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***Original Research Article***

# Determination of Physico-Chemical Parameters of River Majowopa, Sagamu, Ogun State, Nigeria

**Mary Sunday Dauda, John Olukunle Olaofe***

*Department of Chemistry, Faculty of Science, University of Abuja, Abuja, Nigeria*

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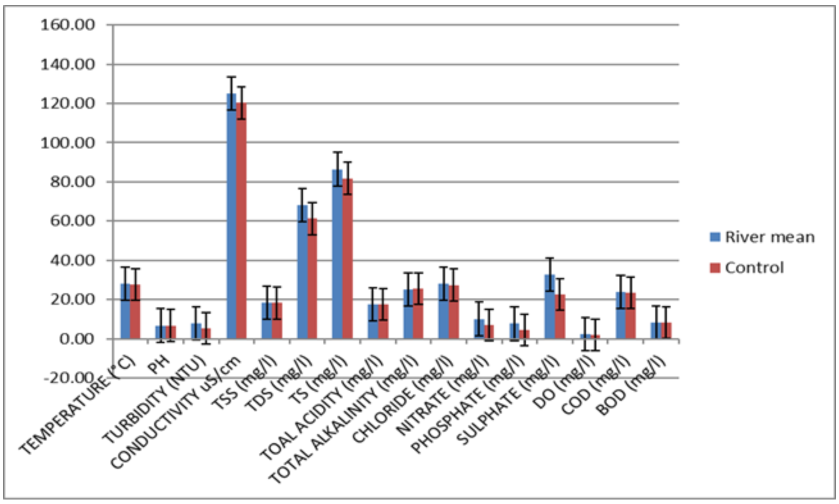
**ABSTRACT**

In this study, the physicochemical parameters of the river Majowopa were determined. The parameters assessed are temperature, pH, turbidity, conductivity, total dissolved solids (TDS), total suspended solids (TSS), total solids (TS), total acidity, total alkalinity, chloride, nitrate, phosphate, sulphate, dissolved oxygen (DO), chemical oxygen demand (COD) and biochemical oxygen demand (BOD). The obtained result revealed that the average value of the parameters analysed are; temperature (27.99±0.51 °C), pH (6.76±0.08), turbidity (7.69±2.51 NTU), conductivity (124.90±18.42 uS/cm), TSS (18.29±2.27 mg/L), TDS (68.17±13.63 mg/L), TS (86.46±13.95 mg/L), total acidity (17.57±2.37 mg/L), total alkalinity (25.23±6.23 mg/L), chloride (27.91±1.92 mg/L), nitrate (10.14±2.28 mg/L), phosphate (7.62±1.85 mg/L), sulphate (32.72±0.87 mg/L), DO (1.60±0.55 mg/L), COD (23.79±5.45 mg/L), BOD (8.31±3.65 mg/L) and that these values are within the WHO allowed limits except for turbidity (7.69±2.51 NTU), nitrate (10.14±2.28 mg/L), phosphate (7.62±1.85 mg/L) and DO (1.60±0.55 mg/L). One-way analysis of variance (ANOVA) carried and the 95% confidence level revealed that the value of each parameter was significantly different (P<0.05) from one site to another. The variation of each parameter observed along the river was as a result of pollution from activities that take place along the river bank and the vicinity of the river.

**GRAPHICAL ABSTRACT**




* Corresponding author's E-mail address: kunlex32@yahoo.com

## Introduction

The rate of water pollution over the years is very alarming. Water pollution has caused several health and environmental challenges especially in Nigeria and other developing countries, led to over 4.6 million deaths from water borne disease and a few number of cases of ascariasis [1]. Kajogbola *et al.* [2] observed that the prominence of measles, pneumonia, malaria, chicken pox and dysentery were the main cause of morbidity at Ibadan, Nigeria. The study also showed that the leading killer diseases in Ibadan are related to solid waste management which over time has been aided by poverty, low standard of living and ignorance. Waste management is a major problem in most third world countries of the world including Nigeria [3]. Indiscriminate disposal of municipal wastes has remained a major threat to surface water in Nigeria [4]. Generally, above 80% of the sewage generated worldwide is discharged without adequate treatment into the environment [5]. Many cities in the developing countries have been developed without adequate and proper planning, this has led to indiscriminate actions including dumping of wastes into water, washing, and bathing in open rivers [6].

