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Identification of *Escherichia coli* in Well Water in Gelogor Utara Hamlet, Kediri District, West Lombok Regency

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Abstract: Water is a very important need for human life. Wells are one of the primary means of obtaining clean water. Along with the rapid growth of settlements, water quality has decreased due to pollution. The presence of *E. coli* bacteria in well water indicates human and animal fecal contamination. The purpose of this study was to determine the content of *E. coli* in well water in Gelogor Utara Hamlet, Kediri District, West Lombok Regency. This type of research is quantitative and descriptive, involving laboratory testing. The test method used to determine the number of E. coli in the sample is the Most Probable Number (MPN) Method listed in SNI 01-2332.1-2006. The results of *E. coli* testing in the well were all positive samples with *E. coli* content >24,000 CFU/100 mL and in sample 2, namely 2,400 CFU/100mL, based on Permenkes Nomor 2 Tahun 2023, namely 0 CFU/100mL, so that the drilled well water in Gelogor Utara Hamlet does not meet the requirements of the Environmental Health Quality Standards for water for Hygiene and Sanitation purposes. Based on these results, the researcher provides advice to society on maintaining the septic tank to prevent seepage in the well, disinfecting it by adding chlorine, and boiling the water before consumption. The expected impact of this research on the community is to provide information to the community regarding the *E. coli* content in the well water they use and to raise public awareness about the importance of managing well water used for daily needs.

Keywords: Drilled Well Water; Drinking Water; *E. coli.*

Introduction

Water is a vital necessity for human life, and therefore, it must be available in sufficient quantity and quality to avoid health problems for those who use it [1]. Water is a vital natural resource for all living things, including humans. Its vital importance makes it a component that must always be protected and its quality maintained. The availability of clean water has a significant impact on health. Good clean water generally must not only be clear, colorless, tasteless, and odorless, but also free from pathogenic bacteria and substances harmful to human health [2].

With rapid residential growth, water quality has declined due to pollution. Water quality standards encompass various characteristics required for specific uses of water sources. These standards are established based on Regulation of the Minister of Health's Nomor 2 Tahun 2023 and are typically presented in the form of statements or numbers [3]. These provisions outline requirements that must be met to avoid health problems, illnesses, technical problems, or aesthetic disturbances. Water quality testing encompasses both physical and microbiological aspects, particularly the presence of *E. coli*. Although E. coli is not exclusively a pathogenic bacterium, its presence can serve as an indicator of water contamination by pathogenic bacteria.

E. coli is a bacterium used as an indicator of sewage pollution and poor water conditions. The presence of *E. coli* in well water indicates human and animal fecal contamination. Generally, well water contamination can originate from human and animal waste disposal, such as toilets and latrines, as well as from unsealed sewage pipes. Fecal contamination in water can cause various diseases, such as diarrhea, typhoid, and cholera.

Well water is commonly used for drinking, bathing, and sanitation. To utilize well water for drinking, the quality of the water to be used must be assessed [4]. Of the various sources of clean water used by the community, drilled wells are a primary choice. Drilled wells are typically around 7-10 meters deep and are widely used in both rural and urban areas to meet household water needs such as washing food, cooking, bathing, and washing clothes [5].

Borehole wells are one means of obtaining clean water. In the Kediri District, particularly in North Gelogor Hamlet, borehole wells remain a primary water source that is still utilised today. One of the hamlets in Gelogor Village, Kediri District, West Lombok Regency is North Gelogor Hamlet. This hamlet is one of the hamlets that lacks open space, which is assumed to cause the distance between the borehole water source and the waste disposal site or septic tank to be less than 11 meters, allowing for bacterial contamination, especially *E. coli*. Therefore, research is needed to determine the biological quality of this water source.

Several previous studies have demonstrated that *E. coli* bacteria are present in clean water facilities [6], including one that utilises a dug well [7]. Apart from clean water, *E. coli* is also found in refilled drinking water [8] and some food [9]. Based on the research above, this study is

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necessary because the presence of *E. coli* bacteria is diverse, ranging from water to food, posing a significant threat to public health.

