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Bacteriological Identification And Characterization Of Tap Water In Umar Suleiman College Of Eduaction Gashua Campus, Yobe State

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ABSTRACT

Water is very important in life for proper function of the human body. The increasing demand for domestic water has led to the indiscriminate use of underground water, such as wells and tap water as a main source of water without regard to portability for human and animal consumption. Bacteria were among the first life form to appear on earth, and are present in most of its habitats such as soil and water. The study identifies and characterized bacteria from the tap water used by the community of Umar Suleiman College of education Gashua. The water samples were collected from various sources in the case study area using swabs stick and in sterile containers to the laboratory for bacteriological analysis. The water samples collected is subjected for a serial dilution technique, microscopic, culture and sensitivity (MCS) and biochemical identification test. The coliform bacteria were analyzed. The bacteriological results of four sampled points have showed presence of E.coli, Salmonella, S. aureus and klebsiella which has clearly indicated the microbiological contamination of the samples. The results revealed that, E. coli is presence in almost the whole sample (41.4%) followed by salmonella (27.6%), S. aureus (17.2%) and klebsiella (13.8%). Furthermore these results have clearly elaborated the unsuitability of the water for human consumption.

Keywords: Bacteriological, E. coli, Salmonella, S.aureus, Contamination, Sensitivity, Microscopic, portability.

INTRODUCTION

In many developed countries the availability of portable water becomes a problem when supply is interrupted frequently and shortages become the order of the day (Popoola *et al.*, 2007). Portable and easily accessible water is essential for good health. Unfortunately, approximately 667 million people worldwide live without access to portable municipal water. Roughly half of these people dwell in sub-Saharan Africa (WHO, 2013). Deficient water supply affects population, health directly and indirectly either causing diarrhoea-related diseases or resulting in diseases linked to poor personal hygiene (Hunter *et al.*, 2010). Furthermore; in developing countries 17% of all deaths of children below 5 years of age are due to diarrhoea (usually following ingestion, of poor quality drinking water) (Pruss *et al.*, 2016).

Water is very important in life for proper function of the human body; its importance is underlined by the assestation that safe drinking water is the bright light of all human kind as much as both right as clean air (Lenton *et al.*, 2015). Water of physiology of human existence depends very much on its availability (Lamikanra, 2011). According to Nikoladze and Alkatal (2016) before water can be described as municipal it has to comply with certain physical chemical and microbiological standards which is designed to ensure that water is portable and safe for a purpose (Tabutt, 2012) municipal portable water is

that which is free from diseases causing microorganism and chemical substance. Water from most sources is unfit for immediate consumption without some of treatment (Roymend, 2009). Water is an essential requirement for the maintenance of a play a role important in the lives of plants and animals reported that 70% of the earth surface is made up of water and man uses water for domestic and industrial, and agricultural purpose (Horan, 2003).

The increasing demand for domestic water have led to the indiscriminate use of underground water, such as wells as a main sources of water without regard to portability for human and animal consumption. As a result of majority of some selected area in Dutse metropolis of these water through pipe borne water Majority of these water sources are particularly some is poorly serve without regard portability in terms of toxic chemical element present. Greater percentage of boreholes are larger constructed with materials such as iron rods. These material is long term introduces toxic chemical due to corrosion in to the water source. Contamination of some sachet water (pure water) in terms of microbes is much more evident due to human activities while chemical contamination of the soil type. Microbial contaminations of undergo water occur when septic tanks and offal's holes are poorly constructed and communities using such tanks are vulnerable to contamination (*New Zealand, 2010*).

Underground water is a good quality water in terms of microbes because it contain no coli form as a result of natural filtration but pollution occur due to indiscriminate dumping of refuse, poor sewage system and activities of man and animal, the underground soil. (*Wilcox, 2010*) explained that water being universal solvent dissolves many organic and inorganic substances that finally sink into the aquifer.

