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Water Quality Assessment of Two Perennial Streams in a Rainforest Region of Nigeria

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Abstract

Physical and chemical parameters are vital indicators to determine the quality of water people consume. Many people rely on collected stream water for consumption and other daily needs because of non-availability or inadequate supply of pipe borne water in most Nigerian settlements. This study was carried out to assess the physical and chemical characteristics of Ibiekuma and Ogidikpe streams in Ekpoma, Edo State, Nigeria. The physical and chemical parameters (temperature, pH, turbidity and dissolved oxygen) of the water samples were determined using standard analytical techniques. All parameters analyzed revealed compliance with drinking water standard except pH in site A (Ibiekuma Stream) that was below permissible limit in some locations. Although the parameters examined were within permissible limits, simple hygiene and public awareness should be encouraged to avoid increase in contamination.

Keywords: Stream, Contaminants, Turbidity, Water consumption and Ekpoma.

Introduction

Water is an essential component for survival of life on earth, and the minerals it contains are important for humans as well as for earth and aquatic life (Arain *et al*., 2008; Lawson, 2011; Murhekar, 2011). It is one of the most essential needs of humans and the most abundant natural resources on the surface of the earth (Oyinloye and Jegede, 2004). It is essential for supporting livelihood, safeguarding public health, providing food security, ensuring environmental sustainability, promoting industrial and economic development, improving living standards and achieving sustainable development (Falkenmark, 2015; Mayzelle *et al*., 2015). Available water sources to man include groundwater, rainwater and surface water (Odiana *et al.,* 2017).

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Since man depend on water, determining its quality is necessary to ensure protection of public health (WHO, 2011). Important physical and chemical parameters that affect the natural water quality are temperature, pH, Turbidity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), alkalinity, nutrients (Nitrate-N, Phosphate-P), etc. (Lawson, 2011; Nduka *et al.*, 2008). These parameters are limiting factors for the survival of aquatic organisms (flora and fauna) (Lawson, 2011). In most rural communities, the predominant source of drinking water is rivers and streams which are usually contaminated by organic substances from upstream users who may as well use water for some agricultural and industry related activities. The outcome of anthropogenic activities along streams and rivers in the world is the alteration of the ecological status of the receiving water body (Ogbogu and Olaide 2002; Akpan 2004; Arimoro and Ikomi 2008; Arimoro2009).

Water, a clear colourless liquid with an insipid taste has been identified as one of the most basic needs and prerequisite for health and sustainable development (Olajuyigbe, and Fasakin 2010). The need to define the quality of water has developed with the increasing demand of this resource. Water is said to be portable when its physical, chemical and microbiological qualities conform to specified standards (WHO 2008). Some pollutants (such as heavy metals) are bio- accumulated and some are biomagnified in food chains and thereby become risk to top predators, including humans (Wokoma and Njoku 2017).

Streams are common sources of water to people over the years and in different places. In a rainforest region like Ekpoma in Edo State, residents heavily depend on water from streams as public water supply is not available coupled with difficulty in accessing ground water. Streams being surface water, could be prone to contaminations from different sources and contaminants. This could pose serious health threat/challenge to its users. This study therefore aimed at assessing the physical and chemical quality of two streams in Ekpoma in comparison with standards to ascertain their suitability or quality for human consumption.

MATERIALS AND METHODS

Study Area

The study was carried out in Ekpoma, Edo State which is a tropical rainforest climate with latitude 6^0 40^1 and 6^0 45^1 N and longitude 6^0 05^1 6^0 10^1E. Farming is a major economic activity done in the study area. Crops cultivated include yams, plantain, maize, mango, pawpaw, pepper, pineapple and cocoyam. The streams studied are Ibiekuma and Ogidikpe.
Ibiekuma stream is within the territory of the Ambrose Alli University Ekpoma flowing southwards through the Ebule village in Orhionmon and down towards Ehor. The stream flows through a secondary rainforest and at the sampling site the stream is subject to log felling. The stream is not a fast flowing one and towards the bank, erosion is fast washing materials particularly sand into the stream thereby reducing its carrying capacity.
The Ogidike stream takes its source from underneath a rock in a valley in Ekpoma. It flows through a narrow but thick vegetation till it becomes a tributary of other larger rivers. The stream is a drinking water source by people in surrounding villages especially during the dry periods. During this time, the normal flow of the stream is interfered by the pumping up of water from the valley to water tankers for sale.

Sample collection

Total of nineteen (19) water samples were collected each from Ibiekuma stream (site A) and Ogidikpe stream (site B) into a 500mL clean and well labeled bottles. However, water sample for dissolved oxygen (DO) was collected using narrow neck 250mL DO bottle, which

was initially rinsed with the sample water and then dipped into the water column and allowed to fill to overflow to remove trapped air bubbles. Samples were fixed immediately using 2mL each of prepared Winkler 1 and 2 reagents (Manganous Sulphate and Alkaline – Iodide azide), and the reagent bottles stoppered immediately so that no air was trapped in them (Wokoma and Njoku 2017). The water samples were collected below the water surface. This was done to prevent the entry of air bubbles and possible surface film likely to be present. The water samples were taken to the laboratory for chemical analysis.

Analyses of Water Samples

Tempereature of the sampled water was determined on site using thermometer calibrated in degree Celsius. pH was measured using Hanna pH metre (Hi-96107 model). Turbidity levels were measured in Nephelometric units (NTUs) in the laboratory using a multi-meter water checker (Horiba U-10). Dissolved oxygen was determined using Winkler's method (Duruibe *et al.,* 2007).

RESULTS

Results of the physicochemical parameters of the two streams (Ibiekuma and Ogidikpe) are shown in table 1.

