ml of HCIO4 was added and the mixture was boiled until a white fume was observed. Then 20 ml of distilled water was added and the mixture was boiled further to release any gas. Finally, the mixture was filtered using Whatman42 paper. (Ranasinghe *et.al*., 2016).

Water sample was digested by HNO3 acid digestion method. To the sample , 5 mL of 65 % HNO3 was added, and then the mixture was boiled gently over a water bath (90°C) for 1-2 h or until a clear solution was obtained . Later, 2.5 mL of 65 % HNO3 was added, followed by further heating until total digestion (Uddin *et.al*., 2016). Further estimation were carried out by standard protocol for estimation of Pb,Cd and Cr. By colorimetric methods.

RESULTS AND DISCUSSION

Mudskippers are used as bio-indicators of pollution in coastal wetland habitats, from the 1980s to the present, since they have distinctive morphological and ecological structure, have amphibians-like lifestyle, could accumulate different pollutants, exposed directly to various pollutants, and are euryhaline organisms (Ansari *et al*., 2014; Bertrand *et al*., 2018). They are sentinel organisms (guard organisms) that are ideal for detecting the effects of pollutants on water and sediments. A sentinel organism must have some special characteristics such as a wide geographical range, high sensitivity to environmental pollutants, and the dominant species in their habitat (Shirani *et al*., 2012a; 2012b).

This study was performed to test the concentration of heavy metals in different parts of mudskipper (*Periopthalmus novemradiatus*). (Images 1,2,3) Table 1and graph 1. presents the heavy metal Pb, Cu, and Cr concentrations in three body parts of mudskipper. Total three samples were analyzed which were weight from Mahim 12.543gm, Dativare 8.221 gm and Palghar 9.242 gm. The concentration of heavy metals like Pb, Cu and Cr in muscles from Mahim the sites, (973.4, 684.3 and 283.7), from Dativare (843.2, 598.3 and 193.5) and from

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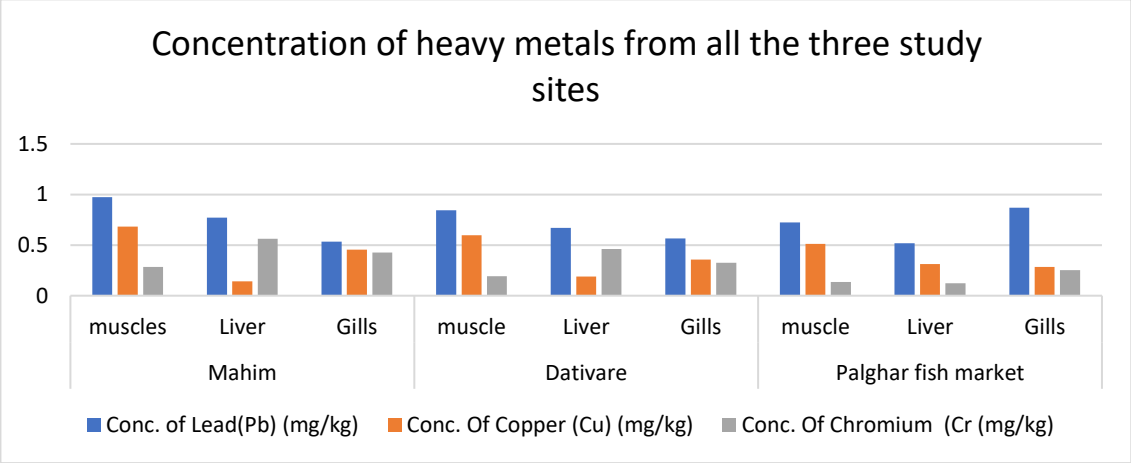
Palghar site (725.3, 513.9 and 137.3(mg/g). accumulation of heavy metal concentration menshened in table respectively.

Length and weight play an important role in the accumulation of heavy metals. Small fish are enriched with accumulated heavy metals from the aquatic microfauna and microflora that constitute their diet (Obasohan *et al*. 2006). (Mohsin and Ambak 1991) found that maturity, which was measured by fish length, influenced the accumulation of heavy metals. In addition, (Ahmad and Suhaimi-Othman 2010) found that mature fish accumulated higher metals compared to juvenile and premature fish. This is because fish with a constant growth rate that inhabit continuous polluted habitats stabilise the accumulation of heavy metals (Ahmad & Suhaimi-Othman 2010).

