Bacteriological Studies of Domestic Water used in Oke-Ejigbo in Ila-Orangun of Ila-Local Government Area Osun, State Nigeria

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Abstract
*Domestic water is very important among the natural resources for the life of all living organisms keeping the water sources environment healthy depends on the biological variability of such particular water source. The maintenance of water sources for its potability uses domestically also depends on regular monitoring of the water sources microbiologically so as to prevent water borne disease outbreaks. In this study water samples was collected from water used for domestic purposes in Oke-Ejigbo community area of Ila-Orangun, Osun state, Nigeria from three stream water sources coded STO1 to STO3 and four Hand dug well water sources coded HDWO1 - O4 and were all assessed for their bacteriological standards. The results of bacteriological assessment including total coliform count, total thermo tolerant coliform count and test for indicators of faecal organisms such as, E. coli, Streptococcus faecalis and Salmonella sp in all collected water samples revealed a high level of faecal pollution of those domestic water sources in the studied area when compared the result with standard values set by some national and international organizations in charge of sanitary quality of safe water for domestic use except in the samples **HDWO1** and **HDWO3** where those indicators of bacterial pollution were absence. The total heterotrophic bacterial counts values obtained from all the analysed samples ranged from highest value of 2.04 x 10^5 cfu/ml STO2 at day 42 to 1.00 x 10^3 cfu/ml of samples HDWO4 where the values were all higher when compared with WHO and NAFDAC standards of 1.000 x 10^2 cfu/ml. The values obtained for both total coliform and total thermo tolerant coliform were also very high and render the samples water sources unpotable and unfit for domestic use when compared with WHO (2006) standard of 10cfu/ml and zero cfu/100ml for total coliform and Thermo tolerant coliform respectively except in the samples HDWO2 and HDWO3 which were found absent of TTC. For faecal indicators organism, all the samples except HDWO2 and HDWO3 were found unfit for usage because of presence of E coli, Streptococcus faecalis and Salmonella sp. The deviations of all the analysed domestic*

water sources of the studied area except samples HDWO2 and O3. It can be concluded that the inhabitat of the studied area are liable to health hazard because of the unsafe water around their living environment.

Key Words: *Health Hazard, potability Thermo tolerant, Indicator Organisms.*

INTRODUCTION

Water is a colourless liquid that forms the natural rivers, streams, lake and other water sources and also forms the constituent of the organisms' fluids (Singh, *et al*, (2011). Water is very important among the natural resources is one of the basic needs of human being, as well as all forms of life (Kolawole *et al*., 2011). The quality of any surface water and ground water are influenced by the environment, human economic growth and activities. Water used for domestic activities comes from river and mostly hand dug well in various human localities, and both are surface water sources that are useful for the sustenance of all forms of life (Venkatesharaju, *et al*., 2010).

The chemical nature of water that makes water to serve as solvent to dissolves many substances serve as the basis for water pollution. The dissolves substances are called pollutant and can serve as culturing medium for the growth of certain microorganisms where pathogens are inclusive.

The quality of water for domestic purposes is important for human health throughout the world, because of the effects of water quality by pollution on human's health, different countries have developed water quality standards to safe the public health. Such standards were developed by some national and international organizations like WHO, EPA, NAFDA, SON and many others.

The sanitary quality of water is the extent of the absence of suspended matters, colour, taste, dissolved chemical pathogens and other offensive objects (Okafor, 1985). Drinking or use of polluted or contaminated water serve as vehicle of water borne illenesses such as cholera, dysentery and many others. In Nigeria as an example of developing country where dangerous and toxic industrial and domestic wastes are disposed off by dumping refuse indiscriminately on to soil surface, rivers and streams without thinking about the aquatic lives in rivers and urban dwellers, water then become very important vehicle for transmission of enteric diseases in many communities (Redwan *et.al*., 2008).

Fertilizer has also be identified by many investigators as the pollutant of surface and underground water that serve as water sources for domestic uses (Fagbemi and Ijah, 1998)

Bacteriological assessment of domestic water has become important because safe drinking water and adequate water sanitation are basic human needs. In bacteriological water analysis, the recovery of conventional indicator bacteria, which includes *E. coli, Streptococcus faecalis* and anaerobic spore forming *Clostridium perfringes* provides reliable means of assessing the extent of pollution as their presence in water is an indicative of a possible presence of enteric pathogens in such water (WHO, 2013). Ila-Orangun town in Ila local government is located geographically in the North-East of Osun State of Nigeria with population of about…60, 500 people.(NPC, 2006).

The area of study is Oke-Ejigbo which is a part of Ila-Orangun which covers the distance of about 1kilometer both length and breadth along Otan-Ayegbaju /Ikirun road to the palace at the centre of Ila-township.

