PARASITOLOGICAL ASSESSMENT OF A DRINKING WATER SOURCE IN UMUAHIA, SOUTHEAST NIGERIA

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ABSTRACT: Water is one of the essential natural resources and a major source of harmful infections including parasites when poorly managed. A parasitological assessment of a drinking water source in relation to water quality was carried out in Umuahia, Southeast Nigeria. The study was carried out between January and June 2018 in four stations. Physicochemical parameters of the water's samples were determined using standard methods while water samples for parasitological assessment were filtered and examined for parasitic load using standard methods. Five (5) parasite species of human health importance were recorded; *Trichuris trichuria* was the most prevalent (33.3%), followed by *Onchocerca volvulus* (16.7%), *Giardia lamblia* (12.5%), *Teania* species (8.3%) and *Entamoeba histolytica* (4.2%) as the least. The study showed that Station 2 which is close to the effluent discharge point and station 4 (raw effluent) recorded the highest parasitic loads (8 and 4 respectively) while stations 1 and 3 recorded the least (3 respectively). The parasitic loads recorded in this study were determined by organic pollution and other anthropogenic activities in the river. The parasites recorded are a source of concern since they are of human medical concern with high prevalence. Consequently, drinking water sources need to be protected to prevent parasitic contamination.

KEYWORDS: Parasites, Effluent, Anthropogenic, Water, Pollution, Prevalence

INTRODUCTION

Water is one of the essential natural resources to which human sustenance and continued existence lies (Omolade and Zainab, 2017). Water has been part of nature from time immemorial and can be contaminated in its natural environment (Omalu *et al.*, 2010). Drinking water could be gotten from sources such as borehole/tap water, well water, dams, rivers, streams, lakes, municipal water and rain water. Most urban and rural communities in the developing countries do not have adequate disposal system for human waste. Inhabitants, therefore, defecate indiscriminately in places not far from their dwelling places, including directly on the soil and rocks, by the sides of the streams, home, ponds, wells and in some cases into the streams (Adegoke, 2000). Industrialization has become an important factor for the development of the countries through the establishment of factories. However, their byproducts which are discharged directly into the environment consists of various kinds of contaminants which contaminates the water surface, ground waters and even the soil especially if not well treated (Ho *et al*., 2012). The effects of pollution on parasites may be positive or negative; decreasing or increasing the rate of parasitism especially infections with endo-parasitic helminths (Sures, 2005). Water shortages and limited access to clean water sources caused by water contamination with pathogenic bacteria, viruses, protozoa (Ferrer *et al*., 2012) and helminths (Chakraborty, 2005) represent a major human health hazard. These contaminations occurred mainly because of improper management of water supplies, reuse of wastewaters, poor sanitation systems, and lack of awareness and poor hygienic behaviour among human populations (Pampiglione, 1987; Ostan *et al*., 2007; Srisuphanunt *et al*., 2010; Ferrer *et al*., 2012). Globally, contaminated water is a serious problem that can cause severe pain, disability and even death. People become infected with these diseases when they swallow or have contact with water that has been contaminated by certain parasites (CDC, 2016). Parasitic infections affect work and productivity as they are usually associated with a diminished capacity to carry out physical work (Chollom *et al*., 2013). Unfortunately, water consumers are usually not aware of the potential health risks associated with exposure to water borne contaminants (Okonko *et al*., 2008). Hence, this study is aimed at assessing the parasitic load of Ossah River, Umuahia in relation to water quality.

MATERIALS AND METHODS

Study area

The study was carried out in Ossah River located in Ossah Ibeku Community in Umuahia North Local Government Area of Abia State, Southeast Nigeria. The section of the river studied lies within Latitude 05º29̉20.00” - 05º31̉40.00”N and Longitude 07º27’50.40” - 07º28’548.00”E (Fig.1). The river was divided into four stations for the purpose of this study. Station 1 is the upstream and control station, located in Ahi Amanso, Ossah community. There are a lot of construction activities going on this area as a result stormwater from the sites discharge into the river. Other activities observed in the station include sand mining, bathing, swimming, washing of clothes and extraction of water for drinking. Occasional human defections were also observed around the river Station 2 is located at Eziama Ossah, 510m down stream of station 1 and 410m downstream of the effluent discharge point. It is shallow and sandy with minimal activities like washing, bathing and limited domestic uses. Station 3 is located at Umuchime Ossah, 610m downstream of Station 2. The station is by a bridge along a road under construction. Human activities were observed during the study include fishing, bathing, swimming, washing of motorcycles, tricycle (keke) and clothes. Station 4 is the point of effluent sampling along the drainage channel, about 170m to the effluent discharge point (EDP) into the river. Ossah River is used by the community for drinking, bathing, washing, swimming and other domestic activities.

