ASSESSMENT OF DRINKING WATER QUALITY IN TINGLOY ISLAND THROUGH MULTIPLE TUBE FERMENTATION TECHNIQUE

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ABSTRACT

Water is considered as one of the most basic necessities of human beings. As a matter of fact, water is of major importance to all living things. Up to 60% of the human adult body is composed of water-- the brain and the heart are composed of 73 % water. Therefore, the researchers studied the drinking water of Barangay Corona, Municipality of Tingloy. The researchers had chosen multiple tube fermentation techniques as their method for laboratory analysis as it detected coli form bacteria which are a very broad group of bacteria that impose risk to human health. They had chosen 30 different sites from Barangay Corona to examine. The researchers transported the samples, preserved in a cooler with ice. Then, they mixed Lauryl Tryptose Broth with water. If coliform bacteria is present in the water, it will induce fermentation which is concluded by gas formation and cloudy appearance. All 30 sites tested were positive. The researchers gathered some data from the Municipal Health office, and it reaffirmed that the deep wells in Barangay Corona were breeding areas of Coliform Bacteria.

Key words: *Drinking Water Quality, Tingloy Island, Multiple Tube Fermentation Technique*

INTRODUCTION

Water has always been an important resource worldwide because humans need water to survive. Drinking water or potable water exhibits a high standard or quality that can be consumed or used without risking one's health. Most of the water that people normally

consume require different types of treatment. Drinking water varies from place to place, and the treatment depends on the source of water. The WHO (2000) reports that polluted drinking water causes death of about 1.8 million people from diarrheal diseases annually worldwide.

Access to drinking water and sanitation is a global concern. Some countries do not worry too much about drinking water, either tap or not. On the other hand, Southeast Asia is unfortunately one of the countries where sanitation is a huge concern. In the Philippines, it is not advisable to drink water directly from the faucet without any means of filtration or boiling. Hence, water stations are abundant, especially in major cities and more developed places in the country. However, there are several places and areas that lack filtration systems, including Tingloy, the only island municipality in the province of Batangas, where diarrhea is ranked 8th (4.66%) in the leading causes of morbidity. People are still dependent on unprotected and unimproved water sources in this area. The use of wind power has been successfully piloted in generating and pumping water from a deep well source for potable water supply distribution to residents and visiting tourists in the scenic island municipality of Tingloy in Batangas. (LWUA, 2010).The deep well is 10-20 meters deep.

Tingloy comprises Maricaban Island, Caban Island, and other minor islets. It is starting to be recognized as one of the popular tourist spots in the Philippines for its pristine and breathtaking beaches. There are several attractions that Tingloy Island can offer namely Masasa Beach, Isla Sombrero, Mapating Beach, Layag Layag Point, Caban Island Beach, Fortales Beach and Bahay Kambing. The increasing number of tourists every year may greatly affect its environment and residents, posing a risk to everyone who utilizes the deep well water source.

According to the Philippine Statistics Authority, the municipality has a land area of 33.07 square kilometers, constituting 1.06% of the 3,119.75-square-kilometre total area of Batangas. Tingloy is politically

subdivided into 15 barangays. In the 2015 census, Tingloy had a population of 17, 919. The population density was 540 inhabitants per square kilometer.

Batangas has been well-known for having farms, perfect for poultries and livestock. Operating a piggery requires monitoring of its environmental impact.

Water quality plays a vital role in one's health. Acceptable quality shows the safety of drinking water in terms of its physical, chemical, and bacteriological parameters (WHO, 2004). According to WHO (2004), in most countries, the principal risks to human health associated with the consumption of polluted water are microbiological in nature. The bacteriological examination of water has a special significance in pollution studies, as it is a direct measurement of deleterious effect of pollution on human health. Coliforms are the major microbial indicator for monitoring water quality.

