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Bacteriological assessment of boreholes and well water quality in dutse metropoly

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Abstract: *This study was conducted to access the bacteriological quality of Boreholes and Wells water. The selected sites are Gida dubu, Fagoji, Yalwawa and Takur site respectively. Samples were collected from these areas; the samples were analyzed to detect the presence of total coli form and Escherichia coli. The results obtained were statistically analyzed using T-test. The results have shown that the all the water samples collected from the study area contain total coli form and Escherichia coli higher than the standard set by the Nigerian Standard for Drinking Water Quality. It is therefore, recommended that Government at all level should ensure that there is provision of adequate and efficient pipe borne water which undergo conventional treatment.*

Key Words: *Total coli form, Escherichia coli, Colony forming unit.*

1. INTRODUCTION:

The quality of drinking water is a powerful environmental determinant of health (WHO, 2010). Water plays an indispensable role in sustenance of life and it is a key pillar of health determinant, since 80% of diseases in developing countries are due to lack of good quality water (Cheesbrough, 2004). Drinking water quality management has been a key pillar of primary prevention for over one and half centuries and it continues to be the foundation for the prevention and control of water borne diseases (WHO, 2010).

Humans may survive for several weeks without food, but barely few days without water because constant supply of water is needed to replenish the fluids lost through normal physiological activities, such as respiration, perspiration, urination, (Murray et *al.*, 2004). The need for water in the day to day activities of man include for cooking, washing, drinking and for industrial activities (Akpoborie *et al*, 2008 and (Ajiwe *et al.*, 2000.)

Microbial water quality is one of the most important aspects of drinking water in relation to the water borne diseases. Detection of indicator bacteria in water means the presence of pathogenic organisms that are source of water borne-diseases. Such diseases can have implication for human health; Faecal coli form bacteria have been used as indicators of contamination by humans and other warm-blooded animals (Pritchard *et al*., 2007). These particular bacteria normally grow in the large intestines (colon) of humans and are present in high numbers in the faeces of humans. The greatest microbial risk are associated with ingestion of water that is contaminated with human or animal faeces (WHO, 2008). Waste water discharges in fresh waters and coastal sea waters are the major sources of faecal microorganisms, including pathogens (Fenwick, 2006).

2. METHOD:

2.1. DESCRIPTION OFTHE STUDY AREA: The study area Dutse metropolis covers about 7382 km^2, between latitude 100^0 25^0 N 120 07'N and longitude 9^0 05' E and 100^0 25^0 E. The Vegetation of the area is characterized by Sudan savannah. With dispersed vegetation, shrubs and grasses.

2.2. SAMPLING TECHNIQUE: In this research purposive sampling technique was used during data collection. To ensure successful data collection, water samples were collected from eight (8) selected Wells and boreholes respectively in the study area. The four areas include Gida dubu, Fagoji, Yalwawa and Takur site.

3. SAMPLE COLLECTION PROCEDURE:

Water samples were collected from Eight (8) boreholes and eight (8) wells in duplicates across the study area in the dry season (April) of 2017. From each of the water sources, samples were collected for the analysis. Standard precautionary measures were adopted to avoid cross contamination of the samples. In order to collect water from a borehole, the selected boreholes were flushed for a while and ensured that samples collected came directly from the underground water aquifer. Sterilized plastic containers were used for collecting water from hand dug wells. This was done carefully to avoid contact between the containers and walls of the wells, thus avoiding contamination of samples. Well labeled sterile bottles were used for collecting the water sample, and were tightly closed immediately. The samples were transported at low temperature (4^0) to the laboratory for Bacteriological analysis of total coli forms count and *Escherichia coli* count respectively.

3.1. SOURCE OF DATA

The sources of data for this research work were both the primary and secondary sources, for the primary source the data was obtained from the result of the analysis of water sample collected from the study area, while the secondary source of data was from text books, Journals, Magazines, Internet and many more.

4. DISCUSSION:

Escherichia coli was found present in all the samples collected from the study area. In borehole water the mean concentration was $0.45x10^1$cfu/ml to$1.5x10^2$ cfu/ml. Therefore, the result obtain revealed that all the samples from boreholes of the study area were statistically higher than Nigerian Standard for Drinking Water Quality (NSDWQ) of (0.00cfu/ml). From Table 4 the results have shown the highest average concentration of *Escherichia coli* in Gida-Dubu boreholes which was $1.5x10^2$cfu/ml. Conversely, the samples collected from Takur site's boreholes have shown the lowest average concentration of *Escherichia coli* ($0.45x10^1$).
However, Escherichia coli was found to be present in all the sampled waters from Wells.

