Health Risk Assessment on Bioaccumulation of Heavy Metals In Edible Fish Sardinella Longiceps (Valenciennes 1847) Collected From Sassoon Dock, West Coast of Maharashtra

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Abstract- *The present study provides evidence of presence of bioaccumulation of some heavy metals (Cr, Cu, Mn, Zn) in Sardinella longiceps (Valenciennes 1847) commonly known as Indian Oil Sardine from study location Sassoon dock, West coast of Maharashtra during January 2019 to March 2022. Concentration of heavy metals from muscle of fish were estimated using Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) method. Concentration of theses heavy metals in muscle tissue was found in following order - Zn>Cr>Cu>Mn. Some of the other studied heavy metals like lead (Pb),Cadmium (Cd),Mercury (Hg), and Arsenic (As) was found under no detectable range (less than 0.01mg/kg).Copperand zinc showed values within permissible limit hence they may not show any toxicological effect. Whereas manganese, chromiumwas found to be above the permissible limit of World Health Organization. Muscle tissue of Sardinella longiceps fish showed bioaccumulation of heavy metals in it leading to threat to the ecosystem. Fish contaminated with heavy metals will indirectly enter the food web and then may lead to chronic as well as acute health risk to humankind.*

Keywords- Bioaccumulation, Heavy metals, Sardinella longiceps, food web.

I. INTRODUCTION

Various anthropogenic activities like urbanization, mining, industrial waste inevitably leads to release of heavy metals in the surrounding environment (Zhang et al.2008) and then by various way it fallsinto dynamic aquatic ecosystem (Shah et al. 2012, Demirak et al.2006). The aquatic ecosystem all over the world are threatened by water pollution caused due to anthropogenic activity which affects all marine species including fish. Natural processes like vegetation,forest fires,leaching of rocks, airborne dust also produces metals which may enters the aquatic system (Nazir R,2015). Metals have toxic effect and ability to accumulate in marine ecosystem hence it is big cause of worrisome (Shrivastava,V. S. 2011,Censi, P. et al.2006). In recent years the heavy metal pollution in aquatic ecosystem has becomeworldwide stress as most of the heavy metals have toxic effects and are perennial. As an aquatic creature fish get exposed to these toxicological heavy metals and may become dietary source of these contaminants to the human beings. It has been also found that different fish species have varying degree of bioaccumulation capacity for same metal (Adeyeye E ,1996).) Levels of heavy metal bioaccumulation in fish get directly concern from their diet hence those which are high in food chain get more contaminated(EFSA, 2005),).There are some metals like zinc,copper , cobalt, selenium which helps in metabolic activities of an organisms hence found in fish and pronounced as essential metals (Bhupanderkumar et al,2012, Amani S.A , Lamia A.A 2012,P. Sivaperumal et al,2007).Perhaps anything beyond permissible limit is injurious to health, hence one has to monitor and research for the value to be in safer side. Due to increased anthropogenic activities led to pollution of heavy metals in aquatic system it led to fall of fish resources and substantial depletion of their nutritive values (Srivastava, R., and Srivastava, N., 2008, Bauvais C, et al.2015)

Fish is the traditional food item which is available for all communities from most natural resource.India ranks third in fisheries and second in aquaculture according to PMMSY report 2021 (pmmsy.dof.gov.in). Sardines are small pelagic clupeid is the largest species landed globally.It is one of the two most commercial fish in India. According to Halweil and Nierenberg nearly one billion people are there who depends on producing processing and trading for their livelihood globally. Fish have been proven to be richest and cheapest sources of proteins, vitamins including dietary supply of omega-3 fatty acids like DHA, EPA.(Domingo 2007, Guil-Guerrero et al. 2007, Pettinello et al. 2000). Kim and Wijesekara have shown that waste of fish processing is a good source of high value bioactive compounds like PUFA, polysaccharides, bioactive peptides, antioxidants, enzymes and many minerals.

In recent years there is tremendous increase in awareness on the significance of nutritional value of fish but there is minute information on fish collected from Sassoon dock, Mumbai which is India's oldest dock and fish get exported to all parts of Mumbai and to other countries also. Hence considering the environmental and health point of view this work was done.Present study is done to access the concentration of heavy metals (**(Cr, Cu, Mn, Zn, Pb, Cd, Hg, As**) from (muscle tissue) flesh of Sardinella longiceps collected from Sassoon dock, Mumbai to explore exposure level of toxicity and to minimize health risk to the consumers. This research will help in generating data of heavy metals found from study location Sassoon Dock, west coast of Maharashtra.

II. MATERIALS AND METHODS

Figure 1. Sardinella longiceps fish (Valenciennes, 1847)

Early morning fresh fishes of Sardinella longiceps (Valeciennes, 1847) figure 1, size of 18-21 cm weighing 65-85grams were collected after landing from the research location Sassoon dock (figure 1), which is located between latitude 18°54'37.692" N and longitude 72°49'2.172"E during January 2019 to March 2022. Fresh fishes were kept in ice box maintaining the original natural architecture of fish organ and brought to the laboratory for heavy metal analysis. Dissection of fishes were done to remove muscle tissue under sterile condition to minimize any contamination. All the chemicals used for the respective research were of AR grades. Heavy metal analysis of Chromium (Cr), Copper (Cu), Manganese (Mn), Zinc(Zn), lead(Pb),Cadmium (Cd), Mercury (Hg), and Arsenic (As) was done with Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) method.

III. RESULT AND DISCUSSION

The heavy metal concentration found in Sardinella longicepswere compared with the standards value of World Health Organization (WHO) and FAO limits. The present study showed that the fish Sardine have varying amount of concentration of various heavy metals in it. The values in concentration have shown in table number 1. Graphical presentation of these concentrations was showcase in figure 2.

