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Phyisco-Chemical Characteristics and Macro Invertebrates of River Benue at Makirdi, Benue State, Nigeria

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Abstract:
Indiscriminate dumping of wastes into rivers without control measures is widely practiced in the developing nations of the World as it is observed in River Benue at Makurdi. To ascertain the health status and integrity of River Benue at Makurdi, water samples and sediments were collected monthly from five different locations on the shoreline of River Benue at Makurdi for a period of two years (July 2011-June 2013). The physico-chemical quality of the water samples were examined using standard methods (APHA, 1999). The sediments were examined for the presence and absence of macro benthic fauna. The results of the physico-chemical parameters indicate the river water samples with the following characteristics: Conductivity (92.97±118.15µS/cm), pH (6.63±0.84), TDS (46.90±60.50mg/L),TSS (62.42±61.57mg/L), Colour (276.50±163.42TCU), Turbidity (63.08±53.01NTU), Temperature (28.74±1.89^{0}C), Bicarbonate (147.89±111.37mg/L), Chloride (148.79±84.27), Nitrate (3.23±4.21mg/L), Sulphate (13.51±14.72mg/L), Phosphate (1.27±1.77mg/L) and Copper (0.19±0.27mg/L). The mean values were generally within the WHO and the Nigerian Standard for Drinking Water Quality accepted maximum limit except for colour and turbidity. The result of ANOVA for all the parameters was significant (P<0.05), except temperature, bicarbonate, nitrate, sulphate, phosphate and copper that were not significant (ANOVA, P>0.05). The result of the sediments showed that a total of 4,451 macro benthic fauna individuals comprising of 4 phyla and 21 taxa were obtained. Athropoda(90.16%) had the highest population of individuals as compared to the other phyla: Annelida (4.74%), Mollusca (3.39%) and Platyhelminthes (1.71%). There was generally low biodiversity of benthic fauna community which indicate the perturbed nature of the study area. A significant relationship at some instances was noticed between benthic fauna group and some physico-chemical parameters indicating association between benthos and hydrochemistry of River Benue. It is recommended that the discharged of effluents and other waste into the River Benue should be controlled and enforced.

***Keywords**: Physico-chemical, Macro invertebrate, River Benue*

1. Introduction

The health of the ecosystem is determined by the taxanomic composition of the community as well as its diversity. Benthic macro fauna are those organisms that live on or inside the deposit at the bottom of a water body (Barnes and Hughes, 1988, Idowu and Ugwumba, 2005). They are used to detect changes in the natural environment, monitor for the presence of pollution and its effect on the ecosystem in which organisms' lives and to monitor the progress of environmental cleanup (Otaway and Gray, 1996, Nkwoji *et al*., 2010). They are use in testing water bodies for the presence of contaminants (Nkwoji *et al*., 2010). Studies have shown that there is entwining relationship between surface water quality and macro invertebrate diversity (Teferi, *et al.,* 2013). The physico-chemical parameters of lakes, ponds and rivers have considerable effect on the aquatic life. These Parameters determine the productivity of a water body. Thus, a change in the physico-chemical aspect of a water body brings about a corresponding change in the relative composition and abundance of the organisms in that water (Adeyemi *et al*., 2009). All the same chemical and physical measurements used in evaluating water quality provide data that primarily reflect conditions that exists when the water sample was taken (Ikomi *et al.,* 2005, Muralidharan *et al.*, 2010). However, physico-chemical and bio monitoring are not mutually exclusive, an optimal limnological study involve both approach (Muralidharan *et al.*, 2010). This is because the biological community gives an indication of past conditions as well as the current situation of the aquatic ecosystem (Nkwoji *et al.*, 2010). Therefore, any negative effect caused by pollution in the community structure can in turn affect trophic relationship (Sharma and Chowdhary, 2011). An additional advantage of macro invertebrates' bio indicators is that they integrate stream conditions related to the flow and chemical characteristics as well as the cumulative impact of multiple potential contaminants (Yagow *et al*., 2006). Biological assessment is therefore a useful alternative for assessing the ecological quality of aquatic ecosystems since biological communities integrate the environmental effects of water chemistry, in addition to the physical and geo-morphological characteristic of rivers and lakes (Stevenson and Pan, 1999). As rural and urban communities in

