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MICROBIOLOGICAL OVERVIEW OF THE MAJOR SURFACE WATER SOURCE IN THE EASTERN NIGERIAN METROPOLIS

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Abstract
The physico-chemical and microbiological characteristics of water samples from major surface water source in the Eastern Nigeria metropolis were examined. The results obtained revealed that the level of phosphate ions, total solids, total hardness, and turbidity were higher than WHO standards for portable water. Similar observations were made with the number of coliforms. There was significant difference between the values obtained from the sampling sites at 5% significant level. The results from sanitary survey and the laboratory analysis clearly indicated that the activities of man around the surface water led to its pollution.
Keywords: Microbiological overview, Major, Surface water, Source

Introduction

The major surface water (niger, oji, ava, ibono, imo, anambra, ebonyi)riversand the tributariesare nearly always polluted but their lotic nature helps to reduce their pollution to the bearest minimum. Water pollution occurs actually when the self-purifying powers are unable to remove materials added to it (1). All domestic, industrial and agricultural wastes have affected in some way the normal life of a river(2).Polluted water is not merely dangerous for human consumption; it can also lead to infection in plants, animals and articles of food (3). Water pollution by chemical and other industrial effluent pose serious problem to man (8).

Metropolis in Eastern Region of Nigeria is known for industrial and commercial activities. As a result of the industries and the open market activities, it is like bee-hive, thickly populate withheterogeneous groups of individual (8). These rivers and the tributaries acts as the terminal disposal point for most of the industries. The aim of the study is to have analyse microbiological overview of these rivers being the major surface water source in the eastern region, Nigeria.

MATERIALS AND METHODS

The six selected sampling points and reports on the sanitary surveillance were shown (Table 1).

Duplicate subsurface samples were collected from these points for both physico-chemical and microbiological analyses.These water samples were collected with clean (sterile) plastic containers for physico-chemical analysis and sterile conical flasks for microbiological analysis. The samples were collected six times over a period of six months.

Physico-Chemical Characterization

Physical and inorganic parameters were determined. Physical parameters included temperature, pH and conductivity. Inorganic parameters include potassium, chloride, phosphate, nitrate, sulphate, iron (Fe^{2+}) and calcium (Ca^{2+}).

Physical parameters:

Temperature: The estimation of the temperature of the six samples was done directly at the sample points using thermometer calibrated in degree centigrade (Celsius).

Conductivity: This was determined by using model 16300 conductivity meter from Hach chemical company, (1979).

pH: The pH was determined by using the Hach DRI calorimeter/pH+ with standard buffer solution of pH 4.0 and 9.0.

Total solids: One hundred ml of water samples was evaporated to dryness in preweighed beakers at 90^0C to constant weight. The difference in weight between the beaker containing the dried sample and the empty beaker represented the total solids. The beakers were left to cool in a desiccator before weighing.The results were expressed in milligram total solids per litre of sample.

Inorganic parameters: The levels of phosphate ions were determined using spectrophotometer with already calibrated standards by Hach chemical company (4). The parameters involving the use of titration method (cartridge digital) included total hardness and chloride ions.

Microbiological parameters:

Solid and liquid media were used in isolating the organisms present in the water samples. Inhibitors such as cycloheximide (antidione) 0.5mg/l and streptomycin-penicilline 30units each/ml were added to the media prepared for the growth of bacteria and fungi respectively (10).

Total viable aerobic plate count; Enumeration of total viable bacteria (Coliforms and *Escherichiacoli*) and fungi by means of plate count was carried out in each water sample. Twenty milliliters of sterile nutrient agar, macConkey agar and Sabouraud Dextrose Aga (SDA) were each dispensed into sterile petri dishes and left to solidify. Then 0.1ml of ten-fold serially diluted samples were placed on the solid agar surface and spread by means of a sterile L-shaped (bent) glass rod. Duplicate plates were incubated at 28^0C+2^0C and 44^0C for 24-48 hours in aerobic atmospheres (10).

Isolation and Characterization of Bacteria

The samples were inoculated on the appropriate media with a sterile wire-loop. These cultures were incubated at 28^0C+2^0C, 37^0C and 44^0C in aerobic atmospheres. Pure cultures were used for the characterization. The characterization was based on the criteria contained in CRC Handbook of Microbiology (10), Bergy's Manual of Determinative Bacteriology (7) and Laboratory Methods in food and Diary Microbiology (10).

The isolates were distinguished on the basis of:

a. Cultural characteristics
b. Morphology and staining reactions
c. Biochemical reactions

Statistical analysis: Analysis of Variance (ANOVA) was done with the mean values obtained for the various physico-chemical parameters and total microbial count using the method stipulated (9).

