Science World Journal Vol. 16(No 4) 2021
www.scienceworldjournal.org
ISSN: 1597-6343 (Online), ISSN: 2756-391X (Print)
Published by Faculty of Science, Kaduna State University

Full Length Research Article

BACTERIOLOGICAL AND PARASITOLOGICAL ANALYSIS OF HAND-DUGGED WELL WATER IN SELECTED AREAS OF RIGACHIKUN COMMUNITY, KADUNA

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ABSTRACT
Inadequate provision of potable pipe borne water in Rigachikun leads to the consumption of untreated and inadequately treated well water which has been responsible for water borne diseases. A total of 20 samples from four locations (Unguwan liman, (ULR), Hayin Rigachikun (HRN), Rigachikun Bus-stop (RBS), and Rigachikun New layout (RNL) five samples each from the locations were collected for total bacteria load and prevalence of parasites using standard Microbiological and Parasitological techniques. The result showed that the total bacterial count in all the samples ranged from 0.78 and 0.84cfu/ml at Rigachikun Bus Stop and Hayin Rigachikun respectively in wet season as the least bacterial load and the highest bacterial load of 3.50 and 2.56 CFU/ML at Unguwan liman and Rigachikun New Layout respectively in dry season. Five genera of bacteria were isolated and identified, Escherichia *coli*, *Staphylococcus aureus*, *Salmonella typhi*, *Bacillus*sp and *Pseudomonas* sp*S almonella*, had the highest occurrence followed by *E. coli* then *Stapylococcus aureus* and *Bacillus* sp., with *Pseudomonas* sp. occurring least. The Parasitological study reveals four genera of protozoan parasites, namely: *Gardia lamblia*, *Entamoeba histolytica*, *Balantidium coli*, and *Cryptosporidium parvum*; the prevalence of the parasites were *Gardia lamblia* 45%, *Entamoeba histolytica* 60%, *Balantidium coli* 10%, and *Cryptosporidium parvum* 35%. The study has shown high level of bacterial and parasitic contamination in all the samples obtained from the selected locations. Hence, there is the need for proper treatment of hand dug well water and hygienic practices by households to reduce the risk of disease outbreak caused by the organisms encountered in this study.

Keywords: Bacterial load, Parasite, Prevalence, Contamination, Hand dug Well water.

INTRODUCTION

Water covers 71% of the Earth surface and biochemically, water is regarded as a "life sustainer" (Nkuma, 2010). All living organisms on the earth need water for their survival and growth, as of now only earth is the planet having about 70% of water. But due to increased human population, industrialization, urbanization, use of fertilizers in the agriculture and man-made activity makes water to be highly polluted with different harmful contaminants (Umeh *et al*., 2020). Due to inability of governments to meet the ever-increasing water demand, most people in rural areas resort to groundwater sources such as wells as an alternative water resource. Thus contamination of drinking water from any source is of primary importance due to the danger and risk of water borne diseases.

Bacteria are ubiquitous, mostly free-living prokaryotic microorganisms typically a few micrometers in length, bacteria were among the first life forms to appear on Earth, and are present in most of its habitats. Bacteria inhabit soil, water, acidic hot springs, radioactive waste, and the deep biosphere of Earth's crust (Flemming and Wuertz, 2019).
Biological contamination is generally due to the introduction of organic waste material into the aquifer system e.g. bacteria. Such microorganisms are responsible for diseases such as typhoid, dysentery, cholera, diarrhea, gastroenteritis and some undesirable characteristic such as taste and odors and sometime corrosion and encrustation in borehole delivery pipes (Edema *et al*., 2001).
Parasites are eukaryotic pathogenic organisms that live on other organisms, called the hosts, and often harmful to their hosts. They depend on their host for survival. Without a host, a parasite cannot live, grow and multiply. For this reason, it rarely kills the host, but it can spread diseases, and some of these can be fatal (Madanire-Moyo and Barson, 2010).'
Water-borne parasitic infections are considered a threat and of public health importance especially in developing countries. Parasitic infections affect work and productivity as they are usually associated with a diminished capacity to carry out physical work (Chollom *et al*., 2013). The objectives of this research is to assess the bacteriological and parasitological contamination of hand dug well water used for human consumption and domestic utilization in some areas of Rigachikun community.

