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AIMS AND SCOPE

The Nigerian Journal of Health and Biomedical Sciences is a multidisciplinary and peer-reviewed journal. This journal was established to meet the challenges of health care delivery in the 21st century in Nigeria and other countries with similar setting in the ever-changing world of science and technology. The health care delivery apart from primary, secondary and tertiary health care systems has a lot of subjects/disciplines. There is a beauty in the diversity of these disciplines in Medicine but the primary goal of maintaining good health of an individual in a stable society, should not be lost to researchers. It is inconceivable that a man with typhoid intestinal perforation after surgical intervention in a tertiary health institution should be allowed to go back to the same old insanitary environment with polluted drinking water. Health education now becomes very relevant for the individual and the society where many sociological problems exist. The application of molecular biology and information technology is taking a center-stage in this century.

The scope of this new journal therefore covers Basic Medical Sciences, Clinical Sciences, Dental Sciences, Pharmaceutical sciences, Telehealth, Telemedicine, Clinical/Biomedical Engineering, Biotechnology in relation to Medicine, Medico-legal aspects of health-care delivery, Social Sciences, Sport Physiology and Medicine, Environment and Health, Primary Health Care and Hygiene. The legal aspects, in particular ethics and health management in the practice of medicine will be given prominent attention in the Nigerian Journal of Health and Biomedical Sciences.

Apart from quality of contents of the journal, the Editorial Board will pay particular attention to rapid publication of the accepted articles of the journal. This is to ensure that speed of dissemination of scientific information amongst researchers march the speed of present globalization where Internet connectivity now has application in practice of Medicine.

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Correlation Studies of Heavy Metals Concentration with Sediment Properties of Some Rivers surrounding the Lagos Lagoon.

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ABSTRACT
Lagos lagoon is a highly polluted water body, which receives enormous amount of domestic and industrial wastes from rivers and streams. In this study, two main Lagos urban rivers Odo-Iyaalaro and Shasha rivers that receive industrial effluents and empty into the Lagos Lagoon were examined. The sediments at the bottom of waters play a role in the study of pollution in the rivers. Upstream of Odo-Iyaalaro River (Point 1) receives the largest volume of effluents and showed the highest level of heavy metals in sediments with concentrations of 108.3mg/l for Pb, 805mg/l for Zn, 94.5mg/l for Cu, 31mg/l for Cr and 42.1 mg/l for Cd. Down the river, the levels decreased to 25mg/l for Pb, 64.5 mg/l for Zn, 22mg/l for Cu, 15.9 mg/l for Cr and 1.9 mg/l for Cd. A good correlation was found to exist between the level of Zn in water and sediment, and also between the CEC and %silt-clay of sediments. Shasha River receives relatively fewer amounts of industrial effluents, but is relatively the main receptacle for municipal and land-based waste. The levels of heavy metals in Shasha River were lower compared with that of Odo-Iyaalaro River, with the upstream points showing concentrations of 20.5mg/l for Pb, 25.3mg/l for Zn, 7.9mg/l for Cu, 30.8 mg/l for Cr and 1.5mg/l for Cd. A good correlation exists between the CEC and all the metals determined, and between the %organic carbon and all the metals determined. Compared with literature data, the results of heavy metals gave an indication of pollution.

KEY WORDS: correlation, heavy metals, sediments, caution exchange capacity, rivers, lagoon.

INTRODUCTION

Bottom sediments are subject to anthropogenic influences like discharge of effluents and the chemistry is governed by several natural factors. Effluents, which are discharged into the rivers, have increased substantially over the years due to industrialisation. These discharges transport important loads of pollutant to the marine environments, including toxic heavy metals. The majority of the compounds released into the water have affinity for particulate matter, therefore the chemical composition of bottom sediments reflect the input of discharged substances to the marine environment. Accumulation of contaminants in the sediments can be linked to local point sources, while sediments in more remote areas reflect the overall level of contamination (1).

