EVALUATION OF MICROBIOLOGICAL QUALITY OF POTABLE WATER FROM SELECTED RESIDENTIAL LOCALITIES AT THE KATUWAWALA AREA, COLOMBO DISTRICT USING THE MOST PROBABLE NUMBER AND TOTAL BACTERIAL COUNT METHODS

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Clean and safe drinking water is essential for sustaining life, yet it remains inaccessible to many, leading to deaths from waterborne bacterial illnesses. Microbial contamination of water is a significant global concern, especially in aquatic ecosystems. The discharge of faecal matter, along with waste from hospitals, industries, and cattle farms, significantly raises bacterial levels in water bodies. Consequently, the microbial quality of potable water is a crucial factor impacting human health and causing water-borne diseases. In Sri Lanka, municipally treated tap water and well water are the primary sources of daily water for households. Groundwater sources, often untreated, are commonly used in developing nations like Sri Lanka. Indicator organisms, such as coliform bacteria, have long been employed to assess water's microbiological quality. The presence of *Escherichia coli (E. coli)* specifically indicates faecal contamination. This study conducted an *in-vitro* experimental analysis of 38 potable water samples (well and tap water) from residential localities in Katuwawala, Colombo district, Sri Lanka. The main objective was to assess the microbiological quality of potable water and identify the safe water resources in this area. The microbial quality of drinking water was monitored using the Total Bacterial Count (TBC) through the pour plate method and assessing Coliform and *E. coli* counts using the Most Probable Number (MPN) method. According to the Sri Lanka Standards Institution guidelines, 25% of well water sampling sites remained within the allowed limit of 10 coliforms/100 ml. However, 62.5% of well water sampling sites surpassed this threshold. Additionally, *E. coli* tests were positive at 50% of the sample sites. In contrast, 100% of the tap water samples had the desired coliform and *E. coli* concentrations. In the Katuwawala area, most of the groundwater sources (wells) exhibited poor microbial quality, rendering them unsafe for consumption. Conversely, tap water demonstrated significantly higher microbiological quality, making it safe for human consumption. These findings highlight the urgent need for regular monitoring and treatment of well water to ensure safe drinking water for the local population

Keywords: Potable water, *E. coli*, coliform, TBC, MPN, microbial quality, fecal contamination
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INTRODUCTION

Water is a basic human necessity. Unfortunately, many people lack the access to clean and healthy drinking water. Deterioration of water quality is one of the main problems that the whole world will face during the 21st century. The availability of the world's scarce water resources has markedly reduced due to the worsening pollution of freshwater resources (UNESCO, 2016). It has become a major global challenge at present (Adejumoke *et al*., 2018). The leading causes of water pollution include urbanisation, agriculture, industrialisation, natural disasters, inadequate sewage treatment facilities, and inadequate water supplies (Lin *et al*., 2022).

Among several types of water contamination, like pollution by biological, physical, and chemical factors, Microorganism-mediated water pollution is regarded as one of the most significant concerns to the aquatic ecosystem across the globe (Hassan Al-Taai, 2021). Thus, the microbial quality of potable water is considered one of the crucial factors impacting human health, causing water-borne diseases by water-borne pathogens. Since bacteria of coliform groups have a direct relationship with the presence of waterborne pathogens, they have been used as indicators of microbial contamination in water, which has historically influenced public perceptions of public health security (Some *et al*., 2021). It has been suggested that the faecal indicator bacteria *Escherichia coli (E. coli)*, serves as a bioindicator of faecal pollution in drinking water. It is released in the faeces of certain reptiles and all warm-blooded mammals (Enriquez *et al*., 2001). The primary pathogenic microorganisms that cause water-related diseases travel through the faecal–oral pathway, where water may act as an intermediary (Suthar *et al*., 2009). In developing nations, biological contaminants are the most frequent and pervasive health concerns linked to drinking water (World Health Organization., 2003). An estimated 80% of infections and more than one-third of deaths in impoverished nations are attributed to drinking water contamination (Some *et al*., 2021). A variety of harmful substances, including disease-causing microorganisms, their poisonous byproducts, and other impurities, can combine to produce severe health problems such as cholera, diarrhoea, typhoid fever, amebiasis, hepatitis, gastroenteritis, giardiasis, campylobacteriosis, poliomyelitis, and worm infestations (Cissé, 2019). The most vulnerable population for these waterborne diseases is children under the age of five, predominantly in Asian and African regions (Cabral, 2010).

