

Analysis of drinking water quality based on biological, physical and chemical parameters in Lekobalo Village, Gorontalo City, Indonesia

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Abstract. Katili I, Baderan DWK, Kumaji SS. 2023. Analysis of drinking water quality based on biological, physical and chemical parameters in Lekobalo Village, Gorontalo City, Indonesia. *Intl J Bonorowo Wetlands* 13: 22-29. Lekobalo Village is a part of the Gorontalo City, Indonesia area, which has not yet received full clean water coverage. Therefore, the community in Lekobalo used the wellsprings as the source of drinking water. An open water tank around the wellspring has been the source of drinking water for people in the surrounding. It becomes a place for household chores such as bathing, doing laundry, and serving as a lavatory. That makes the place look messy due to the household waste around the wellspring, which decreases the drinking water quality there. Hence, a test of the drinking water in Lekobalo is crucially needed. This study is descriptive-qualitative research that was conducted by a direct survey. Sample collection was conducted using sterilized bottles from the laboratory, and the data obtained were analyzed descriptively. This study aims to determine drinking water quality based on biological, physical, and chemical parameters. The research revealed that the quality of drinking water in Lekobalo based on the biological parameter was considered polluted by *Escherichia coli* and coliform bacteria. The findings revealed that the average score of *E. coli* was 10.3 MPN/100 ml and coliform 200.5 MPN/100 mL. In physical parameters, the drinking water quality is relatively good with an average temperature of 20°C, turbidity NTU, scentless, tasteless, and colorless. The drinking water criterion that did not meet the physical parameters is the TDS (Total Dissolved Solid), which is 1,525 mg/L. According to the chemical parameter, the quality of the drinking water is considered relatively good with some average score of arsenic (As) 0 mg/L, fluoride (F) 1 mg/L, nitrite (NO₂) 0.02 mg/L, nitrate (NO₃) 3.6 mg/L, iron (Fe) 0.12 mg/L, Power of Hydrogen (pH) 6.6 mg/L and manganese (Mn) 0 mg/L. The chemical parameters that did not meet the standard qualification of drinking water based on the chemical parameters are chromium (Cr), and cadmium (Cd), as the average scores are 0.34 mg/L and 0.047 mg/L. This study can be used as one of the government's databases as an input in developing programs and activities to improve drinking water quality and control water pollution.

Keywords: Drinking water, Gorontalo, Indonesia, Lekobalo

INTRODUCTION

Water is one of the primary needs for living creatures and the human environment. Humans need water, especially for drinking and daily human activities such as bathing, cooking, washing clothes, and washing kitchen utensils (Daud et al. 2021). The standard categorized as the source of clean water is the water that meets the standard qualification based on the physical, chemical, and microbiological parameters. The normal water that can be used as a source of clean water is surface water, rainwater, and groundwater. The groundwater that naturally emerges from the land surface is called a wellspring. Wellspring is the flow of groundwater that emerges to the land surface naturally. The cut groundwater flow causes that due to the topographical shape of the area and its emergence from rocks (Sudipa and Nurjani 2022).

Gorontalo City is considered an average city in Indonesia which is always connected to the problems of clean water and drinking water service. That can be observed through the data of the Regional Drinking Water Company (PDAM) of Gorontalo City by the end of 2013 revealed that the pipeline service in distributing drinking water only reached 85.9% out of 180,994 residents. On the

other hand, the Lekobalo Village is part of Gorontalo City, which is not involved in the coverage area receiving the thoroughly clean water supply. Therefore, some public places do not receive clean water from PDAM. That causes many people to use the wellspring. The local people use its existence to fill their daily needs for clean water. The wellspring comes from the ground, which most people believe is the grace given to them to be used as the source of drinking water.

The need for drinking water among the people of Lekobalo, if the condition of the environment is good (no flood), can be fulfilled by the wellspring that flows through the pipe hole. However, if there is flooding, the people get the water from the wellspring loaded in an open water tank and use it to complete their daily needs such as showering, laundry, and lavatory. That makes the location around the tanks full of household waste which may lower the quality of the drinking water from the wellspring. People's activities would also be likely to get the water contaminated because the water in the tank is connected to the pipe hole, and it is at a close distance. This contamination may be a chemical substance, and dangerous soap and feces bacteria can cause environmental and water pollution. According to Wiryono (2013), using water as a

place for waste disposal, lavatory, showering, and washing dishes would trigger the existence and spread of disease.