Research Methods

The type of research used is descriptive qualitative, where biological water quality testing involves *E. coli* tests in drilled well water, and the results will be presented in the research data. This research was conducted in July 2025. The test method used to determine the number of *E. coli* in the sample is the Most Probable Number (MPN) Method, as listed in SNI 01-2332.1-2006. The sampling location was carried out in Gelogor Utara Hamlet and then analyzed at the Sekolah Tinggi Teknik Lingkungan (STTL) Mataram Biology and Chemistry Laboratory. The samples in this study were 2 drilled well water samples. The sampling technique used in this study was purposive sampling.
The tools, materials, and research procedures used in this study are presented as follows.

Sampling

The tools used in sampling and sample testing are sample bottles, Bunsen lamps, cotton, ice boxes, clamps, test tubes, Durham tubes, Erlenmeyer flasks, stirrers, autoclaves, analytical scales, beaker glasses, incubators, and measuring pipettes. The materials used in this study included drilled water samples from Gelogor Utara Helmet, sterile distilled water, 70% alcohol, *E. coli* Broth powder, and tissue. Biological sampling was carried out by opening the water tap and placing the sample bottle under it, then filling the bottle with sample water up to a maximum of two-thirds of its capacity.

Testing for *E. coli* content

This test employs the most probable number (MPN) method, which involves specific testing procedures, calculations, and the reporting of *E. coli* test results in water [10]. The first step is to create a medium that supports bacterial growth. Previously, calculations were made on the amount of distilled water needed and the number of grams of powdered materials for making the media as follows:

How to determine the amount of distilled water for EC Broth media :
Number of tubes (2 repetitions) x 5 ml of media/sample x number of samples

for the amount of EC Broth media powder :
18 x 5 x 2 = 180 ml
Gram EC Broth = 37/1.000 x 180 = 6.66 gr

The EC Broth powder, which has been weighed, is then dissolved in an Erlenmeyer flask containing distilled water. Pipette 5 mL of EC Broth into 36 test tubes that have been previously inserted into inverted Durham tubes, then cover with gauze or cotton. Then, sterilize the media using an autoclave at a temperature of 121ºC and a pressure of 1 atm for ±1 hour.

Dilution

First, dilution is carried out by preparing five test tubes and labelling each tube with the signs 10-1, 10-2, 10-3, 10-4, and 10-5. Then, fill each test tube with 9 mL of sterile, distilled water, measured using a measuring cup. Add 1 mL of the sample to each 1 mL of sterile distilled water in the 10-1 dilution tube using a dropper, then shake to mix homogeneously. Next, add 1 mL of the sample from the 10^-2 dilution, then shake it to ensure a homogeneous mixture. Add 1 mL of the sample from the 10-2 dilution into the 10-3 dilution tube, then homogenise. Add 1 mL of the sample from the 10-2 dilution to the 10-3 dilution tube, then homogenise. Finally, add 1 ml of the sample from the 10-4 dilution into the 10-5 dilution tube, then homogenize.

Eschericia coli test

Fix the mouth of the EC Broth media tube to the Bunsen flame, then add 5 mL each from the 10-3 dilution tube into 6 *E. coli* Broth media tubes. Re-fix the test tube and close it with cotton. Fix the mouth of the EC Broth media tube, then add 1 mL each from the 10-4 dilution tube to 6 EC Broth media tubes. Re-fix the test tube and close it with cotton. And last, fix the mouth of the EC Broth media tube. Then, add 0.5 mL each from the 10-5 dilution tube to 6 EC Broth media, and re-fix the test tube, closing it with a cotton plug. Homogenize slowly in all tubes so that the sample spreads evenly throughout the media. Incubate all tubes at 37ºC for 24-48 hours. Observe the presence of air bubbles in the Durham tube and record the tube code that releases gas positively. Determine the MPN value of coliform based on the MPN table.
Furthermore, the MPN calculation is carried out using the formula:

MPN coliform = MPN value x middle dilution [11]

The CFU calculation is carried out using the formula

$$\text{CFU formula} = \frac{\text{number of colonies}}{\text{number of petri dishes}}$$

Results and Discussion

E. coli testing of well water samples using the MPN SNI 01-2332.1-2006 method at the STTL Mataram Laboratory. The test results are presented in the figure below.