MATERIALS AND METHODS

Study Area

The study was conducted using hand dug well water samples in Rigachikun Igabi Local Government Kaduna state Nigeria. Rigachikun is a populated environment within the region code of Africa/Middle East located at an elevation of 596 meters above sea level (wwwgetamap.net)
It coordinates are latitude 10◦37'57" N and longitude 7◦28'22" E

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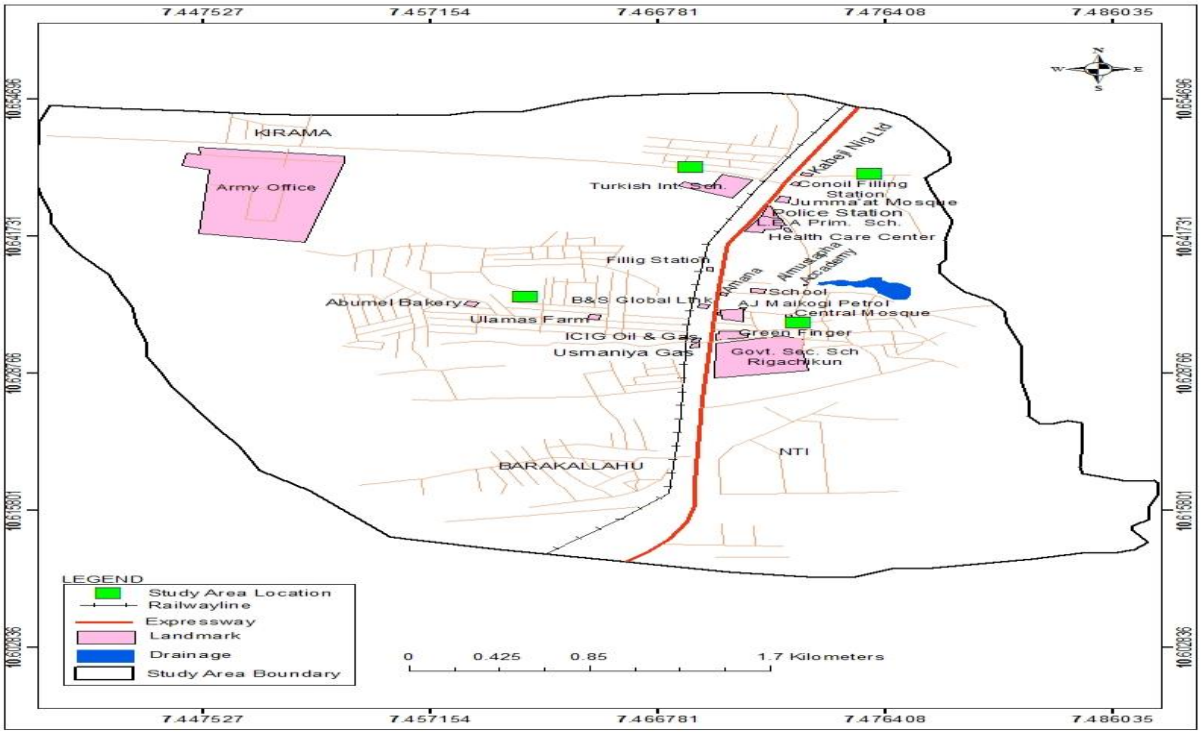

Figure 1: The Study Area Showing Four Sampling locations within Rigachikun Community
Source: Google map

Collection of Water Samples
Methods described by Agwaranze *et al*. (2017) was adopted, a total of five samples each from four locations Unguwan liman, (ULR), Hayin Rigachikun (HRN), Rigachikun Bustop (RBS), and Rigachikun new layout (RNL) were collected for total bacterial load, bacteria species isolated and prevalence of parasites using standard microbiological and parasitological techniques and were transported to Microbiology laboratory Kaduna State University, Kaduna, for analysis of the water samples.

Bacteriological Analysis
The bacterial load of the water samples from the well water were determined by performing ten-fold serial dilution using the pour plate technique, cultured in duplicates. The plates were labeled before inoculation and the culture medium was plate count Agar. Isolation and identification of the organism present in the water samples were carried out using membrane filtration method (Cheesbrough, 2010).

Parasitological analysis
Parasites were isolated and identified using zinc Flotation method described by Chollom *et al*. (2013).