Water pollution happens when unwanted substances find their ways into water bodies such as streams, lakes, wells, rivers, boreholes, and fresh water stored for domestic or industrial use. The major pollutants are often pesticides, herbicides, pathogens, silt and suspended solid particles such as soils, disposed foods, sewage materials, automobile emissions, cosmetics, construction debris and eroded matters from river bank and other waterways. Microbial activities through oxidation and other processes normally decompose some of these pollutants; re-concentrations of these unwanted harmful materials back into the natural food chain now becomes the major problem [7]. Sangodoyin *et al.* [8] studied the water quality levels of both Ogunpa river water and dug wells along the Ogunpa river in Ibadan, Nigeria, and observed that the water quality as determined by various quality parameters are below the acceptable standards. Millions of people in the world, especially in the developing countries are losing their lives every year from water borne-diseases [9]. The benefits of renewable freshwater to humans include water for drinking, irrigation, industrial uses, production of fish, and for such in-stream uses as recreation, transportation and waste disposal [10]. The assessment of water quality is therefore a vital tool to manage land and water resources within a particular catchment [11].

Sagamu is a fast growing industrial town with underground deposits of limestone, which is used majorly in cement production while cocoa and kola nuts are the major agricultural products in the area. Sagamu is an urban area and one of the largest cities in Ogun State. Some major rivers that traverse the area are including the Ibu, Eruwuru and Majowopa river. River Majowopa is characterized with a good number of laundry workshops operating at the river bank.

This research work is aimed at determining the physicochemical parameters of the water samples collected from Majowopa river.

## Experimental

### *Materials and methods*

All the reagents used for this research work were of analytical grade. The sampling site was Majowopa river in Sagamu town. Several activities took place at different locations along the bank of this river which include water fetching, bathing, laundry and carwash. The field survey covered a distance of 1300 m along the river and samples were collected along downstream from five identified locations marked Site A, Site B, Site C, Site D, Site E and control Site K which is 500 m upstream of the study area. The Geo-coordinates of the sampling sites were noted using Digital Compass 1.0 device and map was generated using

GooglpMaps 9.47.3. The map is depicted in Figure 1.

Sample collection and treatment at each location; six composite samples were collected at a depth of 0-15 cm using sample bottle prewashed and properly labelled and then transferred immediately into an ice bath [12]. The temperature and pH were measured at the point of collection and the samples were transferred into a deep freezer to be carried to the Laboratory.

Determination temperature and pH were determined using Hanna Hi 98130 (pH meter combo). Other parameters were determined using the APHA standard methods [12].

**Figure 1.** Map of Sagamu


**Table 1.** Description of the Sampling site

| S/N | Site | Location | Geo-Coordinates |
|---|---|---|---|
| 1 | Site A | Beginning of the study Area | 6°51′28″ N, 3°38′51″ E |
| 2 | Site B | 200 meters downstream of site A | 6°51′25″ N, 3°38′59″ E |
| 3 | Site C | 200 meters downstream of site B | 6°51′23″ N, 3°39′05″ E |
| 4 | Site D | 200 meters downstream of site C | 6°51′30″ N, 3°38′10″ E |
| 5 | Site E | 200 meters downstream of site D | 6°51′17″ N, 3°39′17″ E |
| 6 | Control site K | 500 meters upstream of site A | 6°51′54″ N, 3°38′44″ E |

