Short Research Article

ENUMERATION OF COLIFORMS IN DRINKING WATER SOURCES OF SELECTED BARANGAY IN STA. MARIA, DAVAO OCCIDENTAL PHILIPPINES

ABSTRACT

Aims: The study aimed to determine the presence of coliforms in selected drinking water sources of Sta. Maria, Davao Occidental.

Study design: Three (3) barangays were identified as sampling sites, namely: Barangay Pongpong, Barangay San Isidro, and Barangay San Roque, where spring water, Jetmatic, and manual water pump are the sources of water as samples.

Place and Duration: The study was conducted at Sta Maria, Davao Occidental Philippines from August 2021-December 2021.

Methodology: The quantitative determination of coliforms was conducted using the Petrifilm Method. The samples were analyzed in the SPAMAST Microbiology Laboratory.

Results: Microbial analysis detected the non-fecal coliforms in all sampling sites, particularly the spring water source from Barangay Pongpong, manual water pump and spring water source from Barangay San Isidro and the manual water pump from Barangay San Roque. Meanwhile, no coliforms were detected at Jetmatic source from Barangay Pongpong, Sta Maria, Davao Occidental Philippines.

Conclusion: Generally, the drinking water sources of the three (3) Barangays are above the standard set by Department of Environment and Natural Resources and World Health Organization. Periodic monitoring of the drinking water sources from the selected barangays is highly recommended.

Keywords: Drinking water, Microbiology, Coliform, Public Safety

INTRODUCTION

An adequate, safe and accessible water supply is highly essential to human life. Improving access to safe drinking water can provide health benefits to health. The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international policy forums[1]. Water regulates the internal heat level and gives the premise to body liquids and digestion[2].

Many people struggle to obtain access to safe water. A clean and treated water supply to each house may be the norm in Europe and North America but in the developing countries, access to both clean water and sanitation are not the rule, and waterborne infections are common. Worldwide, waterborne diseases are the cause of the death, and suffering of millions of people, especially, children in developing countries[3].

In the Philippines, people living in rural areas are dependent on groundwater as their source of water. The water is widely utilized for various rural and urban domestic purposes such as drinking, cooking, washing, bathing, and in agriculture and industry. It is recorded that at present, 15.73 million Filipinos live in 212 waterless barangays in Metro Manila and in 432 waterless municipalities in the rest of the country without access to safe water supply[4].

The study of quantitative determination of coliforms in selected drinking water sources of Sta. Maria, Davao Occidental, Philippines, is unique to other studies due to the fact that the Petrifilm™ method is convenient and accessible for determination of coliforms in water. Water resources differ from province to province based on several factors like population density, rainfall patterns, watershed quality, and the rate of groundwater recharge[5].

Flow rules suggest the utilization of Escherichia coli (EC) or thermotolerant ("fecal") coliforms (FC) as markers of fecal tainting in drinking water. Confirmation of E. coli in a water system indicates recent fecal contamination, which may pose an immediate health risk to anyone who consumes the water[6].

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In Sta Maria, Davao Occidental, Philippines, there are no reported data regarding the monitoring and keeping of water sources for safe consumption. The said water sources are water pumps, flowing, and spring water. This study focuses on the determination of coliforms in selected drinking water sources of Sta Maria, Davao Occidental, Philippines. This would benefit the residents of the said barangays as well as the whole municipality, for the people would be aware of the composition of their water drinking sources.

The goal of the study was to accurately determine the bacteria within the drinking water sources of selected barangays in Sta Maria, Davao Occidental using a Petrifilm method. The research aimed to detect and quantify the presence of coliform count in the selected drinking water sources of Santa Maria, Davao Occidental Philippines.

Specifically, it aims to;

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1. To determine the following indicator microorganisms in the three selected Barangays in Sta. Maria, Davao Occidental;
   1.1 Escherichia coli
   1.2 Total coliform
2. To compare the result of coliform analysis on the drinking water from the selected barangays and based on the standard set by DENR:

   2.1 Barangay Pongpong, Sta. Maria, Davao Occidental
   A. Spring/Flowing Water
   B. Manual Jetmatic)

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   2.2 Barangay San Isidro, Sta. Maria, Davao Occidental
   A. Flowing Water
   B. Manual Water Pump
   2.3 Barangay San Roque, Sta. Maria, Davao Occidental
   A. Manual Water Pump

METHODS

The study was conducted at Sta Maria, Davao Occidental, Philippines. Three selected in Barangays of Sta. Maria, Davao Occidental. The distance between Barangay Pongpong to Barangay San Isidro is about 500 meters, Barangay San Isidro to Barangay San Roque is 1 kilometer, and Barangay Pongpong to Barangay San Roque is estimated to have a distance of 1.5 kilometer. Barangay Pongpong has a population of 2,168 making up the 3.77% of the overall population of Sta. Maria Davao Occidental. Barangay San Isidro is a barangay in Sta. Maria Davao Occidental with a population of 2,955; they consist of the 5.14% of the total population of the said municipality. Barangay San Roque holds 1,658 individuals based on the 2020 census and has a 2.29% growth rate.

