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Comparative Physicochemical Pollution Index of Rivers along River Jakara and Its Tributaries

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Abstract **Original Research Article**

Water samples along Jakara River and its tributaries (River Getsi, River Jakara, River Gwagwarwa and River Rafin Malam) in Kano state were analyzed for physicochemical parameters. The physicochemical parameters were determined using the standard methods of America Public Health Agency (APHA).The results obtained are as follows; pH (7.8-8.4); temperature (31-31.1) ^{0}C; conductivity (2759-4862) µs/cm; turbidity (21-190) mg/l; TSS (0-73.5) mg/l; TDS (1379-2431) mg/l; TOC (53.6-326.7) mg/l; DOC (32-57.3) mg/l; BOD (6.3-10.6) mg/l; sulphate (44.3-83.3) mg/l and nitrate (24.5-50.6) mg/l. Except temperature, pH and SO_4^{2-} the values of other parameters determined are above the permissible limit of WHO and NESREA standards. The study indicates that the quality of wastewater along River Jakara is in serious threat of pollution; urgent steps are needed by relevant agencies (SON, NAFDAC, NESREA etc) to initiate remediation that would help to monitor and improve the wastewater along River Jakara.
Keywords: Jakara River, physicochemical parameters, APHA.

INTRODUCTION

Water quality describes the physical, chemical and biological characteristics of water in respect of its suitability for a particular purpose or intended use. It may be good for one purpose and bad for another. The United State Environmental Protection Agency limits the amounts of certain contaminants in tap water provided by United State (U.S) public water system [1].Waste water can simply be defined as water that contains pollutants beyond certain threshold level due to previous usage. The main sources of waste water are industrial, agricultural, domestic etc [2-4].

Physicochemical parameters

The physicochemical pollutants examined include temperature, turbidity, pH, conductivity, total dissolved solid, total suspended solid, biochemical oxygen demand, nitrate, sulphate, total organic carbon and dissolved organic carbon.

Surface water from lakes, streams and rivers are important sources of water for various human activities, notwithstanding, surface waters are also avenue for dumping wastes which consist of inorganic, organic and microbial pollutants. Abdulmojeed and Abdulrahman [5] reported that the use of industrial and domestic wastewater for irrigation on garden constitutes public health concern. Dibofori and Clement [6]; reported physicochemical parameters of the Orashi Rivers at Mbiama of Ahoada West Local Government Area in River State. The result obtained is pH (6.55); temperature (29.2^{o}C); total suspended solid (0.512mg/l); carbonate (0.01mg/l); iron (2.42mg/l) bicarbonate (292.9mg/l) and sulphate (100mg/l). The result showed that iron concentration is above WHO limit of 0.3mg/l while the other parameters examined are within the WHO standard limit. Ajiwe *et al.* [7]; reported the physicochemical components of three satellite rivers (Nworie, Otamiri and Oramirikwa) in Owerri Local Government Area of Imo State. Though, phosphate were found to be above the WHO limit in Nworie and Oramirikwa rivers while pH value of the three rivers analyzed were 5.4, 5.2 and 5.1 respectively which are not within the permissible limit of 6.5-9 of WHO guidelines for water quality.

Aim and Objectives

This research work is aimed at the determination of the physicochemical parameters in water samples along River Jakara and its tributaries.

MATERIALS AND METHODS

Description of Sampling Site: Kano State lies within the latitude 18.35^{o}N and longitude 05.8^{o}E, which

make it to occupy a central position in Northern part of Nigeria. It is a highly populated and industrialized state. There are two main industrial areas in Kano metropolis viz Bo Bompai industrial area and Sharada industrial area [8]. Industrial waste from Bompai indl area are discharged into drain, which channel out to River Getsi, which flows to River Jak then to Jakara dam. Other rivers such as River Gwagwarwa, River Rafin Malam, and Rivers Cija among others also drain from different locations into River Jakara.

