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Physico-Chemical And Microbial Qualities Of Borehole Water In Owerri West, Imo State, Nigeria

R.I. Okechukwu[1], I.C. Mgbemena[1], L.N. Onyechere[1] and N.A. Tony-Chiegboka[2]
[1]Department of Biotechnology and [2]Department of Biology, Federal University of Technology P.M.B. 1526, Owerri, Nigeria.
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Abstract

The physico-chemical and microbial qualities of borehole water samples from Federal University of Technology, Owerri and surrounding communities, all in Owerri West local government area in Imo State, Nigeria where analyzed using appropriate techniques and procedures. The appearance, taste and odour were found to be clear. The pH of all the samples showed slight acidity and range from 6.00-6.27, which did not meet WHO standard. The temperature, total dissolved solids (TDS), turbidity, nitrates, phosphates and sulphates were all within the WHO standard of drinking water. The total bacteria count were too numerous (TNTC) and were above the WHO specified limit for drinking water. The total coliforms and fecal coliforms were also above the WHO standard ranging from 9-39 cfu/100ml and 14-300 cfu/100ml respectively. The presence of *Salmonella* and *Shigella* showed in seven samples ranging from 1-183 cfu/100ml *Vibrio spp* was present in two samples, 1cfu/100ml and 8cfu/100ml respectively. This study reveals that the borehole water samples from the study area are not fit for consumption without conventional treatment. The public health significance of these results and some control measures are discussed.

Keywords: Physico-chemical, Parameters, Bacteriological, Quality, Public health significance.

1.0 Introduction

Water is used every day by different living things for various life activities. The need for clean and portable water cannot be over emphasized. This is because living things are prone to many deadly diseases as a result of the use of contaminated water. According to figures issued by the World Health Organization (WHO, 2002), an average of 50,000 people die each day from diseases associated with contaminated water. This figure is only a grim reminder of how much we need clean water (Yvonne, 1992).

Borehole water is known as water derived from under the ground or beneath the ground surface in soil spore spaces and in fractures of geologic formations, during drilling process (Oliver, 2000).

In Federal University of Technology Owerri (FUTO) and its environs, the use of underground water (Borehole water) is common. Charles *et al.*, 2001, recorded that underground water is more accessible and supplies much of peoples water needs in many regions of the earth. This is because it is less contaminated compared to surface water. Also certain surface waters are inked to traditional or ancestral beliefs. An example of such is Otamiri River located within FUTO and its environs.

In spite of all the advantages of underground water, pollution of this major water supply has become an increasing concern in many nations of the world. In the United States of America (USA) thousands of wells have been closed in the late 20th century because of contamination by toxic substance and pathogenic organism (Wayane, 2006).

It is now generally recognized that the quality of borehole water is important. A large portion of the worlds people do not have access to improved or microbiologically safe sources of water for drinking and other essential purposes (WHO, 2002). It has been estimated that 1.1 billion people do not have access to improved drinking water sources. Consumption of unsafe water continues to be one of the major causes of water borne diseases.

Ground water borehole contamination is defined as

the artificially induced degrading of natural water quality (WHO, 1992). The sources of ground water pollution were classified into three by David, 1991 as follows: municipal, industrial and agricultural sources. Municipal sources include groundwater pollutants from sewer leakages septic tanks and refuse disposals. Industrial sources include several pollutants caused by various industrial activities such as untreated liquid waste (effluents), tank and pipe leakages and mining activities. While agricultural sources/ causes are as a result of pesticides, fertilizers and animal waste application.

2.0 Materials and Method

2.1 Study Area

This paper is narrowed to the physico – chemical and microbial qualities of borehole water in FUTO and its environs all in Owerri West Local Government of Imo State, Nigeria.

