ECRONICON OPEN ACCESS

EC NUTRITION
Research Article

Levels of Lead and Cadmium in the Bone and Muscle Tissues of *Oreochromis niloticus* and *Clarias camerunensis* from River Nun, Niger Delta

Emmanuel N Ogamba[1], Nwabueze Ebere[2] and Sylvester Chibueze Izah[1]*

[1]Department of Biological Sciences, Faculty of Science, Niger Delta University, Bayelsa State, Nigeria

[2]Department of Animal and Environmental Biology, Rivers State University of Science and Technology, Nkpolu, Port Harcourt, Rivers state, Nigeria

***Corresponding Author**: Sylvester Chibueze Izah, Department of Biological Sciences, Faculty of Science, Niger Delta University, Bayelsa State, Nigeria.

Received: February 04, 2017; **Published:** March 01, 2017

Abstract

This study investigated the levels of cadmium and lead in the bones and muscles of *Clarias camerunensis* and *Oreochromis niloticus* from Agudama-Ekpetiama axises of River Nun, Bayelsa state, Nigeria. Samples were harvested by the assistance of local fishermen in the area. The samples were processed and analyzed using atomic adsorption spectrophotometer. Results showed that in the bone and muscle the heavy metal level was 0.031 mg/kg and 0.013 mg/kg respectively (cadmium) and 0.063 and 0.029 mg/kg respectively (lead) for *Clarias camerunensis*, and 0.039 mg/kg and 0.011 mg/kg respectively (cadmium) and 0.051 and 0.043 mg/kg respectively (lead) for *Oreochromis niloticus*. The level of the metal were in the order; lead > cadmium. In both fish species the bones had higher bioaccumulation level. The level of both heavy metals in the different part of fish studied were higher than limits specified by Food and Agricultural Organization/ World Health Organization, Median international standard and European Union. As such, caution should be exercised in the consumption of fish from the study area.

Keywords: *Aquatic ecosystem; Bioaccumulation; Fisheries; River Nun*

Introduction

Food resources are need by all living things including humans [1], which are required for the growth/development and functioning of the body system [1-5]. Food resources needed by humans are derived from vegetation (plant) and animals [1]. These food resources are source of carbohydrate, protein, minerals and essential vitamins [1]. Specifically, within the animals, fishes are a major source of animal protein to humans [6-9]. In developing countries like Nigeria, fish are obtained from the wild (inland water ways) and/ or reared in homestead ponds [10,11].

The Nigerian aquatic ecosystem which serves as habitat for several species of fish is frequently contaminated by anthropogenic activities in the area. Contamination occurs directly through deposition of several wastes stream into the water [12,13] and indirectly as a result of runoff after precipitation. Some of the wastes could emanate from improper discharge of materials used for the spray of pesticides [14-18] and other wastes resulting from industrial, agricultural activities [18].

The composition of waste stream differs. However, heavy metals are frequently released into the environmental via anthropogenic activities and to lesser extent by natural effects. Typically, heavy metals are metals whose specific gravity is ≥ 5 cm^3 [19,20]. Heavy metals become toxic to humans when their concentration is above maximum tolerable level depending on the source, and they have the tendency to bioaccumulate in human body [19, 21]. Lead and cadmium are non-essential heavy metals that are commonly found in the environment. Specifically, cadmium used in the steel and plastics industries [19] and lead is used for battery production. Both lead and cadmium are released into the environment from tyre wear, fuel combustion, batteries, ceramics, cosmetics etc [19,22- 24].

Several diseases have been linked to acute and chronic toxicity in humans [19,25] including growth retardation, diarrhea, bone deformation, kidney damage, anemia, central nervous system disorder, hypertension, liver damage etc. (cadmium) [19, 26] and nervous systems disorders decreased mental ability, learning difficulties, reduced growth, blood anemia, severe stomachache, muscle weakness, and brain damage, premature birth in pregnant women [24,27], vomiting, loss of appetite, central nervous system defects, liver and kidney problems [19].

