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PHYSICO-CHEMICAL ANALYSIS OF OBIZI RIVER IN AWKA SOUTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE, NIGERIA FOR DOMESTIC PURPOSES

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Abstract
Physico-chemical properties of obizi river in awka south local government area of anambra state were analyzed for its pollution level and determined if it will be fit for domestic purposes. It is significant for cooking, drinking, fishing, recreational and other uses. It flows via a channel that may be contaminated by industrial, agricultural, and other anthropogenic activities, limiting its normal uses for cooking, drinking, fishing, recreational and other uses. The parameters analyzed includes temperature (°C), pH, turbidity (NTU^b), conductivity µs/cm, resistivity mg/l, chloride mg/l. Temperature(°C), pH, turbidity (NTU^b) resistivity mg/l and conductivity µs/cm was measured in-situ using mercury thermometer with a range of 10^0C -35^0C, pH meter (HANNA H1991002), turbidimeter (Hl 88703, WAGTECH), conductivity and resistivity multi-meter (HI 991300, Hanna Instruments, Romania) and chloride was determined by titration. The results of the analysis were equivalence with world health organization (WHO) limit for domestic drinking water and other purposes. From the results obtained, it showed that all the parameters analyzed were above WHO permissible limit except resistivity and chloride which is within the world health organization (WHO) limit for domestic drinking water. As much, it is not recommended for human consumption and is recommended that the state government put in place a treatment plant which can be used to treat the obizi river water before being used by the community that depends solely on it for domestic purposes.

Keywords: Water pollution, Physico-chemical parameters, Obizi river, Awka urban.

1.0 INTRODUCTION

Water is considered as one of the essential components of diet that support all forms of life [1]. According to Yadav et al. [2], water covers about 70.9% of the earth's surface. Freshwater, which is vital for sustainable development, covers less than 2% of earth's surface. Surface and underground water are major sources of fresh water but surface water is vulnerable to contamination as contaminants can easily flow into it.

Many people lack access to potable water and about 22% of the world's population per year are affected by water borne diseases [3]. Miime et al. [4] reported that worldwide approximately 1.7 million deaths recorded annually are attributed to unsafe water supplies. Most of these deaths are due to diarrheal diseases which mostly affect about 90% of children. In Africa and Asia, access to potable water is a major problem with above 800 million people affected [5]. (Karamage et al., 2016).

According to Mathew et al. [6] approximately half a million children die annually due to diarrheal diseases. Water resources particularly rivers in the world are degraded by discharge of untreated sewage, untreated industrial wastes for example solvent chemicals, papers and sludge; leaching of agricultural chemicals (fertilizers and pesticides) due to increased human activities.

Islam et al. [7] reported that human activities contributed to water pollution and contaminated water serves as a medium of transmitting dangerous pathogens into humans, animals and plants and about 80% of human diseases are caused by water. Nutrients are important in assessing water quality and they are influenced by agricultural and industrial activities. Farmer [8] showed that, storm water runoff and discharge of sewage into rivers are two major ways that various nutrients enter the aquatic ecosystems. Nitrates (inorganic nitrogen and organic/soluble phosphate) are important in microbial growth and distribution. People living in developing countries use untreated water for domestic purposes [9].

The major sources of water supply in Nigeria are predominantly streams and boreholes in the rural and urban areas respectively. However these sources, in most places, lack reliability. In places inhabited by lower income groups there are little or no public water services which in some cases are usually of questionable quality. Therefore, a good percentage of the residents of these low income areas augment their water needs with that obtained from water vendors whose sources of water are not known.

In anambra state, hand dug wells and boreholes are heavily relied on for water supply to households due to degradation of surface water sources and failure of government to provide good quality water for her citizens. However, poor well construction using cheap materials and location of boreholes close to contaminant sources have affected the quality of this resource with impacts on human health [10]. In this study, therefore, the quality of obizi river water in awka-south local government area of anambra state was investigated to determine its portability and check if it is fit for domestic purposes like drinking, cooking etc. Based on the foregoing, the need for this study is critical in planning for water supply infrastructure in anambra state.