Water pollution is the occurrence of compounds from human activities penetrating the water environment so that it worsens the physical, chemical, and biological peculiarities and esthetic. Thus, if the wellspring is not well conserved, it will reduce its quality. The water's good or poor quality can be examined by testing the water sample (Suryani 2016). The quality testing was conducted using physical, chemical, and biological parameters (Sahabuddin et al. 2014). The examination referred to the quality standards based on its function as drinking water regulated in the Regulation of Health Ministry of the Republic of Indonesia Number 492 the Year 2010 concerning the drinking water consumed after or without the processing that follows the health requirement and can be directly consumed. Gaining good quality water needs an initial process before being consumed. Therefore, an examination to elicit drinking water quality based on biological, physical, and chemical parameters in Lekobalo Village, Gorontalo City, Indonesia, is needed.

MATERIALS AND METHODS

Research location

This study was conducted in Lekobalo Village, Kota Barat Sub-district, Gorontalo City, Gorontalo Province,

Indonesia. There is a wellspring that becomes the source of drinking water. Around the wellspring, a water tank becomes a place for the community to do house chores such as laundry, showering, and lavatory. That makes the environment around wellspring polluted due to the waste, triggering a water quality decrease from the wellspring. Geographically, Lekobalo has located in the City of Gorontalo; the eastern part borders on Pilolodaa Village, the western borders on Dembe I Village of Gorontalo City, southern borders on mountains, Iluta Village and northern borders on Tualango Village, Gorontalo District. This village is located in a coordinate of (0°32'53.03"N, 123°1'3.56"E) (Figure 1).

Procedures

Sampling stage

The test sample was collected using a sterilized carboy. Next, for chemical and physical tests, the water was poured into a bottle whose mouth was swabbed with alcohol. Finally, the sample was poured into a 100 mL bottle specifically used for bacteria for the microbiological test. Each sample bottle was given a name or code using labels and then transferred to the Laboratory of Public Health in the Regional Technical Implementation Unit (UPTD) of the Regional Health Laboratory Bureau of Gorontalo Province to be tested. The sampling was directly tested right after being received at the laboratory.

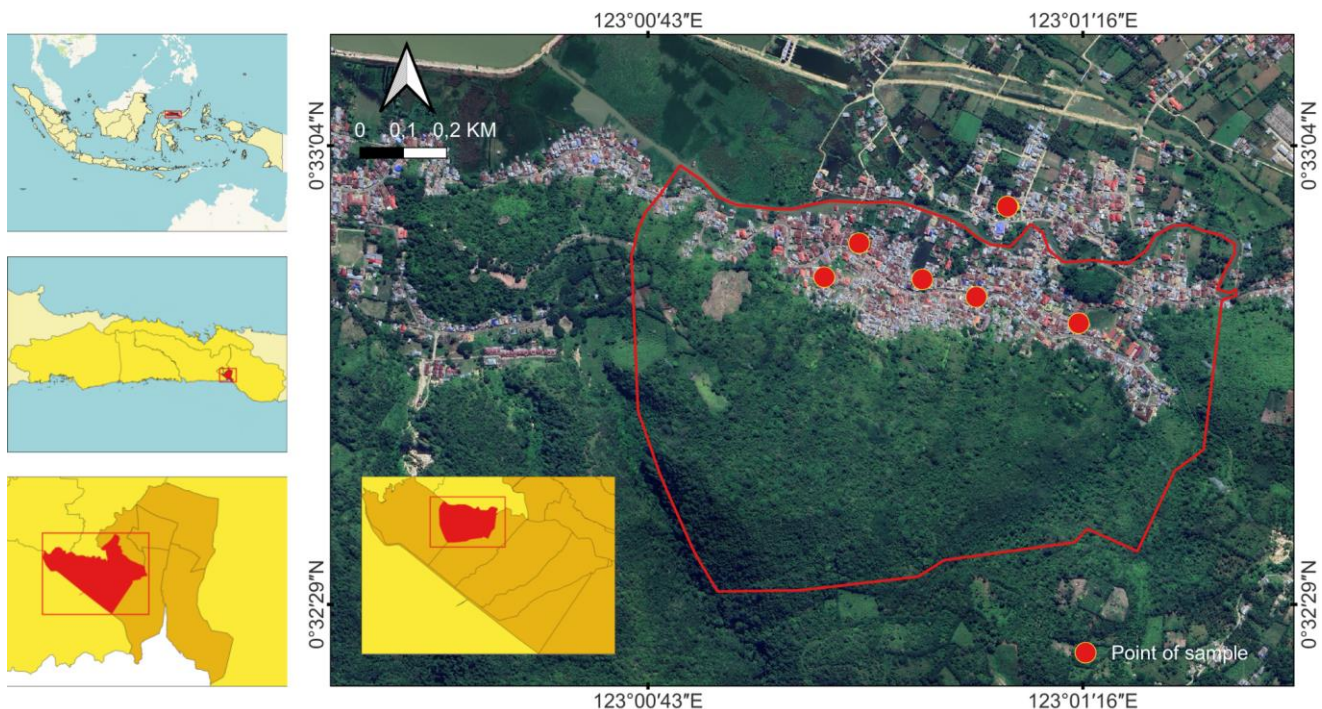


Figure 1. Map of research location in Lekobalo Village, Kota Barat Sub-district, Gorontalo City, Gorontalo Province, Indonesia

