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Comparative assessment of potential toxic metals concentrations in water, sediment and fish *(Clarias gariepinus)* in Epe Lagoon, earthen and concrete ponds in Epe Area of Lagos State

Olowu Rasaq A.[1*], Osundiya Medinat O.[1], Jimoh Abayomi A.[2], Adeosun Festus I.[3], Quadri Elizabeth O.[1], Alegbe M.J.[1]

[1]Department of Chemistry, Lagos State University, Ojo
[2]Department of Fisheries, Lagos State University, Ojo
[3]Department of Aquaculture & Fisheries, Federal University of Agriculture, Abeokuta
*Corresponding author. **Email**: raadeolowu@gmail.com

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The level of some heavy metals , zinc (Zn), cadmium (Cd), copper (Cu), manganese (Mn) and iron (Fe)) in *Clariasgariepinus*from Epe lagoon, earthen and concrete ponds within Epe were investigated using Atomic Absorption Spectrophotometer (AAS) and the analysis of all the samples were done in triplicates. The results revealed the accumulation of metals differently in various parts of the fish namely the head, gills, trunk and tail. Cadmium (Cd) was detected in all the samples but below the permissible level which may be due to few industrial and domestic activities around the Epe axis and locations sampled. The order of accumulation of metals in *C. gariepinus* from both the lagoon and the ponds were Head>Tail>Gill>Trunk and the pattern of PTM distribution was Zn>Fe>Cd>Mn>Cu in all the organs. The concentration of cadmium in the fish sample obtained for lagoon was higher compared to a lower value of 0.166 and 0.114mg/L obtained for earthen and concrete ponds which may be attributed to discharge from anthropogenic activities, domestic and industrial wastes respectively. The mean values of PTM obtained in the fish parts were in the range: Fe (0.333±0.004 – 0.515±0.003mg/L); Zn (0.366±0.003 – 0.553±0.002mg/L); Cd (0.172±0.002 – 0.199±0.0mg/L); Mn (0.038±0.001 – 0.056±0.002mg/L), Fe (0.326±0.002 – 0.542±0.003mg/L); Zn (0.181± 0.001–0.692 ± 0.003 mg/L); Cd (0.166±0.003–0.194±0.001 mg/L); Mn (0.011±0.01–0.050±0.003 mg/L) and: Fe (0.084±0.001–0.235±0.001 mg/L); Zn (0.306 ±0.003– 0.787±0.006 mg/L); Cd (0.114±0.001–0.207±0.001 mg/L); Mn (0.115±0.002–0.122±0.001 mg/L for Epe lagoon, earthen and concrete ponds respectively. The highest concentrations of iron (Fe) and zinc (Zn) was obtained in the fish parts from the earthen and concrete pond compared to that from the lagoon which may be attributed to the fact that these metals are naturally rich in Nigerian soils. It is noteworthy that concentrations of the metals in all the samples analyzed are lower than the permissible limits set by WHO and FEPA which implies that the fish are safe for human consumption.

Keyword: Bioaccumulation, potential toxic metal, human consumption, fish part, deposition, aquatic organisms, ponds

