

Original Research Article

Occurrence of *Escherichia coli* on the Water Resources at Barangays Linao East and Linao West, Tuguegarao City

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Abstract: This study was conducted to evaluate the bacterial load of water from the pump well used by the residents of Linao East and West in Tuguegarao City for the reason that the Barangay is located in a low lying area, that made them prone to flood. The researchers gathered the water samples from all the pump wells in Barangay Linao East and West Tuguegarao City and used Experimental Design to assess the potability of aforesaid water resources. Samples were collected by using sterilized bottles as a container prior to collection the mouth of the pump well was sterilized. It was then inoculated in the Lauryl Tryptose Broth as a presumptive test for the identification of Coliform bacteria after 24-48 hrs. incubation period followed by the Brilliant Green Lactose Bile Broth as a confirmatory test after 24 hrs. incubation period and finally the EC Broth as a completion test to identify the presence of *E. coli* after 24 hrs. of incubation. Production of gas bubbles will be observed as an indication of coliform bacteria. These were conducted at the Metropolitan Water District, Tuguegarao City. Based on the results of the Multiple Tube Fermentation Tests done, it showed that there are water samples positive of *Escherichia coli* at Barangay Linao East and Linao West. There are 29 pump wells in Barangay Linao East and 15 pump wells for Barangay Linao West are considered not potable as they contain coliform bacteria that can bring about gastroenteritis. The possible reason for this outcome is the Geographical location of the both Barangays which is situated in a low lying area and they too have poor environmental hygiene such as poor solid waste disposal and excreta disposal that may lead to water contamination. Aside from this, pump wells are not being examined and treated against pathogenic microorganisms like chlorination, also boiling of water from the pump well is not being performed. Coliform bacteria - a rod-shaped microorganism that will be tested in this study and which indicates contamination of water by human or animal wastes.

Keywords: Tuguegarao City, water, microorganism, *Escherichia coli*.

INTRODUCTION

Humans have always been depended on water for direct survival[1]. It is the most important substance on earth; it enhances and support life. Therefore, water used for drinking must be free from pathogenic organism responsible for water borne disease which is consisting of bacteria, viruses, protozoan and helminthes. It must not contain any substance like organism, chemical or radioactive materials at a level or concentration which would endanger the health and lives of the people.

Statistics shows that only 65% of Philippine household have access to potable water supply[2]. It is quite easy to understand therefore why diarrhea is one of the leading causes of morbidity and infant mortality. While it is recognize that the provision of deep well water reservoir and treatment of drinking water from doubtful sources are the best assurance on the potability of water if should also be appreciated that simple measure and personal hygiene and the provision of clear drinking water vessels are just important.

Various diseases such as diarrhea, typhoid fever and bacillary dysentery is usually cause by coliform bacteria that are found in water through its contamination, millions of cases per year worldwide had been occurred. Actually diarrheal disease was found to be the third leading infectious diseases causing worldwide death wherein there are 2.2 million mortality cases that had been reported by the World Health Organization (WHO)[3]. In Barangay Linao East, there were 18 cases of typhoid fever and 61 cases of diarrhea while in Barangay Linao West there were 15 cases of typhoid fever and 12 diarrhea cases in 2007.

Many cases of diseases caused by coliform bacteria are due to the improper sanitation, poor hygiene and environmental factors that is hazardous to man. Thus, this certain bacteria may be acquired through the use of water resources that may be contaminated.

The utilization of pump well and deep well may be one of the risk factor in acquiring certain diseases caused by coliform bacteria because its potability is doubtful. Most of the residents of Barangays Linao East and West still use pump well and deep well as their source of water. They still prefer this type of water resource because it cost them less compared to NAWASA but the utilization of pump well and deep well cost them even more if they would be acquiring coliform bacteria, because of the possibility of hospitalization.

Based on the geographical location of Barangays Linao East and West, it is located in low-lying area that made them prone to flood. This environmental catastrophe might be the reason of contamination of pump well and deep well which may lead to different intestinal diseases.