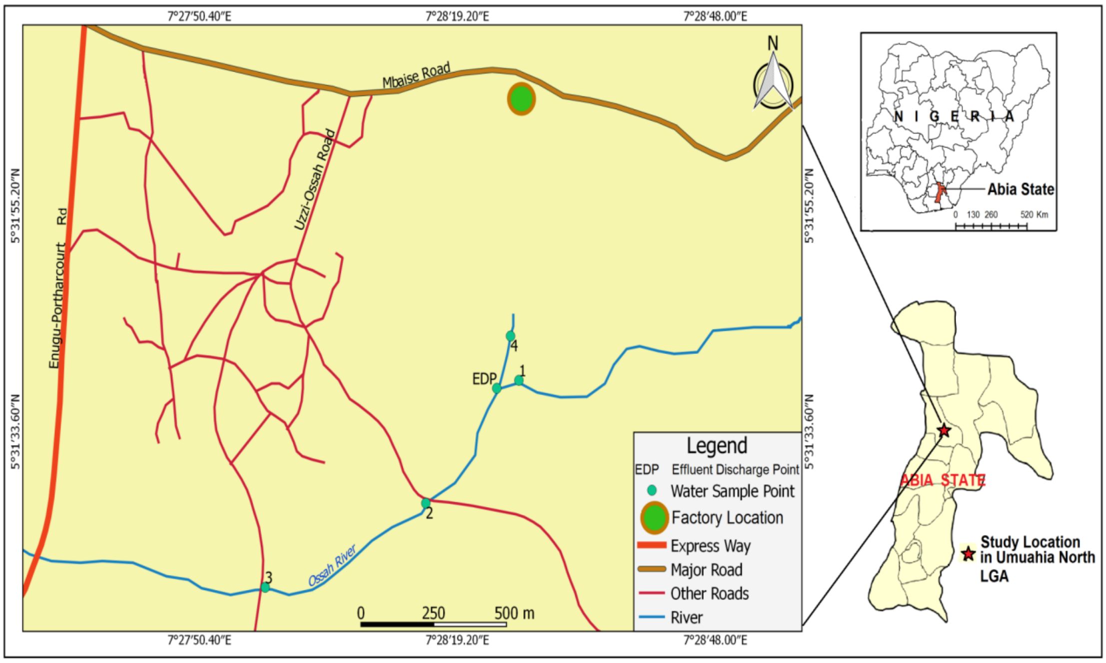

Fig. 1: Sampling Stations of Ossah River, Umuahia, Southeast Nigeria.

Samples Collection and Analyses

Water Samples

Water samples were collected from Ossah River monthly from January to June 2018. The samples were stored in sterilized 1 litre plastic bottles and then taken to the laboratory for analysis. The physicochemical parameters were analyzed using standards methods described by American Public Health Association (APHA) (1998). The results were summarized using Descriptive Statistic Package of Microsoft Excel while one-way ANOVA was used test for significant differences among the stations and Tukey pairwise comparisons test was performed to determine the location of significant difference ($P<0.05$).

Parasitological Samples

A total of 24 water samples were collected along with the water samples and examined macroscopically for physiological characteristics and then transported to the Zoology and Environmental Biology Laboratory, Michael Okpara University of Agriculture, Umudike for parasitological analysis.

Parasitological Analysis

The parasitological analysis was carried out according to Iyagi *et al* (2018). Water samples were filtered through a filter sieve of 0.5 mesh size. The residue was soaked and rinsed thoroughly in a beaker containing 20ml of 5% formal saline (5% formalin in 0.85% of NaCl).

The filtrate was poured into centrifuge tube and centrifuged at 4000 rpm for 6 minutes at room temperature and allowed to rest in test tube rack for 3 minutes. The supernatant was discarded leaving small amount of suspended sediment. A drop of suspended sediment was placed on a clean glass slide and iodine solution was added using Pasteur pipette. It was then covered with cover slip and examined under a microscope using x10 and x40 objectives.

Statistical Analysis: Differences were tested by Chi-square and a P value of < 0.05 was taken as significant.