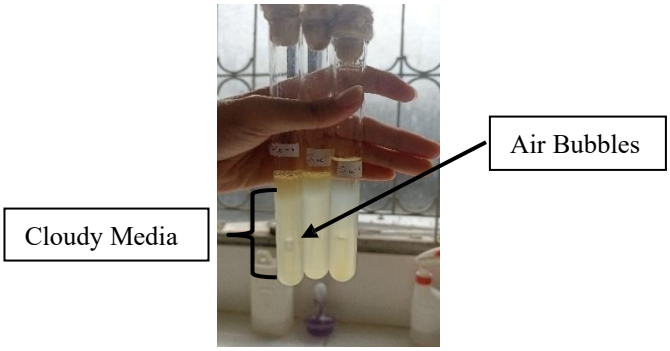

Figure 1. Results of the *E. coli* test on well water

The formation of gas indicates the presence of fecal coliform bacteria, which can break down lactose into acid

and gas during a 24-hour incubation period at 37°C [12]. Bacteria generally thrive at 37°C. Pathogenic E. coli can grow at temperatures ranging from 7°C to 40°C, with optimal growth at 37°C [13]. The presence of gas is evident from the cloudiness of the lactose medium, and the gas formed appears as air bubbles in the Durham tube [14]. The test result is considered positive because the bacteria ferment lactose into gas. Therefore, the formation of gas in the Durham tube indicates the presence of bacteria. The formation of gas is thought to be due to the microbial respiration process that ferments lactose, producing acid and gas, similar to lactic acid bacteria, which can break down carbohydrates and produce gas. The formation of gas in a solution also indicates that microbial respiration is occurring. If the solution changes color to cloudy, it indicates that acid has formed in the solution.

E. coli broth media contains lactose, dipotassium phosphate, monopotassium phosphate, NaCl, peptone, and bile salts. Lactose as a carbon source will be fermented into acid by bacteria, so that only *E. coli* that is able to ferment lactose can grow. Dipotassium phosphate and monopotassium phosphate will control the pH, and NaCl maintains the osmotic balance of the media. Peptone acts as a source of amino acids, while bile salts suppress the growth of gram-positive bacteria. In *E. coli* Broth media, the color change of the medium from clear yellow to cloudy yellow and the presence of gas in the Durham tube indicate a positive result for coliforms, especially *E. coli* [15].

Meanwhile, the results of the MPN E. coli test on well water in Gelogor Utara Hamlet, Kediri District, West Lombok Regency are presented in the table below.

Table 1. Results of the *E. coli* test on drilled well water

Sample	Test results	Permenkes No. 2 Tahun 2023	Informatioan
Sample 1	>24,000		Not Qualify
Sample 2	2,400	0 CFU/100mL	Not Qualify

Based on the results of the examination conducted at the STTL Mataram Laboratory, all well samples in Gelogor Utara Hamlet, Kediri District, tested positive for E. coli. It can be seen that in the first repetition, all samples were negative for E. coli, while in the second repetition, sample 1 tested positive for E. coli at dilutions of 10-3, 10-4, and 10-5. Sample 2 tested positive for E. coli at dilutions of 10-3 and 10-4 only. These results indicate that the water samples do not meet the Environmental Health Quality Standards, as outlined in Permenkes Nomor 2 Tahun 2023, regarding the water parameters necessary for drinking water needs.

Well water quality is significantly influenced by environmental and surrounding factors. Observational surveys and laboratory tests in Gelogor Utara Hamlet indicate that some wells still do not meet standards, primarily due to the proximity of the septic tank to the well and the presence of livestock pens nearby.