Coliform bacteria may be transmitted by waste of animals and human through fecal oral route. Thus, sanitation and proper hygiene must be practiced by the residents of Barangays Linao East and West. This is one of the reason why the researches would like to embark on this study because through ocular observation made by the researchers, most of the area has poor environmental sanitation such as poor solid waste disposal and excreta disposal that is why their water resources may be contaminated by different microorganisms that will cause several diseases to those residents who will utilize the water.

It is therefore necessary for us, to conduct water supply examination specifically deep well and pump well for us to fully determine whether the drinking water resources does contain or does not contain any organisms which could harm the health and lives of the residents of Barangays Linao East and West.

General Objective

- This study was designed to conduct a bacteriologic analysis on the water resources of Barangays Linao East and Linao West, Tuguegarao City.

Specific Objectives

- To determine the number of pump well and deep well that is contaminated by coliform bacteria.
- To determine the coliform organism specifically *Escherichia coli* that are present in the deep well and pump well.

Scope and Delimitations

This study was confined mainly to the assessment of water potability utilized by the residents in Barangays Linao East and West. Only water samples from deep well and pump well were analyzed. Based on the data gathered by the Barangay officials, (year 2007), status of water supply source by type revealed that the

total number of functional pump well in Linao East(7 zones) is about 50 while Linao West(7 zones) is at least 50.

Fifty water samples were taken as a sample in the seven zones Barangay Linao East and fifty for the seven zones Barangay Linao West, respectively. Samples were gathered and 100 ml. water sample is collected from each pump well. The different water samples were assessed and analyzed for the presence of *Escherichia coli* through Bacteriologic Test conducted in Metropolitan Water District Laboratory, Main Avenue, San Gabriel, Tuguegarao City.

Multiple Tube Fermentation Technique was performed using Lactose Tyryptose Broth as a presumptive test for the identification of coliform bacteria after 24-48 hours incubation period whereas the Brilliant Green Lactose Bile Broth is a confirmatory test after 24 hours incubation period and EC Broth as a completion test to identify the presence of *Escherichia coli* after 24 hours of incubation.

Significance of the Study

Water is a basic need and foundation of life but it can also be the very cause of sickness or even death. Epidemics of water borne disease and water contamination have completely swept the world.

The study is undertaken in response to the need to guide the government in strengthening and formulating programs on treating water. The following agencies will be benefited in this study, the Local Government Unit (LGUs), Department of Health (DOH), Allied Health Workers, residents of Barangay Linao East and Linao West and the future researchers.

The Local Government Units (LGUs) will benefit from the findings of this study as these will serve an avenue for sustaining linkages and support to other government entities and non-governmental organizations (NGOs) through technical and financial assistance for the improvement of water resources.

The Department of Health (DOH) should initiate to conduct a program regarding on the safetiness of the water resources. Therefore this study upon its completion would contribute as their baseline data to serve as their basis in imposing programs and health policies.

This study will also inspire and encourage all the medical and allied health workers of Barangays Linao East and West to conduct periodic examinations in the affected areas of the Barangays. These groups may utilize the results of this study as they are the forefront among health practitioners to advocate the proper environmental sanitation that can affect the contamination of water resources.

The result of this study will be the baseline data in helping the residents of Linao East and West to know whether the water they are using is safe to drink or not. If it exceeds the tolerable limits than that of the results of this study, they may report it to the proper authorities for proper action or treatment.

And finally, to the future researchers who will be engaging in studies the same with this research will have a reference and a guide throughout the conduction of their research. And they will be benefited from this study since they will be expose to another or further investigation of the research work.

METHODOLOGY

This chapter presents the research method, respondents, sampling method, research instruments, data collection techniques and statistical tools that will be utilized in the study.

Research Design

This study was evaluated through the use of Experimental method of research for the reason that the researchers would like to conduct a bacteriologic water analysis to determine for the presence of coliform bacteria specifically *Escherichia coli* from water resources specifically from the deep well and pump well of Linao East and West that may cause water borne diseases.

Locale of the Study

The collection of water samples was conducted in Barangay Linao East and West, Tuguegarao City in which the researchers observed that the area has a poor environmental sanitation and is located in a low lying area that made them prone to flood. The laboratory test was done at the Metropolitan Tuguegarao Water District Laboratory, Main Avenue, San Gabriel, Tuguegarao City.

