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Assessment of the Physcio-Chemical and Toxic Level of Aba River and Its Sediment

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Abstract: Contamination of River and its sediments by human activities is on high increase in Nigeria and around the world. This study assessed the physicochemical, biological and heavy metal concentration of Aba river and its sediments. Four water and its sediment samples were collected at Ogbor hill waterside (experimental sites) and Okpulo-umubo (control) from July 2020 to December 2021 at early morning hours. A total of twelve water and sediment samples were collected with a plastic hand trowel to avoid contamination and then stored in plastic bottle polythene bags. Samples were labelled and preserved by storing them in an ice chest on the field. The sediments were air-dried, ground, sieved, and then stored in the laboratory for analysis. The Physicochemical and heavy metals in the water and sediments samples were analyzed using standard methods at *ANAL CONCEPT Laboratory Limited. The result shows that Iron has the highest concentration in the surface water* 15.34 ± 8.58, followed by Manganese 5.89 ± 3.30, and Zinc 0.045 ± 0.00 while heavy metals concentration of the sediment shows that Iron has the highest concentration 2998.46 + 229 followed by Zinc 51.81 + 3.71, Manganese 13.64 + 1.78, and Copper 5.47 + 0.95. The heavy metal in sediment followed in this order Fe > Zn > Mn > Cu > Pb > Cr > Ni > Cd. The heavy metal in the sediment was higher than the concentration of heavy metals in the river. The overall comparison of the physiochemical characteristics of Aba river with WHO & NSDWQ drinking water quality standard confirm that pH (5.77), Conductivity, Turbidity, TDS, Chloride, Magnesium, Iron, Manganese, and Lead are above the permissible limit while Hardness, Nitrite, Nitrate, Sulphate, DS, Calcium, Sodium, Cadmium, Copper, Chromium, and Zinc are within the permissible limit. The concentration of all the metals in the sediments was higher than the water at $p < 0.05$ significantly level. The concentration of these heavy metals results from human activities along the river banks. We recommend proper education on the negative impact of human activity on the river since Aba river is the only river that serve Aba populace.

Keywords: Urbanization, Toxic, Hardness, Ecosystem, Freshwater

1. Introduction

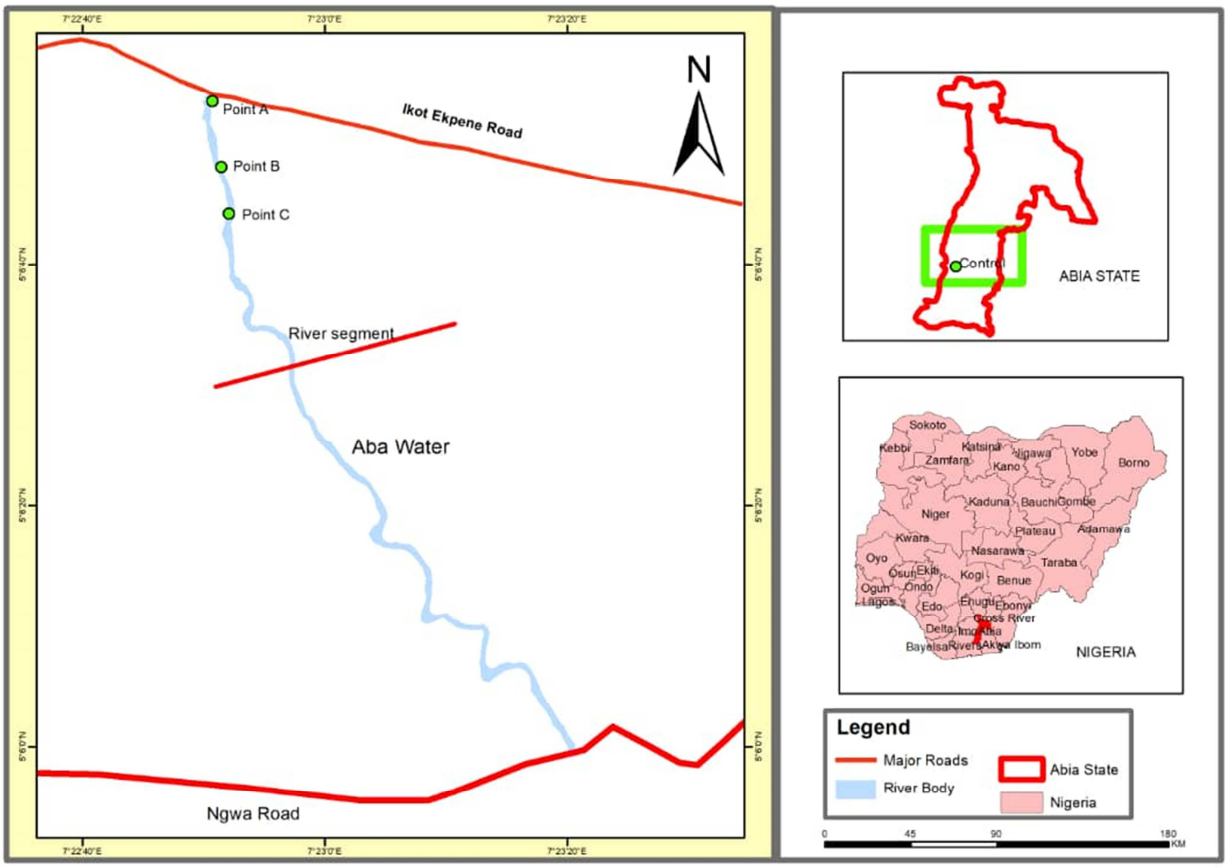
Water is a precious natural resource. It constitutes about 70% of the earth [1]. Of the water occupying 70% of the earth's surface, only 3% is considered freshwater, and 2.6% of this freshwater is inaccessible to humans. They're either locked up in polar ice caps and glaciers, stored in the atmosphere or soil, or are too far underneath the earth's surface to be extracted, which leaves us with about 0.4% of the earth's water which is usable and drinkable for 7 billion people [2]. Although water is an essential resource for humans, human activities such as industrialization, technological advancement, population growth, and urbanization have made it polluted and harmful for humans and other aquatic organisms. The merits of these human activities are innumerable but, its negative impact is a threat to the ecosystem as the effect releases various toxic chemicals, gases, solid wastes as well as microbes of different kinds into the water environment. Water pollution remains one of the global issues affecting all the continents of the world, from North America over the Pacific to Europe and the continent of Asia and as well to the developing continent of Africa. In Nigeria, 52% of the population has no access to potable water despite the purported investments by the Nigerian government in the water supply program [3]. Despite the issue of water scarcity in different places, the threat facing the water is its