RESULTS
The monthly bacterial load in hand dug well water samples collected from four locations within Rigachikun community, indicate that bacterial contamination was significantly lower during the rainy season than dry season, the bacterial load was higher in the month of September than in August, although the differences were not statistically significant. Similarly, it was observed that during the dry season months the bacterial loads were higher during the month of March and least were recorded in January (Table 1).
The species of bacteria isolated from the samples showed five bacteria genera identified: *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi*, *Bacillus subtilis*, and *Pseudomonas aeruginosa*. *Salmonella typhi*, had the highest occurrence followed by *E. coli* then *Stapylococcus aureus* and *Bacillus subtilis*, with *Pseudomonas aeruginosa* occurring least (Table 2).

Table 1: Bacterial load (CFU/ML from hand dug well water samples obtained from selected locations Within Rigachikun Community**.**

Location	Bacteria load in water samples (CFU/ML)					*p* value
	January	February	March	August	September	
RNL	2.23±0.31^a	2.36±0.33^a	2.56±0.32^a	0.86±0.13^a	0.92±0.19^a	< 0.001
RBS	2.14±0.15^a	2.35±0.14^a	2.37±0.11^a	0.78±0.14^a	0.89±0.17^a	< 0.001
HR	2.28±0.22^a	2.33±0.29^a	2.36±0.19^a	0.84±0.26^a	1.19±0.60^a	< 0.001
ULR	3.34±0.33^b	3.46±0.36^b	3.50±0.38^b	1.18±0.23^b	2.19±0.64^b	< 0.001
p value	< 0.001	< 0.001	< 0.001	0.020	< 0.001	

Values are given as mean ±standard deviation. In each row, values with different superscripts have statistically significant difference ($p < 0.05$).

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Key: **RNL**: Rigachikun New Layout; **RBS**: Rigachikun Bus-stop; **HR**: Hayin Rigachikun; **ULR**: Ungwan Liman Rigachikun

Table 2: The Prevalence of Bacterial Species Isolated from Hand dug Well Water Samples Obtained from Selected Locations within Rigachikun Community

Location	No.	*E. coli*		*Staphylococcus sp.*		*Salmonella sp*		*Bacillus sp.*		*Pseudomonas sp*	
		Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry
RNL	5	1(20)	2(40)	2(40)	3(60)	5(100)	5(100)	0(0)	1(20)	0(0)	0(0)
RBS	5	0(0)	0(0)	1(20)	0(0)	2(40)	2(40)	2(40)	2(40)	2(40)	1(20)
HR	5	2(40)	3(60)	1(20)	2(40)	3(60)	3(60)	3(60)	3(60)	0 0)	0(0)
ULR	5	3(60)	4(80)	2(40)	2(40)	2(40)	4(80)	1(20)	1(20)	0 0)	0(0)
Total	20	6(30)	9(45)	6(30)	7(35)	12(60)	14(70)	6(30)	7(35)	2(10)	1(5)

Key: **RNL**: Rigachikun New Layout; **RBS**: Rigachikun Bustop; **HR**: Hayin Rigachikun; **ULR**: Ungwan Liman Rigachikun

The prevalence of parasites in the samples collected from selected wells within Rigachikun Community, showed the presence of four species of parasite identified, namely: *Gardia lamblia*, *Entamoeba histolytica*, *Balantidium coli*, and *Cryptosporidium parvum* (Table 3).

Table 3: Percentage Occurrence of Parasites from Hand dug Well Water Samples Obtained from Selected Locations within Rigachikun Community

Locations	No	*G.lamblia*	*E. histolytica*	*B.coli*	*C. parvum*
RNL	5	0(0.0%)	3(60.0%)	0(00.0%)	0(00.0%)
RBS	5	4(80.0%	3(60.0%)	0(00.0%)	2(40.0%)
HR	5	3(60.0%)	1(20.0%)	1(20.0%)	3(60.0%)
ULR	5	2(40.0%)	5(100.0%)	1(20.0%)	2(40.0%)
TOTAL	20	9(45.0%)	12(60.0%)	2(10.0%)	7(35.0%)

Key: **RNL**: Rigachikun New Layout; **RBS**: Rigachikun Bus-stop; **HR**: Hayin Rigachikun; **ULR**: Ungwan Liman