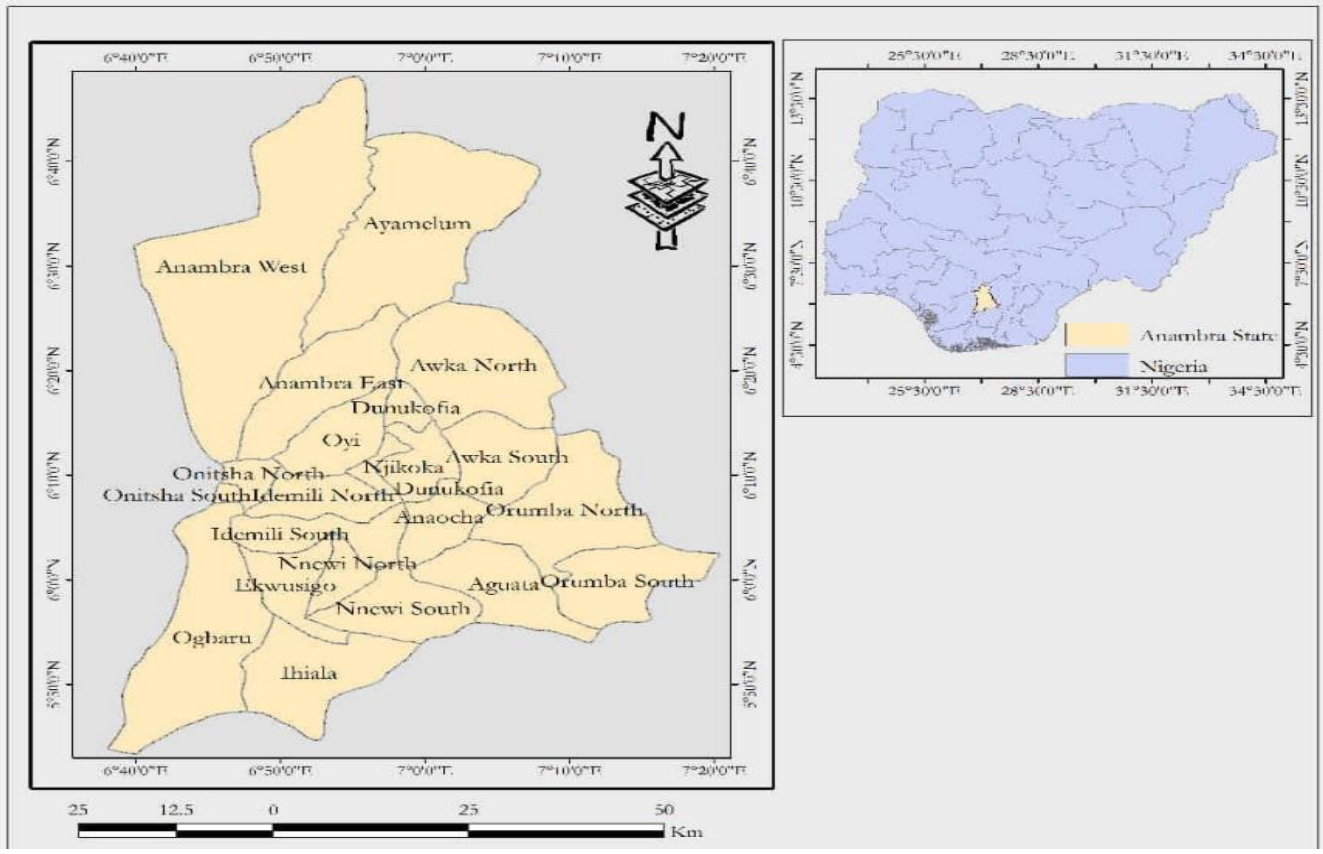

Figure 1: Map representation of Study Area

2.0 STUDY AREA

Description of study area

Anambra state is a state in the south-eastern nigeria. The capital and seat of government is awka. The state's theme is "light of the nation". Boundaries are formed by delta state to the west, imo state and river state to the south, enugu state to the east, and kogi state to the north. Anambra state is located between Latitudes 5° 45´ and 6°46´ N and Longitude 6°31E´ and 7° 03´E and covers an estimated land area of 4887 km^2. Anambra state has a tropical climate with annual average temperature and rainfall of 27°C and 1828 mm respectively. According to the last population census of 2016, the state has a projected population of about 5,527,800. Awka is located within the latitude of 6.333̊ N and longitude of 7.000̊ E and falls within the rainforest climatic region with 33^0C as its mean annual temperature and between 1,400 mm in the north to 2,500 mm in the South as its average annual rainfall. It covers an area of 613 SQ.KM with 15% Highland and 21% plainland. It experiences two seasons in the year, which are the rainy season and the dry season. The rainy season falls between march and september while the dry season is between november and april for about 4-5 months [11]. It is a typical savanna covered with grass.

3.0 MATERIAL AND METHOD

Water for physico-chemical analysis were aseptically collected from obizi river in awka south local government area of anambra state using 250ml sampling bottles (screw capped), according to the procedure described by APHA [12]. A total of three samples were collected, which includes the upstream, located approximately 800m upstream of the effluents discharge entry point from domestic and agricultural waste into the river. Effluents entry point, this site is located in the downstream of the first site at effluent entry point. The site is where effluents discharge from domestic and agricultural waste of inhabitants of the community is discharged into the river. Downstream, this site is located at about 700m downstream from the discharge entry point. The samples were collected in the morning hour. The