Stages of water quality test

The test must be conducted in-situ (where the sample is collected) and ex-situ (in the UPTD of the Regional Health Laboratory Bureau of Gorontalo Province). The test was conducted by referring to the standard drinking water qualification according to the Regulation of the Health Ministry of the Republic of Indonesia Number 49 the Year 2010. The test was repeated three times for each parameter. In addition, a physical parameter test was conducted in-situ (smell and taste) by five panelists. The smell parameter test was conducted directly in the location by taking the sample using a sterilized 100 mL beaker and smelling the aroma. Similarly, the taste parameter test was conducted in the field by pouring a small sample into a sterilized beaker and tasting and feeling the sample. The ex-situ test included the biological (*Escherichia coli* and coliform), physical (temperature, TDS, color, turbidity), and chemical (Arsenic (As), Fluoride (F), Nitrite (NO₂), Nitrate (NO₃), Iron (Fe), power of hydrogen (pH) and Manganese (Mn)) parameter tests.

Biological parameter test

The biological parameter test was conducted to detect the existence of *E. coli* and coliform by using the Quanti-Tray method. There are three steps in this testing. It started with preparing three sterilized bottles and giving them the label of repetition, such as 1, 2, and 3. Then, the sample was poured into each sterilized 100 mL bottle. Each was added colilert powder. After that, it was homogenized and ensured that all colilert reactors were perfectly dissolved. Next, the sample homogenized with colilert powder was poured into a Quanti-Tray; 1 bottle of sample is for 1 Quanti-Tray. The same things were done until it reached six samples in total, and each Quanti-Tray was given similar labels to those on the bottles. Then input the Quanti-Trays one by one in the tray sealer so that the samples were smoothly filled in the mold and the mold was tightly closed. Finally, the six molds were incubated under 30°C for 18 hours, then the color change was observed. The first thing to observe is the existence of coliform bacteria that makes the sample's color change from crystal clear to yellow. The square that changed was marked using a permanent marker. After observing the existence of coliform bacteria, the next step was to observe whether *E. coli* bacteria were in the sample. The sample was then observed using a long Wav UV lamp with a 365 nm wavelength. If fluorescence happens, it was marked using a black permanent marker to make the *E. coli* bacteria test score easy to recapitulate. After completing the observation, the boxes on the molds that positively contained the coliform and *E. coli*. The total boxes found positive were adjusted to the score in a table determining the score of the coliform and *E. coli*.

Physical parameter test

The physical parameter test was conducted to determine the drinking water's physical quality based on several tests, i.e., water temperature, total dissolved solids, color, and turbidity. The color test was carried out using a turbidity meter. First, the repetition 1 test was conducted by pouring

the sample into a beaker as big as 50 mL. After that, the turbidity meter was immersed in the glass, then waited until the device could read the temperature score. Then, the same thing was repeated until it reached 2 to 3 repetitions.

Similar to the temperature test, TDS was conducted using a turbidity meter by the Turbidimetry method. The first step was similar, the repetition 1 test; then, the sample was poured into a beaker amounting to 15 mL, based on the volume capacity of the Turbidity tube. After the tube was filled with the sample, it was covered and ensured that there was no sample left on the outer surface of the tube. Then it was stored in a measuring instrument of turbidity TB200 and anticipated for some time until the device detected the TDS score. After that, a similar thing was repeated until it reached 2 to 3 repetitions.

The first step that should be done on watercolor testing was preparing three 100 mL beakers. Then, the beakers were labeled as repetition 1, 2, and 3. After that, the samples were poured into each beaker as much as 100 mL. Then, the watercolor and other probable anomalies were observed by using a white background.

The turbidity test was begun by testing repetition 1. The initial step was pouring the sample into a turbidity tube amounting to 15 mL according to the volume capacity of the Turbidity tube. After the sample had filled the tube, the tube was covered and ensured that there was no sample left on the outer surface of the tube. The tube was then put in the Turbidity TB200 instrument and anticipated until the device read the turbidity score. Similar steps were carried out until repetitions 2 and 3.

Chemical parameter test

The chemical parameter test was conducted entirely ex-situ in the laboratory. The step of testing the fluoride, chromium, cadmium, nitrite, nitrate, zinc, and manganese is similar. It started with preparing 1 rack of test tubes containing 3 test tubes. Each test tube on the rack was labeled as repetition 1, 2, and 3. Other elements which are not aforementioned have a different initial step. The testing procedures are described in the following paragraphs.

