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BIOLOGICAL QUALITY OF DRILLED WELL WATER AROUND THE SHRIMP PASTE PRODUCTION PLACE IN JOR VILLAGE, EAST LOMBOK DISTRICT

Dini Yuliansari, Enida Fatmalia*, and Wahyudin
Environmental Health Study Program, Mataram College of Environmental Engineering, Mataram, Indonesia
*Email: enidafatmalia@gmail.com

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Abstract: This study aimed to determine the quality of dug well water around the shrimp paste production site in Jor Hamlet, Jor Village, Jerowaru District, East Lombok Regency. The type of research used is an experiment with two parameters based on Minister of Health Regulation Number 32 of 2017, namely Biological Parameters, including *Coliform* and *Escherichia coli.* The sampling points in this study consisted of three water sampling points from residents' dug wells with two repetitions of sampling in Jor Hamlet, Jor Village, East Lombok Regency, and with consideration of sampling points based on the distance of the dug well to the location of making shrimp paste in below 10 meters and the shrimp paste production site does not have a good wastewater disposal system. Water quality around the shrimp paste production site in Jor Hamlet, Jor Village, Jerowaru District, East Lombok Regency, several parameters do not meet the requirements based on Minister of Health Regulation Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene, Swimming Pools, Solus Per Aqua, and Public Baths, namely *Coliform* Parameters, samples at sampling points A and B exceed the Quality Standard, namely 230 in both repetitions, while the Maximum Quality Standard is 50 MPN/100 ml. The *Escherichia coli* Parameters for all samples at all sampling points meet the Quality Standards, namely 0 MPN/100 ml samples, or there may not be *Escherichia coli* in clean water intended for Sanitary Hygiene. The highest research results for *Coliform* and *Escherichia coli* parameters were high at several points due to the distance between the well and the shrimp paste production site, which was very close, and the shrimp paste production site did not yet have a good wastewater disposal system.

Keywords: *Water Quality, Dug Wells, Shrimp Paste*

INTRODUCTION

Water is a natural resource that is needed by living things, especially humans. Water at standard conditions or that can be used is colorless, tasteless, and odorless. Water is a natural resource that is not limited but has natural properties as a solvent. Therefore, water is very easily contaminated by materials or chemicals that can contaminate the water. Water is a natural resource that has a very important function for human life and livelihood and for advancing general welfare, so it is the basic capital and the main factor of development [1].

According to PermenKes No. 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene Purposes, Swimming Pools, Solus Per Aqua, and Public Baths state that Environmental Health Quality Standards for Water media for Sanitation Hygiene Purposes include physical, biological, and chemical parameters that can be in the form of mandatory parameters and additional parameters [2].

Jor Hamlet is located in Jerowaru Village, Jerowaru District, East Lombok Regency. Most of the people of Jerowaru Sub-District are farmers who cultivate rice fields, a small number are fishermen, and some have home industry businesses. Jerowaru Village is a coastal village with a shining name. The hamlet of Jor borders the village of Paremas, which has long been known as a center for shrimp paste production in Lombok.

Based on data obtained from the Work Area of the Jerowaru Health Center, there are the ten highest types of diseases in 2022, namely: ARI, Diarrhea, Influenza, Febrile, GEA, Rheumatoid Arthritis, HT, Asthma Brongkiale, Vertigo, Dermatitis. Then the results of a preliminary study carried out in February 2023 showed that of the ten types of diseases, one of them was diarrhea which had a relationship with the water quality of residents' dug wells around the shrimp paste production site. Water pollution usually occurs in industrial areas due to factory waste. However, it does not rule out the possibility of water pollution also occurring in areas with few industries [3]. Water polluted by organic waste, especially waste originating from the food processing industry, is a fertile place for the proliferation of microorganisms, including pathogenic microbes [4].

According to Indonesia's statistical data for 2020, Indonesia reflects this global pattern. As many as 18% that Indonesian households relied on drinking water and water for their household activities from surface and groundwater sources such as springs, rivers, lakes, and dug wells, which are susceptible to contamination by pathogenic factors that cause diarrhea, namely through the fecal-oral route. It enters the mouth due to consuming drinks and food or using objects contaminated with feces, for example, hands or food containers that are washed using polluted water [5].

