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Bacteriological Assessment of Drinking Water in North Central District, Jigawa State Nigeria

Naima Suleiman Lawan* and Abdulhadi Yakubu

Department of Science Laboratory Technology, Jigawa State Polytechnic Dutse, PMB 7040, Jigawa State Nigeria

**Corresponding author*

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A B S T R A C T

Water is no doubt one of the most important factors in the development of a modern society. The availability of portable water is directly related to the control or elimination of diseases. In this research, fifty water samples were collected from fifteen areas of Jigawa state Nigeria and analyzed for the presence of coliform bacteria as an indicator of fecal contamination. Based on the result, five water samples contain coliform higher than the acceptable limit set aside by World Health Organization (WHO). Three water samples were also found to contain *E. coli* which is an indicator of fecal contamination. Their presence in water may be due to the proximity of water source with pit latrine. There is need for monitoring of activities in the processing of pipe borne water and other water sources in view of raising water quality and standards.

Introduction

Water is fundamental to life for both plant and animal for the performing of their routine activities like metabolism, food absorption by plant roots, photosynthesis and other uses like pharmaceutical companies, textile industries and other many industries. Water also served as a medium for transmitting diseases like typhoid and cholera by bacteria and other microorganisms. Large amount of money, time and energy are spent in provision of good drinking water (i.e. portable water). The need forsake portable water necessities is the bacteriological assessment of water in urban areas (Ochei, 2008). In safeguarding public water supplies, health authorities and water engineers rely on information obtained from the results of frequent bacteriological quality standard for most drinking water in Nigeria. This drinking water must be free from fecal indicator organisms such as *Escherichia coli*, *Salmonella species* and other pathogenic microorganisms. However, the quality of drinking water is assessed based almost entirely on fecal coliform count. Water is no

doubt one of the most important factors in the development of a modern society. The availability of portable water (water free of pathogens and deterioration chemicals) is directly related to the control or elimination of diseases (George, 1985). Drinking water in most communities is obtained from surface source of river, stream and lakes. Such natural water supplies particularly river and stream are likely to be polluted with domestic and industrial waters, i.e. used water of community. Municipal water purification systems have been very effective in protecting the inhabitants against polluted water (WHO, 2002). In order to control the portability of safe drinking water, this research was conducted to determine quality of drinking water based on the presence of coliform bacteria as an indicator of fecal contamination.

Materials and Methods

Sample size/sample collection

Fifty (50) tap water samples were collected from fifteen selected areas of Jigawa central senatorial district. These samples were aseptically transported immediately to the laboratory for microbiological analysis.

Sample preparation and serial dilution

In the presumptive test, a series of nine (9) tubes of lactose broth are inoculated with measured amount of water to observe any lactose fermenting bacteria. Serial dilution was conducted according to standard procedure (Benson, 1998).

Detection of coliform using (MPN)

Serially diluted samples in a test tubes containing lactose broth with inverted durham tubes were incubated at 37^{o}C for 24 to 48hrs. Following incubation, tubes that produced gas were counted and the number were compared with the most probable number (MPN) table to get mpn/ml (Atlas, 1997).

Estimation of aerobic mesophilic bacterial count

One milliliter (1ml) from each dilution of the sample were pipetted into each of the appropriately marked duplicate Petri plates. This was followed by pouring aseptically onto a molten nutrient agar. The prepared petri plates were incubated at 37^{o}C for 24hrs. After incubation, plates with colonies were counted and the numbers obtained were multiplied by the inverse of the dilution factor to get the number of colony forming unit (cfu/ml).

Detection of *Escherichia coli*

A loopful of inoculum from gas positive tubes were streaked on to plates of Levine's Eosine Methylene Blue (L-EMB) and the plates were incubated at 37^{o}C for 24hrs. Following incubation, bluish black colonies with green metallic sheen are suspected to be *Escherichia coli* (FAO, 1993).

Gram staining

A smear of the suspected microorganisms were taken on a glass slide from positive petri dish and the gram staining produce were followed as per standard protocol. The slides were examined under oil immersion microscope (Benson, 1998).

Biochemical characterization

Indole test, Methyl red, Voges-proskauer and citrate utilization test (IMViC) were conducted to confirm the presence of pathogenic microorganism capable of causing water borne disease based on the presence of color change.

Results and Discussion

The result in shows the colony count (cfu/ml), mesophilic bacterial count and appearance of the suspected sample on Eosin Ethylene Blue (EMB) agar (Table 1). The frequency distribution of the colony count in these samples tested showed that the number of colony count found in all the selected areas, Miga town had the highest colony count of 1.90x107cfu/ml while Dutse municipal had the lowest colony count of $1.4x10^3$ cfu/ml. The result obtained from this research work showed that the colony count above World Health Organization (WHO) recommendation limit of $1.5x10^5$cfu/ml were found samples isolated from Miga ($1.9x10^7$cfu/ml), Aujara ($1.8x10^6$cfu/ml), Balago ($1.7x10^6$cfu/ml) and Kiyawa ($1.6x10^6$cfu/ml). The remaining water samples of selected areas were to be below acceptable limits with lowest colony count found in Dutse ($1.2x10^3$cfu/ml). The mesophilic bacterial count (MPN/100ml) of the entire sample tested from fifteen (15) selected areas showed that, Kudai town had the highest of 132MPN/100ml while Madobi town had the lowest of 10MPN/100ml. According to Lievert (2005), coliform count less than 10, between 100 and 300 and greater than 300 is considered as satisfactory, unsatisfactory and dubious respectively.

