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The Worldwide Examination of Bioaccumulation of Heavy Metals from Various Sources in the Body Tissues of *Mugil Cephalus*

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Abstract

In this study, bioaccumulation of the heavy metals (Cr, Cd, Cu, Zn, Pb and Ni) in the liver, gill, gonad and muscle tissues of *Mugil cephalus* were reviewed seasonally. Due to heavy industrial and agricultural activities in the region, the bay has the polluted coastal waters of India. Therefore, the levels of cadmium, zinc, iron were determined in the muscle in the species because of its importance for human consumption and also the liver, gill, gonad were reviewed since these organs tend to accumulate metals. Heavy metal levels were found generally higher in the liver and gill than the gonad and muscle tissues in the species; the levels of all metals in a given tissue were generally higher in *Mugil cephalus* than the other teleost species.

Heavy metals are steady and continue in environment as contaminants in the aquatic environments along with their organisms. They are supposed to be present in the environment as a result of natural processes and also as contaminants due to human activities. According to World Health Organization, metals which occur less than 1% on the earth's crust are tolerable, with certain trace amounts generally found in the environment and when these concentrations surpass a stipulated limit, they may become venomous to the surrounding environment.

Keywords: Heavy metals; Staple; Marine Food

Introduction

Fish, a staple marine food, are considered as the source of protein, polyunsaturated fatty acids and particularly omega-3 fatty acids, Calcium, Zinc and Iron [3] which is considered as one of the rich nutrient sources for humans that contribute to lower the blood cholesterol and reduce the risk of heart diseases [14]. Among the aquatic fauna, fish is considered to be the most susceptible organism to heavy metal contamination. It is a well-known fact that fishes are good indicators of chemical pollution and as a result they are long been used in monitoring metal pollution along the coastal and marine environment. Hence, fishes were considered as better alternatives for investigating the pollution load than the water sample because of the significant level of heavy metals they bioaccumulate. Mullet is detritus and filter feeder inhabiting the coastal estuaries. This species can be considered as a biological indicator for metal pollution because of its capability to accumulate heavy metals in its body [1].

The study conducted by [1] have observed that there is accumulation of six metals (Cr, Cd, Cu, Zn, Pb and Ni) in the tissues of *M. cephalus* from the two locations of Pulicat lake situated on the southeast coast of India. Their results revealed that the Bioaccumulation of heavy metals like Zn, Cu and Pb in *Mugil cephalus* is accumulated in elevated concentrations in various parts of the fish when compared with other metals.

The bioaccumulation of heavy metals depends upon the species, environmental conditions and their inhibitory processes. Considering the risk associated with human health due to the consumption of fish, the concentration of heavy metals (Zn, Pb, Mn, Cu, Cr and Hg) is examined in fish samples collected from the Machilipatnam coast. It was revealed that these metal concentrations were exceeding the limits set by the world health organization (WHO). [10].

The highest metal concentrations were found in the fish sample collected from polluted site of Berbice-Corentyne, Guyana. The accumulation of heavy metal was found to be quite high in the muscle when compared with the gills and liver of *M. cephalus*. These tissues were additionally investigated by light and electron microscopy and the results obtained were compared with the reference site (Less polluted). The existence of large lipid droplets in liver and increase of mucous in gills were some of the most noticeable observations which can be related to heavy metal contaminates [13].

The study undertaken by [15] to examine the presence of eight trace elements consisting of essential elements: zinc (Zn), chromium (Cr), manganese (Mn), iron (Fe) and copper (Cu), and non-essential elements: mercury (Hg), lead (Pb), and cadmium (Cd) in muscle tissues of *M. cephalus* obtained from Opak and Bogowonto river estuaries, in coastal water of Southern Yogyakarta, Indonesia. Fish with total lengths of between 25 and 33 cm were selected. The muscle samples of fish were analyzed for trace elements content by using Mercury Analyzer and Atomic Absorption Spectrophotometer. According to the end result obtained, it may be concluded that the detected trace elements in the muscle of *M. cephalus* from two sampling sites were Cu, Fe, Zn, Hg. Other metals such as Cd, Cr, Mn, Pb were not detected in fish muscle samples from both sites. The order of the mean concentration of trace elements in the muscle tissues of M. cephalus collected in both sampling sites was Fe > Zn > Cu > Hg.

The amount of heavy metals (Hg, Cd, As, Cu, Pb, Cr, and Zn) in the water, sediment and the fish sample (*Mugil cephalus*) were analysed from different sites on Köyceğiz Lagoon System. Potential risk of heavy metal concentrations in sediments underlined significant ecological threat for two sites of the lagoon during winter and spring. The ratio of transfer factors of Cr, Hg, Zn, Cu and as in fish from water was higher than 1, which clearly depicts that fish undergo bioaccumulation of the above said elements from lagoon water. The analysis of individual Target Hazard Quotients (THQs) in the fish tissue indicated safe levels for the local people, but there is possibility of risk in terms of total THQ because the peak THQ value of as suggests that they may experience a certain degree of adverse health effect [6].

