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# Heavy metals concentrations in water and fish collected from Nellore coast, Andhra Pradesh, India

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**Abstract**
Now days the potential toxic effect of heavy metals in the aquatic environment and in organisms has been intensively studied. Grey mullet (*Mugil cephalus*) is commercially important fast moving marine fish species especially during warm weather. The *M. cephalus* is an omnivore and usually inshore, entering estuaries and lagoons. The aim of the present study was to determine the heavy metal contents Arsenic (As), Lead (Pb), Cadmium (Cd), Mercury (Hg), Iron (Fe),Copper (Cu), and Zinc (Zn), in water and tissues like gills, liver and muscle of the grey mullet (*Mugil cephalus*). The fish samples were collected from two different locations like Krishnapatnam and Nelaturu from the Nellore coast. The sample preparation was performed by acid microwave digestion and heavy metals analysis was carried out by AAS. Detected levels of heavy metals in the studied regions represented in Table.1 Heavy metals in coastal water samples, and Table.2 Heavy metals in fish tissues. The results for other heavy metals presented lower to higher amounts at Krishnapatnam and Nelaturu coastal water and fish *(M.cephalus)* tissues samples.

**Keywords:** heavy metals, water, fishes, pollution

## Introduction

Heavy metals are natural trace components of the aquatic environment, but their levels have increased due to industrial, agricultural and mining activities. As a result, aquatic animals are exposed to elevated levels of heavy metals. Some heavy metals such as zinc, copper and cobalt are essential in trace amounts for normal growth and development; however, others such as mercury, cadmium and lead have no biological importance [1] from an environmental point of view, coastal zones can be considered as the geographic space of interaction between terrestrial and marine species. The coastal zones are received a large amount of metal pollution from agricultural runoff, aquaculture chemicals and other industrial activities. Adverse anthropogenic effects on the pollution, and port activities. The discharge of these wastes without adequate treatment often contaminate the estuarine and coastal waters with conservative pollutants (like heavy metals), many of which accumulate in the tissues of the resident organisms like fishes and other aquatic organisms. The levels of metals in upper members of the food web like fish can reach values many times higher than those found in aquatic environment or in sediments. Thus heavy metals contamination in the region is an important issue regarding the health of the aquatic animals and in turn, health of the seafood consumers. Fish, as human food, are considered source of protein, polyunsaturated fatty acids particularly omega-3 fatty acids, Calcium, Zinc, Iron [2] and it is considered one of the high nutrient sources for humans that contribute the lower the blood cholesterol and reduce the risk of stroke and heart diseases [3, 4].
Among the aquatic fauna, fish is most susceptible to heavy metal contamination than any other aquatic fauna. It is well known that fish are good indicator of chemical pollution and as a result they long been used to monitor metal pollution in coastal and marine environment. So, fishes were considered as better specimens for use in the investigation of pollution load than the water sample because of the significant levels of metals they bio accumulate. Hence, harmful substances like heavy metals, released by anthropogenic activities will be accumulated in marine organisms through the food chain; as result, human health can be at risk because of consumption of fish contaminated by toxic chemicals. Grey mullet (*Mugil cephalus*) is commercially important marine school pelagic fast moving fish species especially during warm weather. The *M. cephalus* is an omnivore and usually inshore, entering estuaries and lagoons. The habitat of *M. cephalus*, which is an omnivore, is pelagic, usually inshore, entering estuaries and lagoons. While juveniles feed on invertebrates, adults mostly on detritus, bottom algae and small organisms, occasionally on plankton [5]. Keeping in view of the potential toxicity, persistent nature, as well as the environmental pollution, it is deemed necessary to have the base line environmental data on potential metal contamination so that pollutants can be judged in the environment. This paper presents the data on heavy metal Arsenic (As), Lead (Pb), Cadmium (Cd), Mercury (Hg), Iron (Fe),Copper (Cu), and Zinc (Zn) concentration in fish, *Mugil cephalus* from two different locations (Krishnapatnam, Nelaturu) of the Nellore coast. To the best of our knowledge, this is the first study about the concentrations of heavy metal investigated fish from the Nellore coast area.

