LEVELS OF CADMIUM, LEAD AND CHROMIUM IN IMPORTED FROZEN FISH SOLD IN BAUCHI, NIGERIA

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Abstract
The concentrations of cadmium, lead and chromium were determined in four different species of imported frozen fish sold in Bauchi, Nigeria using Atomic Absorption Spectrophotometric method. The grand mean levels of 0.0021, 0.0562 and 0.0034 µgg $^{-1}$ were obtained for Cd, Pb and Cr respectively with a corresponding range of 0.0001-0.0070, 0.0095-0.1604 and 0.0004-0.0067 µgg $^{-1}$ for the same metals. The differences in the concentrations of the elements determined in the imported frozen fish samples sold in Bauchi were found to be statistically the same (P<0.01 and P<0.05) as determined by a two-way analysis of variance. Heavy metals in the fish studied were found to be within the permissible safety levels for human consumption.

Keywords: Cadmium, lead, chromium, two-way analysis of variance, frozen fish

Introduction
Metallic elements are ubiquitous in the environment. Some of the trace heavy metals are significant in nutrition, either for their essential nature or their toxicity. Copper, iron, chromium, manganese, nickel and zinc have been found to be the essential heavy metals. The non-essential heavy metals include tin, rubidium and zirconium, while lead, mercury, arsenic and cadmium have been classified as toxic heavy metals (Robert, 1990).

The pollution of aquatic environment by heavy metals has been of serious concern to environmentalist. This is probably because of the high level of pollution of surface water arising from the discharge of industrial and domestic wastes into rivers and lakes, especially those running through the major commercial cities. As a result, these rivers carry large quantities of contaminants including heavy metals (Odoemelam *et al,* 1999). Previous work rrevealed high concentrations of heavy metals such as Cd, Pb, Fe, Cu, Ni, Zn, Mn, Mg and Co in some rivers within the proximity of some industrial cities in Nigeria. The discharge of industrial wastes containing toxic heavy metals into water bodies may affect fish and other aquatic organisms, which may endanger public health through consumption of contaminated seafood and irrigated food crops (Oni, 1987).

Heavy metals are commonly found in natural water. Some are essential to living organisms, yet they may become highly toxic when present in high concentrations (Ibok *et al*, 1989). Aquatic animals, including fish bioaccumulate trace metals in considerable amount. Heavy metals therefore bioaccumulate in fish over a long period and are finally transferred to other animals including humans through the food chain (Kemdrim, 1997; Etuk and Mbonu, 1999).

Human activities have drastically changed the biochemical and geochemical cycles and balance of some heavy metals. Heavy metals are stable and persistent environmental contaminants since they cannot be degraded or destroyed. The accumulation of heavy metals in the tissues of organisms can result in chronic illnesses and potential damage to the population (FEPA, 1991).
A lot of frozen fish are imported into Nigeria from Norway and China respectively. Fish from these countries no doubt supplement the protein needs of Nigerians possibly because they are relatively cheap compared with other sources of protein in the country. The aim of this study is to:

(i) determine the concentration of cadmium, lead and chromium in some of the imported frozen fish sold in Bauchi.
(ii) compare statistically the concentrations of all the metals under investigation.

Materials and Method

Analytical reagent (analaR) grade chemicals and distilled deionized water were used throughout the study. All the glass wares and plastic containers used were washed with detergent solution, followed by 20% (v/v) nitric acid, rinsed with tap water and finally with distilled deionized water. The apparatus were then allowed to dry (Audu and Lawal, 2006).

Sampling and Sample Treatment

Imported frozen fish samples were bought in January and February, 2010 from two major whole-sellers in Bauchi, Nigeria. The fish samples bought and analyzed were identified as Clarias gariepinus, Clupea harengus, Trachurus trachurus and Scomber scombrus respectively at the Biological Sciences Programme, Abubakar Tafawa Balewa University, Bauchi. Five specimens of the fish species were purchased on weekly basis for four weeks. A total of eighty (80) imported frozen fish samples were purchased in polyethylene bags and labelled appropriately for the determination. Weekly samples of each specie were allowed to defrost, washed and rinsed with distilled- deionized water. Weekly samples of each specie were oven dried at 60^0C until a constant mass was obtained and then ground to powder using porcelain pestle and mortar. The ground samples were stored in screw-capped polyethylene containers and labeled appropriately for analysis.

Digestion Procedure

0.20 g of the ground aliquot fish sample (in triplicate) was weighed into an empty clean conical flask and digested using 10.0 cm^3 of ratio 1:2 perchloric acid and nitric acid solution ($HClO_4$-HNO_3) (Breder,1982 in Hassan *et al*, 2009). The conical flask and its content were gently heated on a hot plate in a fume cupboard until a clear solution was formed. The conical flask and its content were allowed to cool and 1.0 cm^3 of concentrated hydrochloric acid was added, and gently heated again until a clear solution was formed. The conical flask and its content were allowed to cool and 20.0 cm^3 of water was added to the digest residue, filtered by means of a Whatman number 1 filter paper into a 100.00 cm^3 volumetric flask and made to volume with water (Breder, 1982 in Hassan et al, 2009). The sample solution was then transferred into a screw-capped polyethylene bottle. The solution was analyzed for cadmium, lead and chromium at their respective wavelengths using Buck Scientific Model 210-VGP Atomic Absorption Spectrophotometer. The procedure was repeated for all other samples.