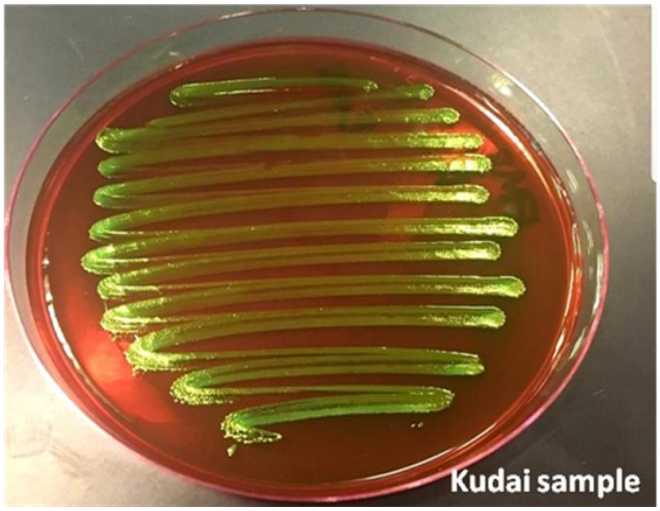
Table.1 Colony count, mesophilic bacterial count and plate appearance of selected town

Site	Mean cfu/ml	MPN/100ml	Appearance on EMB agar
Dutse	$1.2x10^3$	12	NG
Madobi	$1.2x10^4$	10	NG
Kudai	$1.2x10^5$	132	Green metallic sheen
Birnin Kudu	$1.4x10^5$	20	NG
Sindimina	$1.3x10^5$	25	NG
Yalwan Damai	$1.5x10^4$	42	NG
Gwaram Sabuwa	$1.6x10^5$	36	NG
Gwaram Tsohuwa	$1.6x10^3$	56	NG
Kiyawa	$1.6x10^6$	23	NG
Balago	$1.7x10^6$	53	NG
Buji	$2.0x10^3$	12	NG
Gantsa	$2.2x10^4$	20	NG
Miga	$1.9x10^7$	86	Green metallic sheen
Jahun	$1.1x10^5$	29	NG
Aujara	$1.8x10^6$	120	Green metallic sheen

Table.2 Biochemical test confirming the presence of *E. coli* in some water samples

Sample area	Gram staining	Indole	Methyl Red	Voges Proskauer	Citrate
Kudai	-	+	+	-	-
Miga	-	+	+	-	-
Aujara	-	+	+	-	-

Figure.1 Appearance of green metallic sheen on Kudai water sample



Out of fifteen (15) different samples of tap water examined for coliform, only three (20%) sample were found to contain *Escherichia coli* following biochemical test. The biochemical tests (IMViC) (Fig. 1) conducted on the three suspected samples of Kudai, Miga and Aujara confirmed the presence of *E. coli* (Table 2). The presence of *E. coli* can be attributed to poor quality control of distribution system, inadequate supply of water, bad and improper maintenance of the sources of supply. The detection of *E. coli* in this water sample also correlated with finding of American Published Health Association (APHA, 1985) that *E.coli* species are isolated organisms in water samples that makes it as indicator of fecal contamination. Knowing that, water fit for consumption should have *E. coli* count per 100ml should never exceeded five for chlorinated water, we can then say that, all the tap water tested from five different areas designated sites are fit for consumption because it is within limit of WHO (2011) standard.

Water has long been attributed as a means of transmission of some specific diseases agent among many include typhoid fever, paratyphoid fever, cholera, bacterial dysentery, etc. (Cheesebrought, 1984). However, no source of water is 100% free of contamination by microorganisms and other deleterious chemicals, particularly bacteria despite the effective treatment procedures employed (Cheesebrought, 1984).

In conclusion, the contamination may be due to poor maintenance and repair of leakage pipes from the main sources to the final consumers. Test for detection and enumeration of the indicator organisms rather

than that of pathogens as a principle indicator of suitability and portability of water was used as criteria of the degree of pollution quality. From the result obtained, the most probable number technique employed for the investigation of the sample has established its reliability and effectiveness in the detection of Coliform more than pour plate technique. However, the significance of the test and interpretation of result are well authenticated and was used as a basic for standard of bacteriological quality. To this end it should noted that only three samples out of total sample tested from Kudai, Miga and Aujara are more contaminated due to the presence of *E. coli*. Although coliform bacteria were found in all samples tested, the occurrence of less than 20/100ml *E. coli* from all tested water make them within the standard quality limit set by WHO and therefore, found acceptable by human consumption.

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