Arsenic (As) testing was started by preparing three arsenic bottles. Each bottle was labeled as repetition 1, 2, and 3. After that, each bottle was given a sample of as much as 60 mL and added two drops of As1 reagent, one spoonful of As2 reagent, and one spoonful of As3 reagent. Next, the sample was homogenized, and an arsenic stick was inserted through a hole in the arsenic cover and then left for 20 minutes. After 20 minutes passed, the stick was pulled out and matched with the color indicator on the stick tube. Each color indicator has numbers that indicate the score result of As.

The next step was fluoride (F) testing. Initially, 2 mL F1 reagent was poured into each test tube then 5 mL of sample was added. Next, one spoonful of F2 reagent was given, homogenized, and left for 5 minutes. While waiting, the Autoselector instrument was inserted in the spectrophotometer (Spectroquant Pharo 300) so that the tool could automatically measure the parameter being tested. Next, the homogenized sample was poured into a cuvette amounting to 2.5 mL which is suitable for the

cuvette volume. Then it was put into a spectrophotometer testing tool and tested for the amount of its concentration. The score of the testing result will appear on the monitor of the testing tool.

The following step was chromium (Cr) testing. It was started by pouring one spoonful of Cr1 reagent into each test tube; six drops of Cr2 reagent and a 5 mL sample were added. Then it was homogenized and left for 1 minute. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested parameter. After that, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the cuvette volume. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

The next step is cadmium (Cd) testing. Initially, 1 mL Cd1 reagent was poured into each test tube, then added with a 10 mL sample, with 0.2 mL Cd2 reagent and one spoonful of Cd3 reagent. It was then homogenized and left for 2 minutes. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested parameter. Next, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the cuvette volume. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

The following step was nitrite (NO_2) testing. It was started by pouring a 5 mL sample into each test tube, one spoonful of NO_2 reagent, and homogenized and left for 10 minutes. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested parameter. After that, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the cuvette volume used. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

The next step is nitrate (NO_3) testing. Initially, 4 mL NO_3 1 reagent was poured into each test tube, then added with 0.50 mL sample and 0.50 mL NO_3 reagent. It was then homogenized and left for 10 minutes. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested parameter. After that, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the cuvette volume used. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

The following step was Zinc (Fe) testing. It was started by pouring a 5 mL sample into each test tube and three drops of Fe reagent. It was then homogenized and left for 3 minutes. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested

parameter. Afterward, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the volume of the cuvette used. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

For pH testing, a particular test tube to test pH was prepared in the laboratory, where there were only two pH tubes. Thus, 2 test tubes were prepared. The first test was conducted for repetitions 1 and 2 of the clean water sample. After that, the test for repetition 3 of the clean water sample and repetition 2 for the drinking water sample, and the last test was repetition 2 and 3 of the drinking water sample. First, a 10 mL sample was poured into the test tube. Then it was added with four drops of pH reagent and homogenized, ensuring that the outer surface of the bottle was dry. Then it was put in a spectrophotometer (Spectroquant Pharo 300) testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

The following test was Manganese (Mn). The initial step was pouring a 5 mL sample into a test tube. Then four drops of Mn1 reagent and two drops of Mn2 were added. It was then homogenized and left for 2 minutes. While waiting, insert the Autoselector into the spectrophotometer (Spectroquant Pharo 300) tool so that it can be measured automatically based on the tested parameter. Afterward, the homogenized sample was poured into a cuvette amounting to 2.5 mL based on the cuvette volume. Then it was put in a spectrophotometer testing tool and tested on how much the concentration was. The score result of the test will appear on the monitor of the testing tool.

Data analysis

After collecting the data, data analysis was conducted using the descriptive method. A conclusion was drawn by considering the standard quality of drinking water regulated by the Health Ministry of the Republic of Indonesia Number 492 in the Year 2010 concerning the drinking water. If the result were not relevant to the regulated standard quality of drinking water in Lekobalo Village, Gorontalo City, Indonesia, it would not be used as described.

RESULTS AND DISCUSSION

The quality test result of drinking water

The finding result of the quality test of drinking water by referring to the standard quality of drinking water regulated by the Health Ministry of the Republic of Indonesia Number 492 in the year 2010 was delivered in the table below. In addition, the result of the biological parameter test was exposed in Table 1, the physical parameter in Table 2, and the chemical parameter in Table 3.

