Journal of Scientific and Innovative Research 2018; 7(4): 88-91
Available online at: www.jsirjournal.com

Research Article

ISSN 2320-4818
JSIR 2018; 7(4): 88-91

Received: 28-11-2018
Accepted: 30-12-2018

MAKANJUOLA Olakunle Moses
Department of Food Technology, The Federal Polytechnic, P.M.B 50 Ilaro, Ogun State, Nigeria

MAKANJUOLA John Olanrewaju
Department of Science Laboratory, The Federal Polytechnic, P.M.B 50 Ilaro, Ogun State, Nigeria

Correspondence:
Makanjuola Olakunle Moses
Department of Food Technology, The Federal Polytechnic, P.M.B 50 Ilaro, Ogun State, Nigeria
Tel: +2348037136605
Email:
kunle.makanjuola@yahoo.com

An assessment of heavy metals in the sediments of Ogun-Osun river basin, Oke-Odan, Yewa South local government area of Ogun State, Nigeria

MAKANJUOLA Olakunle Moses, MAKANJUOLA John Olanrewaju*

Abstract

This study was carried out to examine heavy metals concentrations in the sediments of upstream, middle stream and downstream sections of Ogun-Osun River Basin, Oke-Odan, Ogun State, Nigeria. Sediment samples were analyzed for selected heavy metals) Cd, Cr, Pb, Zn, Mn, Cu, Ni, As & Fe) by atomic absorption spectrophotometry method. The results revealed heavy metals concentrations ranging from 2.07mg/kg-2.98mg/kg for Cd, 2.12mg/kg-4.66mg/kg for Cr, 5.15mg/kg-17.18mg/kg for Pb, 5.55mg/kg-14.04mg/kg for Zn, 174.62mg/kg-218.83mg/kg for Mn, 0.28mg/kg-1.47mg/kg for Cu, 12.22mg/kg-15.58mg/kg for Ni, 1.15mg/kg-2.32mg/kg for As and 4.53mg/kg-7.38mg/kg for Fe in the three locations. The results showed that the concentrations of Zn, Pb, Cu, Cr, Ni, and as in the sediments are low but may require monitoring to prevent increase. The concentration of Mn was higher than the stipulated limit (50.0mg/kg) set by **USEPA** and this may constitute risk to the people as well as aquatic animals using the water. However, the river sediments are less contaminated but may increase if the water is managed well to continue to enhance its quality.

Keywords: Assessment, Heavy metals, Sediments, Spectrophotometry.

INTRODUCTION

Sediment is an important component in aquatic or marine ecosystems and acts as natural reservoir of contamination [(1)]. Water bodies provide habitat for numerous aquatic lives and help in conserving biodiversity within the ecosystem. Sediments were also considered an important indicator for environmental pollution [(2)]. Rivers are the major source of irrigation, hydropower and recharging the ground water table, storage of water, purification, shipping and landscape [(3)]. Besides carrying different kinds of waste water materials, rivers also carry many particulate nutrients and minerals which play a major role in maintaining the productivity of the water bodies. More than 99% of heavy metals entering into a river can be stored in river sediments in various ways [(4)]. According to [(5)], rivers receives sediments from various points and diffuse sources which are deposited at the bottom of the river and act as both carriers and potential sources of metal accumulation in aquatic food chain by the process of bio magnification.

Trace elements of natural origin are transported by rivers and transferred to the coastal marine system through estuaries hence estuaries constitute a natural reactor in which heterogeneous processes at the interface between dissolved phase and suspended particulate matter, and constitute an important part of the trace element geochemical cycles. Heavy metals can fix in sediment for short periods and a small amount of these fixed heavy metals will re-enter the overlaying water body and uptake by the aquatic biota [(5)]

The ability of a water body to support aquatic life, as well as its suitability for other uses depends on many trace elements. Heavy metal contamination in plants, animals and human are due to environmental pollution through leaching into water bodies, smelting and other process waste from mining and other industries [(6)], hence human health is adversely affected by up-taking of the fishes and water. The accumulation of heavy metals in river sediments has been reported for a number of Countries, including Hong Kong, Nigeria and Brazil [(7,8)]. [(9)] Studied on heavy metals in wetland sediment and the total concentration of heavy metals such as Zn, Ni, Cr, Cu, Pb and Cd and their chemical specification were investigated. [(10)] analyzed seventeen sediment samples from a river and the chemical partitioning of metals

(Cu, Zn, Cd, Pb, Fe, Ni, and Cr) in each sample was determined in four fractions (acid-soluble, reducible, oxidizable and residual). Also, [11] found that mollusk has a potential to be used as bio indicator for the contamination of Cd and Zn in water and sediment of an estuarine environment as indicated by its high concentrated factor (Bio indicator factors) while [12] revealed that heavy metal concentration in water showed no general correlation between metal levels in water. Therefore, the objectives of this present work was to assess the concentration of heavy metals in sediments of Ogun-Osun River Basin, Oke-Odan, Yewa South Local Government are of Ogun State, Nigeria since it serves as the main source of water for the inhabitant as well as determining its domestic and agricultural uses.