sample was placed on ice in a cooler to maintain temperature of the water samples during transportation to springboard laboratory for analysis. The water sample was collected in rainy season (July). The sample was analyzed within 24 hours of collection. Where analysis is delayed, sample was refrigerated at 4^0C. All glass wares used for the collection of water sample were sterilized in an autoclave at 120^0C for 15 minutes. The parameters analyzed includes temperature (°C), pH, turbidity (NTU^b), conductivity µs/cm, resistivity mg/l, chloride mg/l The data obtained were subjected to statistical analysis using ANOVA Single-Factor to determine if there are significant differences between the parameters and world health organization [13] recommended limit.

4.0 RESULTS AND DISCUSSION

Table 1: Comparison results of the analysis with WHO standard

S/N	PARAMETER	WHO
1	**TEMPERATURE**	
	30.0	Ambient (15-25^{O}C)
	30.0	Ambient (15-25^{O}C)
	29.9	Ambient (15-25^{O}C)
Mean	29.96	
2	**pH**	
	6.99	6.5-8.5
	6.91	6.5-8.5
	6.94	6.5-8.5
Mean	6.95	
3	**Turbidity (NTU^b)**	
	04.6	5.0
	10.1	5.0
	12.8	5.0
Mean	9.17	
4	**Conductivity µs/cm**	
	84.5	1000
	109.4	1000
	103.5	1000
Mean	99.13	
5	**Chloride mg/l**	
	55	100
	35	100
	28	100
Mean	39.33	
6	**Resistivity mg/l**	
	0.011	0.00
	0.009	0.00
	0.009	0.00
Mean	0.009	

Tables below shows the results of anova single factor to determine whether there are significant differences between the averages of water quality parameter sampled with WHO standard at 0.5% significant differences.

Table 2: Summary of ANOVA for temperature result for the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	89.9	29.96667	0.003333		
Column 2	3	75	25	0		
ANOVA						
Source of Variation	***SS***	***Df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	37.00167	1	37.00167	22201	1.22E08	7.708647

Within Groups	0.006667	4	0.001667			
Total	37.00833	5				

Table 3: Summary of ANOVA for turbidity result of the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	27.5	9.166667	17.46333		
Column 2	3	15	5	0		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	26.04167	1	26.04167	2.982439	0.159245	7.708647
Within Groups	34.92667	4	8.731667			
Total	60.96833	5				