pollution, which implies that the availability of water does not guarantee its suitability for various needs. The pollution of the aquatic ecosystem has emerged as an environmental issue concerning heavy metals [4]. Environmental contamination by heavy metals is hazardous to organisms [5]. Heavy metals are known to alter the physiological and behavioural processes of animals [6]. They act as endocrine disruptors and can inhibit with synthesis, metabolism, and transport of hormones or receptors [7]. The concentration of heavy metals in the aquatic environment has increased due to erosion, domestic, municipal, industrial wastes, and agricultural activities in recent years [8]. Some other biophysical factors include pH, water temperature, hardness, oxygen concentration, salinity, alkalinity, and dissolved organic matter play significant roles in metal accumulation and toxicity to aquatic lives [9]. The Aba river at a particular site, both the abattoir and PZ industry discharge their wastewater at locations. These discharges increase the concentrations of heavy metals in that site, which disrupts the ecological balance of the Aba River. There is a need to assess the toxic level of Aba because the river serves the populace for agricultural, recreation, and human consumption purposes. Therefore, this study assessed the biological, physical, hydrocarbon characteristics, and heavy metals in Aba River and sediments.

2. Materials and Method

2.1. Study Area

Aba River is in the Southeast Nigeria. It is situated between latitude 5°05'E to 5°30'N and longitude 7°15'E to 7°40'E. The river runs through the city of Aba. It is a tributary of the Imo River. Its headwaters are at Okpu-Umuobo. The River flows in North-South direction and joins the Imo River and recharged by precipitation and groundwater [10].



Source: GIS Map

Figure 1. *Map of the study area.*

Aba is within the tropical rainforest region of Nigeria with a temperature range of between 20°C-36°C lying within the tropics. It has the dry and rainy season; October – March and April – September respectively. The total rainfall decreases from 2200mm in the South to 1900mm in the North. The hottest months are January to March when the mean temperature is above 30°C. The relative humidity is usually high throughout the year, reaching a maximum during the rainy season when values above ninety percent are recorded.

