Comparative Analysis of Water Sample from Njaba River and Borehole Water in Awo Mmama Imo State.

ABSTRACT

The study examined the water quality of selected boreholes and river which serve as the main sources of drinking water to the inhabitants of Awo Mmama Local Government Area in terms of microbial and physicochemical parameters. Water samples were collected and analyzed. The results were compared to World Health Organization standards. The physicochemical parameters were within the river showed low turbidity level corresponding with WHO/EPA-Nigeria recommended guideline value of 0-50NTU. Nitrate concentration was also low in the river. Faecal coliforms, E.coli and Salmonella were also recorded at some points which were higher above recommended level for drinking water by WHO. It was recommended among others that frequent checks should be carried on the borehole areas to identify early incidence of contamination to take action and the surroundings of boreholes should be kept clean by educating the inhabitants.

Keywords: Water, Njaba River, Borehole, Awo Mmama, Imo State

Introduction

Water is one of the essential things needed for the well-being of individuals. The quality of sources of drinking water cannot therefore, be left out. To ensure good quality of drinking water, its microbiological and physicochemical analysis should be done. This analysis will help to identify micro-organisms that results in water- borne diseases and its subsequent effects on the health of people especially the rural folks. Quality drinking water is essential for life. Unfortunately, in many countries around the world, including Nigeria, water has become a scarce commodity as only a small proportion of the populace has access to treated water [1]. Alternative sources of water such as rainwater and ground water have become major sources of drinking water for people living in new settlements and some residents who do not have access to treated water in Nigeria. The need to assess the quality of water from some of these alternative sources has become imperative because they have a direct effect on the health of individuals [2].

The above observation notwithstanding, water bodies are under serious threat by natural and anthropogenic activities around the globe. Increase and changes in environmental pressure threaten groundwater quality and complicate the assessment of its present and future spatial distribution [3]. Pollution of freshwater bodies such as rivers, streams, lakes and ponds is mostly experienced as result of industrial discharge, municipal waste disposal and surface run-off [4]. Inadequate supply of potable water coupled with pollution of surface water have made individuals especially in Wamfie resort to various means of gaining access to and managing their own water supply. Among such means are construction of boreholes and harvesting of rain water.

Contaminants such as bacteria, viruses, heavy metals, nitrates and salt have polluted water supplies as a result of inadequate treatment and disposal of waste from humans and livestock, industrial discharges, and over-use of limited water resources (Singh and Mosley, 2003). Even if no sources of anthropogenic contamination exist there is potential for natural levels of metals and other chemicals to be harmful to human health. Research conducted by [5]indicated that 77% of filtered underground water samples sold as sachet water that were analyzed contained infective stages of pathogenic parasitic organisms. Common pathogens and indicators identified in the [6] study include, Microsporidia spp. (51.2%), Cryptosporidium parvum (63.0%), Cyclosporacayetenens (59.3%), Sarcocystissp. (66.7%), Rotifers (18.5%), and Charcoat Leyden crystals (evidence of allergies or parasitic infection) (44.4%). Ninety-three percent of the samples contained unidentified impurities/artifacts. A total of 29.6% of the samples contained at least one type of parasite, 14.8% contained at least 2 types of parasites, 25.9% contained at least three types of parasites, and 29.6% contained four types of parasites. This has grim public health implications as the organisms identified can cause water related diseases that have serious complications in children and adults particularly immune- compromised individuals.

These factors have led to the growing rate of water borne diseases such as typhoid fever and cholera experienced in this part of the world [7]. The current status as described by the WHO/UNICEF Joint Monitoring Programme indicates that 2.6 billion people are without improved sanitation and nearly 900 million people lack access to improved source of potable water and this situation is unacceptable (WHO/UNICEF,2010).With families living in poverty and local communities often left to look after themselves with none or very little assistance from overstretched or underfunded governments and local communities, a poverty trap is created that simply does not allow for investment in clean water sources and the cycle just continues.

Awo is one of the fast-growing towns in the Northeast of Niger Delta in Nigeria South East Imo state. Population growth coupled with increasing developmental activities has widened the gap between demand and supply of potable water both in quantity and quality. The rapid population growth has overwhelmed the capacity of the State Assembly to provide the most basic service of providing potable water to all the inhabitants at the new areas of settlement (Awo Mmama). The Njaba River has its head water at Niger Delta Basin and runs through the south western in Isu at Isu-njaba town flow through Oguta and then down to Oguta lake. Over the years, the Njaba River has suffered from all kinds of waste from the town including garbage, sludge, rubbish and surface run-off. The major gutters that take waste water from the town are directed into the river. The waste from the auto mechanic at the centre of the town drain into the river and also a car washing bay is just situated at the bank of the river behind the lorry station. There are cow and pig pens around the bank of the river.

