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Research Article

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Determination of the Microbiological and Physio-chemical quality of Borehole water in Orji Amawire in Owerri north local government area of Imo state.

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Abstract

This work focused on the determination of the microbiological and physiological quality of borehole water in Orji-Amawire. This work became necessary because borehole water serves as the major source water supply in the study area. The objectives of the study was to determine the microbiological and physicochemical quality of the Borehole water in Orji-amawire, determine their level conformity with WHO standard and the extent of treatment needed to improve the quality of the water in which an experimental research design was adapted. Three samples were collected laboratory analysis and the result showed that the pH of samples. A and B was not in conformity with WHO standard as well as the total coliform count of samples B and C. therefore the study concluded that the water was unfit for human consumption but require minimal treatment to conform with WHO standard. For this purpose, regular microbiological and physiochemical analysis of water, boiling of water before consumptions and siting of boreholes far from septic tanks was recommended.

Keywords:

Introduction

Water is essential for human existence, and its importance for individual's health and the wellbeing of a nation cannot be underestimated. Notwithstanding, in many developing countries, availability of water has become a critical and urgent problem, and it is a matter of great concern to families and communities. A situation which is worsened by the rapidly growing urban population which increasingly become a problem for governments throughout the world.

According to Wegelm-Shurginga, (1999) "Water resources are the threatened not only by the rapidly increasing demand of the population but also through diminishing quality caused by pollution an saline intrusion.

Accessibility and availability of fresh clean water is a key to sustainable development and an essential element in health, food production and poverty

reduction. As important as water may be, it's economic importance as a medium of water related disease, which c institutes a significant percentage of the disease that affect human,must not be overlooked as an estimated 1.2 billion around the world lack access to safe water (United nations nongovernmental Liaison Services (NGLS)(The world water forum on water, 2003).

Unsanitary water particularly has devastating effects on young children in the developing world. According to (WHO, 2009) every 20 seconds, a child dies from water-related disease, among children under five (5) globally and nearly one (1) in every five deaths - about 1.5 million each year, is due to diarrhoea which kills more young children then AIDS, malaria and measles combined (WHO, 2009). Nearly 90% of diarrhoeal-related deaths have been attributed to unsafe or inadequate water supplies and sanitation conditions affecting a large parts of the world's population (WHO, 2004; Huges and Koplan, 2005).

The quality of groundwater has been found to be a function of natural processes as well as anthropogenic activities. Nitrate compounds, heavy metals and pesticides etc. that are contained in our drinking water can also constitute undesirable pollutant when they are not within world health organization (WHO) guidelines for drinking water. On this backdrop, the principle objectives of municipal water are the production and distribution of safe water that is fit for human consumption (Okonko et al., 2008).

High level of chlorine in treated public water supply could reach with organic matters to form organochlorine compounds which has been found to be carcinogenic when consumed over a long period of time. Hence a high percentage of people are turning to the use of borehole water for domestic cores and drinking even though Sule et al. (2009) in a recent research found out that stress bacterial cells reactivate foster in dechlorinated water than in chlorinated water. From environmental stand point, there is need to ascertain as conformation with microbiological water to spread diseases within a large population. Although the standard vary from place to place, the objective anywhere is to reduce the possibility of spreading water-borne diseases in addition to being pleasant drink, which implies that it must be wholesome and palatable in all respects (Okonko et al.,2008).

Aim

The general objective of the study is to determine the microbiological and physio-chemical quality of borehole water in Orji-amawire in Owerri north local government of Imo State.

Specific objectives

The specific objectives of the study are to analyse data routinely collected water samples from boreholes in other to ascertain:

The level of some physio-chmeical and microbiological parameters present.
The level of some microbiological parameters present.
The level of conformity to the WHO water standard for drinking water of Imo State.

The level of treatment needed to improve the water from the boreholes for drinking

Methodology

Research design

For the purpose of the study, an experimental research design was adopted to determine the microbiological and physio-chemical quality of borehole water in Orji-amawire in Owerri North L.G.A. of Imo State, with the World Health Organization (WHO) water quality standard as a control.

Sampling locations

Water samples were collected from boreholes used as sources of domestic water by students of Imo State University in Orji-Amawire in Owerri North Local government of Imo State. The samples were collected from four hostels:- (a) wisdom hostel (b) Atta hostel (c) New York hostel (d) lady Mary hostel

Collection of water sample

Cotton wool soaked in 70% ethanol was used to sterilize the nozzle of the borehole from which samples were collected. The tap as flowed to flow for two minutes before sterile 1 litre screw capped glass bottles were carefully uncapped and filled with the water and recapped. Water samples were transported to the laboratory in a cooler With ice.

