UNIVERSITY OF NAIROBI

Bachelor of Veterinary Medicine.

BACTERIOLOGICAL QUALITY OF TAP AND STORED WATER IN UMOJA ESTATE, NAIROBI COUNTY.

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DECLARATION

I hereby declare that this project is my original work and has never been submitted or presented, to the best of my knowledge, to any other institution for the award of any degree.

SIGNED: …………………………………………………DATE……………………........

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This project has been submitted with the approval of a University of Nairobi supervisor.

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ABSTRACT

The aim of the study was to determine the bacteriological qualities of stand pipe and stored water in Umoja Estate in Nairobi, Kenya. There were 20 water samples randomly collected in Umoja 1 and Umoja 2 Estates and out of these, 10 samples were stand pipe while 10 were from storage containers. The mean total coliform count for stand pipe samples was 5.2 per 100ml. of water while that of storage containers was 9.5 per 100ml. Fecal Coliforms were isolated from 3(30%) taps and 6(60%) storage containers.

The general source of water for every homestead visited was groundwater. The water was pumped using electricity from boreholes then piped to the households.

CHAPTER ONE

1.1 INTRODUCTION

Safe drinking water is essential to humans and life forms. Water plays an important role in the world's economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation (www.wikipedia.com).

Improper storage of water leads to bacterial contamination, which poses a threat to humans and animals. It is therefore essential to treat drinking water and store it in clean environments.

In the developing world, 90% of all wastewater still goes untreated into local rivers and streams. Only half of the urban population has adequate access to safe drinking water. As a result of the low access rates, diseases caused by polluted water are one of the major health hazards in Kenyan population (www.wikipedia.com).

Low income and densely populated urban areas are particularly affected, with women and children suffering even more (www.wikipedia.com).

The bulk of water supply for Nairobi is from Thika, Sasumua and Ruiru Dams, and Kikuyu springs (UNEP, 2011)

Current estimated water demand for Nairobi is 650,000m^3 per day compared to production 482, 940m^3 per day (WRMA, 2010)

Human and animal wastes are a primary source of bacteria in water. Water supplies should therefore be tested to ensure it is safe from bacterial contamination. Coliform bacteria may not cause disease, but can be indicators of pathogenic organisms that cause diseases. By monitoring coliform bacteria, the increase or decrease of many pathogenic bacteria can be estimated. Due to this association, bacterial safety of drinking water is monitored by testing for coliform bacteria (Brian, 2012).

Contaminated water can lead to waterborne infections caused by bacteria, viruses or protozoa. Bacterial contamination can be due to *Burkholderia, Campylobacter, Legionella, Escherichia, pseudomonas,* non tuberculous *Mycobacteria*, *Salmonella*, *Shigella*, *Vibrio* and *Yersinia* species. Viral contamination could be due to Adenovirus, Enterovirus, Astrovirus, Hepatitis A and E, Norovirus, Sapovirus and Rotavirus.

Protozoan contamination can be caused *by Acanthamoeba*, *Cryptosporidium, Cyclospora*, *Entamoeba*, *Giardia, Naegleria and Toxoplasma.* Helminth contamination- *Drancunculus* and *Schistosoma (*WHO, 2008).

Indicator organisms are used to assess the microbial quality of drinking water. These indicator organisms are coliforms. They are present in the environment and feces of all warm blooded animals and people. The coliform group consists of the total coliforms, fecal coliforms and *E coli.* Total coliforms are common in the environment and are usually harmless. Fecal coliforms are a subgroup of total coliforms and exist naturally in the intestines of warm blooded animals and people. *E coli* are a subgroup of fecal coliforms and are also found in intestines. Water intended for human consumption should contain no indicator organisms (WHO, 2008).

1.2 OBJECTIVES

1.2.1General objective

To investigate the bacteriological quality of tap and stored water in Umoja Estate, Nairobi.

1.2.2 Specific objectives

- **i.** To investigate the total Coliform counts per unit volume of water.
- **ii.** To find out the sources of water supplying the homesteads in Umoja

CHAPTER TWO

2.1 LITERATURE REVIEW

Water has always been a life sustaining drink to humans. Seventy percent of the human body mass is composed of water. It is a solvent in many body solutes and is important in metabolic processes. Sources of water for human use include ground, precipitation, surface water, biological sources, desalinated seawater, water supply network and atmospheric water generator.

