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Physicochemical and microbialstatus of Nworie River, Owerri, Imo State, Nigeria

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ABSTRACT

The physicochemical and microbial status of NworieRiver was investigated. Resultsobtained for physiochemical status showed that aside pH, conductivity, aluminium and iron at some of the sampling points, other physicochemical parameters investigated in this study were blow WHO standards. Pathogenic organisms such asKlebisiella sp.,Vibrocholerae, Proteus sp., and non-pathogenic organisms such as Eschericha coli,Bacillus sp., were among the organisms identified. The pathogenic organisms found in the river water could be agents of water borne diseases. The present study has shown the physicochemical and microbial status of NworieRiver.

Keywords: Physicochemical status, microbial status, pathogenic organism,Nworie River.

INTRODUCTION

The rate at which water bodies are being polluted is now a thing of concern to all stakeholders [10]. In developing countries, high population growth has led to increased human activities. These activities have cumulated to indiscriminate dumping of refuse, waste disposal, etc[8, 9]in water bodies hence, making accessibility and availability of clean and uncontaminated water difficult [14, 20, 21]. Surface water bodies are the most threaten of all the natural water bodies by human activities [11, 13, 16, 25, 26]. In Nigeria, committee of hydrologists and environmental experts are on ground fashioning out ways to reduce the threat posed to water bodies by human activities [12].

NworieRiver, a river that flows throughOwerri, the capital city of Imo State in south-eastern Nigeria and its environs, is among the surface water bodies threaten by human activities. It lies between latitude 5^{o}28N and 5^{o}31N. The river flows in the city through Federal Medical Centre (FMC), AlvanIkoku Federal College of education (AIFCE) and Holy Ghost College all in Owerri, and empties into another river, the OtamiriRiver. There is no doubt that the river is vulnerable to a variety of waste discharged from all these institutions. NworieRiver also receives large quantities of pollutants from human activities such as laundering, bathing, etc. Runoffs also carry solid wastes such as plastics, polythene, pure water sachets, agrochemicals from farm lands surrounding the river, etc, into the water body during rainfall.

Due to the importance of the this river to the local population as fish ground and above all as a source of water for domestic purposes, especially when public water supply fails, this study investigated the level of pollution of NworieRiver using its physicochemical and microbial status.

MATERIALS AND METHODS

Water sample collection

The water samples for the analysis were collected from NworieRiver at four sampling points. The sampling points were designated A, B, C, and D. The sampling points wereat least 150 meters apart. The sampling was done in the

evening against the water current. At each sampling point, twelve composite samples were collected and pooled as a sample. The samples for physicochemical analysis were taken in clean sterile tubes with caps in duplicates, using hand gloves. Water samples for microbial analysis were asceptical collected using sterile tubes. Dissolve oxygen bottles were used to collect samples for dissolved oxygen determination.

Physicochemical characteristicsdetermination

pH, temperature, and conductivity were determined *in situ* using Jenway (model type HANNA 1910)multipurpose tester. Total solid (TS), total dissolved solid (TDS), total suspended solid (TSS) were determined using the methods of [2]. Dissolved oxygen (DO) was determined using the method of [3]. Total hardness and alkalinity were determined using titrimetric methods as described in [1]. Chloride was done using Argentometric method. Sulphates and nitrate were determined using the colometric methods. Metals such as calcium, magnesium, aluminium, and iron were determined using Atomic Absorption Spectrophotometric (AAS) methods as contained in [3].

Microbial analysis

The collected water samples were inoculated on different culture media using the spread plate technique as described by [5] after serial dilution. Organisms isolated were identified according to [4].

