THE RED MULLET *MULLUS BARBATUS* (LINNAEUS 1758) AS AN INDICATOR FOR HEAVY METAL POLLUTION IN IZMIR BAY (TURKIYE)

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Abstract

Monitoring of cadmium, lead, zinc, copper and iron in different tissues of red mullet (*Mullus barbatus* L.1758) was conducted in Izmir Bay during a one year period. The levels of trace elements for *M. barbatus* were between; 0.50-1.10 μgCd/g fresh weight, 3.83-11.44 μgPb/g fresh weight, 0.49-1.05 μgCu/g fresh weight, 19.00-34.89 μgZn/g fresh weight, 90.85-170.11. μgFe/g fresh weight *in gills,* 0.94-1.66 μg Cd/g fresh weight, 2.40-9.43. μgPb/g fresh weight, 1.10-3.20 μgCu/g fresh weight, 42.00-62.25 μgZn/g fresh weight 44.00-114.71 μgFe/g fresh weight in livers, 0.14-0.53 μgCd/g fresh weight, 0.80-2.55. μgPb/g fresh weight, 0.11-0.48 μgCu/g fresh weight, 6.59-10.99 μgZn/g fresh weight 2.12-10.83 μgFe/g fresh weight in muscle tissues.At the end of this study, the edible parts of demersal fish *M. barbatus* which still contain relatively low concentrations, lie just between the safe range given by WHO.

Key Words: Heavy metals, Mullus barbatus, Izmir Bay,

Introduction

The resultant concentrations of metals in biota arise from a series of complex interactions between several processes. In any particular organism, tissue metal concentrations reflect the amount of metal taken up into the organism (1). Especially, investigations of metals in fish are an important aspect of environmental pollution control. Contaminant accumulation in various fish tissues is used as a measure of contaminant exposure and effects. The accumulation of heavy metals in fish depends on several factors, namely trophic concentrations and age/size which comprise the nature and activity of organisms. Physicochemical variables determine its bioavailability by controlling the speciation, binding, release, distribution and biogeochemical pathways of heavy metals in the environment (2). The subject of this study was to screen the trace metal concentrations (Cd, Pb, Zn,Cu, Fe) in different tissues of the demersal fish *M. barbatus* caught in Izmir Bay during a one year period.

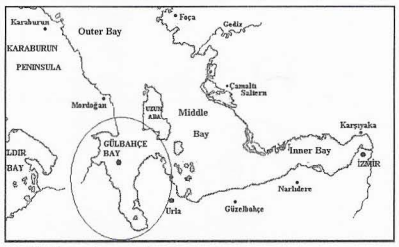

Fig.1. Map of sampling locations.

Sampling area

Izmir Bay (Aegean Sea, Turkiye) receives pollutants from direct urban effluents, industrial zones and the sewage of 3.000.000 inhabitants of Izmir City. Since 1999 only 30-40% of these wastes had been treated in the sewage plant. Effluents from land-based activities are also discharged into Izmir Bay through 11 rivers and 128 channels. The bay is divided into the Inner, Middle and Outer Bay from the standpoint of topographical and hydrographical characteristics. Fish were caught in Gülbahce Bay which is located in middle part of Izmir Bay (Fig.1).

Methodology

During the period November 1999- October 2000, *M. barbatus* specimens were caught in Izmir Bay by trawl from the Gülbahce region of Izmir Bay. All fish samples were placed in plastic bags and stored below –20°C until analysis. Dorsal muscle, liver and gill were taken from specimens of similar size. Single homogenized tissues were also taken for analyses. These samples were prepared according to international standard methods (3). The composite samples were weighed and digested with conc. HNO_3: $HClO_4$ (5:1) under reflux and filtered. Metal samples were analyzed by atomic absorption spectrophotometer using a PYE Unicam SP 9 (AAS). Metals were determined by direct aspiration using air-acetylene flame. Intercalibration fish muscle homogenate samples (IAEA-407/TM from Monaco Laboratory) were used as a quality control sample for the analytical methodology.

