Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.3, No.13, 2013

Heavy metal status in muscles of dry *Trachinocphalus myops* fish from Orita-merin market in Ibadan metropolis South-West, Nigeria

Rasaq A Olowu (Corresponding author)
Department of Chemistry
Lagos State University, P.O. Box 0001, lasu post office, Lagos, Nigeria
Contact phone 08023456434, Email:raadeolowu@gmail.com
[2]Gregory O. Adewuyi,
Department of Chemistry,
University of Ibadan, Ibadan, Nigeria
Contact phone 08027554395, Email:adewuyio@gmail.com
[3]Olumayowa J. Onipede
Department of Chemical sciences
Bell University of Technology Ota Ogun State Nigeria
Contact phone 08122677350, Email: mayowaonipede@yahoo.com

Abstract
This paper determined the levels of chromium (Cr), cadmium (Cd), lead (Pb), copper (Cu) and zinc (Zn) in muscles of dry *Trachinocephalus myops* from Orita-merin market in Ibadan metropolis south-west of Nigeria. Samples were randomly purchased and were digested in concentrated nitric acid and analyzed by atomic absorption spectrophotometry. Zinc had the highest concentration of 124.9±86.7 mg/kg dry weight of the samples, while cadmium had the lowest concentration of 2.5±1.6 mg/kg dry weight of the samples. The concentration of chromium and copper were 5.6±3.5 mg/kg and 5.2±3.1 mg/kg respectively while lead was observed in only one of the samples with a concentration of 3.7 mg/kg. The obtained result revealed that Cr, Cd, Zn and Pb were above the permissible level set by the Food and Agricultural Organization (FAO) maximum limit in food which is Pb (2 ppm), Cd (0.5 ppm), Zn(1 ppm), and Cr (0.05 ppm which may be an indication of possible health risk when exposed consistently over a long time to this type of fish.
Keywords: Heavy metals, Bioaccumulation, Ecosystem, Pollutant, Exposure

1.0 Introduction

Trace metal in fish may be from various sources which is from the aquatic environment which fatokimay include diet of the fish, from water or the sediment or from the terrestrial environment which may be the preservation process and handling (Alquezer et al, 2006), high concentration of lead, chromium, mercury, arsenic, in fish may be traceable to airborne transport of pollutant, industrial highway road and urbanization (Moiseenko and Kudryavtseva, 2001, Olowu et al, 2010), heavy metal enter the aquatic food chain through direct consumption of water or biota or through non dietary routes such as uptake through absorbing epithelia in fish (Burger and Campbell, 2004, Olowu et al 2010), thus, aquatic organism accumulate metal to concentration several fold higher than those of the surrounding medium, the process of water borne metals by fish and other animal through non dietary route is defined as bio-concentration (Liao et al, 2003), fish tend to use the skin, digestive tract as sites of absorption of water borne chemicals. Fish and some other species closely regulate internal metal concentration and sequestration with cellular binding proteins (Burger and Campbell, 2004. Barka et al, 2010), the accumulation of metals in aquatic organism has been linked to decrease survival and reduced reproductive ability.

Also many studies have reported the impact of metal on human consumption from contaminated fish flesh (muscles), fish muscles seems to be more sensitive to surrounding environmental condition, it is believed that metals which end up in water bodies are as a result of direct run-off, industrial dust in steel metallurgy (Henry et al, 2004), and in combination with the atmospheric deposition during drying, thus, making dry fish double exposed to heavy metals as a result of aforementioned sources as well as atmospheric precipitation, hence humans are exposed to high level of trace metal through the food web, animal diet is generally one of the major route of contamination into the human body (Coelhan et al, 2006. Kojadinovic et al, 2007). Pollution in dry fish could be from so many sources such as periodic precipitation contamination with airborne pollutant domestic waste water and gasoline from motor vehicle using leaded gasoline (Rashed 2001, Henry et al 2004, Chandra Sekhar et al, 2003, Barka et al, 2010).

