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IMPACT OF MUNICIPAL WASTE ON THE HYDROCHEMISTRY OF EPE LAGOON, SOUTH WESTERN, NIGERIA

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Abstract

This study investigates the impact of municipal waste on the physicochemical parameters of Epe Lagoon. Three stations were chosen where a lot of human activities take place. The samples were collected from surface water at 10cm depth for 12 consecutive months in duplicates between August 2014 – August 2015. pH, dissolve oxygen, conductivity, total dissolve solids, salinity, temperature, turbidity, dissolved oxygen and the biological oxygen demand were measured. The pH measurement was highest in March with mean value of 7.9±0.17, a rainning month and lowest in October, a dry month with mean value of 6.1±1.21 The mean dissolved oxygen value was 7.17±0.67 mg/l. The annual mean salinity value was 0.08 ppt. The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. The mean nitrate value was 1.31±0.07 ppm. The mean value of alkalinity was 58.34±0.67 mg/l and that of phosphate was 7.52±0.67 mg/l. Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest in the month of June with a value of 94.87 ±1.39 uhoms/cm^{-}. In this study BOD mean value was 1.84±0.67 mg/l . Regulatory bodies should spring into action to control the dumping of munincipal waste along the course of the lagoon so as to prevent the extinction of aquatic life in the water boody.

Key words**:** *Epe Lagoon, municipal, physicochemical parameters, pollution*

INTRODUCTION

The society produces garbage and solid waste every day, the disposal of these wastes into the water pollutes it. Pollution in a water body is a global problem. Diverse use of water are limited and impaired due to pollution. Pollution affects migratory patterns, natural reproductive processes and fish behaviour [12]. [16] attributed water quality problems in Africa to urbanization processes, high birth rate, and industrial development like mining, petroleum extraction, refining, transportation, agricultural practices and the chief source of water pollution as sewage. Nigerian waters are highly polluted by human activities in and around the water thus affecting its chemical and physical properties and systematically destroying the community by disrupting the delicate food web [14]. [2] reported that knowledge of the physicochemical regime of a water body is of great value as it helps to determine biological productivity and it is useful to the entire state or nation. Water quality deterioration usually comes from excessive nutrient input, eutrophication, acidification and organic pollution. The disposal of waste and domestic sewage leads to contamination of the river, lakes or lagoon chronologically affecting its flora and fauna and this is detrimental to human and animal health and safety [13]. Hence, there is a challenge of providing water in adequate quantity and of required quality to reduce hazards to human health and to conserve the water bodies and their environment. Since the physical and chemical parts of aquatic environment are very important factors affecting the biological life in the aquatic system, adequate knowledge of this in relation to aquatic life is necessary [10]. Epe lagoon supports a major fishery in Lagos State, Nigeria. It is also used as a transportation route for people, goods and timber logs from

Epe to other places in South-Western Nigeria. Over the years the population of Epe and other villages along the bank of the lagoon has increased through expanding commercial activities due to its closeness to metropolitan cities of Lagos State. This has led to the abuse of the environment especially as there are no modern sanitary and waste treatment facilities in most of the settlements. Human faeces and other domestic waste are deposited in the lagoon indiscriminately. This study will access the water quality of the lagoon using selected physicochemical parameters for monitoring and to track changes resulting from the impacts of human activities.

MATERIALS AND METHODS

Study Area

Epe lagoon ($2^0$50'- $4^0$10'N, $5^0$30'-$5^0$40'E) has a surface area of 243 km^2. The lagoon has an average depth of about 1.80 m and is sandwiched between Lekki lagoon (freshwater) to the east and Lagos lagoon (brackish) to the west (Figure 1).