The focus of the research was to assess the domestic water used in this area of study for its potability because use of unpotable water is harmful to humans health (WHO. 2013) and can results to water borne illnesses such as polio, hepatitis, cholera and many others enteric diseases (Okonko *et al*., 2008). In this community, the major sources of water used

domestically was streams, rivers and hand dug wells. Therefore, these water sources need to be assessed regularly for their qualities microbiologically in order to avoid health hazard resulting from unsafe water sources.

METHODOLOGY

Samples collection

Three different streams used for domestic activities were collected and coded to be ST01 to ST03 from the studied area and four commonly used hand dug wells were also collected which were equally coded to be HDW01 to HDW04. All the above coded samples were collected into 100ml sterile bottles aseptically and were all covered with their twist cap according to the method of Ademoroti (1997).

All collected water samples were transported to the laboratory in an ice pack immediately for their bacteriological analysis (WHO, 1997). Water samples were collected from their samplying sites for three separate days (1, 2 and 42 days).

TOTAL HETEROTROPHIC BACTERIAL COUNT

Total viable bacteria count was enumerated from all the samples collected using standard plate count as described by APHA, (1981) using spread plate method. The plates were examined after 24-48hours and the observed discrete colonies were counted and recorded in cfu/ml with the formula

$$\text{THB CFU/MC} = \frac{\text{No of colonies x dil,factor}}{\text{Volumes (ml) of plated inoculums}}$$

Enumeration of Total Thermo tolerant coliform bacterial count. (TTC). Membrane filtration Techniques was used for the enumeration of total coliforms present in the known volumes of all water sample analyzed following the method described by APHA (1981) and WHO (1997). Eosin Methylene Blue(EMB) agar was used.

The volume of (100ml) of each water samples was filtered with Millipore filter of the pore size 0.45.µm

The coliform No in Cfu/100ml was calculated as:

$$\text{Total Thermo tolerant coliform/100ml} = \frac{\text{No of Thermo tolerant coliform bact. colonies x 100}}{\text{No of ml of samples filtered}}$$

Note: The plated plate was incubated at 44.5^{o}C for 18-24 hours.

ENUMERATION OF TOTAL COLIFORM

The method used here is the Most Probable Number (MPN) which is also known as Multitude Fermentation (MT). In this techniques series of tubes containing MacConkey broth was used and was inoculated with test parts of the water samples.

All the inoculated tubes were incubated for 24-48 hours for acid and gas production for presumptive positive test APHA (1981); Fawole & Oso, (2004). The bacteria concentration in the samples was estimated using macCrady statistical table.

To confirm the test, the positive tubes from presumptive test were inoculated to EMB agar to observe for greenish metallic sheen which confirm the presence of *E coli* , For completed test, positive colonies on EMB agar were inoculated on a tube of lactose broth with inverted Durham tubes and incubated at 37^{o}c for 24-48 hours. After incubation, tubes were observed for gas and acid formation and then complete the presence of coliform.

TEST FOR FAECAL STREPTOCOCCI

Enterrococcus presumptive broth and Enterrococcus confiratory broth were used to identify and confirm the presence of *Faecal streptococcus* in the water sampled. Deoxychololate

citrate agar (DCA) plates were aseptically streaked with samples studied using wire loop. The plates were incubated at 37^{o}C for 24hours. To confirm that the isolates obtained were species of Salmonella or Shigella isolated colonies on (DCA) plates were stabbed into broth and streaked on triple sugar iron (TSI) agar slant and incubated at 37^{o}C for 24hours. After 24hours of incubation, *Salmonella* sp changed TS1 from red to black colour due to production of hydrogen sulphide

IDENTIFICATION OF BACTERIAL ISOLATES

Common conventional characterization and identification methods of pure isolates were done using colonial, Morphological and Biochemical characteristics. Also microbact ^{TM} identification Kit was used for the identification of members of Enterobacteriaceae.

RESULTS AND DISCUSSION

The total viable counts of the total heterotrophic bacteria at 37^{0}C of the water samples studied from different sampling points was shown in table1. The values obtained at the three (3) days of analysis ranged between ($2.04 \times 10^5 - 1.00 \times 10^3$) cfu/ml (table 1). The highest value was obtained at STO2 sample in day 42, while the least values was obtained from HDWO4 sample at the same day 42 (table 1).

The total coliform counts (TC) obtained from all the analysed coded water samples for the 3 different days examined was shown in table 2, 3 and 4 respectively.

The high values was obtained from all the samples coded ST with the highest of 150 cfu/100ml at sample STOI in all the three days while the low values was recorded at the sample coded HDW with the least at the sample code HDWO3 to be 15 cfu/100ml in all the three days examined.