The most accurate number of coliform bacteria is obtained by testing a large sample of water. Total coliforms can be detected and enumerated in the multiple-tube technique. In this method, coliforms are detected in two stages. In the presumptive test, fermentation of lactose to gas is a positive reaction. Samples from the positive presumptive tube at the highest dilution are examined for coliforms by inoculating a differential medium in the confirmed test (Johnson &Case, 2010).

METHODOLOGY

This chapter presents the Research Design, Research Locale, Research Instruments, Data Gathering Procedure, and Data Analysis

Research Design

This study used experimental type of research design, with random samples. It utilized test configuration so as to guarantee that the correct sort of information, and an adequate specimen size and power were accessible to the analysts.

Research Locale

Corona, a specific barangay in Tingloy, involves fishing and piggery as their livelihood. It has 211 households, 274 families, and a total of 984 for the population of the area. Only 157 (74%) of the total households have their own toilets. The remaining 26% still lack access to proper toilets, and defecate through open-pit.

A total of 50 deep wells are located in six sites within the barangay. Fourteen wells are in Sitio Gumamela, 11 in Orchids, 4 in Ilang-Ilang, 8 in Sampaguita and Rose, and lastly, 5 in Sitio Rosal.

Materials

The researchers used the water that was collected from pumps as their sample. The sample was tested using a Lauryl Tryptose Broth. Following the Multiple Fermentation Tube technique was the use of incubator for growing, insulating, and further investigating of the presence of coliform bacteria. The materials used in the study included water container, incubator tubes plug, fermentation tube, vials, autoclave,, Lauryl Tryptose Broth Pipets and graduated cylinder.

Procedure

Permission to collect samples was secured by the researchers from the Captain of Brgy. Corona, Tingloy Island. Afterwards, the researchers proceeded directly to LPU-St Cabrini College of Allied Medicine Instrumentation Room to continue the laboratory experiments and examinations.

Sample Collection

The volume of sample should be sufficient to carry out all the test required, preferably not less than 2000mL. After all the sample was collected, the researchers left ample air space (at least 2.5cm) to facilitate mixing through shaking.

The researchers collected samples for microbiological examination in non-reactive clear bottles that have not been used. The sampling bottles were provided with plastic screw caps, and ensured that the use of these caps produced nontoxic compounds during sterilization. They covered tops and necks of sample bottles with thin aluminum foil before sterilization

They started Multiple Tube Fermentation Technique analysis of water as soon as they reached the school grounds from Tingloy to avoid unpredictable changes in microbial population. The researchers ensured that the samples were not exposed to light. Iced cubes in the cooler were used to keep the samples in a cool temperature. Keeping the samples between 4 degrees Celsius but not frozen. It reduced the changes that may occur in the bacterial content of the water on storage.

Procedure:

A.Multiple Tube Fermentation Technique

A Test for the Coliform Group

Presumptive Test for Coliform Organism;

a) Shake the water sample 25 times, through an arc of approximately one foot in a time limit not exceeding 7 seconds.

b) Using a sterile 10 ml. pipette, transfer 10 ml. of water sample to each of the large lactose fermentation tubes containing 10 ml, of double strength lactose broth.

c) Incubate all the inoculate lactose fermentation tubes at 34 c for 24 or 48 hours. If EC medium is used, incubate at 45.5 C.

d) After incubation, examine each tube for gas. If no gas has been formed, the tubes should again be incubated for another 24 hours and reexamined for gas. Presence of gas at each examination regardless of the amount of gas is recorded. The presence of gas is a presumptive evidence of coliform organism. Do not confuse air bubbles with actual gas production. If gas is formed, the broth medium will become cloudy and active fermentation may be shown by continued appearance of small bubbles of gas throughout the medium when the tube is gently shaken.

Absence of gas at the end of 48 hours incubation constitute negative test. No other examination needed.

e) All primary fermentation tubes showing gas at the end of 24 or 48 hours should be subjected to the confirmed test, may have many other organisms aside from coliform group that ferment lactose.

