

Short Research Article

ENUMERATION OF COLIFORMS IN DRINKING WATER SOURCES FROM THE SELECTED BARANGAY IN SANTA MARIA, DAVAO OCCIDENTAL PHILIPPINES

Abstract

The study aimed to determine the presence of coliforms namely nonfecal and fecal coliform in selected drinking water sources of Sta. Maria, Davao Occidental. Three (3) barangays were purposively 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.

The study was conducted at Sta Maria, Davao Occidental Philippines from August 2021-December 2021. The water samples were collected aseptically from the identified sources of drinking water of the selected Barangay of Sta Maria, Davao Occidental. The collected sample were brought to the SPAMAST Microbiology Laboratory. One (1) mL of sample was plated aseptically in the Coliform Petrifilm. The plated water samples were incubated at 35-37 degrees celcius for 24 hours. Colonies in the Petrifilm were counted manually and recorded as colony-forming units (CFU).

Microbial analysis detected the presence of total coliforms on the sampling sites from 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. Generally, the drinking water sources of the three (3) Barangays exceeded the national 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. 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 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 the first reported data in the province of Davao Occidental. Moreover, the microbial assessment utilizes the rapid test technique using the Petrifilm method. The 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]. 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 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, aimed to the following; To determine the following indicator microorganisms in the three selected Barangays in Sta Maria, Davao Occidental; namely *Escherichia coli* and total coliform and compare the results of the microbial analysis on the national standards set by Department of Environment and Natural Resources (DENR).

Materials and Methods

The study was conducted at Sta Maria, Davao Occidental, Philippines. Three selected in Barangays of Sta. Maria, Davao Occidental (refer to figure 1). 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 (Figure 1). 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.

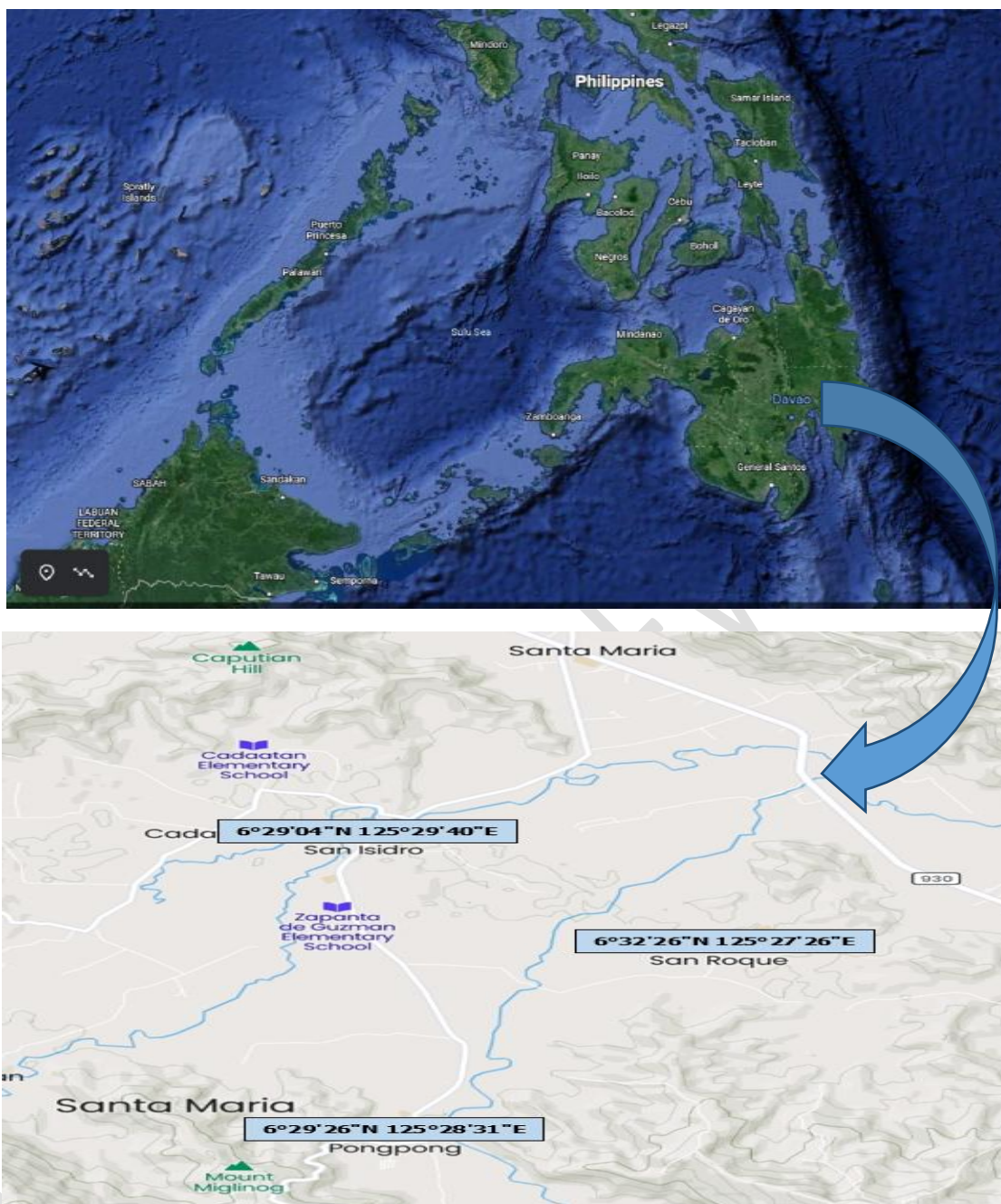


Figure 1. Showing the Map of Sta. Maria Davao Occidental(<https://earth.google.com>)

Study design

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 determined using the 3M Petrifilm 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 for study of determination of coliform in selected drinking water sources of Sta Maria, Davao Occidental Philippines.

