

## EFFECTS OF SOAKING TIME INTERVALS OF HEAVY METALS IN OYSTER IN A CONTAMINATED ZONE IN RIVERS STATE.

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### ABSTRACT

The study was conducted to evaluate the efficacy of different soaking time interval at both seasons in the removal of some heavy metals (Lead, Chromium, Cadmium, Iron, Zinc and Potassium) in Oyster. The result showed that time was significantly different ( $p < 0.05$ ) for Cd, and was insignificant for Pb, Cr, Fe, Zn and K ( $p > 0.05$ ) for rainy seasons. There was a significant difference on 24h soaking while between 46 hours and 96 hours no significant differences was observed during rainy season. In the dry season, result shows that time was significantly different ( $p < 0.05$ ) for Pb, Cr and Cd, but time was insignificant for Fe, Zn and K ( $p > 0.05$ ). The reduction during rainy season was higher than the reduction in dry season. The concentration of Pb, Cr, Cd increased in dry season at different intervals of soaking while Fe, Zn and K reduced slightly. This slow reduction of these heavy metals (Cr, Cd and Pb) through soaking might be as a result of rate of contamination in this creek and the nature of these metals in the atomic circle. The soaking process did not bring about satisfactory results in the reduction of the heavy metals.

**Keywords:** Fish, Food Safety, Food Security, Sea food

### INTRODUCTION

Soaking is a process of replacing shellfish harvested from a polluted area (in clean water) to allow shellfish to clean themselves by continuation of their normal filter-feeding and digestive process (Le Gudyar *et al.*, 2003). It involves the transfer of harvested shellfish to cleaner inlets for self purification. The soaking process unlike cooking allows bivalve shellfish to be marketed as a live or fresh shucked product. This is related to species such as oyster, clams, periwinkle and mussels which are traditionally eaten live or are slightly cooked prior to consumption (Okereke *et al.*, 2017).

Heavy metal is a general collective term which applies to the group of metals and metalloids with atomic density greater than 4g/cm (Daffus, 2002). They are natural components in soil. Some of these metals are micronutrients necessary for plant growth such as Zn, Cu, Mn, N, and Co while others have unknown biological functions such as Co, Pb and Hg (Daffus, 2002). The amounts of most heavy metals deposited to the surface of the earth are many times greater than the depositions from natural background sources. However the metals introduced by human activities have affected water, organisms and sediment quality of most river (WHO, 2006). Heavy metal contamination in aquatic environment is of critical concern due to toxicity of metals and bioaccumulation on aquatic organisms. Heavy metals being non biodegradable can be concentrated along the food chain producing their toxic effects at points far from the source of pollution (Tilzer and Kondker 2003); although some of these metals are essential for proper

metabolism in all living organisms (Burger *et al.*, 2004) and their pollution has harmful effects on biological systems and does not undergo biodegradation. (WHO, 2011).

Toxic heavy metals such as Pb, Co, Cd can be differentiated from other pollutant since they cannot be biodegradable but can be accumulated in living organisms thus causing various diseases and disorders even in relatively lower concentration (Chong and Wang, 2001) sediment, and water near Urban areas commonly contain high levels of these contaminants which constitute a major environmental problem faced by many human induced aquatic environment and organism that feed on them. Shellfish accumulate contaminant such as heavy metal, micro organism directly from water and diet which may reach concentration many times above those in water, food and sediment (Maheswar *et al.*, 2006; Okereke *et al.*, 2017).

Advancement in technology as well as increased in population have led to environmental concerns, increased in concentration of heavy metals, discharge of industrial effluents, petroleum waste water and crude oil spill replete with most common heavy metals in our environment. This Pollution of streams and rivers could occur due to runoffs flowing through agricultural areas where pesticides fungicides etc. may have been applied and industrial districts where there may have been waste deposits. Water, sediments and the biota are generally metal reservoirs in aquatic environments. The concentrations of heavy metals in shellfish, water and sediment may vary considerably depending on annual and seasonal fluctuations

(SCEP, 2001). The extent of accumulation in biota depends on chemical effects of the metal, its tendency to bind to particular materials and on the lipid content and composition of the biological tissue. Various activities by man in recent years have increased the quantity and distribution of these heavy metals in the atmosphere, organism and water bodies. The extent of this wide spread but diffused contamination has increased the concern about their hazards on plants, animals and humans. The aim of this study therefore was to

determine the efficiency of different time intervals of soaking in the removal of these contaminants to ensure food safety.

