Journal of Research in Forestry, Wildlife & Environment Vol. 13(1) March, 2021
E-mail: jrfwe2019@gmail.com; jfewr@yahoo.com
http://www.ajol.info/index.php/jrfwe
jfewr ©2020 - jfewr Publications

ISBN: 2141 – 1778
Asabia et al., 2021

BACTERIOLOGICAL EXAMINATION OF PUBLIC WATER TAPS AND BOREHOLE WATER IN CHOBA COMMUNITY, RIVERS STATE

Asabia L. O, Fawole, O. A, Rufai. S.O , Adesokan , F.B and Oni .O.A.

Forestry Research Institute of Nigeria P. M. B 5054 Jericho, Ibadan.
***Correspondent Author:** *imulep007@yahoo.co.uk;* +234 805 973 3588

ABSTRACT

This study examined the bacteriological quality of public water taps available in Choba community of Rivers State. Public water tap samples were collected using sterile glass jars. The samples were serial diluted and from 10-1 to 10-5 and were plated, the samples were gram stained and viewed under light microscope. Total heterotrophic bacteria was analyzed using spread plate method, feacal and total coliform was enumerated, so also motility test was done for the identification of salmonella shigella spp. Biochemical test and physical parameters were also analyzed. Results showed that bore hole water1 (BHW1) had 9.7 10^5, 2 , 240 and 3 respectively, bore hole water 2 (BHW2) had 1.7x 10^7, 200,4 and were not motile. Public water tap1 (PWT1) had 1.7 x10^6, 60, 20 and 10.public water tap (PWT2) showed 1.6x 10^7, 120, 7, and 16 respectively for each of the tests. Physicochemical properties were also examined and public water tap (PWT1) had the highest alkalinity of 30, temperature of 32.5, pH 3.24 and hardness of 160 while bore hole water 1(BHW1) had 13.9, 30.3, 4.32and 10 for each of the physicochemical parameters respectively. The results showed that the water from the boreholes in the study areas are contaminated with coliform bacteria. There is therefore need to increase awareness of the community towards preventive and treatment approaches in order to minimize the dangers associated with the use of contaminated water. Pipe connections should be checked properly and regularly.

Keywords: Bacteriological analysis, Water quality, Coliform , Diseases and Contamination.

INTRODUCTION

Potable water is an essential ingredient for human's socio economic development. in developing countries, biological contamination of water for domestic uses is of major concern for public health authorities. According to the World Health Organization, approximately 5% of all deaths in these countries are directly related to water diseases. Hence, the importance of quality of water to mankind. One of the important reasons of decline of quality of drinking water may be attributed to the growth of microbes. Therefore, an understanding of bacteriological quality and safety of drinking water has become important. Water is one of the most essential requirements for life on earth. It has been reported that the resources covers more than 70% of the earth's surface ((Ire and Stanley, 2010).

Human being depends so much on water for existence; therefore, a reliable and safe supply of water is necessary for a healthy community. Man can survive without food for 20 days but starts struggling for life in the absence of water just after one day. Water management in most parts of the world has thus been a case point, because of its chemical compound nature with unique properties that includes buoyancy which is the upward force that water exerts, it is the ability of water to allow objects or liquids that are less dense float on it. Thus, fresh organisms and animals can move in any direction; Heat capacity, the ability of water to absorb heat without

undergoing an apparent increase in temperature; Surface tension which allows the formation of rain, that dissolve nutrient in the soil, and therefore, helps water molecules to hold together. Hence, making water a good solvent (Ire and Stanley, 2010).