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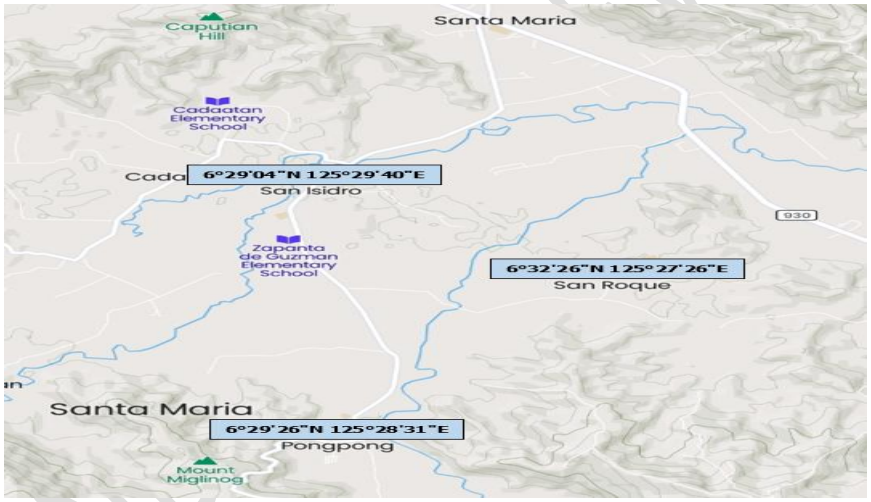

Figure 1. Showing the Map of Sta. Maria Davao Occidental

This study utilized an experimental research design. Experimental research aimed to determine the coliforms of drinking water in selected barangay in Sta Maria, Davao Occidental Philippines. The dependent variables were the 3M Petrilm method microbiological analysis. Purposive sampling technique was the sampling technique employed in the study. Water samples from the various water sources of the three (3) Barangay were collected and tested for coliforms. The schemed of the experimental set-up

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for study of determination of coliform in selected drinking water sources of Sta Maria, Davao Occidental Philippines.

The researchers determined the sites and types of water sources in selected barangays in Sta. Maria, Davao Occidental, Philippines, the site one (1) was the Barangay Pongpong and the water sources are; flowing water and manual Jetmatic. The site two (2) was the Barangay San Isidro and water sources are; flowing water and manual water pump. The site three (3) was the Barangay San Roque and the water source is a manual water pump. There are three (3) samples collected in each source. Bottles are labeled (S1, S2, S3) to differentiate between the first, second, and third specimens collected.

The following Equipments and instruments were used to measure the Total coliforms and *Escherichia coli* present on the different water samples, namely Laminar flow, Autoclave, incubator with the temperature ranging from (30-35 degree Celsius) and Culture Medium (Petrifilm). The 1 mL of collected water samples were inoculated in the Petri plates aseptically in the Laminar flow. Lastly, the incubated Petri plates were counted manually for number of colonies and were interpreted as Colony Forming Units (CFU). The drinking water samples were analyzed and interpreted based on the reference of 3M Coliform Petrifilm method by Bird et al. (2018)[14].

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RESULTS AND DISCUSSION

The drinking water sources from the selected Barangays of Sta Maria were analyzed for presence of coliform using the 3M Petrifilm method. The utilization 3M Petrifilm method was previously used by Belote et al. (2002) in determining drinking water quality[7]. The Petrifilm method reported to good correlation with the Most Probable Number (MPN) method. Moreover, Petrifilm method was also used in the enumeration of waterborne *Escherichia coli* in the environmental waters[8]. Furthermore, Petrifilm method was also used in the enumeration of total coliforms in groundwater sources[9]. In a comparative study on coliform method determination, it was reported to be the most and most consistent method[10].

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The presence of coliform organisms in selected Barangay of Sta Maria, Davao Occidental shown in Table 1. The analysis of samples in Barangay Pongpong found in the spring water source had detected coliforms while E. coli was not present. On the same sampling site but on a different water source, manual, Jetmatic does not have presence of organisms, both E. coli, and coliform. In Barangay San Isidro spring water source, the first sample was the only specimen that had no organisms found, while the other two had detected coliforms. At the same sampling site, the manual water pump detected coliforms in three samples collected. In Barangay San Roque, all the samples had coliforms detected and there was no *E. coli* determined.

