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Full Length Research

Comparative study of bacteriological quality of open and closed well water in Ozoro Metropolis, Delta State

Okere O. L. and Orogu J. O.*

Department of Science Laboratory Technology, School of Science and Technology, Delta State Polytechnic Ozoro, Delta State, Nigeria.

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The bacteriological analysis of open and closed well water in Ozoro, Delta State, Nigeria was assessed with a view to ascertain the bacteriological quality of well water. Six samples were collected from different wells and were labeled as A, B, C, D, E, F; Samples A and B were collected from wells for private use only and was always closed. Samples C and D were collected from wells for public use and were always opened. Samples E and F were collected from wells for private use and always closed, though occasionally opened for public use. A total of 6 bacterial species were isolated from the various samples analysed, they were; *Escherichia coli, Streptococcus faecalis, Proteus mirabilis, Staphylococcus aureus, Clostridium perfringens* and *Klebsiella pneumonia*. Heterotrophic plate count (HPC), total enteric bacterial count and total coliform count using the most probable number (MPN) as well as some physiochemical parameters such as pH and temperature were determined. HPC ranged from 1.7×10^6 to 7.1×10^6cfu/ml, total enteric bacterial count ranged from 1.1×10^6 to 4.2×10^6 cfu/ml and total coliform count ranged from 0 to 1.8×10^3cfu/100 ml. Open well water recorded the higher HPC, enteric bacteria count and MPN than closed well water. The pH values ranged from 7.1 – 7.5, temperature ranged from 24.0 to 26.0°C. *C. perfringes* were the most isolated among all the bacteria with 100% occurrence, while *S. faecalis* had the least occurrence with 50%. The presence of higher number of pathogenic *K. pneumonia, E. coli* and *C. perfringens* among others, encountered in well water is alarming. The presence of these organisms in water should receive particular attention, as their presence indicate public health hazard.

Key words: Open well, closed well, Bacteriological, enteric bacterial, total coliforms.

INTRODUCTION

Well water is obtained from either a hand dug or machine drilled pit. A dug well is a large diameter hole that is usually more than two (2) feet wide and often constructed by hand. Dug wells are usually shallow and poorly protected from surface water runoff. Driven-point (stand-point) wells, which pose a moderated to high risk, are constructed by driving lengths of pipe into the ground (Happi, 2000). These wells are normally around two inches India-meter and less than 25 feet deep and can only be installed in areas with soils such as sand.

Water could be odourless, clean, tasteless and yet unsafe for drinking. It is estimated that as much as 80% of all disease in the world are associated with consumption of water (Palanissmy, 2006). Since microorganisms are widely distributed in nature, they can commonly find their way into most bodies of water including well. The contamination of wells, could be due to improper construction of wells, approximately to toilet facilities, sewers, refuse dumping sites and various human activities around the well (Akinbo and Adeyeba, 2003).

*Corresponding author. Email: joeorogu4real2000@yahoo.com

Portable water is one that is fit for consumption by human and other animals; it is generally called drinking water in reference to its intended use (Onafade and Ilori, 2008). The availability of clean drinking water is a basic right for all people. Unfortunately, many of these wells offer water that is unsafe for human consumption. Over one billion people lack access to safe drinking water, increasing the vulnerability to diarrhoea and parasitic diseases. On a global scale 25,000 people die each day as a result of poor water quality and water related diseases such as cholera and diarrhoea. Typhoid is simply the largest cause of human morbidity and mortility (Stewart-tulle, 2001).

Like many developing nations, Nigeria has a high population of about 170 million people with relative poor infrastructure especially in urban centres. The available sanitary facilities cannot sustain the population and reckless waste disposed could lead to contamination of surface water with faecal materials. Worldwide, contaminated water causes an estimated 6 to 60 billion cases of gastrointestinal illness annually, majority of which occur in rural areas of developing nations where supply is polluted with variety of microorganisms, and adequate sanitary is unavailable (Laurie, 2004). The current study therefore, focused on the assessment, isolation and identification of bacteria in open and closed well water in Ozoro, Delta State, Nigeria, with a view to compare the portability of open and closed well water and implication of consuming such contaminated water.