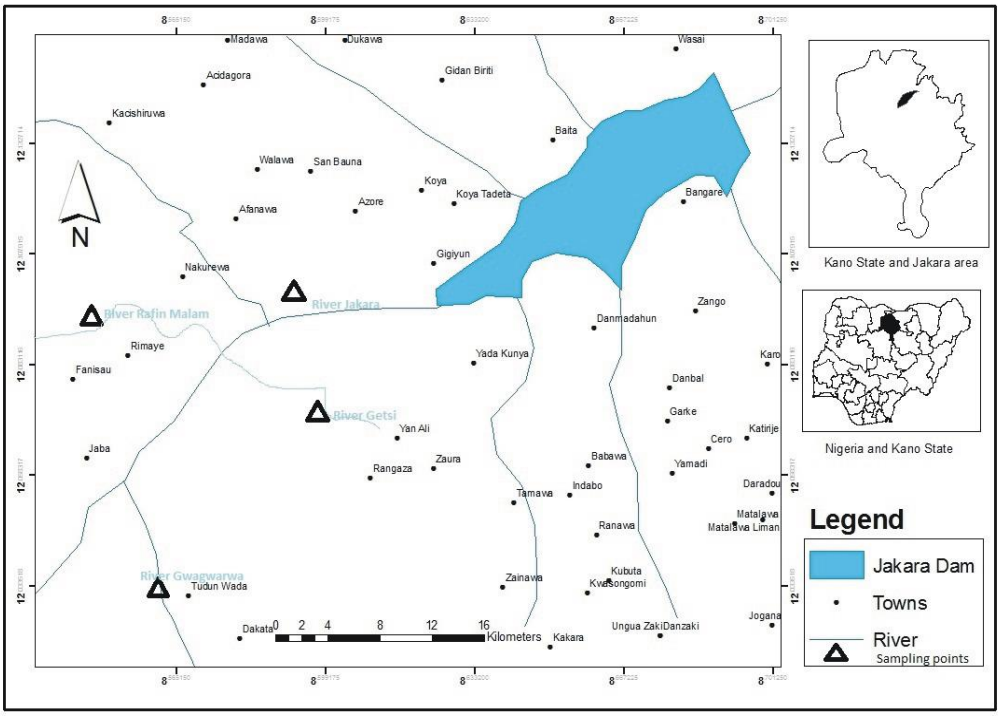

Fig-3.3: Map showing Sampling points along River Jakara and its tributaries in Kano

Experimental

Sample collection, preservation and handling

Composite samples (1000cm^3) were made on each sampling session (morning or evening) by collecting 100cm^3 of water at ten different points. The sampling was repeated for three days within a week along the course of the Rivers (River Gesti, River Gwagwarwa, River Jakara and River Rafin Mallam) using random sampling method. At the end of the sampling session, a total of twenty –one composite samples were collected and labeled in clean glasses.

Procedures

All field meters and equipment were checked and calibrated according to the manufacturer's specifications. The pH meter was calibrated using HANNA 96107 buffers of pH 4.0, 7.0 and 10.0. Dissolved oxygen (DO) meter was calibrated prior to measurement with the appropriate calibration solution (5%HCl) in accordance with the manufacturer's instruction. The spectrophotometers HACH DR 1890 for anions determination were checked for malfunctioning by passing standard solutions of all the parameters to be measured; Blank samples (deionized water) were passed between every three measurements of wastewater samples to check for any eventual contamination or abnormal response of equipment [9, 10]. Analysis was done using standard methods by APHA1998 [16].

RESULTS AND DISCUSSION

Table-1: Shows mean values of some physicochemical parameters of water samples from the sampling stations

Sampling Station	pH	Cond(µs/m)	TDS (mg/l)	Turbidity(NTU)	TSS (mg/l)	Temp(^{O}C)	TOC (µg/l)	BOD(mg/l)	DOC(µg/l)	NO_3 (mg/l)	SO_4(mg/l)
R.Jakara	7.9±0.05	2759±18.8	1379±14.4	130±9.6	73.50±7.5	28±0.4	306.7±4.6	10.60±2.6	49±3.1	40.70±3.1	45.80±3.6
R. Getsi	8.4±0.05	4488±33.7	2246±19.4	132.8±4.16	56.50±1.7	27.1±.19	318.3±10.6	6.30±0.9	51.50±3.0	24.50±2.3	44.30±4.4
R. Gwagwarwa	8.2±0.06	4862±34.9	2434±16.7	190±10.2	46.80±3.9	26±0.2	326.7±7.5	8.70±0.8	57.30±2.4	50.60±4.1	47.50±3.4
R. Rafin Malam	7.8±0.05	4030±29.9	2010±20.8	21±3.9	0±0.0	25.1±0.3	53.60±1.5	9.60±1.2	32±2.2	38.80±3.1	83.30±5.5
NESREA [17]	6.5 - 8.5	500	2000	NS	0.75	<40	1.0	6.0	NS	40.0	500
WHO [11]	6.2 - 9.2	550	1500	5NTU	2.5	NS	1.0	6.0	1.0	50	500

The average values of some physicochemical parameters of water samples collected at River Jakara, River Getsi, River Gwagwarwa and River Rafin Malam are presented in table 1.The parameters determined include pH, conductivity, total dissolved solid (TDS), total suspended solid (TSS), turbidity, temperature, total organic carbon(TOC),biochemical oxygen demand (BOD),dissolved organic carbon(DOC), nitrate (NO_3^-) and sulphate (SO_4^{2-}). From the results obtained River Getsi had the highest pH level of 8.4 while the least was River Rafin Malam with pH level 7.8.The pH of all the samples falls within the W.H.O recommended range value of 6.5-8.5[11],and they all fall in basic region of pH.

