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The Level of Some Heavy Metals in Fish Harvested from Ibeno (A Nigerian Coastal Area of the Atlantic Ocean)

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ABSTRACT

Concentrations of four heavy metals: Lead, Cadmium, Arsenic and Selenium, were determined using Atomic Absorption Spectroscopy in water samples and four species of fish: Scomberomorus tritor, Pseudotolithus typus, Trichiurus lepturus and Shyrua zygaena, harvested from Ibeno, a Nigerian coastal area of the Atlanic Ocean. A fish and water sample from 'Ata NsoIyak' Beach in Oron were used as control. Arsenic and Selenium were not detected in any of the species. Levels of the metals found in Scomberomorous tritor were Lead, 3.700µg/g and Cadmium, 0.867µg/g. In Pseudotolithus typus, the concentrations were Lead 1.850 µg/g and Cadmium, 0.583µg/g. in Trichiurus lepturus, the concentrations were Lead 15.48µg/g and Cadmium 0.717µg/g. in Sphyrua zygaena, concentrations were Lead 3.700µg/g and Cadmium 0.583µg/g. the water sample had concentrations of Lead 0.121µg/g and Cadmium 0.003µg/g. Comparisons with international standards reveal high levels of Lead and Cadmium in the Ibeno area of the Atlantic Ocean. In addition to natural geological processes, municipal wastes and agricultural runoffs, the high level of heavy metal is attributable to the oil exploration activities of the oil industry in the area.
KEY WORDS: Heavy metals, pollution, fish, coastal area, exploration.

INTRODUCTION

It is now recognized that advancement in technology as well as growth in population have led to industrialization and urbanization which in turn have led to environmental pollution resulting from the discharge of industrial effluents replete with most common heavy metals such as Pd, Cd, Cr, Zn, Co, Sb, Cu, and Hg into our environments, particularly natural water[1,2].

Heavy metals provide examples of the transfer of chemicals from one system to another. When Ores, Coal or other materials are extracted or smelted, waste materials containing such heavy metals as Lead, Zinc, Arsenic, Cadmium and Copper, tend to settle out of the air within a few hundred yards of the source where the concentrations may build up in the soil or water to increasing toxic amounts[3, 4].

There are four main sources of aquatic pollution: industrial waste, municipal wastes, agricultural run-offs and accidental spillage. The toxic metals from various industrial and domestic sources are usually discharged at dumpsites and are more often than not discharged into water bodies [5, 6, 7]. Fishes have been known to bioaccumulation these heavy metals in their tissues[8].

A lot of work has been done on the contamination of fishes by heavy metals and the effects of heavy metals toxicity. These authors[9, 10, 11,12] among others, have through their various works on the contamination of fishes, found out that pollutants, especially heavy metals, could cause severe damage to this aquatic life. However, much work is yet to be done on the effect of specific industrial operations on specific areas. This research focuses on possible heavy metal contamination of fishes in an oil prospecting area of Akwa Ibom State, Nigeria.

MATERIALS AND METHODS

The fish samples were procured at the jetty of Exxon mobile, Qua Iboe Terminal, Ibeno from fishermen on their return from high sea fishing in the Atlantic Ocean surrounding the industry. They were stored temporarily in a cooler containing ice block for their preservation. The cooler was quickly covered to avoid possible contamination from the

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environment. They were further preserved in a cool room till the following day when they were analysed. Water sample was also got from the ocean near the jetty. The [13]technique for the determination of trace elements was used in the analysis.

Three grams of the fresh fish fillet from each sample were accurately weighed after pulverization and homogenization. The samples were oven dried and ash digested at 540^0C for 4 hours. The ashes were leached using 10ml of 20% HNO_3 and the volume made up to 50ml with distilled water. Stock solutions were prepared and working standards were prepared by serial dilution of the stock solution. The calibration curves were in strict conformity with Beer Lamberts law. The heavy metals were then determined using Atomic Absorption Spectrophotometer (AAS UNICAM 919). Results obtained from this method are comparable to results obtained by [12] using Capon method.

RESULTS AND DISCUSSION

From the study, the results obtained show that Arsenic and Selenium were not detected. It is gratifying that there were no traces of these dangerous heavy metals.

The case was different with Lead. The study revealed that there were high concentration of Lead reaching 3.7ppm in two species of fish, namely, Scomberemorus tritor and Shyrua zygaena. Both control fish and Pseudotholitus typhus had low Lead concentrations of 1.85 ppm each (Fig. 1, 2 &3). However, Trichiurus lepturus had a Lead concentration of 15.48 ppm which agrees with studies by [12] who reported Lead concentrations as much as 27.44mg/g in the Qua Iboe Estuary.The water sample from the ocean had Lead concentration of 0.121mg/L which is higher than the WHO safety limit of 0.05mg/L[14]. The European Commission (EC) proposed safety limit for Lead is 0.05 ppm in fish and 2 ppm in Shell fish. The UK statutory limit for Lead is 2 ppm in fish and 5 ppm in shell fish [15] while the WHO safety limits for Lead and Cadmium in fish are 2mg/g and 0.05mg/g respectively.