MATERIALS AND METHODS

Extensive laboratory apparatuses were used to conduct the bacteriological tests. Durham tubes was utilized to collect gas generated by bacterial growth. Pipettes were used to transfer water samples from one tube to another. They were sterilized to prevent sample contamination. Beakers were used to measure the amount of distilled water needed for the dilution of medium. Erlenmeyer flasks were used for dissolving the medium. A stirring rod was also used for mixing. An incubator was used for storage and preservation of LTB, BGLB and EC tubes. A Balance, Analytical and Top loading was used to weigh the Broth needed for the performance of the experimental work.

METHODS

Sampling

Water was used as the experimental unit for bacteriological examination. Fifty(50) water samples had been collected from Barangay Linao East and Fifty

(50) water samples from Linao West, Tuguegarao City and were analyzed for the presence of coliform bacteria as a sign of water contamination.

Water samples were gathered from a pump well and deep well. First, let the water flow for 5 minutes. Then sterilize the tap for a minute with the flame from an ignited candle; alternatively a gas burner or cigarette lighter was used. Allow the water to flow for 1-2 minutes at a medium flow rate. Untie the string fixing the protective paper cover and pull out or unscrew the stopper. While holding the cap and protective cover facing downward (so as to prevent entry of dust that might carry microorganisms), immediately hold the bottle under the water jet and fill. A small air should be left to facilitate shaking at the time of inoculation prior to analysis. Lastly place the stopper in the bottle or screw on the cap and fix the brown paper protective cap in place with the string.

Analytical Procedure

Presumptive Test for Total Coliforms

If the sampling bottle is completely full, aseptically pour out 20-30 mL of the water and replace cap. Shake the sample by moving the bottle up and down across 1ft radius for 10 seconds.

First, aseptically transfer 10 mL of the sample into each of the 10 LTB tubes. Alternatively, transfer 20 mL sample to each of the 5 LTB tubes. Mix gently. Incubate LTB tubes $35\pm 0.5^{\circ}\text{C}$ for 24 ± 2 to 48 ± 3 hours. After 24 hours, examine the tubes for gas production. The presence of gas is a presumptive evidence of coliform bacteria. Take note of the presumptive positive (gassing) tubes after 48 ± 3 hours of incubation. Record results. Subject all positive LTB tubes and very turbid non gassing (negative) tubes to confirmed test. Discard clear and turbid tubes that do not produce gas after 48 ± 3 hours of incubation.

Confirmed Test for Total Coliforms

Gently agitate each positive LTB tube and transfer three loopfuls of the culture into a BGLB tube (and EC, see confirmed cells for fecal coliforms). Incubate BGLB tubes at $35\pm 0.5^{\circ}\text{C}$ for 24 ± 2 to 48 ± 3 hours. Examine the tubes for gas production and record the number of positives tubes. Read the Most Probable Number (MPN) of total coliform per 100 mL sample Table 3 using 10 of 10-mL sample volumes. Record results.

Completion Test for Fecal Coliforms

Gently agitate each positive BGLB tube and transfer three loopfuls of the culture into an EC tube. Incubate EC tubes in water bath incubator maintained at $44.5\pm 0.2^{\circ}\text{C}$ for 24 ± 2 hours. Place EC tubes in the water bath incubator within 30 minutes after inoculation. Maintain sufficient water to immerse tubes to level of the medium. Examine for gas production and record the number of positive tubes. Read the Most Probable

Number (MPN) of fecal coliform per 100 mL sample from Table 3 using 10 of 10-mL sample volumes. Record results.

Respondents and Sampling Method

The respondents of the study include residents of Barangays Linao East and West who are utilizing deep well and pump well as their drinking water source. The samples were taken from deep well and pump well.

Collection and Processing of Data

In the completion of the first three chapters of the study the following were done by the researcher: On the gathering of data, a letter was made addressed to the Barangay Chairmen of Linao East and West, Tuguegarao City for the collection of information with regards on the number of pump well and deep well utilized in the aforesaid vicinities, and also for the gather of information on the number of cases of water borne diseases.