(a) Giardia lamblia cyst

(b) Cryptosporidium cyst

(c) Entamoeba histolytica

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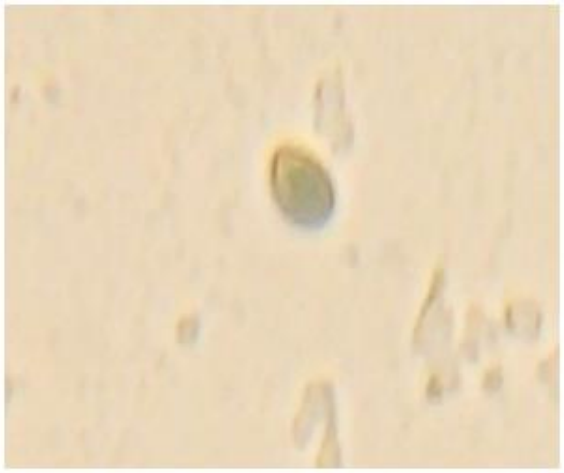

(d) Balantidium coli cyst

Plates a –d: (a) *Giardia lamblia* cyst (b) Cryptosporidium cyst (c) *Entamoeba histolytica* (d) *Balantidium coli cyst*

DISCUSSION

The mean bacterial counts during the dry season months were significantly higher than rainy season (Table1). The highest bacterial load was observed in Unguwan liman and Rigachikun New Layout. This study is in consistent with the findings of Orji *et al*. (2020) during dry season in March. For the wet season, the least bacterial load was obtained at Rigachikun Bus Stop and Hayin Rigachikun in August which shows a significant reduction in the bacterial load as a result of rainfall which reduce the concentration of bacteria in the well water, other natural processes and reduction in high demand for well water as a result of annual rainfall. This finding is related to the findings of Agwaranze *et al.* 2017) for well water analyzed in Wukari, Nigeria. The results of this study also correlates with the report of Bello *et al*. (2013); who reported that all water samples from the well water were highly contaminated with bacteria and were above the permissible limit stated by WHO Standards.

Five genera of bacteria were isolated and identified: *Escherichia coli*, *Staphylococcus aureus*, *Salmonella typhi*, *Bacillus*, and *Pseudomona* (Table 2).
Salmonella, had the highest occurrence followed by *E. coli* then *Stapylococcus aureus* and *Bacillus* sp., with *Pseudomonas* sp. occurring least. *Escherichia coli* was detected in water samples collected over four sampling location in both rainy and dry seasons which indicates fecal contamination of the well water samples being a potential pathogen of the coliform group. Similar findings have been recorded by Idowu *et al*. (2011) on well water samples from Shagamu.

Parasitological results obtained from the study reveals the occurrence of parasites in the well water collected from selected wells within Rigachikun Community. Four genera of protozoan parasites were identified, namely: *Gardia lamblia*, *Entamoeba histolytica*, *Balantidium coli*, and *Cryptosporidium parvum*; with the highest being *E. histolytica* (Table 3)

The high prevalence of *Entamoeba histolytica*, giardia lamblia, *Cryptosporidium parvum* and *Balantidium coli* will lead to the tendency of high rate of amoebiasis infections, possibility of giardiasis, gastrointestinal diseases in human. The findings in this study is closely related to the results obtained by Vantsawa *et al*. 2020) in a study carried out on protozoan parasites associated with different water sources in lokoja metropolis. The result is also in correlation with the report of Ani and Itiba (2015) showing high prevalence of parasites from drinking water sources in Ebonyi state Nigeria. High bacterial and Parasitic prevalence of the well water in this study could be attributed to poor sanitary conditions of some of the wells as most of the wells were found not properly covered, some were observed to be close to latrines, some were found with domestic animals like chicken and goats feeding, drinking and defecating around the surrounding wells which serve as the major source of contamination of the wells. Agricultural activities such as use of manure in which erosion could have washed some bacterial and parasitic contaminants present in manures into the stream could be another means through which the wells got contaminated.
The results indicate a significant threat to the health of human and domestic animals that use the water for consumption and can lead to the some water borne disease outbreak such as, diarrhea, typhoid fever amoebiasis, and many gastrointestinal diseases

Conclusion

From the results obtained from this research, bacteriological and parasitological quality of sampled water from hand dug wells within selected areas of Rigachikun was found unsatisfactory according to the set standard of WHO and NSDWQ. The water therefore may, according to WHO standards considered to be unsafe for drinking hence the need for treatment and proper personal and environmental sanitary practices which must be maintained in and around the wells before consumption in other mitigate the risk of infection.

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