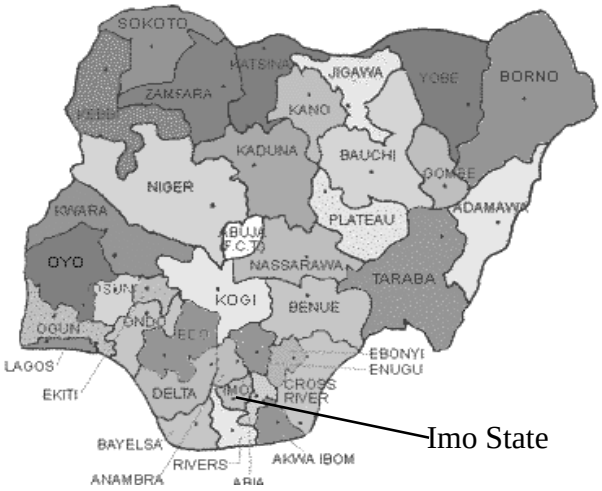

Figure 1A

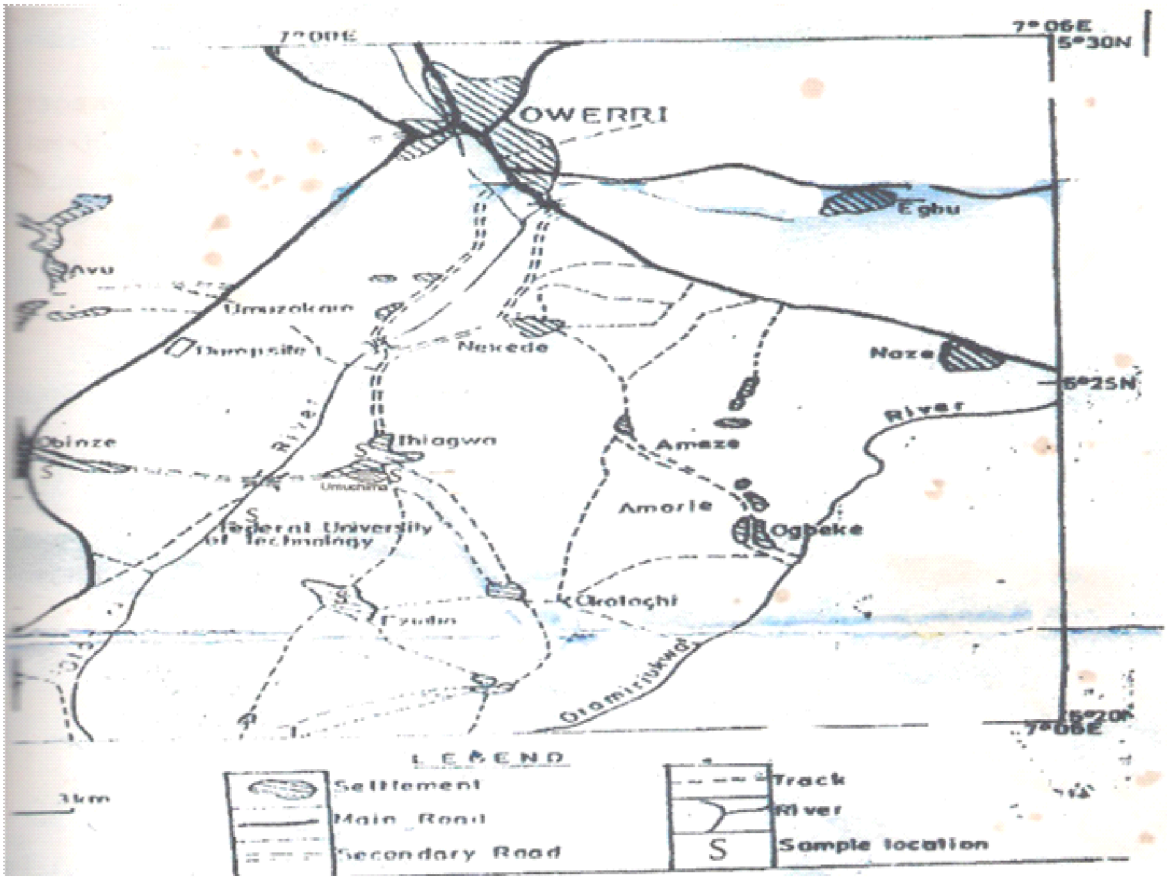

Figure 1B

Figures 1A and B: Maps of the study area, showing sample location

The study area for this research is Imo State. Imo is in south Eastern Nigeria and lies on the latitude 5^0 29^1N, 7^0 2^1E.