Groundwater is one of the earth's most important resources. Common reservoirs of groundwater are springs, hand dug wells and boreholes. They are prone to quality degradation due to poor environmental sanitation. In rural areas, shallow wells are threatened by solid waste disposal and seepage of untreated sewage from septic tanks and pit latrines. In urban areas, shallow well contamination is due to increasing human population, raw sewage and industrial effluents Water is also a source of mineral nutrients to the human body, such as fluoride and copper (WRMA, 2013).

Improper maintenance of water sources could however lead to contamination of water, which poses a threat to human population. Pollution of water has steadily been caused by a variety of bacteria, fungi, viruses and parasites (Abraham *et al*, 2007).

A study of the quality of water in Nairobi River revealed that it is highly contaminated with pathogenic bacteria. Among the bacteria isolated were *E. coli, Enterococcus, Pseudomonas, Salmonella, Vibrio, Shighella, Klebsiella and Proteus* (Abednego *et al*, 2013).

Nairobi's demand for water has grown tremendously over the last 10-20 years; this has led to a significant increase in water supply and distribution systems. This supply is good but during periods of drought, it is not reliable. Most of Nairobi's water supply is from the Tana River. The increasing incidences of drought in the country led to an increase in groundwater abstraction.

This began in the 1930_s and has steadily expanded such that by the year2002, 25% of the overall water supply to the city was from groundwater.

Most of the water wells are operated by large private consumers or by individual residential owners in parts of the city that receive only intermittent supply. They use groundwater as a back-up supply. Potential pollution of Nairobi's groundwater is from solid waste landfills and dumpsites, seepage from latrines, septic tanks, sewer and drains, leakage from underlying storage of petroleum and chemicals, seepage from industrial effluents and infiltration from polluted streams (Stephen *et al*, 2005).

In the developing countries, most cities are located along rivers and have waterborne sanitation systems. Only approximately 10% of wastewater worldwide is treated. This leads to surface and groundwater contamination by discharge of untreated sewage and storm water runoff (UNEP, 2008).

It is not easy to test for every pathogen present in water; for this reason indicator organisms are used to determine presence of contamination. Coliforms are used because;

i. They come from the same source as other pathogens.
ii. They are relatively easy to identify.
iii. They are usually present in larger numbers than more dangerous pathogens.
iv. Respond to the environment and water treatment similarly to many pathogens (NYDH, 2011)

CHAPTER THREE

3.1 MATERIALS AND METHODS

3.1.1Area of study

The study was carried out in Umoja Estate which is situated in Umoja sub location of Nairobi County's Eastland's. The sample bottles used in the study were first washed thoroughly in warm water containing a detergent, rinsed in tap water then finally in distilled water. They were then dried and sterilized in a pressure cooker at 121^0C for 15minutes.

3.1.2 Water sample collection

Random sampling was done in Umoja 1 and 2 Estates.

3.1.3 Sampling from taps

The taps were sterilized using a blow lamp by passing a flame over it until red hot. The taps were opened and water allowed to run for about 2minutes then regulated to allow a thin stream of water to flow. The sample bottle was carefully opened and carefully filled with the tap water, capped then labeled. Each bottle was then placed in a cool box of less than 10^0C then taken to the laboratory for analysis.

3.1.4 Sampling from storage containers

The containers were lifted and water poured into the containers, avoiding spillage onto the sides of the containers. The bottles were then capped and labeled before putting them into the cool box of less than 10^0C and transported the laboratory for analysis within 6hours of collection.

3.1.5 Total Coliform count using the membrane filtration method

An Erlenmeyer flask was connected to the turned off vacuum source and the porous support placed in position. A second flask was placed between the Erlenmeyer flask and vacuum source to act as a water trap.

The filtration unit was assembled by placing a sterile membrane filter on the porous support using a sterile pair of forceps.

The upper container was placed in position and secured.

100ml. of the test sample was poured into the upper container before filtration.

The vacuum source was turned on.

The filtration unit was disassembled after the sample was filtered; the membrane filter removed using a sterile pair of forceps and placed in a Petri dish with Eosin Methylene Blue Agar the side with residue facing up.