Results and discussion

Some demersal fish species (especially *M. barbatus, M. surmuletus* and *Upeneus moluccensis*) are known to accumulate high levels of trace metals in their different tissues, and these species are commonly used in biomonitoring studies.(4) Bioaccumulation in demersal marine fish species adequately reflects the changing levels in the environment for trace metals. The degree of their accumulation depends on their metabolic activity, growth, biochemical composition and reproductive and feeding condition (5,6). The levels of trace elements in demersal fish *M. barbatus*, sampled from Izmir Bay have changed slightly; 0.50-1.10 μg Cd/g fresh weight, 3.83-11.44 μg Pb/g fresh weight, 0.49-1.05. μg Cu/g fresh weight, 19.00-34.89 μg Zn/g fresh weight , 90.85-170.11. μg Fe/g fresh weight *in gills*, 0.94-1.66 μg Cd/g fresh weight, 2.40-9.43 μg Pb/g fresh weight, 1.10-3.20 μg Cu/g fresh weight, 42.00-62.25 μg Zn/g fresh weight. 44.00-114.71 μg Fe/g fresh weight *in livers*, 0.14-0.53 μg Cd/g fresh weight, 0.80-2.55 μg Pb/g fresh weight, 0.11-0.48 μg Cu/g fresh weight, 6.59-10.99 μg Zn/g fresh weight 2.12-10.83 μg Fe/g fresh weight in muscle tissues. The average concentrations and accumulation ratio of heavy metals determined in different tissues of *M. barbatus* are shown in Figs 2, 3. All values being expressed on a μg g-1 fresh weight basis. Previous trace metal levels in muscle of *M. barbatus* are given in Table I from different regions of Izmir Bay. The following order was found between the different tissues in accumulating trace metals; Liver>Gill>Muscle for Zn, Cu and Cd, Gill>Liver>Muscle for Fe and Pb and in general the order of heavy metal concentrations in liver and muscle was Fe>Zn>Pb>Cu≥Cd , and in the gill the order was different Zn>Fe>Pb>Cu≥Cd.

Table I. Previous trace metal levels in muscle of Mullus barbatus from different regions of Izmir Bay. (μg g-1 fresh weight) - **This study*

Location/Metals	Cd	Pb	Cu	Zn	Fe	Year	Ref.
Gulbahce Bay	0.10	1.18	0.95	5.98	5.80	1984	8
Cesme offshore	0.006	0.14	-	-	-	1998	9
Gulbahce Bay	0.25	1.67	0.25	8.71	6.42	2000	*

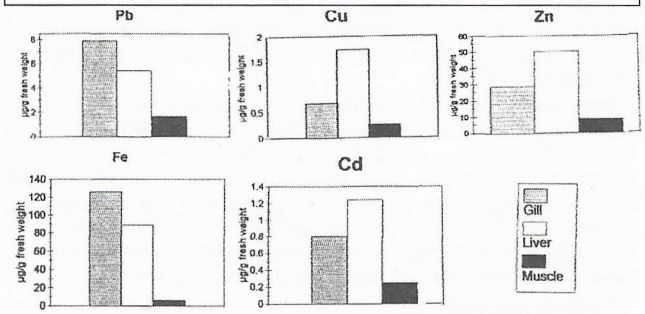

Fig. 2. Average concentrations of heavy metals in different tissues of *M. barbatus* (μg g^{-1} fresh weight).

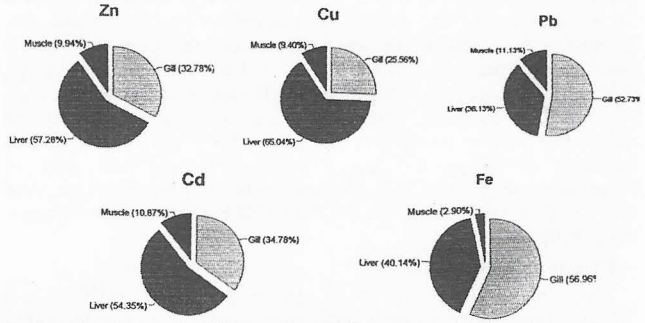

Fig. 3 . Accumulation ratio of Heavy metals in different tissues of *M. barbatus.*

Conclusions

In conclusion, this study indicates that significant long-term changes of heavy metal concentrations in *M. barbatus* in Izmir Bay parallel to the observed increase of Izmir Bay pollution. Since the mid 1980's heavy metal concentrations in sea water have increased remarkably in inner part of Izmir Bay. This is very important because heavy metal pollution of inner part of Izmir Bay represents a serious problem. Although the edible parts of demersal fish *M. barbatus* (L 1758.) which still contain relatively low concentrations, lie just between the safe range given by WHO (0.2 mg/kg wet weight for Cd, 2.0 mg/kg wet weight for Pb, 20.0 mg/kg wet weight for Cu, 50.0 mg/kg wet weight for Zn) (7), it would be prudent to continue monitoring trace metals in demersal fish species which are eaten by humans.

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