2. Confirmatory test

a) Divide one or two Eosin- methylene blue agar plate into sectors and streak into each a loop full of inoculums from a positive presumptive lactose broth tube. Incubate at 34 C for 24 hours.

b) Examine the EMB plates for presence of colonies of coliform bacteria which are purplish red in color, 2 to 5 mm. in diameter, and with a characteristic metallic sheen when viewed with reflected light. The presence of these colonies constitutes a positive confirmatory test.

Morphological and Gram staining studies must be made from typical colonies to establish other characteristic of the coliform group.

B. Colilert

Methodology

Add one packet of powder to the 100 ml water sample in a sterile, non-fluorescing vessel. Cap and shake the vessel to dissolve the powder. Incubate at 35 degree Celsius for 24 hours. Read the results at 24 hours (before 28 hours) and compare against the comparator, the presence of total comparator. The presence of total coliform is confirmed. If yellow, check for blue fluorescence by placing a 6W, 365 nm UV light within 5 inches of the sample. If the fluorescence is greater or equal to the fluorescence of the comparator the presence of E.coli is confirmed.

For MPN analysis (5,10,15 tube for serial dilution) pour the sample reagent mixture directly into a quanty tray, and seal according to instructions. Incubate and read the results as indicated above. Count the number of positive yellow wells and the number of yellow and blue fluorescent wells. Determine the MPN /100ml using table provided with the Quanti – Tray. Incubate for 35 degree Celsius. Long wavelength 365 nm ultra violet lamp for fluorescent reading, Reagents (comparators) in identical sample vessel for evaluation of color and fluorescence in samples.

Data Analysis

The data of Multiple Tube Fermentation Technique was acquired through laboratory techniques, and was analyzed based on fermentative characteristics of the sample. The researches counted the positive tubes based on gas formation and cloudiness of the sample. The statistics treatment used was a descriptive – experimental research method.

The Colilert data was acquired from the Municipality of Tingloy Health Office. The sanitation officers and social workers were the ones who processed the samples from different Barangays.

RESULTS AND DISCUSSION

This chapter elaborates more on the findings gathered from the laboratory examinations. This chapter provides the data gathered from the Municipal Health Office with the result refers to the coliform presence in the Municipality of Tingloy.

Based on the results, the researchers would discuss about the critical data gathered and relevance to the health of the community. Positive reaction from Multiple Tube Fermentation technique is measured, if gas is formed. The medium will become cloudy, and active fermentation may be shown by continued appearance of small bubbles of gas throughout the medium when the tube is gently shaken.

Drinking Water Microbial Test Results Using Colilert Technique

Table 1. Water Analysis in Poblacion 13 Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT1	SITIO DIAMANTE	NEGATIVE
RESIDENT 2	SITIO DIAMANTE	NEGATIVE
RESIDENT 3	SITIO RUBY	NEGATIVE
RESIDENT 4	SITIO PERLAS	NEGATIVE
RESIDENT 5	SITIO PERLAS	NEGATIVE
RESIDENT 6	SITIO PERLAS	NEGATIVE
RESIDENT 7	SITIO PERLAS	NEGATIVE

All of the seven sampling sites tested were negative in Poblacion 13 Tingloy Batangas. This indicated zero presence of coli form bacteria in any of the sites that underwent examination.

Table 2. Water Analysis in Poblacion 14 Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	PUROK ADELFA	NEGATIVE
RESIDENT 2	PUROK ADELFA	NEGATIVE
RESIDENT 3	PUROK ROSE	NEGATIVE
RESIDENT 4	PUROK ROSE	NEGATIVE
RESIDENT 5	PUROK SAMPAGUITA	NEGATIVE
RESIDENT 6	PUROK SAMPAGUITA	NEGATIVE
RESIDENT 7	PUROK SAMPAGUITA	NEGATIVE

All of the seven sampling sites tested were negative in Poblacion 14 Tingloy, Batangas. This indicated zero presence of coliform bacteria in any of the sites that underwent examination.