Metals of detectable concentrations are found in the environment; the presence of metals in sediments is unavoidable. At low concentrations metals play an essential role in many biochemical processes however they can be deleterious to living organisms at higher concentrations. Metal inputs are subject to a variety of processes that determine their fate. Comparison of metal concentrations in sediments or even water, must take into account the processes likely to affect them e.g pH, clay content, organic matter content of sediments (2). Cation exchange capacity is also an important adsorption parameter for metals (3). It roughly correlates with attenuation of some heavy metals and certain other hazardous pollutants since many of the same soil characteristics that influence metal attenuation also influence the magnitude of CEC.

Lagos has been a fast developing and industrialising city with almost a dozen industrial estates and scores of residential-commercial surburbs (4). It is the largest industrial centre in Nigeria with over 70% of industries in Nigeria. There are also many flood plains and a network of marshes, swamps, streams, creeks and rivers, many of which are receptors for domestic, municipal and industrial effluents. These receptors eventually empty into the Lagos Lagoon.

The Lagos Lagoon is a wide expanse of estuarine water extending from the Lagos harbour to the Niger Delta in southwest Nigeria, and is in fact the largest lagoon in the Gulf of Guinea (5). It is located between longitude 3^0 23' and 3^0 40'E and between latitude 6^0 22' and 6^0 48'N. It is a highly urbanized brackish ecosystem impacted mainly by municipal and industrial activities that have significantly increased in the past decades.

Our objective in this paper was to investigate the pollution status of the rivers emptying into the Lagos lagoon by determining the extent of pollution of the sediment by heavy metals and correlating the levels of pollutants with some sediment properties.

MATERIALS AND METHODS

Sampling Sites

Six samples each were collected from Odo-Iyaalaro and Shasha rivers. The sampling points are as indicated on the maps. (fig1 and 2)

Sample Collection and Treatment

Sediment samples were collected from the river bottom using a Van Veen grab sampler. The sediments were immediately transferred into polypropylene bags and transported to the laboratory, where they were air-dried at room temperature, homogenised in a mortar and pestle to pass through a 2 mm sieve.

Chemical Analysis

For total metal analysis samples of finely ground sediment was digested with aqua-regia and analysed using an Atomic Absorption Spectrophotometer, Buck Scientific model 200A. All analysis were carried out in triplicates, and for elements investigated, Pb, Zn, Cu, Cr and Cd, the data were within a coefficient of variation of 5%.

The pH of the sediment was determined using a Jenway 3010 pH meter. The % organic carbon was determined using the Walkley-Blacky method(6). The cation exchange capacity was also determined by saturating the exchange with a buffered solution of the desired cation, and titration with EDTA (7).

RESULTS AND DISCUSSION

The results are summarised in Tables 1 – 4.

Point I of Odo- Iyaalaro river had the highest level of heavy metal in sediments. This is probably due to the fact that the sample was taken under Maryland Ojota bridge, where there is a heavy flow of traffic and lead and other metals are deposited in the environment.

Moving from Point 1 to Point 5, along the course of the river, the level of heavy metals decreased with decreasing distance from the Lagos Lagoon. This could be because accumulation of heavy metals by sediment is linked to local point sources i.e effluents from the different industries will reflect the initial higher levels, whereas the sediments far away from the source will only reflect the overall level of contamination. However the level of heavy metal in sediment at Point 6 is higher than that of Point 5. This could be because there are other tributaries emptying into the Lagos Lagoon. This tributaries flow through point 6 and the water probably contained high levels of heavy metals, more so the organic carbon content is high (4.05%).

For Odo-Iyaalaro, all the sites 1-6 had heavy metal values above the background. All the sites were either close to industries or sewage discharge. The level of heavy metal at site 1 is highest. Site 1 was at Maryland Ojota bridge and this site is close to where several companies in Ikeja, Oregun and environ empty their effluents to the Lagoon via the river. The levels in site 2 is lower than 1 but still higher than background level. The site was also under the Ojota bridge but close to where sewage was discharged . Sewage could contain heavy metals and could lead to the high levels in the sediments. Site 3 was the Ogudu canal creek, some industries can be found in Ogudu and this can account for the high levels of heavy metals at this site.

