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Original Research Article

Microbial and Physicochemical Assessment of New Calabar and Ogba Rivers in Rivers State Nigeria

Confidence Waribo Ihua[1], John Nwolim Paul[2*], Idawarifa Frank Cookey-Gam[3], Victor Chikeobi Osi[4], Richard Owen Obinna[5], Williams Chinedu Onuegbu[4], Gospel Chimenma Dimkpa[3], Ibiso Bruce[6], Mboi Stanley Samuel[7], Chioma Akunnaya Ohanenye[8], Ann Nwala[9], Chimezunem Mandah[2], Priscilla Nyekpunwo Ogbonda[3]

[1]Department of Human Physiology, Faculty of Basic Medical Sciences, College of Medicine, David Umahi Federal University of Health Sciences, Uburu, Ebonyi State, Nigeria
[2]Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria
[3]Department of Public Health Science, Faculty of Basic Medical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria
[4]Institute of Geoscience and Environmental Management, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria
[5]Department of Human Kinetics, Health and Safety Education, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt, Rivers State, Nigeria
[6]Department of Community Medicine, Faculty of Clinical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria.
[7]Department of Dental Health Science, Rivers State College of Health Science and Management Technology, Rumueme, Port Harcourt, Rivers State, Nigeria
[8]Department of Anatomy, College of Medicine and Health Sciences, Rhema University, Nigeria
[9]School of Foundation Studies, Department of General Studies, Rivers State College of Health Science and Management Technology, Rumueme, Port Harcourt, Rivers State, Nigeria

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Abstract: Microbial and physicochemical analysis of New Calabar and Ogba Rivers was done. The results showed that the microbial and physicochemical parameters varied in some parameters such as pH, temperature, biochemical oxygen demand (BOD), Dissolved Oxygen (DO) that were within WHO acceptable limit as well phosphates and nitrates that were low according WHO. It is also evident in this study that physicochemical parameters varied between raining and dry seasons but both rivers were more contaminated and polluted during dry season. Generally New Calabar and Ogba rivers are contaminated with waste products and heavy microbial loads. It is therefore recommended that proper monitoring and control of rivers by the government should be encouraged.

Keywords: Microbial, Physicochemical, New Calabar, Ogba.

INTRODUCTION

The World Health Organization (WHO) analyses quality of water to be a pollution free and suitable for consumption (WHO, 2021). It is the quality that made it consumable and free from contaminants (WHO, 2021). Water contamination is a very serious issue which predisposes users to diseases (Mendel, 2020). Consumption of contaminated water is detrimental to our health, the health of aquatic animals and ecosystem (Mendel, 2020).

Several parameters in water could be regarded as contaminants, water pollution indicators, water quality deterioration indicator (Mendel, 2020).

The microbial and physicochemical parameters often analysed in water include phosphate, bicarbonates, sodium, potassium, nitrates, sulphates, chloride, pH, temperature turbidity, acidity, alkalinity, dissolved oxygen (DO), biological and chemical oxygen demand, electrical conductivity amongst others (Alalibo *et al*., 2018).

New Calabar Rivers are seriously undergoing economic and biological activities that can release pollutants and contaminants to the river which in turn can undermine the water quality predisposing the users to several degrees of dangers (Nwochigouri *et al*., 2023). In view of the above, it became paramount to assess the extent and level of physicochemical and microbial

***Corresponding Author:** John Nwolim Paul
Department of Human Anatomy, Faculty of Basic Medical Sciences, College of Medical Sciences, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt, Rivers State, Nigeria

parameters of New Calabar Rivers to ascertain the level of contamination of the river.

MATERIALS AND METHODS

Study Areas

Samples were collected from New Calabar Rivers such as Choba, Ozuoba, in Obio-Akpor Local Government Area as well as Ikiri, Omoku, in Ogba-Egbema-Neloni Local Government Area of Rivers State.

Sampling Techniques

Samples were collected from River banks at specific locations. All the samples were collected using a test tube. The sample collection was done within six (6) months interval intensively. Samples were made up both wet and dry samples.

