

Metal contamination of a fish species (*Mugil curema*) of the beach of Soumbedioune (Dakar/Senegal)

ABSTRACT

This present work consists in studying the metal contamination of the beach of Soumbedioune, located at the western frontage of the ~~area of Dakar~~. This site, ~~place of unloading of products halieutiques, shelters the channel IV which drains urban water of rejections~~. We evaluated the concentrations of the metal elements (Fe, Zn^{2+} , Cr^{6+}), in *Mugil curema* visible spectrophotometry UV. The metal elements can be very dangerous for human health when they are present in the environment at high concentrations. Thus the evaluation of the metal contamination in the marine organism, in particular fish, makes it possible to envisage a possible contamination of the man. These ults obtained show that the concentrations of the metal elements vary according to the weight and from the size of the mullets. The maximum tent chromium of 133 $\mu\text{g/g}$ is obtained with Mc that out of iron is of 85,5 $\mu\text{g/g}$ with Mca8 and that out of zinc obtained with Mca1 is of 150 $\mu\text{g/g}$. However the found values are definitely higher than the standards established by FAO and the EEC.

Keywords: Mullet, metal parameters, spectrophotometry, contamination.

1. INTRODUCTION

The physicochemical and metal quality of the marine environment plays a very significant role in the determination of biological quality and the degree of the pollution of this medium.

In this medium, all the pollutants particularly heavy metals are subjected as well as the natural substances, in the play the biogeochemical phenomena [1].

These elements can be found in water, with the state or complexes mineral or organic, in form colloidal or particulate are thus distributed in the aquatic environment [2, 3].

Urban worn water is one of the principal ways of metal contribution towards the watery ecosystems [4].

29 The transformation of the metal elements is due to the physicochemical or biological factors
 30 can neutralize these metals but, facilitate their dispersion in the marine environment and
 31 increase their degree of toxicity [1].

32 ~~In sea water, pH appreciably equal to 8, metals exist with the state of trace and are frequently~~
 33 ~~absorbed on the living matter and the suspended particles.~~

34 To this end, several work was undertaken in order to evaluate the levels of metal
 35 contamination of the organism sailor [5, 6] and particularly on pollution by metals at various
 36 edible fish species [7-11].

37 ~~These fish are able thanks to the metabolism to accumulate contaminant elements of the~~
 38 ~~environment in some their bodies.~~ For the monitoring of our coasts, one nowadays calls upon
 39 fish like indicators of the quality of water and the watery ecosystems. ~~The toxicological~~
 40 ~~analyses are made on the potential accumulating bodies like the liver, the gills, the muscles...~~
 41 ~~in order to determine the heavy metal concentrations. Concentrations compared with values~~
 42 ~~of reference indicate the medical risk for the man [12].~~

43 It is very significant to note that the muscles provide a low content of metals because of their
 44 weak metabolic activity but they can be used as circumstantial biological indicator because of
 45 his mass compared to the other bodies like the liver. From a certain concentration of each
 46 heavy metal in the muscle, the man is exposed to the contamination by the fish [13].

47 The goal of this study is to determine the concentrations of metals (Fe , Zn^{2+} , Cr^{6+}) in the flesh
 48 of a fish species (*Mugil curema*) in order to evaluate the level of contamination of our coasts.

49 2. MATERIALS AND METHODS

50 2.1. Site of study

51 The area of Dakar constitutes a significant economic pole in Senegal by its strong
 52 concentration of light and heavy industries located at the seaside. This area comprises several
 53 wet depressions of which coasts. It is accordingly that we were interested in the evaluation of
 54 the metal bio-accumulation of fish of bay of Soumbédioune. The beach of Soumbédioune is
 55 located at the district of Médina of Dakar on the western cornice. ~~It is a place of unloading of~~
 56 ~~the products halieutiques~~ which receives worn water coming from the western channel which
 57 crosses part of the area of Dakar.