Heavy metal	**Muscle (Concentration of heavy metal)**± SD
Cu	2.42 ±0.26
Cr	**5.9** ±0.08
Zn	19.72 ±2.07
Mn	**2.14** ±0.68
Pb	ND
Cd	ND
Hg	ND
As	ND

Table 1: Heavy metal concentration in muscle of Sardinellalongiceps collected from Sassoon dock, Mumbai. Results are expressed in mg/kg, wet weight,.mean value ± standard deviation)

ND-values not detected, less than 0.01mg/kg., N=5
Values above permissible limit of WHO/FAO is shown in BOLD

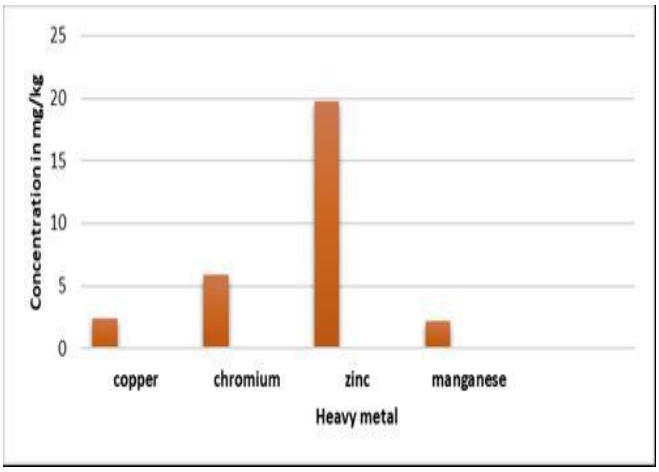

Figure2. Graph showing heavy metal concentration (mg/kg) in Muscle of Sardinella longiceps (Valenciennes,1847).

The concentration of heavy metals beyond permissible limit can cause severe health issue for human consumption (El-Moselhy et al, 2014). In muscle tissues of the said fish the concentrations of different heavy metals are

found different. In muscle tissue zinc is found in highest concentration ranging from 16.3-22.4mg/kg, chromium was present as 5.8-6.0 mg/kg, manganese found as 1.7-3.5mg/kg, and copper found as 2.0-2.8mg/kg. Our values are in concordance with other researchers worked on sardinella longiceps the said fish (Biswas.S,Prabhu RK et al,2012). Zinc and chromium values were found more than and copper values found less than values found by Athira A Raveendran and Qurantulan Ahmed. Quratulan Ahmed et al.,2016 Athira.A.Raveendran,et al, 2021).The toxic heavy metals like Pb, Cd, Hg, As were found in not detectable range.

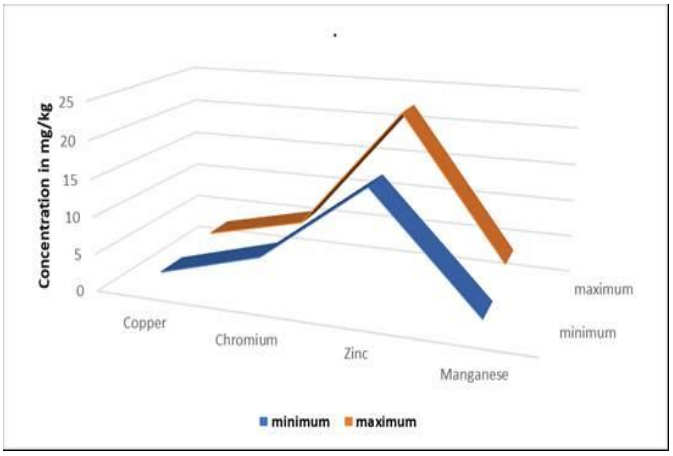

Figure 4.3D view of minimum and maximum concentration of different heavy metals in Sardinella longiceps

Copper, Manganese and Zinc comes under essential metal category, present and plays vital role in completion of many of the physiological enzymatic activities (Kamaruzaman et al. 2011).Chromium is a micronutrient and have shown carcinogenic properties though its working mechanism is not yet completely known (Yujiao Deng et al,2019). Industries like textile, rubber,mining, dyeing, printing, stainless steel production effluent produces large amount of chromium and it enters indirectly in marine ecosystem(Ahmed M.K et al,2013).Chromium toxicity have been proven to show histological alteration in kidney , gills and other organs (Bhatkar N.V.,2011). Manganese is ubiquitous and fifth most abundant metal on the earth.Many of the food contains manganese which is one of the essential trace elementsand also used as dietary supplement. Manganese also acts as a cofactor for many enzymes and absorb by liver and other tissue (Buchman AR,(2014),Nielsen FH, (2012)) Manganese along with vitamin K also helps in blood clotting and homeostasis (Aschner JL, Aschner M,2005).Though higher concentration of manganese in aquatic organism is known to induce excessive oxidative stress and toxic effect and present in all organs of all fishes (J.B. Edward et al, 2013). Low level of manganese is necessary for human health.Amongst all the heavy metals except manganese shows their concentration within permissible limit.Consumption of copious amountof fish containing high number of heavy metals may cause adverse and toxic effect to human health (Tuzen M 2003).

IV. CONCLUSION

Present study showedthat muscle tissue showed different capacity to different heavy metals. Muscle of fish is one of the most edible parts consumed by human. As manganese and chromium foundin exceeding the standard limit, by WHO (1996) and FAO (1983),it is imperative to take precautionary action against bioaccumulation of heavy metals in fish Sardinella longicepsas shows presence of heavy metals beyond the permissible limit. further future study is recommended to keep monitoring the hazardous effect of same. To meet the pollution free nutrition goal, safeguard human health and pollution free environment one must break the cycle of pollution as from anthropogenic pollution to ecosystem to again human being.

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