Media preparation

1.Nutrient Agar: A clean spatular was used to measure 28g of nutrient agar powder in a weighing balance and it was suspended into 1 litre of distilled water and allowed to boil to dissolve completely. It was sterilized by Autoclaving at 121OC for 15 minutes (Bridson, 1998).

2.Membrane Laury Sulphate Broth Agar: A clean spetula was used to measure 76.2 grams of membrane Laury sulphate broth agar in a weighing balance. It was dissolved in 1 litre of distilled water and then it was distributed into a final 100ml screw cap bottle containers. It was sterilized and authoclaved at 121°C for 15 minutes.

Analytical procedures

1. Bacteriological quality determination (membrane filtrate techniques):

The sterile membrane filtration apparatus was placed in position and it was connected to a source of racoum pump with the stop cock turned off. An absorbent pad was places into a sterile Petri dish then 2ml of membrane laryle sulphate broth was poured into it. The funnel of the membrane filter was removed and a filter paper composed of cellulosesters, with pore. Size 0.45um was placed on the base of the porous disc of the filter paper with the aid of a forcep. 100ml of the sample was filtered through the membrane such that the organisms to be enumerated were retained on the surface of the membrane which was placed with the gridlines faced upward on the absorbent pad saturated with membrane lauryl sulphate broth in the petri dish sulphate broth in the petri dish. The procedure was repeated for the other samples and they were incubated at 30°C for 4 hours at a room temperature and then transferred into an incubator and were incubated at 44 C for 18-24 hours after which all yellow colonies were counted.

2. Physiochemical analysis

i. Conductivity and total Suspended Solid: This is done with the conductivity meter.
Plug the conductivity meter to the source of power.
Put 25ml of the sample in a flat bottom flacks.
Put 25ml of deionised water in another flat bottom flacks.
Rains the conductivity and total suspended solid of the deionised water, as a control.
Place the conductivity probe in the flacks containing the water sample and check for the conductivity and total suspended solid reading from the conductivity meter, ii.

ii Procedure for determining colour and turbidity of water with the spectrophotometer.

Switch on the dataloging spectrophotometer.
Rains one of the 25ml bottle with deionised water and the other, the sample of water tube tested.
Determine the colour and turbidity of the deionised water as a control.
Determine the colour and turbidity of the sample and get the reading from the spectrophotometer and record.
iii. Procedure for determining iron, chromium and other heavy metals in water.
Enter the stored program number for the given parameter as stated in 3 above, pillow number.
Fill a 10ml graduated mixing cylinder with 10ml of the water sample
Add the content of one TPTZ of parameter reagent powder pillow to the prepared sample.
Fill the second 10ml granulated mixing cylinder with deionised water.
Add the content of the TPTZ reagent power pillow to the deionsed
water.
Transfer the prepared sample and the blank into two matched 10ml sample cells (bottle).
When the timer beeps, the display will show: mg/I (of the parameter to be measured) TPTZ, insert the blank into the cell holder, and close the light shield.
Press zero to get the reading for the blank.
Put the prepared sample and press read for the reading to appear.

Method of data presentation

Data collected for this research was presented/ analysed using percentage and tables.

Data presentation and Analysis

Table 4.1 Result of physio-chemical analysis

S/N	Parameter	Unit of measurement	Sample A	Sample H	Sample C	WHO guideline
1.	Temperature	°C	26.5°C	23.9"C	25.8"C	-
2	Colour	ptco. unit	1.0	1.01	1.0	20
3.	Odour	-	Unobjectionabl	Unobjectionabl	Unobjectionabl	Unobjectionabl
4.	Taste	-	"		"	11
5.	Turbidity	NTU	1.0	1.0	1.0	5
6.	Conductivity	US/CM	157.2	161.4	92.4	25.00
7.	Pli	-	6.2	6.4	6.6	6.5-8.5
8.	Acidity	Mg/l	210.0	172.0	122.0	-
9.	Alkalinity	Mg/l	14.0	80.0	14.0	-
10.	Chlorine	Mg/l	16.0	14.0	10.0	250.0
11.	Salinity	PPT	0.05	0.05	0.05	100
12.	Iron	Mg/l	0.00	0.0	0.0	0.3
13.	Total suspended solids	Ppm	0.02	0.03	0.01	
14.	Total dissolved	Ppm	78.4	79.2	46.4	1000
15.	Carbon dioxide	Mg/l	37.4	22.0	22.0	-
16.	Sulphate		0.307	0.384	0.36	250
17.	Total hardness	"	10.6	12.0	8,0	400
18.	Calcium hardness	"	8,0	10.0	80	
19.	Magnesium		2.0	2.0	0.0	-