However, many studies have shown that human health risk may occur through the consumption of seafood contaminated with trace metals, some known diseases have been associated with trace metals, mercury has been implicated in neurological effect, cadmium causes carcinogenic diseases, lead is neurotoxic that causes behavioral deficit in vertebrates and cause decrease in survival, growth rate and learning. Metabolism level of 50 ppm in diet can cause reproductive effect in some predators and dietary level as low as 0.1-0.5 ppm are associated with learning deficit of some vertebrate (Burger and Gochfeld, 2005), lead is also carcinogenic, it can damage the nerve system, haematosis, and kidney in fish and in humans while copper has been connected to anemia, chromium has carcinogenic and ulcerative characteristics, zinc is an essential element but at high concentration leads to lung diseases, gastro enteritis, fever, vomiting, muscular coordination problem and dehydration(Agusa et al, 2007. De Souza Lima Junior et al, 2002. Moiseenko and Kudryavtseva, 2001).

Although many research have been conducted on heavy metals in fish hence there seems to be inadequate literature on heavy metals in dry fish sold in market, thus, this study was carried out with the aim of assessing metal bioaccumulation so as to determine the level of heavy metals in the tissue of dry Ijaga fish a fresh water fish to assess the edible fish quality obtained from a market in Ibadan, South-west of Nigeria, with a view of monitoring the tissular distribution of heavy metals in the fish, the species was selected because it represents the indigenous fish not only caught in the creek of Nigeria but also consumed in Nigeria.

2.0 Materials and Method

2.1 Sample collection

Fish were purchased randomly in the market and these represent the cumulative trace metal exposed to by human as it is the last point it get to, before it gets to tables in homes , muscles were analyzed because it indicate the level of heavy metal transfer to human population via food consumption.

2.2 Sample preparation

All reagents and standards were purchased at Sigma- Aldrich chemicals, the samples were bought at orita-merin market in Ibadan metropolis the samples were wrapped in polythene bags and were transferred to the laboratory. 0.1-0.7 g dry weight of representative sample was accurately weighed which consist of the muscles of Ijaga fish, they were then rinsed in acetone then in deionized water, each was then digested in 3 ml of concentrated nitric acid in universal bottle with screw cap and were then digested in the screw capped bottle in water bath until a clear solution was obtained. Each was then made up to 20 ml mark with deionized water. The concentrations of heavy metal in the digested solution were determined by Buck Scientific Model 210-211 VGP atomic absorption spectroscopy for Cu, Pb, Zn, Cr and Cd. The manufacturer's fuel specification, lamp specification, settings and other operational condition were strictly followed and the calibration of the instrument was done with the analytical grade standard stock solution, the average of duplicates for each treatment and standard deviation were calculated using SPSS (Olowu et al 2012 , Ince, 1999. Papagiannis et al, 2004).

3.0 Results and Discussion

Table 1 below revealed that lead was absence in most of the analyzed samples except in the one collected close to the busy traffic road which showed a concentration of 3.7 mg/g compared to other samples that were collected inside the main market. The value obtained for lead was found to be above the daily recommended value by FAO which may be attributed to atmospheric deposition during drying as well as vehicular emission, lead has been reported to have low mobility in biological sample and hence less observed in biological system, hence it has no positive function in biological system, also metals tend to accumulate less in muscles but more in liver kidney and gills because they are metabolically active tissues and hence tend to accumulate metals (Yilmaz, 2003, FAO 1995). Entry of metal into food chain is a considerable hazard because of their high toxicity (Chandra Sekhar et al, 2003, Olowu et al 2010).

Most studies conducted on fish reveal that muscles accumulate the lowest concentration of metals as compared to liver, kidney and fin. Copper, chromium in muscles in particular shows increasing tendency with fish age, the accumulation of metals in fish is as a result of extraction, concentration and accumulation of these metals from water body during scale formation as well as post harvest handling in dry fish (Rashed, 2001). Copper was found in range 2.4 ± 0.4 to 11.3 ± 0.1mg/kg the result is comparable to that obtained by Capelli et al, 2000 in muscles of striped dolphin found dead along Lugarianl coast in Italy which was in the range 3.1 to 11.7 μg/g.