INTRODUCTION

Water is one of the products on earth that is crucial to life on our planet. In order for reasonable improvement to occur, unpolluted water sources are fundamental [1-2]. Streams assume an important job in the improvement of human populaces as they give water to a variety of human exercises. In the course of the most recent couple of decades, the scope of poisons that taint crisp water assets expanded altogether [1-2]. Surface water contamination is turning into a noteworthy worry all through the world as increment in populace estimate, urbanization, industrialization just as horticultural practices further bother the circumstance [2-3]. In spite of the fact that Namibia is definitely not a vigorously industrialized nation, farming and mining are significant supporters of the Namibian economy. Horticulture contributes 5.1% and mining 10% to the Gross Domestic Product (GDP). These two businesses can likewise contribute essentially to the contamination of crisp water sources and mining can influence new water sources in different ways [4]. These incorporate the utilization of water in the preparing of mineral, release of mine profluent just as leakage of tailings. Endless supply of mines water contamination from mine waste rocks tailings still should be overseen. There are four fundamental sorts of mining impacts on water quality [4] :(i) Acid Mine Drainage (AMD), (ii) heavy metal defilement and filtering, (iii) contamination by preparing synthetic chemicals and (iv) disintegration and sedimentation. Acid Mine Drainage (AMD is where sulphuric corrosive is created when sulfides in rocks are presented to air and water. This corrosive is drained from the rocks as long as it is presented to water and air with the assistance of a bacterium *Thiobacillusferrroxidans* [5]. The corrosive can be conveyed from the mine site by water or surface seepage and can be stored in adjacent amphibian frameworks. The draining of heavy metals can be quickened in low pH conditions, which are ordinarily made by AMD. Synthetic chemicals utilized in the handling of metals when the objective mineral is isolated from the metal can likewise contaminate water bodies. In Namibia, mines can establish a noteworthy contamination risk in karst and other auxiliary aquifers if mines are not appropriately overseen and controlled. Karst aquifers are framed when groundwater disintegrates limestone to shape cavities where water can be put away. Living life forms require trace measures of certain heavy metals, for example, iron, cobalt, copper, magnesium and zinc among others and the event that these metals are taken up too much it might be impeding to sea-going living beings [6-7]. Other heavy metals, for example, cadmium, lead and mercury don't have any advantageous consequences for living creatures. Accordingly, the gathering of these metals to high poisonous dimensions could cause serious environmental effect on living beings with no noticeable signs [2,8]. Amassing of heavy metals in oceanic life forms could prompt a decline in fruitfulness of fish populaces or it could have effect on multiplication [8]. Heavy metals may likewise modify the physiological exercises and biochemical parameters in tissues and blood of oceanic living beings [1]. Since the control of multiplication in fishes is mind boggling and influenced by a wide scope of natural factors just as hormones, even low dimensions of contamination could influence rise [1, 8]. Henceforth, at low dimensions, despite the fact that fish probably won't demonstrate any evil impacts, it can prompt long haul decrease in fish supply. Presentation to these heavy metals could at last lead to wellbeing dangers related with the utilization of fish by people [3]. A segment of these well-being dangers, for instance, renal disappointment and liver harm can be caused by contamination to lead (Pb). Exposure to Pb can prompt mental hindrance, extreme lethargies and possible passing [8-11]. Studies have demonstrated that cadmium (Cd) can cause perpetual lethality, for example, disabled kidney working, hypertension and hepatic brokenness though copper and zinc may cause kidney issues, for example, nephritis and anuria [9-11]. Fishes have been in existence just as long as human and with different species, it has provided for the needs of the Nation as a whole [6]. As the need for the consumption of fish increases globally, different means have been put in place to ensure its availability such as Aquaculture [6]. This is done using different method asides the natural habitat (Lagoon) which includes; pond system tanks and pens. Coastal areas have been of immense significance to human but are greatly affected by human actions and other anthropogenic activities {2, 11-15). The pollution of this aqua habitat by the above mentioned sources have adverse effect on the organisms present in them and thereby posing significant environmental risks [7,17]. Research on heavy metals has become so pertinent due to the observed accumulation and the toxic effect of these metals on the organisms and to humans through the food chain [14-17]. For this reason, study and control of these metals are needed. Fishes are very important because they loaded with so many nutrients such as protein and vitamin D(steroid hormone), they provide Iodine in our nutrient, they serve as the best source of Omega-3fatty acids which are good for the brain, they lower the risk of heart attacks and strokes which serve as the most common source of premature death as well as beneficial to the heart. [18].

MATERIALS AND METHODS

Study and Sampling Area

The samplings were conducted in Epe Lagoon and concrete/earthen ponds in Epe. Epe is located in Lagos State, an African megacity which is located in south-western Nigeria on the West Coast of Africa, within latitudes

6^{o} 23'N and 6^{o} 41'N and longitudes 2^{o} 42'E and 3^{o} 42'E. The samples selected for analysis was catfish (*Clariasgariepinus*), water and sediment from the sampling areas.