The Petri dishes were placed in an incubator at 44^0c for 18-24hours at 100%humidity.

The Petri dishes were removed and growth of Coliforms checked. The number for Coliforms per 100ml. was calculated as below;

Number of coliform colonies counted/number of sample filtered ×100, where for this case the sample filtered was 100ml.

CHAPTER FOUR

4.1 RESULTS

From this study, 3 out of 10 taps were contaminated with Coliforms; of which 2 were from Umoja 2 while 1 from Umoja 1. The 2 from Umoja 2 had 48 and 3 total coliform count respectively while the 1 from Umoja 1 had 1 total coliform count per 100ml. of water. The mean total coliform count in tap water was 5.2. Six households out of 10 had coliform contamination in their storage containers with the average total coliform count per 100 ml. of water being 9.5.

Total coliform counts.

Table 1: Total coliform counts and sources of water from each household.

Household number	Total coliform count for tap water	Total coliform count for stored water	Source of water
	Umoja 2		
1	0	6	Borehole
2	48	74	Borehole
3	3	8	Borehole
4	0	3	Borehole
5	0	0	Borehole
	Umoja 1		
6	0	2	Borehole
7	0	0	Borehole
8	0	0	Borehole
9	0	0	Borehole
10	1	2	Borehole
Average	**6**	**10**	

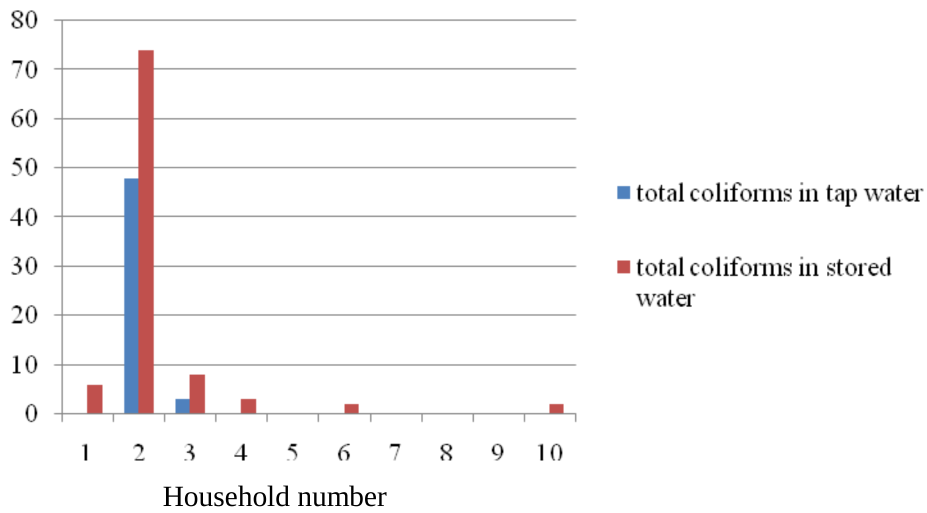

Figure 1: Comparative bar graph showing the difference in coliform counts for tap and stored water.

CHAPTER FIVE

5.1 DISCUSSION

Water is very essential for life and lack of it would mean lack of life. It maintains human, animal and plant life. Water is also a cleaning agent hence high levels of hygiene are maintained with its presence. It is however a potential source of hazard as it is a media for transmission of various pathogens which could affect both humans and animals. It is therefore crucial to provide safe drinking water for both humans and other life forms (UNEP, 2011).

From the study of water supplying Umoja area, there was some level of Coliform contamination of water. Since the entire homesteads visited were supplied with ground water, it reveals that there is insufficient water treatment of the water reservoirs. Out of the 20 samples collected, 9 of them contained fecal coliforms; hence generally 45% of the population in Umoja used contaminated water. Out of the 9 contaminated samples, 3of them (15%) were from tap water, while 6 (30%) from stored water. This shows that even though there could be a good supply of safe water, there is some level of contamination during storage.

From the results, there was a slight difference between Umoja1 and Umoja2 Estates. Out of the 5 homesteads visited in each estate, Umoja 2 had 4 homesteads consuming contaminated water while Umoja1 had 2 homesteads. However, the supply from tap water showed that most homesteads in Umoja had supply of safe water with 80% of them receiving non contaminated water.

