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Evaluation of the metal concentration of copper in the mullet (*Mugil cephalus* Linnaeus, 1758) fishing in the Bay of Oran

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Abstract

Our study focused on the evaluation of copper concentrations in millet (*Mugil cephalus* Linné, 1758) caught in the Oran bay. This fish reflects very well the quality of its biotope, it is a very abundant species in the Algerian coastal waters and highly appreciated by the Algerian consumer. The monthly sampling was spread over a period of fourteen months from February 2012 to March 2013 three organs were considered: liver, detoxification organ, gonads, reproductive organs and muscle representing the consumed part by the man. Heavy metal concentrations were determined by the Atomic Flame Absorption Spectrophotometry as a function of several parameters .This study shows that *Mugil cephalus* contains this desired metal. The results obtained statistically did not reveal any significant difference between the heavy metal contents of the two sexes, in the targeted organs. The concentration levels of this metal indicate a certain pollution of the target area.

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Introduction

The marine environment is contaminated with many chemicals including metallic elements released by industries, agriculture and urban communities. The estuarine and coastal zones, under strong continental influence, are the most affected by this contamination. The latter may affect the health of the marine environment, as it does not undergo biological or chemical degradation. It can thus accumulate in the various links of trophic chains at toxic concentrations in marine organisms (Neathery & Miller, 1975). Let us know that the Bay of Oran is the place of a very strong industrial concentration especially towards the east namely Arzew which is the site of an incessant pollution. We also note the use of coastal waters for the cooling of thermal power stations, in addition to releases of a large number of wastes and pollutants at sea, which can cause many stranding, some marine fauna, observed On the Oranese coast (Boutiba *et al*., 2003).

For this reason this work is conducted to evaluate the rate of pollutant dangerous for the ecology and the environment of this site. The main objective of this study is to ensure the safety of foodstuffs of animal origin, offered to consumers, is one of the priority concerns of food safety, and also to monitor the quality of marine waters, of aquatic organisms.

Materials and methods

Sampling

Our study area is located on the west coast of Algeria (Fig. 1). The Oranais coastline is a set of landforms whose shaping depends directly or indirectly on the actions of the sea. Oran Bay occupies the central part of the Oranan coastline and opens from west to east;

It is bordered on 30km of elevated land and draws a semi-circular almost regular from Cape Falcon to Cap de l'Aiguille. It lies between the Andalusian Bay and the Gulf of Arzew (Leclaire, 1972).

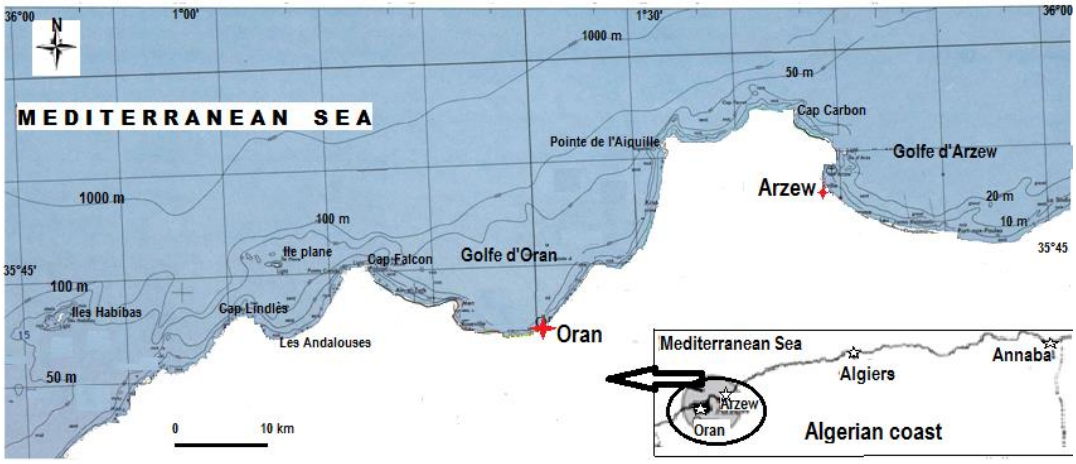

Fig. 1. Geographical position of the study area: the Bay of Oran (Belhoucine *et al*., 2014).

The Mugil cephalus species was selected in this study in relation to its role in the marine ecosystem as it plays an ecologically important role in the flow of energy in marine communities. Because of its regular abundance in the Mediterranean Sea, it is a characteristic part of the food chain and it also serves as prey (Bester, 2004). Many studies have been devoted to his eating habits (Suzuki, 1965, Odum, 1968, Zismann *et al*., 1975, Bishop & Miglarese, 1978). Finally, it is of great local importance because it is one of the most consumed and appreciated by the Algerian population.

Sampling took place over a fourteen month period from February 2012 to March 2013; 330 individuals were sampled at the sampling site. After measurements, the liver, muscles and gonads were removed, weighed and frozen up to the time of their chemical analysis.

Chemical analysis

Determination of trace elements in this fish commonly uses the Atomic Absorption Spectroscopy (SAA) method. Indeed, the *Mugil cephalus* sample must undergo mineralization beforehand.