Similarly, total coliforms were detected in all the sampled water from Boreholes of the study area. The mean concentration detected range from ($0.55x\ 10^1$ to $8.6\ x\ 10^2$ cfu/ml). The results shows that all the samples from Boreholes of the study area were statistically significant higher than the standard set by the Nigerian Standard for Drinking Water Quality (NSDWQ). The result From table 4 equally shows that water sample from Fagoji contain the highest concentration of Total coli forms which was found to be ($8.6x10^2$ cfu/ml) Whereas, the sample collected from Yalwawa Boreholes have lowest average concentration of ($0.55x10^1$ cfu/ml) among all the Boreholes samples. However, Total coli form were found in all the sampled water from the Wells of the study area, the average concentration ranged from $0.8x10^2$ to $7.1x10^2$ cfu/ml respectively. from Table 5 the results have shown that sample collected from Gida dubu contain the highest average concentration of Total coliform ($7.1x10^2$cfu/ml), Whereas, the samples collected from Yalwawa Wells have shown the lowest average concentration among all the Well samples ($0.8x10^2$ cfu/ml).

Therefore, the results revealed that all the samples from wells of the study area were statistically higher than the standard set by Nigerian Standard for Drinking Water Quality (NSDWQ) 10.00 cfu/100ml at 95% confidence level. The result finding is similar to the result of the research conducted at Dutsinma Local Government Area, of Katsina State, Northwestern Nigeria by Amadi Akobundu (2005), which shows the highest mean concentration of total coliform count (TCC) that ranged between mean value of 19.27 cfu/ ml to 23.00 cfu/ ml. and faecal coliform count (FCC) ranged between 6.87 cfu/ml to 94.0 cfu/ml respectively. Faecal contamination of groundwater is responsible for most water borne diseases such as cholera, typhoid and diarrhoea (Amadi, 2009; Egharevba *et al.*, 2010). The Borehole water sample from Fagoji had the highest total coliform count ($8.6x\ 10^2$ cfu per ml), This finding is not surprising considering the high population and close proximity of the borehole to sock away. The sewage could seep slowly into the underground water, thereby polluting it. Also, long term usage of boreholes may lead to deterioration of the water quality, because the pipeline may become corroded with random cracks and in most cases clogged with sediment (Onemano and Otun, 2008). This will allow the passage of inorganic metals and bacteria.

The implication of this finding is the possibility of the presence of pathogens that may cause acute intestinal illness, which are generally considered discomfort to human health and could become fatal for some susceptible groups such as infants, elderly and those who are sick (Addo *et al.*, 2009; Olowe *et al.*, 2005; NSDWQ, 2007). Generally, underground water is often considered as the purest form of water (Shittu *et al.*, 2008), although it's vulnerability to contamination could be due to improper construction, animal waste, proximity to toilet facilities, sewage, refuse dump site and various human activities surrounding it (Shittu *et al.*, 2008).

5. ANALYSIS:

Data generated from the colony counting was subjected to analysis using t test. This help in comparing the quality of the samples collected from each Wells and boreholes with the water quality standards set out by Nigerian standard for drinking water quality (NSDWQ). The values were illustrated in the tables below:

6. RESULT:

The results have shown that all the water samples collected from the study area contain total Coli form and Escherichia Coli higher than the standard set by the Nigerian Standard for Drinking Water Quality (NSDWQ). It is therefore, recommended that House hold should further treat the water obtained from these sources before consumption to prevent the spread of diseases.