## 2. Materials and Methods

The present study conducted during the month of January-2019 by the Department of Marine Biology, Vikrama Simhapuri University, Nellore, Andhra Pradesh, India.

### 2.1 Sample collection

Water samples were collected using pre-cleaned washed (5% HNO3) polypropylene containers. Fish Grey mullet (*Mugil cephalus, Linnaeus 1758*) were caught by gill net and trawl with help of local fisherman, respectively, from the two stations shown in the Fig.1. The first station (A. Krishnapatnam beach) was chosen in west region of the bay, near to the port. The second (B. Nelaturu beach) was in the east phase north area where presence of thermal power plants in Nellore coast. Moreover, the wastewaters of the local area was connected into the sea through small canals. The sampling sites have Fish Landing Centre - FLC, in the region where Boats and a number of small industrial plants are located. Ten fishes selected from each station for the present study.

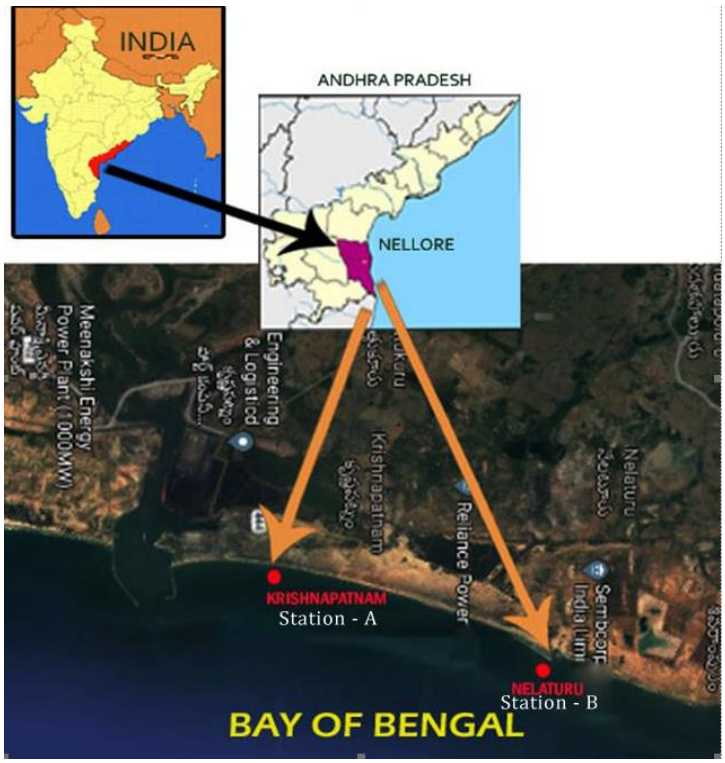


**Fig 1:** Map showing the study areas of Nelaturu and Krishnapatnam coastal regions of Nellore coast of Andhra Pradesh in India

### 2.2 Samples Preparation and heavy metal analysis

Fish obtained from Sampling stations were dissected and their tissue samples viz., gills, liver and muscle were separated for heavy metals analyses, the tissue samples were rinsed with distilled water and blotted with blotting paper. They were digested in $HNO_3$ and $HClO_4$ (3:1 V/V) by placing in the flasks on the hot plate until a clear solution was obtained (S.M.E.W.W., APHA). After this digestion, samples were cooled, diluted, filtered and then determined for metal concentration by using the Atomic Absorption Spectrophotometer- AAS is a very useful technique to determine trace levels of multi-elements in single aspiration. AA-6800 AAS coupled with GFA-EX7 graphite furnace atomizer and ASC-6100 auto sampler from Shimadzu (Koyoto, Japan) was used for heavy metal analysis. A high-density graphite tube was used for atomization. Normal single hollow cathode lamps were used for irradiation followed by APHA [6]. Calibration standards for metal were made by the serially diluting stock solutions with reagent grade distilled water and determined standards were run along with samples.