Sampling Methods and Preparation

(a) Catfish Sampling and Preparation

Samples of *C. gariepinus*from the lagoon were collected with the assistance of fishermen using net while the samples from the earthen and concrete ponds were collected with aid of a net from the pond. Identification of the fish was done in the Department of Fisheries, Lagos State University. Fish collected from the lagoon and ponds were placed in separate buckets with water to keep them alive till the next day. Water samples were collected with plastic bottles; in order to prevent contribution of heavy metals to the sample in it, the bottles were washed and rinsed with dilute nitric acid and then distilled water. After collection, the water was spiked with nitric acid to keep its properties as it were before analysis was done. The samples collected were transported on ice to the laboratory. Each fish was properly cleaned by rinsing with distilled water to remove debris, planktons and other external adherents. It was then drained under folds of filter, weighed, wrapped in aluminum foil and then frozen at –10 °C prior to analysis [2]. The collected sample was stored in a refrigerator to prevent the precipitation of metals and avoid microbial activities until analysis was carried out [8]. For analysis, catfish sample was separated into head, trunk, gills and tail using plastic knife [2,11]. Nitric-peroxide acid digestion was carried out using 5ml of 65% nitric acid and 5 ml of 30%) hydrogen peroxide added to 1g each of sample in a 100ml conical flask placed on a hot plate for about forty-five minutes until the solid dissolved and the volume of contents was reduced to about 5 ml. The content of the flask were then filtered through a 0.45 µMillipore membrane filter paper, transferred quantitatively to a 50 ml volumetric flask by adding distilled water to make up to mark and analyzed for heavy metals (copper, zinc, cadmium, manganese and iron) using Atomic Absorption Spectrophotometer (AAS) model Buck Scientific 210 GVP.

(b) Sediment Samples

Bottom sediment from the study site was collected into pre-cleaned polythene bag using a stainless Van-ven grab, air dried and then sieved with 200 mm mesh screen. 1g of the sediment was taken into 100 ml conical flasks, 5 ml of 0.1 M nitric acid was added and the flask was agitated on an orbital shaker for 30 min at 200 rev/min. The content was filtered into 50 ml standard flask and made up to mark with distilled water for the determination of copper, zinc, cadmium, manganese and iron.

(c) Water Samples

Surface water samples were collected using a plastic container. 5 ml of concentrated nitric acid was added to 100 ml of water sample and evaporated to 25 ml. The concentrate was transferred to a 50 ml flask and diluted to mark with distilled water. Metal contents were determined using Atomic Absorption Spectrophotometer to determine the presence of copper, zinc, cadmium, manganese and iron.

Statistical Analysis

Data generated were analyzed statistically by calculating the mean and standard deviation of the measured parameters. The coefficient of variation of the metals was also calculated

RESULTS AND DISCUSSION

The results obtained from catfish samples collected from Epe lagoon, earthen and concrete ponds for the concentration of Manganese (Mn), Copper (Cu), Zinc (Zn), Cadmium (Cd) and Iron (Fe) are presented in Tables 1 and 2.

Table 1: Triplicate Result for Potential Toxic Metals for Catfish Samples from Epe Lagoon and Ponds

HEAVY METALS		HEAVY METAL CONCENTRATION (mg/L)								
		LAGOON			EARTHEN POND			CONCRETE POND		
		1	2	3	1	2	3	1	2	3
Manganese (Mn)	Head	0.052	0.051	0.053	0.047	0.048	0.049	0.189	0.188	0.190
	Gill	0.038	0.037	0.039	0.031	0.031	0.028	0.120	0.125	0.119
	Trunk	0.041	0.044	0.039	0.055	0.051	0.049	0.122	0.120	0.123
	Tail	0.056	0.058	0.054	0.011	0.011	0.011	0.117	0.113	0.115
	Water	0.057	0.057	0.056	0.177	0.178	0.177	0.007	0.007	0.007