Water samples were collected from the sites located within Federal University of Technology Owerri, and the four major communities surrounding it, which are Eziobodo, Umuchima, Ihiagwa and Obinze.

2.2 Sample Collections:

10 water samples from the above locations were collected. The taps were cleaned with ethanol, opened fully and allowed to run waste for five minutes. This was done to permit clearing the service line. Subsequently, water collected aseptically into sterile containers which were properly labeled for each location.

2.3 Physico – Chemical Analysis

Apart from temperature, which was measured using mercury thermometer in sites at each collection point, other Physico – Chemical parameters were analyzed within 4 hours of collection. pH was measured using Beckham pH meter (Model 7413), while total solids was measured by summing the values of total dissolved solids and total suspended solids. Total suspended solids were measured by filtering 100ml of water samples through known weight of filter paper, weighed later after drying. While total dissolved solids were measured using TDS meter, model 412C. All other inorganic variables including turbidity, sulphates, nitrates, phosphates were measured using a spectrophotometer which is a recommended methodology by the USEPA and WHO (WHO, 2002).

2.4 Microbial Analysis of Samples:

The test for total heterotrophic count was carried out using commercially obtained nutrient agar. The spread plate method was used. The number of colonies were counted and the colony forming unit per 100ml (CFU/ ML) were determined (Okereke *et al.*, 2006).

Test for *Vibrio spp* was carried out using the thiosulphate citrate bile salt (TCBS) agar while test for *Salmonella* and *Shigella spp* was carried out using the *Salmonella* and *Shigella* selective agar (SSA). Spread plate method was used in both of them. Colonies were then counted and the colony forming units per 100ml (CFU/ ML) determined. The direct method for total coliforms (WHO. 2002) was used in determining total coliforms. The medium used was the MacConkey agar with salt.

The test for fecal coliforms was carried out using a membrane filter method (Nester *et al.*, 2004). A millipore membrane filter, (0.45nm) was used.

3.0 Results

The temperature of samples ranged from 2.39 to 25.70°C. Sample J (Las Vegas hostel in Obinze)

Table 1: Result of Physico – Chemical Analysis

Parameters	WHO STD	Samples Locations									
		A	B	C	D	E	F	G	H	I	J
Temperature	20 – 30	25.10	25.00	24.20	25.30	24.80	23.90	25.50	24.50	25.50	25.70
Ph	6.5 – 8.5	6.24	6.00	6.04	6.25	6.19	6.21	6.20	6.30	6.03	6.27
TDS(MG/L)	50	17.00	25.00	32.00	39.00	24.00	26.00	32.00	38.00	18.00	24.00
Turbidity(NTU)	50	2.00	1.00	4.00	5.00	2.00	2.00	3.00	2.00	1.00	3.00
Nitrates(Mg/L)	45	2.10	2.40	1.60	1.40	2.70	2.60	1.50	1.80	1.60	2.00
Phosphate(Mg/L)	5	2.10	2.20	2.60	2.80	1.80	1.90	2.50	2.30	1.60	1.80
Sulphate(Mg/L)	<250	1.20	1.40	1.20	1.10	0.70	0.80	1.50	1.60	2.20	2.20

Description of Samples of Location

FUTO Campus
A = Hostel A
B = Hostel C

Eziobodo
C = Jon-Vill hostel
D = Moonlight Lodge

Umuchima
E = Queen of peace villa
F = Mikado Hostel

Ihiagwa
G = Test of Time lodge
H = Village gate hostel

Obinze
I = Saint city place
J = Las Vegas hostel

had the highest temperature of 25.70^{0}C while sample F (Mikado Hostel in Umuchima) had the lowest of 23.90^{0}C. All samples were within the WHO standard (see Table 1).

