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Bacteriological Assessment of Well and River Water in Ife Town, Osun State, Nigeria

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***Abstract*: In most communities, water is consumed without potability and the major sources of water apart from rainfall are surface such as river water, in some cases, borehole water can be applicable. Water samples from river and well water from different communities in Ife town were randomly collected and bacteriological analysis was carried out on them using standard microbiological methods. The results showed that the least microbial loads value of 0.78 × 10^3cfu/ml was obtained from river water while well water had the highest microbial load with a count of 1.12 × 10^3 cfu/ml. Well water, however, had the highest total coliform (460 MPN/100mL) and lowest coliform count from river with (39MPN/100mL). The isolates identificatied includes, *Alcaligens* spp, *Yesinia enterocolitica, Lactobacillus* spp, *Salmonella* spp, *Enterobacter* spp, *Streptococcus* spp and *Escherichia coli.* Most of these bacteria are gram negative rod and are usually associated with gastrointestinal illness. Proper treatment and surveillance of these water sources should therefore be carried out regularly to prevent public health issues that could be implicated from such unwholesome practice of drinking non-potable water.**

***Keywords*: bacteriological, gastrointestinal, treatment, unwholesome.**

1. Introduction

Water is one of the most important elements for all forms of life. It is indispensable in the maintenance of life on earth. It is also essential for the composition and renewal of cells. Despite of this, human beings are continuing to pollute water sources resulting in provoking water related illnesses (WHO, 2008). Diseases related to contamination of drinking water constitute a major burden on human health. The most common and widespread health risk associated with drinking water is microbial contamination. Up to 80% of all sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. As to 2006 report of World Health Organisation (WHO) approximately three out of five persons in developing countries do not have access to safe drinking water and only about one in four has any kind of sanitary facilities.

Water may also play a role in the transmission of pathogens which are not faecal excreted. Contamination of drinking water with a type of *Escherichia coli* known as O157:H7 can be fatal. Many microorganisms are found naturally in fresh and saltwater (WHO, 1996). The microbiological quality of drinking water has attracted great attention worldwide because of implied public health impacts (Amira, 2011). Total and faecal coliform have been used extensively for many years as indicators for determining the sanitary quality of water sources. Water borne outbreaks are the most obvious manifestation of waterborne disease. Microbiological examinations have several roles in the investigation of waterborne outbreaks. Water is the one of the most common substances known and it is good solvent for many substances, water occur at room temperature as clear, colorless, tasteless liquid which freezing into ice at zero degree centigrade and boil at 1000c, it is essential for life on earth (Amira, 2011).

According to World Health Organization (WHO) in 1967 is the most important need of living things, it is second only to the air we breathe, in fact some scientist believe that all life began in water. Water exists under two major types which includes:

Surface Water: They include the streams, lakes, and shallow wells. The air through which the rain passes may contaminate the water.

Ground Water: They originate from deep well and subterraneous springs. This is virtually free of bacteria due to filtering action of soil deep sand and rock. However, it may become contaminated when it flows along the channels. Poor hygiene behaviors and inadequate sanitation in public places including hospitals, health centers and schools providing access to sufficient quantities of safe water (Ogwegbu and Muhanga, 2005). The provision of facilities for sanitary disposal of excreta and introducing sound hygiene behaviors, are of capital importance to reduce the burden of disease caused by these risk factors. The most common manifestation and cause of mortality in water borne diseases were as result of dehydration due to loss of copious amounts of electrolytes either in vomiting or diarrhea (Ferner, 2001).

Lakes and streams which people use for drinking water,

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bathing and defecating are sources of disease, as is water left by natural disasters. People can also contract a diarrheal disease by eating food that's prepared by sick individuals who have not washed their hands, or touching something handled by an infected person and then putting their own hands into their mouths. Water borne diseases occurrence was observed to follow a seasonal pattern with peaks occurring between the months of January and May followed by drops between June and October and rose again in November. Children below 5 years were found to be more vulnerable to diarrhea of viral origin, gastroenteritis and amoebic dysentery while persons between 15-44 years were more vulnerable to typhoid and cholera (He *et al*.,2015).