The aim of the present study by Hristina Neshovska et al., was to determine the levels of As, Pb, Cd, Hg, Mn, Zn, and Al in gray

mullet [5,16]. The fish samples were collected between June and September 2020 during the fishing season from Varna and Burgas regions. The concentrations of lead, cadmium, and mercury were below the maximum levels and this trend was observed for both studied areas. Varna region was found to be maximum with manganese and the highest concentration of zinc in Burgass.

Heavy metal levels were found higher in the liver and gill than the gonad and muscle tissues, the levels of all metals in a given tissue were generally higher in *M. cephalus*. The concentrations of Zn in the tissues of muscle of *Mugil cephalus* exceeded the tolerable levels for a human consumption and other metals in the edible parts of the investigated fish were in the safety levels for human uses [12].

The accumulation of vanadium levels in different tissues (muscle and organs) of the striped mullet Mugil cephalus [16] and their possible relationships with blood parameters were evaluated in a Natural Protected Area (Lake Faro, Sicily, Italy), during the winter of 2017. Statistical results showed significant differences in concentrations of vanadium of the analyzed tissue of M. cephalus and there is a positive relationship between vanadium concentration in the liver and some hematological parameters (RBC, Hb and Hct) and biometric indices. Our results emphasis the importance of fish blood parameters as sensitive indicators of toxic impact of environmental factors such as metals [5].The concentration of cadmium, lead, copper, zinc, manganese and iron were quantified in muscle, gills, and liver. The declining trend of metals in the tissues of fish samples from both Ennore estuary and off-shore was in the order of Fe >Mn >Zn >Cu >Pb >Cd. On the whole, the highest metal concentrations were found in the fish samples collected from Ennore estuary. The accumulation of metals in the gills and liver of M. cephalus was found to be quite high in comparison with the muscle. Further these tissues were investigated by light and electron microscopy. The presence of large lipid droplets in liver and increase of mucous cells in gills were some of the most noticeable alterations observed and were related to heavy metal contaminants [11].

Water and sediment were tested for cadmium, mercury and lead from Faro and Ganzirri lakes. These heavy metals have been assessed in muscles and serum of Striped Mullet *Mugil cephalus*. A hemograms was conducted to find effects of heavy metals on hematological variables. Student's *t*-test depicted higher Pb levels in the sediments of Ganzirri Lake than Faro Lake. Two-way analysis of variance showed higher Cd and Pb concentration in muscles samples of Striped Mullet from Ganzirri Lake than from Faro Lake. Significant differences were found among hematological parameters as well. The results indicated a significant presence of lead in the environment produces a drastic accumulation of metal in fish muscles [4].

The results showed that Fe, Mn, Pb, and Cu values were higher than standard permissible levels in the North Eastern Region of Lake Manzala. The heavy metal levels in Mugil cephalus tissues were higher in autumn compared to spring and Fe was the most accumulated metal in all examined tissues followed by Mn and Pb. The accumulated heavy metals in the tissues of Mugil cephalus induced several histopathological alterations, especially in the liver and gills [7].

Heavy metals are a serious hazardous component for aquatic ecosystems and human health too. They negatively affect aquatic life functioning through accumulation resulting the physiological and growth disturbances in aquatic lifeforms and moreover it affects the human. Due to an increasing population and development of man-made forms in recent decades the aquatic ecosystem and its surroundings severely distorted. As compared to radical formation heavy metals are highly toxic radical formation compounds. the fishes are most reliable biomarkers of genotoxicity contamination caused due to exposure of heavy metals in aquatic reservoir. Now a days the knowledge is need in heavy metal kinetics and toxicity in fish its important for natural and aquatic resources, and emphasize the use of fish for human consumption.

The concentration of heavy metals in the muscle tissues were above World Health Organization's (WHO) permitted limits in the aquaculture. Even though, the mean concentration of metal compounds in the fish tissues were below recommended limits by FAO and WHO. The estimated daily consumption values were below the standard reference dose which means that the muscle tissues of the fishes are safe for human consumption. In the recent years, world consumption of fish has increased simultaneously

with the growing concern of their nutritional and therapeutic value of benefits. In addition to its important source of protein, fish typically have rich contents of essential minerals, vitamins and unsaturated fatty acids . The American Heart Association (AHA) recommended consuming fish at least twice in a weak in order to reach the daily intake of omega-3 fatty acids. The Targeted Hazard Quotient (THQ) of HM (Heavy Metal) <1 no threat and cause risk factor to human health. In case of continuous consumption of HM contaminant fish probably cause risk and may lead to health issues. According to the studies and findings, human consumption of fish species with low concentration of heavy metals at the current accumulating level is safe for human health.