The pH ranges in all samples turned out to be below the WHO standard. The total dissolved solids, turbidity, Nitrate, Phosphate and Sulphate levels fell within the WHO specified unit (see Table 1).

The variations in *Salmonella* and *Shigella spp*, and *Vibrio spp* were represented together considering their similarity in WHO standard. The results show the presence of *Salmonella* and *Shigella spp* in all the samples were more than the presence of *Vibrio spp*, which appeared only in two samples. Sample B (Hostel C in FUTO campus) and Sample I (Saint City Place in Obinze) were free from both microorganisms (see Table1 and Figure 2). The results in total and fecal coliforms were represented together considering their similarities in WHO standard. The result showed that all the samples did not fall within the WHO standard (see Table 2 and Figure 3).

4.0 Discussion

The temperatures of the entire sample were within the WHO standard. The turbidity (FTU) values were ranged from 1 to 5, and were below WHO standard of 50 FTU. This is an indication of the clarity of the water sample free from materials in suspension (Wayane, 2006).

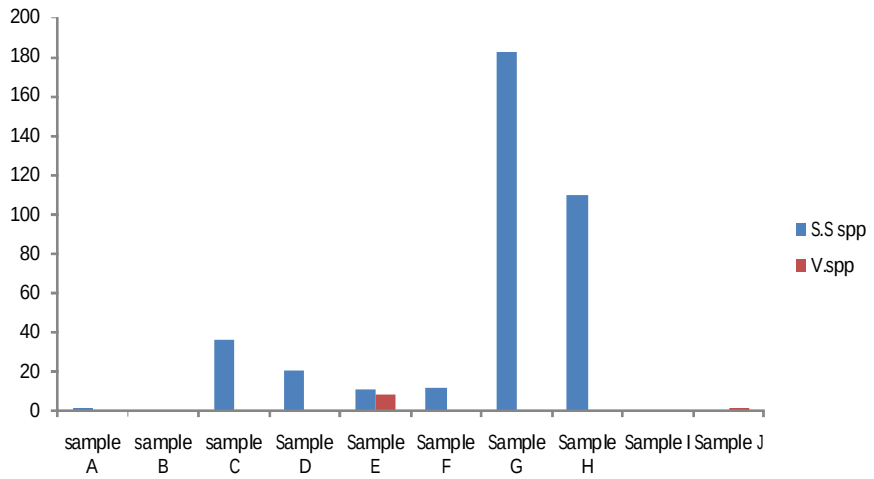

Figure 2: Variation in *Salmonella* and *Shigella spp*. and *Viibrio spp*.

Table 2: Results of Microbial Analysis

Parameters	WHO LIMIT	Samples Locations A	B	C	D	E	F	G	H	I	J
S.S spp (cfu/ml)	-	1	-	36	20	11	12	183	110	-	-
V. spp (cfu/ml)	-	-	-	-	-	8	-	-	-	-	1
THC (cfu/100ml)	<500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500	TNTC >500
TCC (cfu/100ml)	<10	14	19	19	39	251	128	TNTC >300	2	22	TNTC >300
TFC (cfu/100mls)	<10	9	12	12	12	20	32	25	39	13	39

S.S spp = *Salmonella* and *Shigella spp*
V. spp = *Vibrio spp*
THC = Total heterotrophic count
TCC = Total coliform count
TFC = Total fecal count
TNTC = Too numerous to count