However, biological pollutant associated with drinking water includes bacteria, protozoa, virus (*New Zealand 2010*). When intestine discharge have contaminated, the underground water, a large number of coli form bacteria are certain to be present (UNEP-WHO, 2011).

This consist not only the harmless but some pathogenic organic such as fibro cholera a causative agent for cholera, salmonella a causative agent for enteric fever, shigellosis also known as bacillary dysentery is cause by gurus shield and enchiridia coli, a causative agent of urinary tract infection of gall bladder, appendicitis and so forth water common disease is common is villages where their drinking water is source is not subjected to conventional treatment. Bacteria is a type of biological cell, that constitute a large domain of prokaryotic micro-organisms. Typically few micro meters in length, bacteria have a number of shapes, ranging from spheres to rods and spirals. Bacteria were among the first life form to appear on earth, and are present in most of its habitats. Bacteria inhabit soil, water, acidic hot springs, radioactive, water (Fredrickson et al, 2004) and the damp partials of the earth crust. Bacteria also live in symbiotic and parasitic relationships with plants and animals. Most bacteria have not been characterized and only about half of the bacteria phyla have species that can grow in the laboratory (Rappe and Giovani, 2003). The study of bacteria is known as bacteriology, a branch of microbiology. There are typically 40 million bacterial cells in a gram of soil and a million bacterial cells in a milliliter of fresh water. There are approximately 5×10^{30} bacteria on earth (Forbes, 2008).

Underground water is a good quality water in terms of microbes because it contains no conform as a result of natural filtration but pollution occur due to indiscriminate dumping of refuse, poor sewage system and activities of man and animal, the underground soil. (*Wilcox, 2010*) explained that water being universal solvent dissolves many organic and inorganic substances that finally sink into the aquifer. The common water contaminants include organic and micro organic which at high-level possess health effect inorganic substances such as ion and other heavy metals originate from erosion of natural deposit, glass and electronic firms and so forth other inorganic substances include non-biodegradable substances such as insecticide, packing material and detergent exposure to this substances above the limit concentration value can cause health effect such as cancer of the liver, lungs and kidney damage to the central nervous system, skin damage, fluorosis, gastrointestinal distress, Methaemoglosinemia, high blood pressure and so forth. The ground absorbs water and retains it in soil and the pores of rocks. Water that has been absorbed into the ground is known as groundwater and it can be accessed via wells and boreholes (UNEP-WHO 2012). It is often relatively clean and very rich in minerals, which makes it ideal if you need water for irrigation or watering your garden. It can also be filtered and used for outdoor cleaning. However,

groundwater is rarely found near the surface, it tends to be located deep underground. If you want to use groundwater for any purpose, you'll need a way to extract it quickly and reliably. A powerful pump can be inserted into a well or borehole and used to collect as much groundwater as you need. If you're interested in us providing this service find my information here (Tabutt, 2012).

MATERIAL AND METHODS

Sample collection

Purposive sampling was done in collecting six (6) swabbed samples from water valves surface in Ethiopia hostel situated on the campus and community of Umar Suleiman College of Education Gashua at the end of the daily activities to maximize the chance of isolation bacteria that might be present thereon. The swab sticks were moistened with 5 mL of normal saline that was added to the swab sticks case and excess were removed by pressing the swab against tube of the slide (Adeleye *et al.*, 2022). Individual moistened sterile cotton swab was used to swab the tap water valve. This was accomplished in a tri directional manner up/down, left/right and diagonally, recapped and properly labelled. The swabbing sticks were immediately transported to microbiology laboratory for onward bacteriology analysis.

Swab Collection

The swabbing stick was used to swab the tap water valve (two tap water valve from each hostel) were aseptically collected in duplicates. Each sterilize swabbed stick was dipped into aseptically. After collection, the swab sticks were placed back to its crew container and conveyed to the laboratory for analysis.

Preparation of Culture Media

All culture media used were prepared according to the manufacturer's instructions. They were sterilized by autoclaving at 121 °C for 15 minutes.