The zinc concentration was most predominant in all the dry snake fish as shown in figure 1 and the concentration ranged from 51.5 ± 4.7 to 290 ± 12.6 mg/kg, this concentration is very much higher than that obtained by Usero et al 1997 in Ruditape decusalin and Ruditape philippiriarum from the southern coast of Spain, studies have shown that metals accumulate more in lake than rivers and that sediments tend to accumulate around 1000-100,000 times more than water while fish usually have intermediate concentration between water and sediments. Other factors such as industries; metallurgy pharmaceuticals and other environmental factors tend to contribute to high level of metals in fish (Chatterjee et al 2001), these is beside the post harvest handling of dry fish, again it was found that zinc in comparison with other element tend to concentrate more in the muscles of fish (Usero et al

2003, Yi et al 2011,), soft tissues essential metals are incorporated in metabolically important biomolecules with key role in respiratory, pigments proteins enzymes and metalloenzymes (Cravo, et al 2004). The concentration is also found to be higher than the permissible daily intake in the UK which is 50 mg/kg (Usero et al 1997). Research which examine the mechanism of metal accumulation of zinc and copper have proposed that zinc and copper are retained by specific binding protein called metallothioneins; this is found in tissues like liver, kidney, brain, gonads but less is found in the muscles of fish (Papagiannis et al, 2004).). All the samples investigated exhibited high cadmium level which is in the range of 1.3±0.5 to 5.5±0.4 mg/kg dry weight of the sample which is higher than permissible limit set by the Oslo and Paris commission which set a guideline of 2 ppm of cadmium in fish muscles (Burger and Gochfeld, 2005). Cadmium is very toxic (Fatoki et al, 2002). Calcium metabolism is affected by cadmium toxicity and it has been reported that individual with cadmium nephropathy may have renal failure (Klaassen et al, 1986). Several reports by scientist have also linked cardiovascular and skeletal malformation to the consumption of aquatic organism with high level of cadmium concentration (Ayejuyo et al, 2009). The possible sources of cadmium in the study fish may be attributed to effluent discharge from the neighboring industrial area and top soil run off into the river from which the fishes were caught before been transported to the market but the values were lower than earlier report by Olowu and its coworker in some fish samples caught from ijede, Ikorodu lagoon (Olowu et al 2012).. Cadmium has also been described as an inevitable bye product of Zinc refining; a non-corrosive pigment used in manufacture of ship paints (Claudia et al, 2004).

All metals are said to be toxic above certain threshold bioavailable level but Ag, Hg, Cu, Cd and Pb are particularly toxic (Kucuksezgin et al 2006), studies have also reviewed that in a living fish if the rate of metal uptake is less than combined rate of detoxication and excretion, then the metal will not build up hence toxicity is not observed but if the uptake is more than the rate of detoxication combined accumulation ensue and toxicity is observed (Rainbow, 2007), but for a processed and exposed fish contamination can be from a long range transport in the atmosphere and undergo dry and or deposition upon encountering fairly cold environment of the atmosphere (Yang et al, 2007).

Chromium in the samples ranged from ND to 10.4 mg/kg dry weight of the sample, this value is more than that obtained by Burger and Gochfeld 2005 which examines the concentration of metals in commercial fish in New Jersey, studies have shown that chromium level as low as 10 ppm in diets of bird are considered to cause adverse effect in wildlife species (Burger and Gochfeld, 2005) also this seems to be more than the FAO permissible limit of chromium in food which stand at 0.05 ppm

4.0 Conclusion

This study investigated the level of Pb, Zn, Cd, Cu and Cr of myops fish sample from the orita -aperin market. Zinc was found most abundant in the samples obtained from the market and the high level of some of the toxic metals, such as Pb Cr and Cd, above the permissible limit of FAO possibly point at the unsafe status of the fish. The elevated levels of zinc in the fish are the basis for the classification as been polluted but, it represents the level exposed to by consumer. Continuous consumption of the aquatic organisms may be hazardous, being an important pathway for heavy metals in the food chain. Conversely, the constant build up of the metal contaminants can be checked if relevant government agencies ensure strict compliant of industrial standards which stipulate treatment of industrial effluent before discharging such polluted effluents into water ecosystem.

References

Agusa, T., Kunito, T., Sudaryanto, A., Monirith, I., Kan-Atireklap, S., Iwata, H., Ismail, A., Sanguansin, J., Muchtar, M., Tana, T.S., Tanabe, S., (2007): Exposure of assessment of trace element from consumption of marine fish in south-east Asia. Environmental Pollution 145:766-777.