The Niger Delta region of Nigeria has several inland water bodies. The aquatic ecosystem contains several species of fish. Fish rearing from the wild is also a source of livelihood to several communities especially the ones aligning coastal region [10]. The region is also blessed with several water bodies including rivers, creek, creeklets, ponds, lakes etc [12,28,29]. Several human activities are also carried out in the water ways in the area including transportation, dredging, recreation (swimming), washing, fishing etc. During these activities, the fish composition, distribution, abundance and quality could be impacted. Since fish have the tendency to bioaccumulate toxicant, they can be contaminated by different toxicant found in the water aquatic ecosystem [30].

Therefore this study was designed to assess the level of cadmium and lead in two species fish (*Oreochromis niloticus* and *Clarias camerunensis*) at Agudama-Ekpetiama and Tombia town axises, Bayelsa state, Nigeria.

Materials and Methods

Study Area

River nun is one of the major rivers in the Niger Delta with several tributaries. The Nun River passes through several communities in Bayelsa state. The study location (Tombia town and Agudama-Ekpetiama) section of River Nun is located in Yenagoa local government area of Bayelsa state. The section has several trees, grasses and shrubs. Some of the major economic trees in the area include *Irvingia* species, Raphia and Oil palms. Dredging and fish are some of the major anthropogenic activities being carried out in the area during the study period. The climatic condition of the area is peculiar to other part of Bayelsa state as reported in river nun at Wilberforce island axises [12,13,31], Ikoli creek [32-34], Epie creek [35], Kolo creek [38,39].

Sample collection, preparation and Analysis

Three samples each of *Oreochromis niloticus* and *Clarias camerunensis* harvested by local fishermen at River nun at Agdama-Ekpetiama and Tombia town axises, Bayelsa state were purchased. The fish samples were transported to the laboratory in an ice box. The fish samples were washed using sterile water and thereafter they were dried in oven at 105°C for 6 hours [31,33]. The fish was dissected and the bones and muscles obtained. Thereafter the samples were ground using mortar and pestle [31,33]. The samples were hatched and cadmium and lead level in the bone and muscle of both fish (*Oreochromis niloticus* and *Clarias camerunensis*) were analyzed using Atomic Absorption Spectrophotometer (AAS).

Statistical Analysis

Mean data of the result was used to plot chart using Microsoft excel.

Results and Discussion

The level of heavy metals (cadmium and lead) found in bone and muscle of *Clarias camerunensis* from river nun at Agudama-Ekpetiama axises is presented in Figure 1, while the concentration found in bone and muscle of *Oreochromis niloticus* found in the same river is presented in Figure 2. For *Clarias camerunensis*, the concentration of cadmium was apparently higher in the bone (0.031 mg/kg) compare to muscle (0.013 mg/kg) and the lead concentration was higher in bone (0.063 mg/kg) compare to muscle (0.029 mg/kg) (Figure 1). In the *Oreochromis niloticus*, the level of cadmium was apparently higher in the bone (0.039mg/kg) compare to muscle (0.011 mg/kg) and lead concentration was higher in bone (0.051 mg/kg) compare to muscle (0.043 mg/kg) (Figure 2). Within each of the fish, lead concentration was higher compared to cadmium for both bone and muscle. The variation of bioaccumulation in the tissue could be due to their biochemistry and functions [31,40].