Isolation of Bacteria

Each swab stick was aseptically rinsed into freshly prepared Nutrient Broth in test tubes (5 mL per test tube and plugged). The test tubes were incubated at 37 °C for 24 hours for growth which was detected through turbidity. After incubation, a loop full of each broth was streaked progressively to obtain discrete colonies on different culture media (Nutrient Agar, Blood Agar, MacConkey Agar, Mannitol Salt Agar and Salmonella-Shigella Agar). The plates were incubated at 37 °C for 24 hours and then observed at the end of the incubation time for the kind of growth present on each agar.

Gram staining

A gram stain was performed to confirm and identify the pathogen and bacteria were searched in pus cells in urine (Eckburg *et al.*, 2015). While, the Gram-negative rods were identified by gram staining, and such type of culture was then inoculated by streaking to MacConkey agar for subculturing. MacConkey agar is used to isolate and differentiate the Gram-negative enteric bacilli (Schwan *et al.*, 2018). The gram staining procedure are described below;

- i. An oval shape smear was made using a sterile loop in a center of grease free glass slide.
- ii. The smear was heat fixed and later flood with primary dye (crystal violet) for 30 second and washed with distilled water.
- iii. Again its later flood with mordant (Lugol's iodine) for 15 second to fixed the primary dye and wash with distilled water.
- iv. The fixed smear was decolorized with 90% acetone and wash with distilled water
- v. The smear was then counter stained with safranin for 30 second, wash and allowed to air dried.
- vi. It was then examined using oil immersion objective lens (100).

Biochemical Characterization Tests for the Identification of Bacterial Isolates

Biochemical characterization tests ranging from indole, catalase, methyl red, Vogesproskauer, citrate, and triple sugar ion were further conducted according to the procedure reported by Cheesebrough (2006); Ochei and Kolhatkar (2008); Hemraj *et al.* (2013); Aryal (2018) to confirm the identity of the bacterial isolates. The test includes; Catalase, Oxidase, Urease, Indole, Methyl red, Coagulase, and Mortality test was done to identified the organisms as biochemical test.

1.1 Statement of the Problem

The increasing demand for domestic water has led to the indiscriminate use of underground water, such as underground water as a main source of water without regard to portability for human and animal consumption. As a result of majority of people living in living in Federal University Dutse sources their water through underground water. Majority of these water sources are poorly served without regard to its portability due to constant open air defecation practices carried out in most of the area. This leads to the serious problem happening not long ago in Dutse concerning Cholera which led to the loss of countless lives of the residents. Therefore, this work was designed to look for the bacteriological and physicochemical parameters of underground water in Federal University Dutse.

1.2 Aim

The aim of this study was to detect the bacteriological contaminants on tap water valves in female hsostel of Federal University Dutse.

1.3 Objectives

The specific objectives were;

- I. To isolate the bacterial contaminants on tap water valves in female hostel on the campus of Federal University Dutse.
- II. To identify the bacteria isolated on tap water valves in female hostel on the campus of Federal University Dutse.

1.4 Justification

The detection of bacterial contaminants on tap water valves of female hostel Federal University Dutse. Hands are the organ for physical manipulation of the environment. Numerous studies have shown that the tap water valves used by general public become contaminated by variety of pathogenic and nonpathogenic organisms. Therefore, many people are concerned with the presence of pathogenic microbes which leads to water borne diseases and other pollutants such as heavy metals and toxic chemical in their daily drinking water. Therefore, treated water is the main source of safe and reliable water system to comply with the regulations as water that physically looks colorless, odorless and even tasteless is not sufficient to determine that the water is safe for consumption, hence the need for this research work should be examined on bacteriological.