Nigeria and Makurdi in particular continue to rely on surface water sources and shallow wells for their water needs, it is important to know the quality of the water they use as a means of advancing their health in the face of grinding poverty (Akaahan *et al.*, 2010). Apart from this the water quality is also determination for the well being of the fisheries resources is of paramount importance. This study will provide information and the quality of water in river Benue and account the benthic fauna diversity.

2. Materials and Method

2.1. Study Area

The River Benue with its source in the Cameroonian mountains flows westwards into Nigeria. It is the second largest river in Nigeria and measures approximately 310,000 Ha. It is about 1.488Km in length with alluvia fertile flood plains on either banks (Welcomme, 1986). The Benue River flows through Makurdi and confluence with River Niger at Lokoja the capital of Kogi state, Nigeria. Makurdi the capital city of Benue state is located on Latitude $7^0$41' N and Longitude 8^0 28' E. The size of the River Benue within Makurdi and major settlement runs through is approximately 671 meters (Udo, 1981). The rainfall seasons at Makurdi produces a river regime of peak flows from August to early October and low flow from December to April. The rainy season which last for seven months (April to October) has a mean annual rainfall ranging from 1200-2000mm (Nyagba, 1995). High temperature values averaging 28-33^{0}C are recorded in Makurdi throughout the year, most notable from March to April. Harmantan winds are accompanied with cooling effects mostly during the nights of December and January (Nyagba, 1995). All the same the periodic dust plumes associated with this time of the year may encourage surface water pollution (Nyagba, 1995). Five stations were selected along the river course at Makurdi , Benue state for this study as follows:

Site I(N07^0 43.663' E008^0 35.427'): it is located behind Coca cola plc plant along Gboko road and it is approximate 1.5 kilometers away from Site II

Site II (N07^0 43.615' E008^0 35.300'): it is located directly behind Benue Brewery Plc along at Kilometer 5 along Gboko road. This site is impacted by the brewery effluents generated from the factory into the river.

Site III (N07^0 43.649' E008^0 35.302'): this site is located behind Mikap Nigeria Ltd, a rice processing factory along Gboko road. It is approximately 1 kilometer away from Site II and 2.5 kilometers away from site I. This site receive effluents from the rice mill into the river

Site IV (N07^0 44.076' E008^0 32.840'): this site is located behind Wurukum abattoir close the new bridge across the river. Abattoir waste is washed directly into this site. Farming and sand dredging also take place at this site on routine bases.

Site V (N07^0 44.789' E008^0 30.624'): This site is located behind Wadata market along the river water course at Makirdi. Wastes from the heap refuse dumpsite behind the market are leached directly into the river.