Alquezar, R., Markich, S. J., Booth, D.J. (2006): Metal accumulation in the smooth toad fish, Tetractenous glaber, in estuaries around Sydney, Australia. Environmental Pollutuion 142:123-131.

Ayejuyo, O.O, Tovide, O.O., and Moronkola, B.O. (2009) Heavy metal distribution in Crab (Callinect esamnicola) living on the shore of Ojo rivers, Lagos Nigeria.Environmentalist, 29 (2), pp. 33-36.

Barka, S., Pavillon, J., Amiard-Triquet, C. (2010): Metal distribution in Tigriopus brevicornis (Crustacea Copepoda) exposed to copper zinc, nickel, cadmium silver and mercury and implication for subsequent transfer in the food web. Environmental Toxicology. 25: 350-360.

Burger, J., Campbell, K.R. (2004): Species differences in contaminants in fish on and adjacent to the oak ridge reservation Tennessee. Environmental Research 96:145-155.

Burger, J. and Gochfeld, M. (2005): Heavy metals in commercial fish in New Jersey. Environmental Research 99: 403-412.

Capelli, R., Drava, G., De Pellegrini, R., Minganti, V. Poggi, R. (2000): Study of trace elements in organs and tissues of striped dolphins (Steriella coeruleolba) found dead along the Ligurian coast Italy. Advances in Environmental Research 4;31-43.

Chandra Sekhar, K., Chary, N.S., Kamala, C.T., Suman Raj, D.S., Sreenivaso Rao, A. (2003): Fractionation studies and bioaccumulation of sediment-bound heavy metals in Kolleru lake by edible fish. Environment International 29:1001-1008.

Chatterjee, A., Bhattacharya, B., Das, R. (2001): Temporal and organ-specific variability of selenium in marine organism from the eastern coast of India. Advances in Environmental Research 5:167-174.

Claudia, G.V., Batista, D.S, and Batista, N.J.A. (2004) Benthic foraminifera distribution in high polluted sediments from Niteróí Harbor (Guanabara Bay), Rio de Janeiro, Brazil An. Acad. Bras. Ciênc , 76(2), pp. 1-10

Coelham, M., Strohmeier, J. and Barlas, H. (2006): Organochlorine levels in edible fish from marmara sea Turkey. Environment International 32:775-780.

Cravo, A., Bebianno, M.J. and Foster, P. (2004): Partitioning of trace metals between the soft tissues and shells of Patella aspera. Environment International 30: 87-98.

De Souza Lima Junior, R.G., Araujo, F.G., Maia, M.F. Da Silveira, Braz Pinto, A.S. (2002): Evaluation of heavy metals in fish of the sepetiba and iiha grande bays Rio de Janeiro Brazil. Environmental Research Section A 89:171-179.

Fatoki, O.S., Lujiza, N., and Ogunfowakan, A.O. (2002) Trace metal pollution in Umtata River. Water SA, 2(2), pp. 2-13.

Food And Agriculture Organization, (1995): Report on a Regional Study and Workshop on the Environmental Assessment and Management of Aquaculture Development FAO (United Nations) http://www.fao.org/docrep/field/003/ac279e/ac279e00.htm. 14 January 2009.

Henry, F., Amara, R., Courcot, L., Lacouture, D., Bertho, M.L. (2004):. Heavy metals in four fish species from the French coast of eastern English Channel and Southern bight of the North Sea. Environment International 30: 675-683.

Ince, N.J. (1999): Assessment of Toxic interaction of heavy metals in binary mixture a statistical approach. Archives. Environmental. Contamination. Toxicity. 36:365-372.

Klaassen, D.C., Amodur, O.M., and Doull, J. (1986) Casarett and Doull's Toxicology: The Basic Science of Poisons . 3rd ed. New York, MacMillan Publishing Company, pp. 592-59

Kojadinovic, J., Potier, M., Le Corre, M., Cosson, R.P. and Bustamante, P. (2007): Bioaccumulation of trace element in pelagic fish from western Indian ocean. Environmental Pollution 146: 548-566.

Kucuksezgin, F., Kontas, A., Altay, O., Uluturhan, E. and Darilmaz, E. (2006): Assessment of marine pollution in Izmir bay; nutrient, heavy metal and total hydrocarbon concentration. Environment International 32:41-51.