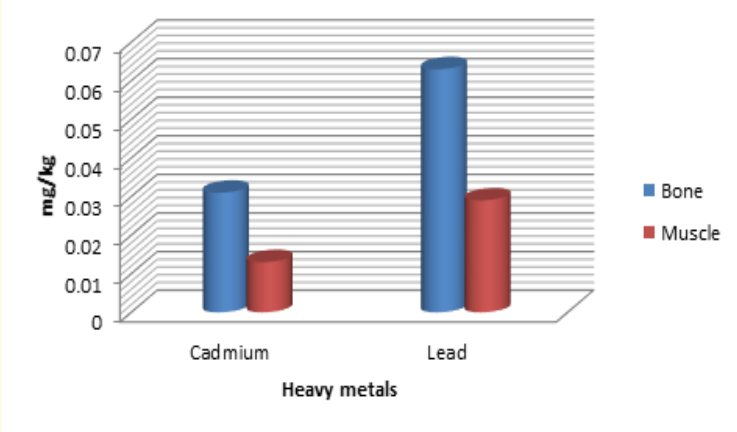

Figure 1: *Cadmium and lead concentration in Clarias camerunensis from River Nun at Agudama-Ekpetiama axises.*

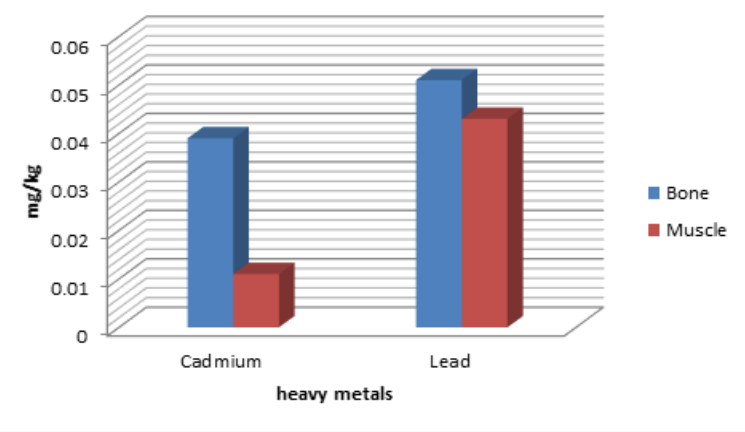

Figure 2: *Cadmium and lead concentration in Oreochromis niloticus from River Nun at Agudama-Ekpetiama axises.*

The concentration of cadmium and lead were higher than the limit of 0.05 µg/g and 0.2 µg/g respectively specified by European Union [10,41-43], 0.3 µg/g and 2.0 µg/g respectively specified by Median international standard [10,42-44] and 0.5 µg/g and 0.5 µg/g respectively specified by Food and Agricultural Organization/ World Health Organization [10,45,46].

The concentration of heavy metals (cadmium and lead) found in this study had some similarity with the level detected in some fish species from surface water in Bayelsa state. For instance, Ogamba., *et al.* [33] reported concentration of 0.028 mg/kg and 0.018 mg/kg in bone and muscles respectively (cadmium), 0.625 mg/kg and 0.218 mg/kg in bones and muscles respectively (lead) (for *Clarias camerunensis*) and 0.044 mg/kg and 0.016 mg/kg in bone and muscles respectively (cadmium), 0.525 mg/kg and 0.486 mg/kg in bone and muscles respectively (lead) (for *Oreochromis niloticus*) from Ikoli Creek, Bayelsa state. Ogamba., et al. [31] reported heavy metals level in gill and liver of *Clarias s gariepinus* from River Nun at Amassoma axises as 0.071 mg/kg and 0.045 mg/kg respectively (for cadmium) and 0.023 mg/kg and 0.049 mg/kg respectively (for lead). Ogamba., *et al.* [6] reported concentration of cadmium and lead in some fish from River Nun at Amassoma axises in the range of 0.014 - 0.015mg/kg and 0.005 - 0.007 mg/kg respectively for muscle and 0.017 - 0.020 mg/kg and 0.015 - 0.019 mg/kg respectively for bones (*Synodontis clarias*), 0.015 - 0.016 mg/kg and 0.005 - 0.007 mg/kg respectively

in the muscles and 0.024 - 0.030mg/kg and 0.024 - 0.028 mg/kg respectively in the bones (*Citharinus citharus*). The slight variation in bioaccumulation in this study with previous studies could be associated to differences in age of the fish, lipid content and feeding habits [10,31,33,40,47]. Also, tissue/organ, age, size of the fish, exposure period, mechanisms of uptake, intrinsic factors could be a major bioaccumulation determinants in fisheries [10,31,33,40,48]. Typically, the bioavailability, intrinsic fish processes and trophic structure of the ecosystem as well as differences in threshold values of each metal is a function of homeostasis in fisheries [10,47].