MATERIALS AND METHODS

Sample collection

Three (3) sampling points were selected at Oke-Odan and it environ during the dry season (November and December of 2017). Sediments were collected with clean polymethyl methasylicate shovel and a small brush at a depth of thirty (30cm). in order to get the conforming sample and favourable comparison of results, all the samples were collected under the same condition in one day. The sediment samples collected were kept in polyethylene Ziploc bags and preserved under a freezing condition (<-10ºC) before analyses. All the samples were then air dried at room temperature and sieved through a 2mm nylon sieve to remove coarse debris. The samples were then crushed into fine powder with pestle and mortar, sieved through a 0.149mm nylon sieve before analyses. All chemicals and reagents used were of analytical grade.

Determination of Heavy Metals: (Cd, Cr, Pb, Zn, Mn, Cu, Ni, As, Fe)

5.06g of each sample was weighed; 4.0ml of perchloric acid, 125ml of concentrated HNO3 and 2ml of concentrated H_2SO4 were added. The content was mixed thoroughly and the heated on a hot plate until dense white fume appeared. It was then allowed to cool to room temperature and 40.5ml of boiled distilled water was added, the solution was filtered completely with a wash bottle into 100ml conical flask and the solution was then stored for subsequent analyses. the digest was analyzed for heavy metals using different wavelengths by atomic absorption spectrophotometry (AAS) method.

RESULTS

Table 1: Results of Heavy Metals Present in Sediments of Ogun-Osun River-Basin (Mg/Kg)

Heavy Metals Determined	Up stream Sediment (Mg/Kg	Middle stream Sediment (Mg/Kg)	Down stream Sediment (Mg/Kg)
Cadmium	2.24±0.02	2.07±0.04	2.98±0.03
Chromium	3.55±0.09	4.66±0.04	1.12±0.06
Lead	5.15±0.06	13.07±0.07	17.18±4.94
Zinc	14.04±0.06	5.68±0.99	5.55±0.54
Manganese	218.83±0.50	207.22±0.03	174.62±0.17
Copper	0.28±0.03	1.47±0.45	0.62±0.35
Nickel	15.58±0.04	12.22±0.02	15.34±0.06
Arsenic	2.32±0.59	1.15±1.06	2.10±0.39
Iron	4.53±±0.54	7.38±0.65	6.39±0.33

Values are means ± standard deviation of 3 determinations

Table 2: USEPA Standard Level for Heavy Metals in Sediments

Heavy Metals	Values (Mg/Kg)
Cadmium	0.99
Chromium	43.4
Lead	35.8
Zinc	121.0
Manganese	50.0
Copper	31.6
Nickel	22.7
Arsenic	10.0
Iron	40.2

Source: USEPA, USA

DISCUSSION

The results of the heavy metals in the sediment samples in the upstream, middle stream and downstream of Ogun-Osun river basin are as shown in Table 1. The cadmium concentration levels are 2.24mg/kg, 2.07mg/kg and 2.98mg/kg for sediments collected at upstream, middle stream and downstream. Higher level of cadmium metal was at downstream sediment while the lowest was at middle stream sediment. All the values obtained for cadmium were far above permissible limit (0.99mg/kg) set by [13]. According to [14], cadmium toxicity is characterized by chest pain and lining of lung due to excessive accumulation of watery fluids. Cadmium is a by-product of zinc and lead mining and smelting and more mobile in the aquatic environment than most of the other metals. Cadmium is similar in toxicity to lead and chromium, where as it is less toxic than copper for plants, while it is equally toxic to invertebrates and fishes [15]. Cadmium is added to the surface water through different sources such as paints, colours and are equally deposited on road surfaces from studded tires. Cadmium is more mobile in the water way body than other metals and has been found to be more persistent in the river body.