**Table 2.** Physicochemical properties of river Majowopa

| S/N | PARAMETERS | A | B | C | D | E | K |
|---|---|---|---|---|---|---|---|
| 1 | TEMPERATURE (°C) | 27.10±0.00 | 28.38±0.04 | 28.17±0.05 | 28.13±0.05 | 28.17±0.05 | 27.55±0.05 |
| 2 | PH | 6.80±0.09 | 6.73±0.05 | 6.65±0.08 | 6.75±0.12 | 6.85±0.05 | 6.73±0.05 |
| 3 | TURBIDITY (NTU) | 4.77±0.45 | 7.83±2.20 | 11.60±0.58 | 7.70±0.76 | 6.57±0.57 | 5.33±0.52 |
| 4 | CONDUCTIVITY uS/cm | 102.63±6.14 | 148.78±5.01 | 136.73±7.91 | 112.67±1.37 | 123.67±8.47 | 120.22±0.56 |
| 5 | TSS (mg/L) | 20.57±1.61 | 19.73±3.03 | 18.10±1.01 | 14.63±0.58 | 18.43±2.05 | 18.23±0.15 |
| 6 | TDS (mg/L) | 54.23±2.41 | 66.47±3.28 | 85.70±4.16 | 56.33±3.36 | 78.10±6.01 | 61.25±1.02 |
| 7 | TS (mg/L) | 74.80±3.34 | 86.20±5.25 | 85.47±4.05 | 70.97±3.16 | 96.53±4.66 | 81.77±1.04 |
| 8 | TOTAL ACIDITY (mg/L) | 18.00±2.97 | 17.83±0.75 | 19.17±1.33 | 13.50±0.84 | 19.33±1.03 | 17.45±0.69 |
| 9 | TOTAL ALKALINITY (mg/L) | 26.00±4.43 | 33.00±2.61 | 24.00±2.00 | 15.83±0.75 | 27.33±2.94 | 25.60±0.59 |
| 10 | CHLORIDE (mg/L) | 27.22±1.50 | 26.75±1.06 | 30.63±0.96 | 25.87±0.55 | 29.08±0.40 | 27.43±0.68 |
| 11 | NITRATE (mg/L) | 11.40±2.13 | 13.43±1.20 | 7.70±0.47 | 9.32±0.46 | 8.83±1.25 | 6.88±0.37 |
| 12 | PHOSPHATE (mg/L) | 5.80±0.62 | 6.00±0.49 | 10.10±0.80 | 8.87±0.61 | 7.33±0.43 | 4.45±0.46 |
| 13 | SULPHATE (mg/L) | 31.77±0.29 | 32.20±0.40 | 33.12±0.67 | 34.00±0.39 | 32.53±0.56 | 22.48±0.49 |
| 14 | DO (mg/L) | 1.83±0.21 | 0.92±0.51 | 2.38±0.29 | 1.52±0.08 | 1.35±0.18 | 2.03±0.18 |
| 15 | COD (mg/L) | 28.33±1.51 | 20.33±1.86 | 31.00±1.79 | 19.47±1.68 | 19.83±1.17 | 23.38±0.65 |
| 16 | BOD (mg/L) | 8.67±1.55 | 13.58±2.54 | 9.45±1.29 | 5.60±0.54 | 4.23±0.81 | 8.20±0.09 |

MEAN±SD, n=6

## Results and discussion

The result of the physicochemical properties indicated a moderately low temperature in all the samples. The cool water was generally more palatable than hot water and at high water temperature, the growth of micro-organisms was enhanced which will in turn affect the taste, colour and odour of the water [13]. The average pH of river Majowopa ranged between 6.65±0.08 and 6.85±0.05, all through the five sites and were within the WHO permissible limit (6.5-8.5) for drinking water [14]. However, the mean pH at each site was found to be slightly acidic which could be resulted from the industrial pollution from the production of $SO_2$ which have been precipitated by rain to make the water of the river acidic [13]. The pH was also influenced by exchange of $CO_2$ with the atmosphere, $CO_2$ is water soluble and the amount of $CO_2$ that will dissolve in water will be a function of temperature and concentration of $CO_2$ in air [15]. The aqueous $CO_2$ will be converted to H2CO3, this will increase the acidity of the water from being neutral to slightly acidic [16] and most metals will become soluble in water as the pH decreases [15].

The mean turbidity observed in this study was higher than the WHO limit (5 NTU). This is highly influenced by particulate matter and suspended particles which might be due to the deposition of some organic matters into the water from the laundry workshops and drainages. The increased turbidity makes the water prone to water borne diseases. This is because the suspended solids become a place of hiding and protection for contaminants from disinfection either by chlorination or UV [17].

