JOURNAL OF SOILSCAPE AND AGRICULTURE
Volume 3, Number 1, 2024
E-ISSN: 2963-7961
Journal Homepage: http://journal.unej.ac.id/JSA

Microbiological Analysis of Well Water Quality in Market and Residential Areas of Kendari City

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ARTICLE INFO

Article History:
Received: 03 - 08 - 2024
Accepted: 23 - 09 - 2024

Keyword:
Community Settlement;
Market;
Microbiological Parameters;
Well Water Quality;

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ABSTRACT

Water is an essential element for human life; without water, humans will experience a lack of fluid, the fluid in the human body is around 50-80. Water can fulfill daily needs through human activities such as washing clothes, water for drinking, bathing, and so on. Well, water is suitable for use if it meets water quality standards. This type of research uses descriptive research methods. This research is located in Baruga Market, Anduonohu Market, Lorong Salangga, and Kendari Permai Kendari City in December 2023. the samples used in this study amounted to 4 wells. The results obtained in this study are that all well water is polluted with E. coli, and Baruga Market well water exceeds the quality standards for Coliform parameters. The presence of E. coli in all well water samples indicates fecal contamination, posing severe health risks such as waterborne diseases. Baruga Market's well water exceeds Coliform standards, likely due to sewage runoff, making it unsafe without treatment. Immediate actions, like improving sanitation and providing clean water alternatives, are necessary to prevent further contamination and protect public health.

INTRODUCTION

Water is a natural resource that is vital for the lives of humans, animals, and plants as the transportation of food substances, as well as a source of energy and various other uses. Regulation of the Minister of Public Works No. 14/PRT/M/2010 on minimum service standards in the field of public works and spatial planning states that the average water requirement is 60 liters/person/day for all purposes. The need for clean water is expected to increase from year to year. The current world population of 6.121 billion requires 367 km3 of clean water per day, so by 2025, the projected need for clean water will be 492 km3 per day (Sasongko *et al*.,2018).

Groundwater can be either deep, well water or shallow well water. Dug wells are one of the most widespread well constructions used to extract groundwater for small communities and individual houses for drinking water at a depth of 7-8 meters from the ground surface. Dug wells provide water from a layer of soil that is relatively close to the ground surface and, therefore, easily contaminated. Drilled wells (pumps) are more profound layers of groundwater that are drilled or layers of soil that are far from the surface soil can be reached so that they are less affected by contamination. Groundwater is generally relatively clean from a microbiological aspect. Still, the chemical content of groundwater depends on the lithospheric formations it passes through or may be due to pollution from the surrounding environment. Minerals can dissolve and be carried away in groundwater flow, changing the quality of the water. Groundwater also often contains high enough elements that make the water brownish yellow and have spots on clothes. It can also interfere with health and is toxic to organs through physiological disorders, including causing liver, kidney, and nerve damage, so it is necessary to find a water treatment technique to reduce levels of iron, manganese, and other heavy metals in water to levels below the required threshold (Rahayu, 2019).

According to Marsono (2009), the quality of dug well water can be affected by seepage of household wastewater, chemical waste, laundry, seepage of nearby polluted river water, and others. Dug well water is vulnerable to pollution due to poor well construction and a depth of less than 15 meters, allowing contaminants to enter the well (Sudiartawan, 2021). The results of research that has been carried out on the quality of surface water and groundwater, the majority of the results are positively polluted (Suamba, 2017). Waste resulting from market activities, if not appropriately managed, can cause pollution, and dirty water seepage from market activities can enter the dug wells of the community around the market(Sudiartawan, 2021). Yunita (2015) states that one of the industrial activities that have the potential to pollute groundwater is market activities; various activities in it can produce polluting waste, substantial waste, and liquid waste; besides being beneficial for the body, water can also be an intermediary for disease transmission due to the presence of microorganisms that can live in it, both pathogenic and non-pathogenic microorganisms. Quality water is water that meets physical, chemical, and microbiological requirements, which are beneficial for human life (Budiarti *et al*., 2013). Examination of microbial parameters is used to determine the degree of water contamination by waste materials originating from humans, animals, and household waste. *Coliform bacteria* are the most critical microbiological parameter for clean water quality. The