Estimation of Physicochemical Parameters

Temperature was measured using thermometers; water pH using pH meters; electrical conductivity measured using conductivity metre, turbidity measured using turbidometre; gravimetric methods were used to determine both total dissolve solids and total suspended solids. Both dissolved oxygen and biochemical oxygen demand were measured using Winkler's method.

Bacterial load and its Quantification

By segmenting bacteria within macrophages and measuring the area occupied by bacterial fluorescence, it is possible to assess the relative bacterial load per cell. The bacterial load was quantified using the following formula:

$$\text{Bacterial load (CF}\mu\text{/g)} = \frac{number\ of\ CF\mu\ on\ plate\ x\ 103}{Dilution}$$

High bacterial load is an indicator of bacterial overgrowth associated with conditions such as bacterial vaginosis and cytolytic vaginosis (Gerum, 2018).

High bacteria load defined in this study as greater than 10^4 colony forming units CFμ per gram of tissue (Gerum, 2018).

RESULT AND DISCUSSION

Table 1: Physicochemical parameters in dry season (mean value)

Parameter s	Choba	Ozuboa	Ikiri	Omoku
Water pH	7.11±0.22	7.00±0.11	6.11 ±1.22	6.1±1.33
Temperature	29.2±0.55	32.13±1.26	31 ± 0.08	29.0±0.72
EC	850.1±3.3	770±29.9	700±0.67	710±0.18
Turbidity	5.22±0.48	5.00±0.44	4.9±0.35	4.5±0.14
Chlorides	126±5.0	124.12±4.1	121±5.2	12±0.14
Alkalinity	16±1.4	15.5±4.2	14.8±3.8	13.8±4.8
Acidity	4±0.06	3.4±0.17	3.0±0.18	2.8±0.16
Phosphates	1.5±1.5	1.0±0.06	1.1±0.16	1.0±0.22
Sulphates	300±50.15	280±0.18	279±1.8	269±1.9
Nitrates	5.0±0.67	4.2±0.78	4.0±0.8	3.9±0.8
BOD	9.2±0.58	8.8±0.42	7.2±0.5	7.4±0.4
DO	8.4±0.3	7.5±0.4	6.6±0.4	5.9±0.33

Choba had the highest mean value for water pH, EC, Turbidity, Chlorides, Acidity, Phosphate, Alkalinity, Sulphates, Nitrates, BOD, & DO. While, Ozuoba had the highest mean temperature.

Table 2: Physicochemical parameters in wet season (mean value)

Parameter s	Choba	Ozuboa	Ikiri	Omoku
pH	5.8±0.11	5.1±0.18	5.7±0.11	5.5±0.12
Temperature	20.4±0.4	18.1±0.13	19±0.11	17.2±0.11
EC	6.00±22	599±0.33	550±1.23	500±0.33
Turbidity	3.8±0.11	3.2±0.12	3.7±0.33	3.3±0.24
Chlorides	100±2.3	99±1.33	97±1.44	96±0.33
Alkalinity	11±1.3	10±0.18	10.1±1.88	9.2±1.22
Acidity	2±0.01	2.5±1.11	2.5±0.11	2.8±1.00
Phosphates	0.5±0.11	0.9±1.00	0.8±2.00	1.0±1.00
Sulphates	2.00±4.5	188±1.22	186±1.00	182±1.76
Nitrates	3.2±0.07	3.1±0.88	2.9±1.11	2.7±1.33
BOD	5.2±0.18	4.9±0.19	4.6±0.18	4.5±0.18
DO	5.6±1.88	5.3±1.99	5.1±1.88	5.0±0.01

Choba had the highest mean value for water pH, Temperature, Turbidity, Chlorides, Alkalinity, Nitrates, BOD, & DO. While, Ozuoba had the highest mean for EC, Sulphate. Omoku recorded the highest Acidity and Phosphate.

