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HEAVY METALS: CAUSATIVE AGENTS FOR NON-COMMUNICABLE DISEASES AND PHYSIOCHEMICAL FEATURES OF WATERS FROM SOME PARTS OF RIVERS STATE, NIGER DELTA BASIN, NIGERIA

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Abstract

Fourteen parameters were analyzed on water samples from some parts of Rivers state in the Niger Delta basin of Nigeria. The parameters were studied to know the health implications of the water. Heavy metals (Iron, Lead, Copper, Nickel, Manganese, Zinc, Chromium, Cadmium, and Cobalt) and physiochemical parameters (pH, Temperature, Electrical Conductivity, Total Dissolve solids and Turbidity) were analyzed. The analytical values were compared with the World Health Organization (W.H. O) standard and Standard Organization of Nigeria (S.O. N) values. The results show that Iron concentration ranges between 0.02-0.05 mg/l, Copper has a concentration range of 0.01-0.047 mg/l, Zinc range from 0.03-0.5mg/l, Chromium range from 0.002-0.034mg/l, Cadmium range from <0.001-0.008mg/l, Cobalt range from 0.01-0.1mg/l, these values fall within WHO and SON standard. Lead concentrations range from 0.01-0.04 mg/l; lead is high in two of the water samples. Nickel concentrations range between 0.02-0.07mg/l, Nickel values are higher than WHO and SON standards in two samples, and Manganese ranges between 0.049-0.993mg/l and its higher than WHO and SON standards in one sample. The physiochemical results range are pH 5.72- 6.27mg/l, Temperature 24.50-25mg/l, these values are within the WHO and SON standard, and Electrical conductivity is 553-111mg/l, are higher than the WHO standard in three samples but they fall within the SON standard. Total Dissolve solids are 261-557mg/l which is within the WHO

standard while one of the samples is higher than SON recommended standard. The turbidity range in concentration is 261-557mg/l. which is within WHO standards but one sample is higher than the SON standard. These values were evaluated and used to determine the health implications of the waters.

Keywords: Metals, physiochemical, water, diseases

Introduction

The human body needs some metals like Cobalt, Copper, Zinc, and Manganese for sustenance but when the concentrations of the metals in the body are beyond the tolerable limit, it becomes toxic. Some heavy metals can destroy the organs of the body even when they are in very little concentration. Heavy metals like lead, mercury, arsenic, and cadmium have no useful needs in the body. They are very toxic/ hazardous to the body. These toxic heavy metals can damage the cerebrum, they can damage the mental ability, the lungs, liver and cause cancer and malignant growth. Heavy metal toxicity can also lead to stunted growth (Brackers de Hugo *et al.,* 2013), especially in children. Some heavy metals are harmful when stored in the body (Malassa et al. 2014). Some of these toxic metals in the body form synthetic bonds (Duruibe *et al.,* 2007) which are very dangerous to human health. Some heavy metals are free radicals and geogenic in nature and they can easily bio-accumulate, they can incorporate into plants, and the human body causing severe health challenges which can lead to the destruction of body organs, cancer, damage to the nervous system, and death. Long exposure to heavy metals can also result in Parkinson's infection, Alzheimer's illness and strong dystrophy. The intensity of heavy metals poisoning depends on the assimilation speed in the organs of the body as well as the duration of exposure to the metals. Engwa et al, 2019, documented the health hazards associated with heavy metal ingestion. In some cases, the heavy metal problems develop gradually while in some other body systems, it has abrupt reactions which result in the breakdown of the body system. The assimilation of heavy metals into the body has resulted in prostate disease (Nkwunonwo *et al.,* 2020). Jaishankar *et al.,* 2014 stated that oxidative pressure of the metals can harm the organs of the body. Heavy metal concentrations in water can be a pollutant and they are generated by anthropogenic and geogenic factors (Amos and Joseph 2016; Coyte et al 2019; Edori and Iyama, 2020; Edori et al, 2019; Hatje et al, 1998; Hutton and Symon, 1986; Battarbee et al., 1988; Nriagu, 1989; Mahboube et al. 2020).

Geology of the Study Area

The study area is within the Niger Delta basin of Nigeria. Niger delta started during the late Cretaceous. There are three depositional cycles in the Niger Delta which are Benin Formation, Agbada Formation, and Akata Formation. The youngest of the depositional sequence is the Benin Formation which has a thickness of about 2500m, it comprises sandstones and shales and some pebbles. The oldest sediment in the Niger Delta Basin is the Akata Formation which has sediment thicknesses which range from 6500m-7000m. Agbada Formation has a sediment thickness of about 3500m.