Different types of natural water are known to exist based on their location among which are; surface water which are bodies of water such as lakes, streams, rivers and oceans, which could be fresh water, brackish and sea water. Surface water tend to be turbid; a property caused by the presence of clay and other light scattering colloid particles. However, microbial populations varies in both numbers and species due to the nutrient composition of water, which can be influenced by nutritional, geographical, biological and climatic conditions *(Pelczar et. al.*, 1993); Atmospheric Water, this includes moisture contained in cloud and precipitation as snow, silt, hail and rain. The dust of the air convey microbes (Microbial flora of this water) found in this water is mostly contributed by the air *(Pelczar et. al.*, 1993); Ground Water which may simply be referred to as water below the earth, it results from precipitation that infiltrates the ground and seeps downward through fractures, pores and other spaces in soil and rock. Usually, ground water is characterized by high TDS concentration, which is a result of dissolved minerals acquired from soils and rocks. Bacteria as well as suspended particle are moved by infiltration in ranging degrees depending on permeability characteristics of the soil and depth to which water penetrates. Examples of the mineral ions or elements are Calcium, Magnesium, Iron and Fluorides. Regarding its high quality with respect to portability and its minimal requirements, ground water is often a preferred source of water for individual homes and small communities (Tchobarnoglous and Schroeder, 1985). Meanwhile, Holmus, (1979) recorded that ground water may be considered unsuitable for direct use in household due to high iron (Fe) content, and then suggested that the water be first purified of the Iron. Ground water comes from springs, shallows wells, deep wells. Natural water supplies particularly streams and rivers are likely to be polluted with domestic and natural wastes, *(Pelczar et al.*, 1993, Abu 2003). Most persons whose source of water supply is surface water are ignorant that a considerable portion of their drinking water may have been used earlier for domestic or industrial purpose and thus contaminated with industrial waste such as agricultural wastes and oil spillage in the case of the study area *(Pelczar et al.*, 1993). Water can be satisfactory in appearance, taste and odour but yet unsafe for drinking when contaminated. The quality of water is a vital concern for mankind since it is directly linked with human welfare (ART, 1986).

In most part of the studied area, (Port Hacourt), settlers established communities next to ocean, river and lakes before populating the rest of the region. However, the problems linked with the lack of water quality resource in Port Harcourt threaten the life of over 2 million people. In a nutshell, no source of water meant for human consumption can be free from pollution. Water pollution not only changes the physical properties like color. Odor, turbidity, taste and temperature but also makes it acidic, alkaline or saline due to the presence of dissolved chemical substances.

The study area is equally prone to regular flooding than other part of the country (Ire and Stanley, 2010). WHO, 1993) stated that typhoid, gastroenteritis and diarrhea are the major water borne killer disease. The rapid multiplication of the infectious agent found in the gut and in the feces has always resulted in elevated concentrations of pathogens in sewage. Hence, the major danger associated with drinking water is the possibility of its recent combination by sewage, human or animal excreta (Pipes, 1981).

It has been reported by various researchers among which are Hutchinson

and Ridgway, (1977) in further experimentations by Pasteur and others that microorganisms were the cause of disease. This lead to the development of bacteriological examination as being a valuable supplement to chemical analysis. From the public health aspect, Frankland (1885) initiated a routine examination of water using gelatin plate counts and later enumerated the concept that microorganism characteristics of sewage must be identified to provide evidence of potentially dangerous pollution. Research made way for detection of normal intestinal floral such as coliform bacteria, faecal *streptococci*, and *clostridium perfringens* which are easier to isolate and identify (PHMS, 1982). It may however indicate the need to increase the frequency of sampling of a giving source, which was previously examined only in frequent materials. The presence of C. *perfringens* together with coliform organisms but not E.coli. The density and the variation of microorganisms found in different water sources vary which may be due to environmental factors preventing in or close to site location, for instance garve cannot pose the same effect as that of a refuse dump to a water source contamination. (Grant, 1996).

Therefore, this study examine the microbiological quality of available public tap water supply and boreholes in Choba community of Akpor Local Government Area in River State of Nigeria to determine among others, total heterotrophic bacteria population, total coliform and enumerate salmonella/ shigella in water samples to ascertain its safety level for human consumption.

MATERIALS AND METHODS

Description of the study area

The experiment was carried out at the microbiology department of university of Port Harcourt. The study area lies within the Niger Delta which features tropical monsoon with two distinct seasons, the raining and dry season.

Sources and sample collection

Samples were collected from public water taps and borehole water at the following locations within the study area (Choba, Obio-Akpor Local Government Area of River State). Public water samples were collected at both Choba along Rumuola, adjacent Tejod pharmacy and Old Wilbros gate after Choba Market, while borehole water samples were collected Behind old Melly Chicken and Chief Obele Okoko Compound. At each sampling point the sterile collecting bottles were filled with water and immediately transported to the laboratory for the required analysis.