Table 1 Cont'd

	Sediment	0.315	0.314	0.312	0.052	0.050	0.052	-	-	-
Copper (Cu)	Head	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Gill	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Trunk	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Tail	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Water	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Sediment	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Zinc (Zn)	Head	0.555	0.551	0.554	0.694	0.692	0.690	0.787	0.788	0.788
	Gill	0.368	0.362	0.368	0.505	0.500	0.502	0.593	0.594	0.590
	Trunk	0.433	0.437	0.430	0.182	0.180	0.181	0.309	0.305	0.304
	Tail	0.406	0.406	0.408	0.603	0.600	0.601	0.680	0.682	0.680
	Water	0.435	0.436	0.435	0.109	0.108	0.109	0.236	0.235	0.232
	Sediment	0.446	0.447	0.445	0.329	0.328	0.328	-	-	-
Iron (Fe)	Head	0.346	0.348	0.342	0.541	0.540	0.545	0.227	0.225	0.224
	Gill	0.487	0.489	0.484	0.419	0.418	0.416	0.194	0.192	0.193
	Trunk	0.514	0.518	0.512	0.364	0.360	0.362	0.236	0.234	0.235
	Tail	0.331	0.337	0.330	0.328	0.324	0.326	0.085	0.083	0.085
	Water	0.133	0.132	0.134	0.135	0.134	0.134	0.036	0.035	0.036
	Sediment	0.683	0.683	0.684	0.759	0.759	0.760	-	-	-
Cadmium (Cd)	Head	0.183	0.180	0.181	0.169	0.164	0.165	0.115	0.113	0.114
	Gill	0.193	0.190	0.195	0.169	0.166	0.168	0.208	0.206	0.207
	Trunk	0.173	0.172	0.170	0.193	0.195	0.194	0.187	0.185	0.182
	Tail	0.199	0.200	0.199	0.182	0.183	0.185	0.202	0.200	0.203
	Water	0.143	0.142	0.141	0.127	0.128	0.129	0.196	0.195	0.194
	Sediment	0.184	0.185	0.186	0.182	0.182	0.182	-	-	-

Table 2: Mean concentrations of potential toxic metals concentration (mg/L) in Catfish samples from Epe lagoon and ponds

Sample Area	Fish Part	Variables	Manganese (Mn)	Zinc (Zn)	Iron (Fe)	Cadmium (Cd)
Lagoon	Head	Mean	0.052	0.553	0.345	0.181
		S.D	0.001	0.002	0.003	0.002
		C.V (%)	1.90	0.36	0.81	1.10
		Range	0.002	0.004	0.006	0.003
	Gill	Mean	0.038	0.366	0.487	0.193
		S.D	0.001	0.002	0.003	0.003
		C.V (%)	2.60	0.36	0.62	1.55
		Range	0.002	0.006	0.005	0.005
	Trunk	Mean	0.041	0.433	0.515	0.172
		S.D	0.003	0.004	0.003	0.002
		C.V (%)	7.30	0.92	0.58	1.16

Table 2 Cont'd

		Range	0.005	0.007	0.006	0.003
	Tail	Mean	0.056	0.407	0.333	0.199
		S.D	0.002	0.001	0.004	0
		C.V(%)	3.60	0.25	1.20	0
		Range	0.004	0.002	0.007	0.001
	Water	Mean	0.057	0.435	0.134	0.142
		S.D(%)	0.6	0	0.001	0.002
		C.V(%)	10.5	0	0.75	1.41
		Range	0.001	0.001	0.002	0.002
	Sediment					
		Mean	0.314	0.446	0.683	0.185
		S.D	0.002	0.001	0	0.001
		C.V(%)	0.64	0.22	0	0.54
		Range	0.003	0.002	0.001	0.002
Earthen Pond	Head	Mean	0.048	0.692	0.542	0.166
		S.D	0.001	0.002	0.003	0.003
		C.V (%)	2.08	0.29	0.55	1.81
		Range	0.002	0.004	0.005	0.005
	Gill	Mean	0.030	0.502	0.418	0.168
		S.D	0.002	0.003	0.002	0.002
		C.V (%)	6.70	0.60	0.48	1.19
		Range	0.003	0.005	0.003	0.003
	Trunk	Mean	0.050	0.181	0.362	0.194
		S.D	0.003	0.001	0.002	0.0011
		C.V (%)	6.0	0.55	0.55	0.52
		Range	0.006	0.002	0.004	0.002
	Tail	Mean	0.011	0.601	0.134	0.183
		S.D	0.007	0.001	0.001	0.002
		C.V (%)	18.2	0.16	0.75	1.09
		Range	0.00	0.002	0.004	0.002
	Water	Mean	0.177	0.109	0.134	0.128
		S.D	0.001	0.001	0.001	0.001