The electrical conductivity fluctuates as we move downstream from site A to E and have its maximum value at site B, which is mostly influenced by the dissolved salt solids and concentration of ions. Meanwhile DO was lowest at site B and the average DO observed in this study (1.60±0.55 mg/L) was below the WHO limit for drinking water. Water organisms continually consume oxygen in the water to aid their food digestion thereby decreasing the dissolved oxygen and thus microbial activity decreases downstream [12]. Nitrate and phosphate concentrations observed in this study are above the WHO safe limit for drinking water. Nitrates, phosphates, and xenobiotic organic compounds are commonly present in waste water from laundry washing [20].

**Table 3.** Mean of Physicochemical properties with control site and WHO standards

| Comparison of river mean with control site and who standards | | | | |
|---|---|---|---|---|
| S/N | Parameters | RIVER MEAN | CONTROL | Who standards (for surface water) |
| 1 | Temperature (°C) | 27.99±0.51 | 27.55±0.05 | <40.00 |
| 2 | PH | 6.76±0.08 | 6.73±0.05 | 6.50-8.50 |
| 3 | Turbidity (NTU) | 7.69±2.51 | 5.33±0.52 | 5 |
| 4 | Conductivity (uS/cm) | 124.90±18.42 | 120.22±0.56 | 1000 |
| 5 | TSS (mg/L) | 18.29±2.27 | 18.23±0.15 | 30 |
| 6 | TDS (mg/L) | 68.17±13.63 | 61.25±1.02 | <1000.00 |
| 7 | TS (mg/L) | 86.46±13.95 | 81.77±1.04 | 1000 |
| 8 | Total acidity (mg/L) | 17.57±2.37 | 17.45±0.69 | - |
| 9 | Total alkalinity (mg/L) | 25.23±6.23 | 25.60±0.59 | 200 |
| 10 | Chloride (mg/L) | 27.91±1.92 | 27.43±0.68 | 250 |
| 11 | Nitrate (mg/L) | 10.14±2.28 | 6.88±0.37 | 10 |
| 12 | Phosphate (mg/L) | 7.62±1.85 | 4.45±0.46 | 5 |
| 13 | Sulphate (mg/L) | 32.72±0.87 | 22.48±0.49 | 250 |
| 14 | DO (mg/L) | 1.60±0.55 | 2.03±0.18 | 2.00 (min) |
| 15 | COD (mg/L) | 23.79±5.45 | 23.38±0.65 | 200 |
| 16 | BOD (mg/L) | 8.31±3.65 | 8.20±0.09 | 50 |

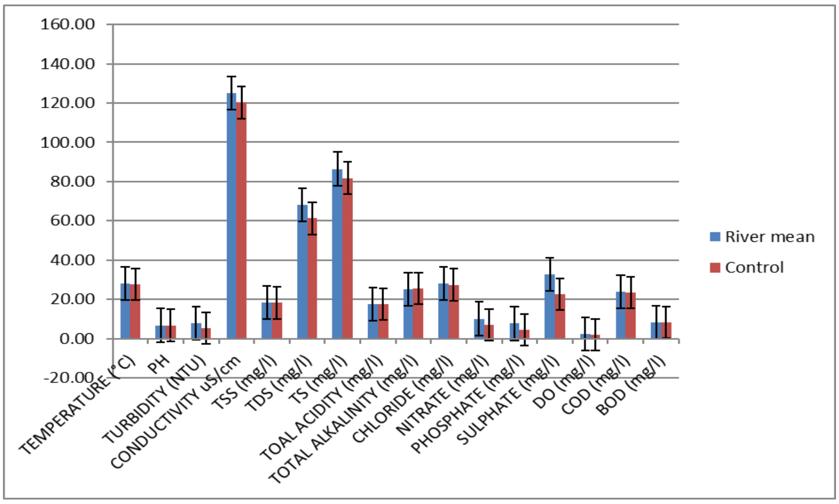



**Figure 2.** Comparison of Physico-chemical parameter of River Majowopa with the control site

Higher concentration of nitrate is toxic to aquatic life and nitrate pollution may cause eutrophication of the stream [16]. Phosphates are not as toxic as nitrate but phosphate may cause eutrophication. The low nutrient SO42- loads also explains the low to moderate levels of BOD and COD requirement. COD ranged between an average value of 19.47±1.68 mg/L and 31.00±1.79 mg/L while BOD level is between 4.23±0.81 mg/L and 13.58±2.54 mg/L. These levels of BOD and COD were similar with the findings of Ali *et al.* [18], and were within the WHO guideline levels.