A. Physical parameters

i. Temperature odour and taste: In the determinant of the temperature of the water sample, all the sample were fund to be within acceptable limits at 25.6°C, 23.9°C, and 25.8°C respectively, all at which fall within room temperature. The same was applicable for both odour and task as no objectionable odour or taste was observed.

ii. Turbidity: According to the result in table 4.1 above, a turbidity value of l.ONTU was observed for all three samples making them acceptable as they all fall within the WHO turbidity limit of 5.0 NTU.

iii. Colour: With respect to the WHO maximum allowable concentration for drinking water of 15ptco (platinum cobalt) it was observed that all thee sample fall within the WHO limit with values of l.Optco for all the samples.

iv. pH: According to the above analytical result presented in table 4.1, a pH value o f6.6 was recorded in sample C (emmaculate hostel) which was found to be in conformity with the WHO standard of 6.5-8.5 but in sample A (festa hostel) and sample Bs (wisdom hostel) pH value of 6.2 and 6.4 respectively was found not to be in conformity with the WHO standard for drinking water.

v. Conductivity: The conductivity level of sample B (wisdom hostel) was found as the highest at 161.us/cm. This was followed by that of sample A (Festa hostel) at 157.2 us/cm and finally 92.4 us/cm was recorded for sample C (emmaculate hostel).

B) Chemical Parameters:

i. Acidity: According to the result above, acidity concentration as high as 210.0mg/L was recording in sample A. This result was followed by sample B with an acidity result of 172mg/L and 122mg/L for sample C.

ii. Chloride: The chloride values of the three samples as recorded in the result stated in table 4.1 above was found to be 16mg/L, 14mg/L and l0mg/L in sample A, B, and C respectively. These results are seen to be in line with the WHO limit for drinking water quality of 250mg/L.

iii. Salinity: The result of salinity of the three samples which indicate the saltiness of the water was observed to be 0.05ppm in all three samples which falls within the allowable limits of l00ppm for fresh water, iv. Iron (fe2+): From the result of analysis earned out as stated in table 4.1 above, no trace of iron was found in all three samples which is in conforminity with WHO standard of 0.3mg/L. v.

Total Suspended Solid: The above result that the total suspended solid of sample B at 0.05ppm was the highest.

The value was then followed by sample A at 0.02ppm and sample Cat0.01ppm

vi. Total dissolved solid: A value of 79.2ppm was recorded in sample A, 78.4ppm is sample B and a value of 46.4ppm is sample C. All three samples were found to be within the WHO limit, of l000ppm for drinking water,

vii. Sulphate: The sulphate concentration of the sample were found to be in tolerable limit as they were found to be 0.307mg/l for sample A, 0.384mg/l for sample B and 0.326mg/l for sample C.

All of which fall below the WHO limit of 250mg/l for drinking water.

viii. Total hardness: By the report of table 4.1 above, total hardness of the sample gotten in relation to its calcium and magnesium hardness, has its highest value of 12mg/l (10mg/l of calcium hardness and 2mg/l of magnesium hardness) in sample B. this was followed by sample of 10mg/l (8mg/l of calcium hardness and 2mg/l of magnesium hardness) and final sample C of 8mg/l (8mg)l of calcium hardness and 0mg'l for magnesium hardness). These figures are seen to be below the WHO total hardness standard of 400mg/l for drinking water.

Table 4.2: Microbiological water quality

Parameter	Unit of measurement	Sample A	Sample B	Sample C	WHO guidelines
Total coliform	MPNY 100ml	0	6	32	0

As stated in table 4.2 above, the result shows that sample C has the highest contamination rate with total coliform rate of 23, which is followed by sample B with total coliform rate of 6. In sample A no coliform was found making it (Sample A) the only sample that fall within the WHO microbiological specification of Zero (10) coliform for drinking water.

3.Objective Three (3): To determine the level of conformity with WHO standard.

By the result as stated in table 4.1 and table 4.2, it was observed that some parameter were in conformity with the WHO water quality standard for drinking water for all three samples except for the PH values of 6.2 and 6.4 for samples A and B respectively which were seen to be more acidic than the standard of 6.5 - S.5 set by WHO for drinking-water.

Also, the micro - biological standard for samples C and B with readings for total coliform of 23 and 6 respectively were also in excess of the W.H.O requirement for the total coliform count of O MPN/100ML.

Therefore by the above analysis none of the samples were seen to be in conformity with W.H.O standard for drinking water.

By the above result as stated in table 4.1 and 4.2. It was observed that just two parameter full shot of the W.H.O drinking water quality standard; pH and total coliform count making the treatments aimed at stabilizing. The pH and sterilizing the water from bacteria.

1. pH Stabilization: This process which is the act of bring a Ph which is either acidic or alkalin to normal.