Certain bacteria, in this case, Coliform Bacteria and Escherichia coli, will reproduce in water and can contaminate water if the amount is excessive because the habitat of these bacteria is in water. Each bacterium has a specific habitat in a particular environment, so if some materials or things bring these bacteria into their habitat, the bacteria will develop well in that habitat [6]. Similar research has been conducted by Annisafitri et al., who stated that pathogenic microbes that multiply in polluted water could cause various diseases. All of them are diseases that can be transmitted easily. One of the bacteria that can be used as an indicator of water pollution is the presence of Coliform bacteria in the water, which indicates the possibility of pathogenic microbes that are harmful to health.[7].

Based on this background, it is necessary to conduct research on the biological quality of dug well water around the shrimp paste production site in Jor Hamlet, Jor Village, Jerowaru District, East Lombok Regency, to minimize the impact and provide information to the local community about the condition of the dug well water used.

RESEARCH METHODS

The type of research used is an experiment with Biological Parameters, including Coliform and Escherichia coli. The sampling points in this study consisted of 3 (three) water sampling points from residents' dug wells with 2 (two) repetitions of sampling in Jor Hamlet, Jor Village, East Lombok Regency, and with consideration of sampling points based on the distance of the dug well to the location of making shrimp paste in below 10 meters and the good owner's house does not have a good wastewater disposal system. This research was conducted in May 2023. The research location was in Jor Hamlet, Jor Village, East Lombok Regency, as the sampling location. Then it was analyzed at the Mataram STTL Environmental Laboratory.

The tools and materials and the research procedures used in this study are presented as follows.

Sampling (SNI 6989.58-2008)

The tools and materials used in sampling are autoclaves, sampling bottles with weights (jerry can sample bottles, glass bottles, sterile sample bottles), rope, brown paper, Bunsen lamps, cotton, label paper, and a cool box (cool box). , Dug well water samples, and 70% alcohol. Biological sampling is carried out using a sample bottle with ballast sterilized first using an autoclave. The sample bottle is then taken to the sampling location in a state where the bottle cap is closed with cotton and wrapped in brown paper. The wrapping paper is opened, the bottle is opened slowly and take the cotton. Pour the spirit into the Bunsen lamp, then light it with a match, sterilize the mouth of the bottle with a circular motion over the spirit fire, then take a sample by releasing the rope wrapped around the bottle into the dug well, filling it up to 2/3 of the sample bottle.

Raise the sample bottle slowly without hitting the wall of the well to avoid contamination. Then ignite the fire on the Bunsen lamp, put the fire in the mouth of the bottle in a circular motion, then close the bottle. The rope is tidied up, and then the sample bottle is wrapped with brown paper and a label affixed to be sent to the laboratory. Samples are taken using a cool box so that the temperature is maintained.

Meanwhile, non-biological (physical and chemical) sampling is carried out by providing a sample bottle that does not need to be sterilized by autoclaving, opening the sample bottle cap and lowering it slowly into the well, inserting a water sample by avoiding contact with air by flowing the sample water in the walls of the bottle to the brim. After the sample bottle is filled, pull the sample bottle slowly so that the sample bottle does not hit the wall of the well. Then remove the strap of the sample bottle, and the sample bottle is closed. Attach a label to send to the laboratory.

Parameter Test Procedure for *Coliform* and *Escherichia coli* (SNI 01-2332.1-2006

This test uses the most probable number or MPN method with three tube series, which includes procedures for making media, testing, and calculating the results of total *Coliform* and *Escherichia coli* tests in water. The test procedure is carried out in 4 stages: multilevel dilution, estimator test, confirmation test, and complementary test. The tools and materials used in this test are Water Samples, Sterile Aquades, LBSS (Lactose Broth Single Strength) Media, LBDS (Lactose Broth Double Strength), BGLB (Brilliant Green Lactose Broth), EMBA (Eosin Methylene Broth Agar), EC (Escherichia coli) Broth Erlenmeyer flask, Stir bar, test tube, test tube Rack, Durham tube, Cotton wool, Label paper, Autoclave, Analytical balance, Ose needle, Beaker glass, Incubator, Bunsen lamp, 10 and 5 ml pipette, Alcohol 70 %, Labels and Tissue. The procedure of this research is as follows.

a) Media Creation

LBDS media was prepared by weighing 39 grams of LBDS powder, dissolved in an Erlenmeyer flask containing 1 liter of distilled water, pipetted as much as 10 ml LBDS and put into three different test tubes for one repetition. LBSS media was made by weighing 13 grams of powder LBSS, dissolved in an Erlenmeyer flask containing 1 liter of distilled water, pipetted as much as 5 ml of LBSS, and put into six different test tubes for one repetition, then BGLB media was prepared by weighing 40.01 grams of BGLB powder, dissolved in an Erlenmeyer flask containing distilled water 1 liter, pipetted as

much as 5 ml of BGLB media and put into nine different test tubes for one repetition.