Generally there is evidence of high levels of contamination for cadmium and lead in the sediment samples. These values are all high, compared to levels of heavy metals in unpolluted sediments as given by Moore and Ramamoorthy (1984). The general trend of heavy metal in the river was Zn Pb Cu Cr Cd

The levels of heavy metals in Shasha River was found to be generally lower than that of Odo-Iyaalaro especially for Pb and Cd, but are still indicative of heavy metal contamination. Levels of heavy metals at Site 2 (Osolo way) were found to be lower than that of Site 1 (Dopemu/Akowonjo way). This could be because there are not many industries discharging effluents into the river at Site 1,and the river could have undergone self-purification by site 2. At Site 6 (along Marina), the levels of heavy metals was higher than 1, this could be because Marina is an area of vehicular activity resulting in deposition of heavy metals as evidenced by the levels in the sediments. The high heavy metal concentrations in the sediments are related to pollution of rivers by municipal and industrial waste discharges. The general trend of heavy metals in the sediment sample was Zn Cr Pb Cu Cd

A correlation analysis of all the parameters in tables 1 and 2 were calculated. All the values above

Table 1: Concentration of metals (ug/g), pH, Organic carbon (%) silt-clay fraction (%) moisture content (%) and carbon exchange capacity (of sediment) of Odo Iyaalaro River.

Sampling point	% Moisture content	Silt-clay	OC	CEC	pH	Pb	Zn	Cu	Cr	Cd
1	2.66	6.8	6.62	4.0	5.57	108.3	805	94.5	31	2.1
2	0.28	4.8	1.36	2.0	6.36	41.3	100	15.6	24.8	2.1
3	3.45	36.8	4.27	5.8	6.37	43.5	109.5	32.9	31.5	3.6
4	4.61	42.8	11.3	10.4	5.14	36	84.5	25.2	30.8	1.9
5	1.74	36.8	2.57	7.4	6.53	25	64.5	15.9	22	8.0
6	4.05	16.8	7.18	7.5	6.60	54.8	266	62.2	29	1.5

Table 2: Concentration of metals (ug/g), pH, Organic carbon (%) silt-clay fraction (%) moisture content (%) and carbon exchange capacity (of sediment) of Shasa River.

Sampling point	% Moisture content	Silt-clay	OC	CEC	pH	Pb	Zn	Cu	Cr	Cd
1	0.27	16.8	0.23	2.0	6.57	20.5	25.3	7.9	30.8	1.5
2	0.18	4.8	0.15	2.0	6.05	ND	60	18.8	18.5	1.7
3	5.05	24.8	4.16	10.63	6.16	48.3	149	32.9	42.8	2.98
4	0.6	4.8	1.4	3.13	6.17	11.3	106.5	42	14.8	1.08
5	2.98	24.8	3.59	4.8	6.92	32.3	57	17.5	33.5	2.1
6	3.21	12.8	3.52	5.35	6.28	40	106.5	21	35.3	2.9