The sites and types of water sources were determined 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 in 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 the 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) [7].

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 [8]. The Petrifilm method reported good correlation with the Most Probable Number (MPN) method. Moreover, Petrifilm method was also used in the enumeration of waterborne Escherichia coli in environmental waters [9].

Furthermore, Petrifilm method was also used in the enumeration of total coliforms in groundwater sources [10]. In a comparative study on coliform method determination, it was reported to be the most consistent method [11]. 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.

In the Philippines, approximately 91% of the country's population have access to at least basic water services; but access is highly discriminatory across the country, with regional basic water services access ranging from 62% to 100%. It was reported that 99% of the one-fifth wealthiest households are more likely to have access to basic water services; while only 80% of the poorest percentiles do [12].

The presence of organisms in selected Barangay of Sta Maria, Davao Occidental, Philippines, is shown in Table 1. The presence of coliforms was quantified in terms of Colony Forming Units (CFU) which are used to estimate the number of viable bacteria in a sample. The analysis of samples in Barangay Pongpong found in the spring water source had detected coliforms while *E. coli* was not present. A TNTC or Too Numerous to Count was also observed at the flowing/Spring sample from Barangay Pongpong, a TNTC is declared when colony counts are above 250 and it is impossible to tell whether colonies are separated. On the same sampling site but on a different water source, manual Jetmatic did not have presence of *E. coli*, nor 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 was detected with coliforms in three samples collected. Furthermore, in Barangay San Roque, all the samples were detected with coliforms but there was no present of *E. coli* enumerated.

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

Water Sources	Treatments	Coliform (CFU/mL)	Remarks	<i>E. coli</i> (CFU/mL)	Remarks
Flowing/Spring water	Pongpong S1	3	Non-compliant	0	Compliant
	Pongpong S1	TNTC	Non-compliant	0	Compliant
	Pongpong S1	4	Non-compliant	0	Compliant
Manual/Jetmatic	Pongpong S2	0	Compliant	0	Compliant
	Pongpong S2	0	Compliant	0	Compliant
	Pongpong S2	0	Compliant	0	Compliant
Flowing/Spring water	San Isidro S1	12	Non-compliant	0	Compliant
	San Isidro S1	48	Non-compliant	0	Compliant
	San Isidro S1	39	Non-compliant	0	Compliant
Manual/Water Pump	San Isidro S2	0	Compliant	0	Compliant
	San Isidro S2	1	Non-compliant	0	Compliant
	San Isidro S2	TNTC	Non-compliant	0	Compliant
Manual/Water Pump	San Roque S1	8	Non-compliant	0	Compliant
	San Roque S1	91	Non-compliant	0	Compliant
	San Roque S1	6	Non-compliant	0	Compliant

Note: DENR Standard: 0 CFU/ml

Moreover, Table 1 shows the comparison of the results with the Department of Environment and Natural Resources (DENR). According to the national standards set by DENR, drinking water must have 0 CFU/ml. The results revealed that only the manual

jetmatic water sources of Barangay Pongpong are compliant to drinking water quality national standards, while the other water samples detected the occurrence of various coliforms.

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 substances to human beings that pose a serious danger to public health, safety or welfare [13]. Drinking water contamination was also reported in the nearby region. Enguito et al. (2013) reported the presence of fecal coliform in Ozamiz city, Philippines. The presence of fecal coliforms was attributed to high discharge of organic waste from toilets, kitchens, piggeries, and commercial establishments associated with the presence of dense populations [14]. Ground water was also reported to be above the maximum presence of coliforms in the drinking water of Mati, Davao Oriental Philippines [15]. Furthermore, drinking water in the upland and coastal communities was also reported to be contaminated with fecal coliform in Misamis Oriental, Philippines [16]. Lastly, surface waters in Marawi [17] and Dugwells water sources in Zamboanga, Philippines [18] were also detected with coliforms.

Conclusions

Based on the results of the study, the following conclusions were formulated; The results of coliform analysis using 3M Petrifilm method on drinking water sources of selected Barangay in Sta Maria were hereby reported. The Jetmatic water sources of Barangay Pongpong were not detected with coliforms. However, water samples from spring water and manual water pumps were detected with coliform microorganisms. The different water sources namely spring water and manual water pump, did not meet 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 strongly recommends the end user to source out alternative sources of drinking water and

implement immediate cleaning in place of the currently utilized drinking water sources. The researcher disseminated the findings of the study to the local officials of the Barangays and encouraged them to have regular monitoring of the water quality.

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Authors Contribution

This work was a product of collaboration of all the authors. The corresponding author responsible in performing the Coliform Petrifilm Assay and the approval of the final manuscript.

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