1.5 Scope

- I. **Spatial scope:** water will be sample within the polytechnic Dutse such as: Hostel of science and technology, Hostel of business and management studies, Hostel of vocational studies, Hostel of engineering and Hostel of health science.
- II. **Variable scope:** this research work is limited on the following testes.
 - Coli form bacteria test
 - Ph test
 - Specific conductivity
 - conductivity
 - Dissolved oxygen (DO)
 - Pressure
 - Temperature

2.0 LITERATURE REVIEW

Water (chemical formula H₂O) is an inorganic, transparent, tasteless, odorless, and nearly colorless chemical substance, which is the main constituent of Earth's hydrosphere and the fluids of all known living organisms (in which it acts as a solvent (Popoola *et al.*, 2007). It is vital for all known forms of life, even though it provides neither food, energy, nor organic micronutrients. Its chemical formula, H₂O, indicates that each of its molecules contains one oxygen and two hydrogen atoms, connected by covalent bonds. The hydrogen atoms are attached to the oxygen atom at an angle of 104.45°. WHO and Unicef (2015) "Water" is also the name of the liquid state of H₂O at standard temperature and pressure. A globule of liquid water, and the concave depression and rebound in water caused by something dropping

through the water surface. Clouds in Earth's atmosphere condense from gaseous water vapor. A number of natural states of water exist. It forms precipitation in the form of rain and aerosols in the form of fog. Clouds consist of suspended droplets of water and ice, its solid state. When finely divided, crystalline ice may precipitate in the form of snow. The gaseous state of water is steam or water vapor (Pruss *et al.*, 2016).

Water covers about 71% of the Earth's surface, mostly in seas and oceans (about 96.5%). Hunter *et al.* (2010) Small portions of water occur as groundwater (1.7%), in the glaciers and the ice caps of Antarctica and Greenland (1.7%), and in the air as vapor, clouds (consisting of ice and liquid water suspended in air), and precipitation (0.001%). According to Maninderet *al.*, 2012; Pruss *et al.*, (2016) Water moves continually through the water cycle of evaporation, transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea.

Water plays an important role in the world economy. Approximately 70% of the freshwater used by humans goes to agriculture (Tabutt, 2012). Fishing in salt and fresh water bodies is a major source of food for many parts of the world, providing 6.5% of global protein (Roymend, 2009). Much of the long-distance trade of commodities (such as oil, natural gas, and manufactured products) is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating, in industry and homes. Water is an excellent solvent for a wide variety of substances both mineral and organic; as such it is widely used in industrial processes, and in cooking and washing. Water, ice and snow are also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, diving, ice skating and skiing (Horan, 2003).

2.1 Classification Of Water

Generally, water bodies are classified in to so many group starting from; Ground water, Rain water, Spring water, and lastly Flowing water.

2.1.1 Ground water

Underground water is a good quality water in terms of microbes because it contains no conform as a result of natural filtration but pollution occur due to indiscriminate dumping of refuse, poor sewage system and activities of man and animal, the underground soil. (Wilcox, 2010) explained that water being universal solvent dissolves many organic and inorganic substances that finally sink into the aquifer. The common water contaminants include organic and micro organic which at high-level possess health effect inorganic substances such as ion and other heavy metals originate from erosion of natural deposit, glass and electronic firms and so forth other inorganic substances include non-biodegradable substances such as insecticide, packing material and detergent exposure to this substances above the limit concentration value can cause health effect such as cancer of the liver, lungs and kidney damage to the central nervous system, skin damage, fluorosis, gastrointestinal distress, Methaemoglosinemia, high blood pressure and so forth. The ground absorbs water and retains it in soil and the pores of rocks. Water that has been absorbed into the ground is known as groundwater and it can be accessed via wells and boreholes (UNEP-WHO 2012). It is often relatively clean and very rich in minerals, which makes it ideal if you need water for irrigation or watering your garden. It can also be filtered and used for outdoor cleaning. However, groundwater is rarely found near the surface, it tends to be located deep underground. If you want to use groundwater for any purpose, you'll need a way to extract it quickly and reliably. A powerful pump can be inserted into a well or borehole and used to collect as much groundwater as you need. If you're interested in us providing this service find my information here (Tabutt, 2012).