The wet mineralization of the samples was carried out according to the method of AMIARD *et al.*, (1987): 1mL of nitric acid is added to 1g of sample and then adjusted to 4 mL of bidistilled water after one hour at 95°C.

This mineralization of the samples is accompanied, on the one hand, by that of the whites, made up of solutions containing the reagent of mineralization (nitric acid) and undergoing the same experimental conditions as the sample, and on the other hand, Intercalibration samples on a standard biological tissue material from Mytilus galloprovincialis (SRM 2976) from the International Atomic Energy Agency of Monaco, allowing us to define the coefficients of variation for each of the metals sought and to control the accuracy And the accuracy of the analytical protocol.

Statistical Processing

The statistical processing of the data was carried out using the Stastica software, and the results are represented as a mean with the standard error (m±SD) in mg/kg. The Student (T) test was used to determine the significance of the differences between the calculated averages. The difference was considered significant at a probability threshold (p) of less than 5% (p> 0.05).

Results and discussion

The sought-after metallic pollutant, Copper, is present in the targeted sub-samples of *Mugil cephalus* from the study sites. These concentrations are totally heterogeneous.

Monthly variation in mean metal concentrations in Mugil cephalus

In general, we are witnessing episodes of rising and falling metallic element concentrations. The average concentration of copper, representing several peaks of concentration, the highest during the month August 19mg/kg as well as the month of April 2012 is 12. 2mg/kg is March 2013 is 14.1mg/kg. Significant fall in concentration in several months in the year 2012 and 2013, the most basic fall is that of October and January 2013 respectively 2.5mg/kg and 2.7mg/kg.

Copper is a xenobiotic listed in the list of hazardous substances (C.E.E, 1982) and also considered as highly hazardous and non-biodegradable pollutants (E.E.A, 1997).

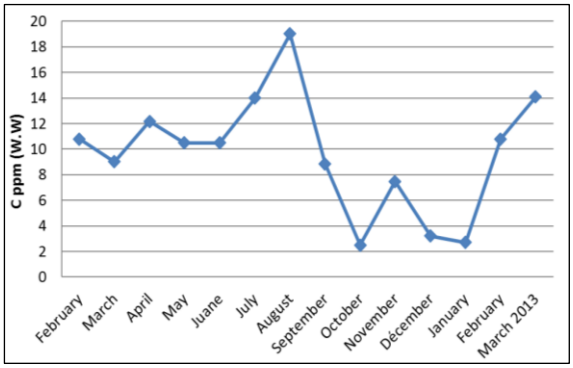

Fig. 2. Monthly assessment of mean concentrations of heavy metals Copper (ppm of W.W) in *Mugil cephalus*.

The period of sexual rest is a phase of gametogenesis characterized by an increased accumulation of nutritive reserves with a synthesis and storage of carbohydrate, lipid and protein materials (Webb, 1997). When nutrients are collected, the concentration of heavy metals automatically drops (metal release at that time) and the accumulation of reserves does not slowly resume until the beginning of the period of sexual rest (Webb, 1997). According to these authors, the reproduction of *Mugil cephalus* occurs from October to January (Landret, 1974, Greely *et al.*, 1987, Ibañez, 1994).

In the Mediterranean, in the Caspian Sea and in the Marmara Sea, the different populations of *M. cephalus* reproduce between June and October (Faouzi, 1938, Morovic, 1963, Farrugio, 1975, J. Brusle & S. Brusle, Nineteen eighty one).

Monthly variation in mean concentrations of Copper metals by sex in Mugil cephalus

On the basis of the results of Fig. 3, bioaccumulation of the pollutant is greater in male than in female, the concentration in males is 0.79m/kg and in females is 0.68mg/Kg the student P test showed no significant difference between the two sexes. Comparison of mean sex concentrations in muscle indicates that copper is more accumulated by females than males.

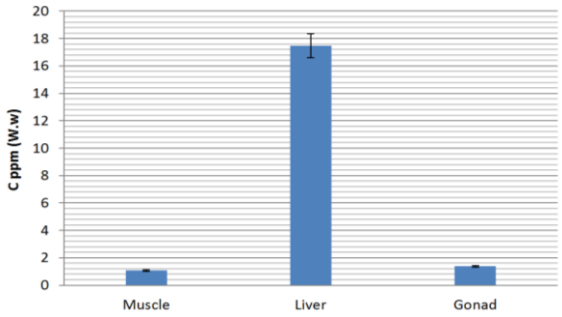

Fig. 3. Assessment of average heavy metal concentrations of organs (ppm W.W) in *Mugil cephalus.*

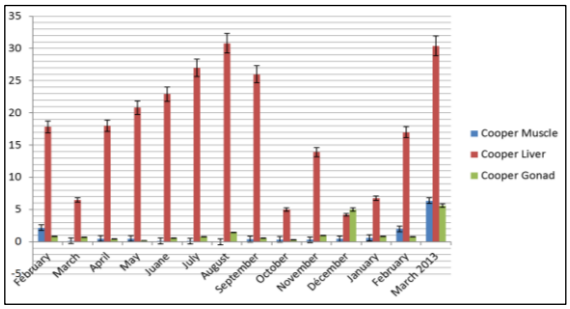

Fig. 4. Assessment of Mean Copper Heavy Metal Concentrations Months and organs (ppm W.W) at *Mugil cephalus.*

