An Assessment of Microbial Water Quality of Shallow Wells For Drinking Purpose In Ringim Town, Jigawa State, Nigeria

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***Abstract*--**The research assessed the microbial water quality of shallow wells for drinking purpose in Ringim Town, Jigawa state. Among the objectives of this research is the identification of the presence of Total Coliform and Escherichia Coli in sampled water. The results were compared with NIS (2007) and WHO (2008) standards so as to assess the quality status of the water for drinking purpose in the town. Five samples of water were analyzed in the laboratory using membrane Filter Method (M.F.). On the issue of contamination, generally, there were high contaminations of water in dry season than in wet season. The number of Total Coliform detected ranges from 1cfu/100ml to 200cfu/100ml while that of E. Coli ranges from 1cfu/100ml to 98cfu/100ml depending on the sample. The comparison of the results with NIS (2007) and WHO (2008) indicates that groundwater samples of the area are not very suitable for drinking. Among the recommendations given are that; borehole water should be treated especially those suspected to contain high number of organisms per 100ml and that public health education on water sanitation is required, especially with routine monitoring of human activities in the area, pertaining all sources of water supply.

***KeyWord*--**Shallow wells, Water quality, Total Cliform, Escherichia Coli Contamination

I. INTRODUCTION

Ringim Local Government is one of the 27 local governments in Jigawa State. Ringim town served as local government head quarter of Ringim local government. Although there are very little literature on the water quality status of drinking water in Ringim town, but some reports compiled at Ringim General Hospital in 2013 have shown that there is high incidence rate of typhoid, diarrchea, dysentery which are suspected to be associated with drinking water people use in the town. Ringim town suffered from flooding incidence in 2013. Ground water within the flooded area in most cases got contamination because of the relationship between the load carried by the river and the recharge of the ground water. In view of the above, the study seeks to assess the microbial quality of shallow wells for drinking purpose in Ringim town.

Akaakan, et al (2010) has pointed out that, due to the depth and structure of the shallow well, contamination with organic and inorganic compounds is a major concern.

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They also gave an example in Ethiopia where after many years of using or drinking water from drilled wells in the Rift Valley area, Ethiopia, dental and skeletal fluorosis became a serious problem.

According to World Health Organization (2013), the quality of water, whether used for drinking, domestic purposes, food production or recreational purposes has an important impact on health. Water of poor quality can cause disease outbreaks and it can contribute to background rates of disease manifesting themselves on different time scales. Contaminated water serves as a mechanism to transmit communicable diseases such as diarrhhoea, cholera, dysentery, typhoid and guinea worm infection.

Most of water-borne pathogens are derive from faeces, it is usual practice to use indicator organisms, usually bacteria, for the analysis of microbiological quality of drinking water. There are a number of indicator micro-organisms that may be used in drinking water quality monitoring programmes. The most commonly used is ESCHERICHIA COLI or as surrogate thermtolerant coliforms (Howard, 2003).

Coliform bacteria (of which Escherichia coli is a member) are often associated with enteric pathogenic organism and have been shown to be useful indicators of the presence of fecal contamination, coliform bacteria also occur normally in the intestines of humans and other warm blooded animals and are discharged in great numbers in human and animal waste. In polluted water, coliform bacteria are found in densities roughly proportional to the degree of fecal pollution. When members of the coliform group are present, other kinds of microorganism capable of causing disease also may be present. (Pepper and Gerba 2004).

TABLE 1
STANDARDS FOR TOTAL COLIFORM AND E. COLI CONCENTRATION FOR DRINKING WATER

PARAMETER (cfu/100ml)	**WHO**	**NIS**
TOTAL COLIFORM	0	10
E. COLI	0	0

Source: WHO, 2008; NIS,2007

II. EXPERIMENTAL

Sampling sites. Samples were collected from five Hand pump (bore hole) within Ringim town in order to assess the microbial water quality status of the water selected from five different locations in the town. Population density and

human activities were taken into consideration in the selection of the sites.

Sample Collection Five water samples were collected six times (3 times in dry season and 3 times in wet season) for this research, so as to obtain reliable results. This is because in wet season there are high recharge of aquifer from rain, a lot of leaching from decomposition, chemical fertilizers added to the soil and high percolation of domestic sewage, while the reverse is the case in the dry season.

*Microbiological Analysis.*Microbiological properties of water are determined by the type and numbers of micro-organisms present in the water. A variety of micro-organisms can be present even in very good quality domestic waters. Most of these micro-organisms are harmless but if the water is polluted disease-causing organisms (pathogens) may be present. It is difficult to determine the presence of all the different pathogenic organisms and therefore, the presence of certain indicator organisms are to give an indication of the possible presence of pathogens. The most common indicator organisms used for domestic water quality assessment are; total coliform and faecal coliforms (Schutt, 2001)

The numbers of total and faecal coliforms was determined, using membrane filtration techniques. A mesasured volume of water (as guided by Unicef POTALAB WAG-WE10016) was filtered through a membrane. Bacteria retained on the membrane and incubated for a recover period of one hour, at 37˚C and 44˚C provided the total and faecal coliforms respectively for 24 hours. If any bacteria are present, it grew into visible colonies that were converted to represent count per 100ml.