Sterilization procedure

Materials used in the course of the laboratory analysis were sterilized by autoclaving at 121˚C for 15 minutes. The inoculating wire loops were sterilized by flaming to red hot using Bunsen burner flame, while hockey stick was sterilized by dipping first into alcohol, then was flamed. All media used were prepared according to manufacturer's directions which was in line with international best practices.

Staining reactions; Grams staining

Smears of the isolates were prepared by taking out inoculums from the starter culture, using a sterile inoculating wireloop and placed on a grease free clean glass slide. The inoculums were spread evenly to form a thin smear of organism. The preparation was air dried and heat fixed by passing the slide three times through a Bunsen burner flame. The heat fixed smear was then stained with few drops of crystal violet solution (known as initial stain) for 30 seconds. After which the smear was gently rinsed with water using sterile syringe and later in a slow running tap water to rinse again. The smear was decolorized with seventy percent (70% v/v) ethanol (known as decolorizer)and finally, stained with one percent (1% v/v) safranin for 30 secs and was equally rinsed with water. The stain smear was dried and viewed with ×100 oil immersion objective of the microscope.

Enumeration of total Heterotrophic bacteria

The analysis of the total heterotrophic bacteria was carried out using spread plate technique as described by APHA (1996). Each sample was diluted using the ten-fold serial dilution method up to 10^{-5} dilution. From each dilution, 1.0mls was used to inoculate nutrient agar plates by spread plate method (APHA, 1996). The plates were then incubated at 37˚C for 24-48 hours. The number of colonies which developed was counted after 24 and 48 hrs of incubation. Results obtained were expressed in colony forming unit per milliliter (Cfu mL^{-1}). For the enumeration of total coliform (MPN 3 Tube method), the most probable number technique was employed for the detection and enumeration of total coliform bacteria in the water samples. The presumptive, confirmed and the completed tests were carried out for all samples.

Enumeration of total coliform (Eijkman test)

This tests for the total coliform though do not distinguish coliform of animal origin from others, but are used for the examination of potable water, since no coliform of any kind should be tolerated in treated water (Okafor, 1995). A loopful of culture from each of the presumptive test tube was inoculated into 10mL of lactose broth medium, with which an indicator called Bromo cresol purple has been added before dispensing into test tube and incubated at elevated temperature (44.5˚C). Cultures with the positive colony changed from purple to yellow and was re-inoculated to fresh EMB agar plates and inoculated at 37˚C for 24 hours and checked for colonies with green metallic sheen.

Identification of isolates

Morphology

The cultures were examined for morphological characteristics like circular smooth, circular rough, irregular smooth and many more.

Motility Test

The test was carried out to determine the presence or absence of flagella as organ of motion in bacteria. The medium used was a semi-solid medium known as motility medium. In the semi-solid medium, motile bacteria swarm and gave a diffuse spreading growth that was easily recognized with the naked eye, ten milliliter of the medium was dispensed into test tubes, plugged with cotton wool and sterilized. It was allowed to solidify in an upright position and incubated for 24-48 hours at 37˚C after inoculating with a straight wire; motility was shown by the diffuse, hazy growth that spreads through the medium rendering it slightly opaque non-motile ones grown only along stab line.

Biochemical Tests

Biochemical tests such as Catalase, Citrate, Indole-production, Methy-Red-Vogues Proskauer, Oxidase and Urease test were performed in duplicate set of tubes for each sample, and there were control which consisted of the medium but with no organism.

Physicochemical Parameters

Alkalinity,Temperature, pH determination, and Hardness were done for each sample.

RESULTS

Microbiological analysis

Total heterotrophic bacteria count

The Figure 1 indicated total heterotrophic bacterial counts that ranged from 1.6×10^6 cfu/mL to 9.7×10^5 cfu/mL. The high bacteria count is an indication of contamination.