FIGURES AND TABLES

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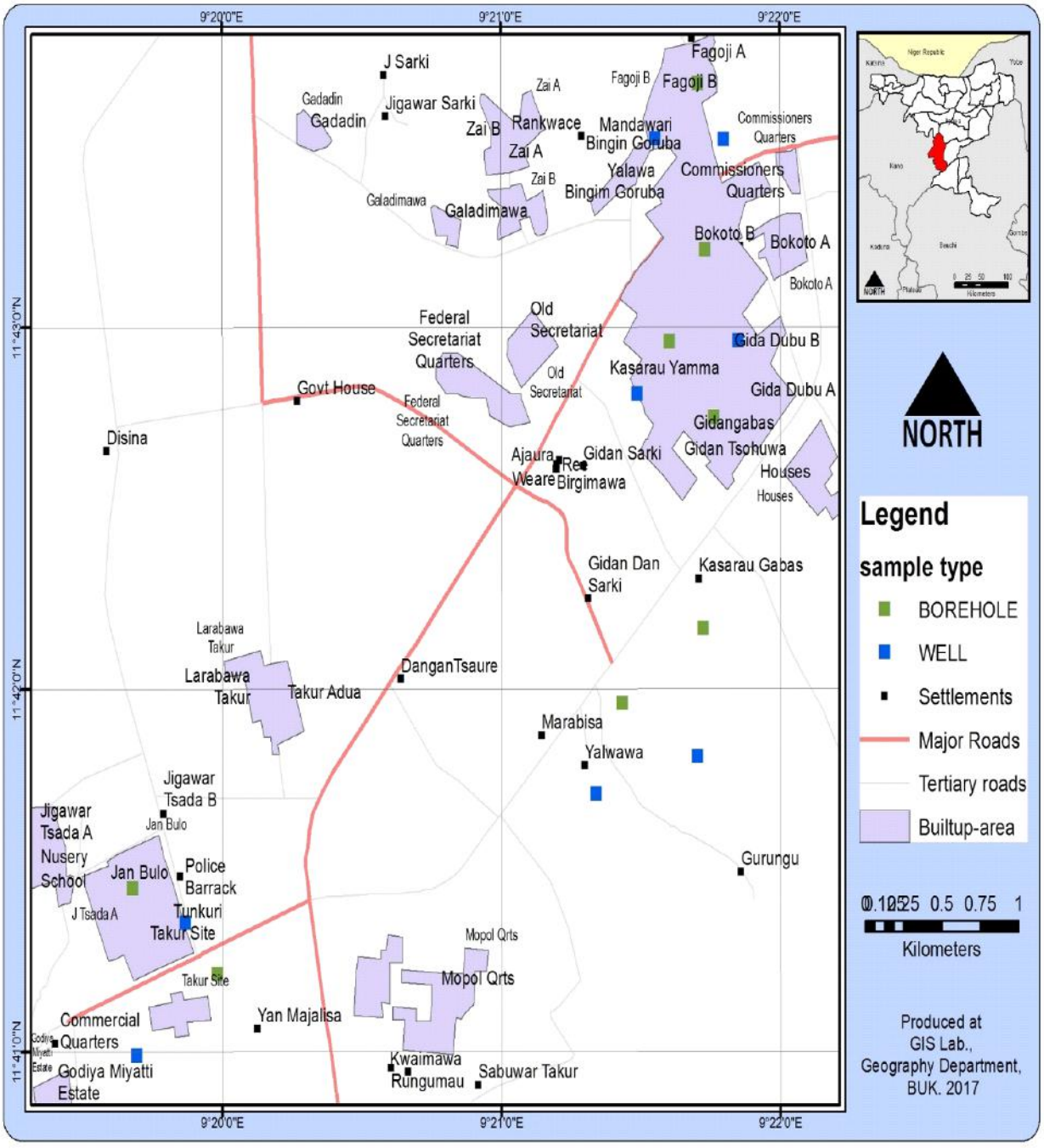

Figure 1. Map of Dutse metropoly showing sampling points across the study areas.

TABLE 1. Total Coliform Count Obtained from Boreholes and Wells in the study area:

S/NO	Sampling Area	Sampling Code	Borehole TCC x 10^2 (cfu/ml)	Well TCC x 10^2(cfu/ml)
1.	Gida dubu	GDB 1	$5.4X10^2$	$13.1X10^2$
		GDB 2	0	$1.1X10^2$
2.	Fagoji	FGJ 1	$15.2X10^2$	$7.4X10^2$
		FGJ 2	$1.9X10^2$	$6.0X10^2$
3.	Yalwawa	YWW 1	$1.1X10^2$	$2.0X10^2$
		YWW 2	0	$1.4X10^2$
4.	Takur site	TKS 1	$7.9X10^2$	$9.8X10^2$
		TKS 2	$1.7X10^2$	$3.0X10^2$

Key: TCC = Total Coliform Count, Cfu =Colony Forming Unit

Total coliform	$5.0X10^2$	10	45125000	1.06	0.39	S
Escherichia coli	2.6X102	0	13520000	1.00	0.42	S

Key: WHO = NSDWQ = Nigeria Standard for Drinking Water Quality, S= Significance

Table2. *Escherichia Coli (E. Coli)* Count Obtained from Boreholes and Wells in the study area

S/NO	Sampling Area	Sampling Code	Borehole TCC x 10^2 (cfu/ml)	Well TCC x 10^2(cfu/ml)
1.	Gida dubu	GDB 1	$1.1X10^2$	$1.4X10^2$
		GDB 2	$1.0X10^2$	$7.0X10^2$
2.	Fagoji	FGJ 1	$9.0X10^2$	$6.9X10^2$
		FGJ 2	$2.0X10^2$	$1.4X10^2$
3.	Yalwawa	YWW 1	$2.1X10^2$	$0X10^2$
		YWW 2	$0.0X10^2$	$6.0X10^2$
4.	Takur site	TKS 1	$5.0X10^2$	$5.2X10^2$
		TKS 2	$6.0X10^2$	$0.0X10^2$

Key: CFU = Colony Forming Unit, TCC= total coliform count

Table 3 The Nigerian Standard for Drinking Water Quality (NSDWQ) standard for Total coliform and *Escherichia coli.*

Parameter		NSDWQ
Total coliform count		10 cfu/ml
Escherichia coli		<1 cfu/ml

Source: - Nigerian Industrial Standard (NIS) 2007.