The result for Total Thermo tolerant Coliform Count (TTC) in cfu/100ml was showed in table 5. The values obtained in all the examined samples for the 3 days ranged from ($3.2 \times 10^3 - 1.00 \times 10^2$) cfu/100ml.

The high values was recorded in all samples coded ST with highest in the samples STO1 at the days of sampling while the low values was recorded for samples coded HDW with least value in sample HDWO4 at day (1) and day (21) days of sampling, code and sample code HDWO (I) and day (21) of sampling respectively. The samples HDWO2 and HDWO3 thus not contained TTC because there was no growth on their respective plate for the three days of sampling period.

BACTERIAL COUNT

Table (1) TOTAL VIABLE BACTERIAL COUNT (CFU/ML)

CODE SAMPLE	SAMPLYING PERIODS (DAYS) (cfu/ml)		
	1	21	42
STO_1	1.15×10^5	1.02×10^4	1.32×10^4
STO_2	2.41×10^4	2.04×10^5	2.11×10^5
STO_3	1.82×10^5	1.40×10^4	1.50×10^4
$HDWO_1$	1.6×10^3	1.06×10^3	1.16×10^3
$HDSO_2$	2.8×10^3	2.08×10^3	2.81×10^3
$HDWO_3$	4.1×10^3	4.01×10^3	3.81×10^3
$HDWO_4$	1.8×10^3	1.05×10^3	1.00×10^3

WHO, (1996) standard is (1.0×10^2)

WHO, (1996) standard (1.0×10^2)

Table 2 Total Coliform Count (TC) cfu/100ml

Coded Samples	Sampling Period Day (1)			MPN/100ml
	10ml	1ml	0.1ml	
STO1	3	2	1	150
STO2	2	2	1	28
STO3	3	1	2	120
HDWO1	2	2	0	21
HDWO2	3	2	0	35
HDWO3	2	1	0	15
HDWO4	3	2	`0	93

The figures are the mean (values of the replicate figures)

Table 3 Total Coliform Count (TC) cfu/100ml

Coded Samples	Sampling Period Day (21)			MPN/100ml
	10ml	1ml	0.1ml	
STO1	3	1	3	160
STO2	3	1	2	120
STO3	3	2	0	93
HDWO1	2	2	1	28
HDWO2	3	2	0	35
HDWO3	2	1	0	15
HDWO4	3	1	1	73

The figures are the mean (values of the replicate figures)

Table 4 Total Coliform Count (TC) cfu/100ml

Coded Samples	Sampling Period Day (42)			MPN/100ml
	10ml	1ml	0.1ml	
STO1	3	1	3	160
STO2	3	1	2	120
STO3	3	2	0	93
HDWO1	2	2	1	28
HDWO2	3	2	0	35
HDWO3	2	1	0	15
HDWO4	3	1	1	73

The figures are the mean (values of the replicate figures)

Table 5: Total Thermo tolerant Coliform Bacterial Count (cfu/100ml)

Coded Samples	Sampling Periods (Days)		
	1st	21	42
STO1	2.7×10^3	2.65×10^3	3.70×10^3
STO 2	1.70 10×10^3	1.95×10^3	1.85×10^3
STO 3	1.65×10^3	1.40×10^3	1.50×10^3
$HDWO_1$	1.20×10^2	1.00×10^2	1.06×10^2
$HDWO_2$	-	-	-
$HDWO_3$	-	-	-
$HDWO_4$	1.00×10^2	1.00×10^2	1.26×10^2

ST - STREAM WATER SOURCES 01-03
HDW – Hand dug well water sources 01-04

Table 6: Indicator Organisms for Faecal Pollution in Sampled Water

Coded Sample	*Escherichia coli*			*Streptococcus faecalis*			*Salmonella* sp		
	1	21	42	1	21	42	1	21	42
STO1	+	+	+	+	+	+	+	+	+
STO2	+	+	+	+	+	+	+	+	+
STO3	+	+	+	+	+	+	+	+	+
HDWO1	+	+	+	+	+	+	+	+	+
HDWO2	-	-	-	-	-	-	-	-	-
HDWO3	-	-	-	-	-	-	-	-	-
HDWO4	+	+	+	+	+	+	+	+	+

Key + = Organism present
- = Organism absent

Discussion

The quality of fresh water sources for domestic use cannot be considered to be stable and can be determined by its bacteriological standard which has been set by national and international organizations which affect the water quality and provides general indication of water pollution to avoid unsafe water for domestic use (Kolawole et al; 2011).