The chromium levels ranged from 2.12mg/kg-4.66mg/kg for all the sediments collected at upstream, middle stream and downstream. The chromium concentrations obtained from these sites are less than 43,40mg/kg stipulated by USEPA. However, excessive amount of chromium in water can lead to lethality to some aquatic species in the river system [13]. Chromium may go into the aquatic body through the small-scale tanneries, natural origins etc [16]. Chromium is available in earth's crust layer with a concentration of 100mg/kg in aquatic environment, Cr+6 and Cr+3 have been found accumulated in many species, especially in fishes such as *Cyrinus carpio, Clarias batrachus* etc. acute toxicity of chromium to invertebrates is highly diversified depending upon the species [15]. According [17], abnormal state of chromium in waste water effluent shows contami9nation from textile and tanneries and when these effluents enter the river, contaminate both the water and sediment of the river.

Lead concentration was recorded as 5.15mg/kg at upstream, 13.07mg/kg at middle stream and 17.18mg/kg at downstream sediments. The observed values of lead in this present work were found to be below the permissible limit of 35.80mg/kg set by [13]. Presently, the lead concentration is safe to aquatic lives but might be possibly destructive later on with population in the river basin. Lead is one of the most established metals known to man and the greater part of its compound is noxious in nature. Lead is found on earth crust in an average concentration of 0.1mg/kg and binds with sulfide ores of zinc, copper and lead obtained as a by-product during processing of ores and is discharged in the surface water through building materials, pipes etc

The concentration of zinc as revealed by the result varied from 5.55mg/kg-14.04mg/kg for all sediments at upstream, middle stream and downstream of Ogun-Osun river basin. The observed value of zinc was found to be below the permissible limit set by [13] (121.0mg/kg), indicating that the water sediments was minimally contaminated by zinc. The main sources of zinc are fertilizers and pesticides used in agriculture, soil erosion due to rainfall, fossil fuel and land construction activities [18; 19]. In the aquatic body, zinc will predominantly combine with suspended materials before finally accumulating in the sediment. Zinc is an essential metal having enzymatic and regulatory roles in biological systems. High concentration of zinc may bring about rot, chlorosis and depress the development of plants while gastrointestinal misery, loose bowels, pancreatic harm and sickliness in both people and animals do occur.

The results of manganese concentrations revealed 218.83mg/kg at upstream, 207.22mg/kg at middle stream and 174.62mg/kg at the downstream sediments. These concentrations exceeded the standard value (50.0mg/kg) set by [13]. The exceeded estimation can lead to neurological problem. Headache, muscle cramps, fatigue and aggressiveness are early signs of manganese toxicity which can then developed into Parkinson's disease like symptoms such as tremors, manganism.

The concentration of copper ranged from 0.28mg/kg-1.47mg/kg for all the sediment samples. According to [13], maximum permissible amount for copper in river sediment is 31.6mg/kg. The observed values were found to be below the permissible limit. However, copper is very dangerous to fishes, invertebrates and other aquatic animals and plants. Aquatic plants have been found to absorb 3 times more copper than plants on dry lands. Also, higher values of copper can harm plant roots by destroying the cell membrane structure, restrain or retard root development and formation of many short auxiliary roots.

The result showed that Nickel concentrations in the sediments of Ogun-Osun river were 15.58kg/mg at upstream, 12.22mg/kg at middle stream and 15.34mg/kg at the downstream respectively. The levels (Nickel) are less than the permissible limit of 22.7mg/kg [13]. Nickel in aquatic bodies form complexes with varying soluble organic and inorganic materials. It absorbs directly on clay and has the capability to co-precipitate with hydroxides of iron and manganese. It is bio-accumulated through aquatic organisms such as phytoplankton, seaweed and algae [20,21].

The concentration of arsenic which was found to be below the permissible level (10.0mg/kg) stipulated by [13] ranged from 1.15mg/kg-2.32mg/kg. The levels are below those stipulated by [13], the concentration may increase in the future due to likely increase in anthropogenic activities.

Iron concentrations in the sediments of Ogun-Osun river were recorded as 4.53mg/kg (upstream, 7.38mg/kg (middle stream and 6.39mg/kg (downstream). The iron in this present study were found to be below the permissible value (40.2mg/kg) set by USEPA. Iron is a constituent of active site of various reproductive hydrogenase, most frequently associated with sulphur containing ligands. Iron together with haemoglobin and ferradoxin plays a central role in metabolism. Although, iron is an essential element needed by the body, consumption of an excessive amount can lead to health effect such as enlarged liver and joint disease [22].

CONCLUSION

It is evident from this work that sediments present in Ogun-Osun river basin were not seriously contaminated with heavy metals. Using this water for recreational purposes, washing, drinking and fishing may not pose any harmful effect to both human and animals in the environment. However, it is advisable to continue to take adequate measures to prevent the entry of sewage, toxic substances and contaminants from industrial sources and agricultural residues from pesticides and insecticides into body of the rivers. Managing the quality of the water and the sediments will further make the water available for the use in terms of quality to the inhabitants of this area.

