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Analysis of the Biological Quality of Clean Water in the Male Dormitory

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Abstract: The use of unclean water is one of the causes of skin diseases. Skin diseases are often suffered by students in the Islamic boarding school environment because sanitation facilities may be inadequate. It is known that the water source in the Islamic boarding school uses drilled well water. The purpose of this study was to determine the quality of clean water in the male dormitory of the Abu Hurairah Mataram Islamic boarding school, which was reviewed biologically. This type of research is descriptive qualitative. The population in this study were all the water taps in the male dormitory of the Abu Hurairah Mataram Islamic boarding school. Based on the results of biological quality tests, including Coliform tests and Eschericia coli tests on water, it is known that the coliform test results obtained in sample A were 18 MPN / 100ml, sample B was 46 MPN / 100ml, sample C was 230 MPN / 100ml, and sample D was 0 MPN / 100ml and the results of *Eschericia coli* in sample A were 24000 MPN / 100ml, sample B was 24000 MPN / 100ml, sample C was 0 MPN / 100ml, and sample D was 0 MPN / 100ml. The water used by students still cannot be said to be suitable for use because of the presence of Escherichia coli and Coliform bacteria that can cause disease in humans. There needs to be treatment to reduce the bacterial content in sanitation facilities in Islamic boarding schools.

Keywords: Clean Water; *Escherichia coli*; Sanitation; Total Coliform.

Introduction

Water is a source of life that is needed for daily activities. Water is one of the most important aspects for human life, animals, plants, and the universe. Water and sanitation are basic community needs that are vital for survival. It is even important that the availability of water and sanitation must be met properly, both in terms of quantity and quality [1]. Unclean water, poor sanitation, and poor hygiene are the second most common causes of skin diseases in developing countries [2]. Skin diseases are included in water-washed diseases, which are influenced by the environment and human behavior. Almost all skin infections are transmitted through direct or indirect contact with the skin. The causes can be germs, viruses, fungi and parasites. Diseases that attack humans can also be transmitted and caused through water. This condition can certainly cause disease outbreaks everywhere [3]. In the health sector, water is one of the environmental media that can play a role in the transmission of disease. In order to maintain the quality of the water used, it is necessary to monitor water quality [4]. Water quality can be determined by the presence and number of bacteria in it [5].

The quality of water sources is closely related to the presence of bacteria. Microbiological parameters in determining water quality are by using coliform bacteria and Escherichia coli as organisms indicating the presence of pollution [6]. Water that has coliform and Escherichia coli values above the established limits has the potential to cause disease [7]. Microbiological indicators are one of the factors reviewed in determining the standard value of water quality. The indicator states that the Most Probable Number (MPN) of Coliform is 0 Coliform/100 mL of water, and for pathogenic bacteria such as Escherichia coli, it is 0 colonies/mL of water. Therefore, if the number of bacteria in water exceeds the standard value that has been set, then the water is not healthy for use [8].

The skin is an organ that is directly related to the environment, so it is more susceptible to physical, chemical, and infection by microorganisms. Many skin diseases cause itching and discomfort for a long period of time. Skin diseases are diseases that are often found in society. Some types of skin diseases include leprosy, dermatitis, scabies, tinea versicolor, smallpox, and others. Common skin problems include dry skin, rough texture, scaly skin on the hands, feet, or face, acne, skin rashes, contact dermatitis or skin inflammation and loss of the epidermis layer [9]. In relation to skin diseases, Islamic boarding schools have long been known to have problems in terms of sanitation. Various common environmental diseases are often a problem in Islamic boarding schools, for example, skin diseases. During the initial observation, data were obtained on 101 students who had skin diseases and experienced itching. Many students, or what are often called students in Islamic boarding schools, suffer from skin diseases caused by unclean water.

The water source facilities used at the Abu Hurairah Mataram Islamic boarding school are drilled wells and next to the boarding school there are rivers and residential areas, all waste produced by residents such as leftover water from washing, leftover kitchen water, used bath water, are directly disposed of into the river, seeing these conditions, it is necessary to analyze the quality of clean water biologically in the male dormitory of the Abu Hurairah Mataram Islamic boarding school.