LOCATION	LOCATION NAMES	LATITUDE	LONGITUDE	ELEVATION
Location 1	Afam street by car wash D-line	N4° 47' 46.9''	E7° 0' 2.04''	5M
Location 2	Mechanic village Anyama by Ikeokwu road	N4° 48' 0.80''	E6° 59' 47.96''	5M
Location 3	Car wash beside Blueridge Abacha road	N4° 49' 10.17''	E6° 59' 17.55''	9M
Location 4	Tombia Street extension GRA phase 3	N4° 49' 27.82''	E6° 59' 16.84''	9M

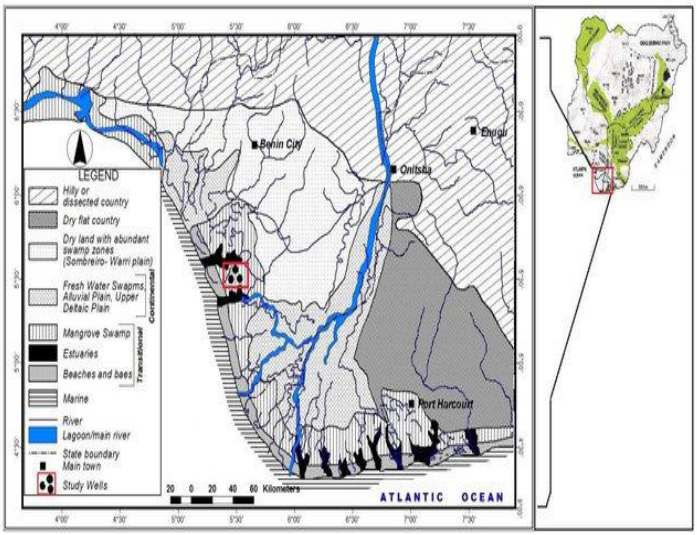

Fig 1: Map of Niger Delta basin (Adopted from Edema et al. 2016

Methodology

Water samples from the study area were collected using the standard water sampling procedure. The deep side and the fast-moving side of the river were chosen for the water sample collection. Care collection of the water was made to avoid picking up water sediments and debris.

Water from the river was used to rinse the sampling container before collecting the water sample for analysis. The water sample container was filled to the brim to avoid space for oxidation. The bottles of the water samples were stored in a cooler to preserve the samples until they can be delivered to the laboratory.

Plate 1. (Location 1): Afam Street Anyama by Ikeokwu road

Plate 2: (Location 2): Machanic village by car wash D-line

Plate 3:(location 3): Car wash Beside Blueridge Abacha road

Plate4: (location 4): Tombia Street extension GRA Phase 3

Laboratory method

Atomic Absorption Spectrometry (AAS) method is used to analyse the heavy metal concentration. Atomic Absorption Spectrometry involves the aspiration of samples into an acetylene flame ignited by a cathode lamp, then the magnitude of the wavelength of radiation that is being absorbed by each element is evaluated/ measured because a specific element has a particular pattern to which it absorbs wavelength.

The apparatus used was a hot plate, 250mp conical flask and 100ml volumetric flask. The conical flask is washed thoroughly using distilled water and then nitric acid. The reagent

used is nitric acid, the samples were digested with Nitric acid before being analysed with AAS.

The procedure for the acid digest analysis involves putting 100mls of the samples into a 250ml conical flask then nitric acid was added into the samples and warmed on a hot plate until white smoke is seen which signifies that processing has ended. The samples were allowed to cool to room temperature and 20mls of refined water was added to bring the heated metals to normalcy and then separated for AAS examination.

Results and Discussions

Table 1: Heavy metals concentration results in the study area.

PARAMETERS	LOCATIONS(LC) OF STUDY; WORLD HEALTH ORGANIZATION (W.H.O); STANDARD ORGANIZATION OF NIGERIA (S.O.N)					
	LC1	LC2	LC3	LC4	W.H.O	S.O.N.
Total Iron	0.049	0.034	0.060	0.023	0.3	1
Lead	0.012	0.042	0.011	0.028	0.01	0.01
Copper	0.047	0.019	0.043	0.022	1	1
Nickel	0.021	0.066	0.019	0.034	0.02	0.02
Manganese	0.049	0.993	0.104	0.079	0.4	0.2
Zinc	0.053	0.495	0.033	0.039	5	3
Chromium	0.002	0.034	<0.001	0.009	0.05	0.05
Cadmium	<0.001	0.008	<0.001	<0.001	0.03	0.03
Cobalt	0.018	0.095	0.011	0.018	0.05	0.05

Total iron: iron helps in blood formation and nourishment. It strengthens the immune system, and bones and helps in oxygen circulation. It helps to normalize blood pressure, when the tolerable limit of iron is exceeded in the body, it causes bone, stomach, nerve pains, indigestion, drowsiness, falling of hair, it can also cause ulcers, difficulty breathing and loss of memory.