Table 1. The result of the quality test on drinking water based on biological parameter

Parameter	Testing method	Average	Quality standard
<i>E. coli</i>	Quanti tray	10.3 MPN/100 mL	0 MPN/100 mL
Total coliform	Quanti tray	200.5 MPN/100 mL	0 MPN/100 mL

Table 2. The result of the quality test on drinking water based on the physical parameter

Parameter	Testing method	Average	Quality
Temperature	Turbidimetry	20°C	Air temp. $\pm$ 3°C
Total Dissolved Solid	Turbidimetry	1525 mg/L	1000 mg/L
Smell	Organoleptic	No smell	No smell
Color	Visual (Direct)	Colorless	Colorless
Taste	Organoleptic	Tasteless	Tasteless
Turbidity	Turbidimetry	0 NTU	25 NTU

Table 3. The result of the quality test on drinking water based on the chemical parameter

Parameter	Testing method	Average	Quality
Arsenic (As)	Spectrophotometry	0 mg/L	0.05 mg/L
Fluoride (F)	Spectrophotometry	1 mg/L	1.5 mg/L
Chromium (Cr)	Spectrophotometry	0.34 mg/L	0.05 mg/L
Cadmium (Cd)	Spectrophotometry	0.047 mg/L	0.005 mg/L
Nitrite (NO ₂)	Spectrophotometry	0.02 mg/L	1 mg/L
Nitrate (NO ₃)	Spectrophotometry	3.6 mg/L	10 mg/L
Zinc (Fe)	Spectrophotometry	0.12 mg/L	1 mg/L
Manganese (Mn)	Spectrophotometry	0 mg/L	0.4 mg/L
pH	Spectrophotometry	6.6 mg/L	6.5-8.5 mg/L

Discussion

Analysis of quality test on drinking water based on biological parameter

Water quality based on biological parameters seen through the content of *E. coli* bacteria showed that the drinking water from the wellspring located in the Lekobalo Village, Gorontalo City, did not fit the criteria of quality standard that is 0 MPN/100 mL. The high composition of *E. coli* in the water was caused by the condition of the surroundings, where a toilet nearby is frequently used for feces disposal. That triggers the high content of *E. coli* bacteria in the water. Another factor that causes the high content of *E. coli* bacteria in the water is the condition when taking the sample. The water tank was fully loaded due to the rainwater that drops daily, which may create the great possibility that *E. coli* contaminates the water, considering the toilet's location is close to the wellspring. Lipinwati et al. (2018) state that water containing pathogenic organisms such as *E. coli* has been polluted with human and animal excrement. As a result, the water cannot be used for drinking, laundry, or cooking food due to a disease-related gastrointestinal such as diarrhea. Therefore, drinking water quality standards required 0 *E. coli* in 100 mL water.

The content of coliform obtained from the test result in the laboratory revealed that the capacity of the drinking water from the Lekobalo Village is not eligible for drinking based on the qualification on quality standard, that is 0 MPN/100 mL. The cause of high-rate coliform in the water from the Lekobalo Village is similar to the high rate of *E. coli* related to the community's activity concerning lavatory usage. That is also supported by Kumala et al. (2019), who stated that the high amount of waste marks the potential of coliform bacteria to breed. Furthermore, the microorganism in water proves that the water was populated by human and warm-blooded animal excrement. That also implies a potential for various pathogenic organisms to live periodically in the gastrointestinal tract to transmigrate in the water.

Analysis of quality test on drinking water based on the physical parameter

Temperature is one of the parameters that have an important role in environmental factors (Baderan et al. 2019). The finding result drinking water temperature in the Lekobalo Village has been eligible for drinking based on the qualification of quality standard that is $\pm$ 3°C (the temperature score reaching 3°C above and below the temperature of the surrounding). When the research was carried out, the air temperature in the research location was around 22°C. Water temperature with an average score of 20°C was obtained during the sample collection in the afternoon and rain. According to Sofiana et al. (2022), a good temperature range for water is between 18-30°C.

The TDS score of the drinking water is not eligible for drinking based on the quality standard of drinking water. The water in the research location had been polluted by people's activity in the wellspring, such as doing laundry and showering. These activities caused more waste and leftovers of soap and detergent. That is also supported by Setiari et al. (2012), who stated that the main factor causing the existence of TDS in water is the leftovers of organic materials and molecular leftovers such as soap, detergent, and surfactant dissolved in the water.

The turbidity score of the test sample obtained had been eligible for drinking based on the quality standard of drinking water. The drinking water in Lekobalo Village does not contain particle and suspension materials that hinder sunlight to penetrates the water. Therefore, the water turbidity level is considered based on the drinking water quality standard threshold determined based on its function. Besides, the environment where the sample is located is considered clean as there was no mud and clay, so the turbidity score is low or comply the quality standard. Pramesti and Puspikawati (2020) stated that the increase in turbidity score was caused by suspended solid materials, clay, mud, and inorganic or highly organic substances.

The test samples that were being tested visually revealed colorless water. According to Kumala et al. (2019), the decrease in water can be indicated by the increase in color parameter rate, that is, the color transformation from brownish to blackish. Therefore, the colored water can be from the chemical substance and colored microorganisms. Thus, to avoid intoxication from

various chemical substances and colored microorganisms, the water should be colorless.