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Research Method

The type of research used is descriptive qualitative, where biological water quality testing is carried out, including Coliform tests and *Escherichia coli* tests on tap water used by students and will be presented with research data. This research was conducted in January 2025. The sampling location was carried out in the male dormitory of the Abu Hurairah Islamic boarding school in Mataram City and then analyzed at the Sekolah Tinggi Teknik Lingkungan (STTL) Mataram Environmental Laboratory. The samples in this study were 4 tap water samples. The sampling technique used in this study was the purposive sampling technique.

The tools and materials used in sampling are sterile sample bottles, a sample box containing an ice pack, alcohol and cotton, sterile latex gloves, a medical mask, a label, and a ballpoint. The initial step in taking biological samples of tap water is done by opening the tap fully and letting it run for 1-2 minutes. Close the tap water and clean the mouth of the tap (water outlet) with alcohol cotton, placing a sterile sample bottle under the tap water and then fill the bottle with sample water up to a maximum of 2/3 of the bottle, spray alcohol on the mouth and cap of the sample bottle before re-closing the sample bottle. Label the sample bottle, then put the sample bottle into a sample box containing an ice pack. The sample is ready to be taken to the laboratory for testing [10].

Meanwhile, the tools used in the sample testing are Bunsen lamps, cotton, clamps, test tubes, Durham tubes, Erlenmeyer flasks, stirrers, autoclaves, analytical scales, beaker glasses, incubators, and measuring pipettes. The materials used in this study were tap water samples in the male dormitory of the Islamic boarding school, sterile distilled water, 70% alcohol, LBDS (Lactose Broth Double Strength) powder, LBSS (Lactose Broth Double Strength) powder, BGLB (Brilliant Green Lactose Broth) powder, EC (*Escherichia coli*) Broth powder and tissue. All materials and glassware, including sample bottles, were sterilized in an autoclave for 20 minutes at a temperature of 1210 °C.

Tests conducted in this study use the most probable number (MPN method, which includes testing procedures, calculations, and reporting the results of total Coliform and Escherichia *coli* tests in water. The Coliform test consists of dilution, predictive test and confirmatory test, while the *Escherichia coli* test consists of dilution and *Escherichia coli* test [11].

The first step is to make a medium for bacterial growth. The media used for the Coliform test are LBDS and LBSS media, while the *Escherichia coli* test uses EC (*Escherichia coli*) Broth media. Previously, the calculation of the amount of aquadest needed and the number of grams of powdered media ingredients was carried out, where LBDS media requires 240 ml of aquadest and 9.36 grams of LBDS media powder. LBSS media requires 240 mL of aquadest and 3.12 grams of LBSS media powder. BGLB media requires 360 ml of aquadest and 14.4 grams of media powder and 12.96 grams of media powder and EC broth media requires 120 ml of aquadest and 4.44 grams of media powder. After all the media have been made, the procedure for testing water quality based on the MPN test is continued.

The MPN test begins with Dilution. Dilution is carried out by preparing 5 test tubes and labelling each tube with the signs 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-1}. Then fill each test tube with 9 mL of sterile distilled water that has been measured using a measuring cup. Add 1 ml of sample into each 1 ml using a dropper into the tube that already contains sterile distilled water in the 10^{-1} dilution tube, then shake it so that it is mixed homogeneously. Next, add 1 ml of sample from the 10^{-2} dilution, then shake it so that it is mixed homogeneously. Add 1 ml of sample from 10^{-2} dilution into 10^{-3} dilution tube, then homogenise. Add 1 ml of sample from 10^{-2} dilution into 10^{-3} dilution tube, then homogenise. Finally, add 1 ml of sample from the 10-4 dilution into the 10-5 dilution tube, then homogenise.

The second step of the *Coliform* test is the Presumptive test. The Presumptive test is carried out in the following manner: fix the mouth of the LBDS media tube on a Bunsen flame, then add 5 mL each from the 10^{-3} dilution tube into 6 LBDS media tubes, and re-fix the test tube and close it with cotton. Fix the mouth of the LBSS media tube, then add 1 ml each from the 10^{-4} dilution tube to 6 LBSS media, and re-fix the test tube and close it with cotton. Fix/sterilise the mouth of the LBSS media tube, then add 0.5 ml each from the 10^{-5} dilution tube into 6 LBSS media, and re-fix the test tube and close it with cotton. Homogenise 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 positively emits gas, and observe the color change that occurs from clear to cloudy.