Conclusion

This study assessed the level of lead and cadmium in the bones and muscle of *Oreochromis niloticus* and *Clarias camerunensis* from River Nun, Niger Delta Nigeria. The study found cadmium and lead concentration in bones and muscles above the maximum allowable limit specified by Food and Agricultural Organization/ World Health Organization, Median international standard and European Union. As such individuals that consumed fishes from the river under study should exercise caution. Also, activities leading to increased heavy metal in the surface water should be regulated by appropriate agencies.

Bibliography

1. Izah SC., *et al*. "A review of the quality assessment of zobo drink consumed in Nigeria". *ASIO Journal of Microbiology, Food Science and Biotechnology Innovations* 1.1 (2015): 34-44.

2. Izah SC., *et al*. "Microbial quality of polythene packaged sliced fruits sold in major markets of Yenagoa Metropolis, Nigeria". *Point Journal of Botany and Microbiology Research* 1.3 (2015): 30-36.

3. Izah SC., *et al*. "Bacteriological Quality Assessment of MalusdomesticaBorkh and CucumissativusL. in Yenagoa Metropolis, Bayelsa state, Nigeria". *British Journal of Applied Research* 01.02 (2016): 05-07.

4. Izah SC., *et al*. "A review of heavy metal concentration and potential health implications in beverages consumed in Nigeria". *Toxics* 5.1 (2017): 1-15.

5. Kigigha LT., *et al*. "Bacteriological Quality Assessment of Meat Pie Sold in Yenagoa Metropolis, Nigeria". *EC Nutrition* 6.6 (2017): 189-195.

6. Ogamba EN., *et al*. "Bioconcentration of Mercury, Lead and Cadmium in the bones and muscles of Citharinus citharus and Synodontis clarias from the Amassoma Axis of River Nun, Niger Delta, Nigeria". *Research Journal of Pharmacology and Toxicology* 1.1 (2015): 21-23.

7. Ineyougha ER., *et al*. "Assessment of Microbial Quality of Smoked Trachurustrachurussold in some Markets of Three South-South States of Nigeria". *International Journal of Food Research* 2 (2015): 16-23.

8. Ogamba EN., *et al*. "Effects of dimethyl 2, 2-dichlorovinyl phosphate on the sodium, potassium and calcium content in the kidney and liver of Clarias gariepinus". *Research Journal of Pharmacology and Toxicology* 1.1 (2015): 27-30.

9. Izah SC and Angaye TCN. "Ecological perception of fish farmers in Yenagoa Metropolis, Nigeria". *Bulletin of Advanced Scientific Research* 1.1 (2015): 26-28.

10. Izah SC and Angaye TCN. "Heavy metal concentration in fishes from surface water in Nigeria: Potential sources of pollutants and mitigation measures". *Sky Journal of Biochemistry Research* 5.4 (2016): 31-47.

11. Angaye TCN., *et al*. "Assessment of untreated groundwater against some common fresh water Fish in Bayelsa State, Nigeria". *Point Journal of Agriculture and Biotechnology Research* 1.2 (2015): 70-76.

12. Agedah EC., *et al*. "Enumeration of total heterotrophic bacteria and some physico-chemical characteristics of surface water used for drinking sources in Wilberforce Island, Nigeria". *Journal of Environmental Treatment Techniques* 3.1 (2015): 28-34.

13. Ogamba EN., *et al*. "Water quality and proximate analysis of Eichhorniacrassipes from River Nun, Amassoma Axis, Nigeria". *Research Journal of Phytomedicine* 1.1 (2015): 43-48.

