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Research Article

Microbial Assessment of Water Quality from Hand-Dug Wells in Makurdi Nigeria

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Abstract

Hand –dug wells are a major source of water for rural dwellers in Nigeria and such, the assessment of water quality from these sources is expedient. This paper examines the microbial contamination from hand-dug wells in Makurdi. A total of eight wells were selected for sampling in the study. Two wells each fromKighir, Adeke, Tionsha and Tyodura all in Makurdi metropolis. To ascertain the microbiological characteristics of the wells under study, both presumptive and differential tests were conducted. The presumptive tests gave the Most Probable Numbers (MPN) per 100 ml of samples. And the differential tests indicated the actual microorganisms present in the individual wells. Results showed that the total coliforms per 100 ml of sample from the various sampling points ranged between 43 to 425 MPN, with Kighir A registering the lowest MPN (of 43 coliforms per 100ml) and AdekeA registering the highest value (of 425 MPN). Overall, findings revealed that hand dug wells yield water of very poor quality microbiologically. All of the wells sampled failed to meet the zero coliform per 100 ml set by WHO. The results from this study clearly demonstrate that the water qualities obtained from hand dug wells are unfit forhuman consumption.

Keywords: Microbial assessment, Water quality, Hand dug, Well, Makurdi.

Introduction

Water is a resource that is both invaluable and vital to the existence of all living organisms. This valued resource is increasingly being threatened as human population grows and the demand for water of high quality for domestic purposes and economic activities increases. Water value is linked to the provision and quality of ecosystems service. According to [1] potable water is precious, we cannot live without it and human activities have profound impact on the quality and quantity of water available. Domestic water is used for drinking, cooking, bathing and cleaning, however, access to safe drinking water and sanitation is critical in terms of health. For instance, unsafe drinking water contributed to numerous health problems in developing countries such as the one billion or more incidents of diarrhea that occur annually [2]. Access to adequate safe drinking water is of prime importance to many governmental and international

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organizations since unbeatably it is the core component of primary health care and a basic component of human development as well as a precondition for man's success to deal with hunger, poverty and death [3]. While water may appear to be clear and pure, with no taste or odour, it may contain elements that can have undesirable effects on human health. Water is classified under two main categories based on its location, they are surface and ground water [4]. The quality of any body of surface or ground water is a function of either or both natural influences and human activity. Contrary to widely held theoretical view of groundwater being the "safest" water, wells are found to be polluted in terms of temperature, mineral contents, particles solute, organic matter and bacterial concentration. The quality of groundwater is determined by testing various parameters of interest on which results are compared with the standard qualities required for water intended for human consumption and use [4]. In Makurdi, the problem of acute water supply has resulted in widespread use of hand dug wells among which some are located in unhygienic areas. According to researchers in Japan [5], it has been shown that bacteria contaminate well water depending on location. Thus, it is suspected that water from wells in these areas could be contaminated according to their proximity to sources of pollutants. This study intends to use hydro chemical analysis of the well water to assess the impact of dumpsite on the quality of the hand dug wells in Makurdi metropolis.

Materials and Methods

Collection of sample.

A total of eight wells were selected for sampling in the study. Two wells each from Kighir, Adeke, Tionsha and Tyodura. Monthly water samples were collected from all sites for four months from June to September, 2014, and December, 2014. Sampling covered both the major wet/rainy and minor rainy seasons. Triplicate water samples were collected in sterile 500 ml Jeri cans from each of the wells from the four locations using asterile stainless steel cup with a 30 ft rope. Samples were kept in a cool box (8 – 10^0C) during transportation to the laboratory and analyzed within 6hours.

Sample analysis. Samples were analyzed in the Benue State Water Board central laboratory immediately after collection.

Determination of Total Coliform Bacteria

10ml of MaCconkey broth was filled in 15 bottles using sterile syringe. The inerted Durham tubes were inserted in each of the bottles and the autoclaved for 15 minutes at 121^0C. The bottles were then remove and placed in a sterile environment. 10ml of the water sample was inoculated in the second five bottles, 1ml of the water was inoculated in the secondfiver bottle while 0.1ml of water was inoculated into the last five bottles. The bottles were kept into an incubator and observed at the end of 24 and 48 hours for presumptive and confirmatory test respectively. The number of positive bottles indicated by colour change and gas formation in each of the rolls were recorded and compared with the bacteria load in the MaCcrady

table. This procedure was repeated for all the water samples [6].