Generally, the total heterotrophic bacterial counts (TBC), total coliform counts (TCC) and total thermo tolerant coliform counts (TTC) values obtained for the two different set of water used domestically in the studied area (Oke-Ejigbo community) in Ila-Orangun which was coded ST (stream source 1 to 3) and HDW (hard dug well water source I to 4). The above bacteriological parameter values were compared with both national and international standard set for potable water used for drinking and domestic use.

The TBC values obtained from sampled stream water (ST) was higher compared to values obtained from HDW. The TBC for ST ranged between (2.11×10^5 – 1.02×10^4) cfu/ml as in table (1) and all the TBC values from stream water samples was higher than the recommendation value by WHO (1996) which was1.0×10^2 cfu/ml for domestic water use. Again, the TBC values for hand dug well water samples analysed ranged between (4.10×10^3 to 1.00×10^3) cfu/ml as in table (1) and were all higher than the recommended value by WHO (1996) has been stated above.

The values obtained for total coliform and thermo tolerant (faecal) coliform per 100ml

in all the examined water samples in the studied area were greatly exceeded the recommended limit of zero cfu/ml by SON (2007) for the two different domestic water used in the studied area. This indicates the high level of faecal pollution of the samples and can potentially posed high health risk for the inhabitat of the studied area. This deduction is exceptional to the users of HDW02 and O3 which does not have any values recorded for faecal contamination.

The MPN index obtained for total coliform counts in all the samples from the studied area indicated high presence of some members of coliform.

The results obtained from this study revealed the presence of indicator organisms of water in all the samples analysed except the samples HDWO2 and O3.

There are presence of all these indicators organisms in the analyzed samples (table 6) and rendered the water used domestically in the studied community useless and unfit for use and can pose a serious health risks to the people in the area Kolawole, et al (2011); Okafor (1985)

CONCLUSION

The domestic water sources used in this studied area did not meet both national and international standard for both domestic and drinking water due to the presence of indicators of water pollution in the water and this is an indication of presence of other pathogenic bacteria and which is unsafe for domestic use except the source HDWO2 and O3 which does not contain indicators of faecal pollution.

RECOMMENDATION

It is recommended that the people in the studied community should try to treat those water sources in their area before use or to look for better alternative water sources for use. Again, sanitary inspectors are also advised to take responsibilities in the studied area seriously to avoid health risks for the people living in that area.

REREERENCES

Ademoroti C.M.A (1996) Standard Methods For Water and Effluents Analysis, 1st Ed Doludex Press Ltd Ibadan

American Public Health Association (APHA) (1981): Standard Methods for the examination of water and Waste water 15th Ed. Washington. PL. USA

Edema, M.O, Onemu A.M & Fapetu, O.M (2001): Microbiology and Physicochemical analysis of different sources of drinking water in Abeokuta. *Nigeria Journal of Microbiology* 15 (1): 57-61

Fagbemi, A.O & Ijah, U.J.J (1998): Effects of Indiscriminate use of fertilizer and pesticides on rural water sources in proceeding of the 11th Annual National Conference of Nigeria Association of Teachers of Technology. (NATT). Pp:.220-224

Fawole, M.O & Oso, B.A (2004): Laboratory Manual of Microbiology. Revised Edi Sprectrum Books Ltd. Ibadan Pp: 1227

Kolawole, O.M Ajayi T. Okyem; A.B & Okoh, A.J (2011): Assessment of water quality in a River (Niger)and its indigenous Clarias geriepinus fish. *Int. T Enurion. Res. Public Health* Pp: 433l-4352

NPC (2006): National population Census

Okafor, N. (1985) Aquatic and Waste Microbiology. 4th Edition, Dimension Publishers, Enugu, Pp:107-127.

Okonko, I.O, Adejoye, O.D Ogunnw T.A; Fajobi E.A & Shittu, O.B (2008) Microbiology and Physicochemical Analysis of Different water samples used for domestic purpose

in Abeokuta and Ojota, Lagos state Nigeria, *Africa journal of Bio. Tech.* 7(5): 617 621

Singh, K.B; Bharati, U.K and Kumar, S. (2011) Physicochemical and bacteriological Investigations of Fuikhu

Venkateshcraju, K; Ravi Kumar, Samashekar, R.K and Prakash, KL Investigation on the River Cauvery of Kollagal stretch in Karnata. Kathmandu university of Sci & Tech 6 (1) Pp 055-65

WHO(2013): Drinking water Guidelins Bacteriological parameters Geneva Stwitzerland, Vol.13

WHO World Health Organization (1997): Guide Line for Drinking water Quality Survalliance & control of communities supplies, 2nd & Genvea, Switzerland , Vol.3 Standard Organization of Nigeria.