### Study Area

The sampling site is located at Latitude  $4^{\circ} 49' 52.32''$  to  $4^{\circ} 46' 12.72''$  North and Longitude  $7^{\circ} 1' 57.36''$  to  $7^{\circ} 4' 57''$  which transverse in Abuloma creek along the Azobie Creek in Port Harcourt, Rivers State

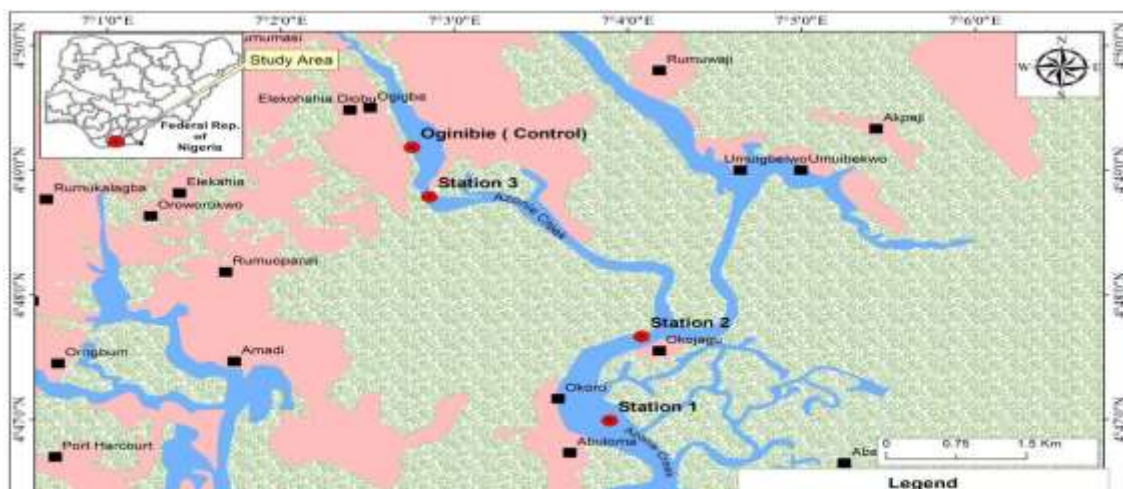


Fig. 1: Map of the sampling stations along the Azonie Creek in River State.

## MATERIALS AND METHODS

### Sample Collections

Oysters were collected on monthly intervals at dry and raining seasons at Abuloma location of the Azobie creek. They were kept in a sterile container and taken to the laboratory for soaking process. At the laboratory, these samples were extensively washed and rinsed with normal tap water to remove dirt, debris and surface contaminants

The Oyster were put into a soaking tank. The process of soaking involves placing harvested contaminated shellfish in a bowl filled with seawater and allowing the animal's sufficient time to purge off these pathogenic compounds and chemicals. This was left to stand for 24h thereafter the water was replaced. This process was repeated every 24h intervals to 96h. The contaminant settled at the bottom of the tank and then is removed at the end of each cycle. At the end of the process, the edible parts of oysters were removed from the shell with a sterilized sharp knife. They were later transferred to the laboratory for heavy metal analysis.

### Determination of Heavy Metals in Soft Tissue of Shellfish

Five grams (5g) of homogenized samples were weighed into acid-washed petri dishes and dried at  $105^{\circ}\text{C}$  for about 16 hrs (overnight) to determine the dry matter. 20ml of 1.0M HCl was added together with 20ml of distilled water. It was digested. The 5ml of conc. HCl was added to 10ml and the procedure was repeated and it was allowed to cool for 30 mins. The digested sample was then diluted and filtered through a Whatman No 1 filter paper into a 50ml volumetric flask containing distilled water. The digested samples were analyzed for heavy metals by using Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer model 403) (Ward and Young, 1982). The use of standards, determination of the metal concentration for each of the sample were obtained based on Beer Lambert's law which states that absorbance is directly proportional to the concentration of metal at a particular wavelength.

### Data Analysis

The data were subjected to three-way analysis of variance (ANOVA) for heavy metal

analysis. The statistical analysis was done with the aid of SPSS (Statistical Package for Social Sciences) Computer Statistical Software Package Version 21.

