

METAL CONCENTRATIONS IN THE GREY MULLET (*MUGIL  
CEPHALUS*) FROM VISAKHAPATNAM

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ABSTRACT

Concentrations of seven metals (zinc, manganese, iron, copper, nickel, cobalt and lead) have been determined in six different tissues of grey mullet (*Mugil cephalus*) caught in the waters of Visakhapatnam harbour (east coast of India). The concentrations of metals were high in the gills, eyes and liver and low in muscles. In most metals there was no direct relationship between the metal concentration in the tissues and the weight of the fish. High metal concentration found in the waters of harbour area appears to be responsible for a greater accumulation of these in the tissues.

The ability of marine species to concentrate a number of metals coming from mining or industrial waste has been reported by several workers (Nickless, Stenner and Terrille, 1972; Topping, 1973; Zingde, Singbal, Moraes and Reddy, 1976; Greig, Wenzloff and Pearce, 1976). Fishes are known to concentrate metal in their body tissues in varying proportions depending upon the species, environmental conditions and feeding habits. Since fish forms an important item of food for man, it can become an indirect source of heavy metals entering the body, leading sometimes to toxic effects. Mulletts are among the few fishes which can survive in a polluted habitat. However mulletts, particularly juveniles, can be exterminated when pollution increases due to heavy metals discharge through industrial wastes (Paperna, 1975). In India, grey mulletts are cultured in estuaries and ponds and are much relished as food. The present work was aimed at determining the concentration levels of various metals in different body tissues of mullet in a polluted environment.

During the 21st cruise of *RV Gaveshani*, eight grey mulletts were caught from Visakhapatnam harbour area. They were immediately kept in a deep freeze until analysed. Four of these fish samples of different sizes after thawing were wiped dry and weighed to give total wet weight. Brains, eyes and livers of all the eight fishes were pooled together and analysed to give average metal concentration and the other tissues such as larger dorsal muscles, bones and gills were analysed separately in four samples and the average concentrations calculated. All the tissues were dried at constant temperature of 110°C, weighed and subjected to wet oxidation with  $\text{HNO}_3$  and  $\text{HClO}_4$  (Topping, 1973) until a clear solution was obtained. The digested sample was then made up to 10 ml with distilled water and aspirated in the AAS flame, running the standards simultaneously. The coefficients of variation in the values of Zn, Mn, Fe, Co, Ni, Cu and Pb were found to be 3.2, 13.0, 3.7, 7.3, 12.1, 4.6 and 8.6% respectively. The surface water was also analysed for particulate and dissolved metal concentration. All the analyses were done using Hilger-Watts AAS model H 1550.

Table I gives the average metal concentration in various tissues of the grey mullet and Table II gives the metal concentrations in muscles, gills and bones and also in the surface water sample collected from the same area.

*Table I.* Average concentration of trace metals in mullet tissues (ppm dry weight).

Tissue	Zn	Mn	Fe	Co	Ni	Cu	Pb
Eyes	387.1	5.9	44.5	1.4	9.3	1.4	12.7
Brain	221.1	62.3	—	70.0	6.2	—	26.6
Liver	120.0	26.6	106.2	39.2	—	21.6	62.6
Muscle	52.4	3.5	16.2	4.1	2.9	3.3	8.8
Gills	345.4	45.6	118.6	17.9	7.8	14.6	41.6
Bone	265.0	40.3	32.9	8.4	7.6	4.7	16.4

### *Zinc*

Zinc concentration in different tissues showed a wide range of variation from 52.4 to 387.1 ppm (Table I). Lowest concentrations was found in the muscle while the highest was in the eyes followed by the gills (387.1 and 345.4 ppm respectively). These values were higher than those observed by Zingde, Singbal, Moraes and Reddy (1976) in fishes from the Goa coast. An examination of the results shows that the concentration of zinc in gills and bones is related to the weight of the fish (Table II).

### *Manganese*

The average concentration of manganese ranged from 3.5 to 62.3 ppm (Table I). Highest concentration was found in the brain (62.3 ppm) followed by gills and bones (45.6 and 40.3 ppm) respectively. In muscle the concentration was very low (3.5 ppm). There seems to be a direct relationship between fish weight and the concentration of manganese in the gills and bone (Table II).