Table 1: Microbiological analysis of water samples from public water taps and boreholes in Choba Community

Treatment	**Total heterotrophic bacteria count (CFU/mL)**	**Faecal coliform count MPN (100)**	**Total coliform test (MPN)**	**Total salmonella/shigella count**
BHW_1	9.7×10^5	2	240	3
BHW_2	1.7×10^7	200	4	-
PWT_1	1.7×10^6	60	21	10
PWT_2	1.6×10^7	120	7	16

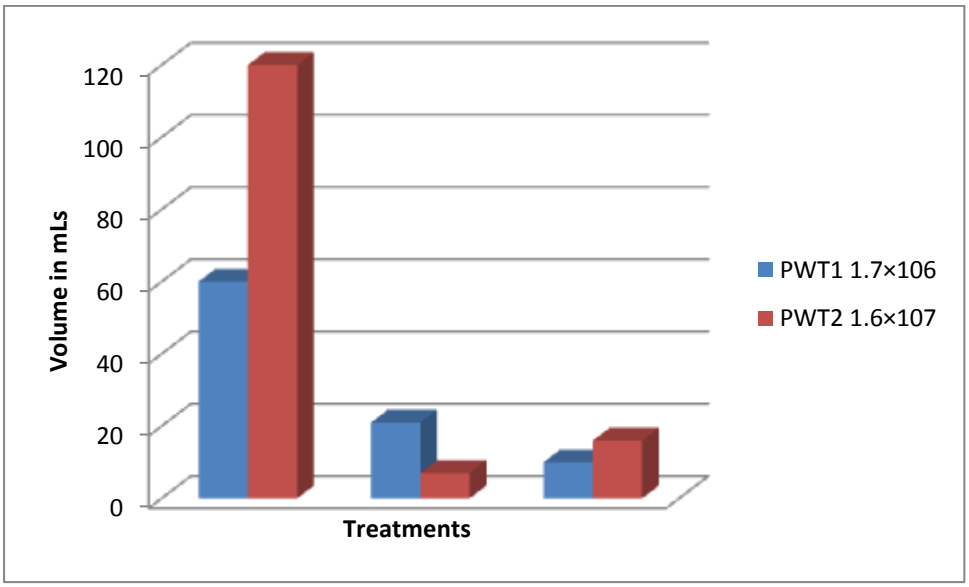

Figure 1: Micobiological analysis of water samples from public water taps and boreholes in Choba Community

Table 2: Physicochemical properties of water samples from boreholes and public water Taps in Choba

Water Sample	**Alkalinity(mg/L)**	**Temperature (°C)**	**pH**	**Hardness**
BHW_1	13.9	30.3	4.32	10
BHW_2	20	29	4.82	20
PWT_1	30	32.8	4.81	180
PWT_2	25	33	3.24	160