Table 2 Cont'd

		C.V (%)	0	0	0	0.78
		Range	0.001	0.001	0.001	0.002
	Sediment	Mean	0.051	0.328	0.759	0.182
		S.D	0.001	0	0	3.40
		C.V (%)	1.96	0	0	18.68
		Range	0.002	0.001	0.001	0.002
Concrete Pond	Head	Mean	0.189	0.787	0.225	0.114
		S.D	0.001	0.001	0.002	0.001
		C.V (%)	0.53	0.13	0.89	0.88
		Range	0.002	0.001	0.003	0.002
	Gill	Mean	0.121	0.592	0.193	0.207
		S.D	0.003	0.001	0.001	0.001
		C.V (%)	2.48	0.17	0.52	0.48
		Range	0.006	0.004	0.002	0.002
	Trunk	Mean	0.122	0.306	0.235	0.185
		S.D	0.002	0.003	0.001	0.003
		C.V (%)	1.64	0.98	0.43	1.62
		Range	0.003	0.005	0.002	0.005
	Tail	Mean	0.115	0.681	0.084	0.202
		S.D	0.002	0.001	0.001	0.002
		C.V (%)	1.74	0.15	1.19	0.99
		Range	0.004	0.002	0.002	0.003
	Water	Mean	0.007	0.234	0.036	0.195
		S.D	0	0.002	0	0.001
		C.V (%)	0	0.85	0	0.51
		Range	0	0.004	0.001	0.002
	Sediment	Mean	-	-	-	-
		S.D	-	-	-	-
		C.V (%)	-	-	-	-
		Range	-	-	-	-

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RESULTS

The mean concentrations of metal in the various fish part collected from Epe lagoon, earthen and concrete ponds from Epe Lagos Nigeria are shown in Table 1.

Results of the analysis of the metals in the catfish parts analyzed revealed that the metals were differentially accumulated in the head, gill, trunk and tail which in agreement with earlier report [2, 11-12]. In the catfish organs from Epe lagoon, the orders of manganese accumulation were tail (0.056± 0.002), head (0.052 ±0.001), trunk (0.041± 0.003) and gill (0.038± 0.001). Zinc concentration is in the order of head (0.553 ±0.002); trunk (0.433 ±0.004) tail (0.407± 0.001) and gill (0.366± 0.002). The concentration of iron is in the following order trunk (0.515 ±0.003); gills (0.487±0.003), head (0.345±0.003) and tail (0.333± 0.004). For cadmium, the order is tail (0.199± 0.000): gill (0.193±0.003); head (0.181±0.002); and trunk (0.172± 0.002). The accumulation of the metal in the fish parts obtained from earthen ponds were in the order of trunk (0.050± 0.003), head (0.048 ±0.001); gill (0.038± 0.001): trunk (0.030± 0.002) and tail (0.011± 0.007) for manganese and Zinc concentration is in the order of head (0.692 ±0.002); tail (0.601 ±0.001) gill (0.502± 0.003) and trunk (0.181± 0.002);. In iron the order is head (0.542 ±0.003); gills (0.418±0.002); trunk (0.362±0.002) and tail (0.134± 0.001). For cadmium, the order is trunk (0.194± 0.001): tail (0.183±0.002); gill (0.168±0.002); and head (0.166± 0.003) In concrete pond from Epe, the order of manganese concentration in the fish organ from the concrete pond is as follows: head (0.189 ±0.001); trunk (0.122± 0.002): gill (0.121± 0.003) and tail (0.115± 0.002). Zinc is in the order of head (0.787 ±0.001); gill (0.592± 0.001): tail (0.681± 0.001) and trunk (0.306± 0.003). Iron concentration are in this order trunk (0.235± 0.001): head (0.225±0.001); gill (0.193±0.001); and head (0.084± 0.001) while the order of accumulation of cadmium is gills (0.207±0.001); tail (0.202 ±0.002) trunk (0.185± 0.003).and head (0.114± 0.001) respectively.

The concentration of manganese was found to be higher in the sediment with a concentration value of (0.314 mg/L ± 0.002) and this is followed by earthen pond water sample ((0.177 mg/L ± 0.001) while the least value of 0.011 mg/L was recorded for earthen pond fish sample. Manganese had an overall mean value of 0.043 mg/L, 0.035 mg/L and 0.137 mg/L in the fish part of lagoon, earthen and concrete ponds respectively. Zinc exhibited a higher concentration value of 0.789 mg/L in the concrete head fish sample and the least value of 0.109mg/L was obtained in the earthen pond water sample. The overall mean concentration of zinc in fish part of concrete pond was found to be higher (0.592 mg/L) compared to 0.494 and 0.435 mg/L obtained for the lagoon and earthen pond fish parts respectively. The concentration of iron was higher in the lagoon fish part compared with the ponds samples but was highest in the earthen pond sediment with a concentration value of 0.579 mg/L followed by the lagoon sediment (0.183 mg/L) which agreed with earlier reports (2,11). Cadmium was found to exhibited highest concentration in the lagoon tail and the least value 0.114 mg/L was recorded in concrete pond fish head sample.