**RESULTS**

The metal concentration in the soft tissues at the beginning of the experiment are presented in (Table 1) The result showed that, time was significantly different ( $p < 0.05$ ) for Cd, and was insignificant for Pb, Cr, Fe, Zn and K ( $p > 0.05$ ) for rainy seasons. The concentration of the six heavy metals were significantly higher at the initial concentration except than the essential nutrient which was within permissible limit. There was a significant difference on the first day of soaking while between 46 hours and 96 hours no significant differences was observed during rainy season. In the dry season ,the ANOVA result

shows that time was significantly different ( $p < 0.05$ ) for Pb, Cr and Cd, but time was insignificant for Fe, Zn and K ( $p > 0.05$ ). The rate of heavy metals reduction during rainy season was higher than the reduction in dry season. The concentration of Pb, Cr, Cd increased in dry season at different intervals of soaking while Fe, Zn and K reduced slightly. The different time intervals on soaking in periwinkle had no effect on Pb at both season. ). The same effect was recorded for Cd. At different time intervals of soaking during dry season, the concentration of potassium was reduced slightly. The different time intervals on soaking had no effect on Pb at both season. The same happened for chromium concentration at both season. The different time intervals on soaking in periwinkle had no effect on Fe and Zn at both season. The soaking time had no effect on K at both season.

Table 1: Effect of different time intervals of soaking on heavy metals in oyster during rainy season

	Pb	Cr	Fe	Zn	Cd	K
24hrs	1.615 ± 1.10 <sup>a</sup>	4.16 ± 0.33 <sup>a</sup>	1456.04 ± 2257.28 <sup>a</sup>	33.2 ± 13.66 <sup>a</sup>	1.04 ± 0.049 <sup>b</sup>	1659.01 ± 745.26 <sup>a</sup>
46hrs	1.598 ± 1.07 <sup>a</sup>	4.06 ± 0.306 <sup>a</sup>	1449.72 ± 2246.97 <sup>a</sup>	33.04 ± 13.70 <sup>a</sup>	1.00 ± 0.095 <sup>b</sup>	1658.60 ± 744.51 <sup>a</sup>
72hrs	1.59 ± 1.07 <sup>a</sup>	4.104 ± 0.359 <sup>a</sup>	1440.93 ± 2251.74 <sup>a</sup>	33.18 ± 14.75 <sup>a</sup>	0.99 ± 0.105 <sup>b</sup>	1657.63 ± 743.61 <sup>a</sup>
96hrs	1.591 ± 1.07 <sup>a</sup>	4.072 ± 0.511 <sup>a</sup>	1447.58 ± 2246.49 <sup>a</sup>	32.51 ± 13.40 <sup>a</sup>	1.00 ± 0.064 <sup>b</sup>	1656.74 ± 742.78 <sup>a</sup>
Control	4.65 ± 14.80 <sup>a</sup>	3.990 ± 0.632 <sup>a</sup>	1378.38 ± 2176.92 <sup>a</sup>	29.75 ± 10.46 <sup>a</sup>	0.741 ± 0.437	1602.13 ± 768.73 <sup>a</sup>

Column mean ± STD with same letters is not significantly different at 0.05 significant level

**Table 2: Effect of different time intervals of soaking on heavy metals in oyster during dry season**

	Pb	Cr	Fe	Zn	Cd	K
24hrs	2.35 ± 1.29 <sup>b</sup>	2.32 ± 0.73 <sup>a</sup>	1422.75 ± 2150.54 <sup>a</sup>	22.72 ± 15.44 <sup>a</sup>	3.85 ± 6.36 <sup>b</sup>	1605.93 ± 829.44 <sup>a</sup>
46hrs	2.33 ± 1.26 <sup>b</sup>	2.31 ± 0.72 <sup>a</sup>	1420.82 ± 2145.73 <sup>a</sup>	22.77 ± 15.59 <sup>a</sup>	3.83 ± 6.32 <sup>b</sup>	1558.10 ± 769.84 <sup>a</sup>
72hrs	2.32 ± 1.26 <sup>b</sup>	2.30 ± 0.72 <sup>a</sup>	1415.11 ± 2155.19 <sup>a</sup>	22.20 ± 15.27 <sup>a</sup>	3.82 ± 6.32 <sup>b</sup>	1539.67 ± 741.33 <sup>a</sup>
96hrs	2.31 ± 1.26 <sup>b</sup>	2.29 ± 0.73 <sup>a</sup>	1415.64 ± 2152.49 <sup>a</sup>	23.29 ± 16.45 <sup>a</sup>	3.51 ± 5.84 <sup>b</sup>	1528.03 ± 727.26 <sup>a</sup>
Control	1.79 ± 1.20 <sup>a</sup>	3.07 ± 1.23 <sup>b</sup>	1492.67 ± 2234.41 <sup>a</sup>	29.63 ± 14.90 <sup>b</sup>	0.68 ± 0.380 <sup>a</sup>	1637.49 ± 803.73 <sup>a</sup>