RESULTS AND DISCUSSION

Table 1: Physicochemical characteristics of NworieRiver

Parameters	A	B	C	D	WHOStandards
pH	7.01±0.02	6.56± 0.06	5.69±0.12	5.80± 0.01	6.50-8.50
Temperature(^{o}C)	25.10±1.01	26.13±0.91	25.84±0.84	26.11±0.47	20-30
Totalhardness(mg/l)	22.00±0.78	18.60±0.63	21.36±1.09	36.01±1.03	500.00
TS(mg/l)	75.50±2.11	96.22±1.96	272.78 ±2.43	356.16±2.02	500.00
TSS(mg/l)	11.29±0.24	17.08±0.52	21.36±0.76	36.01±0.80	50.00
TDS(mg/l)	64.21±1.90	79.14±1.21	251.00±0.50	320.06±0.71	250.00
Conductivity(mg/l)	102.90±0.49	125.83±0.02	402.27±0.04	513.08±1.00	100.00
DO(mg/l)	3.60±0.01	1.50±0.03	1.21±0.16	3.42±0.18	10.00
Alkalinity (mg/l)	19.81±2.95	17.32±1.44	13.82±0.96	33.28±0.63	600.00
Sulphate (mg/l)	3.00±0.15	1.82±0.98	1.20±0.00	4.01±0.17	250.00
Nitrate (mg/l)	0.10±0.07	0.40±0.10	0.20±0.10	0.20±0.05	10.00
Chloride (mg/l)	7.60±0.31	15.11±1.01	13.08±0.54	18.93±0 62	250.00

Results are mean and standard deviation of triplicate determinations

The physicochemical characteristics of a water body are important in the determination of its productive capacity and effect on the biota [16]. Consumption of low pH (Table 1) water could lead to acidosis, which results in peptic ulcer [9]. The low pH observed in C and D sampling points could be as result of human activities. These activities may have caused the death of some aquatic life forms. These aquatic life forms release proteins including ammonia upon death and decay. The released ammonia dissolved in water hence causing a drastic change which manifest as low pH [8, 9, 22, 25, 32]. Temperature of water is important in terms of its intended use. For instance drinking water should have temperature range of 20-30^{o}C [28]. Temperature range (25.10- 26.13^{o}C) of Nworie River falls within WHO standard for drinking water. Water hardness was originally described as the soap-destroying power of water, caused by the presence of calcium and magnesium salts. Consumption of hardness water could set up problem in the system. [23]noted that degree of water hardness (dH) is determined by the concentration of calcium carbonate. Total hardness range (10.01- 22.00 mg/l) of the studied river falls within 1-2 degree of water hardness hence indicating the soft nature of the river water [29]. Solids found in a water body exist as total, suspended, or dissolved[15]. Total solid (TS), an estimate of whole solids in a water body as observed in Nworie River ranged between 75.50-356.17 mg/l. Some of these observed solids existed as un-dissolved suspended solids (11.29- 36.01 mg/l) as observed in the present study and most dissolved to form dissolved solids (64.21-320.16mg/l) as the case with Nworie River. Consumption of water with high solid could lead to gastrointestinal upset, which may pave way for other gastrointestinal diseases [1]. Conductivity is related with total dissolved solids in a water body. [1] noted that for estimates of conductivity of water, total dissolved solids are divided by a factor range 0.55-0.90. The high conductivity values observed in C and D water sampling points could be attributed to high dissolved solids observed at the points. Dissolved oxygen (DO), is the oxygen present in a dissolved form in a water body [23]. It is labile and can be easily be reduced by carbon compounds to form carbon (IV) oxide (CO_2). It is generally related to the ability of a water body to hold aquatic life forms [1, 23]. Dissolved oxygen levels of Nworie River were lower than that of WHO standard. Alkalinity of water is primarily due to carbonate, bicarbonate and hydroxide content [1]. Sulphate, nitrate, and chloride in water are indicators of agrochemical usage on lands surrounding the river. These may have entered the river as runoff during rain fall.Aside alkalinity that results in unpleasant taste, consumption of sulphate, nitrate and chloride polluted water could result in gastrointestinal irritation, infantile methaemoglobinaemia, etc, in

the system. [1, 15,24]. The observed values for alkalinity, sulphate, nitrate, and chloride in this study were lower than WHO standards.

Table 2: Some metal composition of Nworie River (mg/l).