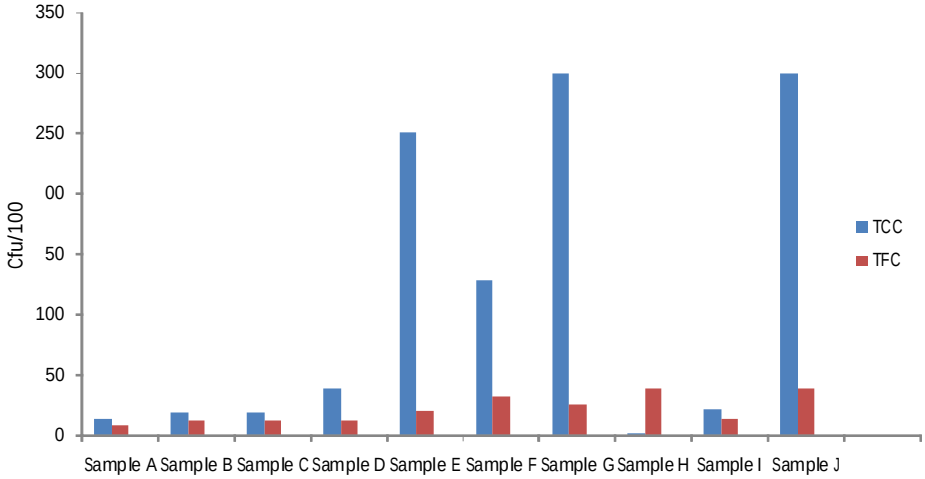

Figure 3: Variation in total coliforms and fecal coliforms.

The pH value ranged from 6.00 to 627. The values were not in accordance with the WHO standard. They were below the WHO standard showing slight acidity. This is probably as a result of the high level of microorganisms which during metabolism produce acids. These result corresponded with the result of Azike, 2003 and Wills, 1997.

The result for nitrates, phosphate and sulphate were all within the range given by WHO. This is probably due to the observed non-use of fertilizers and pesticides/herbicides in the area.

The result of bacterial qualities of the borehole water samples in Table 2 and Figures 2 and 3 did not meet the WHO standard for bacteriological quality. This implies that it is not suitable for drinking, but could be used for other purposes such as laundry, and toilet flushing (WHO, 2002).

The total heterotrophic count was more than the WHO specified limit, the fecal coliforms ranged from 9 to 399 (CTU/100ml). This showed that there was fecal contamination in all the sampled locations, which fall short of the WHO specification. The presence of fecal contaminates shows that, FUTO campus and its four surrounding communities do not have proper sewage treatment and may have leakages from sewer pipes *Salmonella* and *Sligella spp* were present in seven out of ten samples ranging from 1 to 183 Cfu/100ml. These results did not meet WHO standard for drinking water and shows that the water from sampled locations are polluted and consumers are prone to waterborne disease. This may be attributable to so many refuse dumps found within Eziobodo, Umuchima and Ihiagwa and less refuse dumps in FUTO campus and Obinze. The results tally with Azike, (2003) and Oliver, (2005) isolated *Salmonella* and *spp* from sampled water which was attributed to refuse dumps in the study areas. Sample E (Queen of peace villa) and J (Las vegas hostel) showed presence of *Vibrio spp* of 8 Cfu/100ml respectively. This did not meet the WHO specification indicating that the water from these areas is prone to cause cholera.

5.0 Conclusion

Borehole water is a source of water supply in both rural, urban areas and developing countries. This study reveals that borehole water samples derived from FUTO campus and its four major surrounding communities is not suitable for drinking. There was fecal contamination in all the sample locations, which fall short of the WHO specification. The government and FUTO authorities should be aware of this which can best be described as a public health problem. It is important that adequate attention be given to maintaining and improving its hygienic quality for human consumption. It is suggested that proper installation of septic tanks be made to solve and also remove borehole pollution to it barest minimum or wiped out completely. It is also recommended that before consumption of borehole water, conventional treatments such as boiling, filtering or chlorination is done to avoid water borne diseases.

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