



Evaluation of Pathogens Transmitted from Drinking Water Sources and its Public Health Implications

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Abstract

*Microbial contaminants of water have been a great challenge to public health. These microbial agents such as bacteria, protozoa and fungi are capable of causing diseases and affect the drinking water quality. This study was carried out to assess pathogens transmitted through drinking water from two selected boreholes in the study areas. Water samples were tested for five characteristics using APHA analytical techniques and results were compared with WHO standard. Microbial quality analysis was done by preparing samples into different dilution factors and culture on different agar. Biochemical tests were used for the identification of isolated bacteria. Pathogens encountered were *E. coli*, *S. aureus*, *Klebsiella aerogenes*, *Serratia marcescens*, *Bacillus cereus* and *Salinococcus roseus*. All isolated organisms were present with few colonies above <1cfu/ml WHO permissible limit of water quality. The detection of medically important pathogens in this present study indicates infection to the public health. Hence, water should be treated for microbial safety before drinking.*

Keywords: Pathogens; borehole water; Igboora and public health.

Introduction

The dependability on water as a vital and essential constituent of protoplasm for the existence and wellbeing of man and other living creatures has stressed the need for its portability. Water is a major natural resources that contributes to good public health services over the world. Poorly managed water sources can cause disease causing pathogens to be transmitted by affecting public health and reducing water quality standard for human consumption. Hence, the consumption of unsafe water has historically held a place in transmission of waterborne infections. The infection affects the human host by causing severe diarrhea in affected people and devastating effect in immune compromised host. The public health challenge of waterborne illnesses comes due to continued engagement in practices that contaminate drinking water sources which represents an ever-present risk of human infection. World Health Organization(WHO) guidelines for drinking-water quality (WHO, 2022) reiterates the protection of public health associated with drinking-water quality. However, if the target to ensure quality of drinking water will succeed, it is important to maintain a standard of healthy level of alkaline mineral with pH ranged 7.0-9.5, absence of contaminants and odour, tasteless and colourless water as often emphasised by WHO to minimize and

eliminate the potential sources of water related infections in all our drinking water sources. In other to achieve meaningful public health improvement in water related infections, it is necessary to re-evaluate and determine the transmitting potential of water for newly emerging pathogens. Also, it is inevitable to identify the factors influencing the transmitting potential of water in relationship with the prevalence of water-borne transmission. The prevalence of waterborne diseases has been reported in some countries like United States, India, Bangladesh and in comparison to Nigeria with the prevalent waterborne disease of Dracunculiasis, Hepatitis, cholera and Typhoid (Nwabor *et al.*, 2016; Adeyinka *et al.*, 2014). In 2015, it is estimated that about 68% of people had access to basic sanitation with 4.5 million people are at risk of poor sanitation globally.

According to Lim *et al.* (2012), poor water and sanitation is responsible for 0.9 percent of global Disability-Adjusted Life Years (DALY) or 300,000 mortalities per year. Food and water borne infectious diseases according to the World Health Organization (WHO) currently had a loss of 6.64 million DALY with children under 5 years of age and population in low-income countries bearing the most burden. Hence, it is imperative to concertedly reduce



and eliminate water-borne disease which represents an area of concern in the world. An update on contaminations at small scale is inevitable about the pathogenic contaminants of borehole water source in Igboora, Ibarapa Central Local Government area Oyo State in order to improve the health standard of the people in the community. Hence, the study aims to assess water borne pathogens from two selected bore hole in Igboora for water quality.

Material and methods

Sampling techniques

This study was conducted using borehole water in Ibarapa Central Local Government Area council in Igboora including: Olorunsogo and Igboora market area respectively. Sampling of borehole water was based on convenience in the selected areas. Each selected borehole water in the area was visited for water sample collection. The water was allowed to waste for some minutes before collection into a sterile bottle with fitted screw cap. After each collection, water from each site was correctly labelled and transported carefully to the Department of Science Laboratory Technology Oyo State College of Agriculture and Technology Igboora for laboratory analysis.

Laboratory Description and Analysis of the Water Samples

Water quality characteristics

Water quality characteristics such as Appearance, Temperature, Biochemical Oxygen Demand (BOD), Hydrogen ion concentration (pH) and turbidity of the sampled borehole water were determined using the standard methods of American Public Health Association (APHA, 1985).

Microbial Examination

Each sample was examined for microbes. The inoculation of 0.1ml of serially diluted samples was cultured on various selective agar at 37°C for 24 to 48hrs. Sub-culturing was done to obtain pure isolates and plates with significant growth were selected for identification based on their biochemical properties as described by Cheesbrough (2006).