2.2. Methodology

Twelve water samples and sediments were collected from three locations at Okpulu-Umuobo road (Latitude 5.1431, Longitude 7.3560) (Control), (Latitude 5.11488, Longitude 7.38075) (Site A), (Latitude 5.11484, Longitude 7.38072)

(Site B), (Latitude 5.11420, Longitude 7.38036) (Site C) for one and six months between 10th July 2020 to 8th December 2021 at early hour morning with a sterile two liters polyethylene bottles using a grab method. The guidelines for the collection of water samples for analysis were strictly followed. Relevant information on the history and location were supplied and labelled. The water samples were immediately transferred to *ANAL CONCEPT Laboratory Limited for analysis.* Each river sediment sample was collected at the same points where the water samples were gotten. A total of twelve sediment samples were collected with a plastic hand trowel to avoid contamination and then stored in polythene bags. Samples were labelled and preserved by storing them in an ice chest on the field. The Physicochemical and heavy metals in the water and sediments were analyzed using standard methods [11].

3. Result

Table 1. *Biological, Physical and, Hydrocarbon characteristics of Aba River.*

Parameters	Sampling Station/Point				Overall
	Control	Point 1	Point 2	Point 3	
pH	4.92±0.42^{b}	5.88±0.55^{ab}	6.69±0.29^{a}	5.61±±.30^{ab}	5.77±0.19
Conductivity (µs/cm)	26.51±1.36^{c}	2006.46±584.61^{a}	1515.33±480.42^{ab}	452.41±122.66^{bc}	1000.18±218.67
Salinity (mg/l)	13.31±0.73^{b}	676.30±198.42^{a}	432.38±142.94^{b}	139.63±33.67^{b}	315.41±70.57
Turbidity (NTU)	10.25±2.59^{b}	37.08±7.52^{a}	39.58±8.61^{a}	34.00±6.91^{ab}	30.23±3.71
Total Dissolved Solids, TDS (mg/l)	14.50±0.78^{c}	1101.68±320.64^{a}	836.23±263.77^{ab}	247.20±66.61^{bc}	549.90±831.79
Total Suspended Solids, TSS (mg/l)	7.50±0.55^{c}	17.00±5.03^{bc}	32.75±5.50^{a}	27.92±1.12^{ab}	21.29±2.32
Alkalinity (mg/l)	5.67±0.56^{b}	45.75±15.26^{a}	20.00±14.70^{ab}	15.58±1.88^{ab}	21.75±4.42
Hardness (mg/l)	10.42±0.45^{b}	149.67±58.43^{a}	97.83±128.72^{ab}	34.67±22.92^{ab}	73.15±128.98
Nitrite (mg/l)	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±00.00
Nitrate (mg/l)	0.97±.093^{a}	1.81±0.30^{a}	1.48±0.92^{a}	1.65±0.39^{a}	1.48±0.15
Chloride (mg/l)	8.55±0.42^{b}	741.60±249.05^{a}	264.50±86.42^{ab}	84.16±19.68^{b}	274.70±76.28
Sulphate (mg/l)	0.92±0.33^{b}	2.92±0.64^{b}	11.42±3.40^{a}	6.58±2.11^{ab}	5.46±1.14
HCO_3^- (mg/l)	0.62±0.06^{b}	4.60±1.51^{a}	1.35±0.20^{b}	2.94±0.74^{ab}	2.38±0.46
Dissolved Oxygen (mg/l)	6.75±0.36^{b}	6.80±0.09^{ab}	5.90±0.32^{a}	5.93±0.19^{a}	6.35±0.99
Biochemical Oxygen Demand (mg/l)	0.79±0.19^{b}	1.60±0.25^{ab}	2.08±1.70^{a}	1.9±0.27^{a}	1.59±0.17
Chemical Oxygen Demand (mg/l)	1.19±0.30^{b}	2.38±0.38ab	3.12±0.73^{a}	2.84±1.45^{a}	2.38±0.25
Total Hydrocarbon Content (mg/l)	0.24±0.04^{b}	0.43±0.05^{b}	1.23±0.40^{ab}	3.62±1.63^{a}	1.38±3.13
BTEX (mg/l)	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±0.00^{a}	<0.001±0.00
PAH (mg/l)	0.0029±0.00^{b}	0.0047±0.00^{b}	0.013±0.01^{ab}	0.038±0.05^{a}	0.014±0.04
TPH (mg/l)	0.17±0.03^{b}	0.33±0.04^{b}	0.96±0.30^{ab}	2.69±1.22^{a}	1.043±0.33
Nitrogen (mg/l)	0.0012±0.00^{c}	0.0022±0.00^{ab}	0.0029±0.00^{a}	0.0015±0.00^{bc}	0.0019±0.00
Phosphorus (mg/l)	<0.039±0.00^{b}	<0.149±0.02^{a}	<0.17±0.14^{a}	<0.096±0.06^{ab}	0.113±0.014
Calcium, Ca (mg/l)	0.93±0.48^{b}	0.73±1.33^{b}	1.11±1.93^{b}	7.59±6.47^{a}	2.59±4.50
Magnesium, Mg (mg/l)	0.16±0.05^{b}	1.01±0.79^{b}	1.17±1.63^{ab}	2.50±2.82^{a}	1.21±0.26
Sodium, Na (mg/l)	4.12±1.10^{b}	5.83±0.40^{ab}	7.62±2.27^{a}	7.08±4.03^{a}	6.165±0.47
Potassium, K (mg/l)	0.27±0.09^{b}	6.92±1.83^{ab}	8.001±10.22^{a}	5.039±4.45^{ab}	5.058±6.89
Total Coliform (MPN/100ml)	240.83±88.76^{b}	1263.25±343.64^{a}	717.92±293.14^{ab}	1216.83±356.74^{a}	859.71±153.40
E. coli (MPN/100ml)	90.17±26.24^{b}	687.58±299.39^{ab}	677.33±300.69^{ab}	1207±359.70^{a}	665.52±146.526
Dissolved Organic Carbon, DOC (mg/l)	0.0021±0.00^{c}	0.0035±0.00^{ab}	0.0041±0.00^{a}	0.0027±0.00^{bc}	0.0031±0.00

