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BACTERIOLOGICAL ASSESMENT OF DRINKING WATER FROM DIFFERENT SOURCES IN KOFAR YANDAKA KATSINA, KATSINA STATE

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ABSTRACT
Microbiological analyses of drinking water samples from Kofar yandaka in Katsina metropolis were carried. The area was selected because of its dense population and the water used in the area were from different sources. A total of 15 samples (5 each) from well, jerry can and borehole were analysed. Aerobic plate count, coliform count and detection of some potential pathogens were carried out using standard procedures. The results obtained were compared with the standard recommended by WHO for drinking and recreational water. Aerobic plate count varied from $3.38x10^6$cfu/ml in well water to $6.1x10^5$cfu/ml in jerry can water. Most Probable Number (MPN) of coliform was found to range from 7±1.66 to 21±36.9 for all the water samples. Salmonella and E. coli were detected in both jerry can and well water. The aerobic plate count exceeded the acceptable limits and therefore indicates pollution of the water. The drinking of non-portable water in the area may expose the local community to the dangers posed by these sources of water.The study therefore stresses the need for the provision of safe drinking water to the area so as to avoid the risk of contracting water borne illnesses.
Keywords: Drinking water, Escherichia coli, Salmonella, Katsina

INTRODUCTION

Water is one of the most important of all natural resources known on earth. It is important to all living organisms, most ecological systems, human health, food production and economic development (Postel *et al.*, 2003). The safety of drinking water is an ongoing concern within the global village. Traditionally, the safety of potable water supplies has been controlled by disinfection, usually by chlorination and coliform population estimates. However, it has been reported that coliform-free potable water may not necessarily be free of pathogens (Sim *et al.*, 2006).

The provision of portable water to the rural and urban population is necessary to prevent health hazards. Portable water is the water that is free from disease producing microorganisms and chemical substances that are deleterious to health.

Water houses the largest number of living organisms when compared with other habitats and one of the essential chemicals of life upon which all life forms depend. Physiologically, water is the medium forall biochemical reaction in man. Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards, which are designed to ensure that the water is palatable and safe for drinking. Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells. Unfortunately, clean, pure and safe water only exists briefly in nature and is immediately polluted by prevailing environmental factors and human activities.

The public health significance of water quality cannot be over emphasized. Many infectious diseases are transmitted by water through the fecal-oral route. Diseases contacted through drinking water kill about 5 million children annually and make 1/6th of the world population sick World Health Organization (WHO, 2004). Water is vital to our existence in life and its importance in our daily life makes it imperative that thorough microbiological and physicochemical examinations be conducted on water. Water is said to be potable when the physical, chemical and microbiological qualities conform to specified standard. To achieve this, such raw water is subjected to purification processes that range from simple long-term storage to enable sedimentation of some suspended solid to aeration, coagulation, flocculation and disinfection among other treatments (Ajewole, 2005). The aim of the work is to determine the microbiological quality of water from various sources used for different purposes in Kofar Yandaka Katsina

MATERIALS AND METHODS

Study Area

Katsina State, covering an area 23,938 sq. km., is located between latitudes 11Â°08'N and 13Â°22'N and longitudes 6Â°52'E and 9Â°20'E. The state is bounded by Niger Republic to the north, by Jigawa and Kano States to the east, by Kaduna State to the South and by Zarnfara State to the West. Katsina State forms part of the extensive plains known as the High Plains of Hausa land. The study area was Kofar Yandaka in Katsina Metropolis.

Sample Collection

A total of 5 samples were collected from each of tap, well, borehole and jerry can water making a total of 20 samples. Water samples were collected from each water sources using a sterile glass sample bottle (500ml) in the morning. The well was sampled by connecting the bottles to ropes, both of which were previously disinfected with 70 % alcohol and dried in sterile air. The rope was lowered to immerse the bottle in the water to fill. When the bottle was filled, it was pulled out of the well and corked firmly. For the boreholes, the nozzles of the boreholes was swabbed with cotton wool soaked in 70% (V/V) ethanol. Tap water sample was collected using sterile glass sample bottle (500ml); the water was allowed to gush/run for about for 1minute before the collection is done. Water sample from the jerry can was aseptically collected directly after the cap and the outlet was sterilized with alcohol. The sample bottle was covered and transported to the laboratory for further analysis.