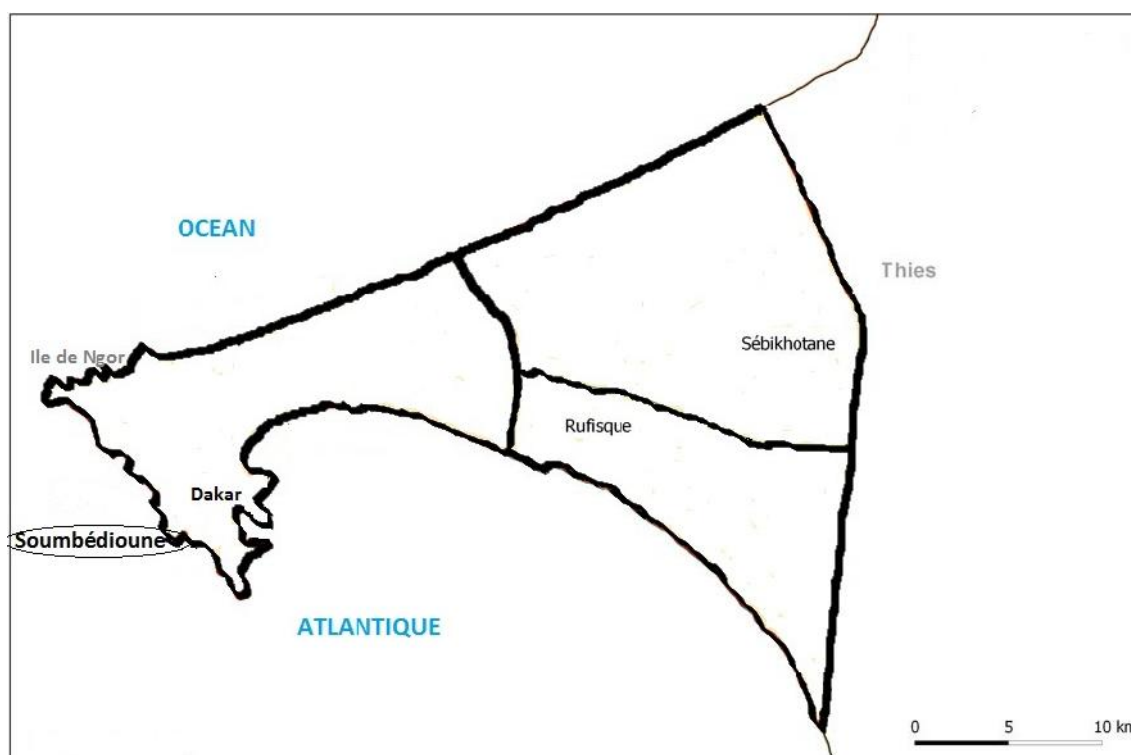


Figure 1: Site of taking away of the mullet

2.2. Sampling

Sampling constitutes a crucial stage of our study. The set aim is to obtain a range of representative samples which reflects all the physical and chemical characteristics of the studied site. The principal stages which characterize a step of sampling are the development of a strategy of samplings on the sites and their conservations.

The fish samples were collected on the level of bay of Soumbédioune by a fishing with feet. They are transported to the laboratory then preserved at the refrigerator with -20 °C before the preparation.

2.3. Preparation of the samples

At the laboratory, we dissected fish then the flesh was taken and dried with the drying oven during two hours with 60°C until the weight does not vary anymore and finally the samples were crushed and preserved in plastic sachets.

2.4. Extraction of metals

For mineralization, three catches of 0,5 gram of the powder obtained is attacked by 4 ml of nitric acid HNO_3 (14 N) in capsules out of glass then placed at the drying oven with 80 °C during one hour for the digestion of fabric and the total evaporation of the acid. The product of digestion is recovered with a few ml of water distilled and included in a graduated flask of

50 ml by adding distilled water. The solution thus obtained is used for the reading with photometer PF 11.

2.5. Experimental methods

The analysis of the metal elements (Fe, Zn^{2+} and Cr^{6+}) in the flesh of *Mugil curema* was carried out at the organic physical environmental analysis chemistry laboratory of the technology and Faculty of Science (Dakar).

These analyses were made by spectrophotometry UV-VISIBLE using photometer PF 11 in four stages.

2.5.1. Preparation of the white and the sample

The white can be consisted of demineralized water or the sample to be analyzed without addition of reagents.