Means within rows with different superscripts are significant ($p<0.05$)

The water samples collected in the third site read: the hydrocarbon values reads: BTEX <0.001±0.00 mg/L, PAH 0.038±0.05mg/L, while TPH 2.69±1.22. The biochemical oxygen demand (BOD) recorded 1.9±0.27 mg/L, Chemical Oxygen demand 2.84±1.45 mg/L, while Dissolved Oxygen 5.93±0.19 mg/L. DO record a lower value when compared to the obtained at the control site. BOD and COD values were higher. The microbial parameters: Total Coliform 1216.83±356.74MPN/100ml and E. coli 1207±359.70 MPN/100ml have higher values than the control site.

The Alkalinity of the water sample was 15.58±1.88mg/l. The pH is 5.61±0.30, the hardness value was 34.67±22.92 mg/L, Nitrate 1.65±0.39 mg/L, Sulphate 6.58±2.11 mg/L, Chloride 84.16±19.68 mg/L, Nitrogen 0.0015±0.00, HCO_3^- 2.94±0.74, Magnesium 2.50±2.82 mg/L, Sodium 7.08±4.03 mg/L, Phosphorus <0.096±0.06, Potassium 5.039±4.45 mg/L, and Calcium 7.59±6.47 mg/L. The values were higher when compared to the obtained at the control site, while Nitrite has the same value as the control site. The Total Dissolved Solids (TDS) were 247.20±66.61 mg/L. The amount of the total suspended solid was 27.92±1.12, the turbidity was 34.00±6.91 NTU, and Conductivity 452.41±122.66 (µs/cm), Salinity was 139.63±33.67 mg/L. The values above the water sample collected at the control site.

The figure 2 represents the comparative parameters of water samples collected at different seasons during the study period. Water conductivity (µs/cm) was highest at the second water sample followed by the first water sample. The water salinity (mg/L) was highest at the first water sample, while the third sample recorded the lowest. TDS (mg/L) was highest at the second water sample and lowest at the third sample. Total Coliform and E Coli

(MPN/100ml) was highest in the third water sample followed by the fourth water sample. Water hardness and chloride were highest at the first sample and lowest at the third sample.

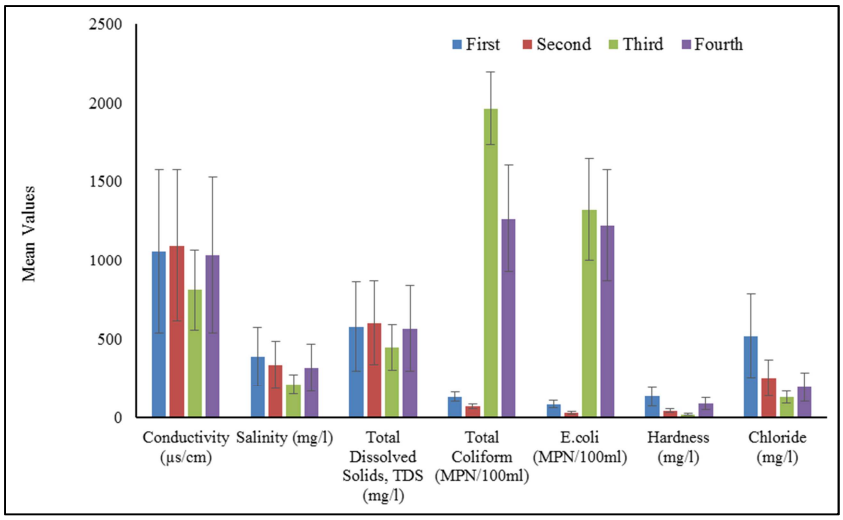


Figure 2. *Comparative periods of water sample collection for Biological, Physical and Hydrocarbon of Aba River.*