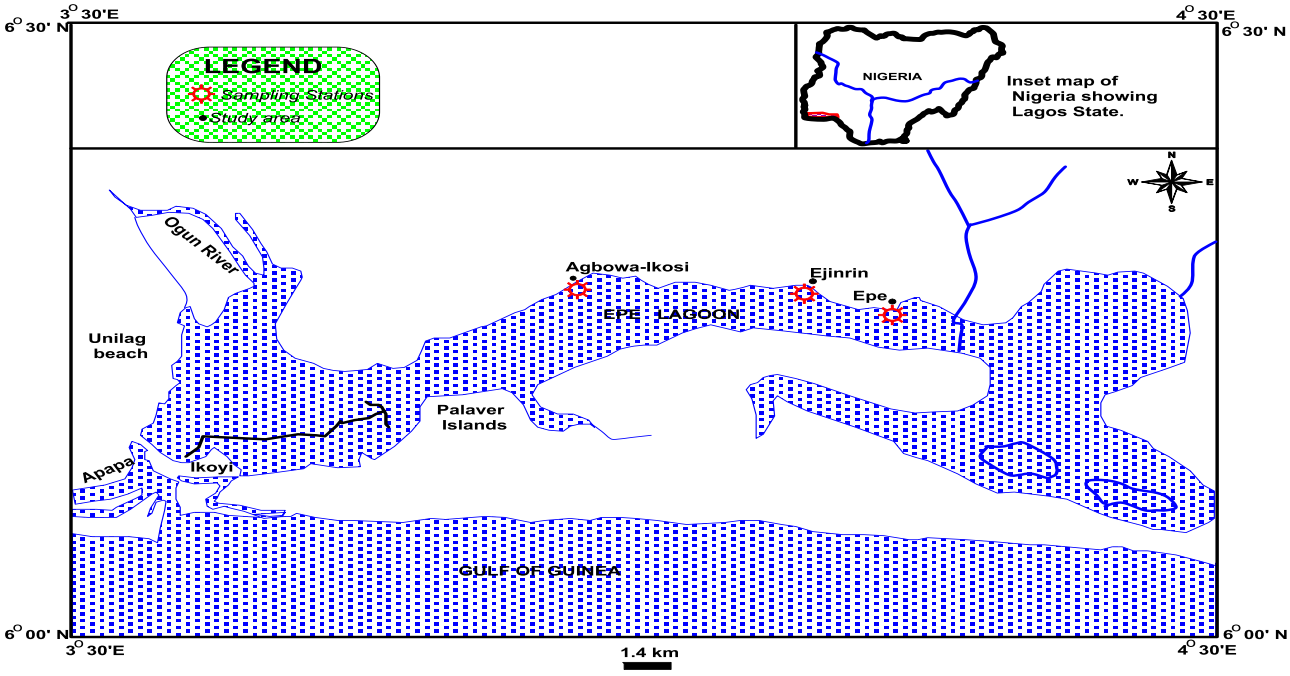

Fig.1:Map of Epe Lagoon showing the study areas.

Fig.1. Epe Lagoon map showing the study area.
Source: Field Survey (August, 2014 – July, 2015

Sample Collection and Analysis

Duplicate water samples were collected from the randomly selected sampling stations of Epe, Ejirin and Ikosi. The sites chosen were at the main market axis of the stations where a lot of human activities such as washing, bathing and fish landing takes place, they were chosen to reflect the municipal activities around the lagoon that will affect its water quality. The samples were collected from surface water of 10cm depth for 12 consecutive months between August 2014 – August 2015. pH, conductivity, total dissolve solids, salinity and temperature were determined using the Ezodo combined meter (Model PCT- 407). Turbidity was determined according to EPA method 180.1 using Portable Turbidimeter, Model 2100P (Cat.No, 46500-88). The dissolved oxygen was measured *in-situ* by a portable digital dissolve oxygen meter (Jenway model 9071). The Biological Oxygen Demand was an empirical determination of O_2 required to oxidize the organic matter in water sample during an incubation period of 5 days at 20^0C. The DO was measured at the beginning and end of the incubation period. BOD = (Initial DO –Final DO) mgl^{-1}. Spectrophotometer (Jenway 6405 uv/vis) was used to determine the Nitrate level while Nitrite was determined *in-situ* using a