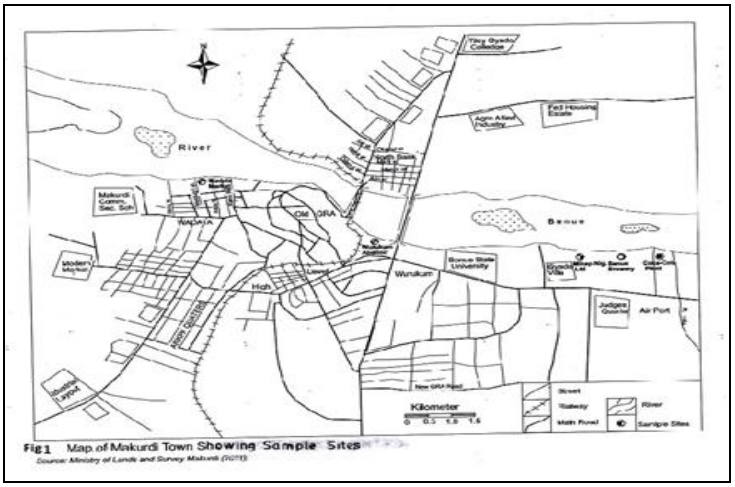

Fig1 Map of Makurdi Town Showing Sample Sites

2.2. Water Sample Collection and Analysis

Water samples for physico-chemical analysis were collected at five different points from each of the five sampling locations. Fortnightly routine sampling was conducted between 8:00am and 12:00 noon on each sampling day. The water samples for physic-chemical analysis were collected bottles of 1,500 mL capacity at the depth of 20cm. Sampling bottles and containers were rinsed three times with River water at each sampling site before sample collection. The water sampler was rinsed for about six times at each sampling site before the collection of the samples. Each sample container was treated according to the analysis to be carried out on it on the field before they were transported to the laboratory. Surface water temperature, TDS, Conductivity and pH were determined in situ on the field with measuring meters, while copper, nitrate, chloride, bicarbonate, sulphate, phosphate, TSS, turbidity, colour, and were examined in the laboratory using standard methods (APHA,1999).

2.3. Benthic fauna Sample collection and Analysis

Three successful hauls of benthic samples were taken from each station using a van Veen grab(0.1m^2) from an anchored boat with an out-board engine of 25 HP during the 24 months study period. The two shovels of the grab were held open by a small bar. The grab was then lowered into the river bed at the sampling sites. When the grab reaches the bottom of the river, the bar was

automatically released. The two shovels of the grab sampler were closed tightly with sand and mud captured in it. The content of the grab were emptied into a polythene bags, labeled properly and taken to the laboratory for sorting and analysis. In the laboratory the samples were sieved in order to remove fine sediments and any other extraneous material. Each of the sediment sample collected was washed three times in the Laboratory through three sets of sieves, 1st 2mm, then 1mm and finally 0.5mm mesh size sieves to collect the macro benthos in them(Esenowo and Ugwumba,2011). The retained macro benthos were poured into bottles and labeled properly. The benthic fauna samples were then fixed with 4% formaldehyde. The washed and preserved sediments with benthic invertebrates were poured into a white enamel tray and sorted out. The sorting was made effective by adding moderate volume of water into container to improve visibility (George *et al*., 2009). Large benthic fauna were picked out using forceps while the smaller ones were pipette out. The preserved animals were identified under light and stero dissecting microscope and counted. The identification was carried out using keys by Day (1967), Pennak (1978), Water and Rivers Commission, (2001) and Merit and Cummins (1996).

2.4. Data Analysis

Microsoft excel 2007 was used for graphical illustrations. Means were determined using SPSS version 20.ANOVA was determined to test the significant difference among means of water quality parameters across stations and between seasons.

3. Results

The result presented in Table 1 is the summary of the descriptive statistics of physic-chemical parameters indicating the minimum, maximum, mean values and standard errors of the parameters. Conductivity recorded the highest value of 1,071.00µS/cm, while copper had the least value of 0.00mg/L during the study period. The standard error around the means was substantially high and random among the physic-chemical parameters examined. Analysis of variance (ANOVA) was significant at 5% for most the parameters except for temperature, bicarbonate, nitrate, sulphate, phosphate and copper ($P>0.05$). Table 2 is the result of the correlation analysis of the Benthic fauna in River Benue at Makurdi. The result indicates that the Benthic fauna did correlate significantly with pH, surface water temperature and nitrate. However Mollusca correlated significantly with sulphate only. The data in Figure 2 depicts the benthic fauna composition in river Benue for two years. The result indicates the phylum Arthropoda had more benthic individuals as compared to the other phyla during the study period.

