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ASSESSMENT OF BACTERIOLOGICAL QUALITY OF WELL WATER AROUND DOGON DAWA DISTRICT IN BIRNIN GWARI LOCAL GOVERNMENT, KADUNA STATE

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ABSTRACT
The inadequate supply of clean drinkable water and the frequent pollution of existing supplies have created very serious health problems for people living in developing countries like Nigeria. Water serves as a vehicle for the transmission of diseases like typhoid fever, botulism, diarrhea, dysentery, *Schistosomiasis, ascariasis*, acute severe syndrome etc. which have contributed immensely to the stagnation of the economic development of some of these nations. The assessment of bacteriological quality of well water was conducted to ascertain the quality of water consumed in the District. Water obtained from wells, streams and boreholes are not always chemically pure, even rain water contains dissolved materials from the air as well as suspended dust mixed with microorganisms. Twenty samples were collected from twenty different wells in four different areas that made up Dogon Dawa district. 100ml sterile bottles were used in collecting the water samples and capped carefully after transferring the water into the bottles, each bottle was assigned a code for easy identification, put into ice box and transported to Kaduna State Water Board Central Laboratory for analysis The Multiple tube fermentation technique was used to determine total coliform count and Eosin methylene blue was used to determine fecal coliform count. Some physicochemical parameters of the water samples such as turbidity, temperature, pH and dissolved oxygen (DO) were also determined. In all the 20 well water samples collected in Dogon Dawa district, there were very high bacterial count of between 26.20 -19.00 $x10^2$ cfu/ml which exceeded the recommended level of zero coliform/ml. The physicochemical parameters correlated with the bacterial contamination of samples. The turbidity of all samples of well water of between 8.0 - 9.0 NTU also exceeded the recommended level of 1.0-5.0 NTU. This study has shown that there is a high level of bacterial contamination of well water by pathogenic organisms in Dogon Dawa district. To reduce the high incidence of well water contamination, it is advocated that wells dug must be deep, far away from latrines and covered adequately.

Keywords: Bacteriological Quality, Physicochemical Parameters, Assessment, Well Water, Dogon Dawa District

INTRODUCTION
Water as a universal solvent and one of the most important natural resources is the only substance that occurs at ordinary temperature in all three states which are solid, liquid and gas (APHA, 1991). It covers three quarter of the earth's crust as swamp, lakes, rivers, seas and oceans. Water also occurs in the soil beneath the earth surface as a vast ground water reservoir, and in gaseous state as water vapor. It occurs as fog and clouds (APHA, 1991). The importance of water cannot be over emphasized due to the necessity of water for the survival of living organisms, because all the cells and organs functions made up in our entire anatomy and physiology depends on water for their functioning. In addition to the daily maintenance of our bodies, water also plays a key role in the prevention of disease. Drinking eight glasses of water daily can decreases the risk of colon cancer by 45%, bladder cancer by 50% and it can potentially even reduce risk of breast cancer (Britton, 1991).

The inadequate supply of clean drinkable water and the frequent pollution of existing supplies create very serious health problems for people living in developing countries like Nigeria. water serve as a vehicle for the transmission of diseases like typhoid fever, botulism, diarrhea, dysentery, *Schistosomiasis, ascariasis,* acute severe syndrome etc. which have contributed immensely to the stagnation of the economic development of some of these nations (Okoufu *et al*.,1990). Water obtained from wells, streams and boreholes are not always chemically pure, even rain water contains dissolved materials from the air as well as suspended dust mixed with microorganisms (Prescott and Clein, 2008). Impurities floating as suspended matter consisting of insoluble materials of greater density than water which can be removed by sedimentation and in the form of bacteria. The World Health Organization (WHO) estimates that up to 80% of health challenges in developing countries are water and sanitation related (Cheesbrough, 2000). High incidence of childhood diarrhea, helminthiasis, trachoma and the overall high mortality rates are associated with poor environmental sanitation (Admassu *et al.,* 2004). The contamination of water remains a problem of global concern contributing to high mortality rates from water and food borne diseases (Olukosi *et al.,* 2008). *Escherichia coli* is a