portable battery operated Spectrophotometer (HACH model). Spectrophotometer (Jenway 6405 uv/vis) was used to determine the phosphate level. *Ex-situ* analysis of carbonate and hydroxide was used to determine alkalinity by titration with standard acid to pH about 8.3, the end point was detected using phenophthalin indicator. Data collected from the study were subjected to descriptive statistical analysis. Analysis of Variance (One-Way), Means, standard deviation and standard error.

RESULTS AND DISCUSSIONS

The mean dissolved oxygen value was 7.17±0.67 mg/l. Of all the three sampling sites Ejirin had the highest disolved oxygen mean value of 7.35±0.15 mg/l and Agbowa-Ikosi had the lowest mean value of 7.07±0.87 mg/l (Fig.2).

The annual mean salinity value was 0.08 ppt. Ejirin had the highest disolved oxygen mean value of 7.03±1.04 next to Epe which had a mean value of 6.97 ±0.65 and Agbowa-Ikosi had the lowest 6.95±0.98.

The pH measurement was highest in March with mean value of 7.9±0.17 which is a rainning month and lowest in October which is a dry month with mean value of 6.1±1.21 (Fig. 4).

The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. The mean turbidity value was 68.04±0.67 mg/l (Fig. 5).

Table 1. Mean Values of the Physicochemical Parameters of the Epe Lagoon. (August, 2014 – July 2016)

	DO	Temp	pH	Salinity	Turbidity	Nitrate	Alkalinity	Phosphate	Conductivity	BOD
Epe	7.09	27.07	6.97	0.04	57.31	1.33	56.21	7.72	77.69	1.60
Ejirin	7.35	27.36	7.03	0.08	57.94	1.30	59.00	7.38	75.85	2.09
Agbowa	7.07	26.95	6.95	0.10	58.86	1.31	59.80	7.45	86.08	1.76
Mean	7.17	27.13	6.98	0.13	58.04	1.31	58.34	7.52	79.87	1.82
SEM	0.129	0.107	0.071	0.00	0.95733	0.029	0.797	0.122	1.592	0.120
Unit	ppm	°C		Ppt	uhoms/cm	ppm	ppm	Ppm	ppm	ppm

Source: Field Survey (August, 2014 – July, 2015).

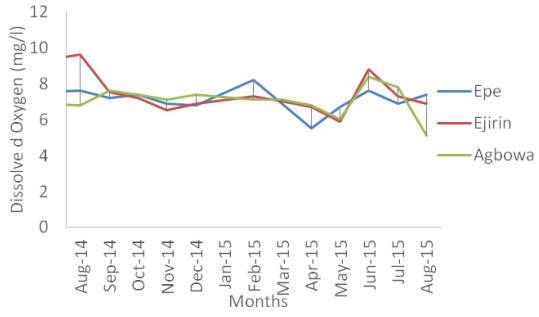

Fig. 2. Monthly Variations of Dissolved oxygen (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

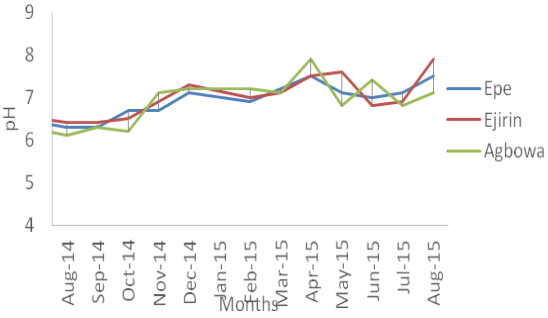

Fig. 4. Monthly Variations of pH level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