Parameter	Unit	Min	Max	Mean	Std. Error
Conductivity	µS/cm	9.90	1071.00	92.79	10.78
pH		5.00	9.00	6.63	0.07
TDS	mg/L	6.81	521.33	46.90	5.52
TSS	mg/L	5.00	410.00	62.42	5.62
Colour	TCU	23.00	580.00	276.50	14.92
Turbidity	NTU	3.00	258.00	63.08	4.84
Temperature	^{0}C	23.00	33.50	28.74	0.17
Bicarbonate	mg/L	40.00	880.00	147.89	10.17
Chloride	mg/L	35.47	546.03	148.79	7.69
Nitrate	mg/L	0.10	18.48	3.23	0.38
Sulphate	mg/L	0.80	90.00	13.51	1.34
Phosphate	mg/L	0.04	12.20	1.27	0.18
Copper	mg/L	0.00	1.45	0.19	0.02

Table 1: Descriptive statistics of Physico-chemical characteristics in River Benue at Makurdi

Parameter	Arthropoda		Annelida		Mollusca		Platyhelminthes	
	P≤0.01	P≤0.05	P≤0.01	P≤0.05	P≤0.01	P≤0.05	P≤0.01	P≤0.05
Conductivity	0.04	-0.19*	0.12	0.18	-0.09	0.34	0.04	0.18*
pH	0.01	0.94	0.08	0.41	0.01	0.93	0.13	0.17
TDS	0.04	-0.18*	0.11	0.24	-0.11	0.22	0.02	0.20*
TSS	0.03	-0.19*	0.14	0.12	0.05	0.56	0.12	0.17
Colour	-0.24	0.01	0.16	0.07	-0.06	0.52	0.01	0.22*
Turbidity	-0.34**	0.00	0.03	0.77	-0.09	0.28	0.13	0.15
Temperature	-0.13	0.17	-0.03	0.75	-0.02	0.76	0.03	0.78
Bicarbonate	0.00	0.98	0.26**	0.00	-0.08	0.33	0.02	0.22*
Chloride	0.03	0.72	0.25**	0.01	0.11	0.24	0.02	0.83
Nitrate	-0.17	0.06	0.07	0.47	0.04	0.68	-0.11	0.25
Sulphate	-0.25**	0.01	-0.00	0.98	0.04	-0.18*	0.04	0.66
Phosphate	0.06	0.53	0.03	0.19*	0.11	0.23	-0.04	0.66
Copper	-0.09	0.29	0.14	0.22*	0.09	0.29	0.24**	0.10

Table 2: Correlation between Physico-chemical parameters and Benthic fauna in River Benue at Makurdi