Groundwater is usually less vulnerable to the immediate influence of contamination source due to its barrier effects provided by the overlying soil and its unsaturated zone (WHO, 2008).

Contamination can however arise if the integrity of the reservoirs is interfered with. This can happen in cases of bursting of walls of a borehole or any other reservoir. This is seen in the results obtained from the samples from households' numbers 2, 3 and 10. This could also be due to seepage of wastes from latrines, septic tanks, sewer and drains (Stephen *et al,* 2005). The poor drainage of Umoja Estate could also be a great contributor to the contamination of water reservoirs. This is usually observed during the rainy season whereby the area gets flooded frequently. The area also occasionally faces a problem in bursting of the sewer drains.

The study also reveals a greater contamination in stored water as shown in Table1with household number 1, 2,3,4,6 and10 positive for coliform growth. This suggests that there was a significant level of further contamination during storage. This can be due to storage in dirty containers, fetching stored water using dirty utensils, leaving open the storage containers or even dipping dirty hands into the stored water. Maintaining quality of water during collection and transport is the responsibility of the household. Good hygienic practices are required, even in the storage. The nature and likelihood of contamination can vary according to season, more during rainfall (WHO, 2008).

CHAPTER SIX

6.1 RECOMMENDATIONS

From this study, I would recommend regular sampling of water in Umoja for tests. Sampling should be random but should be increased in times of epidemics, flooding or emergency operations or following interruptions of supply (WHO, 2008).

I would also recommend that people in Umoja area who own groundwater reservoirs be taught how to prevent contamination by;

i. Building vermin proof caps on the wells or boreholes.
ii. Disinfection of the reservoir, pump and plumbing after repair.
iii. Disinfection of water in the reservoir.
iv. Keeping pumps, well pipes and equipment off the ground when they are being repaired.

People should also treat stored water at home to avoid diseases. This can be done by use of disinfectants like chlorine or even boiling of water to reduce microbial load. Storage of water should also be done in clean containers, which should have lids in place all the time.

I would also recommend the practice of personal hygiene during water handling. This includes washing hands after visiting the toilet, before handling drinking water.

6.2 CONCLUSION

From the results obtained in the study, it can be concluded that the water in parts of Umoja area is not fit for human consumption as it does not meet the WHO standards of drinking water. This is shown by the presence of Coliforms in 9 of the 20 samples tested. Residents of Umoja area are generally ignorant on the hygiene of handling water. Many homesteads had containers that were left open, yet it had drinking water in it. This therefore explains the more contamination in stored than tap water in the area.

REFERENCES

1) **Abednego M., Mbaruk A., John Mbithi, John Maingi (2013)**. Water borne bacterial pathogens in surface waters of Nairobi River and health implications on communities downstream Athi River. *International Journal of Life Science and Pharma Research*. Volume 3, January- March 2013.

2) **Abraham N.R, Macedo A.J, Gome L.H, Tarares F.C.A (2007).** Occurrence and resistance of pathogenic bacteria along Tiete River downstream of S'ao Paulo in Brazil.

3) **Brian O**. (**2012).** Guide to drinking water, 2nd edition.

4) **http//www.wikipedia.org**

5) **Kenya Bureau of Standards (1985).** Specifications for drinking water part3. Methods for biological and microbiological tests for drinking water.

6) **Stephen F. & Albert T. (2005).** The role of groundwater in water supply of Greater Nairobi, Kenya.

7) **UNEP (2008).** Environmentally sound technologies for urban and domestic water use efficiency.

8) **WHO (1998).** Guidelines for drinking water quality. 2nd edition, volume 2. Health criteria and other supporting information. WHO, Geneva, Switzerland.

9) **WHO (2004).** Guidelines for drinking water quality.by Joyce M. Donohue Charles, D. Abernathy, Peter L. George H. WHO, August 2004. Geneva, Switzerland.

10) **WHO (2008).** Guidelines for drinking water quality, 3rd edition, volume 1. Water safety plans. WHO, Geneva Switzerland.

11) **WHO (2008).** Guidelines for drinking water quality, 3rd edition, volume 1. Microbial aspects. WHO, Geneva, Switzerland.