The responses of five panelists towards the test sample showed that the drinking water in the Lekobalo Village was not smelly and tasteless. This result is relevant to the quality standard of drinking water that should not be smelly and tasteless. Moreover, standardized drinking water must be physically colorless, odorless, plain, and clear (Permana et al. 2020).

Analysis of quality test on drinking water based on chemical parameter

Arsenic content obtained from the analysis results in the laboratory revealed that the drinking water from the wellspring in the Lekobalo Village, Gorontalo City, has low arsenic content and has been eligible for drinking based on the quality standard, which is 0.05 mg/L. The absence of stimulants for high levels of arsenic, such as in volcanoes, mining, and other industries, causes the low arsenic content. That is related to a notion by Sembel (2015), who stated that naturally, arsenic could penetrate an environment through volcanic ash produced by volcanic eruptions, rocks weathering, and minerals containing arsenic that penetrate the groundwater. In addition, nature, human activities, and household waste can cause arsenic to penetrate the environment.

The result obtained for fluoride content in the test sample has been eligible for drinking based on the quality standard of drinking water, which is 1.5 mg/L. The quality condition of drinking water in the Lekobalo Village is considered good. Therefore, it can be used as the quality drinking water standard that meets the regulations. According to Nuradi and Jangga (2020), fluoride content ranging from 1-1.5 mg/L will strengthen teeth' enamels. However, ranging from 1.5-4 mg/L, the fluoride may cause dental fluorosis, and if the content of fluoride ranges from 4-10 mg/L for a long time, it does cause not only dental fluorosis but also skeletal fluorosis that will cause the skeletons that support the body becomes weakened.

The chromium content obtained from the test did not become eligible for drinking based on the quality standard of drinking water, which is 0.05 mg/L. That indicates the drinking water in the Lekobalo Village was contaminated by chromium, a heavy metal. The high rate of chromium, the heavy metal containing the water, is caused by people's activities around the wellspring that creates household waste. That is relevant to the statement by Nuraini et al. (2017), who stated that chromium, the heavy metal in water, is from nature with a very small amount such as rock weathering process and the runoffs from lands. However, chromium heavy metal can increase in numbers due to human activities such as industry, household waste, and other activities through the wastes that penetrate the waters. According to Mauna et al. (2015), chromium (Cr) is a heavy metal essential for our body. Moreover, it is needed for the metabolism process of insulin hormone and regulating sugar blood level. However, it may be intoxicating if it is consumed in high numbers. Besides, the toxic nature of chromium is carcinogenic or can cause cancer. Therefore, considering the test result in this

parameter, the drinking water in the Lekobalo Village is not recommended to be used for drinking as it has the potential to endanger our health.

The result of cadmium (Cd) testing revealed it was not eligible for drinking based on the quality standard of drinking water, which is 0.03 mg/L. That is affected by human activities around the wellspring that created domestic wastes so that the rate of Cd, the heavy metal content in the water, exceeds the limit of quality standard of drinking water which had been determined. These results are aligned with Irsan et al. (2013), who stated that the detected heavy metals mark the decreased quality of groundwater as pollutants which were cadmium (Cd), Lead (Pb), and Manganese (Mn) that are from industrial wastes, landfills leaching, excessive use of fertilizer and domestic wastes. Other sources that can cause Cd heavy metal pollution are agricultural and livestock activities, metal coatings, oil spills, plastic, coal, batteries or accumulators, and garbage deposits. According to Irsan et al. (2013), the pollution caused by cadmium (Cd) negatively impacted the ecosystem and human living.

Furthermore, cadmium heavy metal in the drinking water used for daily consumption, could harm the body's health if consumed beyond limitation. Therefore, considering the result analysis of this parameter, the drinking water from the wellspring is not eligible for the source of drinking water as it may harm our health. That is relevant to a notion by Ghifari et al. (2022), stating that Cd metal is categorized as a non-essential metal like Lead (Pb), Mercury (Hg), and Arsenic (Ar). Non-essential metals do not function in the human body unless becoming toxic and poisonous stated by Adhani and Husaini (2017).

Based on the quality standard determined, the Nitrite test result revealed that the drinking water from the wellspring could be used as the source of drinking water. The result obtained was eligible for consumption based on the quality standard of drinking water, 3 mg/L. The low nitrite content in this drinking water is caused by the absence of human activities that use organic fertilizer, which can trigger the high nitrite content in the water. Based on a notion by Indrayani et al. (2015), the natural source of nitrite and nitrate is the nitrogen cycle, while the source of human activities comes from the use of nitrogen fertilizer, industrial wastes, and human organic wastes.