*.** Correlation is significant at the 0.01 level (2- tailed)*

** Correlation is significant at the 0.05 level (2-tailed)*

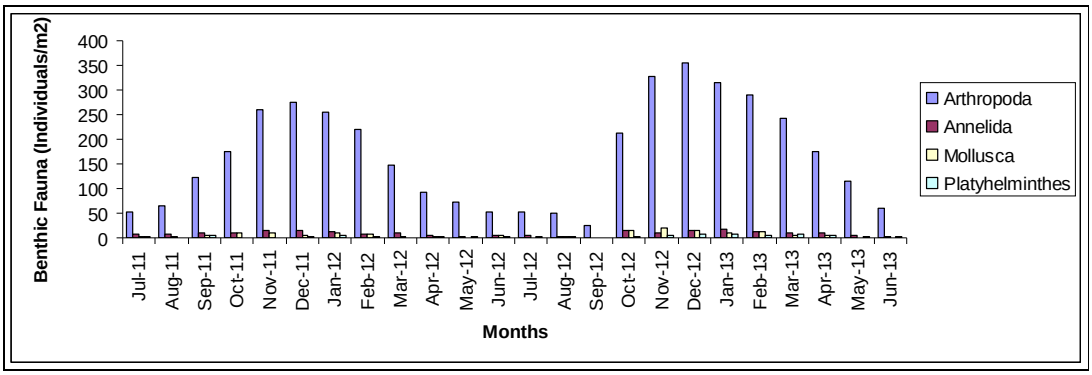

Figure 2: Composition of Benthic fauna along River Benue water course at Makurdi

4. Discussion

Conductivity indicates the presence of ions in the water which is usually due to the saline intrusion and leaching. The conductivity is an indispensable water quality parameter for indicating risks associated with salinity. The result of mean conductivity of water samples obtained in this study was 92.79 ± 10.78µS/cm. This result was below the maximum limit of 1000.00µS/cm specified by WHO and Nigerian standard for drinking water quality (WHO 2004, NSDW 2005). The mean conductivity result obtained in this study is slightly higher as compared to the result of the previous study in River Benue that reported mean conductivity value of 86.85 ± 2.43µS/cm (Eneji *et al.*, 2012). The mean conductivity result of this study may be due to lack of saline intrusion in River Benue at Makurdi. The result of this study however disagreed with that of Ezekiel *et al*. (2011). They reported higher mean values of conductivity of 4695.86 ± 2885.24µS/cm in Sombreiro River Niger Delta, Nigeria. Degefu *et al.* (2013) reported higher values of conductivity that ranged from 327.67 - 492.87µS/cm in the upper Awash River, Ethiopia. Nevertheless, the result of the conductivity of this study conforms to the result of an earlier study in River Kahuzi - Biega in Congo (Bagalwa *et al.*, 2012). Similarly the result of the conductivity reported by Emere and Nasiru (2007) of an urbanized stream Kaduna, Nigeria was in agreement with the findings of this study. This parameter does not give cause for concern and it makes the water suitable for aquaculture use.

The term pH indicate the alkalinity or acidity of a solution on a scale of 1-14. pH affects many chemical and biological processes in water (Vyas and Bhawsar,2013). The mean pH value of 6.63 ± 0.07 obtained during this study falls within the recommended range of 6.5 - 8.5 set by the WHO and National standard for drinking water quality in Nigeria (WHO 2004, NSDWQ 2005). Previous study in River Benue reported pH in the range of 5.9 - 6.8 (Okayi *et al.*, 2011). Similarly Eneji *et al.* (2012) reported the mean pH value of 7.01 ± 0.03 in River Benue at Makurdi. Higher pH values are an indicator of pollutant intrusion. The mean value of pH of this work shows that there is no intrusion of pollutants impacting on the study. The result of this study disagrees with that of Abowei (2010) who reported a pH range of 7.3 - 7.6 in Nkoro River, Niger Delta, Nigeria. Similarly, Indabawa (2010) reported a mean pH of 7.2 at Challawa River in Kano state which disagrees with the result of this study. However, the mean pH value of Sombreiro River conforms to the result of this study (Ezekiel *et al.*, 2011). Narasimha and Benarjee (2013) reported that pH range of 6.0-9.0 is suitable for fish culture and growth. This result agrees with the findings of this study as the pH obtained in river Benue during the study at most of the sample sites is suitable for the growth of the fish community.

The total dissolved solids (TDS) in water consist of inorganic salts and dissolved materials. High values of TDS may lead to change in taste of water and deteriorate plumbing and appliances. During the present investigation the mean TDS value of 46.90 ± 5.52 mg/L was obtained. This result falls within the WHO recommended value of 1000.00mg/L and 500.00mg/L of the National standard for drinking water quality (WHO 2004, NSDWQ, 2005). This results conforms to the result of an earlier study in River Benue which reported mean TDS value of 45.10 ± 1.13 mg/L (Eneji *et al.*, 2012). The low level of TDS during the study may be due to the low surface run off into the River. Dunsin *et al.* (2012) reported lower values of TDS of 18.50 ± 6.75 mg/L in a drainage channel in south western Nigeria. The TDS values obtained during the course of this study is suitable for fish culture and growth in River Benue (WHO 2004).