common member of the intestinal micro-fauna of both human and warm blooded animals. It is an opportunistic pathogenic implicated in acute urinary tract infections (U.T.I) and gastrointestinal tract infections. It is a consistent and predominant facultative inhabitant of the human gastro intestinal tract, thus its regular presence in the intestine and faces of warm blooded animals makes the bacterium an indicator of fecal pollution (Yang *et al.,* 2004) The presence of fecal coliforms in water indicates that contaminants are present and may show that the water is unsuitable for consumption (Ahmed *et al.,* 2005). Concern over the quality of water received wide attention among researchers (Omofonmwam and Eseigbe, 2009). Wells are usually polluted as result of physical processes geo chemistry of the environment and anthropogenic activities, consequently consumers of such waters are exposed to series of health risks. Water contamination events often results from discharges from waste water treatment facilities, over flowing sanitary sewer system, waste materials find their ways from domestic and industrial sewage and also run off of animal fecal matters during heavy storm (Maynard *et al.,* 2005). Exposure to contaminated water through ingestion of infectious agents contained in drinking water is a significant mode of transmission of gastrointestinal tract infection (Umoh *et al.,* 2006).

This study investigated bacteriological quality of well water obtained from Dogon Dawa district in Birnin Gwari Kaduna State.
Due to the large consumption of well water which are usually untreated in some parts of Birnin Gwari led to high the prevalence of water related diseases like cholera, typhoid, dysentery, botulism, schistosomiasis and giardiasis (Ahmed *et al.,* 2005). This problem can be from several factors that can compromise the quality of water because there are several domestic and industrial sewages, and also improper disposal of municipal solid waste and near source of contamination in drains and areas occupies by grazing animals (Suthar *et al.,* 2009). Total coliform include coliform and environmental species that can serve as a parameter to provide basic information on water quality.

As result of high evaporation during the long dry season poses serious limitations on available water resources, the two large river systems which are Kaduna and Gurara run through the state and provide opportunities for good sources of water supply but many of the tributary streams dry up during the long dry season as mentioned earlier.
Nitrate and bacteria are both major contaminants resulting from human activity (Powell *et al.,* 1990) and serve as indicators of well water contamination largely due to surface water intrusion. Nitrate contamination is both of health and an environmental concern (Hubbard and Sheridan, 1989). Groundwater vulnerability and agricultural pollution may be indicated by nitrate pollution (Bruggeman *et al.,* 1995) of which concentrations in groundwater tend to remain the same over time (Glanville *et al.,* 1997). Surface water can be contaminated with cyst organisms, enteric viruses, and bacterial organisms including coliforms (Rice, 1989). If coliform bacteria are found in water from a well, it is generally indicated that surface water is entering the well, often through inadequate construction (Fedkiw *et al.,* 2000; Fawcett and Lym, 1992). Since surface water can contain contaminants like pathogens, the presence of coliform bacteria can indicate the possible presence of pathogens and other harmful pollutants (Corzatt, 1990; Whitsell and Hutchinson, 1973; Wikstrom, 1989). Potential contaminants must be kept from reaching groundwater (Wikstrom, 1989; IEN, 1992; USEPA, 1998). The prevention of contamination is best since the cleanup of groundwater is expensive and difficult (Poweel *et al.,* 1990). If contamination does occur, the only realistic solution may be to obtain a new water source or treat the water before use (Oweel *et al.,* 1990; Weigman and Kroehler, 1990; IEN, 1992). The only true standard for nitrate is the drinking water standard, established by the Safe Drinking Water Act, of 10 mg/L (Spalding *et al.,* 1993; Hubbard *et al.,* 1989). When nitrate levels exceed 10 mg/L, doctors recommend using bottled water (Fedkiw, 2000; Weigman *et al.,* 1990). Infants under three months are nitrate sensitive (Fedkiw, 2000) and are the primary reason for the nitrate standard since those under six months may suffer from methemoglobinemia if they ingest nitrate from drinking water (Spalding *et al.,* 1993). For 23 infants less than six months old a 10 mg/L, 10 day health advisory level is set while for adults the 10 mg/L level is the lifetime health advisory level (Fedkiw, 2000). This study investigated the bacteriological quality of well water obtained from Dogon Dawa district in Birnin Gwari Kaduna State.

MATERIALS AND METHODS

Test tubes, Test tube racks, Conical flask, Durham tubes, Beakers, Measuring cylinder, Petrish dish, Wire loop, Hand gloves, Masking tape, Cotton wool, Aluminum foil paper, Autoclave, incubator, Nutrient agar, Eosin Methylene Blue, Double and Single Lactose broth.