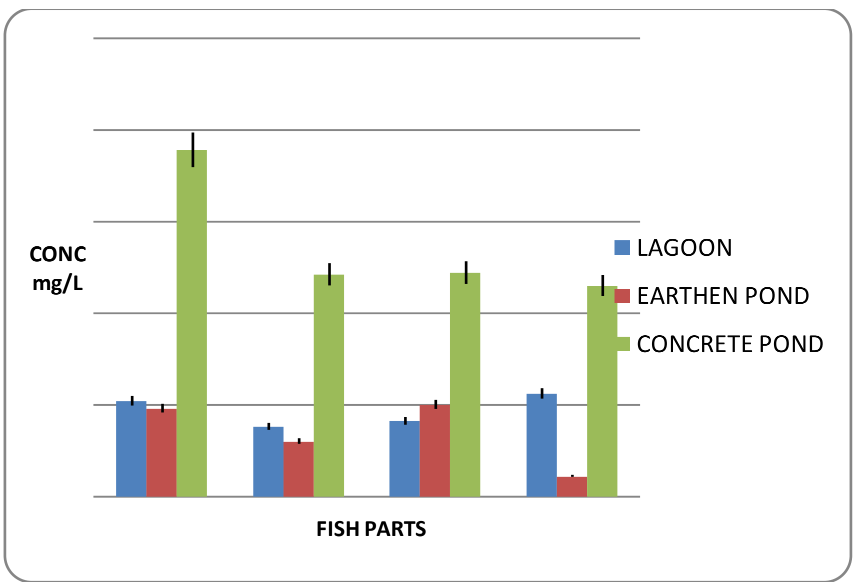

Figure 1: Concentration of Manganese (Mn) in Fish Parts from Epe Lagoon and Fish Ponds in Epe

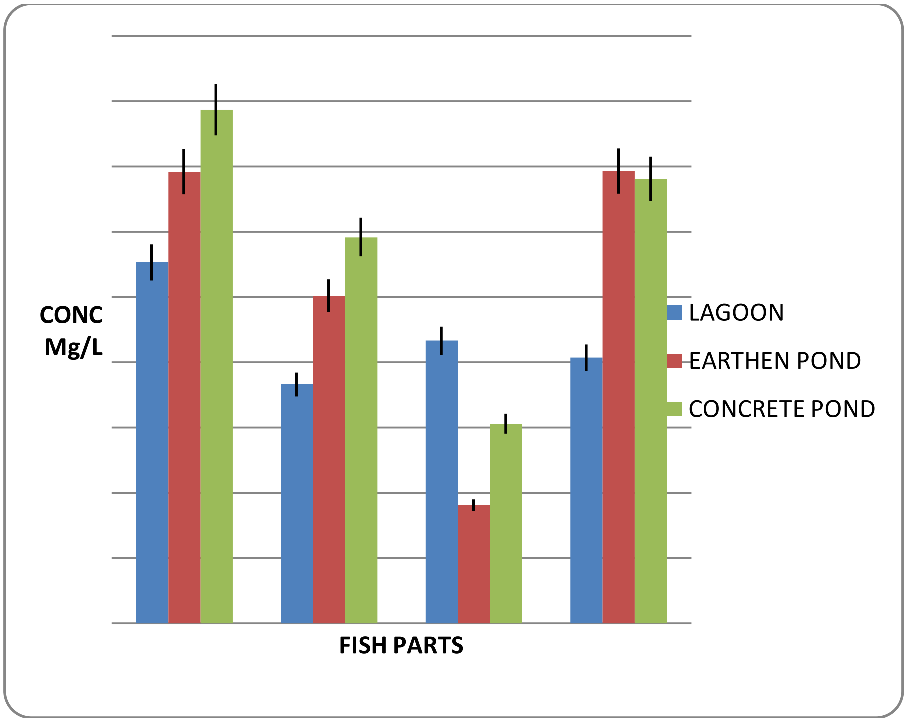

Figure 2: Concentration of Zinc (Zn) in Fish Parts from Epe Lagoon and Fish Ponds in Epe

