



## Contamination of Sarotherodon Melanotheron by Lead, Zinc and Copper: Case of PORTO-NOVO lagoon, South of the Republic of Benin

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### Abstract

*Pollution of lakes and lagoons is today in Africa a true environmental problem that has negative consequences and sometimes irreversible damage to aquatic ecosystems. These consequences have repercussions on the very serious human health. In Benin fishing mainland is about 75% of the national fish production accounts for nearly 31% of the national consumption of animal protein. Fishing products in general and fish in particular are very important foodstuffs and anything that affects these products has direct repercussions on the food chain. Indeed caught fish in our rivers have high levels of heavy metals such as lead, mercury, etc. This is a very serious danger to the trophic chain. The objective of this study is to assay the trace metal elements such as lead, copper and zinc can make a comparative study of the levels of heavy metals in pulp fresh fish. Atomic absorption spectrophotometric method was used for the determination of lead content in fish Sarotherodon melanotheron. Mineralization following the protocol HACH and the determination of content of lead, copper, and zinc in the pulp fresh fish were performed. The analyzes showed that the average levels of trace elements measured are very high and range from 1.71 mg / kg and 4.96 mg / kg; far exceeding the maximum tolerable set by WHO is 0, 3 mg / kg.*

**Keywords:** Fishes; mineralization; spectrophotometry; metal elements traces.

### Introduction

The loss of biodiversity, environmental problems and public health are caused by toxic pollutants that are discharged into waterways in general and in particular in coastal lagoons.

This pollution can have irreversible effects on aquatic ecosystems such as the disappearance of animal and plant species, contamination of the food chain with significant economic consequences.

Toxic pollution of aquatic environments are mainly driven by the hydrocarbons derived from petroleum, domestic and industrial wastes that accumulate gradually to reach toxic levels that exceed those tolerated by the body causing harmful effects on health. Problems associated with contamination by heavy metals were first highlighted in the industrially advanced countries because of their larger industrial spills and especially the accidents due to pollution by mercury and cadmium in Sweden and Japan<sup>1-5</sup>. Since the industrial and urban activities are increasing in all regions of Africa, the problems related to toxic pollution are becoming increasingly worrying.

However, studies on the African continent are very rare and scattered. Among the first who are interested in pollution studies in Africa some researchers conducted they studies on the

various environmental problems in a monograph devoted to pollution in African inland waters and in a tropical marine ecosystems<sup>6,7</sup>.

The need for sound management of water resources and control discharges of waste that gradually destroy the environment has led some African researchers interested in the fight against pollution of surface waters; include among others the work on the contribution to the physico-chemical study of the lake ecosystem Dayet in Morocco and the research on the fish food with azolla ecosystem agropiscicole in Rwanda<sup>8,9</sup>. The various techniques used to determine the content of trace elements can be grouped into four types of methods are: chemical, physico-chemical methods, nuclear methods and biochemical methods. These types of analyzes to measure the content of micropollutants in water, sediments, plants and aquatic species such as fish, crustaceans, algae etc.. But most of these methods are very expensive and their use is mentioned only a very small number of recent studies in Africa<sup>10-12</sup>.

In Africa, by far the method most commonly used for the determination of heavy metals is that of atomic absorption spectrophotometry (AAS). It has the advantage of being rapid, sensitive, and simple to analyze complex mixtures without prior separation. For most metals, the basic technique involves

spraying a torch, while some metals very low concentrations, using the technique of graphite furnace which proceeds by electrothermal atomization. Analysis techniques commonly used to measure the lead content in the pulp fish are spectrophotometry and X-ray fluorescence.

In the African sub-region, several analytical techniques have been used to determine the lead content in *Sarotherodon* and *Tilapia guineensis* melanotheron such as mineralization NF EN ISO 15587-1 and -2<sup>13</sup>. The method of atomic absorption spectrophotometry and the method of kits MERCK NOVA 60 (spectrophotometer) were also used<sup>14,15</sup>.