The water in some of the well's changes colour during heavy storms. Natural or human activities can be a source of contamination to groundwater [8]. The quality of the water together with its ecological integrity has raised concerns due to indiscriminate disposal of waste into the river. Individuals who do not have access to the water supplied by Nigeria Water Department (FMWR) depend on river and boreholes for their source of water. Some of these boreholes are constructed in the riparian areas of the river whilst

others are scattered uphill of the town. Some are also located in premises of fuel station. Various observations such as change of the colour of water in the wells have made some of the well owners decided to abandon their boreholes whilst others heavily depend on them for drinking and other domestic purposes. There are latrines, and septic tanks sited few meters to some of the boreholes. The study therefore sought to assess the water quality of River Njaba and boreholes in the area in respect to their microbial load and physicochemical parameters.

MATERIALS AND METHODS

STUDY AREA

Awo-Omamma (also Awo-Omamma), in the Northeast of Niger Delta is an oil-rich town [1] on the banks of Njaba River in Nigeria's South East Imo State. It is a potential tourism hub in the region due to its species of wildlife in Umuezukwe and green vegetation. It covers about 89.2 square kilometres,[3]:13 on the bank of Njaba River and lies in tropical rain forest, with hot and rainy seasons. According to Rich Piazza, a volunteer with the Peace Corps in Awo-omamma, a four-day torrential downpour typifies the extreme of the rainy season in the town.

Fig1. A view of Njaba River from Umuezukwe waterfront

Awo-Omamma is bounded in the North by Amiri, Imo State in Oru-East, and Mgbidi and Otulu Nigeria both in Oru-West. In the East it shares boundaries with Okwudor in Njaba LGA. In the West Awo-

Omamma is bounded by Akabo, Oguta LGA, Awa, Oguta LGA, Abiaziem and Ngbele communities in Oguta LGA, and in the South by Eziama Obiato and Njaba River.

Traditionally, villages and autonomous communities in Awo-omamma include: Ubogwu (Ofekata I); Ubachima (Ofekata II); Okworji, Umubochi,(Ofekata III); Umuezeali, Umueme,(Ofekata IV); Umuokwe, Obibi, Ohuba,(Eziawo I); and Isieke, Umuezukwe, Ubahaeze and Umuezike, (Eziawo II). A proposal for creation of Eziawo 111 autonomous community, consisting of Umuezukwe and Umuezike communities, has been before Imo State House of Assembly.[29] The following postcodes (ZIP codes) apply to respective autonomous communities of Awo- Omamma: 474111 (Eziawo 1), 474112 (Eziawo 11), 474113 (Ofekata 1), and 474114 (Ofekata 11).

Fig. 2: Awo-Omamma Nigeria. Coordinates 5º39’23’N 6º56’4’E

SAMPLING PROCEDURE

Water samples were collected from River Njaba, and also from the respective borehole at Awo Mmama from May, 2021. Triplicate samples were taken from each site/point of the river (Plates 1) at sampling period. Triplicate samples were also taken from the respective wells. A total of 3 samples were taken. In all, a total of 6 samples from both the river and the boreholes were taken for the analysis in this study. Water samples were collected in the morning between the hours of 08:00amand 10:00am WAT.

Sterile bottles were used to collect samples for microbiological analysis. Sample containers and lids were rinsed with some of the sampled water except for microbiological analysis and then filled to the rim leaving an air space of at least 2.5cm to ensure homogenize sample for laboratory analysis and the lids

were carefully tightened or sealed. They were then labelled and immediately placed in a cold ice chest at temperature of 4oC to prevent possible alteration of parameters and also to ensure that micro-organisms remain viable though dormant. Samples were then transported to laboratory for analysis. All the physico-chemical were done at Awo Mmamma and the microbiological analysis were also performed in the microbiological laboratory of Infor Research Laboratory Port Harcourt, Rivers State.

Fig 3. Water Samples

Laboratory Procedures

Identification of Bacterial Isolates

Bacterial isolates from the plates were identified by morphological appearance, gram staining and biochemical tests.

