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Physical chemical and biological quality test of spring in meurandeh

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ABSTRACT

The spring in Meurandeh is a source of water that is widely used by residents as drinking water and natural medicine. This water is also often consumed raw without being processed. This study aims to determine the quality of the springs in Meurandeh. This type of research is descriptive qualitative with observational data collection methods. The data collected in this study was compiled, explained, and analyzed. Parameters tested include physical, chemical, and biological parameters. Physical parameters include odor, color, dissolved solids, and temperature. Chemical parameters include pH, hardness, iron, fluoride, DO, nitrate, nitrite, cyanide, detergent, and manganese. While the biological parameters are total Coliform and E.coli. Measurements of odor, dissolved solids, DO, temperature, and pH were carried out directly in the field. Tests for hardness, iron, fluoride, nitrate, nitrite, cyanide, detergent, manganese, total coliform, and E. coli were carried out at the Testing Laboratory of the Banda Aceh Center for Standardization and Industrial Services. The results showed that 14 of the 16 parameters tested met the requirements for drinking water quality according to the Minister of Health of the Republic of Indonesia Number 492 of 2010. Meanwhile, the other two did not meet these requirements, namely pH and total Colliform..

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INTRODUCTION

Meurandeh is a village located in Langsa Lama District, Langsa City, Aceh Province. Based on the results of observations in this village, there is a spring that the local people call "mbes-mbesan". This spring is used as a source of drinking water by the local community. In addition,

they also believe in and use the spring water as a natural medicine, which is consumed to cure various diseases. However, no processing is carried out before the water is consumed. It is feared that this condition may harm the health of the body because the quality of the water is not known with certainty. So far, there is no research about water quality in Meurandeh. Based on RI Minister of Health No. 492 of 2010 there are several standards for the quality of water suitable for consumption, which are grouped into physical, chemical, and biological parameters.

To make it safer for consumption, the water should be treated first. There are several variations of water treatment, namely by boiling, filtration, or chlorination (Sari and Raksanagara 2018). Boiling water is effective enough to kill coliform bacteria, which is one of the biological factors that are an indicator of water quality standards in RI Minister of Health Regulation No. 492 of 2010. Boiling water at 70°C for 3.5 seconds can reduce the number of coliform bacteria by about 105 CFU/g (Saputro 2019). Meanwhile, filtration can improve water quality on several physical and chemical factors of water. The more sophisticated the filtration system, the more physicochemical factors the water quality will improve. Simple filtration can increase pH, reduce water TDS, and eliminate odors because materials such as palm fiber, charcoal, coral, and quartz sand play a role in this (Nursahidin et al. 2021). Meanwhile, chlorination is a disinfection process using chlorine gas (Cl2) to prevent the growth of pathogenic bacteria in water (Nursahidin et al. 2021).

Scientifically, everything needs to be studied in detail based on generally accepted scientific concepts. By knowing the exact conditions related to a thing, risk analysis is easier to predict. For example, the microbial content in water has the potential to cause certain diseases. The research conducted by Hutasoit revealed that food sanitation including water sources has a strong influence on the occurrence of diarrhea because it has been contaminated with Escherichia coli bacteria (Hutasoit 2020). However, the opposite condition can also occur if the condition is positive, then utilization can be maximized. The unique characteristics of this spring can be a selling point in itself (Hutasoit 2020).

Based on the Minister of Health Regulation of the Republic of Indonesia No. 492 of 2010, the physical parameters considered include odor, color, dissolved solids (TDS), turbidity, taste, and temperature. Chemical parameters included as mandatory parameters include pH, manganese, chloride, hardness, iron, aluminum, selenium, cyanide, nitrite, nitrate, cadmium, total chromium, fluoride, and arsenic. The biological parameters include total coliform and E. coli. Water with a pH < 6.5 will cause metal corrosion (eg drinking water pipes) which will dissolve lead, copper, cadmium, etc. which are toxic to the human body (Muzayana and Hariani 2019). The high iron content makes the water colored, tastes bad, and can cause disturbances in the blood vessels. The high manganese content makes water neurotoxic, which is characterized by insomnia, then weakness in the legs and facial muscles so facial expressions become frozen (Hermansyah 2021).