In Benin, the research on water pollution is very few. Examples include the work on the assessment of the impact of activities on the water and dye organics near lagoon of Cotonou then the methodology and results of the diagnostic eutrophication of Lake Nokoué<sup>16,17</sup>. The trophic chain of a marine protected area in relation to their physico-chemistry: Case Gbézoumè in the town of Ouidah was assessed<sup>18</sup>. Recently the study was evaluate on chemical pollution of a tropical lagoon (water, sediment, fish) Porto-Novo and found that the quality of water and sediments of the lagoon of Porto-Novo is not likely to protect aquatic life and fish kills often seen at the lagoon could be justified by the high concentrations of heavy metals (Pb, Cd and Hg) also the depletion of dissolved oxygen in the lagoon resulting from chemical degradation algae and waste ending up in the lagoon without treatment<sup>19</sup>.

As the waters of the lagoon of Porto-Novo become increasingly hostile to aquatic life, we investigated the extent of this hostility against living organisms in the lagoon and to try to understand the evolution the content of trace metals such as lead, copper and zinc at the *Sarotherodon melanotheron* according to size and weight.

The objective of this research is to investigate the contamination of *Sarotherodon melanotheron* by lead, copper and zinc.

To achieve this goal the dosages of these three trace elements were performed with an atomic absorption spectrophotometer.

## Material and Methods

The fish were purchased from fishermen on the lagoon of Porto-Novo and kept in a cooler with ice to the laboratory. The weight and size of fish vary respectively between 10 g and 110 g and between 11 cm and 18.5 cm.

**Method of analysis of lead, copper and zinc in pulp fish:** Fresh fish were weighed and distributed according to their weight in test tubes sealed with a cap and then transported to the laboratory in a cooler with ice. Each sample of fresh fish pulp was replicated four times for a total of 20 samples.

Mineralization of the Chair of fresh fish was done following the

protocol HACH and lead, copper and zinc were determined by a colorimetric assay atomic absorption spectrophotometer with Spectr AA 110 of Laboratory of Soil Science, Water and environment (LSEE) of the National Institute of Agricultural Research of Benin (INRAB).

**Statistical Analysis:** Statistical analyzes to determine the lead, zinc and copper contents in the pulp of fresh fish were made with Microsoft Excel computer.

## Results and Discussion

In terms of different work, field surveys and analyzes in accordance with the methods described above, changes in content of lead, copper and zinc as a function of average weight and size of fish caught in the lagoon of Porto Novo was evaluated.

More specifically, the determination of lead, copper and zinc in pulp fresh fish was conducted to determine the content of lead, copper and zinc in the pulp of *Sarotherodon melanotheron*. We present different results which are then followed by analysis and interpretation of data.

**Table-1**  
Average weight, average sizes and average contents of lead, copper and zinc of fishes

Average weight of fish (g)	Average sizes of fish (cm)	Average contents of lead (mg/kg)	Average contents of copper (mg/kg)	Average contents of zinc (mg/kg)
29.98	11.60	4.9687	1.7600	190.5040
40.05	12.77	2.8481	1.3962	247.1907
60.04	14.75	1.8387	1.2425	191.2092
70.10	15.50	1.7300	0.9312	114.1897
101.50	17.75	2.4083	0.7937	35.8232

**Evolution of the content of lead, copper and zinc in pulp fresh fish:** Content of lead, copper and zinc in pulp fresh fish was determined and its evolution as a function of average weight and the average size of fish caught is shown in figure-1, 2 and 3.

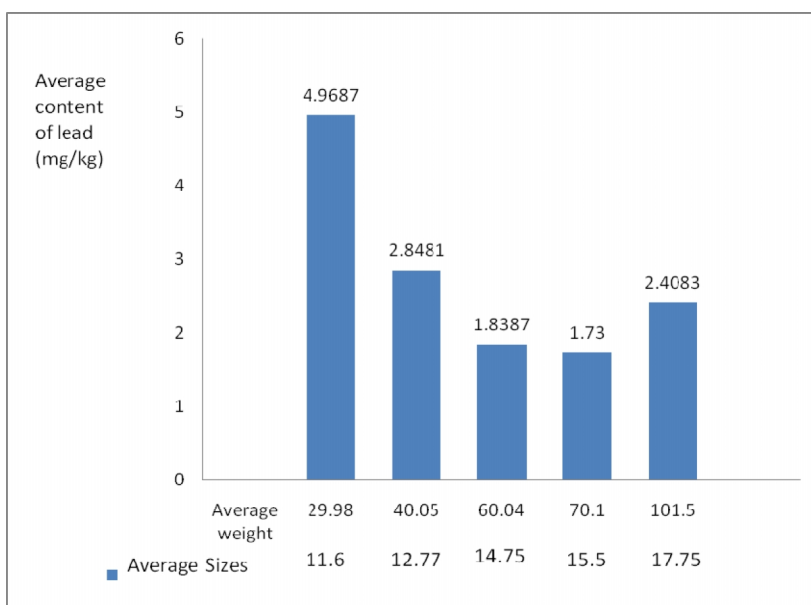
The results obtained after the analysis of samples in atomic absorption spectrophotometer flame show that only the levels of lead far exceed the standards in Benin which is 0.3 mg / kg for the chair of fish fresh set by Ministerial Order N ° 0362 APR / D-CAB / SGM / HRD / DP / AS Ministry of Agriculture, Livestock and Fishing fixing of maximum levels for certain contaminants in foodstuffs. The standards of copper and zinc are 3 mg / kg and 1000 mg / kg respectively.