Table 4: Summary of ANOVA for pH result of the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	20.84	6.946667	0.001633		
Column 2	3	25.5	8.5	0		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	3.619267	1	3.619267	4431.755	3.05E07	7.708647
Within Groups	0.003267	4	0.000817			
Total	3.622533	5				

Table 5: Summary of ANOVA for Conductivity result of the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	297.4	99.13333	169.3033		
Column 2	3	3000	1000	0		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	1217341	1	1217341	14380.59	2.9E-08	7.708647
Within Groups	338.6067	4	84.65167			
Total	1217680	5				

Table 6: Summary of ANOVA for Chloride result of the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	118	39.33333	196.3333		
Column 2	3	300	100	0		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	5520.667	1	5520.667	56.23769	0.001692	7.708647
Within Groups	392.6667	4	98.16667			

Total	5913.333	5				

Table 7: Summary of ANOVA for Resistivity result of the water samples

Anova: Single Factor						
SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Column 1	3	0.029	0.009667	1.333E06		
Column 2	3	0	0	0		
ANOVA						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	0.00014	1	0.00014	210.25	0.000132	7.708647
Within Groups	2.67E-06	4	6.67E-07			
Total	0.000143	5				

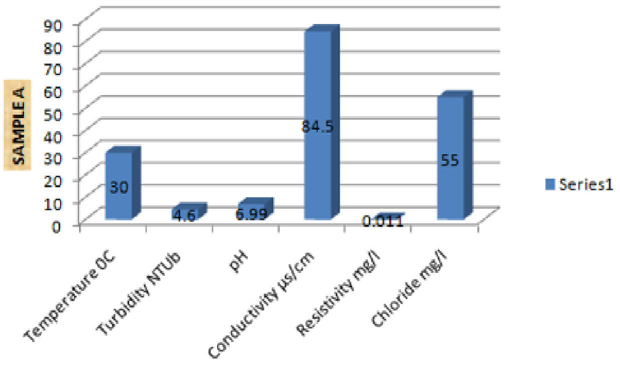

Figure 2: Graph of sample A against parameters

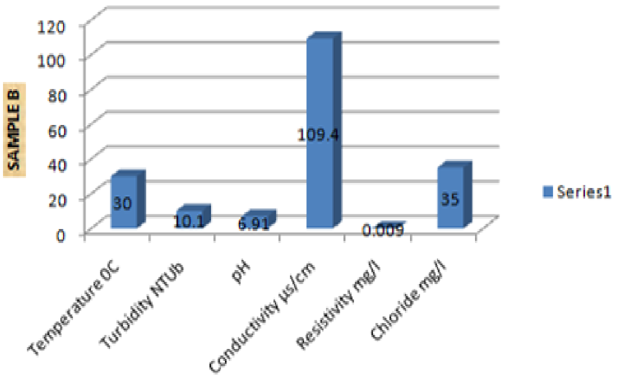

Figure 3: Graph of sample B against parameters

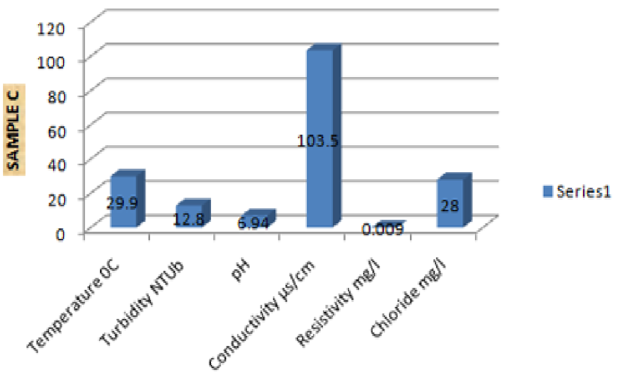

Figure 4: Graph of sample C against parameters

The temperature of water samples was all higher than the WHO recommended limits, as seen in Table 1 above. Statistically the values of temperature for the three different locations and WHO recommended limits were statistically not significant at $p \leq 0.05$ as seen from table 2. The mean temperatures of the three different locations were also not significant. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. The higher temperatures are ascribed to the high-level climatic status of the region because it is located at the tropical region. Because of this high-level temperature, there is increased growth of micro-organisms which leads to the presence of taste, colour and odour in the water.