Study Area

Dogon Dawa district is located in Birnin Gwari Local Government Area, Kaduna state, Nigeria. Its geographical co-ordinates are located on the latitude 11° 2' 0'' North and longitude 7° 5' 0" East of the Greenwich Meridian with a population of over 20,000 people.

Sample Collection

Twenty water samples were collected from twenty different wells in four different locations that make up of Dogon Dawa district. One thousand milliliters (1000ml) of sterile bottles were used in collecting the water samples and were capped carefully. Each bottle was assigned a code for easy identification and were placed in ice box and were transported to Kaduna State Water Board Central Laboratory for analysis.

All the water samples collected were subjected to some physicochemical analysis such as temperature, pH and dissolved oxygen (DO) at point of sampling while turbidity was determined at the laboratory.

Media preparation

The Nutrient agar, Eosin Methylene Blue, Double and Single Lactose broth were prepared according to manufacturer's instructions and were sterilized using autoclave 121^0C for 15 minutes.

Total Bacterial Count

The total bacteria in the water samples were estimated and each water sample was serially diluted with the dilution factor of 100 in the ratio of 1:100 and the aliquot was inoculated into 19ml of nutrient agar, properly mixed and poured into a sterile Petri dish.

Total Coliform Count

The multiple tube fermentation technique as described by Collins and Lynne and Mackie and McCartney was used. Varying

amounts of water samples were added to double and single strength Lactose broth in sterile tubes as follows. 10 ml of water sample was transferred into 5 bottles containing 5 ml double strength medium each, subsequently 1 ml of water sample was transferred into 5 bottles containing 5 ml single strength medium. Lastly 0.1 ml of the water sample was transferred into 5 bottles containing 5 ml single strength medium. The bottles were incubated at 37˚C for 24 hours after which they were all examined for production of acid and gas. Sterile distilled water was used as a negative control for each test batch. Total coliform count was obtained by the most probable number (MPN) of coliform per 100 ml of water sample by making reference to the most probable number table after combination of various positive and negative results and the positive tubes were all confirmed by using a Lactose broth which was also indicated by production of gas.

Fecal Coliform Count

Fecal coliform count was determined using Eosin Methylene Blue medium employing, the pour plate technique. On Eosin Methylene Blue (EMB) agar, *E. coli* strains appeared as greenish with metallic sheen colonies and this was further confirmed by the ability of the organism to ferment lactose at 44.5^0 C while *Aerobacter aerogenes* pinkish mucous colonies

RESULTS AND DISSCUSSION

Contamination of all wells could be due to improper construction of wells, refuse dumping sites and various human activities around the wells. Water generally from these wells is not safe for drinking except some form of treatment is carried out. Table 1 showed the physicochemical parameters of the water samples examined, pH had values ranging from 6.25 – 6.55 which fell within the standard range of 6.5 – 8.5. The table also shows a high level of turbidity with values raging between 8.00 – 9.20NTU, falling short of the standard-1.0-5.0NTU. The results of bacteriological analysis presented in Table 2 showed bacteriological counts of well water samples in the study area, all the wells were grossly contaminated with bacteria colonies above the WHO prescribed limit of less than 0 Bacteria Colony count/100 mL for untreated water (Wagner and Lanoix, 1958; WHO, 1971).

Aerobacter aerogenes, Escherichia coli, and *Pseudomonas aeruginosa were found in the well water studied.* Bacterial counts in Dogon dawa had 26.20 X 10^2cfu/100ml. On the whole, the bacteria counts of samples exceeded the WHO recommended drinking water quality. These figures represent the degree of bacterial contamination of well water in the four areas in Dogon Dawa district alongside total coliform and fecal coliform counts.

Table 1: Some Physicochemical Parameters of water samples from Dogon Dawa district

Community	Number of samples	Parameters			
		pH	Turbidity (NTU)	Temperature (^{0}C)	Dissolved oxygen(mg/L)
Dogon Dawa	5	6.25	9.00	28.26	1.76
Wusan	5	6.44	8.00	28.86	2.96
Lacha	5	6.34	9.20	28.60	1.60
Rafin Gora	5	6.55	8.00	28.74	1.52
range		6.5-8.5	1.0-5.0	25-45	1.0-10