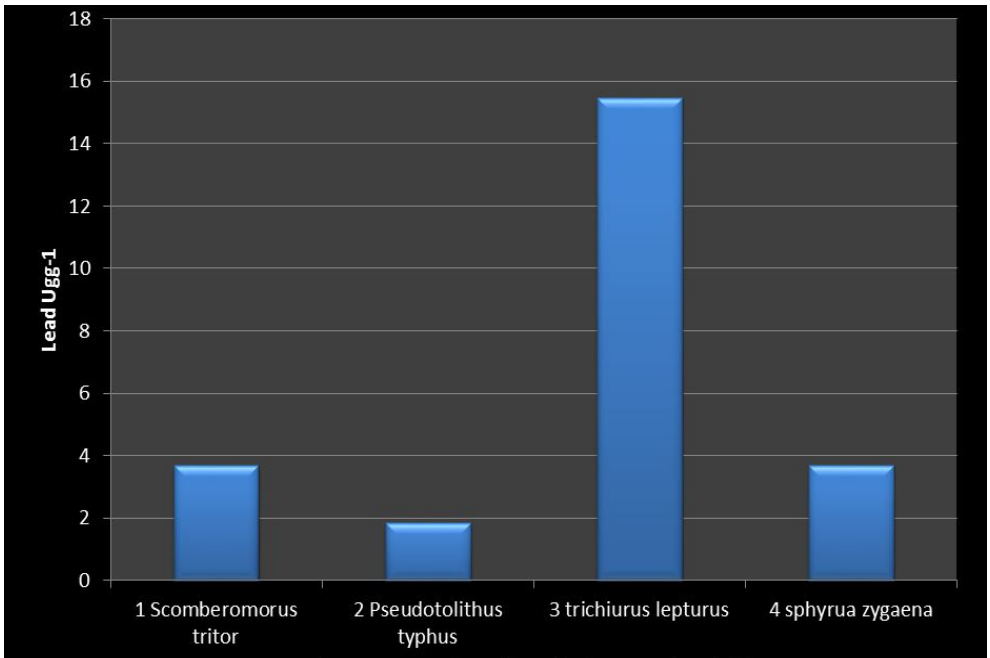

Fig I Concentrations of Lead in four species of Fish

For Cadmium, the four fish species showed higher concentrations of the heavy metal than international standards. The water sample from the ocean contained Cadmium concentration of 0.003mg/L. Cadmium concentration in Scomberomorous tritor was 0.867 ppm, Pseudotolithus typus 0.583 ppm, Trichiurus lepturus 0.717 ppm and Sphyrua zygaena, 0.583ppm(fig.2&3). This group of researchers[12] reported Cadmium concentration of 0.66mg/g in the Qua Iboe Estuary . The control fish, Pseudotolithus typus got from a river devoid of industrial waste point contamination had a result 0.006 ppm that conforms to the international standards. The European commission (EC) proposed limit for Cadmium is 0.05 ppm in fish and 0.2 ppm in shell fish.

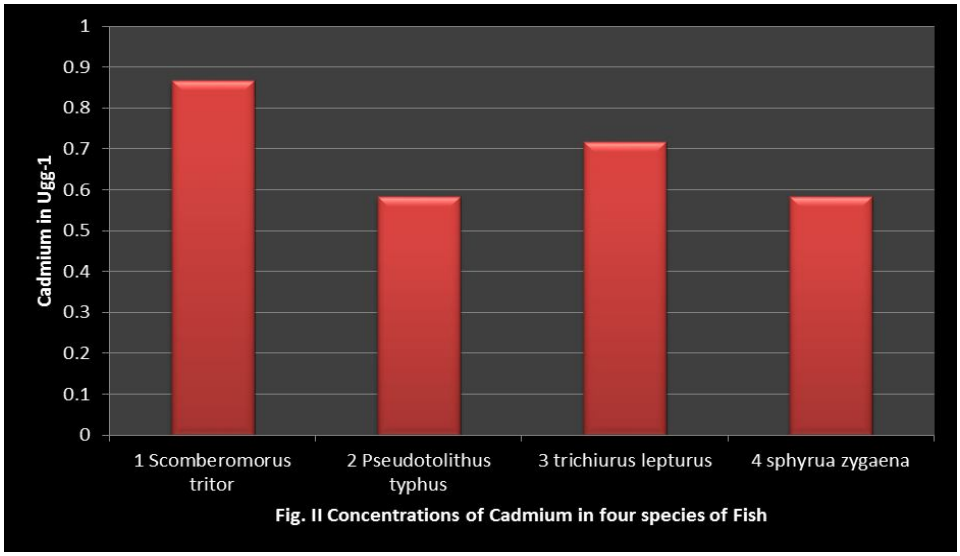

Fig. II Concentrations of Cadmium in four species of Fish

The levels of Lead and Cadmium in this study are several times higher than both the UK and EC statutory limits and Joint Expert Committee on food additives of the Food and Agricultural Organization of the United Nations and World Health Organization (JECFA) Provisional Maximum Tolerable Weekly Intakes (PMTWIs) of Lead: 0.25mg/kg body weight/week and Cadmium: 0.007mg/kg weight/week and also the Provisional Maximum Tolerable Daily Intakes (PMTDLs) for Lead: 0.21mg/day for 60kg adult and Cadmium 0.06mg/day for a 60kg adult[15]