METHODOLOGY

Study area

The study area was Ozoro, the local government headquarter of Isoko North local government area of Delta state, South-south region of Nigeria.

Sample collection

The well water used in this research was collected from different wells that serve as source of drinking water in Ozoro, Delta State.

The samples were collected in exactly 250 ml sterile bottles with capped screws which have been sterilized before collection. The samples were immediately taken to the laboratory for analysis. Samples were collected in duplicates:

1. Samples A and B were collected from wells that are for private use only and always closed.
2. Samples C and D were collected from wells that are for public use and were always opened.
3. Samples E and F were collected from wells that are for private use and always closed, though occasionally allowed for public use.

Physicochemical parameters of samples

pH determination

The pH of the sample was determined using a digital electrode pH meter (Clida Instrument PHS-25C Precision). The electrode meter was standardised prior to use using buffer solutions of pH 4, 7 and 9 before every measurement. This was done by dipping the electrode of the pH meter into the water sample and thereafter the reading on the pH screen was recorded. This was done for all the samples at each analysis.

Temperature determination

The temperature of each sample was measured using mercury bulb thermometer. The thermometer was cleaned with distilled water and immersed into the samples.

Microbiological analysis of samples

The water samples were examined for:

a. Total bacterial counts.
b. Total enteric bacterial count.
c. Total coliform counts using the multiple tubes or most probable number technique.

Total bacterial counts

This was carried out according to the standard methods for examination of water and waste water (American Public Health Association, 1995). 0.1 ml of sample was taken and dispensed in sterile Petri dish containing sterile molten agar (that is, Nutrient Agar and Eosin Methylene Blue). The plates were incubated upside down at 37^{o}C for 24 h. After incubation, the total bacterial counts were then recorded as number of bacteria per ml of each water samples.

Total enteric bacterial counts

Using a sterile pipette, 1 ml of the sample was pipette into a test-tube containing 9 ml of sterile distilled water. The dilution was continued until the fifth dilution was attained. Sterile and cool molten MacConkey Agar was poured ascetically into the petri dishes. The sterile pipettes were used to pipette 0.1 ml of the sample into labelled petri dishes. A sterile spreader was used to spread the samples on the plate, the plates were then incubated in an incubator for 24 h at 37^{o}C. After 24 h of incubation, the plates were examined and the number of colonies in the plates were counted and recorded as cfu/ml. Duplicate plates were prepared for each of the samples and the average count was recorded.

Table 1. Physiochemical parameters of sample.

Samples	Temperature (°C)	pH
A	25.4	7.2
B	25.0	7.5
C	26.0	7.3
D	25.3	7.2
E	24.3	7.1
F	24.0	7.2

Table 2. Total bacterial count, total enteric bacterial count and total coliform count (MPN) of water samples.

Samples	Heterotrophic plate count (CFU/ml)	Total enteric bacteria count (CFU/ml)	Total coliform count (CFU/100 ml)
A	2.0×10^6	1.5×10^6	0.9×10^1
B	1.7×10^6	1.1×10^6	0
C	4.5×10^6	4.2×10^6	1.8×10^3
D	7.1×10^6	2.9×10^6	1.8×10^3
E	3.1×10^6	1.7×10^6	3.5×10^3
F	3.6×10^6	2.1×10^6	9.2×10^2

Total coliform counts

This was carried out using the multiple tube test fermentation technique. The technique is made up of three tests: the presumptive, confirmed and the completed tests. The 5:5:5 tube test as discussed by Salle (1973) and Eninnaya and Nnochiri (1975) was used. The qualitative coliform test was carried out according to the method of Fawole and Oso (2004) as thus explained.

Presumptive test

This was done by inoculating sterile lactose broth containing inverted Durhan's tube in a test tube with the water sample. Incubation was done at 37°C for 24 to 48 h. Acid and gas production was taken as a prospective presumptive test for coliform.