Most Probable Number (MPN)

The isolation and enumeration of total coliform bacteria was carried out using the *Most Probable Number* (MPN) method. The MPN method is the most commonlyused method in determining the approximate number of coliforms in a water sample [7]. The presence or absence of total coliform bacteria was observed as characteristics visible change such as gas production after a 48 hour incubation period. The result was thencompared against an MPN table.

Estimation Methods

The microbiological characteristics of the understudied wells were estimated using both presumptive and differential tests. These tests are a means to ascertain the bacteria contents as well as their associated health risks.

Presumptive tests

To determine the MPN, three sets of five tubes containing the same growth media (MacConkey broth) and Durban tubes were prepared. Each set received a measured amount of water sample such as water and food. What was important was that, the second set received 100-fold less. Thus, each set was inoculated with an amount 10-fold less than the previous set and incubated for 48 hours. Tubes showing colour change from purple to yellow and gas collected in the Durban tubes after 24 hours were identified as positive. Counts per 100ml were calculated from Most Probable Number Tables.

Differential tests

To isolate the organismsdetected in the presumptive tests, differential testswere carried out. Fermentation of lactose afterincubation at 44^0Cshowing the presence of any amount of gas in the inverted inner tube after 24hours indicated a positive reaction. Absence of gas production in 24 hours incubation even though growth of acid production is present was regarded asa negative reaction.

Indole test after incubation of peptone water culture at 44^0Cfor 24 hours 0.2-0.3 ml of Kovacs reagent wasadded and the tube gently shaken. When the test was positive, a deep red colour appeared in the upperlayer almost immediately.

Data analysis

Result were analyzed using Analysis of Variance (ANOVA) with the aid of Microsoft excel 2007 version.

Results and Discussion

Table 1. Total Coliforms per 100ml of sample from the various sampling locations in Makurdi.

Location	Total coliform per 100ml/MPN
Kighir A	43
Kighir B	45
Adeke A	425
Adeke B	342
Tionsha A	55
Tionsha B	75
Tyondura A	47
Tyondura B	71

Table2. Type of organisms normally found in Differential test sampling

Location		
Kighir A	E-Coli type 1	Sewage
Kighir B	Intermediate type 1	Soil
Adeke A	Intermediate type 1	Soil
Adeke B	Intermediate type 1	Soil
Tionsha A	Intermediate type 1	Soil
Tionsha B	Intermediate type 1	Soil
Tyondura A	Intermediate type 1	Soil
Tyondura B	Intermediate type 1	Soil