Then EMBA Media was prepared by weighing 36 grams of EMBA powder, dissolved in an Erlenmeyer flask containing 1 liter of distilled water, as well as EC Broth Media made by weighing 37 grams of EC Broth powder, dissolved in an Erlenmeyer flask containing 1 liter of distilled water, pipetting as much as 5 ml of EC Broth media and putting it into nine different test tubes for one repetition. All the media is placed in an inverted Durham tube, then covered with gauze or cotton. Media, Aquades, and all tools and materials used for the test were sterilized using an autoclave at 121ºC and 1 atm pressure for ±20 minutes.

b) Dilution

Steps of multilevel dilution are carried out by preparing 5 test tubes and labeling each tube with the marks 10-1, 10-2, 10-3, 10-4, and 10-5. Then each test tube is filled with 9 ml of distilled water. Sterile that has been measured using a measuring pipette/volume pipette. A pipette as much as 1 ml of the sample and put it in a test tube that has been labeled 10-1, then homogenized with a Vortex Mixer, a test tube containing 9 ml of distilled water and 1 ml of sample into a 10-1 dilution. Then 1 ml of distilled water was taken from the 10-1 dilution, put into a 10-2 test tube, homogenized with a Vortex Mixer, and became a 10-2 dilution. Next, the 10-2 dilution is taken one 1 ml to be put in 10-3, the 10-3 dilution is taken one 1 ml to be put in 10-4, and the 10-5 dilution is taken one 1 ml to be put in 10-5. All dilutions were homogenized with a Vortex Mixer.

c) Estimator Test

The second stage, namely the estimator test, was carried out by fixing the mouths of the LBDS media tubes on the Bunsen flame then adding 5 ml each from the 10-3 dilution tubes into 3 LBDS media tubes, in addition to fixing the mouths of the LBSS media tubes then adding each 1 ml of the 10-4 dilution tube into three tubes of LBSS media, and the remaining three tubes of LBBS media were added 0.5 ml each of the 10-5 dilution and re-fixed all the test tubes and covered them with cotton then homogenized slowly throughout the entire tube so that the sample spreads evenly throughout the media.

Then all the media containing the tubes were kept at 37°C for 24-48 hours. After 24-28 hours of incubation, the media is observed if there are air bubbles in the Durham tube and the media turns cloudy. The media is positive for Coliform. The results are then recorded and coded, and the positive number in each dilution.

d) Affirmation test

Water samples from the LBDS and LBSS tubes were positive, which was indicated by bubbles in the Durham tube and a change in the color of the media. Then put 2 drops into the 2% BGLB tube. BGLB media was then incubated at 37 ºC for 24-48 hours. The presence of gas in BGLB strengthens the presence of Coliform Bacteria in water samples and tubes, whose positive samples are then recorded and calculated using the formula below.

The MPN (Most Probable Number) or APM (Most Probable Number) number is calculated using the formula listed in SNI 01-2332.1-2006. The Coliform calculation formula uses the formula below.

$$\text{MPN } Caliform = MPN\ x\ \frac{1}{\text{mid}-\text{dilution}}$$

e) Complementary/perfection test

The complementary/perfection test stage begins by preparing the EMBA media from the test tube to the petri dish aseptically ± 20 ml per petri dish. Then wait for the media to cool down and inoculate/inoculate with the media from the affirmation test, namely 2% BGLB media, by dipping the loop needle that has been fired at the end of the wire on the Bunsen lamp into the positive BGLB media and then streaking it on the EMBA media in a zigzag manner. At the time of collection, it is recommended to stick a hot wire loop on the edge of the tube so it doesn't get too hot. The EMBA media is then labeled to prevent them from being mixed up.