Table 3. Water Analysis in Poblacion 15 Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	SITIO ATIS	POSITIVE
RESIDENT 2	SITIO ATIS	NEGATIVE
RESIDENT 3	SITIO ATIS	POSITIVE
RESIDENT 4	SITIO ATIS	NEGATIVE
RESIDENT 5	POBLACION 15	POSITIVE
RESIDENT 6	SITIO CHICO	NEGATIVE
RESIDENT 7	SITIO SAMPAGUITA	NEGATIVE
RESIDENT 8	SITIO CHICO	POSITIVE
RESIDENT 9	SITIO MANGGA	NEGATIVE
RESIDENT 10	SITIO UBAS	POSITIVE

Five out of ten sampling sites tested were negative in Poblacion 15 Tingloy Batangas. This indicated 50%presence of coliform bacteria in the sites that underwent examination.

Table 4. Water Analysis in Barangay San Juan Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	SITIO YELLOW BELL	NEGATIVE
RESIDENT 2	SITIO YELLOW BELL	NEGATIVE
RESIDENT 3	SITIO YELLOW BELL	POSITIVE
RESIDENT 4	SITIO YELLOW BELL	POSITIVE

Two out of four sampling sites tested were positive in San Juan Tingloy Batangas. This indicates 50%presence of coliform bacteria in the sites that underwent examination.

Table 5. Water Analysis in Sitio Lambingan Barangay Papaya Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	SITIO LAMBINGAN	NEGATIVE
RESIDENT 2	SITIO LAMBINGAN	POSITIVE
RESIDENT 3	SITIO LAMBINGAN	POSITIVE
RESIDENT 4	SITIO LAMBINGAN	POSITIVE
RESIDENT 5	SITIO LAMBINGAN	POSITIVE

Four out of five sampling sites tested were positive in Poblacion 14 Tingloy Batangas. This indicates 80% presence of coliform bacteria in the sites that underwent examination.

Table 6. Water Analysis in Barangay Pisa Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORIM
RESIDENT 1	MAHOGANY PISA	POSITIVE
RESIDENT 2	NARRA	POSITIVE
RESIDENT 3	MAHOGANY PISA	POSITIVE
RESIDENT 4	NARRA	POSITIVE
RESIDENT 5	SITIO ILANG ILANG	POSITIVE
RESIDENT 6	NARRA	POSITIVE
RESIDENT 7	SITIO ILANG ILANG	POSITIVE

Seven out of seven sampling sites tested were positive in Brgy. Pisa Tingloy Batangas. This indicates 100%presence of coliform bacteria in the sites that underwent examination

Table 7. Water Analysis in Barangay Corona Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	SITIO ROSE	NEGATIVE
RESIDENT 2	CORONA	POSITIVE
RESIDENT 3	SITIO GUMAMELA	POSITIVE
RESIDENT 4	SITIO ROSE	POSITIVE

Table 7 continued…

RESIDENT 5	SITIO GUMAMELA	POSTIVE
RESIDENT 6	SITIO ORCHIDS	POSITIVE
RESIDENT 7	SITIO ORCHIDS	POSITIVE
RESIDENT 8	SITIO SAMPAGUITA	NEGATIVE
RESIDENT 9	SITIO SAMPAGUITA	POSITIVE
RESIDENT 10	SITIO ROSE CORONA	POSITIVE
RESIDENT 11	SITIO ORCHIDS	POSITIVE

Nine out of eleven sampling sites tested were positive in Brgy.Corona Tingloy Batangas. This indicates 82%presence of coliform bacteria in the sites that underwent examination.