presence of these bacteria indicates a low level of *hygiene* that endangers health (Depkes RI, 1991). Infectious diseases that are spread by water directly are called *waterborne diseases*. Diseases are not transmitted due to the use of water but can occur because water has been contaminated by harmful or toxic compounds (Munfiah *et al*., 2013). Therefore, the authors are interested in conducting a study on "Analysis of Well Water Quality Based on Microbiological Parameters in Markets and Community Settlements in Kendari City."

METHODS

Location and Time

This research uses laboratory-based descriptive research methods. This research was conducted at Baruga Market, Pasar Baru, Lorong Salangga, U.H.O. Kendari New Campus, Kendari Permai Housing, and U.P.T. Halu Oleo University Microbiology Integrated Laboratory in December 2023.

Method of Colloecting Data

The population in the study were all wells around Baruga Market, Pasar Baru, Lorong Salangga Settlement, U.H.O. New Campus, and Kendari Permai Housing and the samples used were 4 wells, the sampling technique used *purposive sampling.*

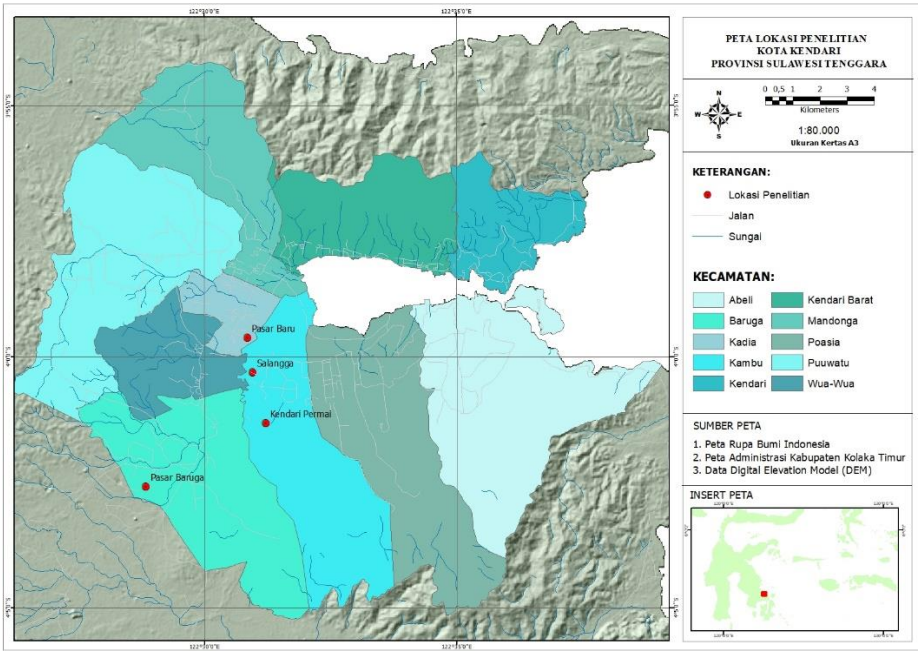

Figure 1: Research Location Map

Data Analysis

The M.P.N. (Most Probable Number) method measured water quality directly in the laboratory. Measurement data were analyzed descriptively by comparing laboratory results to the maximum allowable limit or water quality standard for sanitary hygiene. Microbiological parameters investigated in this study include Total Coliform with a maximum limit of 50

CFU/100 ml and E. Coli with a maximum limit of 0 CFU/100 ml by Permenkes RI No. 32 of 2017.