ND – Not Detectable

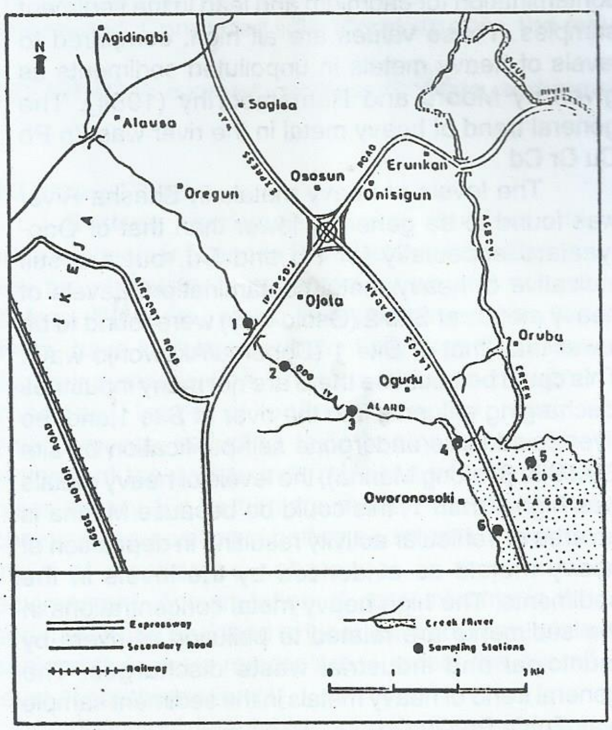

Fig 1: **Map of of Odo-Iyaalaro river, showing the sampling points.**

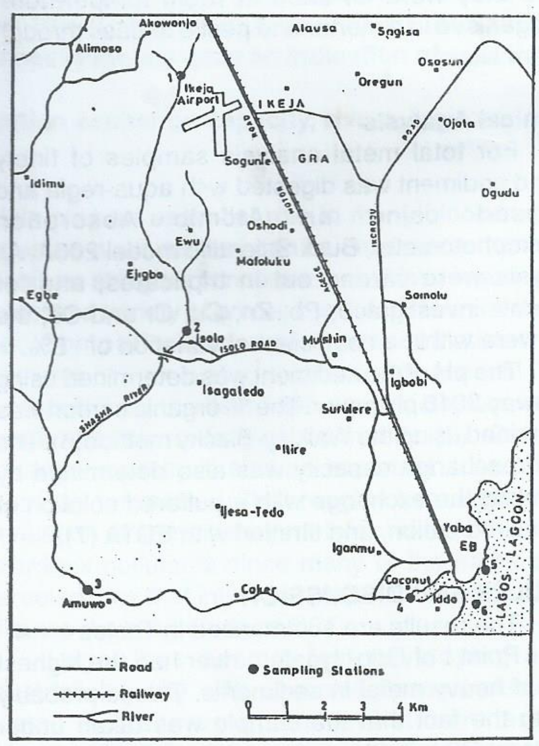

Fig 2: **Map of Shasha river, showing the sampling points.**

***Table 3*: Correlation of pH, cation exchange capacity (of sediment), Organic carbon (%) silt-clay (%) and metal concentration of sediments in Odo Iyaalaro River.**

	pH	CEC	OC	Silt-clay	Pb	Zn	Cu	Cr	Cd
pH	1.00								
CEC	-0.33	1.00							
OC	-0.74	0.73	1.00						
Silt-clay	0.20	0.82	0.27	1.00					
Pb	-0.35	-0.39	0.21	-0.61	1.00				
Zn	-0.33	-0.42	0.20	-0.56	0.99	1.00			
Cu	-0.24	-0.16	0.34	-0.35	0.94	0.94	1.00		
Cr	-0.54	0.24	0.68	-0.04	0.51	0.42	0.90	1.00	
Cd	-0.41	-0.36	0.19	-0.56	0.97	0.99	0.90	0.41	1.00

***Table 4*: Correlation of pH, carbon exchange capacity (of sediment), Organic carbon (%) silt-clay (%) and metal concentration of sediments in Shasa River.**

	pH	CEC	OC	Silt-clay	Pb	Zn	Cu	Cr	Cd
PH	1.00								
CEC	-0.11	1.00							
OC	0.22	0.84	1.00						
Silt-clay	0.62	0.66	0.68	1.00					
Pb	0.26	0.84	0.90	0.80	1.00				
Zn	-0.53	0.81	0.66	0.12	0.54	1.00			
Cu	-0.19	0.82	0.67	0.54	0.65	0.38	1.00		
Cr	0.32	0.76	0.74	0.88	0.93	0.31	0.73	1.00	
Cd	-0.1	0.80	0.80	0.58	0.84	0.56	0.90	0.85	1.00