Pathogenic microorganisms and heavy metal contamination is a very harmful case in water as it an alarming case worldwide due to human activities and advance in technology which brings about health implication. There is an adverse effect associated with water contamination with pathogenic organisms such as *Escherichia coli, Salmonella spp, Vibrio cholera* and more. These effects can be outbreaks of cholera, diarrhea, dysentery, and many more with the mass spread within a time space with implications on health in the community. Moreso, antibiotics resistance has been a major problem as many microorganisms has evolved the effect of antibiotics by efflux pump and limiting permeability with modification of target. Thus, proper monitoring of water for microbiological analysis is a grand cause for curbing of an outbreak of diseases in the communities with cases of water-related borne diseases.

This research work is aimed at investigating the microbiological safety of wells and river water in Ife town, Osun state, Nigeria so as to prevent an outbreak of waterborne diseases.

2. Materials and Methods

A. Sample Collection

Four water samples (2 well and 2 river) were collected from Ife and Modakeke town, both in Osun State, Nigeria, with 1litres sterile bottle and were labelled prior to collection and were designated, they were taken to Microbiology laboratory of Applied Sciences Department, of Osun State Polytechnic, Iree for further analysis (Fawole and Oso, 2004).

B. Bacteriological Analysis

The total heterotrophic bacterial count was performed on solidified nutrient agar plates and incubated at 37°C for 24 hours. At the end of the incubation period, sub culturing was done to obtain pure culture of bacterial isolates.

The Most Probable Number technique was used for enumeration of Total Coliform Count (Fawole and Oso, 2004).

C. Identification and Characterization of Isolates

The pure bacterial strains were identified on the basis of their morphological and biochemical tests. The pure cultures of the bacterial isolates were subjected to various morphological and biochemical characterization tests such as color, shape, elevation, consistency, margin, gram staining, catalase test, MRVP (Methyl Red-Voges Proskauer test), fermentation of sugars, and indole (Olutiola, 1991). In order to determine the identity of bacteria isolates, results were compared with standard references of Bergey's Manual of Determinative Bacteriology (Buchanan and Gibbons, 1974).

3. Results and Discussion

A. Results

The bacteriological analysis of well and river water sample from Ife town, Osun state were carried out and presented in the tables below;

Table 1
Total heterotrophic bacteria count of well and river water sample from Ife town, Osun state

Samples	**Bacterial Count (cfu/ml)**
Sample A	1.28×10^3
Sample B	1.12×10^3
Sample C	0.88×10^3
Sample D	0.78×10^3

Keys:
Sample A: Isale-Agbara river water
Sample B: Modakeke well water
Sample C: Esinmirin river water
Sample D: Mokuro well water

Table 2
Most probable enumeration of coliform bacteria of well and river water sample from Ife town, Osun state

Samples	Colifom **Count (MPN/100ml)**
Sample A	39
Sample B	460
Sample C	39
Sample D	460

Keys:
Sample A: Isale-Agbara river water
Sample B: Modakeke well water
Sample C: Esinmirin river water
Sample D: Mokuro well water

4. Discussion

The spread of diseases through fecal contamination of water sources particularly in developing and under developed countries are a common phenomenon that has been well reported (WHO, 1996). In the most residential area as well as most part of Ife, availability of treated pipe-borne water is rare. Even in these areas, public water supply is quite irregular. The poor or average classes which constitute more than 80% of the population which cannot afford the high cost of borehole drilling are forced to dig wells as alternative source of water supply for drinking and sanitary purpose. The viable bacterial count which is a measure of the microbial load of the well water sample obtained in this study (0.88 to 1.23×10^3 cfu/ml) and river water (0.78 to 1.12×10^3 cfu/ml) which exceeded the recommended limit (<500cfu/ml). This shows that the wells