RESULTS

Physicochemical Result

Physicochemical parameters for each sampling stations of Ossah River are shown in Table 1. All the pH values were acidic ranging from 4.60 to 6.30 and outside acceptable limits (6.5-8.5). Station 4 (effluent) recorded the lowest mean value (5.37). The electrical conductivity (EC) ranged between 52.9 and 198.8µS/cm. Station 3 was significantly lower ($P<0.05$) than the others while the effluent recorded the highest value. Total Dissolved Solids (TDS) ranged from 25.7 to 99.1mg/l. Station 3 was significantly lower ($P<0.05$) than Stations 1 and 4. The dissolved oxygen (DO) values ranged from 3.2 to 6.4 mg/l; all but one was below the acceptable limit (>6mg/l) while biochemical oxygen demand values ranged from 1.50 to 4.20 mg/l. Some values recorded in Stations 1 and 4 exceeded the acceptable limit (3mg/l). Stations 1 and 4 were significantly different from Stations 2 and 3. Station 1 was also significantly different ($P<0.05$) in Chemical Oxygen Demand (COD) ranging from 7.8 to 21.5 mg/l. Station 3 was significantly lower ($P<0.05$) than Stations 1 and 4. The nutrient values were generally low. Nitrate values ranged from 0.9 to 5.8mg/l while phosphate and sulphate ranged from 0.5 to 3.2 mg/l and 0.3 to 0.9 mg/l respectively. Station 3 was significantly lower than the other stations in phosphate and sulphate.

Table 1: Summary of Physicochemical Parameters recorded Ossah River, Umuahia (with range in Parenthesis)

Parameters	Station 1 X±SEM	Station 2 X±SEM	Station 3 X±SEM	Station 4 X±SEM	NESREA 2011	P-Value
pH	5.38±0.22 4.6-6.0	5.60±0.21 4.8-6.3	5.55±0.19 4.8-6.2	5.37±0.16 4.9-5.8	6.5-8.5	P>0.05
Electrical Conductivity (µS/cm)	$98.5±4.52^{ab}$ 80.7-110.5	$73.8±4.34^{ab}$ 56.4-84.4	$58.4±2.35^{b}$ 52.9-65.9	$102.6±19.34^{ac}$ 75.4-198.8	-	P<0.05
Total Dissolved Solids (mg/l)	$49.4±2.06^{a}$ 41.5-55.3	$36.8±2.33^{ab}$ 26.8-42.1	$29.2±1.24^{b}$ 25.7-33.1	$51.4±9.59^{ac}$ 37.9-99.1	-	P<0.05
Dissolved Oxygen (mg/l)	5.1±0.29 3.8-5.7	5.7±0.26 4.7-6.4	4.8±0.35 3.2-5.5	5.1±0.34 3.5-5.9	>6	P>0.05
Biochemical Oxygen	$3.3±0.33^{a}$ 2.1-4.2	$2.1±0.20^{b}$ 1.6-3.0	$2.1±0.15^{b}$ 1.5-2.5	$2.8±0.28^{a}$ 1.8-3.8	3	P<0.05

Demand (mg/l)						
Chemical Oxygen Demand (mg/l)	17.3±1.36[a] 12.0-21.5	10.5±0.94[bc] 7.8-13.6	9.8±0.4[b] 7.8-11.2	14.0±1.15[ac] 10.3-18.2	30	P<0.05
Phosphate (mg/l)	2.0±0.25[a] 0.9-2.7	1.8±0.20[a] 0.9-2.3	0.7±0.08[b] 0.5-1.0	2.3±020[ac] 1.8-3.2	3.5	P<0.05
Sulphate (mg/l)	0.7±0.07[a] 0.4-0.9	0.5±0.03[a] 0.4-0.6	0.4±0.03[b] 0.3-0.5	0.6±0.04[ac] 0.4-0.7	100	P<0.05
Nitrate (mg/l)	2.6±0.27 1.7-3.4	2.00±.21 1.1-2.6	1.9±0.28 0.9-2.5	2.9±0.63 1.4-5.8	50	P>0.05

a, b, c = Means with different superscripts across the rows are significantly different at p<0.05; SEM= Standard Error of Mean; NESREA – National Environmental Standards and Regulation Enforcement Agency (2011).