## 3. Results and Discussion

### 3.1 Heavy metals in water

The purpose of this work to determine the presence of a particular group of metals in water ecosystem of the Krishnapatnam and Nelaturu coastal areas. Having record to the possibility of bioaccumulation of these metals in tissues of living organisms, including fish it was necessary to find out whether the metals determined in the water samples were to be accumulated in the fish.

The ranges of the heavy metals present in the water samples collected from Krishnapatnam, Nelaturu coastal regions of Nellore coast during the study period obtained from AAS analysis was presented in the Table.1respectively. Except few metals like Hg, Fe, Cu, and Zn, the remaining heavy metal load in coastal water was far below toxicity threshold level in comparison with W.H.O allowable limits in water [7].

**Table 1:** Mean± SD (n=6) concentrations of Heavy metals (mg/lt) present in sea water samples collected from Krishnapatnam, Nelaturu, coastal regions of Nellore coast of Andhra Pradesh comparison with WHO standards.

| S. No | Name of the metal | Nelaturu coast (Mean ± SD) | Krishnapatnam coast (Mean ± SD) | W.H.O Standards |
|---|---|---|---|---|
| 1 | Arsenic (As) | 0.96±0.018 | 1.154±0.002 | 0.01 |
| 2 | Lead (Pb) | 3.24±0.31 | 3.122±0.018 | 0.01 |
| 3 | Cadmium (Cd) | 2.327±0.067 | 1.98±0.72 | 0.003 |
| 4 | Mercury (Hg) | N.D | N.D | 0.001 |
| 5 | Iron (Fe) | 0.032±0.007 | 1.62±0.0.16 | 0.2 |
| 6 | Copper (Cu) | 0.77±0.014 | 0.85±0.010 | 2.0 |
| 7 | Zinc (Zn) | N.D | 0.011±0.001 | 3.0 |

### 3.2 Heavy metals in fish

The ranges of the heavy metals present in the fish *M.cephalus* collected from Krishnapatnam, Nelaturu coastal regions of Nellore coast during the study period obtained from AAS analysis was presented in the Table.2 and Heavy metal pollution in the marine environment is determined by measuring its concentration in water and living organisms.

**Table 2:** Mean± SD (n=6) concentrations of Heavy metals (µg/g) present in mullet fish *M.cephalus* collected from Krishnapatnam, Nelaturu coastal regions of Nellore coast of Andhra Pradesh.

| S. No | Name of the Metal | **Krishnapatnam Coast** (Mean ± SD) | | **Nelaturu Coast** (Mean ± SD) | |
|---|---|---|---|---|---|
| | | ***Grey mullet fish - Mugil cephalus*** | | | |
| | | **Gill** | **Liver** | **Gill** | **Liver** |
| 1 | Arsenic (As) | 0 | 0.036±0.011 | 0.010±0.001 | 0.016±0.001 |
| 2 | Lead (Pb) | 0.328±0.010 | 0.126±0.010 | 0 | 0.074±0.014 |
| 3 | Cadmium (Cd) | 0 | 0.02±0.001 | 0 | 0.314±0.011 |
| 4 | Mercury (Hg) | 0 | 0.03±0.001 | 0 | 0 |
| 5 | Iron (Fe) | 87±42.57 | 59.67±14.87 | 55.32±9.16 | 46.0.7±8.11 |
| 6 | Copper (Cu) | 0.84±0.037 | 19.67±2.33 | 0.61±0.24 | 11.41±1.24 |
| 7 | Zinc (Zn) | 13.29±2.15 | 17.48±2.31 | 16.31±2.46 | 12.57±1.64 |