The petri dish containing EMBA media was then incubated at 37 ºC for 24-48 hours. The presence of shiny black streaks (metallic black, red colonies) on the EMBA agar media or metallic green with black dots on the EMBA media colonies confirms the presence of *Escherichia coli* in the water sample. CFU (Colony Forming Unit) calculations for E. Coli and Coliform use the CFU formula listed in the standard method by APHA, AWWA, and WEF [7]. The Coliform calculation formula uses the formula below.

CFU= Number of colonies/ number of incubated petri dishes

RESEARCH RESULTS AND DISCUSSION

The Coliform parameters in this study used three samples of dug well water. After testing, it was found that samples A and B did not meet the quality standards of the Minister of Health, namely above 50 MPN/100 ml. The *Escherichia coli* parameter shows that from the three samples of dug well water that have been tested, the results of drilled well water in all three samples meet the established quality standard, namely 0 MPN/100 ml.

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Table 1. Coliform Parameter Test Results

Name	Test Result	Quality Standard	Criteria
Sample 1	230	50 MPN/100 ml	Not Qualified
Sample 2	230	50 MPN/100 ml	Not Qualified
Sample 3	36	50 MPN/100 ml	Qualified

Source: Primary Data for 2023

Table 2. Escherichia coli Parameter Test Results

Name	Test Result	Quality Standard	Criteria
Sample 1	0	0 MPN/100 ml	Qualified
Sample 2	0	0 MPN/100 ml	Qualified
Sample 3	0	0 MPN/100 ml	Qualified

Source: Primary Data for 2023

The method often used in checking water quality is using the MPN (Most Probable Number), which detects fecal coliform bacteria's content and Escherichia coli bacteria's presence with the closest estimate of the number [8].

The prediction test, namely, using Lactose broth media (LB), shows a positive result; a positive result can be marked with the formation of gas or bubbles in the Durham tube. It is because Coliform and E.coli bacteria can ferment lactose to become acid gas formation in the Durham tube, and the medium turns cloudy. This result is in line with another study [9], which stated that turbidity in the medium is caused by the formation of acids resulting from bacterial fermentation of the coliforms. Other research also mentions that the more bubbles in the Durham tube, the Durham tube will rise or float upwards [10]. After the positive results are shown in the lactose broth media, then proceed with using the EMBA media, where after incubation on the media, the results are shown in figure 1.