**Lead content in fish:** Evolution of the lead content in terms of the average size and average weight of fish (figure-1) show that the size of fish caught is proportional to their weight increases as the size depending on the weight of the fish. It was found that

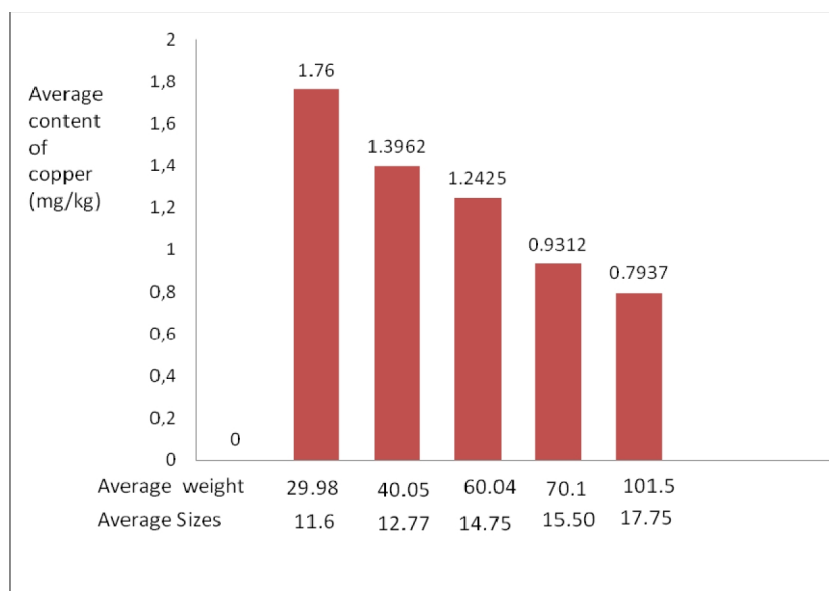
the lead content of 4.9687 mg / kg for fish with an average weight of 29.98 g and then decreases to 4.9687 mg / kg to 1.73 mg / kg for fish weighing average is between 29.98 g and 70.1 g and it grows again to 2.4083 mg / kg for fish that weigh between 70.1 g and 101.5 g.

This finding may be explained by the fact that the fish fry are more susceptible to pollution of trace metals because their bodies are more fragile and cannot arrive to remove part of lead