14. Inyang IR., *et al*. "Effect of glyphosate on some enzymes and electrolytes in Heterobranchusbidosalis (a common African catfish)". *Biotechnological Research* 2.4 (2016): 161-165.

15. Inyang IR., *et al*. "Effect of dimethoate on lactate dehydrogenase, creatinine kinase and amylase in Clarias lazera". *Biotechnological Research* 2.4 (2016): 155-160.

16. Inyang IR., *et al*. "Effects of Lambda cyhalothrin on some electrolytes and metabolites in organs of Parpohiocephalus obscurus". *Biotechnological Research* 3.1 (2017): 6-10.

17. Inyang IR., *et al*. "Effects of Lambda cyhalothrin in protein and Albumin content in the kidney and liver of Parpohiocephalus obscurus". *EC Pharmacology and Toxicology* 2.3 (2016): 148-153.

18. Izah SC., *et al*. "Environmental Impacts of Oil palm processing in Nigeria". Biotechnological Research 2.3 (2016): 132-141.

19. Izah SC., *et al*. "A Review on Heavy Metal Concentration in Potable Water Sources in Nigeria: Human Health Effects and Mitigating Measures". *Exposure and Health* 8.2 (2016): 285-304.

20. Idris MA., *et al*. "Pharmaceutical industrial effluent: heavy metal contamination of surface water in Minna, Niger State, Nigeria". *Bulletin of Environment, Pharmacology and Life Sciences* 2.3 (2013): 40-44.

21. Elinge CM., *et al*. "Assessment of heavy metals concentrations in bore-hole waters in Aliero community of Kebbi State". *Advances in Applied Science Research* 2.4 (2011): 279-282.

22. David TW., *et al*. "Investigation of heavy metals in drinking water (sachet and bottled) in ago-Iwoye and environs, Ijebu North lga, Ogun state, Nigeria". *Scholarly Journal of Biotechnology* 2.1 (2013): 1-6.

23. Omotoriogun TC., *et al*. "The Physicochemical characteristics of Ibiekuma River Ekpoma, Nigeria". *Journal of Wetlands Ecology* 6 (2012): 01-06.

24. Muhammad I., *et al*. "Determination of some heavy metals in wastewater and sediment of artisanal gold local mining site of Abare Area in Nigeria". *Journal of Environmental Treatment Techniques* 1.3 (2014): 174-182.

25. Azizullah A., *et al*. "Water pollution in Pakistan and its impact on public health - A review". *Environment International* 37.2 (2011): 479-497.

26. Dabai MU., *et al*. "Evaluation of some trace metal levels in the water, fish and aquatic plant in River Sokoto, North-western Nigeria". *Asian Journal of Applied Sciences* 1.5 (2013): 195-199.

27. Naseem R and Tahir SS. "Removal of Pb (II) from aqueous solution by using bentonite as an adsorbent". *Water Research* 35.16 (2001): 3982-3986.

28. Izah SC and Srivastav AL. "Level of arsenic in potable water sources in Nigeria and their potential health impacts: A review". *Journal of Environmental Treatment Techniques* 3.1 (2015): 15-24.

29. Izah SC and Ineyougha ER. "A review of the microbial quality of potable water sources in Nigeria". *Journal of Advances in Biological and Basic Research* 1.1 (2015): 12-19.

30. Seiyaboh EI., *et al*. "Length-Weight Relationship and Condition Factor of Five Fish Species from River Brass, Niger Delta". *Biotechnological Research* 2.4 (2016):187-192.

31. Ogamba EN., *et al*. "Bioaccumulation of heavy metals in the gill and liver of a common Niger Delta wetland fish, Clarias garepinus". *British Journal of Applied Research* 1.1 (2016): 17-20.

32. Ogamba EN., *et al*. "Water quality and levels of lead and mercury in Eichhorniacrassipes from a tidal creek receiving abattoir effluent, in the Niger Delta, Nigeria". *Continental Journal of Environmental Science* 9.1 (2015): 13-25.