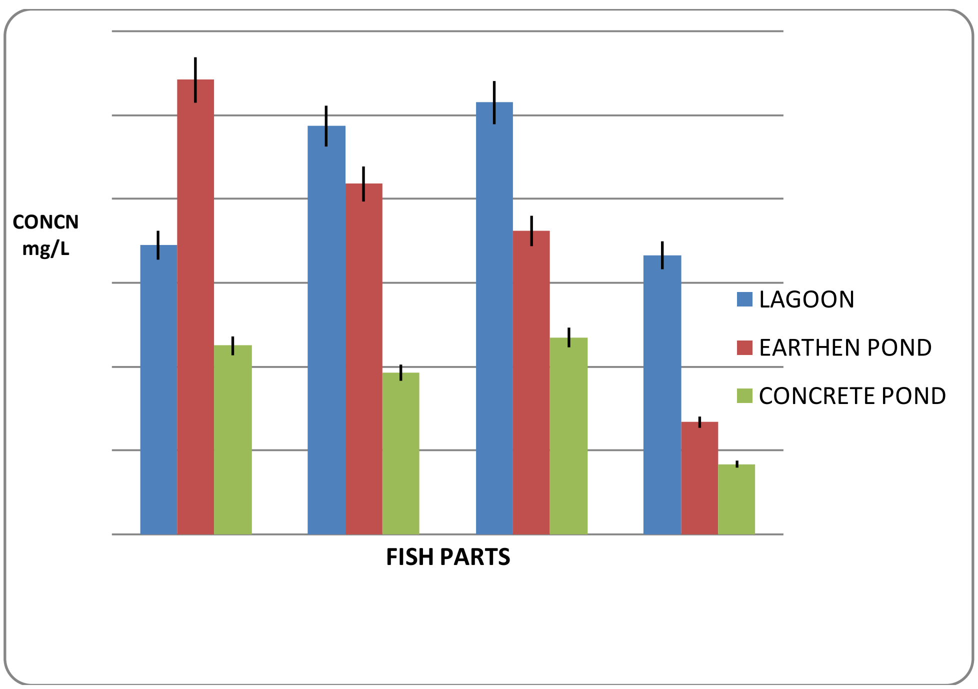

Figure 3: Concentration of Iron (Fe) in Fish Parts from Epe Lagoon and Fish Ponds in Epe

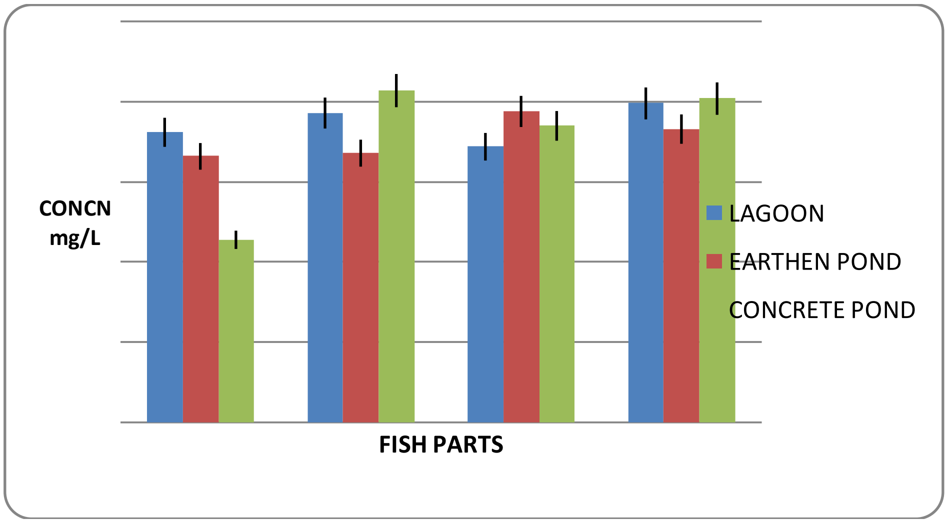

Figure 4: Concentration of Cadmium (Cd) in Fish Parts from Epe Lagoon and Fish Ponds in Epe