Column mean ± STD with same letters is not significantly different at 0.05 significant level.

## DISCUSSION

In this study, heavy metals were found to have exceeded national environmental standard and regulation enforcement agency WHO (2011) standards. These heavy metals have bioaccumulated in these shellfish. These patterns has been observed in other studies. Kotze *et al.* (2006) Okereke *et al.* (2017) and Senthil *et al.* (2008) also reported significant bioaccumulation of these metals. The high value of Fe for oyster could be due to its availability in the water and sediments where they feed on. This agrees with other sea foods where elevated amount of Fe was found in their tissues (Yilmaz *et al.*, 2007). Iron is essential trace metal that play a major role in the metabolic process that help in the regulation of blood. After 96 hours of soaking for raining seasons, the initial concentration of Fe was increased than Zn and K (Okereke *et al.*, 2017)

Soaking on this shellfish had no effect on zinc. This could be as a result of Zn having a range that is higher than other metals indicating that these shellfish can partially regulate Zn concentration (Chong and Wang, 2001). Zinc has a protective effect against toxication of cadmium and lead (Calabrese *et al.*, 1985). Zinc is an essential element for animals and humans, the recommended daily allowance is 10mg/day in growing children and 15mg/day for adults. It has a protective effect against the toxication of both cadmium and lead (Calabrese *et al.*, 1985).

A deficiency of zinc is marked by retarded growth, loss of taste and hypogonadism, leading to decrease in fertility, zinc toxicity is rare, but when the concentration is up to 40mg/kg, it may induce toxicity, characterized by symptoms of irritability, muscular stiffness and pain loss of appetite and nausea (Le Guyader, *et al.*, 2003) After 4 days, Pb, Cr and Cd were not affected. This is in line with the work of Gefford *et al.*, (2002) which state that these metals were slowly eliminated than Zn or Copper when the kinetics of heavy metal elimination from shellfish was recorded. The accumulation pattern of Cd Pb and Cr in this study conformed closely with the work done by Vinodlini and Navayan (2008) where they carefully observed the trend of bioaccumulation of heavy metal in oyster

The concentration of Pb, Cr and Cd ranged from (0.001 to 2.0mg/kg) that is above the standard limit WHO, (2011). A high level of Cd in this study is hazardous. This could be very dangerous in shellfish according to the study of Alibabis *et al* (2007) and it is one of the most toxic heavy metals even at relatively low concentrations (Dural *et al.*, 2006; Fianko *et al.*, 2007; Yilmaz *et al.*, 2009). High concentration of lead causes liver damage and renal failure in humans (Venugopal, 1977)

These heavy metals can remain in the body of the consumer for a long period of time and can bioaccumulate for many years after exposure to low levels (Groundwork, 2002). The slow reduction of these heavy metals (Cr, Cd and Pb) through soaking might be as a result of rate of contamination in this creek and the

nature of this metals in the atomic circle (Tarek and Ali, 2007; Okereke *et al.*, 2017)

## CONCLUSION

The present study provides the concentration of heavy metal in periwinkle in this creek which can be related to the industrial and human activity in this creek. The micro nutrient that was analyzed were not affected by soaking. Lead, chromium and cadmium analyzed from this work were not within permissible levels for human consumption by the commission of the European communities (2001). These metals were not reduced by soaking. These might be as a result of rate of contamination in this creek and rate of recontamination during the soaking process. The soaking process did not bring about satisfactory results in the reduction of the heavy metals although it increases the concentration of the micro nutrient slightly.

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