Table 1: Sampling Station with Sanitary Surveillance

Points	Location	Surveillance
1	Within commercial areas	Refuse clump around the river, bathing, noticeable algal bloom, washing of cloths and working tools
2	Outskirt commercial areas	Farm activities at the bank, bathing, refuse and house whole debris
3	Textiles, industrial areas	Effluent discharge from industry, farm activities around the bank
4	Military Barracks	Effluent and sewage discharge, animal and human effluents
5	Out-skirt human settlement	Debris, dead animal, fishes and fossils
6	Behind towns and villages	Transportation of people across the river by canoe. Men and women blood and burnt candle littered, refuse dump etc, waste of all sorts, both human and animal feaces found everywhere within the river.

RESULTS:

Physico-chemical parameters:

There was a slight variation in the temperature values in the sample points over monitoring period. Sample point I had a lower value than others with 24^0C. Sample points 2 and 3 had lower pH values than others with 5.5 and 6.9 respectively. There were marked variations in the values recorded for conductivity in the various points with 212ms/cm (Table 2).

Maximum value for total solids was recorded for sample point 3 with 800mg/L. There was also marked variation in the values recorded for total hardness with maximum values of 236mg/L for sample point 6. Sample point 5 recorded lower values for phosphate ions than others with 0.15mg/L. Sample point 6 recorded the maximum value for chloride ion concentration with 70.00mg/L (Table 2). It was observed that there were no significant differences with temperature and pH values at $P<0.05$. There were significant differences with conductivity, total hardness, and

phosphates and chloride values at P<0.05.

Table 2. Mean values of physic-chemical parameters of the water samples

Sp	Temp ^{0}C	pH	Conductivity	Total solids mg/L	Total hardness mg/L	(PO_4^{3-}) mg/L	(cL) mg/L
1	24	7.0	15	100	26	0.45	18.50
2	28	5.5	50	600	30	0.35	50.00
3	30	8.5	25	800	60	0.018	24.00
4	26	7.5	31	100	26	0.30	25.00
5	28	6.9	45	300	110	0.15	26.50
6	28	8.0	212	416	237	0.22	70.00

Sp = Sampling Points

Table 3. Total Viable aerobic microbial counts

Sampling points	Fungi x 10^3cfu/mi		Bacteria x 10^3cfu/mi	
	37^{0}C	28^{0}C	37^{0}C	28^{0}C
1	Ng	1.40	0.61	0.72
2	Ng	6.00	1.40	1.60
3	2.00	4.60	4.20	5.00
4	0.50	4.10	3.50	0.36
5	1.50	1.50	0.85	0.89
6	Ng	Ng	0.77	0.84

Ng = No growth

Microbiological Parameters

It was observed that sample points 1 and 2 yielded no fungal growth at 37^{0}C. Similarly point 6 yielded no fungal growth at both 37^{0}C and 28^{0}C (Table 3).

The maximum bacterial growth count was recorded for sample point 3 at 28^{0}C with 5.00 x 10^3cfu/mL. Similarly the maximum fungal count was recorded for sample point 3 at 28^{0}C with 4.6 x 10^3cfu/mL (Table 3).

It was also observed that *flagellates*, *chlamydomonas* and *streptocomycetesboris* were isolated from the samples.

Table 4. Mean total viable aerobic plate counts for E.coli and coliforms.

Sampling points	Total coliforms x 10^3cfu/mL	E.Coli x 10^3cfu/mL
1	0.47	0.17
2	1.30	0.13
3	3.80	2.30
4	2.20	0.16
5	0.68	0.15
6	0.35	0.11

Discussion and Conclusion

The temperature values recorded for the sampling points did not exceed the range as stipulated by WHO standards for drinking water (9). There was no significant difference between the values recorded over the monitoring period at $P<0.05$. This could be attributed to the fact that rivers in the eastern region of Nigeria are flowing surface water body.

Similarly pH values were within the range stipulated by WHO standard (9). There was only an exception which was the value recorded for sampling point 2 with pH 5.5. These could be attributed to tree flowing of water. There was marked variation in the conductivity values and also significant differences in the means of the values recorded for different points.

The total solid values recorded for sampling point 2 and 3 were higher than the correlated positively with high biochemical oxygen demand and intensified odours and testes (6 and 5).

Solids that settle out of solution blanket the stream-bed smothering bottom organismsand hindered the reproductive cycle of fishes (4). Sampling 5 and 6 recorded total hardness values higher than the highest desirable level of WHO standard (9). This makes the water samples unfit for human usage for cloth washing. This is because the causative agents for hardness, calcium ions and magnesium ions precipitate soap and reduce its cleansing effects.

The water samples are also not fit for industrial use because they could cause scale in water distribution mains and hot water heaters (10). The phosphate levels in all the water samples were above the WHO standards (9) including that the phosphate ions were pollutants.

It was observed that all the water samples contained more than stipulated number of coliforms per 100ml. The water samples are contained *Escherichiacoli* which is an indicator of feacal pollution

(9).

In conclusion, the result revealed that, only temperature and some pH values were within the stipulated range of WHO standards for drinking water. Other parameters – conductivity, total solids, total hardness and phosphate recorded pollutant level values. In addition, all the water samples contained *Escherichiacoli*, which is a faecal indicator organism. It is therefore evidenced that the water samples were both faecally and organic matter polluted, and therefore not fit for human consumption.

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