The Authors wish to acknowledge the technical assistance provided by Oni, Zainab Ajoke in the overall preparation of this work.

REFERENCE

1. Gaine EJ. Distribution and Fractionation of heavy metals in Gomti river sediments-a tributary of the Ganges, India. Journal of hydrology. 2005; 312 (1-): 14-27
2. degregori I, Pincochet H, Aranccibio M & Vida A. Grain size effects on trace metal's distribution in sediments from two coastal areas of Chile. Bulletin of environmental contamination toxicology. 1996; 57:163-170.
3. Dong ZR. Density of river morphology and diversity of bio-communities. Journal of Hydraulic Engineering. 2003., 48 (11):1-6.
4. Salomons W & Stigliani WM. Bio geodynamics of pollutants in soil and sediments: risk assessment of delayed and non-linera response. Springer, New York. 1995; 331-343
5. Theofanis ZU, Astrid S, Lidia G & Calamano WG. Contaminants of sediment: re-mobilization and de-mobilization. Science total environment. 2001., 266: 195-202
6. Anasari TM, Ikram N, Najam-ul Haqm, Fayyaz O, Ghafoori & Khalid N.ESSENTIAL TRACE METAL (Zn, Mn, Cu, and Fe) levels in plants of medicinal importance. Journal of Biological Science. 2004., 4;95-99.
7. Liang P, Wu SC, Zhang J, CaoY, YuS & Wong MH. The effects of mariculture on heavy metal distribution in sediments and culture fish around the pearl river, Delta region, South China. Chemosphere. 2003., 148: 171-177.
8. Essien JP, Antai SP, & Olajire AA. Distribution, seasonal variations and eco toxicological significance of heavy metals in sediments of Cross River estuary mangrove swamp. Journal of Water, Air and Soil Pollution. 2009., 197: 91-105
9. Li QS, Wu ZF, Chu B, Zhang N, Cai SS & Fang JH.Heavy metals in coastal wetland sediments of Pearl River estuary, China. Journal of Environmental pollution. 2007.,158-164
10. MorilloJ, Usero J & Gracia I.Partitioning of metals in sediments from Odiel River. International Journal of Environment.2002., 28:263-271
11. Abdullahi MH, Sid J & Aris AZ. Heavy metals in Meretrix Roding, Water and Seiments from estuaries in Sabah, North Borneo. International Journal of Environmental Sciens Education. 2007; 2:69-74
12. Mohammad AH, Bhuiyan MA, Islam SB, Dampare L & Shigeyuki S.Evaluation of hazardous metal pollution in irrigation and drinking water systems in the vicinity of coal area of North Western Bangladesh. Journal of hazardous Material. 2002; 18(1): 210-221
13. USEPA. National recommended water quality criteria. United State Environmental Protection Agency. (http:// www.epa.gov./ostwater/pci/revcom:25.
14. Duruibe JO, Ogwuegbu MOC & Egwurugwu JN. Heavy metal pollution and human bio toxic effects. International Journal of Physical Sciences. 2007; 2:112-118
15. Moore JW & Ramamoorthy S. Heavy metals in the natural water: applied monitoring and impact assessment. Springer, New York. 1984:228-246.

16. Howorth R, Evans G, Groudace W & Cundy AB. Sources and timing of anthropogenic pollution in Ensenada de San Simon, Glacia, NW Spain. Journal of Science and Environment. 2005; 340:149-176.
17. Pachpande BG & Ingle ST. Recovery of Chromium by chemical precipitation from tannery effluent. Oriental Journal of Chemical. 2005; 20(1):117-123.
18. Higgins SA, Jaffe BE & Fuller CC. Reconstructing sediment profiles from historical battymetry change in San-Pablo Bay, California. Estuarine coastal shelfscience. 2007; 73:165-174
19. Chen Z, Saito Y, Kanai Y, Wei T, Lil & Yaoh. Low concentration of heavy metals in the Yangtze estuary sediments, China: a diluting setting. Journal of Estuarine and coastal shelfscience. 2004; 60:91-100
20. Turekian KK & Wedepohl DH. Distribution of the element in some major units of the earth's crust social. Bulletin of Geological Ammenities. 1961; 72: 175-192.
21. Hakanson L. An ecological risk index for aquatic pollution control, a sedimentological approach. Water resources. 1980; 14: 975-1001.