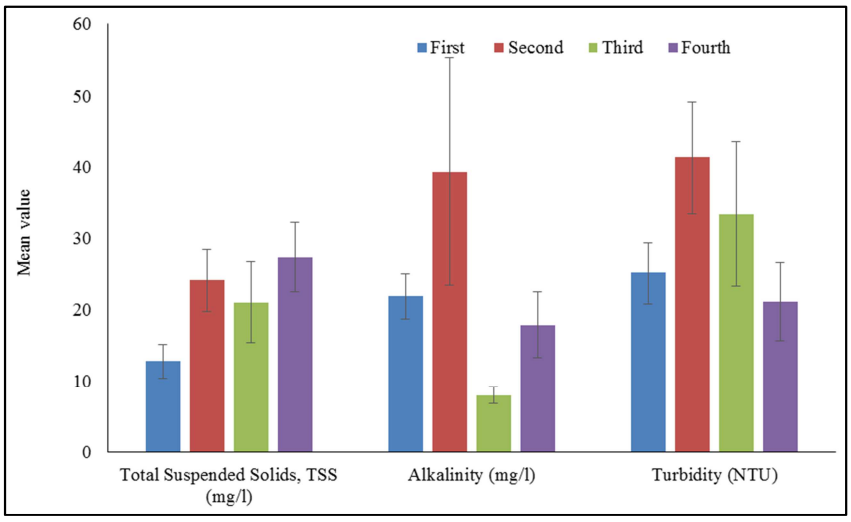


Figure 3. *Comparative periods of water sample collection for Biological, and Physical of Aba River.*

Figure 3 explains the spatial variation of Total suspended solids, Alkalinity, and Turbidity of the Aba river collected at four different seasons. The TSS was highest at the fourth water sample and lowest at the first water sample. Alkalinity was the peak at the second water sample and lowest at the third sample, turbidity was also peak at the second water sample and lowest at the fourth water sample.

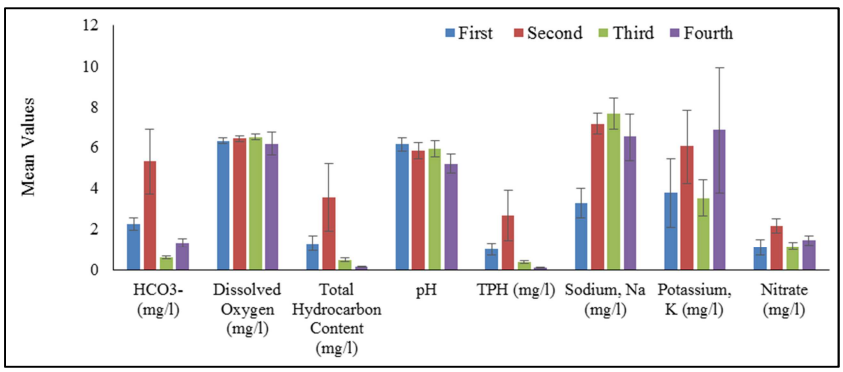


Figure 4. *Comparative periods of water sample collection for Biological, and Physical of Aba River.*

The concentration of HCO_3 is highest in the second water sample and lowest in the third water sample. The Dissolved Oxygen was highest in the third water sample and lowest in the fourth water sample. The concentration of DS almost has the same value in the four water samples. Total Hydrocarbon content was highest in the second sample followed by the first, and lowest in the fourth water sample. The sample pH ranges from 5.61 to 6.69. The pH was slightly acidic to neutral. Sample four has the highest acidic concentration, while the second sample is neutral. The third sample shows the highest concentration of TPH, while the fourth sample has the lowest value of TPH. The value of Sodium was highest in the third water sample and lowest in the first water sample. The concentration of Potassium was highest in the fourth sample followed by the second sample and was the lowest in the third sample. The Nitrate was highest in the second water sample and lowest in the first water sample.