To this end, 100ml of water was filtered through a membrane with pore size of about 0.45um, which traped the bacteria on its surface. The membrane was then placed on selective agar or a thin absorbent pad that had been saturated with a medium designed to grow or permit differentiation of the organisms sought.

III. Results And Discussion

This presents the results of laboratory analysis and their discussion. As indicated in the methods adopted, the scope of this research is to examine the presence of Total Coliform and Escherichia Coli (E. Coli) in the samples of water within the study area.

Total Coliform Count (CFU/100ML)

The overall result of the analysis of samples shows that total coliform were detected in almost all the samples as indicated in table 2 and 3

TABLE II
TOTAL COLIFORM RESULT (DRY SEASON)

Sample _Code	Type	March (2014) (cfu/100 ml)	April (2014) (cfu/10 0ml)	May (2014) (cfu/1 00ml)	Mean (Dry Season)	STDV
A	Hand pump	2	2	4	3	1.15
B	Hand pump	0	200	20	73	110.15
C	Hand pump	2	16	0	6	8.72
D	Hand pump	2	150	0	51	86.03
E	Hand pump	11	0	35	15	17.90

Source: Laboratory Analysis (2014)

TABLE III
TOTAL COIFORM RESULT (WET SEASON)

Sample_ Code	Type	July (2014) (cfu/10 0ml)	August (2014) (cfu/10 0ml)	Sept. (2014) (cfu/10 0ml)	Mean (Wet Season)	STDV
A	Hand pump	0	0	0	0	0.00
B	Hand pump	24	150	0	58	80.57
C	Hand pump	0	10	1	4	5.51
D	Hand pump	5	12	2	6	5.13
E	Hand pump	1	2	3	2	1.00

Source: Laboratory Analysis (2014)

Table 2 and table 3 show the presence of coliform bacteria in sample A (Hand Pump).The result indicates the degree of safety and cleanness of water as one compares the result with that of WHO (2008) and NIS (2007) standards. In March and April 2cfu/100ml were recorded each, 4cfu/100ml detected in May. In July, August and September 0.00cfu/100ml were observed. With this result one can easily explain that, although the values of total coliform exceed the WHO value in March, April and May, still the number detected is encouraging, especially when you compare it with NIS standard. In the case of wet season result (July, August and September) the result shows that the water is safe for drinking purpose because the result obtained tally with WHO (2008) standard and by far less than that of NIS (2007) standard (10cfu/100ml).

The hand pump with sample code B has 0.00cfu/100ml both in March and in September, which corresponds with WHO (2008) standard and NIS (2007) standard limit. In case of the values obtained in April, May, July and August have shown that the water is unsafe for drinking purposes, because the values recorded were 200cfu/100ml, 20cfu/100ml, 24cfu/100ml and 150cfu/100ml respectively. All the stated values are above the limit of WHO (2008) and NIS (2007) standards. Highest values were recorded in April as well as in August probably as a result of poor sanitation around the source point of the sample.

Sample C indicates 0.00cfu/100ml in May and July which are in conformity with WHO (2008) standard, but the same source point of sample C tested in March recorded

2cfu/100ml, 16cfu/100ml in April, 10cfu/100ml in August and only 1cfu/100ml recorded in September.This means all the values stated exceed the WHO recommendations but the NIS standard accept any value from 10cfu/100ml and below, that is the water is safe for drinking, such as the example of 2cfu/100ml in March and 1cfu/100ml in September.

Tables 2 and 3 indicate the record of sample D. From the record, only 0.00cfu/100ml recorded in May, satisfied the WHO (2008) recommendation in its guideline. All the remaining records such as 2cfu/100ml in March, 150cfu/100ml in April, 5cfu/100ml in July, 12cfu/100ml in August and 2cfu/100ml in September exceed the maximum value recommended by WHO (2008). This implies that the water is unsafe to be used for drinking and other domestic uses. But with regards to NIS (2007) standard, the total coliform maximum value is 10cfu/100ml. That is why 150cfu/100ml recorded in April and 12cfu/100ml in August is above the limit. That is unsafe to be used for drinking purpose during those months. The contamination is decreasing probably due to high recharge of the ground water in wet season.

Sample E has the following results for total coliform count in March (11cfu/100ml), April (0.00cfu/100ml), May (35cfu/100ml), July (1cfu/100ml), August (2cfu/100ml) and September (3cfu/100ml) were recorded. WHO (2008) recommends that any value of total coliform greater than zero (0) tend to make water unsafe for drinking purpose. As such only April value is within the permissible limit as recommended by WHO (2008). All other values are above the limit, generally referred to as unsafe for drinking purpose. As usual, the NIS standard (2007) indicate values obtained in July (1cfu/100ml), August (2cfu/100ml) and September (3cfu/100ml) to be safe because of the reasons discussed earlier. The the level of contamination decrease from dry season to wet season which also explain the nature of contamination as the quantity of ground water increases.