Table 1: Concentration of heavy metals from all the three study sites

Study sites	Sample Tissue	Conc. of Lead(Pb) (mg/kg)	Conc. Of Copper (Cu) (mg/kg)	Conc. Of Chromium (Cr) (mg/kg)
Mahim	Muscles	0.974	0.684	0.283
	Liver	0.771	0.142	0.562
	Gills	0.535	0.456	0.425
Dativare	Muscle	0.843	0.598	0.193
	Liver	0.670	0.189	0.461
	Gills	0.565	0.357	0.324
Palghar fish market	Muscle	0.725	0.513	0.137
	Liver	0.517	0.312	0.124
	Gills	0.8693	0.2831	0.2532



Graph.1. graphical representation of Concentration of heavy metals from all the three study sites

The mudskippers are euryhaline and can tolerate a sudden and dramatic shift in salinity (Soltanian and Fereidouni, 2019). They can tolerte a very wide range of fluctuations in salinity and temperature (Chen *et al*., 2015). Mudskippers that are traveling through the land between aquatic habitats are likely to face sudden changes in a variety of environmental factors, including salinity (Sutton *et al.*, 2018).In the present study it was mesured from farm saliniyt in 4.5 ppm and pH was 7.62.

Heavy metal pollution in water causes biological disturbance to organisms, where it can be identified and assessed by specific biological tests on relevant bio-indicators such as mudskipper. Early identification of biomarker responses in potential bio-indicators 1080 Santoso *et a*l., 2020 plays an important role in the success of biomonitoring before the effects of heavy metal pollution adversely affect the entire population or community (Georgieva *et al*., 2016; Almeida Duarte *et al*.. 2017; Bouzahouane *et al*., 2018). Jing *et al*. (2017) stated that, the exposure of mudskippers to Pb resulted in an excessive production of reactive oxygen species (ROS). Oxidative stress is thought to be the key path to the initiation of heavy metal toxicity in fish. In this study the concentration of Lead (Pb) were recorded as 0.725 to 0.974 gm/kg; 0.565 to 0.771 gm/kg and 0.517 to 0.565 gm/kg in muscles, liver and gills respectively from all the study areas. Which were below the 30 mg/kg recommended by FAO and WHO.

In this study the concentration of copper (Cu) were also recorded less than 30 mg/kg recommended by FAO and WHO, as 0.513 to 0.684 gm/kg; 0.142 to 0.312 gm/kg and 0.283 to 0.456 gm/kg in muscles, liver and gills respectively from all the study areas.

In this study the concentration of chromium (Cr) were recorded as 0.137 to 0.286 gm/kg; 0.124 to 0.562 gm/kg and 0.253 to 0.425 gm/kg in muscles, liver and gills respectively from all the study areas. which is below the recommended USFDA 12-13 mg/kg food safety guidelines.

Highest concentrations of lead, copper and chromium were estimated in mudskipper from different body and and different sites. Higher copper level 0.6843 gm/kg, chromium in liver 0.5625 gm/kg and lead 0.9734 gm/kg recorded in muscles from Mahim prawn culture farm. As campaired to other other study sites prawns culture farm monitored as more heavy metals in their estimated values. Even those were below than permissible values.

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CONCLUSION

The analysis of heavy metal concentrations in the liver, gill, and mussel parts of Mudskipper provides insights into their bio accumulation potential and the potential effects on their health. High concentrations of heavy metals in these tissues can indicate pollution and the presence of contaminants in the aquatic ecosystem. Highest concentrations of lead, copper and chromium were estimated in mudskipper from different body and and different sites. Higher copper level 0.6843 gm/kg, chromium in liver 0.5625 gm/kg and lead 0.9734 gm/kg recorded in muscles from Mahim prawn culture farm. As campaired to other other study sites prawns culture farm monitored as more heavy metals in their estimated values. Even those were below than permissible values recommended by USFDA, FAO and WHO. So it's a suggestion or the recommendation to the fish farmers to mentioned all those parameter in the healthy limits.

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