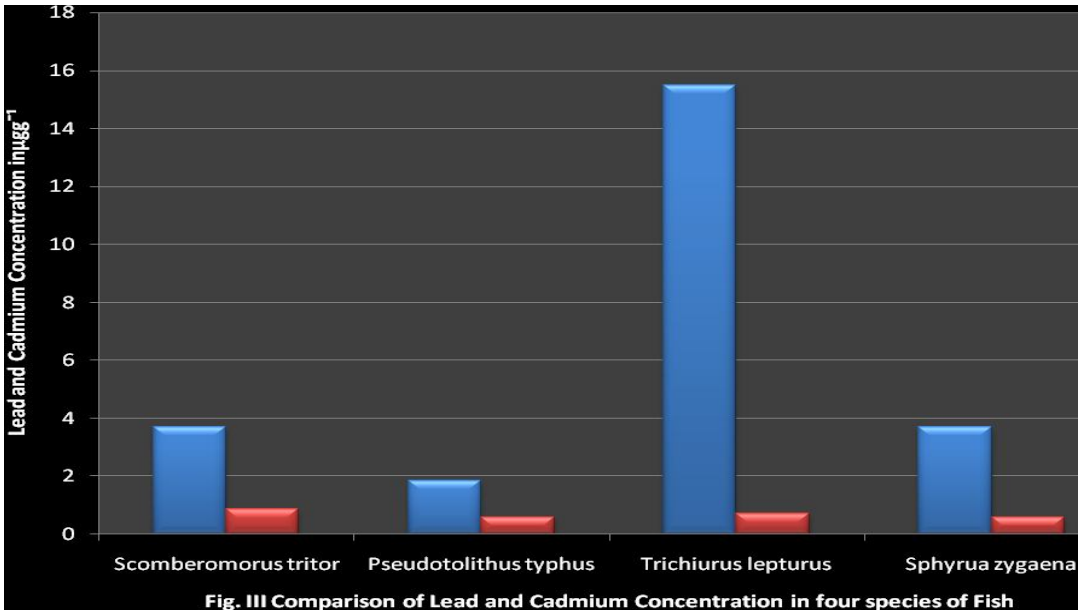

Fig. III Comparison of Lead and Cadmium Concentration in four species of Fish

These high levels of heavy metal concentration may be attributable to the point source industrial effluents discharged and accidental oil spills by the oil industry into the ocean, in addition to municipal wastes, agricultural runoffs and the natural geological processes. The environmental effect can be disastrous and imminent if the point source pollution is allowed to persist without a check.

Lead has adverse effects on the Central Nervous System (CNS) Peripheral Nervous System (PNS), blood, bone marrow, kidney and reproductive system [16]. The effects include: reduced neuropsychological functioning [16, 17], encephalitis, inattention, IQ defects [18] peripheral nervous defects, reduced nervous conduction [19].Inhibition of the biosynthesis of heme resulting in anaemia [20], glomerular and tubular damage, potentiated suppression of spermatogenesis with Cadmium exposure. Other health effects where Lead has been implicated are cot deaths (Sudden infants' deaths syndrome) and still births.

In the case of Cadmium, the affected sites are the lungs, gastrointestinal track, liver, kidney, bones, enzymes, blood and prostrate gland [16]. The health effects include; bronchitis, pneumonitis [21]; nausea, vomiting, abdominal pains, gastro enteritis, diarrhoea, dizziness, emphysema, toxaemia, proteinuria, amino aciduria, phosphaturia, glycosuria [22], intense pain, lumber pain, osteomalacia, softening of the bone (ItaiItai disease, patients die a painful death), inactivated enzymes, hypertension, anaemia and cancer. Cadmium replaces zinc in some enzymes with a consequent impairment of catalytic activity of enzyme [23].

This work reveals that Ibeno area of the Atlantic Ocean, a major fishing zone of Akwa Ibom State of Nigeria is polluted with Lead and Cadmium. It has also established that fishes are better specimens for use in the study of contamination levels of natural waters than water samples.

Consequent upon these research findings, the federal and state governments should investigate the means of disposal and sponsor the testing of the industrial effluents of the oil industry.

Further research should be undertaken to determine the level of some other heavy metals and other indices of pollution in the environment that had not been determined in this study.

Finally, in the interest of our environment which is our greatest asset and for the sound health of our people, industries should be made to be environment conscious and friendly.

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