Water samples were taken from positive LBDS and LBSS tubes in a presumptive test, then 1 ml was inserted into the BGLB tube. Incubate the BGLB media at 37C for 24-48 hours. The method for determining a positive sample is the same as the presumptive test, namely, the presence of bubbles in the Durham tube confirms the color change from clear to cloudy, the presence of Coliform in the water sample. Then note the combination of the number of tubes that show positive results in the confirmation test in each dilution. Then, determine the MPN Coliform value based on the MPN table and calculate it with the MPN and CFU formulas.

Another test that was also conducted in this study was the *Escherichia coli* test. This test also began with the dilution process that was explained previously, followed by fixing the mouth of the EC Broth media tube on the Bunsen flame, then adding 5 ml each from the 10-3 dilution tube into 6 EC Broth media tubes, and re-fixing the test tube and closing 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, and re-fix the test tube and close it with cotton. Fix/sterilize the mouth of the EC Broth media tube, then add 0.5 ml each from the 10^{-5} dilution tube into 6 EC Broth media, and re-fix the test tube and close it with cotton. Homogenise 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 positively emits gas, and observe the color change that occurs from clear to cloudy. Determine the MPN coliform value based on the MPN table and calculate using the MPN and CFU formula.

MPN Coliform = MPN value x middle dilution [12]

$$\text{CFU Formula} = \frac{\text{Number of colonies}}{Number\ of\ Petri}$$

Results and Discussion

The Abu Hurairah Mataram Islamic Boarding School is one of the Islamic boarding schools located in Mataram City, West Nusa Tenggara. The Abu Hurairah Islamic Boarding School was established in 2002. In terms of education, the Abu Hurairah Mataram Islamic Boarding School has complete levels of education ranging from elementary school to high school, and at the junior high and high school levels, it is mandatory to live in dormitories.

Sampling

This study analyzes the biological quality of clean water used by residents of the boarding school for hygiene and sanitation at the Abu Hurairah Mataram Islamic Boarding School. The source of clean water comes from drilled well water and is flowed through a pipe system and used directly through the water tap.

Tap water sampling is carried out aseptically in order to minimize the occurrence of microorganism contamination in the sample. This is done in various ways during sampling, starting from sterilizing the sample bottle with an autoclave, using sterile latex gloves and a medical mask, cleaning the mouth of the tap with alcohol cotton before taking the sample, spraying alcohol on the mouth and cover of the sample bottle before re-closing the sample bottle. These methods need to be done because the parameters tested in this study are biological parameters that require high accuracy and sterilization.

Sampling that is done carelessly and does not pay attention to sterility is feared to result in samples that have been contaminated, not real samples, causing the test results to be invalid and cannot be interpreted correctly. Sterilization ensures that the samples collected are not contaminated by microorganisms that are not related to the study, which can affect the results of the study [13].

Testing for Coliform and *Escherichia coli* content

The samples tested in this study were tap water samples from drilled wells and used for daily activities (hygiene and sanitation) of students at Islamic boarding schools. Water for Hygiene and Sanitation Needs is water used for personal and/or household hygiene needs [14], such as for bathing, washing clothes and food ingredients, and cooking.

Biological water quality testing in this study was repeated 2 times for each sample and test parameter to obtain valid results. The media used in each parameter is different because each bacterium has a specific medium for growth. This medium has a different composition and functions as food for bacteria. Culture media provides an artificial environment that simulates natural conditions that are important for growth [15]. In addition to being a place to grow and develop, physiological activity also occurs in the media [16].

The occurrence of this physiological activity will cause the media condition to change after incubation for 24 hours. Media with positive results are marked by a change in color in the media and the presence of gas bubbles in the Durham tube. caused by the metabolic activity of Coliform and *Escherichia coli* bacteria, which ferment lactose to produce acid and gas. Coliform bacteria ferment lactose using the β-galactosidase enzyme to form acid and gas if incubated for 24-48 hours at a temperature of 36±2°C [17]. This is in accordance with the test results and can be seen in the image below.