The preparation of the sample to be analyzed consists in adding reagents in 5 or 10 ml of the prepared solution. It is a method of analysis per proportioned addition. It is very significant to respect the reading time prescribes in the protocol of analyses to ensure a homogeneity of the solution to be proportioned.

2.5.2. Preparation of the photometer

The apparatus comprises several methods of reading of the content of the element to be proportioned: Visocolor, Visocolor Eco or nanocolor. The method, to choose, depends on each element and its measurement is posted directly on the screen of the apparatus.

2.5.3. Adjustment of the zero of the concentration

The zero of the concentration must be regulated before each measurement.

2.5.4. Measure prepared sample

To place the sample prepared in the measuring cell and to directly read the concentration of the sample posted on the screen of the apparatus in mg/L.

3. RESULTS AND DISCUSSION

3.1. Analyze metal parameters in fish

The results of the analyses of the average contents of heavy metals, for a series of three measures to the flesh of *Mugil curema* and their standard deviations were gathered in the following table.

111 **Table 1: Contents of metals (Cr⁶⁺, Fe and Zn²⁺) of µg/g of dry weight in the flesh of**
 112 **the mullets**

Metals Mullets	[Cr ⁶⁺] $\pm\sigma$ (µg/g)	[Fe] $\pm\sigma$ (µg/g)	[Zn ²⁺] $\pm\sigma$ (µg/g)
Mca1	133 $\pm$ 8,5	26,3 $\pm$ 5,7	150 $\pm$ 14
Mca2	21,3 $\pm$ 6,8	40,5 $\pm$ 12	70 $\pm$ 10
Mca3	18,7 $\pm$ 1,5	6,7 $\pm$ 0,5	<LD
Mca4	13,7 $\pm$ 1,1	6,0 $\pm$ 2,6	<LD
Mca5	8,7 $\pm$ 2,1	23,5 $\pm$ 2,1	<LD
Mca6	15,3 $\pm$ 3,7	6,3 $\pm$ 1,0	<LD
Mca7	17,3 $\pm$ 3,2	46,7 $\pm$ 1,5	<LD
Mca8	15,3 $\pm$ 3,2	85,5 $\pm$ 6	<LD
Mca9	15,3 $\pm$ 1,5	60,3 $\pm$ 6,0	<LD

113

114 < LD: lower than the limit of detection

115 The analysis of the results of metals on the level of the mullets shows that chromium presents
 116 on average a high concentration of 133µg/g with the mugil curéma 1 (Mca1) and its minimal
 117 value is of 8,7 µg/g with Mca5.

118 Iron records concentrations which vary between 6 to 85,5 µg/g of dry weight.

119 Zinc is not detected for the Mca3 mullets in Mca9 on the other hand, one notes a variation of
 120 70 µg/g with Mca2 with 150µg/g with Mca1.

121 The contents obtained for certain mullets are however higher than the standards established
 122 by the OMS/FAO for the zinc which is of 70µg/g and for the chromium which is of 5,5µg/g
 123 according to the CEE/R n466/2001 [14].

124 For iron the value reference is of 20µg/g, which corresponds to the limiting value to which
 125 the toxic effects related to the food quantity of iron introduced can appear [15].

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3.2. Study of the variation of the content of each metal in the mullets

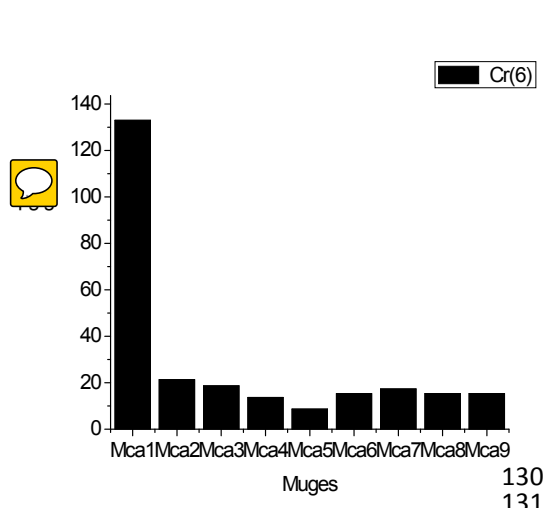


Figure 2: Chromium content (6)