The content of nitrate heavy metal in this study obtained was eligible for consumption based on the quality standard of drinking water, which is 50 mg/L. Furthermore, that indicated factors causing nitrate content in the water, such as the fertilizer runoff that contains nitrate, which does not pollute the water in the research location. Thus, the nitrate content in the wellspring drinking water was eligible for consumption based on the determined quality standard. However, according to Sitepu et al. (2021), nitrate can penetrate the water directly due to the runoff of the fertilizer that contains nitrate.

According to the result obtained for zinc (Fe) content in the drinking water, that is 0.3 mg/L, it was indicated that Fe heavy metal pollutants do not pollute the drinking water in the Lekobalo Village. Therefore, the result demonstrated the quality of the drinking water had been eligible for

drinking, and the water is categorized as good for consumption. According to Supriyanti and Endrawati (2015), zinc (Fe) is an essential metal that living creatures need present in a certain number. However, an excessive amount of it will cause toxic effects.

The pH content in the drinking water located in the Lekobalo Village is still considered eligible for drinking based on the quality standard of clean water and drinking water, which is 6.5-8.5 mg/L. The research showed that the water quality based on the pH parameter in a neutral category (or normal based on its function) had been regulated in the determined quality standard of water. According to Sahabuddin (2012), the pH of normal water ranges from 6.5-7.5. Budiyo and Sumardiono (2013) stated that pH (pouvoir Hydrogen) reflects the hydrogen ion concentration in the water. Therefore, the pH content can be used to determine the base or acid levels of water.

The quality test of drinking water concerning Manganese content yielded that the water does not contain manganese heavy metal. However, the test result is relevant to the physical parameter test such as smell, color, and turbidity that is considered eligible for consumption based on the determined quality standard of drinking water. It is because the methods to check the content of manganese in the water is by observing its color changes, whether it has a taste and whether the water is muddy or not. That echoes the notion by Febrina and Ayuna (2015), stating that water containing excessive manganese (Mn) will create a taste, color (brown/purple/black), and turbidity.

It can be concluded that the quality of drinking water in the Lekobalo Village, Gorontalo City, Indonesia, is polluted by *E. coli* and coliform bacteria. The findings revealed that the average score of *E. coli* was 10.3 MPN/100 mL and coliform 200.5 MPN/100 mL. Based on physical parameters, the quality of drinking water in the Lekobalo Village, Gorontalo City is relatively good concerning temperature, turbidity, smell, taste, and color measurements. In comparison, the parameter that did not fulfill the quality standard on physical is TDS (Total Dissolved Solid), which reached an average score of 1,525 mg/L. Moreover, according to chemical parameters, the quality of the drinking water is relatively good concerning the tests on Arsenic (As), Fluoride (F), Nitrite (NO₂), Nitrate (NO₃), Zinc (Fe), pH, and Manganese (Mn). On the other hand, Chromium (Cr) and Cadmium (Cd) did not fulfill the quality standard based on the chemical parameter. The average score of chromium is 0.34 mg/L and Cadmium 0.047 mg/L. Therefore, it is suggested to conduct further research to observe the impacts of the drinking water quality on the community in the Lekobalo Village, Gorontalo City, Indonesia.

