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Bacteriological evaluation of well water in Zaria Metroplis

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ABSTRACT

This study examined the bacteriological quality of hand-dug well water from five selected areas in Zaria, Nigeria considering the popularity of hand-dug well water as a source of domestic water supply in most homes across the metropolis. The total heterotrophic bacterial (THB) counts of well water samples obtained during the dry season ranged from 1.4 × 10^3 to 2.7 × 10^4 CFU per ml while the THB of well water samples obtained during the rainy season ranged from 3.1 × 10^3 to 1.1 × 10^5 CFU per ml. Coliform count ranged from 350 to 2400 MPN per 100 ml for well water samples obtained during both the wet and dry seasons. The result of the study revealed that water from all the wells under study did not meet minimum permissible THB standard (100CFU/ml) and total coliform standards (10/100 ml) set aside by the world health organization (WHO) and therefore not safe for drinking or for other domestic purposes. Extraction and use of such water without some forms of physical and chemical treatment poses serious risk to public health. It was also discovered that the level of contamination was higher in rainy season when compared to dry season, a wide spatial variation was also observed.

Keywords: Bacteriological quality, well water and permissible standard, contamination, public health.

INTRODUCTION

In most developing countries (including Nigeria), access to potable water has become a mirage and exploitation of groundwater through the construction of hand-dug wells is a major source of drinking water for majority of the populace [1]. Despite the considerable investments of Nigerian government in water supply programme, over 52% of its population has no access to potable water [2]. Water covers 70.9% of the earth's surface and is vital for all known forms of life [3]. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation.Wells are categorized based on the nature of construction: open dug wells are generally considered the worst type of groundwater sources in terms of faecal contamination and bacteriological analysis [4]. Dug wells with windlass or hand pumped or mechanically pumped well are generally regarded to be less prone to contamination [5]. [6] assert that open or poorly covered well heads pose the commonest risk to well-water quality; the possibility of the water being contaminated is further increased by the use of inappropriate water-lifting devices by consumers. The commonest physical defects leading to faecal contamination of dug wells are associated with damage to, or lack of, a concrete plinth, and with breaks in the parapet wall and in the drainage channel [6]. The most serious source of pollution of well water is contamination by human waste from latrines and septic tanks resulting in increased levels of microorganisms, including pathogens [5]. The public health significance of water quality cannot be over emphasized. Many infectious diseases are transmitted by water through the fecal-oral route, also the world health organization WHO, [5] reported that diseases contacted through drinking water kill about 5 million children annually and make 1/6th of the world population sick. thus this work is aim at investigating well

water use for drinking and other domestic uses in Zaria metropolis in other to ascertain if the water is safe for drinking or not.

MATERIALS AND METHODS

Sample Collection

Water samples were collected from five randomly sampled hand-dug well from each of the five designated areas (Wusasa, Sabon gari, Zaria city, Samaru and Kwangila) across Zaria metropolis from June 2011 to March, 2013. The water samples (1 L) were aseptically collected into a sterile sample bottle, labeled and transported to the laboratory in ice packed coolers for microbiological analysis.

Microbiological Analysis

The Most Probable Number- multiple tube fermentation technique was used for Coliform enumeration. In the presumptive test for Coliforms, five 10-mL, five 1-mL, and five 0.1-mL volumes of the appropriate dilution of the water sample were inoculated in fifteen fermentation test tubes with an inverted Durham tubes vial in lactose broth. The inoculated test tubes were incubated for 48 h at 37°C, and those presenting gas and acid were confirmed using eosin methylene blue agar (EMB) at 37°C for total colifom. A heterotrophic plate count (HPC) was also performed using the spread plate method in nutrient agar at 37°C for 24 hrs. All procedure was carried out under strict aseptically procedure in other to avoid contamination [7].