Table 8. Water Analysis in Barangay San Isidro,Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	BUGTONG SAN ISIDRO	NEGATIVE
RESIDENT 2	BANALO SAN ISIDRO	NEGATIVE
RESIDENT 3	SAN ISIDRO	POSITIVE
RESIDENT 4	SAN ISIDRO	POSITIVE
RESIDENT 5	SAN ISIDRO	POSITVE

Three out of five sampling sites tested were positive in Brgy.San Isidro, Tingloy Batangas which indicate 60%presence of coliform bacteria in the sites that underwent examination.

Table 9. Water Analysis in Barangay Gamao, Tingloy

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RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	SAN PEDRO I GAMAO	POSITIVE
RESIDENT 2	SAN PEDRO II GAMAO	POSITIVE
RESIDENT 3	SITIO AURORA GAMAO	POSITIVE
RESIDENT 4	SITIO AURORA GAMAO	POSITVE
RESIDENT 5	POSO GAMAO	POSITVE

Five out of five sampling sites tested were positive n Brgy. Gamao, Tingloy Batangas which indicate 100%presence of coliform bacteria in the sites that underwent examination.

Table 10. Water Analysis in Barangay San Pedro Tingloy Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	POROK BAGONGSIKAT II	POSITIVE;
RESIDENT 2	PUROK SAN MATEO	POSITIVE
RESIDENT 3	PUROK BAGONGSIKAT I	POSITIVE

Table 10 continued…

RESIDENT 4	REBOMA ORIENTAL	POSITVE
RESIDENT 5	REBOMA ORIENTAL	POSITVE
RESIDENT 6	REBOMA OCCIDENTAL	POSITIVE
RESIDENT 7	REBOMA OCCIDENTAL	POSITVE
RESIDENT 8	REBOMA OCCIDENTALQ	POSITVE
RESIDENT 9	PUROK BAGONG SILANG	POSITIVE
RESIDENT 10	REBOMA OCCIDENTAL	POSITIVE

Eleven out of eleven sampling sites tested were positive in Poblacion 14,Tingloy, Batangas. It indicates 100%presence of coliform bacteria in the sites that underwent examination.

Table 11. Water Analysis in Barangay Makawayan, Tingloy, Batangas

NAME	LOCATION	TOTAL COLIFORM
MYLENE ROSALES	SITIO ADELFA	POSITIVE
LOURDES REYES	SITIO ADELFA	POSITIVE
ARNOLD DELACRUZ	SITIO EVERLASTING	POSITIVE
CLERENCE CUASAY	SITIO CABALERO	NEGATIVE
EDUARDO TOLENTINO	SITIO BOUGAINVILLEA	POSITIVE

Table 11 continued…

MAKAWAYAN	SITIO GUMAMELA	NEGATIVE
ERLINDA BACAL	SITIO GUMAMELA	POSITIVE
JOSEPHINE SALAZAR	SITIO ADELFA	POSITIVE
ROMELITO CUASAY	SITIO ADELFA	POSITIVE
JENNIFER BACAL	SITIO ILANG ILANG	POSITIVE

Eight out of ten sampling sites tested were positive in Brgy. Makawayan, Tingloy Batangas which indicate 80%presence of coliform bacteria in the sites that underwent examination.

Table 12. Water Analysis in Barangay Talahib,Tingloy, Batangas

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	PUROK 5	NEGATIVE
RESIDENT 2	PUROK 2	POSITIVE
RESIDENT 3	PUROK 1	POSITVE
RESIDENT 4	PUROK 2	POSITIVE
RESIDENT 5	PUROK 1	POSITIVE
RESIDENT 6	PUROK 4	POSITIVE
RESIDENT 7	PUROK 3	POSITIVE
RESIDENT 8	PUROK 2	POSITIVE
RESIDENT 9	PUROK 5	NEGATIVE
RESIDENT 10	PUROK 5	POSITIVE

Eight out of ten sampling sites tested were positive in Brgy.Talahib, Tingloy Batangas, which indicate 80% presence of coliform bacteria in the sites that underwent examination.