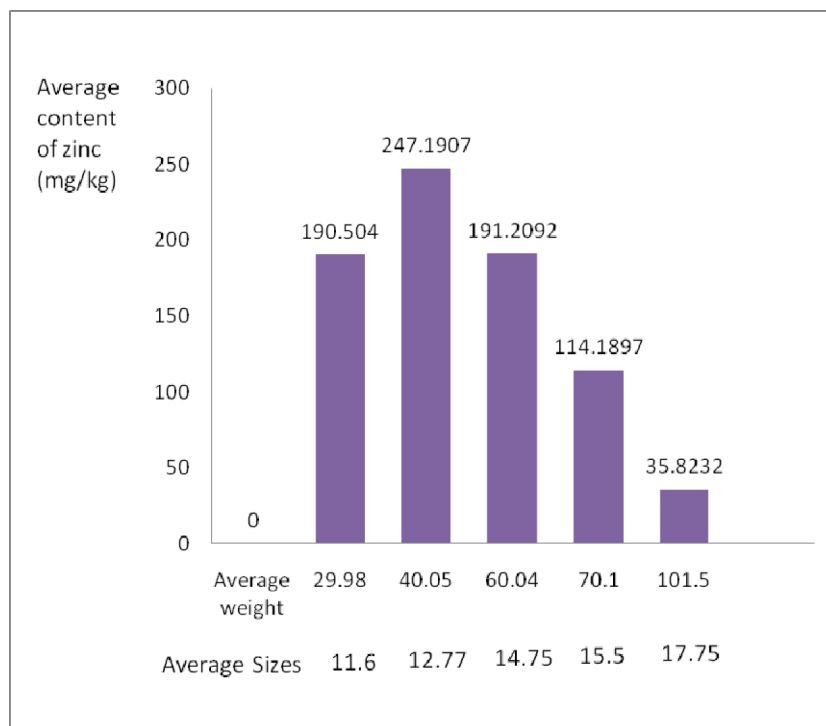
accumulated in their bodies as those with higher weight. They grow, they remove some of the lead when their average weight is between 30 g and 70.1 g. From an average weight of 70.1 g lead content increases again. This new accumulation in fish with a weight greater than 70.1 g can be explained by the fact that Sarotherodon melanotheron, eat his own small, and this probably explains the high rate of lead at the biggest Sarotherodon melanotheron and large sizes.



**Figure-1**  
 Evolution of the lead content by weight average and the average size of fish



**Figure 2**  
 Evolution of copper content by weight average and the average size of fish



**Figure-3**  
**Evolution of zinc content by weight average and the average size of fish**

**Copper content in fish:** The evolution of copper based on the average size and average weight of fish (figure-2) show that the size of fish caught is proportional to their weight increases as the size depending on the weight of the fish. It was found that the copper content is 1.76 mg / kg for fish with an average weight of 29.98 g and then decreases to 1.76 mg / kg to 0.7937 mg / kg for fish weighing average is between 29.98 g and 101.5g.

This observation can be explained by the fact that *Sarotherodon melanothon* remove accumulated copper in their chair as they grow and become bigger.

**Zinc content in fish:** The evolution of the zinc content in terms of the average size and average weight of fish (figure-3) show that the size of fish caught is proportional to their weight increases as the size depending on the weight of the fish. It was found that the zinc content is 190.504 mg / kg for fish with an average weight of 29.98 g and then she thinks of 190.504 mg / kg 247.1907 mg / kg for fish with an average weight of 40.05 g, then it decreases from 247.1907 mg / kg to 35.8232 mg / kg for fish whose average weight is between 40.05 g and 101.5g.

This finding may be explained by the fact that the fish fry are more susceptible to pollution of trace metals because their bodies are more fragile and cannot arrive to remove some of the accumulated zinc in their bodies as those with higher weight. They grow, they continue to accumulate zinc in their chair when their average weight is between 29.98 and 40.05 g then when

they reach the average weight, they begin to eliminate some of the zinc when their weight average varies between 40.05 g and 101.5g.

### Conclusion

Research work has shown that fish caught in the lagoon of Porto-Novo has a very high rate of lead ranging from 1.73 mg / kg and 4.96 mg / kg, high copper ranging between 0.7937 mg / kg and 1.76 mg / kg, then a high level of zinc of between 35.8232 mg / kg and 247.1907 mg / kg. These rates are excessively high due certainly lead to bottlenecks that stand out from the nets of fishermen and lurk deep in our rivers and lagoons; various household wastes, handicrafts, agricultural and industrial products that are dumped into our waterways.

The comparative study of trace metal concentrations shows that they do not accumulate in the pulpit of *Sarotherodon melanothon* the same way. We also note that the evolution of their respective rates in the pulpit fresh fish varies from one metal to another.

The presence of these heavy metals and their high rates of fish in the pulpit are certainly due to their presence and their availability in the phytoplankton of the lagoon of Porto Novo on the one hand and the ability of *Sarotherodon melanothon* of accumulates or excrete trace metals.

Different high rates obtained in the pulpit *Sarotherodon*

melanotheron exceed all the maximum values set by tolerable and effective in Benin. This shows that fish and other fish products our waterways are increasingly contaminated by heavy metals.

The pollution of rivers is increasing day by day and begins to alarming proportions, which is an environmental hazard and health very serious that we must take seriously because fish products in general and Fish in particular are nearly 35% of consumption in Benin and represents an important part of consumer products in the sub-region<sup>20</sup>.

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