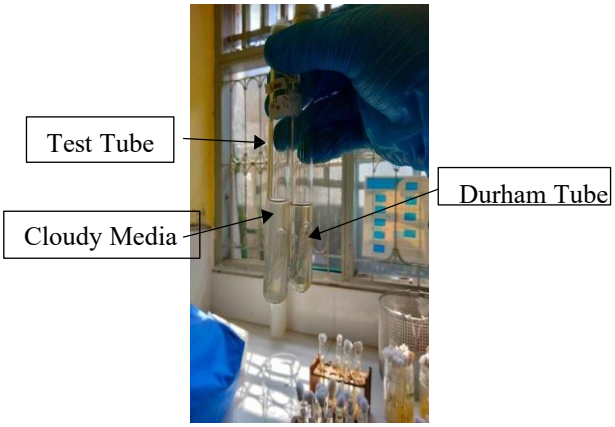

Figure 1. Presumptive Test Results for Total Coliform

Next, the test carried out after the Presumptive test for the total coliform test is the confirmation test. This test uses BGLB media with the following test results.

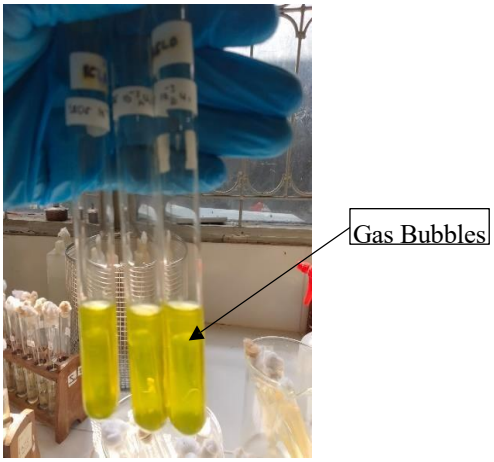

Figure 2. Confirmation Test Results for Total Coliform

The results of the calculation of the biological quality testing of clean water for total coliform parameters based on the MPN Table and CFU formula are presented in the table below.

Based on Table 1, EC broth media for the Escherichia coli test, after incubation for 24 hours, produces bubbles in the Durham tube and cloudy media as seen in the image below.

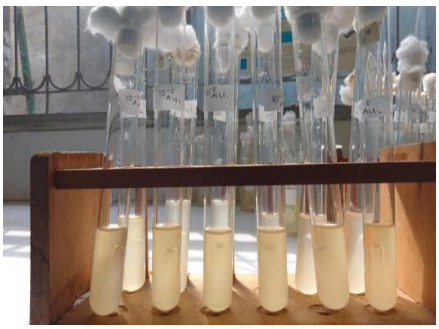

Figure 3. *Eschericia coli* Test Results

Media that are positive in the *Escherichia coli* test, after being calculated using the MPN and CFU formulas, produce bacterial colony numbers as in the table below.

Table 1. Results of Biological Quality Testing of Clean Water Parameters of Total Coliform

Sample Code	Repetition	Total Coliform (CFU/ 100 ml)	PERMENKES Nomor 2 Tahun 2023	Info
Sample A	1	36		Not Qualify
	2	0		Qualify
Sample B	1	20		Not Qualify
	2	72	0 CFU/100 ml	Not Qualify
Sample C	1	230		Not Qualify
	2	230		Not Qualify
Sample D	1	0		Qualify
	2	0		Qualify

Information Code:
Sample A : Kitchen Faucet
Sample B : Toilet Faucet 1
Sample C : Toilet Faucet 2
Sample D : Wudhu Faucet

Table 2. Results of Biological Quality Testing of Clean Water Parameters of Escherichia coli

Sample Code	Repetition	*Eschericia coli* (CFU/ 100 ml)	PERMENKES Nomor 2 Tahun 2023	Info
Sample A	1	24.000		Not Qualify
	2	24.000		Not Qualify
Sample B	1	24.000		Not Qualify
	2	24.000	0 CFU/100 ml	Not Qualify
Sample C	1	0		Qualify
	2	0		Qualify
Sample D	1	0		Qualify
	2	0		Qualify

Information Code:
Sample A : Kitchen Faucet
Sample B : Toilet Faucet 1
Sample C : Toilet Faucet 2
Sample D : Wudhu Faucet

Based on the test results table presented above, it can be seen that several samples do not qualify the SBMKL (Standard Baku Mutu Kesehatan Lingkungan: Environmental Health Quality Standards) based on the PERMENKES Nomor 2 Tahun 2023, namely 0 CFU/100 ml.