By the above result, the stabilization process will be aimed at increasing the pH from 6.3 and 6.4 respectively to 7. This could be achieved through either of the following:-

a). pH Correction Filter:- Treatment by means of pH correction filter, involves the use of a neutralizing, media, generally composed of crushed and processed limestone. This media dissolves in the water as it passes through the filter and the natural alkalinity of the filter media raises the pH.

b). Soda Ash sodium hydroxide injection: In this method soda ash (sodium carbonate) and sodium hydroxide is injected into the water system which neutralize the acid in water an raise the pH to normal.

2. Disinfection of water: Disinfection which is the process in which most or nearly all micro - organism in water are killed through the use of chemicals, heat, or ultraviolet rays is the measure way to ensure a total coliform free water as recorded in samples B and C. This could be achieved through either of the following:-

a). Boiling of water at house hold level at 100°c for five (5) minute will destroy disease causing organisms and disinfect the water.

b). Chlorination: This process of adding chlorine to the water to kill all micro - organisms in it. This could be achieved through the used of chlorinated filter that will be attached at the mouth of the ape and also use of chlorine tables for purification of the water, which must be used according to the specification of the producer.

c). The use of an uncounted house hold bleach, which contain four to five percent sodium hypochlorite will also disinfect water when two to three drops are added to each liter of water and the water is left to stand for thirty (30) minutes

Discussion

From this study, it has been observed that quality of borehole water in orji amawire varies from each other, also that the rate of contamination of boreholes in Amawire varies from other, is minimal as seen from the result in table 4.1 and 4.2.

In the three samples conducted, all other physiochemical parameter which including total hardness, total dissolved and suspended solid, iron, sulphate and chlorides were all seen to which include temperature, colour odour, taste, turbidity conductivity including total hardness, total dissolved and suspended solid, iron, sulphate and chloride were all seen to be below the WHO water quality standard except for ph and sample B of 6.4 with difference of 0.3 and 0.1. Making sample C to be the only sample that passed the W.H.O. physiochemical standard for drinking water pH of 6.6.

The micro-biological analysis conducted on these samples showed a very high contamination rate in sample C with a total coliform count of 23 and Sample B with total coliform count of 6 which count in drinking water sample. Leaving sample A as the only sample that was found fit from the microbiological analysis with a zero (0) total coliform count A condition which is accredited to feacal contamination from septic tank due to the closeness of these bore holes and the septic tank which situation is a confirmation of the report by NAFDAC which found borehole water samples to be polluted with high microbial load.

The above result agrees with perverse research conducted by Lyasade et al .(2012), that bore hole water needs minimal treatment before consumption in other to meet the WHO standard for portable water supply as only pH and the total coliform count were found to be above the sit limit for drinking water.

Conclusion

The physiological parameters of the samples were within the acceptable limits by WHO standard for drinking water except the pH values which were comparatively low in Sample A and B. Although some of the chemical parameters fell below the approved standard, they were judged to be acceptable since they were not above the required maximum permissible limit for drinking water.

With two of the samples (Sample B and C) found to be contaminated with coliform bacteria it is concluded that none of the samples is fit for human consumption as they are either physiochemically polluted or contaminated with bacterias.

References

Huges, J.M and Koplan, J.P. (2005). Saving life through global sate water. Journal of emerging infectious diseases, 11 (10): 1636- 1637.

lyasde, J.U. and Idiata, D.J. (2012). Determining the borehole water quality in Edo South, and Edo North area of Edo State. Research Journal in engineering and applied Science. 1 (4) 209 - 213.

Okonko, I.O., Ogunjobi, A.A., Adejoye, A.D., Ogunnusi, T.A., and Olasogba, M.C. (2008). Comparative Studies and microbial risk assessment of different water samples used for processing frozen see foods in Ijora - Olopa, Lagos State, Nigeria. African Journal of Biotechnology, 7(16): 2902 - 2907.

Sule, I.O., Oyeyiola, G.P.O. and Agbabiaka, T.O. (2009). Comparative bacteriological analysis of Chlorinated and Dechlorinated Pipeborne water. International Journal of biological science, I (1): 93 - 98.

United Nation Non Governmental Liaison Services (NGLS), Third World Water Forum on water, Blockade Myth, illusions in Development and co-operation, 2003, 30, 1.

Weglin-Schuringa, M (1999). Water Demand Management and the urban poor. International Research Centre (IRC), Hague, www.who.int/entitv/water_sanitation_health.

WHO, Diarhhoea: Why children are still dying and what can be done. 2009.

World Health Organization (WHO). (2004). Water, sanitation and hygiene links to health .http//:www.who.int/water__sanitation_health/ publications/ facts2004/en/print.html.

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