33. Ogamba EN., *et al*. "Bioaccumulation of Chromium, Lead and Cadmium in the bones and tissues of Oreochromisniloticus and Clarias s camerunensis from Ikoli creek, Niger Delta, Nigeria". *Advanced Science Journal of Zoology* 1.1 (2016): 13-16.

34. Seiyaboh EI., *et al*. "Seasonal Variation of Physico-Chemical Quality of Sediment from Ikoli Creek, Niger Delta". *International Journal of Innovative Environmental Studies Research* 4.4 (2016): 29-34.

35. Seiyaboh EI., *et al*. "Spatial Variation in Physico-chemical Characteristics of Sediment from Epie Creek, Bayelsa State, Nigeria". *Greener Journal of Environment Management and Public Safety* 5.5 (2016): 100-105.

36. Seiyaboh EI., *et al*. "Physico-chemical Characteristics of Sediment from Sagbama Creek, Nigeria". *Biotechnological Research* 3.1 (2017): 25-28.

37. Seiyaboh EI., *et al*. "Assessment of Water quality from Sagbama Creek, Niger Delta, Nigeria". *Biotechnological Research* 3.1 (2017): 20-24.

38. Ogamba EN., *et al*. "Water quality, phytochemistry and proximate constituents of Eichhorniacrassipes from Kolo creek, Niger Delta, Nigeria". *International Journal of Applied Research and Technology* 4.9 (2015): 77-84.

39. Seiyaboh EI., *et al*. "Seasonal Variation in Length-Weight Relationship and Condition Factor of Five Fish Species from Kolo Creek, Niger Delta". *Greener Journal of Agricultural Sciences* 6.11 (2016): 342-348.

40. Aghoghovwia OA., *et al*. "Bioaccumulation of Heavy metals in different tissues of some commercially important fish species from Warri River, Niger Delta, Nigeria". *Biotechnological Research* 2.1 (2016): 25-32.

41. EU. "The Commission of the European Communities, Commission regulation, (EC) No. 22112002 amending regulation (EC) No. 466/2001 setting maximum levels For certain contaminants in food stuff in order to protect public health". Official Journal of the European Communities 7.2.2002,L37/5-L37/6 (2002).

42. Senarathne P., *et al*. "Heavy metal levels in food fish, Etroplussuratensis inhabiting Bolgoda Lake, Sri Lanka". *Vidyodaya Journal of Science* 13 (2006): 115-126.

43. Senarathne P and Pathiratne KAS. "Accumulation of heavy metals in food fish, Mystusgulio inhabiting Bologoda Lake, Sri Lanka". *Sri Lanka Journal of Aquatic Science* 12 (2007): 61-75.

44. Philips DJH. "Developing country aquaculture – trace chemical contaminants and public health concerns". In: Environment and Aquaculture in Developing Countries. R.S.V. Pullin, H. Rosenthal and Maclean J.L. (eds.), ICLARl'V1 Conference Proceedings 31 (1993): 296- 311.

45. FAO/WHO. "Evaluation of certain food additives and the contaminants mercury, lead and cadmium". WHO Technical Report, Series No. 505 (1989).

46. Elnabris KJ., *et al*. "Heavy metal concentrations in some commercially important fishes and their contribution to heavy metals exposure in Palestinian people of Gaza Strip (Palestine)". *Journal of the Association of Arab Universities for Basic and Applied Sciences* 13.1 (2013): 44-51.

47. Eneji IS., *et al*. "Bioaccumulation of Heavy Metals in Fish (Tilapia Zilliand Clarias Gariepinus) Organs from River Benue, North Central Nigeria". *Pakistan Journal of Analytical and Environmental Chemistry* 12.1-2 (2011): 25-31.

48. Perera PACT., *et al*. "Bioaccumulation of Cadmium in Freshwater Fish: An Environmental Perspective". *Insight Ecology* 4 (2015): 1-12.

Volume 7 Issue 3 March 2017