Table 3: Microbial load of New Calabar and Ogba River (>10^4) (Dry season) (MEAN VALUE)

Microbes	Microbial Load	Extent of Microbial Load
S. aureus	10^6	HEAVY BACTERIAL
H. influenza	10^7	HEAVY BACTERIAL
P. aeruginosa	10^6	HEAVY BACTERIAL
S. maltophilia	10^8	HEAVY BACTERIAL
E. Coli	10^7	HEAVY BACTERIAL
S. Typhi	10^8	HEAVY BACTERIAL

S. maltophilia and *S. Typhi* were most frequent, while the least frequent microbial load was *S. aureus* and *P. aeruginosa.*

Table 4: Microbial Load of New Calabar and Ogba Rivers (>10^4) (Raining season) (MEAN VALUE)

Microbes	Microbial Load	Extent of Microbial Load
S. aureus	10^8	HEAVY BACTERIAL
H. influenza	10^7	HEAVY BACTERIAL
P. geruginosa	10^9	HEAVY BACTERIAL
S. maltophilia	10^7	HEAVY BACTERIAL
E. Coli	10^8	HEAVY BACTERIAL
S. Typhi	10^9	HEAVY BACTERIAL

P. geruginosa and *S. Typhi* were the most frequent microbial load, while *H. influenza*, and *S. maltophilia* had the least load.

DISCUSSION

The results of physiochemical and microbial parameters obtained from water samples from New Calabar Rivers during the dry and wet seasons across the rivers are presented in table 1, 2, 3, and 4. The results revealed variations across the measured parameters.

When Table 1 and Table 2 values were compared, it revealed that pH, temperature, EC, DO, BOD, COD, chloride, alkalinity, acidity, salinity and sulphate levels recorded across locations in dry season were higher than the levels recorded in wet season for New Calabar Rivers. In contrast, the average turbidity, phosphate and nitrate recorded across locations in wet seasons.

pH values in some locations in the dry season and all the samples in wet season is below the recommended range according to World Health Organization (2018). It is also in consonance with the study of Mendel, (2020).

The seasonal variation in pH attributed to rain water and aquatic photosynthetic activities the temperature range is within the recommended values by WHO, 2018. It is also in agreement there is a little decrease in electrical conductivity during wet season and this is due to dilution from rain water while higher electrical conductivity during dry season may be due to dissolved solids and tidal effects as well as increase heat and this is in consonance with the study (Aladinma, 2018).

Turbidity in both rivers is above the WHO set or recommended values. Higher turbidity in the rivers during wet season is an indication that organic matters were discharged into rivers during wet season. Waste products deposited in the river is the reason for the increase turbidity.

From Table 3 and Table 4, it is revealed that there is heavy microbial load in the rivers during wet and dry season. This has led to pollution and contamination of the water bodies and this is in consonance with work of Igwe, 2018 who stipulated that heavy microbial loads in the rivers leads to water contamination and pollution and predisposes the users to infection. The level of DO recorded in dry season meets the WHO recommendations while DO and BOD levels in dry and wet seasons went below the required and recommended values and it is in consonance with similar work carried out Jumatin *et al.,* 2018 who reported same in her study.

Higher BOD is due to released decayed organic matter, nutrient, microbial load.

Excessive sulphate concentration in rivers indicates high release of domestic matters and is in consonance with some studies who reported lower things. Lower nitrate level was recorded and this is inconsonance with similar study on Ogba river who reported low nitrate concentration in dry land.

The levels of phosphate and nitrates concentrations indicate increase load of waste matters rich in nutrients. The level of variations in the microbial and physicochemical parameters across the sampling

points and between seasons showed that New Calabar rivers receives waste at different locations as well as different degree. It is evident in this study that New Calabar River is contaminated due to heavy loads of microbes.

CONCLUSION

This study succeeded in evaluating the quality of New Calabar and Ogba Rivers. The pH, temperature, DO, BOD and turbidity were beyond the recommended WHO values as accepted worldwide. Chloride, sulphate also recorded a rise in threshold values. Nitrates were low according to WHO. Generally New Calabar and Ogba rivers are contaminated with waste products and heavy microbial loads.

RECOMMENDATIONS

i. Proper monitoring and control of the rivers should be encouraged to guide against waste deposits in the New Calabar River.
ii. Portable water should be provided to the people of the regions by government and non-governmental organization, this will go as far as reducing infection.
iii. Infection control units should be established in the regions to prevent death.

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