In general among the seven selective heavy metals Arsenic (As), Lead (Pb), Cadmium (Cd), Mercury (Hg), Iron (Fe), Copper (Cu), and Zinc (Zn) at Krishnapatnam coast Lead (0.328±0.010), Iron (87±42.57), Copper (0.84±0.037) and Zinc (13.29±2.15) were observed in the gill of *M.cephalus* among these Fe and Zn was observed higher concentrations because gills are primary accumulation spots, while heavy metals entering into the fish body. In the liver tissues higher concentrations were observed metals like Lead (0.126±0.010), Iron (59.67±14.87), Copper (19.67±2.33) and Zinc (17.48±2.31) and moderate concentrations of Arsenic (0.036±0.011), Cadmium (0.02±0.001), and Mercury (0.03±0.001) was observed.

Nelaturu coast Arsenic (0.010±0.001), Iron (55.32±9.16), Copper (0.61±0.24) and Zinc (16.31±2.46) were observed in the gill of *M.cephalus* among these Fe and Zn was observed higher concentrations because gills are primary accumulation spots while heavy metals entering into the fish body. Lead, Cadmium, Arsenic was not detected. In the liver tissues higher concentrations were observed metals like Iron (46.0.7±8.11), Copper (11.41±1.24) and Zinc (12.57±1.64) and moderate concentrations of Arsenic (0.010±0.001), Lead (0.074±0.014), Cadmium (0.314±0.011), and Mercury was not observed in the gills and liver tissues. Metal uptake and accumulation has a direct link with the feeding habit of fish and where fish resides in water [8]. The results compared with the World Health Organization (W.H.O) allowable limits in food [9]. Also it was generally observed that Fe, Cu and Zn were more concentrated in the gill and liver parts of the fish, although there was a lack of general pattern of uptake and elimination which is species dependent [10]. Thus the concentrations of several metal accumulation were significantly different due to the fish species, seasonal and biological differences like size, food source and environmental conditions like water chemistry, salinity, temperature and contaminants.

## 4. Conclusion

This study has presented data on the levels of heavy metals in water and various body parts of fish from coastal regions of Nellore. Although the results obtained showed signals as danger posed to consumers of sea foods and water from this stream but the possibility of deleterious effects after long period cannot be ruled out. This is as a result of the fact that this water body serves as the receptor for domestic wastes as well as runoff from industrial wastes where toxic metals from various sources and also fertilizers, washing activities of the ships at port functions and other agrochemicals are frequently used. There is therefore the need for continual assessment of the level of pollution of this stream with metals from the mentioned sources with a view to reducing the level of pollution via education and public enlightenment.

The environmental parameters of waters affect the toxicity of the metal either by influencing the physiology of organisms or by altering the chemical form of the metal in water. The heavy metal concentration in water is an important factor to be considered to assess the health of this important water body. This event increased, ambient heavy metal concentration will result in bioaccumulation in the tissues of commercially important edible species of fin fish, shellfish and ecologically important species. That is an inherent danger of higher bioaccumulation of toxins in the edible species that may result in severe health hazards to the consumers especially human. These animals can be directly harvested for human or livestock consumption, from wild or farming sources can serve to transfer of the metals tropically to carnivores, and can modify the speciation, cycling, and transport of metals in marine systems. Heavy metals accumulate in different tissues of mullet fish with different magnitudes. Generally, metals accumulation in muscle was lower than gills. The present study main concern suggested to adopt some treatment technologies to control the heavy metal concentrations in the waste disposals into the natural environment and prevent further marine pollution by the general population and by the industrial and the government authorities to minimize the pollution and conserve the marine aquatic life.

It is evident that with reference to the present study on heavy metals in the coastal waters of the Nellore coast, we can do the further studies on determination of heavy metals in the coastal sediments also in the edible fishes present in the coast to study the bioaccumulation and toxicity factors related to heavy metals.

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