One hundred (100) samples were obtained from the two Barangays. The respondents were chosen

through stratified randomization. Prior to collection of water samples the researchers first flamed the mouth of the pump well and let the water flow for sterilization purposes and the researchers placed the samples in a sterilized bottles. The samples immediately brought to the laboratory for its analysis. The researchers performed Bacteriological analysis of the water samples using Multiple Tube Fermentation Technique (LTB, BGLB and EC broth) for the determination of coliform bacteria.

Statistical tool for Data Analysis

The data gathered were statistically measured with the use of mean, frequency counts and percentages.

PRESENTATION AND INTERPRETATION OF DATA

This chapter presents the findings of the study. The data were organized and presented in a table form for easy understanding. The table was supplemented with interpretations and discussions.

Table 1. Frequency count and Percentages of Water Potability (pump well) in Barangay Linao East and West

Barangay	Non-potable		Potable		Total
	Frequency	%	Frequency	%	
East	29	58	21	42	50
West	15	30	35	70	50

Based on the table 1, it shows that there are 29 number or 58 % of water samples in Barangay Linao East and 15 number or 30 % of water samples in Barangay Linao West that were found to be contaminated of Escherichia coli. There were 21 or 42 % in Barangay Linao East and 35 number or 70 % of water resources in Barangay Linao West taken from pump wells are considered potable.

The possible reason for this outcome is the Geographical location of Barangays which is located in a low lying area. Since Barangay Linao East is situated in a lower area compared to Linao West, there is greater number of contaminated water samples in Barangay Linao East for the reason that they suffered most of the burdens brought about by frequent floods. Moreover, the place has a poor environmental sanitation such as poor solid waste disposal and excreta disposal that may lead to water contamination. Aside from this, pump wells are not being monitored and treated against pathogenic microorganisms. Deep wells are not included as a water sample because it is not already functioning due to El Niño phenomenon.

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Summary of Findings

Results shows that there are 29 or 58% water samples for Barangay Linao East and 15 or 30% water

samples in Barangay Linao West that are contaminated with Escherichia coli. Basically, there are some intermingling reasons for the occurrence of this output such as the following:

The Metropolitan Water District Laboratory is conducting water testing every month. Analysis and treatment of water samples focuses mainly on NAWASA. In connection to this, there is no agency designated to monitor and treat pump wells and deep wells against coliform bacteria. This is the reason why there is a great number of contaminated water in pump wells.

Based on the Geographical location, Barangay Linao East is at lower area compared to Barangay Linao West that is why Linao East suffered most of the negative effect carried out by frequent flood. Furthermore, most of the Barangays are in unsanitary conditions and have such poor hygiene behaviors that their exposure to risks of incidence and spread of pathogenic microorganisms, are enormous. Multiple Tube Fermentation Technique is a reliable method used to analyze drinking and non-drinking water. This is a standard technique recommended by the Department of Health.

Conclusions

Based on the findings of the study, the researchers conclude that among the 100 water samples taken from pump wells that have been analyzed, there are 29 water samples in Barangay Linao East and 15 water samples in Barangay Linao West are positive of Escherichia Coli, consequently, there are water resources that are not safe for human consumption. It further concludes that different factors such as easily flooded area and poor environmental sanitation are a cause for water contamination.

Recommendations

Based on the results of this study, the following recommendations are visualized:

- The use of Multiple Tube Fermentation Technique is specifically for Escherichia coli. It is recommended that future researchers should conduct IMVIC test for the determination of the other coliform bacteria not only Escherichia coli but also for Shigella and Salmonella.
- The Department of Health (DOH) in cooperation with Local Government Unit (LGU) together with City health Office (CHO) and the Barangay Officials of Linao East and Linao West should conduct an information dissemination regarding the results of the water analysis conducted by the researchers in order for the people to be aware on the quality of water they are utilizing and also to implement alternative ways to minimize water contamination such as chlorination and boiling of water.
- It is recommended that instead of performing confirmatory test using BGLB and completion test using EC Broth, the future researchers can use Eosin Methylene Blue for detection and isolation of Escherichia Coli since it is less time consuming and more economical to use.
- It is also recommended that future researchers that will conduct studies related to this must also include other supplemental test such as colony counting which will make their study more specific and reliable.

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