Table 2: Bacteriological Counts of Well Water Samples from Dogon Dawa District

Community	Number of Samples	Bacteriological counts		
		General bacterial counts (x10^2CFU/ml)	Total coliform counts (MPN/100ml)	Faecal coliform counts
Dogon Dawa	5	26.20	168.00	83.60
Wusan	5	25.40	112.80	57.80
Lacha	5	19.00	114.60	33.40
Rafin Gora	5	21.60	312.00	109.80

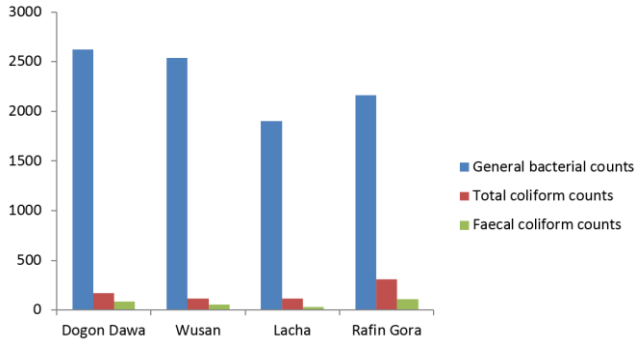

Figure 1.The Degree of bacterial contamination of well water in the four major areas of Dogon Dawa District

DISCUSSION

Several studies have revealed that ground water contamination by fecal pathogens generally occur through surface run-off, leaching and direct fecal deposition into water bodies via several livestock production activities like confined animal feedlot, free range system and land spreading of manure (Ahmed *et al*., 2005).

Coliform bacteria have been used as indicators of the bacteriological quality of ground water (Ahmed *et al.,* 2005). The presence of coliform is an index of bacteriological quality of water especially the isolation of fecal coliform such as *Escherichia coli* (Tuthil *et al.,* 1998) which is of fecal origin. Detection of *E. coli* indicates recent pollution because the organism cannot survive for long period outside of their natural habitat which is the intestinal tract of animals. Therefore, World Health Organisation (WHO, 1997) recommended that both treated and untreated water samples should have zero *E. coli*.

An acceptable pH for drinking water is between 6.5-8.5, recommended by WHO as a guideline value, 75% of the water samples studied met this requirement and also in the absence of a distribution system acceptable range may be broader which will also trigger bacterial contamination In drinking water the higher the turbidity level the higher the risk that people may develop gastrointestinal diseases. Turbidity level should not be more than 5 Nephelometric Turbidity Unit (NTU) and ideally it should be less than 1NTU. All the water samples examined in Dogon dawa district exceeded the recommended level, none fell within the range 1.0-5.0NTU. High turbidity serve as a sign of highly pronounced bacterial activities and it abundance in water (WHO, 1997).

The high turbidity is probably due to increase in concentration of materials released into the wells through human activities as also

observed by Adekunle, (2009). Decreased Dissolved Oxygen (DO) level may also be an indication of too many bacteria and lead to high Biological Oxygen Demand (BOD), and this is evident in all the samples, especially in Rafin Gora which had dissolved oxygen value of 1.52mg/l. The growth and survival of bacteria especially fecal indicators are affected by environmental factors such as temperature which ranges from 25^0C-45^0C. The average temperature value of well water at the point of sampling in the four major areas in Dogon Dawa district was 28.6^0C.

The spread of diseases through fecal contamination of water sources particularly in developing and under developed countries are a common phenomenon that has been well reported (WHO, 2004) In all the 20 well water samples collected in Dogon dawa district, there were very high bacterial counts which exceeded recommended level of zero coliform/ml, but according to National Ground Water Association (NGWA) 10 coliform/100ml can be accepted as long as the value do not prevail for long period. Base on this, some of the samples can be considered safe for drinking and other activities that involve the use of water. The high coliform count observed was an indicative of the likely presence of other pathogenic organisms in the water samples analyzed and also the hypotheses can be declared accepted. Based on the observations and oral questioning of the resident of the study area, majority of the wells were constructed not far away from the latrines which is in parallel with the WHO recommendations (WHO, 2004).

Conclusion

This study has shown that there is a high possibility of bacterial contaminations of well water in Dogon dawa district. To reduce the high incidence of well water contamination, it is advocated that wells dug must be deep, far away from latrines and covered adequately. Also good and proper personal and environmental sanitary practices must be maintained in and around the wells. Boiling well water before it is being used for drinking purposes and also the use of filters will also go a long way in averting the danger of waterborne diseases

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