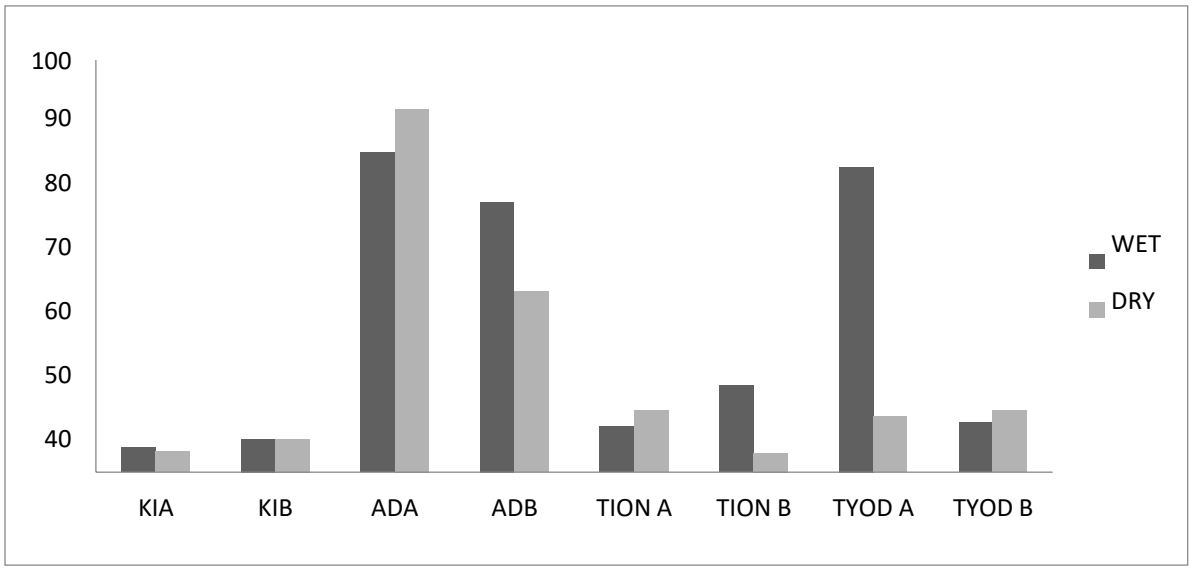

Figure1. Mean Value of E.Coli in hand-dug wells

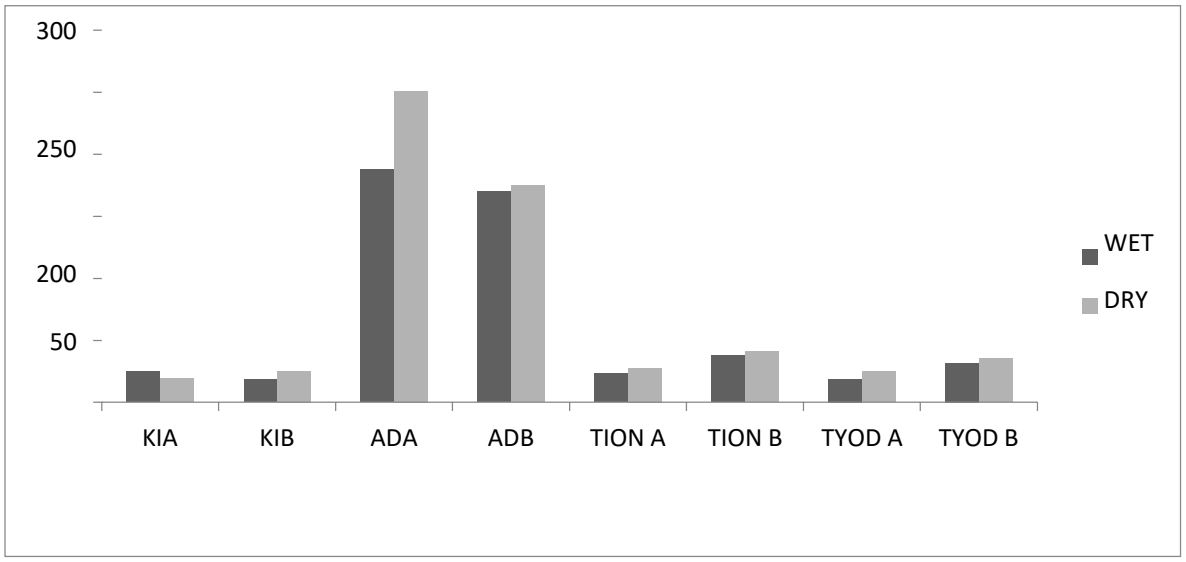

Figure 2. Mean Value of Coliform in hand-dug wells.

In Figure 1, Adeke A recorded high E coli level in dry season and moderate in wet season while Tyondura A recorded high E Coli level in wet season. Also, as can be seen from Figure 2, Adeke A recorded high Coliform level in dry season. Adeke B recorded almost the same level in both season while the rest locations recorded below average. Table 1 shows that the total coliform per 100 ml sample from the various sampling points ranged between 43 to 425 MPN, with Kihir A registering the lowest MPN (of 43 coliforms per 100ml)

and Adeke A registering the highest value of (425 MPN). The results showed that hand dug wells yield water of bery poor quality microbiologically. All of the sampled wells failed to meet the zero coliform per 100 mlset by [8]. Water quality was inferior when it rained as compared to the dry season.

Conclusion

The results from this study clearly demonstrate that the water qualities obtained from hand dug wells are unfit for human consumption. Certain wells have microbiological contamination with the potential for fatal consequences if consumed untreated by humans.To this end, there is an urgent need to develop some form of local treatment to purify hand dug wellwater for people in the Naka road (Kighir, Adeke, Tionsha and Tyodura) and other similar places inMakurdi town. This will help go a long way to ensurethat the Millennium Development Goals (MDGs) are achieved by 2020.

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