Table 3
Colonial morphology of the isolates of well and river water sample from Ife town, Osun state

Isolates	Color	Edges	Optical Characteristics	Raise/Flat	Wet/Dry	Mucoid/Non mucoid
A1	Greyish-white	Smooth	Opaque	Slightly raised	Wet	Non-mucoid
A2	Cream	Irregular	Opaque	Flat	Wet	Mucoid
A3	Whitish	Irregular	Opaque	Raised	Wet	Mucoid
B1	Greyish-white	Smooth	Opaque	Slightly raised	Wet	Non-mucoid
B2	Greyish-white	Smooth	Opaque	Raised	Wet	Non-mucoid
C1	Greyish-white	Smooth	Opaque	Slightly raised	Wet	Non-mucoid
C2	White	Smooth	Opaque	Flat	Wet	Non-Mucoid
D1	Greyish-white	Smooth	Opaque	Slightly raised	Wet	Non-mucoid
D2	Greyish-white	Smooth	Opaque	Slightly raised	Wet	Non-mucoid
D3	White	Smooth	Opaque	Raised	Wet	Mucoid

Keys: Sample A: Isale-Agbara river water, Sample B: Modakeke well water, Sample C: Esinmirin river water, Sample D: Mokuro well water

Table 4
Morphological and biochemical characteristics of well and river water sample from Ife town, Osun state

Isolates	Gram Rxn	Shape	Catalase	Coagulase	Oxidase	Indole	Methyl-red	Motility	Sugar fermentation	Microorganisms
A1	-ve	Rod	+ve	-ve	-ve	+ve	+ve	Motile	+ve	*Escherichia coli*
A2	+ve	Rod	+ve	-ve	+ve	-ve	-ve	Motile	-ve	*Alcaligens spp*
A3	+ve	Cocci	-ve	-ve	-ve	-ve	-ve	Non-motile	+ve	*Streptococcus spp*
B1	-ve	Rod	+ve	-ve	-ve	+ve	+ve	Motile	+ve	*Escherichia coli*
B2	+ve	Rod	+ve	+ve	-ve	-ve	+ve	Non-motile	+ve	*Yesinia enterocolitica*
C1	-ve	Rod	+ve	+ve	-ve	-ve	+ve	Motile	+ve	*Salmonella spp*
C2	-ve	Rod	+ve	-ve	-ve	-ve	-ve	Motile	+ve	*Enterobacter spp*
D1	-ve	Rod	+ve	-ve	-ve	+ve	+ve	Motile	+ve	*Escherichia coli*
D2	-ve	Rod	+ve	+ve	-ve	-ve	+ve	Motile	+ve	*Salmonella spp*
D3	+ve	Rod	-ve	-ve	-ve	-ve	-ve	Non-motile	+ve	*Lactobacillus spp*

Keys: Sample A: Isale-Agbara river water, Sample B: Modakeke well water, Sample C: Esinmirin river water, Sample D: Mokuro well water

contain very high level of microbial contaminant that make water obtained from them a threat to public health. The values obtained for the samples from the river water were higher than well water from. This is possibly gross contamination due to particles from the surroundings. However, the sanitary quality of potable water is determined primarily by the kinds of microorganisms present rather than by the microbial count (Bonde, 2007). This result also confirm with earlier report of Olowe *et al.,* (2005)

The most probable number (MPN) per 100 ml obtained for the well water samples has 39mpn/100ml while river water has 460mpn/100ml which clearly exceeded standard limit set by WHO, (2014). This suggest that the well and river water samples have been contaminated by potentially dangerous micro-organism and are therefore not fit for drinking and domestic purposes. This was confirmed by the characterization of the isolates from the well water samples from the locations under study which were highly contaminated with *Escherichia coli, Alcaligens spp, Streptococcus species*, *Yesinia enterocolitica, Salmonella spp, Enterobacter species,* and *Lactobacillus spp*. The most predominant is that the enteric coli forms *Escherichia coli*.