RESULTS AND DISCUSSIONS

Table1.Sample Analysis Results of Salangga Settlement Well Water and Baruga Market Well Water

No.	Samples	Parameters	Results	Maximum Limit	Unit	Methods
1.	Salangga Well Water	*Coliform* *E.Coli*	29 Positive	500	MPN/100ml	Double TubeScratch
2.	Baruga Market Water	Coliform *E.Coli*	>110 Positive	500	MPN/100ml	Double TubeScratch
3.	Kendari Permai Well Water	*Coliform* *E.Coli*	1,5 Positive	500	MPN/100ml	Double TubeScratch
4.	New Market Well Water	*Coliform* *E.Coli*	3,6 Positive	500	MPN/100ml	DoubleTube

Based on the analysis results (Table 1), it is known that Salangga well water contains *Coliform* bacteria at 29 and is positively contaminated with *E. coli* M.P.N./100ml. However, the *Coliform* value is still below the maximum level allowed. The presence of *E. coli* in the Salangga well the sample is thought to be caused by *feces from* the *septic tank* because the distance between the *septic tank* and the water source is <10 meters and the cleanliness of the environment around the residents is not well maintained. According to Winarni and Dinarjati (2013), *E. coli* bacteria are normal flora bacteria in the human colon and are excreted in the form of *feces*. Furthermore, Sunarti (2015) stated that. *E. Coli* bacteria in water can be used as an indicator of *fecal* pollution and poor water conditions.

Figure 2: Documentation of Microbiological Analysis of Well Water in Market and Residential Areas in Kendari City; (a) water sample collection, (b) Well water samples prepared in test tubes for microbiological testing, (c) The incubation process of the test tubes in an incubator to test for the presence of *Coliform* bacteria, d) The growth results of *Coliform* bacterial colonies on agar media in a petri dish after incubation, e) "The test results showed that the water samples were positive for the presence of Coliform bacteria, indicating microbiological contamination in the water.", f) Water samples showed negative results in the microbiological test, indicating no growth of Coliform bacteria in the water.

The presence of Coliform bacteria can indicate poor water conditions and water pollution. *Coliform bacteria* in well water are caused by contamination from animal feces and garbage. The presence of *Coliform* bacteria that exceeds the maximum level allowed in water sources indicates that there is a source of clean water pollution (Putra, 2017). *Coliform* bacteria are a group used for water pollution, feces, and unfavorable conditions for water and foodstuffs (Sari, 2019).

The results of the analysis of OK water samples at Pasar Baruga obtained total *Coliform* bacteria were >110 MPN/100ml using double tubes, while *E. coli* obtained from Pasar Barugawell water was positively obtained through the scratch method in the media. The results

of analyzing water samples with coliform >100 MPN/100 ml indicate that the water samples have poor quality and are polluted by *coliform bacteria*. *Coliform bacteria* can be used as indicators of water, soil, or food quality because they can indicate contamination from *feces* or other sources.

Hidayah *et al.* (2022) stated that *Coliform* bacteria are a class of intestinal bacteria that live in the human digestive tract. These bacteria are commonly used as indicators of water quality. The number of *Coliform bacteria* colonies is positively correlated with the presence of pathogenic bacteria, so these fecal *coliform bacteria* become pollution indicators (Widyaningsih*et al.*, 2016). A lot of *E. coli* in water can hurt human health and the environment. *E. coli* is a bacterium commonly found in the intestines of humans and animals, but some types can cause infection and disease, especially if consumed with contaminated food or drink. Some symptoms of *E. coli* infection include diarrhea, abdominal pain, nausea, vomiting, fever, chills, and dizziness; these symptoms usually appear 3 to 4 days after exposure to the bacteria and can last for several days to several weeks. Diarrhea caused by *E. coli* can be bloody or non-bloody, depending on the type of bacteria that causes it.