Total Suspended Solids (TSS) is an indication of the amount of erosion that took place nearby or upstream. In this study the mean TSS value of 62.42 ± 5.62 mg/L was recorded. However, this result disagrees with the earlier study in River Benue that reported mean TSS of 18.3 ± 14.00 mg/L (Eneji *et al.*, 2012). The concentration of TSS in this study is due to the level of surface run off in the River. Bilotta and Brazier (2008) reported that TSS in excess 8.00mg/L increased the rate of drift of benthic fauna in surface water. Based on the above findings the TSS concentration in River Benue during the course of this study may contribute to the drift of the benthic fauna in the River. The result of this study however disagrees with the result of an earlier study in River Illo, Ota Nigeria that reported higher value of total suspended solids 620.79 ± 288.45 mg/L (Longe and Omole, 2008). Similarly Ogunfowokan *et al.* (2005) reported TSS concentration of 333.33 ± 173.20 mg/L in a stream in south west Nigeria which is at variance with the findings of this present investigation. The TSS concentration of between 80-100Mg/L will cause injury to the gills of the fish.(Fadaeiferd *et al* ., 2012). The TSS concentration of the water samples at some instances may cause injury the gills of the fish of the River Benue.

Colour of water is vital as most water users be it domestic or industrial usually prefer colourless water. The mean value of colour obtained in this study was 276.50 ± 14.92TCU. This result exceeds the recommended standard of 15.00TCU set by WHO and National standard for drinking water quality in Nigeria (WHO 2004, NSDWQ, 2005). This parameter has no health effect but is

an indication that the water contains pollutants that are contributing to the colour of the water and affects the aesthetics of the water that leads to consumer rejection of the supply. Colour does not affect fish directly but it restricts light penetration and restricts aquatic plants growth (Olopade, 2013).

Turbidity in the water may be due to organic and or inorganic constituents. Also turbidity is often determined and used as surrogate measure of total suspended solids (Bilotta and Brazier, 2008). During this study the mean turbidity of 63.08 ± 4.84 NTU was obtained. This result exceeds the recommended standard value for turbidity of 5.00NTU (WHO 2004, NSDWQ 2005). However, this result disagrees with the findings of an earlier study in River Benue that reported a mean turbidity value of 4.88 ± 0.06 NTU (Eneji, *et al.,* 2012). The turbidity result of this present investigation may be due to surface run off into the River. Turbidity induced changes in the water body may change the composition of an aquatic community. Indabawa (2010) reported higher mean value of 550.00 NTU turbidity in Challawa River, Kano state Nigeria during his study which disagrees with the findings of this study. Gupta and Gupta (2006) reported that warm water fishes did not show any behavioural reaction until the turbidity get to 20,000mg/L. The values of turbidity obtained in this study may not affect the fish community in River Benue.

Surface water temperature is an indispensable ecological factor that regulates the physiological behaviour and distribution of aquatic organisms. Lower temperatures are reported to likely reduced metabolism and growth (Abowei, 2010). The present study record a mean surface water temperature of 28.74 ± 0.17^0C. This result agrees with the result of an earlier study in River Benue that reported surface water temperature mean value of 28.20 ± 0.06^0C (Eneji, *et al.,* 2012). Okayi *et al*. (2011) reported a surface water temperature that range from 20.00 - 23.10^0C in River Benue which is in disagreement with the result of this study. Abowei (2010) reported surface water temperature that varied from 27.00^0C – 31.00^0C in Nkoro River ,Niger Delta, Nigeria which is in conformation with the result of this study. A mean surface water temperature of 31.00^0C was reported in the Challawa River which disagrees with the result of this study (Indabawa, 2010). The surface water temperature range in this study may be attributed to the atmospheric temperature within Makurdi metropolitan area that was obtained at Nigerian Meteorological Agency Makurdi. The average monthly atmospheric temperature ranged from 14.50 - 38.20^0C during the study period. Although WHO does not set any limit value for surface water temperature higher values in water above 30.00^0C may lead to the suppression of all benthic organisms (Ishaq and Khan, 2013).