Bacteriological Analyses

Sample Preparation and Serial Dilution

Ten (10ml) milliliter of each water sample was transferred into a tube containing 90ml of buffered peptone water, this was labeled 10^{-1} dilution. From the 10^{-1} dilution, 1ml was transferred to another tube containing 9ml of buffered peptone water and labeled 10^{-2}. The procedure was repeated to 10^{-5} dilution.

Aerobic Plate Count (APC)

This was carried out by pour plating technique after serial dilution (Egboh and Emeshih, 2007). Using a fresh syringe, 1ml of sample from each dilution was transferred into appropriately labeled duplicate petridishes. This was followed by pouring cooled molten nutrient agar in each petridish, homogenized by swirling and allowed to solidify. Finally the plates were incubated at 37°C for 24 hours. Following incubation, plates that contained between 30-300 colonies were selected and average of the colonies from the two plates was multiplied by the inverse of the dilution factor to get cfu/ml.

Enumeration of Coliform Bacteria using Most Probable Number (MPN) Method

This was carried out using multiple tube fermentation technique (Egboh and Emeshih, 2007). About 10ml of each sample was inoculated into the first sets of test tube (5 tubes per set) each containing 10ml sterile double strength lactose broth with inverted durham tubes (ensuring that no air bubble is captured). Then 1ml of each sample was inoculated into 5 tubes each containing 5ml sterile single strength lactose broth with inverted durham tubes. Then 0.1ml was also inoculated into five test tubes each containing 5ml of sterile single strength lactose broth withinverted durham tubes. The tubes were incubated at 37°C for 24-48 hours. Following incubation, tubes showing gas production were counted and compared with the MPN table adopted for determination of most probable number (MPN) of coliforms.

Detection of *E. coli*

From the positive tubes showing lactose fermentation (gas production), a loopful of broth from the tube was streaked on the Eosine Methylene Blue (EMB) Agar plate and incubated for 24 hours at 37°C. Colonies that formed green metallic sheen on EMB were suspected to be *E. coli* and those that form pink were suspected to be *Enterobacter aerogens* (Cheesbrough, 2006).

Detection of *E. coli* O157:H7

Isolates that formed green metallic sheen on EMB were streaked on Sorbitol MacConkey Agar, and incubated at 37°C for 24hours as described by Centre for Disease Control (CDC, 2004). After incubation, the plates were observed for the presence of colourless colonies which would be tested using serological kit for confirmation of *E. coli* O157:H7.

Detection of *Salmonella*

This was carried out according to the method of Egboh and Emeshih (2007). A loopful of inoculum from each of the serially diluted tubes was streaked on *Selmonella-Shigella*(SS) Agar plate and labeled accordingly. Finally the plates were incubated at 37°C for 24 hours. After incubation, the colonies were Gram stained and tested for motility.

Biochemical test for characterization of bacteria

Bacterial isolates were characterized on the basis of their colonial morphology, Gram staining and biochemical characteristics as demonstrated by (Cheesbrough 2005).

Catalase Test
Two drops of hydrogen peroxide were dropped on a clean grease free slide. An applicator stick was used to collect the test organism and then smeared on the drops of hydrogen peroxide and then observed for an immediate bubbling of gas which indicates a positive test (Cheesbrough, 2005).

Citrate Utilization Test
Simmon's citrate agar was prepared according to manufacturer's instruction and autoclaved at 121^{o}C for 15 minutes. The autoclaved media was kept in a slanty position and allowed to solidify. Using a sterilized straight wire loop, the slope was streaked and the butt was stabbed with a saline suspension of the test organism. This was Incubated at 37^{0}C for 48 hours and observed for colour change (Cheesbrough, 2005).