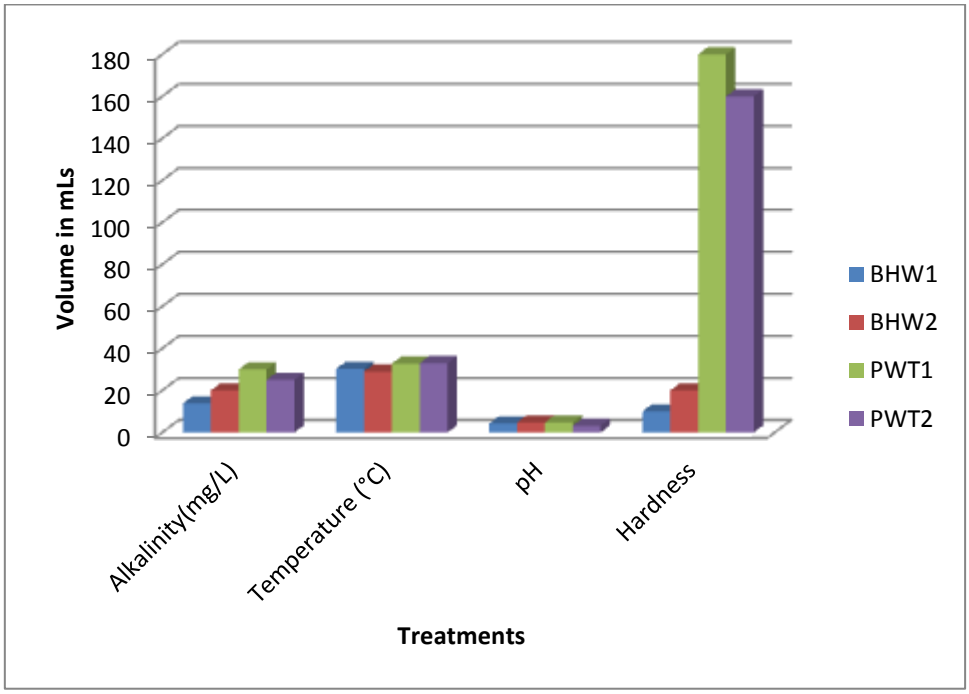

Figure 2: Physicochemical properties of water samples from boreholes and public water taps in Choba

Table 3: Coliform Count of Presumptive Test

Examples	10mL	1mL	0.1Ml
BHW_1	3	3	0
BHW_2	1	0	0
PWT_1	2	2	0
PWT_2	1	1	0

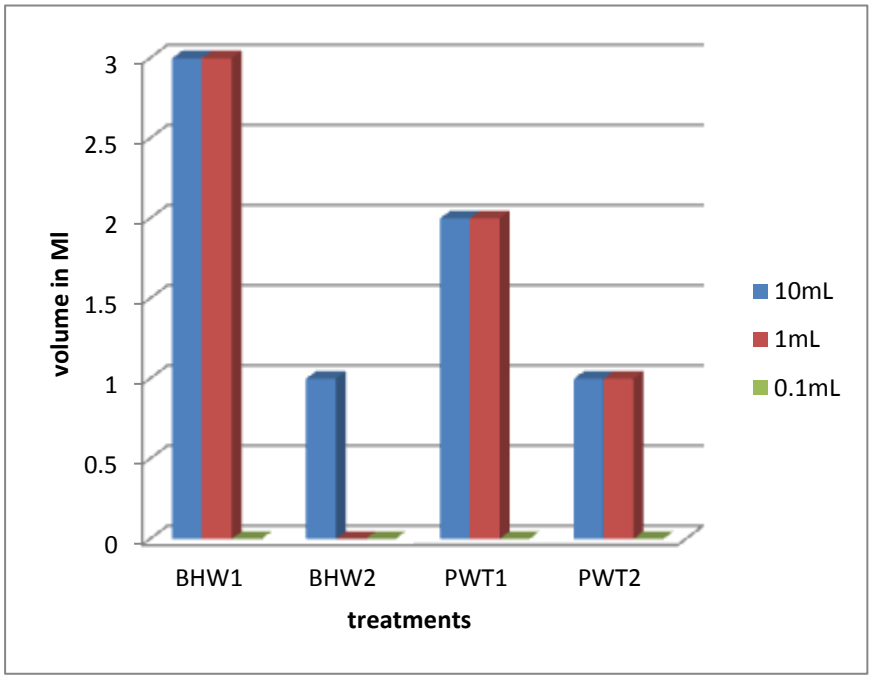

Figure 3a: Coliform Count (A) Presumptive Test

Table 3b: Confirmed Test for water samples

Samples	Type of colony
BHW_1	Greenish metallic sheen colonies
BHW_2	Light pink colonies
PWT_1	Greenish metallic sheen colonies
PWT_2	Pinkish colonies

DISCUSSION

The total heterotrophic bacterial count of the water sample presented revealed that bacteria population of the entire water sample ranged from 1.6×10^6 cfu/mL to 1.7×10^7cfu/mL. This means that water from BHW1 had the highest bacterial count, while the lowest bacterial count of 1.7×10^6 cfu/mL was from the public water tap along East West road, Choba. Water from the public water tap must have been treated and gone through all the purification process from the source prior to being supplied to the community, whereas, borehole water may not have been purified probably because of the cost and the process involved. Also, it has been reported by the World Health Organisation (WHO, 1983), that, depending on the environment, quality of ground water increase with increasing depth. Movement and source of ground water explains why there are variations in the bacterial counts of the water samples.

Results of coliform counts revealed that all the water samples were contaminated with faecal materials. Coliforms are indicator of mammalian colonic contamination. The coliform counts in the water samples ranged from 4-240. The highest coliform count 240cfu/mL was gotten from BHW1 sample. People living around BHW1. Might defecate close to the bush. Thus, making it possible for the faecal matters due to erosion or surface runoff to find its way to the source. When aqifeters are located near pit toilets, contamination of domestic water can occur.