Bicarbonate (HCO_3^-) is one of the major chemical constituents that make up 99 percent solute content of natural water. In this present study the mean bicarbonate concentration of 147.89 ± 10.17mg/L was obtained. This result is in disagreement to the findings of Sharma and Chowdhary (2011) who reported mean bicarbonate concentration 471.16 ± 221.40 mg/L in Himalayan River, Tawi. The bicarbonate result obtained in this present study may be due to the anthropogenic impact of wastes that contain bicarbonate substances into the River. Alkalinity of natural water is due to bicarbonate. Low alkalinity is for low production, medium alkalinity for medium production and high alkalinity is for high production (Olopado, 2013).

Chloride is widely distributed in nature in the form of sodium, potassium and calcium chloride. Chlorides are naturally found in all types of water and it may be as a result of dissolving minerals. Higher concentration of chloride in natural fresh water can cause water to have an objectionable salty taste, corrode water plumbing system and has laxative effect on humans that consume such water. Such concentration of chloride is observed to be an indication of pollution from chloride sources like organic waste of animal origin and effluents from industries (Eneji, *et al.,* 2012). In this present investigation the mean chloride concentration of 148.79 ± 7.69 mg/L was obtained. This result disagrees with the findings of an earlier study in River Benue that reported mean chloride concentration of 1.26 ± 0.05 mg/L (Eneji *et al.,* 2012.). Studies have revealed that chloride concentration above 100.00mg/L in the water may burn the edges of the gills of a fish with a long term effects. Therefore the acceptable limit is 0.00mg/L (Bhatnagar and Devi, 2013). The chloride concentration of the water samples obtained at the sample sites during this study may burn the edge of the gills of the fish at these sites. However the mean chloride value obtained in this study is below the recommended chloride standard of 250.00mg/L for drinking water quality (WHO 2004, NSDWQ 2005). Sharma and Chowdhary (2011) reported mean chloride ion concentration of 36.81 ± 12.78mg/L in Himalayan River, Tawi. The mean chloride value obtained in this study may be due to the wastes that may leach chloride into the River. Chloride concentration beyond 250.00mg/L is reported to impacts a peculiar taste to water making it unacceptable for consumption (Saxena, 1987).

Bicarbonate is the oxidized form of nitrogen and end product of decomposition of organic matter. The presence of nitrate in a lotic system mostly depends on the activity of nitrifying bacteria, stream currents and the characteristics of the catchments area, domestics and agricultural sources. Water with high nitrate content may cause methemoglobinemia (blue - baby syndrome) and such waters should not be consumed by pregnant women or infant. In this study, the mean concentration of nitrate was 3.89 ± 0.29 mg/L. This result is far below the recommended standard of 50.00mg/L nitrate for safe drinking water quality (WHO, 2004, NSDWQ, 2005). Similar trends of nitrate were reported in surface waters (Agboola and Dunloye, 2011, Ogidiaka *et al.* , 2012). The mean nitrate value in this study may be due to the activities of nitrifying bacteria in the River. Other studies even reported lower nitrate concentration in the surface waters (Sharma, *et al*., 2013).

Sulphur is present in natural waters as sulphate. During the present investigation mean sulphate ion concentration of 13.51 ± 1.34 mg/L was obtained. This concentration was far below the 250.00mg/L recommended value set by WHO and 100.00mg/L by National standard for drinking water quality in Nigeria (WHO 2004, NSDWQ 2005). Sulphate is found in fertilizers and can lead to water pollution due to increased sulphate concentration in water body that is washed from the farm (Shinde *et al*., 2011). Sulphate in surface water is also leached from runoff containing relatively large quantities of organic sulphur compounds. (Shinde *et al.,* 2011). The supply of sulphate ions in surface water under natural conditions are due to reactions of water with sulphate containing rocks, biochemical and chemical radiation of sulphides and a few sulphur compounds. (Shinde *et al.,* 2011). Shinde *et al*. (2011) reported sulphate concentration which varied from 14.08 - 19.83mg/L. This result disagrees with the findings of this study. The sulphate ion concentration in the present study may be due to run off of fertilizers from the farms on the catchments of

the River Benue into the water as was observed during the course of the study. Sulphate is a source nutrient that facilitates the growth of planktons that support the fish population in River Benue.