The presence of coliform bacteria in water is caused by the entry of household waste, which is the highest source of biological pollution. The waste comes from the kitchen, bathroom, laundry, waste from household industries and human waste. Waste management that is not managed properly can cause environmental pollution that can have a negative impact on human health [18]. Water quality assessment based on the presence of coliform in water can be used as an important parameter to determine water safety, where its presence is an indicator of water pollution [19]. Piles of rotting household waste around water sources that produce seepage water that is absorbed and flows into the ground are one of the causes of bacterial contamination in groundwater [20].

The presence of *Escherichia coli* in water indicates that the water has been contaminated by human faeces, so that water standards for sanitation hygiene and drinking water require Escherichia coli to be 0/100 ml [21]. *Escherichia coli* is an important indicator because the number of colonies is positively correlated with pathogenic bacteria [22]. One of the factors contributing to the presence of Escherichia coli bacteria is that the water source does not meet the requirements [23]. If we look back, environmental conditions greatly affect the biological quality of water at the sampling location. The sampling location, which is quite close to the resident's TPS and septic tanks, is one of the factors in the presence of *Escherichia coli* bacteria in the water.

The presence of *Escherichia coli* bacteria in water can cause various environmental diseases such as diarrhoea and skin problems [24]. This negative impact is certainly felt by the students who live in the dormitory and use biologically contaminated water for their daily needs. The contaminated water contains intestinal pathogenic bacteria, namely coliform and *Escherichia coli,* as previously explained, where these pathogens can cause poisoning and cause various diseases such as urinary tract infections, meningitis, septicemia and others [25].

This is in accordance with what happened in the field, based on data from the management of the Islamic boarding school, most students have experienced itching, rashes, redness of the skin and diarrhoea in the past month. This is certainly a concern for the management of the boarding school, because so far, the Islamic boarding school has been known to have problems in terms of sanitation.

Therefore, to reduce cases of disease due to unclean water, it is hoped that the management of the boarding school will be more active in reminding and instilling awareness

among students to continue to maintain the environment, such as encouraging counseling activities about the importance of environmental cleanliness, especially clean water, community service activities for cleanliness, waste management training, application of the principles of 3R (Reuse, Reduce and Recycle) and throw of garbage in its place.

Diseases caused by using unclean water will also have an impact on the learning process of students. For students, skin diseases will greatly affect the level of concentration, which will result in a decrease in the quality of learning and will ultimately decrease the achievement of the students [26].

Therefore, monitoring the presence of total Coliform and *Escherichia coli* is very important in evaluating water quality for public health purposes. Water treatment and checking the physical condition of water sources periodically are very necessary, considering that there are a lot of students at the Male Dormitory of Abu Hurairah Islamic Boarding School. Water treatment that can be done is Disinfection. Disinfection is the administration of disinfectants in the form of chlorine or alum at a certain level so that it can kill microbes contained in the water, making the water safe for daily use. Chlorine must be given according to the dosage so that it can effectively kill microbes, chlorine levels that are too high will cause the remaining free chlorine to be high in the water and cause health problems, one of which is eye and skin irritation [27], while if the chlorine level is too low it cannot kill microbes effectively so that it is possible that microbes are still alive in the water [28].

Conclusion

Based on the research that has been conducted, it can be concluded that the biological quality of clean water in the Abu Hurairah Mataram Islamic Boarding School Male Dormitory still does not meet the environmental health quality standards based on PERMENKES Nomor 2 Tahun 2023. The Quality Standards set are 0 CFU/100 ml for both parameters, namely Total Coliform and *Escherichia coli*. Several samples such as Samples A, B and C in the Total Coliform test did not meet the quality standards because there were still Coliform bacteria in the samples around 20-230 CFU/100ml, while in the Eschericia coli test, samples A and B contained very high Eschericia coli bacteria, namely 24,000 CFU/100ml. Based on these results, the researcher provides advice to the management of the Islamic Boarding School to check and maintain the source of clean water regularly and to treat the water by providing chlorine as a disinfectant to kill bacteria in the water. In addition, it is expected to instill awareness in students to continue to protect the environment because this will have a big impact on the learning process later, such as encouraging outreach activities on the importance of environmental cleanliness, especially clean water, community service activities for cleanliness, waste management training, application of the 3R principles (Reuse, Reduce and Recycle) and throw of waste in its place.

Author's Contribution

Dini Yuliansari: Compiling and Designing Analysis; Enida Fatmalia: Conducting Analysis and Writing Articles; Wahyudin: Collecting Data

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