Water of good quality must have a low total bacterial count fewer than 100 cfu/mL (pelczar *et. al.*, 1993), whereas (WHO, 1993) standards demands that, drinking water should have a total heterotrophic bacteria count of <1cfu/mL. Therefore, these water samples are below the required standard of WHO. The characterization and identification of the bacterial from the water samples showed that the isolates were identified as *streptococcus sp*., *Escherichia sp* and *enterobacter sp*. *E.coli* was common to BHW_1 and BHW_2. *streptococcus sp*. was isolated from PWT_1A, *Enterobacter sp*., *shigella sp*. was isolated from PWT_1A, salmonella was isolated from BHW_2.

Unlike Escherichia coli which is commensal, and inhabits the intestinal colon of human and other warm blooded animals (MCkane and Kande, 1996). The presence of these organisms isolated from the water samples suggests that the water was inadequately treated in contrast to what was stated earlier.

Other parameter for the quality of water tested includes pH, which ranged from 3.24 to 4.82. The pH for all water samples analyzed in this study is, 4.32BHW_1, 4.82 BHW_2, 4.81 pHW_1, 3.24 PTW_2. This pH is favourable to pathogenic bacteria which prefer the acidic pH for growth (Linton and Dick, 1990). This can be compared with high heterotrophic bacteria count in BHW2 (1.7×10^7cfu) which has a pH of 4.82

Alkalinity of water had the same pattern to that of pH. The alkalinity for PWT1 and PWT2 were high because the pH is acidic. The hardness of the water samples ranged from 10-180. This is probably due to the presence of rust (Aluminum) from the pipe used to channel the water.

The temperature of the water sample ranged from 29 to 33. Temperature is a physical property because it damages with weather conditions. The temperature indicates that there is hot springs among

the site sampled. This also can explain the high titers of the total heterotrophic bacteria. These temperatures are also typical of the topics.

CONCLUSION

The result of this research showed that the water from boreholes in the study areas are contaminated with coliform bacteria. There is need to increase the awareness of the community towards preventives and treatment approaches to minimize the danger associated with the use of contaminated water. This can involve awareness on the treatment by boiling of water before use for drinking and pipes that are free from rust (aluminum steel) should be used in the distribution system to avoid rusting of the pipe which can lead to leakage of the pipes. Pipe connection should be checked properly and regularly to ensure that leakage doesn't occur or should be immediately detected and corrected when they occur. Boreholes should be dug to WHO approved standard. Plastic tanks should be used for storage of water before distribution and the interior of the tanks should be periodically washed to avoid microbial multiplication in the tanks.

REFERENCES

Abu, G.O. (2003): the polymerase chain reaction (PCR). A solution to phenomenon of viable but non-culturable pathogens in useable water in Nigeria. 2nd earth conference Port Harcourt.

APhA (1985): America public health association in standard method for examination of water and waste water (6th ed). Washinton, D.C

APHA (1996): America public health association in standard method for examination of water and waste water (6th ed). Washinton, D.C

ATR, African Technical review, (1986): Water supply Africa: *pollution solution* March, P.58.

Bonde, G. J. (1977). Bacterial, indicators of water pollution". In advanced on Aquatic Microbiology, Vol 1, edited by Droop, M. R. and Jannash, H.W. academic press Cambridge UK.

Bonde, G.J. (1962). "Bacterial indicators of water pollution". Teknist forlag, Copenhagen

Chorley R.J. (1996): Global decline in water quality. A serious problem, U.S. water news online

Cuicshank, R., Duguid, J.P., Marmoin, B.P., and R.H.A Swain, (1985) : medical microbiology, Vol 2: the practice of medical microbiology. Churchhill livingstone, Edinburgh (12th ed). Pg587

DHSS, Department of Health and Social Security (1997); the biological examination of water supplies. Department of health and Social Security, Report No. 71, London, M.N.S.O.