Phosphorus is present in the form of phosphate in natural waters and generally occurs in low concentration. Phosphorus is a nutrient for plant growth and a fundamental element in the metabolic reaction of plants and animals (Shinde *et al*., 2011). Phosphorus also controls algal growth and primary productively in surface waters. In most natural waters, phosphorus usually ranges from 0.005 - 0.020 mg/L (Shinde *et al.*, 2011). Algae require only small amounts of phosphorus. However, excess amounts of phosphorus can result to eutrophication leading to excessive algal growth (Shinde *et al*., 2011). In the present study period, mean phosphorus concentration of 1.21 ± 0.16 mg/L was obtained. This result was not in agreement with the result of earlier study in River Benue that reported mean phosphate concentration of 5.34 ± 0.32 mg/L (Eneji *et al.*, 2012). All the same, Okayi *et al*. (2011) reported phosphate in River Benue in range of 0.07 - 0.17mg/L. Similar higher trends of phosphorus in the range of 2.60 - 5.56 mg/L were reported in Abesan River, Lagos (Agboola and Denloye, 2011).Nevertheless the result of this study agrees with that of Ogunpa River at Bodija, Ibadan Oyo State (Ogidiaka *et al*., 2012). Similarly, Alagua and Aleleye (2012) reported a mean phosphorus value of 0.05 in a Creek in Niger Delta, which disagrees with the result of this study. Dunsin *et al.* (2012) reported low values of less than 1.00 mg/L of phosphorus during their study period. In this present investigation, plausible reasons for the concentration of phosphate determined may be probably attributed to surface water runoff. Phospahate in water is source of nutrient for the growth of planktons which may serve as source of food for the fish and increases their population in River Benue.

Copper is an important element that facilitates the action of some enzymes in the body of humans. It is essentially important in the synthesis of catecholamine. During this study a mean copper concentration of 1.45±0.27mg/L was obtained. This mean copper concentration is below the WHO and National standard for drinking water quality in Nigeria (WHO 2004, NSDWQ 2005). The result of this study disagree with the findings of an earlier study in River Benue at Makurdi that reported a mean copper concentration of 0.056mg/L (Eneji *et al*., 2011). Possible sources of copper in river Benue may be due to the municipal waste and lecahtes that are washed into river through the activities of man.

The major factor that affects the occurrence and distribution of benthic fauna in lotic and lentic systems include, physico-chemistry, the nature of the substrate, (bed material), water current, food availability, flood, drought, vegetation and shade (Hussain and Pandit, 2012). Nevertheless during this present study surface water temperature, pH and nitrate did not correlate significantly with any of the benthic fauna group throughout the study period. All the same other studies reported significant correlation between surface water temperature, pH nitrate and benthic fauna group (Ishaq and Khan, 2013; Mohan *et al*., 2013). The lack of significant correlation between surface water temperature, pH nitrate, and benthic fauna during this study may be due to other environmental variables are interacting with the benthic fauna groups.

5. Conclusion

The study revealed that parameters like conductivity, TDS, colour, turbidity, chloride, sulphate and phosphate had higher values beyond standard at some instance which is indication of a polluted environment. More so the pysico-chemical parameters were noticed to be correlating significantly with the benthic fauna which is indication that the physico-chemistry of the river Benue is impacting the benthic fauna community in the river. It is recommended that proper management of the river should be put in place to prevent water quality and bio diversity of the river for sustainable development.

6. References

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