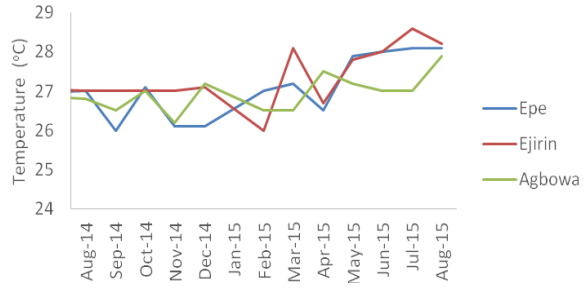

Fig. 3. Monthly Variations of Temperature (°C) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

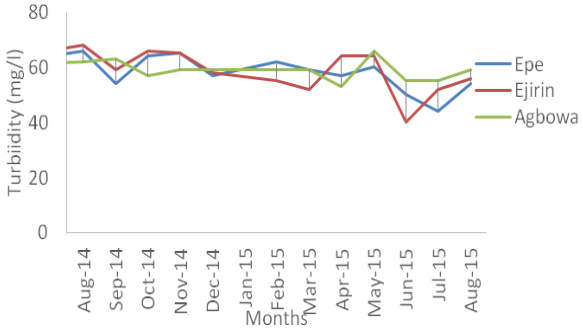

Fig. 5. Monthly Variations of Turbidity (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015

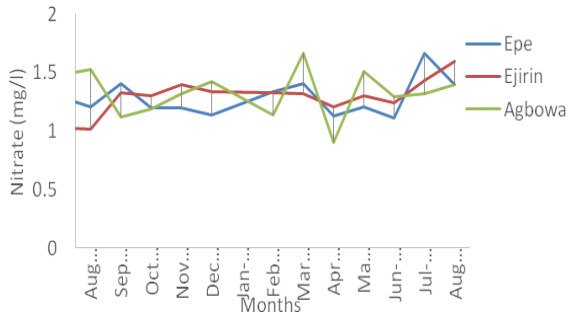

Fig. 6. Monthly Variations of Nitrate (mg/l) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

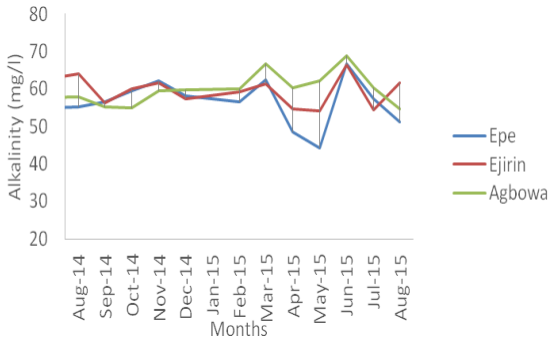

Fig.7.Monthly Variations of Alkalinity (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

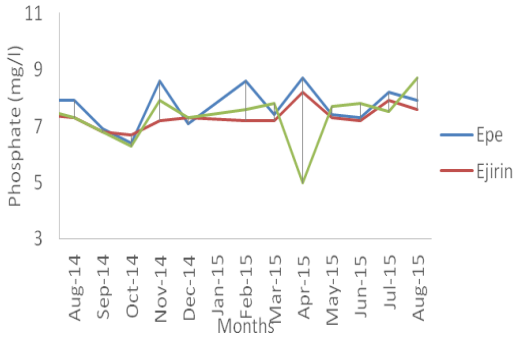

Fig. 8.Monthly Variations of Phosphate (ppm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

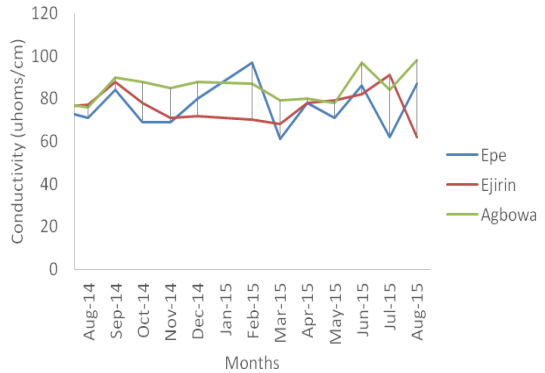

Fig. 9. Variations of Conductivity (uhoms/cm) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