Table 13. **Water Analysis in Barangay Papaya Tingloy, Batangas**

RESIDENT NUMBER	LOCATION	TOTAL COLIFORM
RESIDENT 1	PINGKILUHAN PAPAYA TINGLOY	POSITIVE
RESIDENT 2	PINGKILUHAN PAPAYA TINGLOY	NEGATIVE
RESIDENT 3	PINGKILUHAN PAPAYA TINGLOY	NEGATIVE
RESIDENT 4	LAMBINGAN PAPAYA TINGLOY	NEGATIVE
RESIDENT 5	PINGKILUHAN PAPAYA TINGLOY	POSITIVE
RESIDENT 6	CANDALERO PAPAYA TINGLOY	NEGATIVE
RESIDENT 7	PINGKILUHAN PAPAYA TINGLOY	POSITIVE
RESIDENT 8	CANDALERO PAPAYA TINGLOY	POSITIVE
RESIDENT 9	CANDALERO PAPAYA TINGLOY	POSITIVE
RESIDENT 10	PINGKILUHAN PAPAYA TINGLOY	POSITIVE
RESIDENT 11	PINGKILUHAN PAPAYA TINGLOY	NEGATIVE
RESIDENT 12	PINGKILUHAN PAPAYA TINGLOY	POSITIVE

Seven out of twelve sampling sites tested were positive in Brgy. Papaya, Tingloy Batangas. This indicates 58% presence of coliform bacteria in the sites that underwent examination.

Based on the data that the researchers gathered from the Municipal Health Office, the top 3 spot contaminated with coliform

bacteria are as follow, Brgy. Gamao, Brgy. Pisa, and Brgy. San Pedro, with 100% of contamination. The possibility of contamination of the source of water also lies with the environment factor, particularly the poultry and piggery near private wells in each household (Dono et al. 2016). Agriculture and livestock hardly affect the fecal bacteria presence in drinking water. This kind of sanitation issues is experienced in different countries and poor communities. According to Naziah Darvesh et al. (2017), globally one fourth of the population still have no access to clean water and still defecate in open-pit. These unsanitary practices widely increase chances of deep well water fecal contact. Livestock and unsanitary personal hygiene are the major components that lead to high level of fecal bacterial contamination.

Poblacion 15 and Brgy. San Juan share the lowest level of fecal bacterial contamination based in Colilert Method with 50%. According to Beer (2014), with the appropriate steps, actions and continued vigilance of the public regarding sanitation, the quality and safety of water can be assured. Considering that Poblacion and Brgy. San Juan are near the center of Municipal Government of Tingloy, they might have better hygienic practices compared to other barangays. But still 50% level of contamination rings a bell for the Municipal government.

Table 15. Percent of positivity based in Multple Tube Fermentatio Technique

Multiple Tube Fermentation Technique		
Number of Tubes positivity	Number of Sites	Percent of
1tube	4	13.33%
2tubes	5	16.66%
3tubes	13	43.33%
4tubes	7	23.33%
5tubes	1	3.33%

There were 4 sites that got 1 tube positive with 13.33% positivity rate, 5 sites got 2 tubes positive with 16.66% of positivity, 13 sites got 3 tubes positive with 43.33% of positivity, 7 sites got 4 tubes positive with 23.33% positivity, and 1 site got 5 tubes positive with 3.33%positivity. A total of 30 sites were tested, with 30 sites had 100 % positivity in Multiple Tube Fermentation Technique.

Table 16. Percent of positivity based in Colilert Method

Colilert Technique			
Site Number positivity Tested	Number of site Site	Number of Positive	Percent of
1	3	2	66.67%
2	1	1 100%	
3	2	2 100%	
4	3	3 100%	
5	2	1	50%
TOTAL	11	9	82%

There were 3 sites tested and 2 got positive with 66.67% positivity in site number 1. There was 1 site tested and 1 got positive with 100% positivity in site number 2. There were 2 sites tested and 2 got positive with 100% positivity in site number 3. There were 3 sites tested and 3 got positive with 100% positivity in site number 4. There were 2 sites tested and 1 got positive with 50% positivity in site number 1. A total of 11 sites were tested and 9 got positive with 82 % positivity in colilert method.