Results and Discussion

Table 1 shows the concentrations of cadmium, lead and chromium determined in imported frozen fish samples sold in Bauchi, Nigeria. The variations in the mean concentrations of all the elements determined in the imported frozen fish sold in Bauchi were found to be statistically not significant ($P<0.01$ and $P<0.05$) as determined by a two-way analysis of variance (ANOVA).

Table 1: The mean concentrations and range in µgg $^{-1}$ of cadmium, lead and chromium in imported frozen fish sold in Bauchi, Nigeria

Fish name	Cd	Pb	Cr
Clarias gariepinus	0.0018	0.0907	0.0033
	0.0001-0.0045	0.0385-0.1381	0.0013-0.0067
Clupea harengus	0.0022	0.0703	0.0046
	0.0009-0.0042	0.0095-0.1604	0.0035-0.0058
Trachurus trachurus	0.0032	0.0213	0.0032
	0.0010-0.0070	0.0149-0.0273	0.0012-0.0050
Scomber scombrus	0.0013	0.0425	0.0025
	0.0005-0.0020	0.0284-0.0539	0.0004-0.0043
Grand mean=	0.0021	0.0562	0.0034

Among the four different imported frozen fish samples sold in Bauchi, Trachurus trachurus had the highest mean cadmium concentration of 0.0032 µgg $^{-1}$ and was least in Scomber scombrus with a mean concentration of 0.0013 µgg $^{-1}$. The mean concentration of cadmium in the fish samples studied ranged from 0.0013 to 0.0032 µgg^{-1} with a grand mean concentration of 0.0021 µgg $^{-1}$. This grand mean value of 0.0021 µgg $^{-1}$ is below the permissible limits of 0.05-0.10 µgg $^{-1}$ set by the European Commission report limit in fish (E.C., 2001) and also far below the permissible limit of 0.50 µgg $^{-1}$ prescribed for human consumption (FAO, 1983). Cadmium has no essential function in human beings and is highly toxic. Low level of protein and other elements such as calcium and iron in the diet may increase cadmium absorption (Kriberg, 1990). From the results, the general trend for the mean concentration of cadmium determined in the imported frozen fish sold in Bauchi showed that: Trachurus trachurus> Clupea harengus>Clarias gariepinus> Scomber scombrus).

Lead poisoning is more dangerous in children than adult. This is because once lead enters the human body it tends to concentrate in the bones and remains in the bone in a relatively inert form causing low ill effect (Toxfaqs, 1999).

The mean concentration of lead in the frozen fish samples analyzed ranged from 0.0213 to 0.0907 µgg $^{-1}$ in which Trachurus trachurus had the lowest mean concentration of 0.0213 µgg $^{-1}$, while Clarias gariepinus had the highest average concentration of 0.0907 µgg $^{-1}$. The grand mean concentration of lead determined in this study was 0.0562 µgg $^{-1}$. The general trend for the average concentrations of lead analyzed in the imported frozen fish sold in Bauchi revealed that: Clarias gariepinus>Clupea harengus >Scomber scombrus>Trachurus trachurus. The grand mean concentration of lead determined in this investigation (0.0562 µgg $^{-1}$) is far below the recommended limits of 2.0 µgg $^{-1}$ set in New Zealand and United Kingdom respectively (Nauen,1983).

Clupea harengus imported frozen fish samples had the highest mean chromium concentration of 0.0046 µgg $^{-1}$, while the lowest average chromium concentration of 0.0025 µgg $^{-1}$ was recorded in Scomber scombrus. The average concentration of chromium in the imported frozen fish sample under investigation ranged from 0.0025-0.0046 µgg $^{-1}$ with a grand mean level of 0.0034 µgg $^{-1}$. Comparatively, the concentration range in this study was below the concentration range of 0.65-0.92µgg $^{-1}$ reported in four commercially valuable marine edible fish species from Parangipettai Coast of India(Raja et al,2009) and also far below the reported literature values of 1.03-1.79 µgg^{-1} for some fish species from Iskenderun Bay(Yilmaz, 2003). The general trend for the mean levels of chromium determined in the fish samples studied showed that: Clupea harengus> Clarias gariepinus> Trachurus trachurus> Scomber scombrus. Chromium is a mineral that humans require in trace amounts. The mechanism of its action in the body and the amounts needed for optimal health are not well defined (Porfe & Sherwn, 2003).

On a comparative basis, the grand mean concentrations of cadmium, lead and chromium in the imported frozen fish samples sold in Bauchi are still within the acceptable limits.

Conclusion

The results of the determination of cadmium, lead and chromium in imported frozen fish samples sold in Bauchi showed that all the metals investigated were detected. The metals determined were found to be below toxic level. Two-way analysis of variance revealed that there was no significant difference ($P<0.01$ and $P<0.05$) within the treatment means and the block means respectively.

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