Lead: Lead is very toxic and corrosive. No amount of lead is tolerable in the body. The entrance of lead into the body can cause blindness, respiratory problems, cancer and death.

Copper: copper helps in the formation of blood, boosting the immune system, protecting the body cells, and keeping the brain healthy while excess copper in the body results in kidney and liver failure, gastrointestinal problems, headaches, stomach cramps, nausea, and diarrhoea.

Nickel: Nickel helps in body metabolism. Excess nickel in the body causes lung, stomach and kidney problems, when there is skin contact with nickel, it results in skin irritation and inhalation of nickel results in respiratory problems. Nickel affects the brain when there is an excess of it in the body, which results in cancer and death.

Manganese: Manganese helps in metabolic activities and the healthy formation of bone. It reduces inflammation. When the tolerable limit of manganese is exceeded in the body it can result in neuro retardation, Parkinson's disease, loss of appetite, headache, weakness, hearing challenges, insomnia, irritation of the skin, cardiac problems and sagging of the skin.

Zinc: Zinc promotes the immune system, helps in the healing of wounds, and controls diarrhoea, Excess of zinc in the body is hazardous because it causes stomach pains, vomiting, nausea, fever, coughing, fatigue, and headache.

Chromium: Chromium helps in the development of the brain. It helps to maintain sugar levels in the body. Much chromium in the body damages the respiratory tract, liver, and kidney, causing indigestion, difficulty in breathing, cardiovascular disease, cancer and death.

Cadmium: Cadmium does not have any significant benefit to the body but the excess of it causes cancer, lung and kidney disease, weakens the bones, gastrointestinal problems, and death.

Cobalt: Cobalt participates in blood formation. The excess of cobalt results in organ damage, retard the brain and causes inflammation, fatigue, nausea, drowsiness, weakness of joints, oxygen deficiency and eventually death. Table 2: Physiochemical parameter results of the water samples.

PARAMETERS	LOCATIONS (LC)						
	LC1	LC2	LC3	LC4	RANGE	W.H.O	SON
pH	6.27	5.72	6.25	5.77	5.72- 6.27	6.5 – 8.5	6.5 – 8.5
Temperature (˚c)	25.00	25.00	25.00	24.50	24.50-25	20-30	20-30
Electrical conductivity (EC)	705.7	1113	552.6	790.3	553-111	500	1000
Total dissolved solids (TDS)	352.9	556.5	261.3	395.2	261-557	1000	500
Turbidity	4.00	6.00	2.00	6.00	2-6	5	5

The physiochemical features of the waters of the study area are recorded in table 2. The results are compared with the W.H.O. and S.O.N standards.

pH: The results show that LC2 and LC4 are more acidic than recommended values of WHO and SON while LC1 and LC3 are within the pH recommended value. The acidic nature of the surface water can cause heavy metals poisoning when it's ingested into the human body, it can result in kidney, and liver diseases, stomach cramps, nausea and diarrhoea. The acidic nature of surface water can as well cause cracking of the teeth and bone. Contact with acidic water and skin can result in skin irritation.

Temperature: The temperature of the water is within the WHO and SON standard

Electrical Conductivity: The electrical conductivity is higher than the world health organization standard while LC2 is higher than the S.O.N standard. Electrical conductivity does not have a health challenge for humans.

Total dissolved solids: All the samples are within the estimated range of the W.H.O. standard but LC2 is higher than the S.O.N standard

Turbidity: The whole samples have turbidity that falls within the W.H.O. standard but LC2 and LC4 are more than the S.O.N standard (Table 2). The locations 2 and 4 samples tend to harm the skin due to dissolved materials that are pollutants in the water.

Conclusion

All the parameters (heavy metal and physiochemical) of the waters did not conform to WHO and SON standards, some are within the WHO and SON standards while some other water samples have parameters that are higher than the WHO and SON recommended values. The implication is that the waters with higher values of these parameters tend to increase in values thereby becoming more toxic for domestic use. Proper approach and usage of the surface waters can help to manage the heavy metals concentrations because anthropogenic factors play more crucial roles in elevating the heavy metals in the water than geogenic factors.

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