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Mercury Contamination of Fish Consumed in Enugu, Southeast Nigeria

Peter U. Achukwu[1], Daniel N. Ezeasor[2], Chigozie N. Okwuosa[1], Nkiruka C. Azubike[1], *Silas A. Ufelle[1], Okechukwu S. Onwukwe[1], Ngozika O. Achukwu[1], Ndubeze Ezemba[3], Amaechi U. Katchy[3], Chinwe Chukwuka[4]

[1.] Department of Medical Laboratory Sciences, Faculty of Health Sciences and Technology, College of Medicine, University Of Nigeria Enugu Campus, Enugu State, Nigeria.
[2.] Department of Veterinary Anatomy, Faculty of Veterinary Medicine, University of Nigeria Nsukka, Enugu State Nigeria.
[3.] Department of Anatomy, Faculty of Medical Sciences, College of Medicine, University Of Nigeria Enugu Campus, Enugu State, Nigeria.
[4.] Department of Internal Medicine, Faculty of Medical Sciences, University of Nigeria
Tel: +234-8038728223, Email: peter.achukwu@unn.edu.ng

Abstract: Mercury has been characterized as the most toxic water contaminants in the world. Methylmercury accumulates in fish and other sea food which are eventually consumed by man hence exposing them to the risk of mercury poisoning. The present study was aimed at determining the level of mercury contamination of fish consumed in Enugu, south east Nigeria. Different species of local dry fish were harvested from major water bodies in Enugu. The mercury content of the local dry fish species was determined using spectrophotometry and atomic absorption spectrophotometry. Imported fish delicacies served as control for the analysis. Results of the analysis showed significantly high empirical values of mercury in the local fish species when compared with the control. Fish consumed in Enugu has levels of mercury which are significantly higher than the WHO recommended values.
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Key words: Methylmercury, Enugu, Fish.

INTRODUCTION

At present, a notable proportion of diet worldwide consists of foods of aquatic origin; either consumed fresh or processed and may come from freshwater or salt water (Khaniki *et al*., 2005). Emphasis has been laid on the consumption of fish as an alternative to meat, poultry and dairy products due to its lower levels of saturated fat, cholesterol and calories. (Velez and Montoro, 1998)

Manmade chemicals and naturally occurring substances which have been concentrated by industrial processes get accumulated in the bodies of larger fish as they feed on smaller ones whose gills have absorbed these chemical substances. (Kuepper and Waiya, 2004)

Contamination of water bodies by mercury is widespread in the world (Wienberg, 2010) Organic mercury compounds are of great interest today because they are often found in the food chain and have previously been used in antiseptics (IPCS, 1990). Organic mercury is also found in fungicides and industrial waste run-off (O'Shea, 1990). As a result, exposure to these materials is likely when they find themselves in water bodies and subsequently food chain.

The consumption of fish, sea foods and their derived products has been identified as the major pathway through which humans are exposed to mercury, especially methyl mercury (Khaniki *et al*., 2005). Most fish, both freshwater and saltwater, contain methylmercury (CICAD, 2003).

Exposure of young children to mercury can have deleterious effects on the nervous system, preventing sheaths from forming properly. It has also been shown to cause damages to the central nervous systems, endocrine system, kidneys and other organs. Long term exposure to mercury is fatal. Mercury and its compounds are also toxic to foetuses and infants and sometimes teratogenic (Galadima and Garba, 2011).

It has been suggested that organic mercury especially, methyl mercury, could be a major form of mercury contaminating most Nigerian water and aquatic life (Musa et al., 2009). A study carried out by Achukwu *et al* (2012) during the period of June and November 2007 revealed significantly high levels of mercury contamination of some water bodies in Enugu.

This study was therefore undertaken to estimate the level of mercury contamination of fish consumed in Enugu, South East Nigeria.

MATERIALS AND METHODS

The materials used for this study were local dry fish from Nigerian fishing waters and imported fish to serve as controls and basis for comparison.

THE DETERMINATION OF RELATIVE QUANTITY OF Hg IN FISH

The procedure adopted by the Association of Agricultural Chemists (AOAC, 1990) was used for this assay. 2.0g of each sample of dry fish (local assorted species, Geisha and Sardine) was pre-ashed in crucible (2hrs) until completely charred on a hot plate. The charred fish material was then pre-cooled. It was then placed in muffled furnace and ashed at 500^{o}C for 3 hours until the ash became greyish. After ashing, it was cooled, weighed and transferred into 50ml volumetric flask after carefully washing the crucible with 5.0ml of 30% Potassium Hydroxide which promotes the precipitation of Hg from the greyish ash.

The paste was diluted to 50ml volume with deionized water and assayed for Hg content spectrophotometrically.

RESULTS

The results of the study were expressed in tables 1 and 2.