Results and Discussion

Water samples of the borehole water that constitute sources of drinking water to people

in the study area were investigated. Table 1 gave the result of quality analysis of the sample water. The water parameters analyzed include Temperature, pH, Appearance, Biochemical Oxygen Demand and Turbidity. The general observation of the result revealed that 4(80%) of the water quality properties measured were at the normal level when compared to WHO standard with the exception of turbidity. It was observed that each of the borehole water had values for the five measured parameters. The values of Temperature, pH, BOD and Turbidity varied between sample A and sample B. Table 1 shows that sample A (7.96NTU) had the higher record of turbidity value compared to sample B (4.83NTU). The implication of this is that, sample A is not safe for human consumption and harmful to human health. This is also confirmed from the value of WHO standard permissible limit for water quality in Table 1. The higher record of turbidity of sample A could be attributed to the observed impacts of human related abattoir activities in the area. The analyzed pH values of sample A (7.90 mg/l) and sample B (7.40 mg/l) fall within the range of WHO standard values (Table 1). It is important to note that these pH values recorded are within the WHO standard, thus indicating that the pH levels of the water samples would not create public health risk in the area. Likewise, the value of pH reported in this study is higher than the range of 5.5 - 6.5 reported by Magaji and chup (2012). BOD is said to be among the essential water quality parameters (Ojekunle and Lateef, 2017). The observed values of BOD in this study are within the WHO value (50 mg/l) for both samples. Also, the range values 24.0°C - 26.0°C recorded for temperature was considered to fall within the mesophilic range of temperature for most pathogenic microbes whose optimum temperature for growth is 37°C (Arora, 2004).

Table 1: Water quality analysis of bore-hole water samples

Parameters	Sample A	Sample B	WHO Standard
Appearance	Clear	Clear	Clear
Temperature (°C)	24.0	26.0	24-32 °C
pH(mg/l)	7.90	7.40	6.5-8.5
BOD(mg/l)	8.67	13.58	50
Turbidity (NTU)	7.96	4.83	5

The summary of the microbial analysis as presented in table 2 showed the distribution of microbial isolates of the bore-hole water in



different sample locations. The result of this present study indicated that all the samples were positive for at least one pathogenic organisms with each strain present as biocontaminants in the samples. Thus, the recovery of diverse bacteria pathogenic species from sampled water implied that they are found in water and are of public health significance which needed to be eliminated in drinking water sources. The counts obtained for each isolate from all the water samples exceeded the World Health Organization permissive limit of <1CFU/mL which suggest that the borehole water is not safe for

drinking. The distribution of the result indicated that *E. coli*, *S. marcescens*, *Klebsiella aerogenes* and *Staphylococcus aureus* were present as biocontaminants of sample A while one strain each of *Bacillus cereus* and *Salinococcus roseus* form some characteristics colonies at 37°C in sample B (Table 2). Reviewing the literature, findings from this study support previous claim by Iroha *et al.* (2018); Agwu *et al.* (2013); Adekoyeni and Salako (2012), which have consistently shown that contaminated drinking water harbours different pathogenic microbes of medical importance.

Table 2: Distribution of microbial isolates from the borehole water samples.

Sample	Microbes					
	<i>Escherichia coli</i>	<i>Staphylococcus aureus</i>	<i>Bacillus cereus</i>	<i>Klebsiella aerogenes</i>	<i>Serratia marcescens</i>	<i>Salinococcus roseus</i>
A	+	+	-	+	+	-
B	-	-	+	-	-	+

- means organisms is missing

+ means organisms present with few colonies

According to the article on Encyclopedia Britannica (2022), Coliform bacteria serve as critical indicators of water quality. The isolated microbes in this study, were present as coliform bacteria and the presence of others indicated that microbes other than coliform bacteria were present as disease causing bacteria indicating a contamination route exist into the water source and thereby polluting the water. The isolation of *E. coli* from sample A suggested that fecal pollutants from animal waste are entering the water source. This could be connected to the proximity of the drinking water to abattoir waste water activities near the borehole thereby giving the disease-causing bacteria chance to enter the water source. Poor land uses and absence of proper maintenance due to indiscriminate activities that contaminate ground water around the bore hole could also make water to lose its quality from the source. Some of the isolated bacteria from this study, *klebsiella aerogenes* and *Escherichia coli* are capable of producing endotoxin harmful to human host and are able to predispose human health to severe illnesses of Urinary Tract Infection (UTI), diarrhea, sepsis, bacterial blood infection and *Staphylococcus aureus* with associated pneumonia and bone infection among others. The severity health risk of these pathogens are detrimental to the immune system of Immune compromised to water containing microbial contaminants.

Conclusion and Recommendation

The outcome of this study revealed that the sampled borehole water harboured some pathogenic contaminants of medical importance. The occurrence of this pathogens implied that people who drink contaminated water are at risk of water-borne illnesses. Hence, effort should be made to boil and treat water before consumption to avoid the danger involved in public health.

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