Liao, C., Chen, B., Singh, S., Lin, M., Liu, C. and Han, B. (2003): Acute toxicity and bioaccumulation of arsenic in Tilapia Oreochromis mossambicus from blackfoot disease area in Taiwan. Environmental Toxicology. 18: 252-259.

Moiseenko, T.I. and Kudryavtseva, L.P. (2001): Trace metal accumulation and fish pathologies in areas affected by mining and metallurgical enterprises in Kola region Russia. Environmental Pollution 114:285-297.

Olowu, R.A , Ayejuyo, O.O. . Adewuyi, G.O, Adejoro, ,I.A. Denloye, A.A.B. . Babatunde A.O and Ogundajo, A.L. (2010):. Determination of heavy metals in fish tissues, water and sediment from Epe and Badagry lagoons, Lagos, Nigeria. E-Journal Chemistry.,7(1): 215-221.

R.A. Olowu, Onwordi, C.T., Denloye, A.A. Osundiya, M.O Adebayo, N.O. Owolabi, M.S. Tovide, O.O. Moronkola, B.A. Omoyeni. O.A, Ajuwon O.R. (2012): Heavy Metals in Oreochromis niloticus (Linnaeus, 1758) (Persiformes: Cichlidae), Ictalurus punctanus (Rafinesque, 1818) (Suliriformes: Ictaluridae) and Bottom Sediments from Lagos Lagoon Proximal to Egbin Power Plant, Ijede, Ikorodu, Lagos Nigeria. Research Journal of Environmental and Earth Sciences 4(3): 237-243.

Papagiannis, I., Kagalou, I., Leonardos, J., Petridis, D., Kalfakakuo, V. (2004): Copper and Zinc in four fresh water fish species from lake Pamvotis Greece. Environment International 30:357-362.

Rainbow, P.S. (2007): Trace metal accumulation: Models metabolites availability and toxicity. Environment International 33: 576-582.

Rashed, M.N. (2001): Monitoring of environmental heavy metals in fish from Nasser Lake. Environment International 27: 27-33.

Usero, J. Gonzalez-Regalado, E. and Gracia, I. (1997): Trace metal in the bivalve molluscs Ruditapes decussatus and Ruditapes philippinarum from the Atlantic coast of southern Spain. Environment International 23(3): 291-298.

Usero, J., Izquierdo, C., Morillo, J. and Gracia, I. (2003): Heavy metals in fish Solea vulgaris, Anguilla, Anguilla, Liza aurata from salt marshes on the southern Atlantic coast of Spain. Environment International 29: 949-956.

Yang, R., Yao,T., Xu, B., Jiang, G. and Xin, X. (2007): Accumulation features of organochlorine pesticides and heavy metals in fish from high mountain lakes and Lhasa River in the Tibetan plateau. Environment International 33: 151-156.

Yi, Y., Yang, Z. and Zhang, S. (2011): Ecological risk assessment of heavy metals in sediment and human health risk assessment of heavy metal in fishes in the middle and lower reaches of the Yangtze river basin. Environmental Pollution 159:2575-2585.

Yilmaz, A.B. (2003): Level of heavy metals Fe, Cu, Ni, Cr, Pb, and Zn in tissues of Mugil cephalus and Trachurus mediterraneus from Iskenderun bay Turkey. Environmental Research 92: 277-281.

Table1 showing the mean concentration of metals in fish samples

SP	Cr(mg/kg)	Cd(mg/kg)	Pb(mg/kg)	Cu(mg/kg)	Zn(mg/kg)
.	1.2±0.2	1.3±0.5	ND	2.4±0.4	192.5±19
SP2.	6.3±0.2	5.5±0.4	ND	4.2±1.9	87±4.1
SP3.	10.4±0.2	2.0±0.8	ND	3.9±1.3	290±12.6
SP4.	7.6±2.4	1.3±0.3	ND	3.5±4.0	82.5±3.5
SP5.	3.0±1.1	1.5±0.2	ND	6.3±1.4	101.5±6.7
SP6.	ND	1.5±0.2	ND	3.3±0.4	51.5±4.7
SP7.	ND	2.5±1.1	ND	11.3±0.1	124.5±3.5
SP8.	ND	4.3±0.7	3.7±1.0	6.5±1.3	70±8.5

Key: ND= not detected, Mean ± standard deviation.