TABLE 1: RESULTS OF SPECTROPHOTOMETRIC QUANTITATION OF HG IN LOCAL DRY FISH MIXTURE SPECIES.

Type Of Fish	Body Part	Hg Content/Kg Body Weight (Spectro-20)	Hg Content/Kg Body Weight (using AAS)
Cat Fish	Flesh Gills	3.0 ng/ml 7.2 ng/ml*	3.01 ng/ml 7.25 ng/ml*
Tilapia	Flesh Gills	2.8 ng/ml 5.7 ng/ml*	2.82 ng/ml 5.80 ng/ml*
Mackerel	Flesh Gills	4.3 ng/ml 6.2 ng/ml*	4.5 ng/ml 6.7 ng/ml
Local Fish mixture species	Flesh Gills	4.3 ng/ml 6.8 ng/ml*	4.7 ng/ml* 6.9 ng/ml*

* High Hg content

The empirical values of the quantitation of Hg in local dry fish showed that the level of Hg in the flesh of Cat fish, Tilapia, Mackerel and a mixture of assorted species was within the WHO and Canadian tolerable levels which had an up limit of 5.0ng/ml (UNEP Chemicals, 2002) however, the level of Hg in the Gill of the fishes was higher than the tolerable levels.

In Table 2, both fishes had Hg content within the prescribed safety margin by the WHO (UNEP Chemicals, 2002) it must be noted in this type of fish package, the gills were not included.

TABLE 2: RESULTS OF QUANTITATION OF Hg IN IMPORTED FISHES

Fish Delicacy	Body Part	Hg Content/Kg Body Weight using Spectron-20	Hg Content/Kg Body Weight using AAS
SARDINES			
a. St. Titus	**Flesh**	**0.029 ng/ml**	**0.031 ng/ml**
b. Queen of the Coast	**Flesh**	**0.032 ng/ml**	**0.033 ng/ml**
GEISHA			
a. Mackerel®	**Flesh**	**0.043 ng/ml**	**0.045 ng/ml**
b. Geisha®	**Flesh**	**0.045 ng/ml**	**0.045 ng/ml**

DISCUSSION AND CONCLUSION

Compounds that are used in industrial production (plastics, gloves, electric bulbs and tubes, laboratory reagents and drugs) in most countries like Nigeria, do find their way into the food chain as a contaminant in consumable water, fishes and other food stuff of animal origin. Analytical monitoring of the residues of these substances are done in most developed countries like US, Britain, Canada in order to obviate potential health hazard (Plaa and Duncan, 1976).

In Nigeria, the presence of Hg in fish caught in waters is suggestive of its contamination by the metal. This could be as a result of the bioaccumulation of Hg compounds from industrial and other sources in water where it can be transformed into methylmercury possibly by microbial activity in the bottom sediment. The present massive, uncontrolled and unauthorized dumping of both chemical and some imported biological waste substances into rivers/waters and bushes in Nigeria may constitute a health hazard in Nigeria. It may in time lead to such a large scale of environmental pollution that would deleteriously affect the health of both human beings and animals.

The value of methylmercury in the consumable flesh and gills of fishes revealed a relative increase in the Gills content when compared with the flesh of the fish. This confirms an earlier report by WHO (2000) that the gills accumulate most impurities and heavy metals such as mercury, cadmium and Lead. This may have been the reason for high content of Hg in stock fish (head). In addition, the waters where stock fish thrive, especially Norway and Sweden have been noted to have high content of Hg and other heavy metal (WHO, 2003).

The low content of Hg in imported tinned fishes could have been attributed to the type of fishes used and the water where they thrive. For instance both variants of Sardines® and Geisha® are devoid of the gills. Their contents are mainly flesh. Only trace quantities were obtained from them.

Polluted waters contribute to the Hg content of test substances like fishes especially those caught in the requisite waters due to their varied Hg content (Sanger, 1998). This could be possible due to the bioaccumulation of the Hg through the food chain. It therefore accounts partly for the differences obtained from fishes from different waters.

In conclusion, it may be inferred that dwellers in Enugu that are faced with contamination of their food substances especially fish by Hg and its compounds. In order to achieve an efficient utilization of fish and water, safe for human consumption, competent, professional screening as may be approved by concerned authorities e.g. WHO, FAO, FEPAR, CICAD is advocated to enable consumers to adhere to safety margin. This will not only protect human beings and domestic animals, but will help in the upkeep of wildlife (including birds and fishes) from accidental intoxication.

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Corresponding Author:
Achukwu Peter U,
Department of Medical Laboratory Sciences, Faculty of Health Sciences and Technology, College of Medicine, University Of Nigeria Enugu Campus, Enugu State, Nigeria.
Tel: +234-8038728223
Email: peter.achukwu@unn.edu.ng

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