Compared to some of the major cities in South Africa, access to clean and safe drinking water is opposite to what is found in other developed cities but this is not the case in some cities, towns, and most villages where there is constant erratic supply of potable water, and in some cases, there is no water supply system[11]. This implies that the drinking water supply in urban areas has safe and proper sanitation in contrast to rural areas that have obtained water from unprotected ponds or tanks, wells, cisterns and sometimes streams and rivers. Therefore, if the drinking water source is safe and clean, definitely that there will be no presence of microorganisms determined.

The presence of organisms in selected Barangay of Sta Maria, Davao Occidental, Philippines, is shown in Table 1. The analysis of samples in Barangay Pongpong found in the spring water source had detected coliforms while E. coli was not present. On the same sampling site but on a different water source, manual Jetmatic does not have presence of organisms, both E. coli, and coliform. In Barangay San Isidro spring water source, the first sample was the only specimen that had no organisms found, while the other two had detected coliforms. At the same sampling site, the manual water pump detected coliforms in three samples collected. In Barangay San Roque, all the samples had coliforms detected and there was no E. coli determined.

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Table 1. Results of Coliform analysis on drinking water sources of Selected Barangay of Sta. Maria, Davao Occidental.

WATER SOURCES	TREATMENTS	TOTAL COLIFORM (CFU/mL)	E. COLI (CFU/mL)
Flowing/Spring water	Pongpong S1	3	0
	Pongpong S1	TNTC	0
	Pongpong S1	4	0
Manual/Jetmatic	Pongpong S2	0	0
	Pongpong S2	0	0
	Pongpong S2	0	0
Flowing/Spring water	San Isidro S1	12	0
	San Isidro S1	48	0
	San Isidro S1	39	0
Manual/Water Pump	San Isidro S2	0	0
	San Isidro S2	1	0
	San Isidro S2	TNTC	0
Manual/Water Pump	San Roque S1	8	0
	San Roque S1	91	0
	San Roque S1	6	0

Note: Standard: 0 CFU/ml

TNTC

Table 2 shows the comparison of Department of Environment and Natural Resources (DENR) standards and the analysis results. Results revealed that only the manual jetmatic of Barangay Pongpong is qualified for water quality standards, while the other water samples detected the occurrence of various coliforms. This result indicates that the no occurrence of coliforms in water sources is safe for water consumption by its constituents. According to DENR standards for water quality emphasizes that a zero/100mL count of coliforms must be

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found in any water sources for safe drinking water consumption. Further, all surface waters of the country shall be free from carcinogenic, mutagenic, or teratogenic to human beings that pose a serious danger to public health, safety or welfare[12].

Table 2. Water Quality of Water Sources Based Standards set by DENR standards.

BARANGAY	WATER SOURCES	ORGANISM	QUALITY STANDARD
Pongpong	Flowing/Spring Water	Coliform	Non-compliant
	Manual Jetmatic	Coliform	Compliant
San Isidro	Flowing/Spring Water	Coliform	Non-compliant
	Manual Water Pump	Coliform	Non-compliant
San Roque	Manual Water Pump	Coliform	Non-compliant

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According to DENR standards for water quality emphasizes that a zero/100mL count of coliforms must be found in any water sources for safe drinking water consumption. Further, all surface waters of the country shall be free from carcinogenic, mutagenic, or teratogenic to human beings that pose a serious danger to public health, safety or welfare[12]. Moreover, the drinking water from ground sources of Barangay Madas, Mati Davao Oriental

Philippines was reported above the maximum level as stated by the Philippine National Standard for drinking water[13.]

CONCLUSIONS

Based on the results of the study, the following conclusions were formulated;

The result of coliform analysis using 3M Petrifilm method on drinking water sources of selected Barangay in Sta Maria was hereby reported. The Jetmatic water sources of Barangay Pongpong were not detected with coliforms. However, the water samples from spring water and manual water pump were detected with coliform microorganism. The different water sources namely spring water and manual water pump did not conform the water quality standards set by DENR for water consumption. Moreover, only the manual jetmatic water source conformed to the DENR water quality standards. Furthermore, the researcher recommended to the end user to source out alternative sources of drinking water and immediate cleaning in place of the pumps and other accessories that might be the source of the contaminants. The researcher disseminated the findings of the study on the local officials of the Barangays and encourage to have a regular monitoring of the water quality.

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