The turbidity of water samples was all higher than the WHO recommended limits, as seen in table 1. Except sampling point A, which is within WHO recommended limit. Statistically turbidity of the samples is not significant at $p \leq 0.05$ as seen from table 3. The mean turbidity of the three different locations was also not significant. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. The high-level turbidity of the obizi river was because of the fast speed at which the river flows. Fast flowing rivers carries more particles than slow flowing rivers, indicating that the river is polluted with plants and animals remains, undersurface feeding fish, algae blooms and flooding. Turbidity is without doubt connected to total suspended solids, but doesn't amount to high turbidity and the other way around [14]. According to Jason et al., [15] high turbidity is accordant with high suspended solids. Turbidity of obizi river is above the WHO recommended limit for drinking water quality.

The pH of water samples was all higher than the WHO recommended limits, as seen in table 1 above. Statistically the values of pH for the three different locations were statistically not significant at $p \leq 0.05$ as seen from table 4. The mean pH of the three different locations was also not significant. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. pH which is a measure of the acidity or alkalinity of a water sample and since the pH of the river is above WHO recommended limits, this shows that the pH of obizi river is acidic and will not be good for drinking. pH is mostly affected by the pollutant discharged into the river by anthropogenic activities.

The conductivity of water samples was all higher than the WHO recommended limits, as seen in table 1 above. Statistically the values of conductivity for the three different locations were statistically not significant at $p \leq 0.05$ as seen from table 5. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. The mean conductivity of the three different locations was also not significant. The conductivity in water is caused by disintegration of limestone and other minerals containing carbonate [16].

The chloride of water samples were all within WHO recommended limits, as seen in table 1. Statistically the values of chloride for the three different locations and WHO recommended limits were statistically significant at $p \leq 0.05$ as seen from table 6. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. The mean chloride of the three different locations was also significant. Chloride naturally occurs when metal that is in water reacts with hydrochloric acid if not, it shows that the water is contaminated. Chloride can also be found in water as a result of anthropogenic activities.

The resistivity of water samples were all within WHO recommended limits, as seen in table 1. Statistically the values of resistivity for the three different locations and WHO recommended limits were statistically significant at $p \leq 0.05$ as seen from table 7. Figure 2, shows the results of upstream effluent discharge entry into the river, Figure 3, shows the results of main effluent effluent discharge entry into the river while Figure 4, shows the results of downstream effluent discharge entry into the river. The mean resistivity of the three different locations was also significant. Resistivity can be found in water as a result of anthropogenic activities.

5.0 CONCLUSION

Because we are in the era of civilization today, the way we deal with water management is of great important because of its usefulness and the negative impact it has on human lives when consumed the contaminated water. Because of the mere truth that water is life. Everyday aquatic systems all over the world receive polluting runoffs of domestic, industrial processes, fertilizers, pesticides, sewage, and mining drainage. Obizi river flows through many communities along with several tributaries and some man-made canals. Along this channel, rapid industrialization is taking place day by day and so this most peaceful area is changing in industries and urbanization. Most drains of these industries carry effluents from factories and also from adjacent residential colonies with their sewage which is finally discharged into obizi river and its tributaries. This research was conducted to determine the wallop of agricultural and industrial activities on obizi river through analyzing the some of the physicochemical properties, which include temperature, turbidity, pH, conductivity, chloride and resistivity. The analysis done have the following findings: The mean values obtained for all the parameters showed that some parameters are within WHO recommended limit while some parameters were above WHO recommended. The higher values obtained was as a result of waste discharge into the river from anthropogenic activities, which can present serious health danger to the communities who rely on obizi river as their source of domestic water without treatment.

6.0 RECOMMENDATIONS

1. Adequate monitoring of the obizi river qualities for traces of the contamination.
2. Government should ensure that waste are not dumped in obizi river by instituting an enforcement delegation.

3. Proper awareness should be done to educate the community on the danger of consuming the obizi river before treatment.

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