Conductivity measurement assessed was above 4000 µs/cm for River Getsi, River Gwagwarwa and River Rafin Malam while River Jakara was 2759 µs/cm. The conductivity measurement of the various stations were above the WHO recommended level of 550 µs/cm [11].The high conductivity recorded in the sampling areas could be attributed to sewage discharged into the Rivers which may contain inorganic contaminant [12].

The result of total dissolved solid were above 2000mg/l for River Getsi, River Gwagwarwa and River Rafin Malam while River Jakara was 1379.3mg/l. Except for River Jakara, the total dissolved solid determined were above the WHO recommended values of 1500mg/l. The values of conductivities are directly related to the total dissolved solids hence conductivity measures the amount of dissolved solid and metal ion. This could be attributed to sewage discharged, industrial waste and commercial activities in the sampling locations [8].

The turbidity assessed shows the highest value in River Gwagwarwa which is 190NTU while the least value was 21NTU for River Rafin Malam. The turbidity of the various sampling stations are above the WHO recommended level of 5NTU. The high turbidity measurement recorded could be linked to soil erosion, decayed plant and animal, sewage [13]. Total Suspended Solid examined were 73.5mg/l, 56.5mg/l and 46.8mg/l for River Jakara, River Getsi and River Gwagwarwa respectively. This may be attributed to solid waste from both the industrial and commercial areas [14].

Temperature determined at the various sampling station were within the range of 31ºC – 31.1ºC. The temperature of the various sampling stations falls within the NESREA recommended level of below 40º C. This could be attributed to ambient environmental temperature, water depth, flow rate among others [14, 12]. Total organic carbon (TOC) assessed for the various sampling stations, River Gwagwarwa had the highest value of 326.7mg/l while River Getsi and River Jakara had 318.3mg/l and 306.7mg/l respectively but River Rafin Malam was 53.6 mg/l. This could be as a result of industrial effluent, domestic waste and agricultural activity around the stations. The concentrations of the total organic carbon in the four sampling station were above W.H.O recommended level of 1.0µg/l.

Biochemical oxygen demand (BOD) determined at the various stations, revealed highest value of 10.6mg/l at River Jakara while the least value was 6.3mg/l at River Getsi. The four sampling stations had BOD above WHO recommended limit of 6.0mg/l. These high values show that there is tremendous enzymatic decomposition of organic matter by microbial action to produce

methane gas or alcohol. These high microbial actions could be linked to sewage disposable material leading to organic contaminant [12, 15].

Dissolved organic carbon (DOC) examined shows the highest value of 57.3mg/l at River Getsi while the least value of 32mg/l was recorded at River Rafin Malam. The concentration of DOC at the four sampling stations fall above W.H.O recommended limit of 1.0µg/l. These high values could also be attributed to sewage and other related chemical [12, 13, 8].

Highest nitrate values of 50.6 mg/l and least value of 24.5mg/l were recorded at River Gwagwarwa and River Getsi respectively. Except for River Gwagwarwa, the nitrate concentration are within the WHO recommended limit of 50mg/l. These high values at River Gwagwarwa may be attributed to the discharge of agricultural wastes such as fertilizers and other nitrogenous materials into the River [14].

Highest Sulphate values of 83.3mg/l and least value of 44.3mg/l at River Rafin Malam and River Getsi respectively. The concentration of sulphate at the four sampling station falls within the recommended W.H.O level of 500 mg/l.

CONCLUSION

Water samples along Jakara River and its tributaries (River Getsi, River Jakara, River Gwagwarwa and River Rafin Malam) in Kano state were analyzed for physicochemical parameters and some organic pollutants. The physicochemical parameters were determined using the standard methods of America Public Health Agency (APHA) while the organic pollutants were extracted and analyzed using Gas chromatography-mass spectrometer(GC-MS).The result are as follows; pH (7.8 - 8.4); temperature (31-31.1) ^{0}C; conductivity (2759-4862) µs/cm; turbidity (21 - 190) mg/l; TSS (0 - 73.5) mg/l; TDS (1379 - 2431) mg/l; TOC (53.6 - 326.7) mg/l; DOC (32 - 57.3) mg/l; BOD (6.3-10.6) mg/l; sulphate (44.3 - 83.3) mg/l and nitrate (24.5 - 50.6) mg/l. Except temperature, pH and SO_4^{2-} the values of other parameters determined are above the permissible limit of WHO and NESREA standards. The study indicates that the quality of wastewater along River Jakara is in serious threat of pollution*;* urgent steps are needed by relevant agencies (SON, NAFDAC, NESREA etc) to initiate programmes that would help to monitor and improve the wastewater along River Jakara.

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