The presence of *E. coli* in the first and second samples is influenced by poor well sanitation systems, such as wells that do not meet health standards, namely, approximately 3 meters apart. This allows seepage into groundwater, resulting in contaminated wells with E. coli bacteria. Decreased groundwater quality is also caused by poor sanitation, such as seepage from septic tank wastewater. Feces or feces that settle at the bottom of the tank and will slowly seep into the ground, this is where the process of microbiological groundwater pollution occurs [16]. According to the Working Group on Drinking Water and Environmental Sanitation (POKJA AMPL), the distance between wells should be 10 meters from septic tanks [17].

Another factor influencing the presence of E. coli in well water is the presence of livestock pens near the well. These animal wastes can be a source of E. coli contamination. The distance from the pens, which are sources of contamination, to the well is generally less than 11 m.

The recommended distance between the well and the pen is at least 30 m [18]. The distance between the well and the livestock pen should be at least 11 meters to avoid the high risk of contamination, both physical, chemical, and biological. Generally, people have livestock pens close to the groundwater sources they use. Groundwater contamination can be caused by livestock waste being directly discharged into drainage channels or rivers without treatment at the source. This can potentially contaminate the quality of well water in the surrounding environment and impact the presence of *E. coli* in the well [19].

The presence of *E. coli* bacteria in water indicates fecal contamination and a potential disease risk. Waterborne pathogens cause approximately 7.2 million illnesses and 6,630 deaths annually [20]. Water can become a source of disease transmission if the water used does not meet established quality standards [21].

The most common disease caused by *E. coli* is diarrhea. *E. coli* in water originates from contamination by animal and human waste, which can cause a bowel disorder called diarrhea. The presence of E. coli in water indicates that the water is unfit for consumption [22]. Diarrhea is one of the diseases that can be caused by consuming water contaminated by *E. coli* bacteria.

The bacteria that most often cause disease in humans are *E. coli*, which produces a toxin called Shiga toxin. Watery or bloody diarrhea, fever, abdominal cramps, nausea, and vomiting are symptoms of infection caused by this bacterium. These conditions can range from mild to severe. Children are more susceptible to complications from *E. coli* infections, such as kidney failure and even death [23].

Prevention measures that can be taken to reduce the impact of *E. coli* bacterial contamination include ensuring a safe distance of at least 10 meters between the well and the source of pollution, maintaining the septic tank to prevent seepage in the well, disinfecting it by adding chlorine [24], and boiling the water before consumption.

The above prevention can certainly be done if the community has awareness about the importance of processing well water used daily, education about the dangers of *E. coli* bacteria needs to be done through health counseling by related parties including researchers, because this water processing will be carried out by the community itself to maintain the health of themselves and their families and the environment, starting from maintaining environmental health and implementing clean and healthy living habits.

Conclusion

Based on the research conducted, it can be concluded that the biological quality of clean water in Gelogor Utara Hamlet, Kediri District, West Lombok Regency, still does not meet the environmental health quality standards as outlined in PERMENKES Nomor 2 Tahun 2023. The Quality Standards set are 0 CFU/100 ml for *E. coli*. Neither sample met the requirements because the E. coli contained in the samples exceeded the quality standards; namely, sample 1 had a count of > 24,000 MPN/100 mL, and sample 2 had a count of 2,400 MPN/100 mL. Based on these results, the researcher provides advice to society on maintaining the septic tank to prevent seepage in the well, disinfecting it by adding chlorine, and boiling the water before consumption. If this treatment is not carried out, it can be hazardous to the health of individuals who use *E. coli-contaminated* water, whether for personal hygiene or drinking purposes. Therefore, public education and awareness are needed regarding the importance of water treatment, monitoring water quality and maintaining environmental health.

Author's Contribution

Enida Fatmalia: Collect Data, Conducting Analysis and Writing Articles. Wahyudin: Compiling and Designing Analysis.

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