These are pathogenic organisms mostly of fecal origin. Any water source used for drinking or cleaning purpose should not contain any organism of fecal origin (Olowe *et al.,* 2005). Presence of enteric coliforms especially *Escherichia coli* makes the water samples unsuitable for human consumption according to the guidelines set by WHO for the evaluation of bacteriological quality of drinking water (WHO, 2014). Apart from environmental hygiene and population density, the presence of Salmonella species in some of the wells in this area may also be attributed to drainage and flooding from contaminated surface water into unprotected well shafts. Findings from this study clearly highlight the non-conformity of well water samples studied with the WHO standard recommendation for safe potable water. A situation where enteric pathogens are grossly isolated from sources of water consumed by humans is a serious problem which calls for vigilance on the part of the authorities as it signals possible future outbreak of water borne diseases. Such disease outbreaks

may spread widely within the country and even possibly extend to neighboring countries. It may also be due to poor sanitary condition around the areas where such wells are located or drawing water from the wells with contaminated containers, a practice that is common among the users since individuals bring along their own water containers in some cases. The high morbidity that is recorded from enteric diseases such as diarrhea, dysentery and typhoid fever in the country may be due to wide spread consumption of contaminated well water.

5. Conclusion

Water from these sources analyzed is used for drinking, cooking, laundry and bathing purposes. As pathogenic microorganisms are present in it, there is a greater risk of water borne diseases such as diarrhea, salmonellosis amongst other as runoff and sewage with open defecation are closer to the water source.

6. Recommendation

Based on this study, adequate monitoring and surveillance of these water sources should therefore be carried out regularly. In cases where surveillance is not carried out, the water should be purified using chlorine, boiling or other water purification methods. Prevention of these diseases is often better and cheaper than their treatment hence, all efforts geared towards the prevention of an outbreak of an epidemic should be taken very seriously by all stakeholders and government and other relevant agencies.

References

[1] Amira, P. A., C. V. Ofoegbu., and T. Morrision. (2011). Hydro chemical assessment of groundwater quality in parts of Niger Delta. Environmental geology, vol. 14, no. 3, pp. 195-202.

[2] Bonde, G. J. (2007). "Bacterial Indication of Water Pollution in Advances in Aquatic Microbiology," Academic Press, London.

[3] Fawole, M. O. and Oso, B. A. (2004). Characterization of Bacteria: Laboratory Manual of Microbiology. 4th Edition, Spectrum Book Ltd., Ibadan, 24-33.

[4] Ferner, H.I. (2001). Geological and hydrogeological influence on the Nigerian environment. Journal of water resources, Vol. 2, pp. 36-44.

[5] He, A., Chikanka, A. T., Loveth, N. W. (2015), Evaluation of Bacteriological Quality of Surface, Well, Borehole and River Water in Khana Local Government Area of Rivers State, Niger Delta. Annals of Clinical and Laboratory Research, 5(3):183-190.

[6] Ogwuegbu, M. O. C., Muhanga, W. (2005), Investigation of lead concentration in the blood ofpeople in the copper belt province of Zambia. Journal of the Environment, 1:66–75.

[7] Olowe, O. A., Adekunle F. M., Oladele G.P. (2005). Bacteriological Quality of Water Samples in Osogbo metropolis," African Journal of Clinical and Experimental Microbiology, Vol. 6, No. 3, pp. 219-222.

[8] World Health Organization (WHO). (2008), Guidelines for drinking water quality. World Health Organization, Geneva.

[9] World Health Organization and Joint Monitoring Programme Report, WHO/JMPR. (2014). Water Sanitation Health.

[10] World Health Organization, (1996). "Guidelines for Drinking Water Quality: Health Criteria and other Support Information. pp. 18-97.