In Sri Lanka, an Asian country, about 85% of the population can access safe and organized drinking water from piped lines and protected dug wells. Among them, 44% have access to piped tap lines, 3% of the population have access to tube wells and about 36% of the rural population acquire safe drinking water through protected dug wells. Fifteen per cent of the Sri Lankan population does not have access to safe drinking water facilities within 200m of their residence (Development Bank, 2015). The communities in urban low-income settlements in Sri Lanka who do not have access to pipe-borne water and proper drainage systems procure their water needs mainly from dug wells that are too shallow and located close to toilets. Exposure to vector-borne diseases may badly affect people's health (Bandara, 2003). Sri Lankan urban, suburban, and rural areas utilize surface and groundwater, with or without proper treatment for drinking purposes (Mahagamage & Manage, 2019). Since there is no proper evaluation of well water prior to consumption in Sri Lanka it is critical to ensure groundwater quality to prevent water-borne illnesses. On the determination of the microbiological quality of well water, few publications could be found in Sri Lanka (Arulnesan *et al*., 2015). Thus, this study's principal objectives are to identify faecal contamination, monitor surveillance, assess the efficacy of disinfection procedures, check the cleanliness and integrity of the water distribution system and finally, assess the microbial quality of potable water in the Katuwawala area. (Thus, the primary objectives of this study are to identify faecal contamination, monitor water quality surveillance, evaluate the effectiveness of disinfection procedures, check the cleanliness and integrity of the water distribution system, and assess the microbial quality of potable water in the Katuwawala area.) This region is densely populated with residential areas, borders, and university students. It is located in Boralesgamuwa, Colombo district, Western province, Sri Lanka and this area also has a substantial industrial environment (Hudson Institute of Mineralogy, n.d.). The majority of the population in this area utilizes municipal pipelines and dug wells for their daily water usage. To our knowledge, this is the first study in Sri Lanka to monitor groundwater (well water) and tap water in parallel to predict the safe potable water source.

METHODOLOGY

The study was an *in-vitro* experimental study of 38 potable water samples (Both well and tap water) from residential localities of Katuwawala area, Colombo District, Sri Lanka. Samples were collected from four locations in the Katuwawala area, which are approximately 4 km apart. Dug wells (either covered or open) in the selected locations were used to gather well water and public/municipal water lines to get tap water over the study period, they are located in very close proximity, to determine the microbial quality of water, possible source of contamination, intermediate contamination, and treatment efficiency of tap water. After the residents were explained about the significance of the study, their consent was obtained. Aseptically collected water samples were transported to the Microbiology Laboratory, Faculty of Allied Health Sciences, in General, Sir John Kotelawala Defence University, Werahera. The SLS Reference Standard procedures for evaluation of Total Bacterial Count (TBC) by pour plate method, coliform and *E. coli* count using the Most Probable Number (MPN) method (Sri Lanka Standard 516: Part 1, 1991, Sri Lanka Standard 614: Part 2, 1983) were followed for testing collected water samples. After a predetermined amount of time (about 1 month), water samples were taken from the same sources and retested to ascertain the microbial community's spread throughout that time as the microbial quality changed through time and influences of climate changes (Valenzuela *et al*., 2009). Samples of both well and tap water were collected again from four different locations for additional verification of potential groundwater contamination in the place where the microbial quality was discovered not up to the standard regarding the used parameters. These procedures are considered standardised to monitor portable water quality in Sri Lanka. Data was recorded and analysed using a computer-based statistical package, IBM SPSS version 27.

RESULTS AND DISCUSSION

During the study period, none of the tap samples were positive for coliform and *E. coli*. As a result, 100% of the tap water samples met the desired coliform ((10 coliforms/100 ml) and *E. coli* levels (0 *E. coli*/100 ml). As per the SLSI guidelines, 25% of well water sampling sites remained within the allowed limit of total coliforms, which is 10 coliforms/100 ml. The allowed threshold of total coliforms has been surpassed by 62.5% of well-water sampling sites in this study. Additionally, *E. coli* tests were positive at 50% of the sample sites. This situation is serious because coliform bacteria are thought to pose a risk to health because they may be signs of the existence of pathogenic microbes (Ganegoda *et al*., 2018) and *E. coli*, serves as a bioindicator of faecal pollution in drinking water (Enriquez *et al*., 2001). Furthermore, this study discovered that most of the wells surrounding specific sampling locations have severely contaminated water due to faecal contamination. Additionally, in this study, the findings were reviewed about the factors that contribute to groundwater contamination, including seasonal variations, inadequate protection and treatment of the water, inadequate drainage systems, unfavourable geographic conditions, and unsanitary surroundings (Valenzuela *et al*., 2009).

CONCLUSIONS/RECOMMENDATIONS

The results of this study indicate that the microbial quality of tap water is far higher than that of well water in the selected area. It proved that the treatment efficiency of tap water is in a satisfactory level. Furthermore, there were no intermediate contaminations confirming maintenance of the distribution system of municipal tap water was also up to a satisfactory level. It was also found in this study that faecal contamination exists in around fifty per cent of well water sampling sites in the study area. These findings align with previously reported studies. This issue poses a serious public health concern, as it has a substantial impact on the local population. Therefore, it is essential to take action to improve the quality of the well water, including monitoring and maintaining public wells. Additionally, it promotes quick action to ensure water safety and halt additional degradation of water bodies. These results underline the importance of regularly assessing the microbiological quality of potable water across the whole country using large sample sizes and to ensure that drinking water supplies remain suitable for use.

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