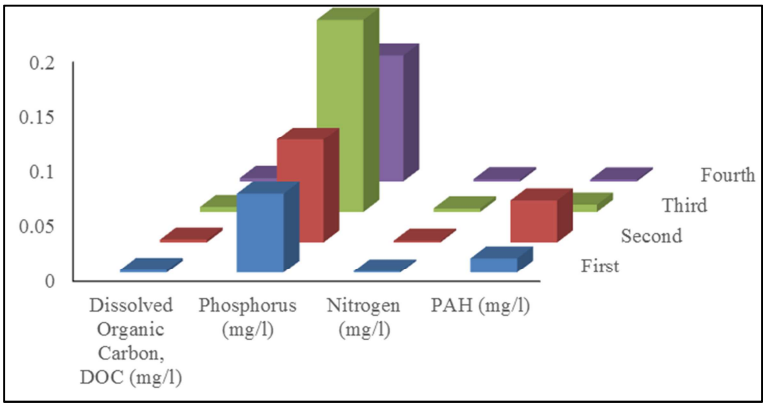


Figure 5. *Comparative periods of water sample collection for Biological, and Physical of Aba River.*

The figure 5 above shows the comparative parameters of water samples collected at different seasons during the study period. Dissolve Organic Carbon (mg/L) was highest at the second water sample followed by the first water sample. The Phosphorus (mg/L) was highest at the third water sample, while the first sample recorded the lowest. Nitrogen (mg/L) was highest at the second water sample and lowest at the third sample. PAH was highest in the second water sample followed by the fourth water sample.

Table 2. *Heavy Metal Concentration of Surface Water.*

Heavy metals	Sampling Station/Point				Overall
	Control	Point 1	Point 2	Point 3	
Cadmium, Cd (mg/l)	0.00158±0.00^{a}	0.00133±0.00^{a}	0.0019±0.00^{a}	0.001±0.00^{a}	0.0014±0.00
Copper, Cu (mg/l)	0.0075±0.00^{a}	0.0066±0.00^{ab}	0.0075±0.00^{a}	0.0038±0.00^{b}	0.0063±0.00
Chromium, Cr (mg/l)	0.001±0.00^{a}	0.001±0.00^{a}	0.001±0.00^{a}	0.001±0.00^{a}	0.001±0.00
Zinc, Zn (mg/l)	0.013±0.00^{b}	0.10±0.00^{a}	0.051±0.15^{ab}	0.015±0.00^{b}	0.045±0.00
Iron, Fe (mg/l)	0.060±0.03^{b}	61.02±31.74^{a}	0.089±0.04^{b}	0.19±0.10^{b}	15.34±8.58
Manganese, Mn (mg/l)	0.018±0.00^{b}	23.46±12.22^{a}	0.059±0.04^{b}	0.035±0.01^{b}	5.89±3.30
Lead, Pb (mg/l)	0.001±0.00^{b}	0.0014±0.00^{a}	0.063±0.03^{b}	0.001±0.01^{b}	0.016±0.00

Means within rows with different superscripts are significant ($p<0.05$)

The table shows the overall heavy metal concentration of Aba River. The concentration of Iron was the highest 15.34±8.58, followed by Manganese 5.89±3.30, and Zinc 0.045±0.00. The concentration of the heavy metal was highest during the first sample collection at point 1: Iron 61.02±31.74^{a}, Manganese 23.46±12.22^{a}, and Zinc 0.10±0.00^{a}.

Table 3. *Overall Heavy metals concentration in Aba River Sediment.*

Heavy Metals	Sampling Station/Point				Overall
	Control	Point 1	Point 2	Point 3	
Nickel, Ni (mg/kg)	0.39±0.09^{b}	0.69±0.17^{ab}	0.76±0.30^{ab}	1.34±0.47^{a}	0.80±0.15
Manganese, Mn (mg/kg)	6±0.95^{b}	13.84±3.23^{ab}	14.76±3.69^{ab}	19.95±4.53^{a}	13.64±1.78
Zinc, Zn (mg/kg)	14.27±1.27^{c}	60.26±5.73^{b}	58.39±1.36^{b}	74.33±±3.79^{c}	51.81±3.71
Lead, Pb (mg/kg)	0.71±0.37^{b}	5.23±1.16^{a}	7.32±2.21^{a}	7.21±1.60^{a}	5.122±0.77
Cadmium, Cd (mg/kg)	0.12±0.03^{a}	0.17±0.03^{a}	0.13±0.03^{a}	0.16±0.30^{a}	0.151±0.01
Chromium, Cr (mg/kg)	0.95±0.30^{ab}	0.72±0.27^{b}	1.59±0.48^{a}	1.51±0.50^{a}	1.19±0.20
Copper, Cu (mg/kg)	0.61±0.48^{c}	4.06±0.22^{bc}	6.45±1.86^{ab}	10.77±2.67^{a}	5.47±0.95
Iron, Fe (mg/Kg)	882.62±41.35^{d}	2082.45±15.80^{c}	4454.48±34.49^{b}	4574.3±16.53^{a}	2998.46±229.93

Means within rows with different superscripts are significant ($p<0.05$).