TABLE 4 Comparison between the mean concentration of Total coliform and Escherichia coli in sampled water obtained from Boreholes in the study area with Nigeria Standard for Drinking Water Quality (NSDWQ) using T-test.

Variable	**Gida dubu (mean)**	**NSDWQ cfu/ml**	**Variance**	**T. value**	**Sign**	**Remarks**
Total coliform	$2.7x10^2$	10	1458000	0.99	0.42	S
Escherichia coli	$1.5x10^2$	0	245000	4.74	0.05	S
Variable	**Fagoji (mean)**	**NSDWQ cfu/ml**	**Variance**	**T. value**	**Sign**	**S**
Total coliform	$8.6x10^2$	10	88445000	1.28	0.33	S
Escherichia coli	$0.55x10^1$	0	24500	1.57	0.26	S
Variable	**Yalwawa (mean)**	**NSDWQ cfu/ml**	**Variance**	**T. value**	**Sign**	**S**
Total coliform	$0.55x10^1$	10	60500	0.98	0.42	S
Escherichia coli	$1.1x10^2$	0	220500	1.000	0.42	S
Variable	**Takur site (mean)**	**NSDWQ cfu/ml**	**Variance**	**T. value**	**Sign**	**S**
Total coliform	$4.8x10^2$	10	1922000	1.54	0.26	S
Escherichia coli	$0.45x10^1$	0	5000	9.00	0.01	S

Key: WHO = NSDWQ = Nigeria Standard for Drinking Water Quality, S= Significance.

Table 5 Comparison between the mean concentration of Total coliform and Escherichia coli in sampled water obtained from Wells in the study area with Nigeria Standard for Drinking Water Quality (NSDWQ). Using T- test.

Variable	**Gida dubu (Mean)**	**NSDWQ Cfu/ml**	**Variance**	**T. value**	**Sign**	**Remarks**
Total coliform	$7.1x10^2$	10	720000	1.18	0.35	S
Escherichia coli	$1.1x10^2$	0	245000	3.00	0.09	S
Variable	**Fagoji (mean)**	**NSDWQ**	**Variance**	**T. value**	**Sign**	**S**
Total coliform	$4.0x10^2$	10	2312000	1.17	0.36	S
Escherichia coli	4.1x102	0	1512500	1.51	0.27	S
Variable	**Yalwawa (mean)**	**NSDWQ**	**Variance**	**T. value**	**Sign**	**S**
Total coliform	$0.8X10^2$	10	720000	1.32	0.32	S
Escherichia coli	$0.3X10^2$	0	180000	1.00	0.42	S
Variable	**Takur site (mean)**	**NSDWQ**	**Variance**	**T. value**	**Sign**	**S**

Key: **WHO = NSDWQ = Nigeria Standard for Drinking Water Quality, S= Significance**

7. RECOMMENDATIONS:

Considering the recorded high number of Total coli form count and *Escherichia coli* obtained from the result, it is therefore recommended that:

- The Ministry Water Resources and sanitary inspectors should ensure that the distance between pit latrines to any source of water **supp**ly meet the recommended distance of 30 meters set by the regulatory agencies.
- Government at all level should ensure that there is provision of adequate and efficient pipe borne water which undergo conventional treatment.
- There should be the creation of awareness through community mobilization by concern authorities to the resident on Well excavation, maintenance and siting.
- there is need for the resident in the study area to boil their water before consumption.
- Government should encourage and sponsor similar research in other areas of the state so that the status of the water use for public consumption can be ascertained.
- The implementation of regulations on safe drinking water by the National Standard for drinking Water Quality (NSDWQ) and other enforcements agencies will go a long way to reduce incidences of water pollution and associated water borne diseases.

8. CONCLUSION:

This study recorded high number of coli form counts and Escherichia coli count in water samples collected and analyzed from the study areas therefore, making it unfit for human consumption and require further treatment. The water sample contained bacteria in excess of the permissible limit recommended by Nigeria standard for Drinking Water Quality (NSDWQ).

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