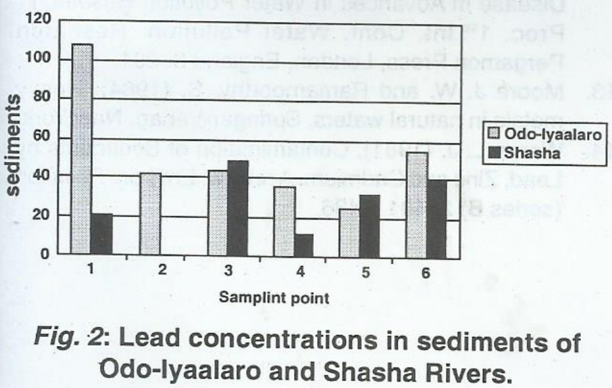

***Fig. 2*: Lead concentrations in sediments of Odo-Iyaalaro and Shasha Rivers.**

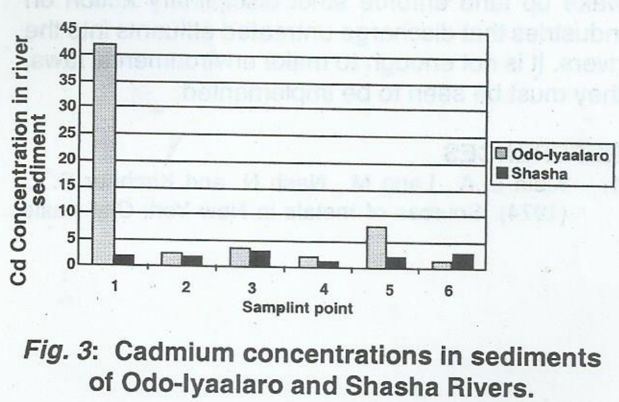

***Fig. 3*: Cadmium concentrations in sediments of Odo-Iyaalaro and Shasha Rivers.**

0.6 were significant on the two-paired t-test.

For Odo-Iyaalaro river, apart from Cr, none of the heavy metals showed a significant correlation with total organic carbon; no significant correlation was observed between the metals and either pH, CEC or silt- clay. This means that the concentration of Cr increased with increase in the amount of carbon in the sediments but neither pH, CEC, nor silt-clay had any significant influence on the levels of the heavy metals. Angelidis and Aloupi(8), studied metals in sediments of Rhodes Harbour, and reported a good correlation among the metals studied. Our study revealed a good correlation among the heavy metals Zn, Cu, and Cd with Pb,and this supports the common source of the metals.

For Shasha River, there was a good

correlation between the cation exchange capacity and all the parameters determined as shown in Table IV. There was also a good correlation between the percentage organic carbon of the sediment and all the metals determined, which agrees with the fact that sediments with high proportion of organic carbon are likely to contain above average concentrations of zinc, cadmium and probably lead (9). The good correlation between the percentage silt-clay fraction of sediment and heavy metals also proves that metals are associated with the carbon since the organic rich sediments are usually also finer in size (9).

The higher levels of heavy metals in the city area sediments than in the downstream sediments probably indicate the vehicular emissions and the municipal wastes as the dominant source of the heavy metals.

Heavy metals along the bank of the Odo Iyaalaro and Shasha rivers were above the common concentration range (for non-contaminated soil). The values for toxic metals were close to the maximum tolerable concentrations especially for the sites that were in the main city area (Ojota- Maryland Bridge and Marina). It is therefore important that effective measures from the legislative, and the environmental agencies be developed and enforced. These would be necessary to reduce the pollution and prevent the adverse effect resulting from exposure to toxic metals.

CONCLUSION AND RECOMMENDATION

The study sites show a high level of heavy metals in the sediments both inOdo-Iyaalaro and Shasha rivers. Federal Ministry of Environment and Lagos State Environmental Protection Agency must wake up fand enforce strict disciplinary action on industries that discharge untreated effluents into the rivers. It is not enough to make environmental laws, they must be seen to be implemented.

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