2.1.2 Flowing water

Water found in streams, rivers and lakes with underwater currents can be reasonably clean. The fact that the water in these sources is constantly flowing or moving often prevents pollutants from building up. As a result, if you have access to a flowing water source, you can use it for irrigation and similar purposes (Pruss *et al.*, 2016). While it may not be as mineral-rich as groundwater, this type of water can be cheap and easy to collect. You simply need to choose a pump that can extract water quickly and in reasonably large quantities. We suggest opting for a submersible pump for this application (Michael and Arnold, 2017).

2.1.3. Spring water

The term 'standing water' refers to any body of water that isn't flowing or in motion. Standing water can easily be stagnant, polluted and unhealthy. If you have a body of standing water on your property, you may wish to get rid of it. You can use a submersible pump or powerful non-submersible pump to drain a body of standing water (Anonymous, 2007).

2.1.4. Rainwater

Rainwater is significantly cleaner than standing water but may be dirtier than flowing water or properly collected groundwater. Once filtered, however, it can be used for a number of different purposes. We offer a variety of pumps specifically designed to harvest rainwater once it has fallen (Pruss et al, 2016). Water is an essential requirement for the maintenance of a play a role important in the lives of plants and animals reported that 70% of the earth surface is made up of water and man uses water for domestic and industrial, and agricultural purpose (Horan, 2003).

2.2 Water Contamination

Water is contaminated when solid waste domestic and industrial effluent find their way into drinking source. Paddilla and moima (2010) explain that surface application agricultural and domestic wastes effluents have result in localize migration of nutrient and micro-organism into the shallow aquifer. Nitrogenous compounds, the use of fertilizers and insecticide on farm, most of this when washed by rain will eventually reach the underground source of drinking water (Michael and Arnold, 2017).

2.3 Microbial Contaminants

Newly constructed wells usually free from microbes but contamination sets in because of manual method of drawing water and other environment effluent, faecal material of human and animal. Example of these contaminants as compiled by (Anonymous 2007) include cyst like cyst like cryptosporidium and girdia, bacteria like typhus, feacalcoilform cholera and virus, (New Zealand 2010) also reported that most common health risk contaminants associated with drinking water is the microbial contaminants associated with drinking water is the microbial contamination from disease causing organism such as bacteria, virus, protozoa.

2.4 Indicator Organisms

The present of indicator micro organism in water indicate pollution but their absence does not necessarily guarantee the quality of water. It was revealed that there are many micro organisms associated with water and it is impracticable to attempt the routine isolation of each because they are present in small number, the approach that has been adopted is to analyse for indicator microorganism. (UNEP-WHO 2012).

2.5 Coliform Bacteria

This includes all rod shaped, nonspore forming gram negative bacteria that ferment lactose within 48 hours at 37 °C. The most common species are *Escherichia coli* and *Enterobacteraerogenes*. Others are *Salmonella* spp., *Vibrio cholerae*, *Shigella* spp., *Klebseilla*, spp. (Michael and Arnold, 2017).

2.6 Physicochemical parameters of water

2.6.1 Alkalinity

Alkalinity of water is it is capacity to neutralize acid, the amount of a strong acid needed to neutralize the alkalinity is called the total alkalinity reported in mg/L as carbonate. The alkalinity of some water is due only to bicarbonate of calcium and magnesium. The pH of alkaline water having a pH value of above 8.3 contains and possible hydroxide in addition to bicarbonate. The alkalinity fraction equivalent to the amount of acid needed to lower the ph value is called phenolphthalein alkalinity.

2.6.5 Conductivity

Electrical conductivity is the measurement of the ability of a solution to carry electric current. Since their presence is dependent upon the presence of irons in solution an excellent indicator of the total dissolve solid in water. Conductivity is measured per cm. it is temperature dependant ranging from 20-25c that is use in expressing result (Gray, 2016).

2.6.6 pH

pH is defined as the logarithm of the reciprocal of the hydrogen in concentration and it is a measure of the acidity or alkalinity of a solution or water.