Table I: Physicochemical parameters

	Temperature ^{o}C	pH	Turbidity NTU	DO mg/L
	24	6.80	0.32	1.21
	25	6.60	0.41	1.18
	26	6.30	0.43	1.20
	27	6.00	0.40	1.18
	24	6.20	0.48	1.21
	26	6.40	0.50	1.15
Ibiekuma stream	25	7.10	0.56	1.05
	28	7.30	0.54	0.09
	26	7.90	0.53	0.16
	27	6.20	0.59	0.25
	27	6.00	0.64	0.10
	27	7.10	0.65	0.43
	27	6.40	0.73	0.52
	25	7.30	0.71	0.38
	28	6.40	0.70	0..31
	27	6.80	0.66	0.30
	25	7.20	0.64	0.44
	26	7.50	0.77	0.38
	27	7.30	0.62	0.42
MEAN	26	6.72	0.58	0.63
	26	7.20	0.53	1.24
	25	7.50	0.73	1.21
	24	7.00	0.60	1.23
	26	7.30	0.68	1.20
	24	8.10	0.62	1.24
	25	7.80	0.75	1.22
	24	8.30	0.66	1.20
	25	7.80	0.65	0.85
Ogidikpe stream	26	8.10	0.71	1.23
	25	7.30	0.80	0.48
	24	7.30	0.87	1.17
	25	7.80	0.74	0.66
	27	8.40	0.85	0.58
	26	8.00	0.87	0.41

	24	7.90	0.75	0.35
	26	7.50	0.71	0.43
	26	7.70	0.75	0.39
	25	8.30	0.83	0.47
	25	8.00	0.81	0.45
MEAN	25	7.76	0.79	0.94

DISCUSSION

Temperature of the Sampled Water

Temperature of the sampled water ranged between 24 and 28^{o}C for site A. The temperature ranged between 24 and 27^{0}C in site B. The temperature range in the two sites fall below the acceptable limits of 29 ˚C set by WHO (1998) and 30 ˚C set by NESREA (2007). Therefore, the temperature of the streams was good enough for the survival of aquatic plants and animals in the two streams. The temperature obtained in this study is consistent with what was gotten by Omaka *et al,* (2014) in Abakaliki Ebonyi State but inconsistent with the one reported by Odiana and Edosomwan (2019) which had value ranged from 27 °C to 30°C. Comparatively air and water temperature for site A was higher than for site B. Generally, fluctuation in water temperature is closely related to that of the surrounding air. The differences in temperature of the two sites can be explained by the fact that site A was exposed to direct heat of the sun; whereas site B was shaded with vegetation hence does not allow direct sun penetration.

pH of the Sampled Water

The pH values for site A were slightly neutral at the beginning of sampling and remained so throughout. But in site B, the pH was initially in the neutral range and later became slightly alkaline. The range in both sites are 6.00-7.90 and 7.00-8.40 for sites A and B respectively. The pH range is in accordance with the one reported by Onyekwere and Chibuzo (2015) in Abriba Abia State. Also Odiana and Edosomwan (2019), reported a pH value range between 6.7 and 7.6 in Edo State. Some of the pH values obtained in Site A are however below the lower limit of WHO (2011) and NESREA (2009) permissible limits of 6.5 and 8.5 respectively. pH is positively correlated with electrical conductivity and total alkalinity (Gupta *et al*.,2009). One of the significant environmental impacts of pH is the effect that it has on the solubility and thus the bioavailability of other substances (Khan *et al*., 2012).

Turbidity of the Sampled Water

The turbidity or the transparency values recorded for both sites during the sampling period ranged between 0.32 and 0.77 NTU for site A. It however ranged between 0.53 and 0.87 NTU for site B. The turbidity recorded in this study is below the WHO (2010) standard of 25 mg/L. The recorded values in site A were low compared to value recorded in site B. This shows that site A had a low turbidity and hence better transparency than site B. Basically, turbidity in streams could increase during wet season due to surface run off during and after the rains. Human activities that disturb land such as construction, mining and agriculture, can lead to high sediment levels entering water bodies during rain storms due to storms water run off (EPA, 2002).

Dissolved Oxygen of the Sampled Water

Dissolved oxygen recorded for both sites ranged from 0.09 to 1.21 mg/L in site A and 0.35 to 1.24mg/L in site B, with site A having lower value. This compares favourably with the 0.24 to 21mg/l reported by Edoghotu and Aleleye- Wokoma (2007) in the Ntawoba Creek, Port Harcourt. However, this finding is at variance with 4.32 – 6.62 mg/L reported by Obire *et al*. (2003) in Elechi Creek, Rivers State. The range of DO observed in this study is however suspect for aquatic organisms as many aquatic organisms cannot survive if DO is depleted below

4mg/L (Zhang, 2007). In this study, DO values obtained were below WHO standard of 4.0 – 5.0mg/L. The DO is one of the most important parameter. Variation in dissolved oxygen might be due to temperature, photosynthesis, respiration, aeration, organic water and sediment concentration (Budget and Verma, 2006). The reduced dissolved oxygen may affect the aquatic life. DO is important to health of aquatic ecosystems as all aquatic animals need oxygen to survive. High levels of bacteria or large amounts of rotting plants decreases DO percentage saturation resulting to large fluctuations in dissolved oxygen levels throughout the day which can affect the ability of plants and animals to thrive (Omaka *et al.,* 2014).

Conclusion and Recommendation

The physical and chemical parameters of the sampled water from Ibiekuma and Ogidikpe streams in Ekpoma Edo State were evaluated to ascertain their level of contamination. In this study, all the parameters analyzed complied with drinking water standard except pH in Ibiekuma stream that was below permissible limit in some locations. Simple hygiene and public awareness should be encouraged to avoid increase in contamination

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