Indole Test
The test organism was inoculated into a tube containing tryptone water and incubated for 48 hours at 37^{o}C. Following 48 hours of incubation, 2 drops of kovac's reagent were added and observed for the formation of red ring at the surface of the medium which indicates positive test (Cheesbrough, 2005).

Triple sugar iron (TSI) Test
Triple sugar iron agar slant was streaked and stabbed (butt) with a saline suspension of the test organism and was incubated at 37^{o}C for 24 hours. Following 24 hours incubation, the tube was observed for sugar fermentation, hydrogen sulphide production and gas formation. Yellow butt (acid production) and red pink slope indicated fermentation of glucose, cracks and bubbles in the medium indicates gas production from glucose fermentation. A yellow slope and a yellow butt indicate fermentation of lactose and glucose. Blackening along the stabbed line or throughout the medium indicate hydrogen sulphide production (Cheesbrough, 2005).

Methyl Red Voges Proskauer Test (MR-VP)
This was carried out according to Fowale and Oso (1998). Two different tubes each containing MR-VP broth were inoculated with the suspended test organism, incubated at 37^{o}c for 2-3 days. Five drops of methyl red indicator were added to each tube. Red color indicate negative (alkaline test). On the second tube of each organism, VP test was carried out by addition of 1ml napthol solution followed by 1ml of 40% KOH solution. This was agitated and allowed to stand for about an hour and then observed. Pink to red color indicates the presence of acetyl, methyl carbinol (VP-positive). A reddish brown colour indicates negative (VP-negative) (Cheesbrough, 2005).

RESULT AND DISCUSSION
The result of the work showed mean aerobic mesophilic bacterial count to range from <30 to 5.40 x 10^5 cfu/ml in the different water samples from the different sources. None of *E. coli* or Salmonella was detected in tap water. Also *E. coli* 0157:H7 was not detected.

Table 1: Mean Counts (cfu/ml) and Detection of some Bacteria from the Drinking Water.

Water Source	Mean APC (cfu/ml)	Mean CC (cfu/ml)	No. of samples that yielded		
			E. coli	*Salmonella*	*E. coli* 0157:H7
Tap	<3.0 x 10^1	0	0	0	0
Well	9.5 x 10^3	21±6.73	2	1	0
Borehole	<3.0 x 10^1	6±2.33	1	0	0
Jerrycan	5.4 x 10^5	7±4.04	1	1	0

All the water samples studied had no regular treatment except the tap water which are usually brought from far away, from these water samples well, jerry can and boreholes have the MPN above the recommended level and tap and borehole are within the permissible limit of drinking water. Analysis of well water showed coliforms count of more than 10 per 100 ml of water and *E. coli* was detected. In all the water samples *E. coli*, was detected except tap water, Salmonella also was present in two samples, well and jerry can. From the water samples only one had an excellent and one with acceptable and the remaining two are out of range recommended for drinking water. *E. coli* 0157:H7 were also found to be absent. On the other hand of aerobic plate count, (APC) is used as an indicator of bacterial populations on a sample were also above the recommended limit by WHO except that of tap water which is within the range. Therefore, from this study only one sources of water is microbiologically safe which is the tap water.
Presence of *Salmonella* in the water samples analysed is not in agreement with EPA water standard for recreational use which states that this pathogenic organism must not be present in water, because they are of public health significance, having been associated with gastrointestinal infections such as diarrhoea,

dysentery, typhoid fever and other form of infection Environmental Protection Agency (EPA, 2003). The presence of *E. coli, Salmonella* spp as well as *Shigella* spp *and Vibrio* spp have been documented as National Primary Drinking Water Regulations (NPDWRs) or primary standards which protect public health by limiting the levels of contaminants in drinking water (EPA, 2002).

CONCLUSION

In conclusion, majority of the water sources (well, borehole and jerrycan) hadunacceptable values of coliform and all had *E. coli* indicating possible fecal contamination of thesources.

Recommendations

There should be regular sanitation of drinking water sources, periodic bacteriological appraisal and construction and distribution of portable water. There is also need for regular examination of water for the presence of organisms, chemicals, and other physical contents with a view to eliminate all hazards or to reduce them to acceptable levels.

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