Esrey, S.A (2000), Rethinking sanitation: Panacea or pandorn's box. In water sanitation and health chorus, I. Ringelband, U. Schlag, G. and O. Schmoll (eds) World Health Organisation, water series W.A Publishing, London

FAO, Food and agricultural Organisation (1990); Water for life . F.A.O, Rome.

Furon, R. (1967): Problem of water, New York; America elsevier publication cooperation Inc.

Grant, W., Steele, G and S.A Isorho (1996): Spontenous ambitions possibly related to indigestion of nitrate contaminated well water-lacirage county Indiana. 1991-1994. Morbidity and mortality weekly report. 45: 569-571.

Graun, G.. F. and L. J. Maccabe, (1983). Review of the causes of water-borne diseases outbreaks. *Journal of American water works association* (65): 72-84.

Hinrichson, D., Robey, B and Upadhgay. (1998): solution for water shortage, world population report. John Hopkins university. School of Public health. Baltimore.

Holmus, D and A. Holmes (1979): physical Geology, (3rd edition) BAS printers, P.87.

Hutcinson, M and J. Ridgway (1977). Microbiological aspect of drinking water supplies. In Skinner, F. A and J. M Shewan (1997) editors. Aquatic microbiology. Academic press (London). P. 179-214

Ire F. S., Stanley H.O., A. A. Ibiene and N. Frank-Peterside (2010). Essentials of entrepreneurship (pg 115-119, 140-146)

Levine, W. C., Stephenson, W. T. and G. F. Craun (1986-1988): waterborne diseases outbreaks. Centers for disease control, Morbidity and Mortality weekly Report. 39 (ss-1): 1-13, 1990

Linton, H.A., and Dick, M. H. (1990): Principles of Bactteriology, virology and immunity (8th edition)

Manja, E.S., Maurya, M.S. and D. M. Rao (1982): a simple field test for the detection of faecal pollution of drinking water, Bull WHO; 769-801

Mcfeters, G.A. (1990): enumeration, occurance and significance of injured indicator bacteria in drinking water, P. 470-492. In G.A. Mcfeters (ed). *Drinking water microbiology*. Spriyer. Verlag, New York.

Mckane. L and Kandel. J. (1990): Principles of Bacteriology, virology and immunity. General microbiology and immunology (8th edition)

Mitchell, R. (1992): Series: *Environment Microbiology.* Wiley incoorperation. 576: 15. Dc 20

Okafor, N. (1995): Aquatic and Waste Microbiology, Fourth dimension publisher, Enugu.

PHMS, (1982). The bacteriological examination of drinking water supplies;Report on public health and medical subjects, No. 71, (5th edition). Her majesty's stationery office, London.

Pipes, W.O. (1981). Bacterial indicator of pollution CPC press incoorperation. Boca Raton. FL. 242.

Prescott, M. L., John,P. H and A.K., Donald (1996) Microbiology (3rd edition) W.M.C Brown publishers, U S A. p.850-855

Prescott, M. L., John,P. H and A.K., Donald (2005): Microorganisms in aquatic environment. In Microbiology (6th edition) W.M.C Brown publishers. USA 29-633

Sridhar, in M.K.C (2000): ground water in Nigerian urban centers problems and options: Chorus U. Ringelband, G, Schlag and o. Schmoll (edition) WHO water series.

Taylor, D. J., Green, N.P.O and G.W Stout (1998): Biological science (3rd edition) Cambridge university press, united kingdom. P.312

Tchobanoglous, T and D. Schroeder (1985) *water quality*. Vol. 1 Addison; Wesley series

Toranzos, G.A (1991): current and possible altenate indicators of faecal contamination in tropical waters. *A short review, Enkiron, toxicol. Water quality*. 6; 121-130

WHO, (1983): Guidelines for drinking water Quality Vol. 3, World Health Organisation , Geneva Switzerland.

WHO, (1993): Guidelines for drinking water Quality Volume 1, recommendations (2nd edition). World Health Organisation, Geneva Switzerland.

WHO, (2003): Guidelines for drinking water Quality 3rd edition, World Health Organisation, Geneva Switzerland.

WHO, (2006): Guidelines for drinking water Quality (3rd edition), incorporating 1st Addendum, World Health Organisation , Geneva Switzerland. P. 29.