This table shows the analysis of Heavy metals concentration of the sediment at Aba river at different sample collection points 1, 2, & 3: the highest Nickel concentration 0.76±0.30 mg/L, Lead 7.32±2.21 mg/L, and Chromium 1.59±0.48 mg/L are highest at point 2, the concentration of Manganese 19.95±4.53 mg/L, Zinc 74.33±3.79 mg/L, Copper 10.77±2.67 mg/L, and Iron 4574.3±16.53 mg/L was highest at point 3. Cadmium 0.17±0.03 mg/L was highest at point 1.

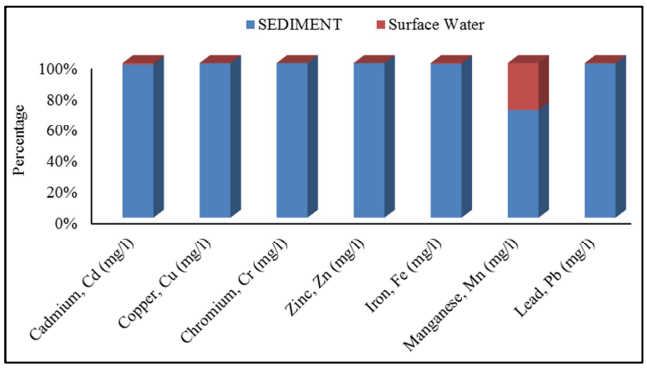


Figure 6. *Percentage Composition of Heavy Metals in the Aba River and Sediments.*

Figure 6 represents the mean percentage of the different samples collected from the water environment. From the samples collected, both water and sediment: Cadmium in the water sample represents 0.15% while the sediment has 99.85%, Copper represent 5.48% of the water sample while the sediment contains 94.52%. The percentage concentration of Chromium in the water sample is 1.20% and in the sediment 98.80%. Zinc concentration is 5.19%, while the sediment has 94.81%. Manganese has 13.64% in the water sample and 86.36% in the sediment. Lead percentage concentration in the water sample is 5.12% and 94.88% in the sediment sample. Manganese has the highest percentage concentration in the water sample, while Cadmium has the highest percentage concentration in the sediment samples.

4. Discussion

The overall comparison of the physiochemical characteristics of Aba river with WHO & NSDWQ drinking water quality standard. The Aba river serves multipurpose functions for swimming, bathing, laundry, irrigation, farming, and livestock watering. The populace of Aba has made the water unfit by dumping waste generated from domestic and industries into the water body. In the management of our environment, water quality parameters are a necessary tool therefore, there is a need to equate the physiochemical parameters of Aba water with the WHO and NSDWQ standards. Table 4 illustrates WHO and NSDWQ drinking water standards. The overall pH of the water samples collected at the different study sites (5.77±0.19) with WHO and NSDWQ standards shows that the pH of the Aba river is above the acceptable limit at that period of sampling indicating that Aba river is acidic and cannot be useful for some purposes do not require acidic water.

Table 4. *Standards for drinking water quality by the Nigerian Standard for water Quality (NSDWQ) and World and Health Organization (WHO).*