Escherichia Coli (E-Coli) Count per 100ml

WHO (2008), Natural ground water should contain no faecal bacteria unless contaminated. WHO recommended number of E. Coli for drinking-water is zero organism per 100ml.The results obtained after laboratory tests have shown that some of the water sources in the study area contain E-Coli, right from the source point. The result is presented in tables 4 and 5

TABLE IV
E. COLI COUNT PER 100ML (DRY SEASON)

Sample Code	March (2014) (cfu/100ml)	April (2014) (cfu/100ml)	May (2014) (cfu/100ml)	Mean (Dry Season)	STDV
A	0	6	0	2	3.46
B	0	40	10	17	20.82
C	0	0	0	0	0.00
D	0	98	0	33	56.58
E	1	0	3	1	1.53

Source: Laboratory Analysis, 2014

TABLE V
E. COLI COUNT PER 100ML (WET SEASON)

Sample _Code	July (2014) (cfu/100ml)	August (2014) (cfu/100ml)	Sept. (2014) (cfu/100ml)	Mean (Wet Season)	STDV
A	0	0	0	0	0.00
B	5	50	0	18	27.54
C	0	0	0	0	0.00
D	3	0	1	1	1.53
E	0	0	0	0	0.00

Source: Laboratory Analysis, 2014

In Sample A (Hand Pump) throughout the two seasons (Dry and Wet Seasons) only in April were traces of E. Coli detected, but all tests conducted in other months (March, May. July, August and September) have shown zero organism per 100ml (0.00cfu/100ml). Thus the results make the water to be a little bit safe for drinking purpose, because almost all the tests indicated zero organism per 100ml. The exception is that of April which may be attributed to external forces such as poor sanitation.

The hand pump with sample code B contains some E. Coli bacteria detected during laboratory analysis. In April, 40cfu/100ml, May, 10cfu/100ml, July, 5cfu/100ml and August 50cfu/100ml were detected in a sample, while zero organisms per 100ml were detected in March and September. In this respect, the water has risk of contamination because of the presence of E-coli bacteria as recommended by WHO (2008) and NIS (2007).

Sample C is the only sample that meets the requirement given by NIS (2007) and WHO (2008) guidelines for water quality for drinking purposes. In all tests conducted (about six times) have shown zero organism per 100ml (0.00cfu/100ml). This indicates the water has good quality and safe for drinking purposes.

Table 4 and table 5 indicate the result of E. Coli presence in Sample D. From the record, zero organism per 100ml was confirmed in March, May and August, while in April 98cfu/100ml was detected, 3cfu/100ml obtained in July and 1cfu/100ml in September. The result of April (98cfu/100ml) indicated something serious happened which led to high level of contamination probably due to external influence related to poor sanitation. The decline in contamination as one moves from dry season to wet season may be as a result of recharge of aquifer (WHO, 2008 and NIS, 2007).

The Hand Pump (Sample E) shows zero organism per 100ml (0.00cfu/100ml) for April, July, August and September. But in March and May 1cfu/100ml and 3cfu/100ml were recorded respectively. This means the water has risk of contamination as given by WHO (2008) and NIS (2007). The source point is fairly clean. The result shows reduction in contamination possibly because of the recharge of the groud water.

IV. Summary, Conclusion And Recommendations

Summary of Findings

The findings of the study can be summarized as follows;

- Water supply in Ringim is mainly from hand pump well sources
- The comparison of the results with WHO (2008) and NIS (2007) standards indicate that groundwater of the area is virtually unsuitable for drinking. For instance, almost all the water samples examined have traces of Total Coliform and E. Coli count. The general picture of the results is quite discouraging and too bad, because almost all the values obtained exceed the required standard for drinking water internationally and locally.
- There is higher contamination by total coliform bacteria in the dry season than in the wet season.

V. Conclusion

The conclusion one can draw from this study is that ground water is not as clean as usually assumed, especially water from shallow aquifer. Water from such shallow sources are open to contamination even when hand pumps are fitted.

Secondly, the findings of this research give some hints on the possibility of outbreak of waterborne diseases such as Diarrchia, Typhoid and Gastro enteritis (G.E.) and so on.

VI. Recommendations

Based on the findings, the following recommendations are made;

- ❖ Monitoring of the Water Quality should be paramount by the Jigawa State Water Board and the inhabitants from time to time.
- ❖ Public health education on water sanitation is required, especially with routine monitoring of human activities in the area, pertaining all sources of water supply.
- ❖ Boreholes waters should be treated especially those suspected to contain high number of organisms per 100ml, until quality standard are maintain.
- ❖ There is the need for further researches in areas not covered by this research and which pose meaningful challenges to environmentalists and researchers in water quality.

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