Gram Staining Techniques

Smears of the bacterial isolates were made and fixed by air drying. The smears were then covered with crystal violet stain for 60 seconds and rapidly washed off with water. The smears were then covered with Lugol's iodine for 60 seconds and rapidly washed off with water. The smears were decolorized with

acetone alcohol and washed off after 10seconds. The smears were finally flooded with safranin for 2minutes and washed off with clean water. The back of the slides were then wiped and placed in a draining rack for the smear to dry before they were viewed with X oil immersion objectives lens according to Cabral (2010). Gram positive bacteria gave purple coloration while gram negative bacteria gave pinkish coloration.

Mobilty Test

Smears of the bacteria isolates were made on glass slides and covered with cover slips (wet amount preparation). These were viewed under the microscope for bacterial motility [9].

Catalase Test

This is used to differentiate those bacteria that produce the enzyme catalase such as staphylococci from those with no catalase producing bacteria such as streptococci. About 2ml of hydrogen peroxide solution was poured into several test tubes for each of the bacterial isolates. Using a sterile wooden stick, each colony of the bacterial colony of the bacterial colony was immersed in each of the hydrogen peroxide solution. Active bubbling within 10 seconds is an indication of a positive test while none is an indication of a negative test [10].

Citrate Utilization Test

This is for the identification of Enterobacteriacea. Each of the test organisms were inoculated onto sterile agar slopes of Simmon Citrate agar in each case using stab inoculation techniques.

The inoculated agar slopes were incubated at 37oc for 24hours. A bright blue coloration is an indication of a positive test while none is an indication of a negative test [11].

Coagulase Test

Drop of distilled water was placed on each of the test organisms. A colony of each of the test organisms was emulsified in each of the drops to make a thick suspension and mixed gently for each of the test organisms. Clumping of the organism within 10 seconds is an indication of a positive test while none is an indication of a positive test while none is an indication of a negative test [11].

Indole Test

Some microorganisms are capable of hydrolyzing the amino acid, tryptophan and one of the end product is indole. The ability of a microbe to carry out this reaction can be used for biochemical characterization. The test organisms were suspended in sterile peptone preparation (about 3ml) in test lube and incubated at 37oc

for 48 hours after which Kovac's reagent was added and shaken gently. A red coloration in the surface layer is an indication of a positive test while none is an indication of a negative test [11].

Oxidase Test

The method of [12] was adopted for the test. A piece of filter paper was placed in a clean petri dish and three drops of fleshly prepared oxidase reagent was added in each case of the test organism. With a sterile stick, each colony of the test organism was removed and smeared on each oxidase reagent drop on the filter paper. The development of a blue purple coloration is an indication of a positive test while none is indication of negative test.

Sugar Fermentation Test

Each colony of the different test organisms were inoculated onto sterile agar slopes of triple sugar iron agar using stab inoculations techniques. The inoculated agar slopes were incubated at 37oc for 24 hours. The different colours of the slopes and butts in addition to the presence of gas production and hydrogen sulphide production (blackening) is indicative of the Enlerobacteriaceae present [11].

RESULTS

Table 1: Physicochemical Parameters Analysis of Borehole and River Water

S/N	PARAMETERS	WHO'S STD	BOREHOLE			NJABA RIVER		
1	Appearance	Clear	Ubachima	Umuowa	Ubarogu	Upstream	Midstream	Downsream
2	Colour	15	3	3.5	3	3	4	3
3	Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
4	Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
5	Turbidity	50	2.95	3.28	3.43	3.61	3.43	2.32
6	Temperature	-	29.5	29.5	29.5	30	29.5	28
7	pH	6.5 -8.5	7.29	7.44	7.21	7.15	7.52	7.62
8	Electricity	100	0.19	0.24	0.24	0.27	0.34	0.55
9	Hardness	250	59.71	60.73	63.86	59.61	55.19	51.63
10	TDS	250	0.03	0.29	0.30	0.88	0.49	0.24
11	DO	6.0	4.02	4.06	3.99	3.47	4.02	4.08
12	BOD	4.0	3.61	3.34	3.79	3.32	3.56	3.37
13	SULPHATE	250	1.21	1.49	1.37	2.66	2.16	1.06
14	NITRATE	40	0.07	0.07	0.06	0.19	0.19	0.22
15	TBC	0-30	30.5	31	31	37	32.5	30.5
16	TCC	0-2	2	2.5	2.5	7	6	2.5

Biochemical Characteristics of Bacterial Isolatesfrom Borehole and River Water Samples

The possible bacteria identified in river water were *Eshericheе coli, pseudomonas* spp, and proteins spp. The gram reactions of the bacteria isolated and identified in this study were of gram negative reactions.