The concentration of the total dissolved solids (TDS) observed in river Majowopa ranged between 54.23±2.41 mg/L and 85.70±4.16 mg/L with an average of 68.17±13.63 mg/L which are all within the WHO standards [14]. When the total dissolved solids (TDS) concentration is high, it poses no health threat because TDS is a secondary standard for drinking water and it will perform more of an aesthetic function rather than a health threat. A high TDS value may also indicate dissolved ions concentration which may cause the water to be salty or have brackish taste, corrosive, resulting in scale formation and consequently decreasing the performance of water heaters [19]. The mean range of chloride concentration (26.87±0.55 – 30.63±0.96 mg/L) recorded in the study were found to be much lower than that of the WHO limits of 250 mg/L for chloride.

In this study, the level of acidity of the river was ranging from 13.50±0.84 mg/L to 19.33±1.03 mg/L, which was in agreement with the observed slightly acidic pH. Drinking acidic water may negatively affect the human lymphatic and digestive systems. This observed result for the river was influenced by the growing industrial activities in Sagamu, leading to prevailing presence of $CO_2$ and $SO_2$. The alkalinity value observed in this study ranged between 15.83±0.75 mg/L and 33.00±2.61 mg/L, and within the WHO limit (200 mg/L) for drinking water. High alkalinity value normally cause scale formation and bad taste [19].

As seen in Table 3, there is a progressive deterioration in the quality of water in the river as observed in the parameters analyzed when compared to the control site. One-way analysis of variance (ANOVA) was conducted at 95% confidence level. The results revealed that the value of each the parameters was significantly different ($P<0.05$) from one site to another along the river downstream and it was observed that most values are higher at site B and C. This might be due to the high level of activities at the two sites. Some physico-chemical parameters such as temperature and dissolved oxygen play vital roles in the rate of chemical reaction and the nature of biological activities. As can be seen in Table 2, all the physico-chemical properties of the water samples from all the five sites considered in this study compared with the WHO standards [14] indicates that the river average value of all the parameters analyzed except turbidity, nitrate and phosphate fall within the stipulated range of acceptability for drinking water. However the value of all parameters observed at the study site were above what was observed at the control site.

## Conclusion

The physico-chemical parameters of water samples from river Majowopa Sagamu, Ogun State Nigeria were determined. This study revealed that the average value of the physico-chemical parameters of river Majowopa were temperature (27.99±0.51 °C), pH (6.76±0.08), turbidity (7.69±2.51 NTU), conductivity (124.90±18.42 uS/cm), TSS (18.29±2.27 mg/L), TDS (68.17±13.63 mg/L), TS (86.46±13.95 mg/L), total acidity (17.57±2.37 mg/L), total alkalinity (25.23±6.23 mg/L), chloride (27.91±1.92 mg/L, nitrate (10.14±2.28 mg/L), Phosphate (7.62±1.85 mg/L), Sulphate (32.72±0.87 mg/L), DO (1.60±0.55 mg/L), COD (23.79±5.45 mg/L), BOD (8.31±3.65 mg/L) and that these values are within the WHO allowed limits except for turbidity (7.69±2.51 NTU), nitrate (10.14±2.28 mg/L), phosphate (7.62±1.85 mg/L) and DO (1.60±0.55 mg/L). The significant difference observed in the values of parameters from one site to another may be due to the waste water generated from the laundry shops finding its way into the water body. However, the results observed in this study indicated that the quality of the water in river Majowopa might be susceptible to future deterioration which may arise from the release of contaminants such as phosphate, nitrate, and organic acids found in laundry waste water into the river. This is basically due to the continuous laundry activities along the river as revealed in Table 3 (by comparing the values observed at the control site to the study site). To prevent this, the waste water from the laundry shops should be adequately treated before discharge into river Majowopa.

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## Disclosure statement

No potential conflict of interest was reported by the author.

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