RESULTS

The results of the plates sampling points designated as FHA, FHB, FHC, FHD, MHA, MHB, MHC and MHD are isolated in Table 1. However, the results for identification of the possible bacteria detected in tap water valves samples are depicted in Table 1.

Table 1: Morphological and Gram Staining Reaction of Bacteria Isolated from the Tap Water Valves

Sample	Morphology	Gram reaction
FHA	Bacillus shape	-ve
FHB	Rod shape	-ve
FHC	Non spore rod shape	-ve
FHD	Cocci in shape	+ve
MHA	Rod shape	-ve
MHB	Cocci in shape	+ve
MHC	Bacillus shape	-ve
MHD	Rod shape	-ve

Keys: FH: Female hostel, MH: Male hostel +ve: gram positive -ve; gram negative

Table 2: Biochemical Characterisation Tests of the Bacterial Isolates

Sample	G-reaction	Biochemical test				Isolates
		Citrate	Catalase	Indole	Methyl-red	
FHA	-ve	+	+	-	+	<i>S. typhi</i>
FHB	-ve	-	+	+	+	<i>E. coli</i>
FHC	-ve	-	+	-	+	<i>Shigiella spp.</i>
FHD	+ve	+	+	+	-	<i>S. aureus</i>
MHA	-ve B	-	+	+	+	<i>E. coli</i>
MHB	+ve	+	+	+	+	<i>S. aureus</i>
MHC	-ve	+	-	-	+	<i>S. typhi</i>
MHD	-ve	-	-	+	+	<i>E. coli</i>

Key: + = positive; - = negative; -ve= Gram negative G-reaction: Gram reaction

Table 3 Percentage Occurrence of the Isolated Bacteria

Organism	Number (%) prevalence
<i>S. typhi</i>	8 (27.6%)
<i>E. coli</i>	12 (41.4%)
<i>Shigiella spp.</i>	4 (13.8%)
<i>S. aureus</i>	5 (17.2%)
Total	29 (100%)

DISCUSSION

Results obtained from the Table 1 show that isolates from the tap water valves sampled from FHA, FHB, FHC, FHC, FHD, MHA, MHB, MHC and MHD had five gram negative bacterial isolates and three gram positive bacterial isolates as previously reported by Bamigboye and Amina (2018); Adeleye *et al.* (2020); Amoo *et al.* (2021) in their respective examination of drinking water quality.

In respect to the biochemical characterization of the isolates, the results have clearly suggested that all the water samples harbored *Enterobacteriaceae* which includes *E. coli*, *Salmonella*, *Shigiella*, and *Staphylococcus* during the conduct of this study. And this is in line with agreement of the finding of Ochei and Kolhatkar (2008) as reported on his study conducted in Gambia.

As recorded in this current study, *E. coli* was present in almost the whole sample (41.4%) followed by *Salmonella spp.* (27.6%), *S. aureus* (17.2%) and lastly *Shigiella spp.* (13.8%) These bacteria have been

equally reported by Okareh et al. (2018); Adeleye et al. (2020); Amoo et al. (2021); Sitotaw et al. (2021); Raji et al. (2021); Falnyi et al. (2022); Adeleye et al. (2022) as being synonymous with water. *E coli* is one of the pathogens linked with the tap water valves (Slavik et al., 2020).

RECOMMENDATION

Owing to the results obtained in this study, it is recommended that the water tap valve must not be freely touched apart from on/off. Again, routine monitoring and assessment of the source of water being pumped into the tanks are highly recommended. The need to increase the frequency of sampling and quality assessment of the water in the tanks is also desirable with a view to effectively monitoring its portability. Finally, early detection of possible groundwater pollution can enhance faster employment of remedial measures to avert public health crises.

CONCLUSION

The results obtained in this study have revealed that the water tap present in the students' campus recorded the presence of *E. coli* that was found to be beyond the percentage limits with 47.4% as it also recorded the presence of total and fecal coliforms. This strongly implies that the water obtainable from all the taps during sampling was not fit for human consumption. Consequently, water stored in storage tanks may not always be of primeval quality as it ought to be.

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