Table number 15 represented the data acquired by the researchers through laboratory procedure which is entitled Multiple Tube Fermentation Technique. While table number 16 was the data gathered by the researchers from the Municipal Health Office of Tingloy, Batangas.

The most number of tube that tested positive were 3 tubes which was 43.33%, while 1 tube got all 5 tubes tested positive equivalent to 100% through Multiple Tube Fermentation Technique. In Colilert Method, there was a total of 11 sites randomly chosen to be tested. In site numbers 2, 3, and 4, they got 100 % positivity with site number 5 as the lowest with 50% positivity.

The colilert data is acquired from the Municipal Health Office through their own examination.

Cost Analysis

The cost in supplies for a negative MF analysis was between 150PhP and 212PhP. The cost in labor was approximately 125PhP. This labor cost included not only the actual hands-on laboratory analysis time but also the cost of production and quality control of the medium. If there were positive colonies, the cost of a positive test, in labor and materials, averaged 275PhP. (Federal Register, vol. 53, no. 88, May 6, 1988, p. 16348). The cost of MF and MTF analysis will be appreciably higher under the new coliform rule requiring fecal or E. coli differentiation of positive samples.

The Multiple Fermentation Technique costs vary, if it will test positive from the presumptive level of examination or vice versa. 1 site needs 5 tubes to be tested that costs 20PhP each. The researchers needed a total of 5 tubes, 100PhPper site. The researchers needed a total of 5 Durham tubes, 45PhP per site, 1500PhP for the broth for 30 sites costs 50PhP per site, 10PhP for specimen bottle per site, 500PhP for the consumables like cotton, yarn, ice, newspaper and 17PhP per site. If tested positive, additional 150Php per site which tested positive

for the growth medium and disposable petri dish, 195Php for presumptive test and additional 150Php for confirmatory are needed. A total of 345 per test, if tested positive from presumptive test is necessary.

CONCLUSIONS

The Colilert Method which was conducted by the Municipal Health Office determined the presence of Coliform Bacteria in 10 out of 12 sampling areas, chosen randomly with different prevalence rate. Barangay Gamao and Barangay San Pedro got 100 % positivity from coliform bacteria contamination. While Barangay Corona got 82% contamination rate from coliform Bacteria through Colilert .Multiple Tube Fermentation Technique conducted by the researchers, 30 out of 30 sites tested positive from coliform Bacteria.

There was 18% gap between Multiple Tube Fermentation Technique and Colilert examination. Both techniques suggest that Barangay Corona drinking water was contaminated with Coliform Bacteria. Multiple Tube Fermentation Technique had higher results compared to Colilert. It was more economical to use Colilert method rather than the Multiple Tube Fermentation Technique because it cost less amount of money. Compared to Colilert, Multiple Tube Technique used 5 tubes, while on the other hand, it only used 1 tube. Colilert can also significantly identify the presence of E.*coli* through the use of UV light. Colilertis was best to be used in an Island like Tingloy because of its innovative properties.

RECOMMENDATIONS

Based on the study conducted, the researchers offer the following recommendations:

Increase the level of awareness of the community to further educate and develop their hygiene practices. Giving attention to unimproved water sources may reduce the rural people's immediate consumption of polluted water. Advise them to protect their drinking source from direct contact with animals particularly the piggery and poultry in their lot. There is an urgent need for emergency steps to stop further water quality deterioration, and improve the present quality to protect the public from waterborne diseases.

The Municipality of Tingloy can provide a water qualifying body in the island to ensure that the people drink uncompromised water by testing the water sources as often as possible.

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