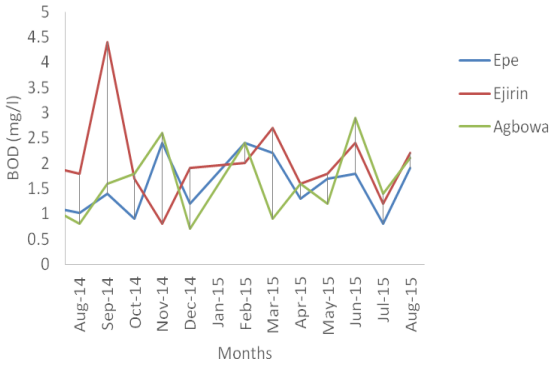

Fig. 10.Monthly Variations of BOD (mg/l) level in Epe Lagoon
Source: Field Survey (August, 2014 – July, 2015)

The nitrate value was highest in the dry month of Feburary with mean value of 1.79 ±0.06 ppm and lowest in April with mean value of 0.9±0.11 ppm. The mean nitrate value was 1.31±0.07 ppm (Fig. 6).

The mean value of alkalinity was 58.34±0.67 mg/l and that of phosphate was 7.52±0.67 mg/l. Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest value of 94.87 ±1.39 uhoms/cm^{-1} in the month of June (Fig.9).

In this study mean values of BOD ranged from the least of 0.55 ±0.03 mg/l in the month of December to the highest in the month of June with a value of 3.5 ±0.39 mg/l. The mean value was 1.84±0.67 mg/l (Fig.10).

The mean dissolved oxygen value was 7.17±0.67 mg/l which is just slightly below [7] recommendation of 8-10 mg/. Of all the three sampling sites Ejirin had the highest disolved oxygen mean value of 7.35±0.15 mg/l. Agbowa Ikosi had the lowest mean value of 7.07±0.87 mg/l (Fig. 2). These values are good pointers to the productivity of these water bodies and to the fact that they can accommodate diverse organisms. [9] reported that dissolve oxygen for optimum performance in fish is >4. Dissolve oxygen is defined as the measure of the amount of gaseous oxygen dissoled in an aqueous solution [5]. It is an important indicator of the productivity and ecological status of a water. Although the concentration of dissolved oxygen generally decrease as temperature of water increases [6] from this study dissolve oxygen and temperature increased

simultaneously during the months of June and July.

pH is the negative logarithm of hydrogen ion concentration. This value is an indication of the acidity or alkalinity of a solution [3]. Ejirin had the highest pH mean value of 7.03±1.04 which could be as a result of high solubility of ammonia from waste which is often caused by phytoplankton bloom. Epe had a mean pH value of 6.97 ±0.65 while Agbowa-Ikosi had the lowest 6.95±0.98. This is within the recommended range of 6.0-9.0 by the Federal Ministry of Environment*. The pH measurement was highest in March with mean value of 7.9±0.17 which is a rainning month and lowest in October which is a dry month with mean value of 6.1±1.21.

Salinity is seen as a strong normalizing factor in the aquatic ecosystems. Salinity values are influenced by evaporation, precipitation and river inflow [11]. The annual mean salinity value was 0.08 ppt. This is similar to the result reported by Jimoh *et al.,* (2011). This confirmed that the lagoon is relatively fresh and stable from season to season. This freshness could be due to the its being sandwiched between two water bodies: Lekki Lagoon and River Oshun which might override the possible salinity effect of the Lagos Lagoon. The freshness could also be due to heavy rainfall during the period of the study. The water turbidity was highest in March with mean value of 68.3±3.15 mg/l and lowest in the month of June with mean value of 47 ±1.21 mg/l. These values were slightly higher than the WHO limit. This might be as a result of decomposition of organic matter from domestic waste input. Turbidity is the measure of the ability of water to transmit the light that restricts light penetration and limit photosynthesis [12].