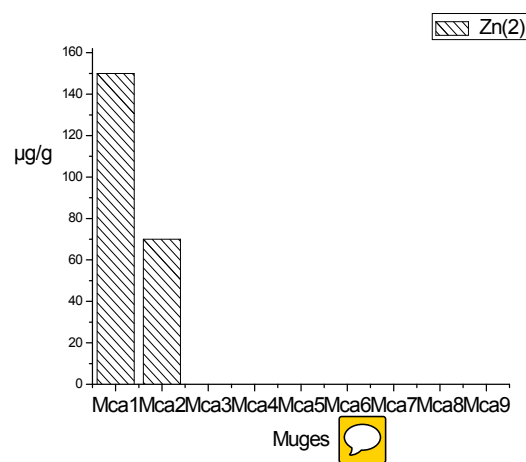


Figure 3: Zinc content (II)

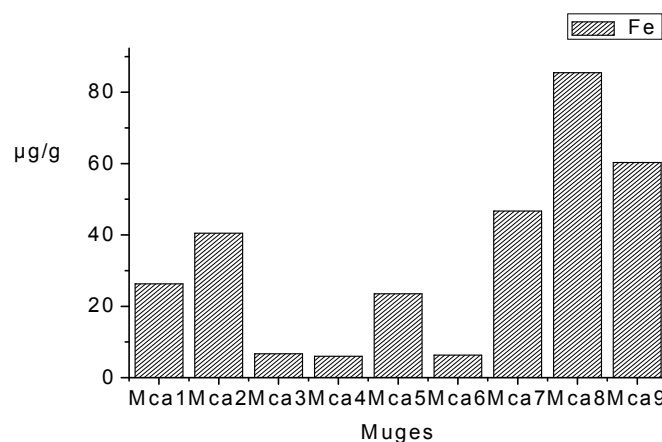


Figure 4: Content of metal iron

The correlation between the concentrations of metal and the size of the species depends on several factors, such as the metabolism of specific metal in fish, the type of fabric considered, competition between the effects of ageing, the tissue growth and the availability of metal in the environment [16, 17].

Concentrations of metals higher present at the young species generally reflect time court of accumulation in fish, combined with the higher rate of metabolism compared to the adult organism [18, 19].

The differences in concentrations metal between the species can be related to the habitat, the mobility of fish, the food, or with other characteristics of the behavior.

According to our study, the maximum content chromium (VI) plates some is obtained with Mca1 whose size is larger (figure 2). This could be explained to the fact why the oldest fish are contaminated because they have a more significant residence time compared to the least old. They thus accumulate of chromium which is a very toxic element and not essence [20].

Just as zinc, the detected concentrations are higher for the oldest mullets whose weights and size are more significant (figure 3). The least old need the essential elements for the growth. It is for that, that they consume all accumulated zinc.

The accumulation of iron is more significant for the mullets whose weights and size are less significant (figure 4). This could be explained owing to the fact that the least old fish need more iron than oldest because this one is a trace element essential to their growth.

4. CONCLUSION

The pollution of the environment by heavy metals (iron, chromium, zinc, copper, nickel, mercury, arsenic and cadmium) is due to emissions coming from the human activities.

Within the framework of this work, we established the profile of contamination of the coasts of the area of Dakar, by the proportioning of heavy metals in the flesh of *Mugil curema*. The analyses were carried out by spectrophotometry UV-VISIBLE using photometer PF-11.

The results obtained, starting from biological biological indicator, allow an evaluation of the state of contamination by iron, the zinc and the chromium of the littoral dakarois. A quantification of the impact of the contributions anthropic of these metals in the aquatic environment was also carried out.

The strong contents of metals found in the flesh of *Mugil curema*, revealed the real danger which this part of the littoral dakarois presents, which is used for the fishing and the unloading of the products halieutics. Moreover, the fish consumption of this zone can cause a problem of public health.

It is urgent to carry out a regular control based on an effective policy whose actors will be the State, the industrialists and the scientific community.

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