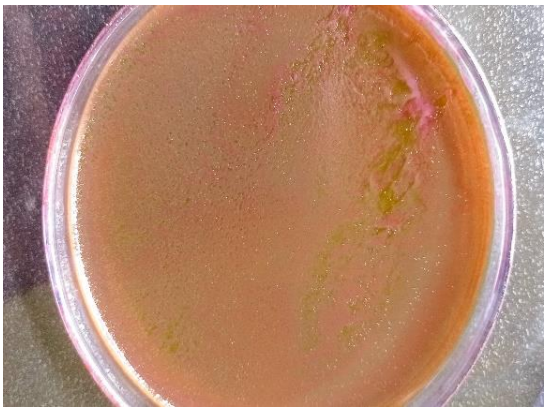

Figure 1. Positive results for coliform bacteria in sample A of well water

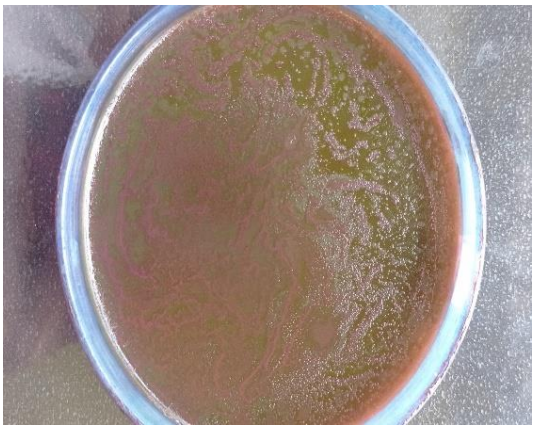

Figure 2. Positive results for coliform bacteria in sample B of well water

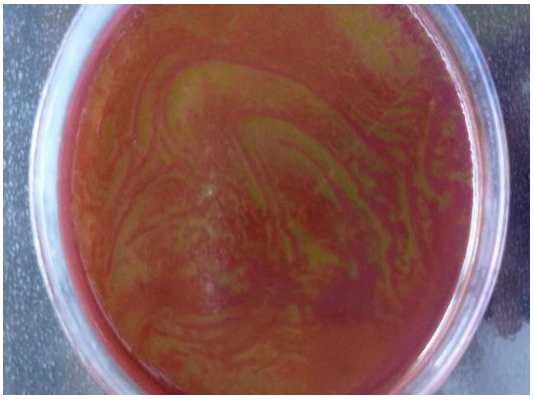

Figure 3. Positive results for coliform bacteria in sample C of well water

One of the factors that can affect the results of research on the *Coliform* parameter test is the sampling location adjacent to the shrimp paste production site, where the nearest dug water well sample location is 2 meters from the shrimp paste production site. The closer the pollutant is to the water source, the more *Coliform* bacteria it will contain in the water source.

Well, water is very vulnerable to contamination by sources of pollution originating from household waste. Contamination from domestic households can come from leaking septic tanks, leaking sewers, and garbage disposals [11].

In addition, each shrimp paste production site used as a reference location for sampling dug well water needs a better wastewater disposal system from these production activities, causing the dug well water test results to be positive. The manufacture of shrimp paste produces liquid waste, which can contaminate the environment because it contains organic compounds. These organic compounds can be nutrients for the growth of *Coliform* bacteria, thereby increasing the presence of *Coliform* bacteria. *Coliform* is a group of bacteria used to indicate waste pollution and unfavorable

conditions for water [12]. *Coliform* bacteria are indicator bacteria for the presence of pathogenic bacteria.

The high content of *Coliform* bacteria in water can lead to other pathogenic bacteria because these bacteria have properties that can positively correlate with other pathogenic bacteria. According to another research [13], the higher the level of *Coliform* bacteria contamination, the higher the risk of other pathogenic bacteria. These pathogenic bacteria certainly harm health and cause disease in humans. The presence of fecal coliform bacteria in water can indicate that the water has been contaminated with feces [14].

In the *Escherichia coli* parameter test, all dug well water samples showed negative results. No *Escherichia coli* bacteria were found in all samples because the location of the dug well water samples was not close to a direct pollutant source such as a septic tank. Because *Escherichia coli* bacteria is a group of bacteria originating from the digestive tract, namely the lower intestinal tract of warm-blooded animals, including humans, therefore *Escherichia coli* bacteria are more commonly found in feces. E. coli is an indicator bacteria for contamination of human/animal feces in the environment and is a causative agent of diarrheal disease, especially in toddlers [15].

The *Coliform* parameter test value is high, but the *Escherichia coli* parameter test value is absent, so this can be caused because the Coliform found in positive results is a type of *non-fecal Coliform*. *Non-faecal Coliform* is a type of bacteria not from human feces but from dead animals/plants. So there is no correlation between the high content of *Coliform* bacteria in the dug well water and the absence of *Escherichia coli* bacteria.

Coliform bacteria, such as the examples species Citrobacter spp, Enterobacter spp, and Klebsiella spp, can also be found in the environment such as soil, vegetation, or surface water, whose presence is not always related to fecal contamination; these bacteria belong to a group of non-fecal coliform bacteria [16].

Coliform bacteria can occur because the distance between the well and several waterways is not too far away, so they can contaminate the well water [17]. It aligns with research conducted by [18], which also found positive coliform results in testing well water samples in Karakan Village, Sukaharjo Regency.

One of the factors that can affect the presence of coliform bacteria in well water is the habit of people who ignore cleanliness around the well. In addition, people habits in making wells do not use well covers and carry out daily activities such as bathing and washing at the edge of the well, so that it can easily cause contamination of well water [19].

If the people in the village use dug well water as a source of drinking water, then it needs to be processed so that the water is suitable for consumption. According to [20], it is necessary to boil it first or add disinfectant to the water to disinfect coliform bacteria if you want to use the well water as drinking water.

CONCLUSION

The water from the dug wells around the shrimp paste production in Jor Hamlet, Jor Village, Jerowaru District, East Lombok Regency, is biologically seen from the *Coliform* parameter test, which is said not to meet the requirements based on Minister of Health Regulation Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitary Hygiene Purposes. Samples A and B showed a value of 230 MPN/100 ml exceeding the quality standard of 50 MPN/100 ml. The results of the *Escherichia coli* parameter test were that all samples met the quality standard requirements, namely 0 MPN/100 ml.

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