The nitrate value was highest in the dry month of Feburary with mean value of 1.79 ±0.06 ppm and lowest in April with mean value of 0.9±0.11 ppm. The mean nitrate value was 1.31±0.07 ppm. Of all the three sampling sites Epe had the highest nitrate mean value of 1.33 ±0.15 ppm and Ejirin had the lowest mean value of 1.30±0.02 ppm. [10] in the study of Agboyi creek in Lagos State recorded nitrate value of 3.62 ± 0.45 ppm which exceeded the recommended limit by World Health Organisation for drinking and bathing hence the need for FEPA intervention. Effect of human activities are seen in the nitrite, nitrate and sulphate concentrations. Nitrate is thought to be produced by autotrophic nitrobacter combining oxygen with nitrite in the bioconveter [6]. Sulphate is the main nutrient for algae and higher values could lead to eutrophication. Phosphate mean values ranged from 6.94 ±0.15 mg/l in the month of December to the highest in the month of April with a value of 8.87 ±1.37 mg/l. The mean value was 7.52±0.67 mg/l. Of all the three sampling sites Epe had the highest phosphate mean value of 7.72 ±1.16 mg/l and Ejirin had the lowest mean value of 6.38 ±1.24 mg/l. There was no significant difference (P >0.05) among the three sampling sites in Epe lagoon. Higher phosphate was observed during the raining season, this is the peak of agricultural activities. Washing of cow dung and washing with phosphate based detergent could also be responsible for the high values in phosphate. Sulphate is a major culprit in eutrophication and this could pose threat to fish production, destroy food web and decrease biodiversity [8]

Conductivity mean values ranged from 76.94 ±5.35 uhoms/cm^{-1}in the month of November to the highest in the month of June with a value of 94.87 ±1.39 uhoms/cm^{-1}. The mean value was 79.84±2.67 uhoms/cm^{-1}. Of all the three sampling sites Agbowa Ikosi had the highest alkalinity mean value of 86.08 ±1.16 uhoms/cm^{-1} and Ejirin had the lowest mean value of 75.85 ±1.84 uhoms/cm^{-1} . Conductivity recorded in the wet season might be due to increase in the concentration of cations such as calcium, magnesium and sulphate during the rains. Conductivity is based on the capcity of water to conduct current. The more the ions in the water the more the conductivity [1]. [15] reported that conductivity can be used as an indication of primary productivity and thus fish production. The values for Conductivity reported in Epe lagoon compares favorably well with results of [2] for Ikere gorge, Ibadan, Nigeria. Biochemical Oxygen Demand is the measure of total dissolve oxygen consumed by

microorganisms for biodegradation of organic matter. [4] reported that a BOD level above 5 mg/l is an indication of water pollution. In this study BOD mean values ranged from 0.55 ±0.03 mg/l in the month of December to the highest in the month of June with a value of 3.5 ±0.39 mg/l. The mean value was 1.84±0.67 mg/l. Of all the three sampling sites Ejirin had the highest BOD mean value of 2.69 ±1.16 mg/l and Epe had the lowest mean value of 1.60 ± 0.04 mg/l. These values are within FEPA values.

CONCLUSIONS

Most of the measured parameters, except turbidity, were within FEPA permissible range and WHO standards. However, it is interesting to note that most of the values were at the brink of the permissible limits and almost exceeding it. Presently the water supports aquatic life but if the input of munincipal waste is not curbed, it will make the lagoon highly polluted and render the water unfit for aquatic life. However, to sustain the ecological status of the lagoon, waste management through recycling and reuse should be encouraged. Regulatory bodies should spring into action to control the dumping of munincipal wastes along the course of the lagoon so as to prevent the extinction of aquatic life.

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