Metal	A	B	C	D	WHO Standards
Calcium	0.05± 0.01	0.10±0.03	0.31± 0.01	1.49±0.67	200.00
Magnesium	0.03± 0.00	0.01± 0.00	0.06± 0.01	0.31±0.00	150.00
Aluminium	0.12 ± 0.05	0.18 ± 0.04	0.62± 0.08	0.83± 0.02	0.2
Iron	0.20 ± 0.06	0.34 ± 0.07	0.56 ± 0.12	0.38± 0.01	0.3

Results are means and standard deviation of triplicate determinations

Table 2 revealed the presence of calcium (0.05-1.49mg/l), magnesium (0.01-0.31mg/l),aluminium (0.12-0.83 mg/l) and iron (0.20-0.56mg/l). Calcium and magnesium in water impairs its taste, and can result in gastrointestinal irritation, which may be severe in the presence of sulphate [1, 15, 24]. Aluminium has been implicated in demenia and iron known for water discolouration, astringent taste and possible gastrointestinal diseases on consumption [1, 25].

Table 3: Microorganisms identified and isolated from Nworie River water

Microorganism	A	B	C	D
Escherichia coli	+	+ +	+ + +	+ + +
Klebsiella sp.	+ +	+	+ +	+ +
Proteus sp.	+	+	+ +	+ + +
Shigella sp.	+	+	+	+
Salmonella sp.	+	+	+	+
Staphylococcus epidermidis	+	+ +	_	_
Bacillus sp.	+	+ +	_	+
Chromobacteria sp.	_	_	_	_
Vibrocholerae	+	+	+ +	+ +
Pseudomonas aeruginosa	+	+ +	+	+
Citobacter sp.	+	+ +	+ +	+ +

+++ = Present in high concentration;++ = Present in moderate concentration;+ = Present in low concentration; - = Absent

[15, 30] noted that microorganisms are commonly present in surface water. [30]further noted that wide range of indigenes species of microorganisms is usually present in water. This is line with present study. Organisms such as *Eschericha coli*, *Klebisiella sp.*,*Vibrocholerae*, *Proteus sp.*, *Shigella sp.*,*Salmonella sp.*,*Staphylococcus epidermidis*, *Bacillus sp.*,*Pseudomonas aeroginosa*, and *Citobacter sp.*,(Table 3) were among the wide range of organisms identified and isolated from Nworie River water. The presence of these microorganisms has practical significance in terms of human activities [31]. For instance, *Escherichacoli*signifies faecal coliform contamination of a water body [17, 31]. *Eschericha coli*, *Klebisiella sp.*, *Proteus sp.*, *Shigella sp.*, *and Salmonella sp.*, belong to the family known as*Entrobacteriaceae*[27]. Their presence in water indicates faecal waste contamination [6]. The presence of microorganisms in water becomes important when their health impact is considered. Aside *Eschericha coli* and some *Bacillus sp.*, Most Microorganisms have been implicated as a causative agent of one waterborne disease or the other. For instance,*Salmonella sp.*, *Shigella sp.*, and *proteus sp.*, are the causative agents of typhoid fever, dysentery and urinary tract infection respectively [6, 7, 27].*Staphylococcus epidermides* causes wound infection and endocarditis[7]. [6]noted that the presence of number of microorganisms in water depends on the contamination and the ability of the organisms to survive or multiply.*Vibrochlorae*, *Pseudomonas aeruginosa*, and *Citobacter sp.*, identified in the present study further indicate the presence of more pathogens in Nworie River. The differences observed in concentrations of these organisms could be as a result of human activities. The presence of these identified organisms in Nworie River may be an indication of possible water borne diseases such as typhoid fever, cholera, dysentery, etc on consumption of water from the river by humans.

CONCLUSION

The present study has shown the Physicochemical and microbial status of Nworie River, Owerri, Imo State. Although most of the investigated physicochemical parameters were blow WHO limits yet those depend on the river should always purify and sterilize the water from the studied river before usage in order to free it from both physicochemical and microorganism contaminants.

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