References

1. Al-Busaidi M, Yesudhason P, Al-Mughairi S, Al-Rahbi WAK, Al-Harthy KS et al., (2011), Toxic metals in commercial marine fish in Oman with reference of national and international standards, Chemosphere, 85: 67-73.

2. Athalye RP, Vidya Mishra, Goldin Quadros, Vidya Ullal and Gokhale KS (2001), Heavy Metals in the Abiotic and Biotic Components of Thane Creek, India Ecology, Environment and Conservation 7: 319-325.

3. Chan HM, Tritonopoules M, Img A, Receeveur O, Johnson E (1999) Consumption of fresh

4. ater fish in Kahn awake: risks and benefits., Environmental Research 80: 213-22.

5. Francesco Fazio, Giuseppe Piccione, Katia Tribulato, Vincenzo Ferrantelli, Giuseppe Giangrosso (2014). Bioaccumulation of Heavy Metals in Blood and Tissue of Striped Mullet in Two Italian Lakes, Journal of Aquatic Animal Health 26: 278-84.

6. Francesco Fazio, Concetta Saoca, Marilena Sanfilippo, Gioele Capillo, Nunziacarla Spanò (2019), Response of vanadium bioaccumulation in tissues of Mugil cephalus (Linnaeus 1758), Science of the Total Environment, 689: 774-80.

7. Genc TO, and Yilmaz F (2018). Heavy Metals Content in Water, Sediment, and Fish (Mugil cephalus) From Koycegiz Lagoon System in Turkey: Approaches for Assessing Environmental and Health Risk, Journal of Agriculture, Science and Technology 20: 71-82.

8. Heba N Gad El-Hak, Marwa I Saad El-Din, Ranwa A Elrayess (2021). Bioaccumulation of heavy metals and their histopathological impact on Mugil cephalus from the North Eastern Region of Manzala Lake, Egypt, Regional Studies in Marine Science 45: 101841.

9. Hristina Neshovska, Iliyan Manev, Veselin Kirov (2022). Comparative study of the heavy metal levels in grey mullet (Mugil cephalus) from the northern and southern bulgarian black sea coast., tradition and modernity in veterinary medicine, 7: 66-69.

10. Jordao CP, Pereira MG, Bellato CR, Pereira JL, Matos AT (2002). Assessment of water system for contaminants from domestic and industrial sewages, Environment Monitoring and Assessment 79: 75-100.

11. Krishna PV, Madhusudhana Rao K, Swaruparani V and Srinivas Rao D (2014). Heavy Metals Concentration in Fish Mugil cephalus from Machilipatnam Coast and Possible Health Risks to Fish Consumers, British Biotechnology 4: 126-35.

12. Lourduraj Arockia Vasanthi, Peranandam Revathi, Jayaprakash Mini, Natesan Munuswamy (2013). Integrated use of histological and ultrastructural biomarkers in Mugil cephalus for assessing heavy metal pollution in Ennore estuary, Chennai, Elsevier., Chemosphere 91: 1156-64.

13. Meltem Dural, M Z Lugal Göksu, Argun Akif Ozak, Bariş Derici (2006). Bioaccumulation of some heavy metals in different tissues of Dicentrarchus labrax L, 1758, Sparus aurata L, 1758 and Mugil cephalus L, 1758 from the Camlik lagoon of the eastern

coast of Mediterranean (Turkey), 2006, Environ Monit Assess 118: 65-74.

14. Sivakumar Rajeshkumar, Dhivya Karunamurthy, Grayson Halley, Natesan Munusamy, an integrated use of histological and ultra-structural biomarkers in Mugil cephalus for assessing heavy metal pollution in east Berbice-Corentyne, Guyana, International Journal of Bioassays 4: 11, 4541-54.

15. Storelli MM, 2008; Potential human health risk from metal (Hg, Cd and Pb) and polychlorinated biphenyl's (PCBC) via sea food consumption: Estimation of target hazard quotients (THQs) and toxic equivalent (TEOs). Food and Chemical Toxicology 46: 2782-8.

16. Tony B Satriyo, Yuhan F Maulida, Sandy B Wibowo, Riza Y Setiawan, Ratih I Adharini (2021). Presence of trace elements in muscles of Mugil cephalus from Yogyakarta coast, Indonesia December, AACL Bioflux, 14: 3432-9.

17. Vardi Venkateswarlu and Chenji Venkatrayulu (2020). Bioaccumulation of heavy metal lead (Pb) in different tissues of brackish water fish Mugil cephalus (Linnaeus, 1758), Journal of Applied Biology & Biotechnology 8: 1-5.

18. WHO (1591-1991) Inorganic Mercury Environmental Health Criteria, Vol.118. Geneva- World Health Organization.