RESULTS AND DISCUSSION

Table 1: Total bacteria count of water samples in various parts of Zaria for the months of March to November

Month	Location	THB (CFU/ml)
March	Zaria city	2.7×10^4
	Kwangila	1.0×10^4
	Sabo	3.5×10^3
	Wusasa	4.5×10^5
	Samaru	7.0×10^3
July	Zaria city	1.1×10^5
	Kwangila	9.9×10^3
	Sabo	4.9×10^4
	Wusasa	3.1×10^3
	Samaru	7.5×10^3
September	Zaria city	1.1×10^5
	Kwangila	3.1×10^3
	Sabo	6.3×10^4
	Wusasa	3.9×10^3
	Samaru	4.0×10^3
November	Zaria city	5.0×10^4
	Kwangila	1.4×10^3
	Sabo	9.3×10^4
	Wusasa	4.5×10^4
	Samaru	1.9×10^3

Total heterotrophic bacteria count gives an indication of the level of the general bacteria population in a system and is considered as a good general indicator of overall water quality. Heterotrophic microorganisms include both members of the natural microbial flora of water environments and organisms present in a range of pollution sources. The total heterotrophic bacterial (THB) counts of well water samples obtained during the dry season (November and March) in Zaria metropolis ranged from 1.4×10^3 to 2.7×10^4 CFU per ml while the THB of well water samples obtained during the wet season (April and September) ranged from 3.1×10^3 to 1.1×10^5 CFU per ml as shown on table 1.

The WHO standard for heterotrophic bacteria in potable water supplies states that the total heterotrophic bacterial count should not be more than 100 CFU/ml [8]. Based on the WHO standards, the well water samples that were obtained in all the five parts of Zaria metropolis during the dry and wet seasons are unacceptable for human consumption because of their high bacterial loads.

The cultivation and enumeration of coliform indicator bacteria remains the primary method for testing the microbiological quality of fresh waters for drinking, recreation, fishing, and industrial uses. Coliforms which are indicators of pollutions in drinking water ranged from 350 to 2400 MPN per 100 ml for well water samples obtained during both the wet and dry seasons (Table 2).

Table 2: Most probable number of coliforms in water samples obtained from various parts of Zaria for the months of March to November

Month	Location	MPN index/100ml
March	Zaria city	2400
	Kwangila	2400
	Sabo	2400
	Wusasa	1600
	Samaru	2400
July	Zaria city	1600
	Kwangila	34
	Sabo	2400
	Wusasa	350
	Samaru	2400
September	Zaria city	1600
	Kwangila	350
	Sabo	2400
	Wusasa	540
	Samaru	920
November	Zaria city	70
	Kwangila	1600
	Sabo	1600
	Wusasa	1600
	Samaru	240

CONCLUSION

According to US EPA standards, water samples in which coliforms are detected should be considered unacceptable for drinking as they are regarded as the principal indicators of water pollution. The WHO standards for total coliforms are 10/100 ml [9] and WHO, [8]. According to one way analysis of variance conducted on the results, there was no significant difference on the THB, and total coliforms from all the study areas at $P > 0.05$. The high count of these bacteria in the water sources could be due to any of the following: improper disposal of sewage and wastewater from domestic activities, discharges from septic tanks and latrines close to some of the wells and in-appropriate siting of wells very close to dumpsites. This is in agreement with the work of Nwachukwu and Otokunefor [10] which also stated a correlation between high bacterial load in borehole water supplies and discharges from septic tanks and waste materials from a nearby dumpsite.

The general THB obtained for water samples during the wet season is higher than that of water samples obtained during the dry season while the MPN of coliforms for water samples obtained during the wet season is the same with the MPN of coliforms for water samples obtained during the dry season. Several researchers have reported seasonal variations in water quality. Works in northwest England [11], Nigeria [12], Gambia [13] and Kenya [14] have all shown higher microbial counts in water sources during the wet season or after periods of rainfall compared to the dry season. This may be due to increased run-off from faecally polluted dry soils [12]. Zaria city had the highest THB of 1.1×10^5CFU/ml for well water samples obtained during the wet season and 5.0×10^4 CFU/ml during the dry season this could be attributed to the high population density of the area compared to other areas under study.

Recommendation

Public awareness on the need to construct good wells above ground levels with covers to protect the well from runoff during raining season and dirt from various external sources and also wells should be constructed meters away from latrines and treatment of water locally by boiling before use should also be encourage as this will go a long way in reducing or eliminating the microbial load in the water.

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