Confirmed test

This was carried out by streaking the surface of sterile MacConkey Agar with the loopful of the tube with a positive presumptive test as shown above. Incubation was done at 37°C for 24 h. A colony with pinkish or reddish colour was taken as a confirmed test for a typical coliform.

Completed test

This was carried out by inoculating sterile MacConkey broth containing inverted Durham's tube with loopful of a typical colony from the confirmed test. Incubation was done at 37°C for 24 to 48 h. The presence of acid and gas formation showed a completed test for coliforms.

Characterization of isolates

The bacterial isolates on the plates were characterized based on the observation of some parameters such as the shape of the colony, edge, pigmentation, elevation, colony surface, consistency, a size and optics characteristics of different colonies. Various biochemical tests were carried out for further identification of the isolates, as well as various staining techniques as described by Fawole and Oso (2004).

RESULTS AND DISCUSSION

A total of six (6) bacterial isolates, which were isolated from various samples, were analyzed. The bacterial isolates were *Escherichia coli, Streptococcus faecalis, Proteus mirabilis, Staphylococcus aureus, Clostridium perfringens and Klebsiella pneumonia.*

Table 1 shows the temperature of the samples, which ranged from 24.0 26.0°C. The lowest pH of 7.1 was recorded for sample E, while the highest pH of 7.5 was recorded for sample B. The pH values for all samples were all alkaline.

Table 2 shows that sample D recorded the highest bacteria count (7.1×10^6 cfu/ml). The lowest count of 1.7×10^6cfu/ml was observed in sample B.

Table 3. Occurrence of bacterial in water samples.

Bacterial isolates	A	B	C	D	E	F
Escherichia coli	+	-	+	+	+	+
Streptococcus faecalis	-	-	+	+	-	+
Proteus mirabilis	+	-	+	+	+	-
Staphylococcus aureus	+	+	+	-	+	+
Clostridium perfringens	+	+	+	+	+	+
Klebsiella pneumonia	-	-	+	+	+	+

Total enteric bacteria count as shown in Table 2 revealed that the sample had counts, which ranged between $1.1x10^6$ and $4.2x10^6$ cfu/ml. However, C had the highest enteric bacteria count ($4.2x10^6$cfu/ml) during analysis.

Table 2 also shows the result of total coliform count using most probable number (MPN) method for all samples. It was shown that the highest faecal coliform was observed in samples C and D during analysis ($1.8x10^3$ cfu/ml).

Table 3 shows the occurrence of bacterial in water samples. A total number of six (6) bacteria species were isolated: *E. coli, S. faecalis, P. mirabilis, S. aureus, C. perfringens and K. pneumonia* and this is in line with the report of September et al. (2004) who obtained similar result.

In this study, *C. perfringens* was the most isolated of all samples, while *S. faecalis* was the least isolated (Table 3). The wide distributions of coliforms and other microorganism in most water samples are shown in the result of this study with *E. coli* occupying an interesting position. The recovering of *E. coli* indicates recent contamination and risk of exposure or other bacterial pathogens. *E. coli* can cause different disease of economic importance. For example, fw2 diarrhea and gastrointestinal disorder.

CONCLUSION AND RECOMMENDATIONS

From the results obtained, samples B (Closed well) met the World Health Organization (2005) standard for portable water. The other samples fail to meet the standard. The isolation of *E. coli* in samples A, C, D, E and F indicates the poor quality of the water.

RECOMMENDATIONS

1. To avoid any possible seepage from toilet pits, wells should be situated far from toilet pits.
2. To reduce the number of *Klebsiella* and *Proteus* spp. possibly of vegetative origin, the wells should be covered when not in use.
3. Indigenes of the community should be enlightened and educated on good sanitary hygienic practices.
4. Practice of personal hygiene after passing of faeces should be enforced.
5. Indiscriminate keeping of trash bins or buckets on the ground near the wells should be stopped.
6. The various agencies and institutions concerned with water quality control and public health should pay serious attentions to both public and private wells to avoid health problems.
7. Faeces should be disposed safely especially those of local latrines even for children should be avoided completely.
8. Boiling of drinking water before consumption should be encouraged.

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