Parameter	Unit	NSDWQ	WHO
	Heavy metals		
Iron (Fe)	mg/l	0.50	0.05
Lead (Pb)	mg/l	0.01	0.01
Zinc (Zn)	mg/l	3.00	0.01
Copper (Cu)	mg/l	1.00	2.00
Chromium (Cr)	mg/l	0.05	0.05
Manganese (Mn)	mg/l	0.20	0.40
Cobalt (Co)	mg/l	NS	NS
Arsenic (Ar)	mg/l	0.01	0.01
Cadmium (Cd)	mg/l	0.003	0.003
Mercury (Hg)	mg/l	NS	0.006
Nickel (Ni)	mg/l	0.02	0.07
Sodium (Na)	mg/l	200	200
	Physical parameters		
pH		6.50 – 8.50	6.50 – 8.50
Dissolved oxygen	mg/l	7.50	NS
Biochemical oxygen Demand (BOD)	mg/l	NS	NS
Chemical oxygen Demand (COD)	mg/l	NS	NS
Total dissolved solids (TDS)	mg/l	500	500
Total hardness (TH)	mg/l	150	100
Total Alkalinity (TA)	mg/l	NS	NS
Temperature	°C	NS	30
Turbidity	NTU	5.00	5.00
Electrical conductivity (EC)	ds/m	1.0	0.9
	other cations and anions		
Nitrate (NO_3^-)	mg/l	50.0	50.0
Nitrite (NO_2^-)	mg/l	3.00	3.00
Total Calcium (Ca)	mg/l	75.0	75.0
Chloride (Cl^-)	mg/l	250	NS

Parameter	Unit	NSDWQ	WHO
Fluoride (F^-)	mg/l	NS	1.50
Phosphate (PO_4^-)	mg/l	NS	NS
Sulphates (SO_4^{2-})	mg/l	100	100
Ammonia (NH_4^-)	mg/l	5.00	0.50
NS – Not stated			

The overall total solid of the water samples collected at different sites was 21.29±2.32 mg/L. If compared with the WHO and NSDWQ (500 mg/L), we observed that the TDS Aba river is within the acceptable limit of WHO & NSDWQ. This means that the Aba river is not polluted. The overall turbidity gotten was 30.23±3.71 NTU, which exceeds the WHO and NSDWQ. The high turbidity resulted from the abattoir and Nigeria brewery company waste discharge. Sulphate 5.46±1.14 and hardness 73.15±128.98 are within the permissible limit, and Chloride (274±76.28) is above the limit.

The overall differences in the heavy metals in sediment collected at different points in the Aba river, some of the parameters detected are higher in the sediment are Manganese 13.64±1.78, Zinc 51.81±3.71, Lead 5.122±0.77, Copper 5.47±0.95, and Iron 2998.46±229.8, while Nickel 0.80±0.15, Cadmium 0.15±0.01, and Chromium 1.19±0.20 were low in the sediment. The heavy metal in Aba sediment followed in this order Fe > Zn > Mn > Cu > Pb > Cr > Ni > Cd. The heavy metal in the sediment was higher than the concentration of heavy metals in the river. The accrual of heavy metals in the river sediment resulted from urbanization, untreated waste discharged from the nearby industries, abattoirs, farmlands around the river surged the heavy metal bioavailability.

Previous studies on the Physicochemical and Microbiological Study of the Aba River, the result shows that Dissolved oxygen, Ammonia, Total suspended solids, Iron, Electrical conductivity, and Turbidity exceeded World Health Organization (WHO) standard and Nigerian Standard for Drinking Water Quality (NSDWQ), while the remaining parameters fall within WHO and NSDWQ standards [8]. Another Study [9] added that the result of physicochemical parameters of Aba river at Ogbor Hill side shows that Dissolved Oxygen (DO) is 4.44 ± 0.70 mg/L, and Nitrate 7.58 ± 6.25 mg/L was below National and International standards of drinking water quality. The value of WQI calculated was 83.05. The result revealed that the Aba River at Ogbor hill has poor quality. Therefore, it is unfit for human consumption. In 2017, [10] discovered that the concentration of Iron, Copper, Chromium, and Manganese in the Aba River is above the WHO and FMEnv Standard limits for surface water. The level of heavy metal contamination in the sediment and River of Aba by [11] observed that the concentration of heavy metals in water (Cd, Pb, Ni, and Cr) were higher than their recommended limits for potable water except Fe were within the limited in the sediment. The concentration of all the metals in the sediments was higher than the water at $p < 0.05$ significantly level. These results correspond to our findings that the Aba river and sediment are contaminated with heavy metals due to the human activities carried out along the river bank.

5. Conclusion

The concentration of heavy metal and physicochemical characteristics of Aba river depends on the location/point of sample collection and the activities that happens in the such location. Within the permissible Limit: Hardness, Nitrite, Nitrate, Sulphate, DS, Calcium, Sodium, Cadmium, Copper, Chromium, and Zinc. Above the permission Limit: pH (5.77), Acidic, Conductivity, Turbidity, TDS, Chloride, Magnesium, Iron, Manganese, and Lead. The presence of heavy metals in Aba river demands for regular testing of the water. Awareness should be spread among the populace on the effects of heavy metal contamination of water body.

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