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REFERENCES

- Adhani R, Husaini. 2017. The Heavy Metals Around the Community. Pustaka Buana, Banjarmasin. [Indonesian]
- Baderan DWK, Hamidun MS, Utina R, Sukirman R, Rifal D. 2019. The abundance and diversity of Mollusks in mangrove ecosystem at coastal area of North Sulawesi, Indonesia. Biodiversitas 20 (4): 987-993. DOI: 10.13057/biodiv/d200408.
- Budiyo, Sumardiono S. 2013. Water Processing Technique. Graha Ilmu, Yogyakarta. [Indonesian]
- Daud SUD, Kumaji, SS, Arpin. 2021. Identification of *Escherichia coli* bacteria in dug wells in Kota Timur District of Gorontalo City. Sci Dr Aloe Saboe J 8 (1): 1-6.
- Febrina L, Ayuna A. 2015. Study on the reduction of Iron (Fe) and Manganese (Mn) contents in groundwater using ceramic filter. Tech J 7 (1): 35-44. [Indonesian]
- Ghifari F, Santoso A, Suprijanto J. 2022. The potential risks of human health as the impacts of consuming *Perna viridis* containing Cadmium. J Mar Res 11 (1): 19-29. DOI: 10.14710/jmr.v11i1.32338. [Indonesian]
- Indrayani E, Nitimulyo KH, Hadisusanto S, Rustadi R. 2015. Content analysis of nitrogen, phosphor, and organic carbon in Sentani Lake-Papua. J Hum Environ 22 (2): 217-225. DOI: 10.22146/jml.18745. [Indonesian]
- Irsan PR, Hasan W, Chahaya I. 2013. Analysis on Cadmium (Cd) in a well water around the farming area in Mompang Village, Padangsidimpuan Angkola Julu District, Padangsidimpuan City in 2013. Jurnal Neliti 10 (2): 14665. [Indonesian].
- Kumala IGAI, Astuti NPW, Sumadewi NLU. 2019. Quality Test of drinking water in a wellspring of Baturiti Village, Baturiti District, Tabanan Regency. J Environ Health 5 (2): 100-105. [Indonesian].
- Lipinwati, Darmawan A, Kusdiyah E, Karolina ME. 2018. Quality Test of refill drinking water in Jambi City. Jambi Medical Journal 4 (2): 203-210. [Indonesian]
- Mauna RB, Ma'rufi I, Ningrum PT. 2015. The content of chromium (Cr) on liquid wastes and river water and health complaints from the community around the electro-planting industry (a study in x electro-planting industry Tegal Besar Sub-district, Kaliwates District, Jember Regency). Artikel Ilmiah Hasil Penelitian Mahasiswa 2015: 1-6. [Indonesian]
- Nuradi, Jangga. 2020. Analysis of Fluoride content on several branded bottled water distributed in Rappocini District, Makassar City. Jurnal Media Analis Kesehatan 11 (1): 56-61. DOI: 10.32382/mak.v11i1.1509. [Indonesian]
- Nuraini RAT, Enderwati H, Maulana IR. 2017. Analysis on the content of Chromium (Cr) the heavy metal in water, sediment and green shell (*Perna viridis*) in Trimulyo Waters, Semarang. Trop Mar J 20 (1): 48-55. DOI: 10.14710/jkt.v20i1.1104. [Indonesian]
- Permana B, Syaefi DI, Syaefi H, Olifvia O, Fitri NC, Sundari NR, Saharai W, Vanesia D, Aini AN, Gamellia BO, Katipah K, Arif M, Anggraeni A. 2020. Analysis on physical characteristics and acidity degree towards the quality of drinking water refill package from 20 houses in RW 01 Cilember Sub-Village, Jogjogan Village, Cisarua District, Bogor Regency. Risenologi 5 (1): 54-69. DOI: 10.47028/j.risenologi.2020.51.82. [Indonesian]
- Pramesti DS, Puspikawati SI. 2020. Analysis on turbidity test of bottled drinking water distributed in Banyuwangi Regency. J Pub Health 11 (2): 75-85. [Indonesian]
- Sahabuddin ES. 2012. Water pollution and the achievable sustainability of natural resources. Edu Pub J 11 (2): 102-111. DOI: 10.22487/preventif.v11i2.59. [Indonesian]
- Sahabuddin H, Harisuseno D, Yuliani E. 2014. Analysis of water quality status and load capacity of Wanggu River pollution in Kendari City. J Waters Eng 5 (1): 19-28. [Indonesian]
- Sembel DT. 2015. Environmental Toxicology. Andi Offset, Yogyakarta. [Indonesian]
- Setiari NM, Mahendra MS, Wayan I. 2012. Identification of pollutant sources and analysis on water quality of Tukad Yeh River in Tabanan Regency by using pollution index method. Ecotrophic 7 (1): 383535. [Indonesian]
- Sitepu DMB, Ima YP, Kartika IWD. 2021. Content of Nitrate and Phosphate in water of Telagawaja River, Karangasem Regency, Bali. Curr Trends Aquat Sci 4 (2): 212-218. [Indonesian]
- Sofiana M, Kadersah A, Sofarini D. 2022. Water quality impacted from wastes as the indicator of sustainability development in Sub Das

- Martapura, Banjar Regency. Jurnal Teknik Lingkungan 8 (1): 18-31. DOI: 10.20527/jukung.v8i1.12966 . [Indonesian]
- Sudipa N, Nurjani. 2022. The Potentials of pollutants and quality of wellspring of Penida and Guyangan as the standard source of drinking water in Nusa Penida. Ecotrophic 16 (1): 36-44. DOI: 10.24843/EJES.2022.v16.i01.p04. [Indonesian]
- Supriyanti E, Endrawati H. 2015. The content of Iron (Fe) heavy metal in water, sediment, and green shell (*Perna viridis*) in the Tanjung Emas Waters, Semarang. Trop Mar J 18 (1): 38-45. DOI: 10.14710/jkt.v18i1.512. [Indonesian]
- Suryani A. S. 2016. Community perception in using clean water (a case study on riverside community in Palembang). Aspirasi 7 (1): 33-48. [Indonesian]
- Wiryo 2013. Pengantar Ilmu Lingkungan. Pertelon Media, Bengkulu. [Indonesian]