### *Iron*

High concentrations of iron were found in the gills (118.6 ppm) while in the muscles and bone the concentration was low (16.2 and 32.9 ppm respectively, Table I). The concentration of iron in a particular tissue seems to be more or less constant regardless of the body weight (Table II).

### *Cobalt*

The variation in cobalt concentration in mullet tissues was high and ranged from 1.4 to 70 ppm. Highest concentration (70 ppm) was found in the brain followed by liver (39.2 ppm) and gills (17.9 ppm) while the eyes and the muscles had low concentrations (1.4 and 4.1 ppm respectively). It can be seen from Table II that cobalt concentration has no relation with the body weight.

### *Nickel*

This metal was present in very low concentrations as compared with the other metals. Highest concentration was found in the eyes (9.3 ppm) followed by gills (7.8 ppm) and the lowest concentration was in the muscles. There was no relation between nickel concentration and the weight of the fish.

Table II. Concentration of trace metals in muscle, gills and bones of four fish samples (ppm dry weight) and in surface sea water ( $\mu\text{g/l}$ ).

Tissue	Wet. wt. of fish (g)	Zn	Mn	Fe	Co	Ni	Cu	Pb
Muscle	42.4	50.8	4.3	16.8	4.6	2.4	2.6	16.3
	43.4	54.9	2.2	17.2	4.7	2.1	4.7	2.9
	51.5	53.6	4.7	15.4	5.3	3.4	3.1	8.1
	56.3	50.1	2.8	15.6	1.9	3.7	3.5	7.9
Gills	42.4	165.2	27.9	113.4	14.3	8.9	—	13.8
	43.4	233.1	40.1	108.4	12.0	8.9	12.8	50.8
	51.5	468.0	68.6	143.9	19.2	7.2	13.3	40.9
	56.3	515.4	45.7	109.9	26.2	6.4	17.6	60.8
Bones	42.4	106.7	30.9	29.9	8.7	5.9	9.1	21.2
	43.4	195.9	46.8	36.3	7.8	8.5	6.9	4.5
	51.5	331.2	52.2	35.6	8.7	8.9	2.0	30.5
	56.3	426.4	31.3	29.7	—	7.1	1.0	10.6
Water (Particulate)		81.3	24.9	178.3	2.1	0.6	0.3	0.3
Water (Dissolved)		66.3	124.2	63.0	1.1	7.4	15.3	5.6

### Copper

Higher concentrations of copper were found in the liver and gills (21.6 and 14.6 ppm respectively) and low concentrations in the eyes and muscles (1.4 and 3.3 respectively). Copper concentration in general did not show any relation with the body weight of the fish.

### Lead

The concentration of this metal ranged between 8.8 and 62.6 ppm. Liver had the highest concentration and muscle the lowest. The concentration of lead in the other tissues was as follows: gills—41.6 ppm, brain—26.6 ppm, bone—16.5 ppm and eyes—12.7 ppm. There was no relation between lead concentration and the weight of the fish.

### Metals in water

As can be seen from Table II, Zn, Mn and Fe were present in high concentrations in the surface water both in soluble and particulate form. About 74% of iron was present in particulate form and 26% in soluble form. Manganese, on the other hand showed a reverse trend (17% in particulate and 83% in soluble form). Zinc was 45% in soluble and 55% in particulate form. The concentrations of other metals were relatively low, the soluble fraction being more than the particulate fraction.

From Table I, it can be inferred, that the concentration of all the seven metals studied was lowest in the muscle which forms the main edible part of the fish. High concentrations were found in the gills, eyes, liver and brain. In gills and eyes, high values might be due to

their constant exposure to sea water. According to Goldberg (1965), the muscus exposed to sea water acts as surface adsorption sheet for either selective or general accumulation.

Visakhapatnam port has several activities such as shipbuilding, loading of ferromanganese ore and loading and unloading of other cargo. In addition to these, a part of the city sewage finds its way into the port waters through a narrow drain and thus increases the pollution load (Ganapati and Raman, 1973, 76). Probably because of these activities, heavy metals such as iron, manganese, zinc and lead are found in high concentrations in water both in dissolved and particulate form (Table II). High concentration of trace metals observed in the tissues of the mullet may be because of its feeding habits. The grey mullet being a detritus feeder obtains its food by ingesting fine sediment particles (Brulhet, 1975; Das, 1977). Probably heavy metals are ingested along with detritus. This is not so in pelagic fishes which feed in the column of water (Eustace, 1974).

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