DISCUSSION

Heavy metals are ubiquitous and exist naturally in the earth crust and they are persistent in nature with high half-life. When these metals exist at a substantial level, they form a part of the human diet and provide a variety of purpose in metabolic activities [19]. Conversely, when these metals are present above tolerable levels in the body system, they become pathogenic and might therefore result in serious health consequences [20-22]. This work examined the concentration of selected heavy metals Manganese (Mn), Zinc (Zn), Iron (Fe) , Cadmium (Cd) and Copper (Cu) in the head, gill, trunk and tail of *Clariasgariepinus* from the Epe lagoon, earthen and concrete fish ponds from Epe, Lagos, southwest Nigeria. The results of this study revealed that Mn, Zn, Fe Cd and Cu were all present, in different concentrations, in the fish part samples which is in agreement with findings of Olowu*et al* on Epe lagoon [2, 12]. Manganese was detected in lagoon, earthen and concrete ponds samples and the level of manganese (Mn) in fish samples was high especially in the fish head from the concrete pond which is closely followed by fish gills and trunk of concrete pond which is in agreement with other findings (23). Mn is ingested directly through the gills or indirectly from food and taken up from sediment via gut. Manganese levels in the head, gills, trunk and tail are below the recommended standards of 0.5 mg/L [24]. The order of manganese accumulation in the fish sample was Head> Gill>Trunk >Tail. The concentration level in the head and gills could also be attributed to the fact that water always passes through mouth and gill when the water is filtered; this is correlated with the findings of Olowu *et al.* [2, 12,]. From this study, Zinc was present in all the analyzed samples but had the highest

concentration (0.789±0.001 mg/L) in the fish head from concrete pond compared to others with Cadmium having the lowest concentration of 0.166 ± 0.003 mg/L in the fish gill of the earthen pond which is in agreement with earlier findingsand a similar trend was observed in crustaceans [2, 12, 25- 26] but was different from Chindah and Braide (17). The higher concentration of Zinc obtained in the fish sample studied could be attributed to human activities and vehicle movement that occur in the studied environment. Human activities such as petrochemicals from the nearby spent engine oil wastes; the use of chemicals, zinc-based fertilizers by farmers, welder and automobile mechanic workshops could also enhance a high concentration of this metal in soils and surrounding waters. The level of heavy metals recorded in water and fish sample in this study were generally low, when compared to the WHO/FEPA [27-28] recommendation. Iron was found in all the samples analyzed with highest concentration observed in the sediment sample of earthen pond compared to lagoon sediment sample and the high value obtained may be attributed to the high abundance of iron in Nigerian soil [29]. Fe is involved in the hemoglobin synthesis in the red blood corpuscles of the blood and it also help with red blood cell production. Fe is an essential element in human diet and plays a significant role in metabolic processes. . In this study, the observed mean value of Fe in the fish parts are below the recommended limits of 0.5mg/L in fish foods [24,30]. Though an essential heavy metal, Fe has the tendency to become toxic to living organisms, even when exposure is low. Cadmium (Cd) was obtained in the entire sample analyzed except in the concrete pond sediment and cadmium like several other substance could be absorbed through the gills and has been well-known to cause damage to fish gills. Cadmium poisoning could lead to anemia, renal damage, bone disorder and cancer of the lungs in human [24]. The concentration levels of cadmium (0.114-0.199 mg/L) obtained in fish samples from the study site were below the WHO/FEPA maximum permissible limit of 0.5mg/kg in fish food [27-28]. The levels were also low in comparison to 0.270mg/100g recorded for fishes of the River Niger which make the fish from the lagoon and ponds safe for human consumption.

The concentration of Copper (Cu) in all the samples analyzed were below 0.001 mg/L and copper is one of the metals, which are important to human health as well necessary for the synthesis of hemoglobin [31]. Its presence in the lagoon and ponds may be attributed to accumulation of domestic and agricultural wastes.

CONCLUSION

The results of this finding present a valuable baseline data on the heavy metals in the water, sediments and fish from Epe lagoon, earthen and concrete ponds in Epe area of Lagos, Nigeria. The study revealed that the concentrations of heavy metals recorded in the fish, water and sediment samples were below the WHO & FEPA recommended limits which are an indication that the fish from the studied area is safe for human consumption.

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