Variation of mean concentrations of Copper in the three organs (muscle, liver, gonads) in mules in Mugil cephalus

In this study, size, and sex parameters were not considered. The average concentrates of copper in the muscle are low, it represents 1.07mg/kg, the gonads represents 1.37mg/kg, unlike the liver concentration, are more important than the other two organs are 17.46mg/kg. It is generally accepted that muscle tissue is not an organ in which metals accumulate (Legorburu, 1988). According to other authors; Muscle tissue, especially fish, is hardly involved in its metabolism and accumulation (Guns *et al.*, 1984, El nabawi *et al.*, 1987, Hornung and Ramelov, 1987). In the literature, the amounts of heavy metal bioaccumulation in tissues may vary depending on the length and weight of the samples (Barghigiani and Ranieri De, 1992; Zyadah, 1999), as our biological material is a large fish; we have observed a quantity of metals sufficiently important in each organ of these fish. Similar findings have already been reported in other research groups that have worked on Mugil cephalus in Turkey (Yilmaz, 2008).

This also coricide to another study was carried out in the same country by Bahar Yilmaz, 2003.

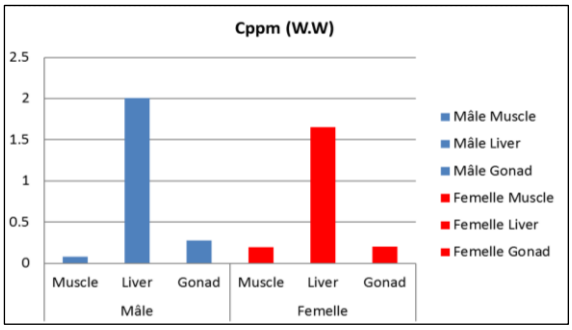

Fig. 5. Variation of mean concentrations of Copper in the three organs (muscle, liver, gonads) in mules in *Mugil cephalus*.

Seasonal evaluation of mean heavy metal concentrations (ppm of P.F.) in Mugil cephalus

The order of the seasonal variations of metallic contents differs from each season of the year. Observing these results shows that the highest grades are those of summer as well as the lowest are in autumn. One might think from these results that thermal extremes favor the bioaccumulation of metals. It can also be assumed that the salinity/temperature relationship is responsible for seasonal fluctuations in the accumulation of heavy metals. Les résultats de cette étude montrent plus qu'une distribution significative dans l'espace que dans le temps. La variation saisonnière de la concentration de métaux lourds a été étudiée dans plusieurs révisions (Philips, 1976, Denton et Burdon-Jones, 1981). Cependant, les résultats montrent que les notes varient selon la période de récolte et semblent dépendre de la saison des récoltes (Mousataid *et al.*, 2005).

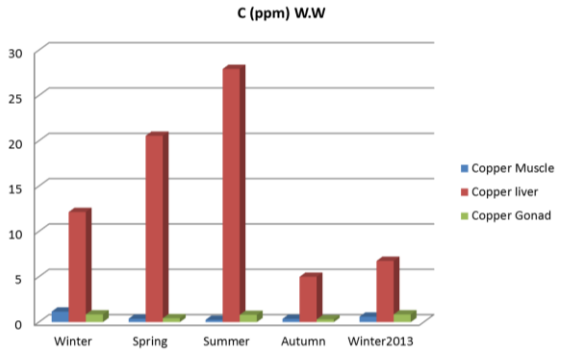

Fig. 6. Seasonal variation in mean heavy metal concentrations of Copper (ppm of W.W) in *Mugil cephalus*.

Comparison of heavy metal contents (ppm P.F.) in Mugil cephalus with respect to the maximum permissible doses (D.M.A.)

We note that the average doses of heavy metals found in *Mugil cephalus* compared to those provided by the D.M.A. literature are not disturbing and therefore do not constitute an immediate danger to the consumer.

Table 1. Comparison with dose limits (D.M.A).

	Copper
Mugil cephalus Present study	09.31 mg/kg P.F.
Food	-
Fish	5 mg/g P.S (g) 30ppm PF(g)

B) G.I.P.P.M. (1973) [Interministerial Group on Pollution Problems of the Sea]
(F) CSHPF (1990) [Higher Council of Public Hygiene of France]
(G) CNRMS of Australia (1992) [National Council for Medical Research and Health]

Conclusion

The study we have carried out shows that, in view of the results obtained and by comparison with the limit values found in the literature, we can conclude that the two bays are not polluted despite the presence of metal contaminants but without any significant difference between her. Bioaccumulation occurs preferentially in the liver and gonads compared to the muscle of *Mugil cephalus*. On the other hand, a relationship was established between the laying period and the high trace metals in relation to sexual maturity, which corresponds to increased hepatic activity occurring after fattening of the species after the breeding period.

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