Table 2: Biochemical characteristics of bacterial isolates from borehole and river water samples

Samples	Media	Morphological characteristics	Gram Reaction	Oxidase	Mol Test	Indole test	Spore Stain	Catalase Test	Citrate test	Coagulate test	Sugarfe rm Test S B G H_2S	Possible Bacteria
Ubachima	NA	Pinkish raised Mucoid	Gram Negative rod	-	-	-	-	-	-	-	**Y Y** - -	Escherichia coli
Umuowa	NA	Bluish green Colonies spreading over the plate	Gram Negative rod	-	-	-	-	-	-	-	R Y - -	Pseudomonas spp
Ubarogu	NA	Milkish elongated mucoid colonies spreading over the plate	Gram Negative rod	-	-	-	+	-	-	+	R Y + -	Proteus spp
Up river	NA	Bluish green colonies spreading over the plate and milkish elongated mucoid colonies spreading over the plate	Gram Negative rod	-	-	-	+	-	-	+	R Y - -	Pseudomonas spp
											R Y -+ -	Proteus spp
Middle			Gram Negative rod	-	-	-	-	-	-	-	R Y - -	Pseudomonas spp

river Down stream	NA	Bluish green colonies spreading over the plate Bluish green colonies spreading over the plate	Gram Negative rod			R -	Y -	Pseudomonas spp

Key: A-F = locations, N.A = Nutrient Agar, += Positive, - Negative, S = slope coloration G = Gas Production, H2S= Hydrogen sulphate production, Y=Yellowish coloration (acidic). R = Reddish pink coloration (alkaline production), Mot, = Motility test.

Fig 4: River contamination by human activity

DISCUSSION

Physicochemical Parameters of Borehole and River Water

The physic-chemical analysis shows that water appearance of test samples of boreholes and river water were of WHO's standard and the color did not meet the world health organization (WHO) standard. This is comparable with the study of [14]. All the water sample colours were below WHO standard. A similar study by [15] reported similar observation. The temperature, pH were at normal rang. The electrical conductivity and hardness were below World Health Organization Standard (Table 1).

The borehole water had a higher value of hardness than the river water samples analysed. Total bacteria count (TBC) and total coliform count (TCC) were high in river than in borehole water. Dissolved oxygen (DOI) and Biological oxygen demand (BOD) were at world health organization range. Sulphate and nitrate were below WHO's standard in both river and borehole water. The upriver had more bacteria and coliform than the mid river and down river [16-17].

CONCLUSION

Water is an indispensable resource necessary for the sustenance of life. Due to rapid urbanization, water supply in developing countries (including Nigeria) is inadequate, resulting in the sourcing of water from various avenues. In general, the sampled water from the boreholes in the study area would be classified as acidic. However, there was a balance between acid and alkalinity in the pH of Njaba River. Electrical conductivity and TDS values were low in the wells and the river studied. Turbidity values were below WHO limit at all the sites of the river sampled. High turbidity is associated with disease causing organisms and has negative impact on consumer acceptability. Continuous use of the water for drinking poses a threat to the users. There were presence of total coliform, faecal coliform and E.coli in the wells and the river at levels above WHO/ EPA-Nigeria limit which indicate contamination of the water source by human and animal waste [18]. The greatest risk to public health from microbes in water is associated with consumption of drinking– water that is contaminated with human and animal excreta [13].With reference to WHO/EPA-Nigeria standards, the boreholes and River Njaba could be considered not good for drinking purposes.

RECOMMENDATIONS

Based on the outcome of the study the following is recommended;

1. It is recommended that water quality analysis be carried out on all the boreholes in the area frequently. This will ensure that incidences of contamination are noticed earlier for remedial action to be taken.
2. The inhabitants should be educated on the need to keep their surroundings clean most especially around the boreholes.
3. The community should be educated on the need to keep the receptacles used for the fetching of the water clean always as to prevent contamination.
4. The groundwater should be raised well above surrounding ground level to divert runoff water when constructing groundwater to avoid unnecessary seepage and contamination.

5. It is also recommended that further studies are conducted in the area to the specific pathways through which contamination occurs so as to make prevention of contamination much easier.

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