Assessment of well water quality in Baruga Market and Residential Communities in Kendari City is critical due to the potential health risks associated with microbiological parameters. Studies have shown that well water from various locations often does not meet microbiological standards, with the presence of *E. coli* and coliform bacteria posing a significant health hazard (Ezeh *et al*., 2020; Tosepu*et al*., 2023); this is supported by the statement of Yunus (2018)which explains that the presence of *Coliform* bacteria found in gallon drinking water depots, indicates that the gallon depot water is not safe for direct consumption. *Coliform* bacteria levels above 0 can have a high risk of gastrointestinal disease. *Fecal coliform* bacteria in well water indicate that the dug well water has been polluted and is not suitable for consumption as drinking water, as Decree of the Minister of Health Number 907/MENKES/VII/2002, so if the dug well water is used as drinking water, it needs to be processed by boiling first or by adding disinfectants to the water (Darma, 2020).

The results of the analysis of Kendari Permai well water samples obtained *Coliform* 1.5 MPN/100 ml and Positive *E. coli* M.P.N./100 ml. The high population activity also increases the amount of domestic waste, thus affecting groundwater quality. In addition, population activities can produce different domestic wastes that have a significant impact on the quality of groundwater sourced from infiltration wells in residential areas. Based on Table 1, the location point of the Pasar Baru water sample is known to contain coliform bacteria with a total value of 3.6 MPN/100 ml, which shows positive results also on *E. coli* bacteria. The M.P.N. value indicates the number of *coliform bacteria* contained in 100 mL of water samples. According to the standards set out in PERMENKES RI/492/MENKES/Per/IV, the maximum limit for the number of *Coliform bacteria* in the water that is safe to drink is 0 M.P.N./100 mL (Kemenkes RI, 2010). The results of water testing of new market water are still classified as clean water because the maximum number of *Coliform* for water to be classified as clean is 50 M.P.N.

coliform/100 mL for non-piped water and 10 M.P.N. coliform/100 mL for piped water (Ministry of Health RI, 1990).

The presence of *Coliform* bacteria in drinking water samples indicates that the level of sanitation and cleanliness of drinking water is still minimal. *Coliform* contamination in Pasar Baru borehole water samples can be caused by a lack of hygiene around the well. Shallow wells are one type of well that is commonly used to collect groundwater. Shallow wells provide water that comes from a layer of groundwater that is relatively close to the surface soil. Therefore, it is easily contaminated through seepage (Wulan, 2016). According to Hadijah (2017), water that Coliformbacteria has contaminated is consumed without proper treatment, so the impact of health problems will occur to consumers, so excellent and correct water management is needed. The presence of *Coliform* bacteria in borehole water samples allows the presence of other bacteria, such as *Klebsiella* and *Pseudomonas, because* these bacteria are abundant in the soil (Kusuma *et al.*,2015). The presence of *E. coli* in all well water samples indicates fecal contamination, posing a serious health risk due to the potential presence of pathogens that can cause waterborne diseases like diarrhea and dysentery. Baruga Market's well water also exceeds Coliform standards, showing signs of environmental contamination, likely from sewage or waste runoff. This makes the water unsafe for consumption without treatment, emphasizing the need for urgent interventions, such as improving sanitation infrastructure and providing clean water alternatives. These findings highlight significant public health risks and call for both immediate and long-term solutions to prevent future contamination.

CONCLUSIONS

Based on the results of the research conducted show that 4 (four) location points, namely Baruga Market, Pasar Baru, Lorong Salangga U.H.O. Kendari New Campus, and Kendari Permai Housing, contain and have been contaminated by *Coliform and E. coli* bacteria caused by *feces*. Hence, they are not suitable for consumption. To address water contamination, authorities should enhance sanitation infrastructure, such as upgrading waste disposal systems and improving sewage treatment to prevent fecal contamination. Public health campaigns are vital to raise awareness about safe water practices and hygiene. Immediate water treatment solutions, like installing filtration systems or promoting home-based methods, can mitigate risks. Regular water quality monitoring and enforcing regulations on well construction and sanitation are essential. Affected water sources should be rehabilitated or replaced with alternative supplies. Lastly, ongoing research must inform policy and ensure long-term water safety in Kendari.

ACKNOWLEDGMENTS

The author would like to thank colleagues from the University of Halu Oleo, State Islamic University Sunan GunungDjati Bandung who have provided insights and expertise that greatly helped this research.

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