Parasitic Load Result

The parasitological assessment of the water samples in different stations revealed varied parasitic loads. The parasite species recorded in the study were mainly helminthes, represented by *Trichuris trichuria*, *Onchocerca volvolus* and *Teania sp*. *Guardia lamblia* and *Entamoeba histolytica* was the only protozoan parasites recorded (Table 2). The five (5) parasites recorded are of human health importance. *Trichuris trichuria* was the most prevalent (33.3%), followed by *Onchocerca vulvulus* (16.7%), *Guardia lamblia* (12.5%), *Teania* sp. (8.3%) and the least were *Entamoeba histolytica* (4.2%) (Table 2). There was no significant difference (P>0.05) in the prevalence of the parasites Chi-square analysis was applied. Spatial distribution of the parasites showed that Station 2 recorded the highest parasitic load made up of all the parasites (8); with 3 eggs of *T. trichuria*, 1cyst of *G. lamblia*, 2 eggs of *O. volvolus*, 1 cyst of *E. histolytica*, 1 egg of *Teania* sp. Stations 1 and 3 recorded the least parasitic load - 3 eggs of *T. trichuria* only and 1 egg each of *T. trichuria*, O. *vulvolus* and *Teania sp* (Table 3). There was also no significant difference (P>0.05) in the spatial distribution of the parasites when Chi-square analysis was applied.

Table 2: Overall prevalence of parasite species identified in the study area

Parasites Isolated N=24	No of parasite	Prevalence (%)	P-Value
Trichuris trichuria	8	33.3	0.13
Giardia lamblia	3	12.5	
Onchocerca vulvulus	4	16.7	
Teania sp.	2	8.3	
Entamoeba histolytica	1	4.2	
Total	**18**	**27.7**	

Table 3: Spatial Distribution of the parasites recorded in Ossah River, Umuahia.

Parasites	Station 1	Station 2	Station 3	Station 4	P-Value
T. trichuris	3	3	1	1	0.66
G. lamblia	0	1	0	2	
O. vulvolus	0	2	1	1	
E. histolytica	0	1	0	0	
Teania sp.	0	1	1	0	
Total	**3**	**8**	**3**	**4**	

DISCUSSION

The physicochemical parameters recorded in study indicated signs of pollution stress from cumulative impacts (Station 1) to industrial effluent (Station 2) and effluent (Station 4). Station 3 showed signs of less anthropogenic impact. There are two principal monitoring strategies: physicochemical analysis and biomonitoring. Physicochemical analyses are important methods to get detailed qualitative and quantitative 'snapshot' data on water quality and the character of contamination. Together with additional biological analysis are needed (Goldschmidt, 2016). Conversely, as aquatic organisms spend most part of their life under the specific conditions of the site, biomonitoring offers the temporal integration of all impacts and allows the integrated analysis of different factors and their complex interactions in a reliable and cost-effective way (Valdecasas and Baltanás, 1990). The parasitological analysis of the water samples revealed a presence of parasitic species of human health importance. Some of the parasites were common and have been recorded in related studies except for *Onchocerca volvulus* (Ani and Itiba, 2015; Iyaji *et al*., 2018). The overall prevalence recorded in this study could be attributed to anthropogenic impacts including effluent discharge and was higher than 25.0% recorded by Nilson *et al* (2012), 19.9% by Yousefi *et al* (2009) and 15.6% recorded by Iyaji *et al* (2018) but lower than 28.1% recorded in a stream by Ani and Itiba (2015). However, the observed prevalence recorded in related studies could be attributed to the prevailing circumstances in different environments. Spatial analysis of the parasitic load showed that station 2 had the highest parasitic load 8(44.4%), followed by 4 (22.2%) recorded in station 4. The high parasitic load recorded in station 2 could be attributed the industrial waste water (effluent) discharged in between stations 1 and 2 flows down to station 2 while station 4 is the effluent sample. Station 2 recorded all the parasites encountered while station 4 recorded the three of the most prevalent because of parasites tolerance adaptation in harsh conditions. Salama *et al* (2016) observed that an increment in the parasitic load in one of the stations was due to the flow of wastewater from the city into that station. The presence of waterborne parasites in certain natural waterbodies helps explain the tolerance adaptation of these parasites in adverse conditions, which has affected ecosystem diversity (Nasser et al, 2003; Culurgioni *et al*., 2013). Chollom *et al* (2013) suggested that parasitic organisms are maintained by a viable ecosystem in remote settlements in Nigeria where poor sewage disposal among others thrive the most. When water becomes contaminated by parasites, it can cause a lot of illness, pain, discomfort, disability or even death. People suffer as a result of diseases caused by *Entamoeba histolytica*, *Giardia lamblia*, etc which are among the water borne parasite. These are neglected tropical diseases of which Nigeria is among the endemic areas.

CONCLUSION

The parasites recorded are a source of concern since they are of human medical concern with high prevalence. Consequently, drinking water sources need to be protected to prevent parasitic contamination.

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