Even though the water from this spring is not treated first by the local community before being consumed, so far no one has been found to have been poisoned by drinking it. Even more healing occurs after drinking the water. So, people consider this spring as a sacred object that has been used for generations. Based on this background, this study aims to examine the physical, chemical, and biological qualities of springs in Meurandeh.

RESEARCH METHODS

Research Design

This type of research is descriptive qualitative with an observational data collection method (Faisal and Atmaja 2019). Descriptive research is research that aims to make a systematic, factual, and accurate description or description of the facts, characteristics, and relationships between the phenomena studied.

Population and Samples

The population of this research is mbes-mbesan spring water in Meurandeh Village. For the samples, we used 2 liters water of to be tested in the laboratory. Samples were carried out by grabbing samples, namely taking water from the research location directly for analysis in the laboratory (Costa and Tuas 2022). This sampling technique was chosen because the quality of this spring water tends to be stable.

Instruments

The indicators in this research are divided into biological indicators, chemical indicators, and physical indicators. Physical indicators contain odor, color, dissolved solids, and temperature. Chemical indicators contain pH, hardness, iron, fluoride, DO, nitrate, nitrite, cyanide, detergent, and manganese. While the biological indicators contain total Coliform and E. coli. Tools used in this research include: pH meter, DO meter, thermometer, TDS meter, measuring cup, burette, measuring flasks, filter paper, spectrophotometer, pipette volume, measuring pipette, analytical balance, nutmeg glass, micropipettes, test tube, electric bath, calibrated oven, cuvette, separating funnel, parchment paper, and spatula.

Procedures

In this study, water quality testing was carried out in the field and the laboratory. Parameters tested directly in the field included odor, pH, dissolved solids, temperature, and dissolved oxygen (DO). The parameters for color, hardness, iron, fluoride, nitrate, nitrite, cyanide, detergent, manganese, total coliform, and E. Coli were tested at the Laboratory of the Center for Standardization and Industrial Services in Banda Aceh.

Procedures For Physics Quality Test

The odor was tested by holding the nose close to the spring water. The color was tested by comparing the visual of the sample with colored suspension with known concentration. The color unit is the color obtained from 1 ng platinum/L in chloroplatinate ion form. Dissolved solids were measured by dipping the tip of a TDS meter into the water. The temperature was tested directly in the research location by dipping the tip of the thermometer.

Procedures For Chemical Quality Test

pH was measured by dipping the tip of a pH meter into the water. Hardness was measured by some procedures, which are the standardization of Na2EDTA solutions with ZnSO4.7H2O, determination of total hardness, and calculation of the total hardness level (CaCO3). Iron consent in the sample was calculated by using a calibration curve or linear regression line equation after checking the standard solutions and the sample by using an SSA carbon furnace. Fluorida consent was measured by using fluoride test kit. Dissolved oxygen was measured by dipping the tip of the DO meter into the water. Nitrat, nitrit, and cyanide in the sample were measured by using the spectrophotometry UV-Vis method. Detergent concentration in the sample was measured by MBAS (Methylene Blue Active Surfactant) method. Manganese concentration was measured by the spectrophotometry method.

Procedures For Biological Quality Test

Total coliform E. coli was tested by using the membrane filter method.

Data Analysis

Data analysis was carried out qualitatively, so it included qualitative research (Ibrahim et al. 2018). As for the observation on data collection in question, namely testing the quality of water based on predetermined parameters. The data collected in this study was compiled, explained, and analyzed.

RESULTS

The results of tests that have been carried out on spring water samples in Meurandeh include physical, chemical, and biological parameters.

1. Physical Parameters

The test results on the physical parameters show that all the test parameters meet the quality standards (Table 1).

Table 1. Results of Water Quality Test on Physical Parameters

Parameter	Standard		Results	Information
	Units	Condition		
Smell	-	No smell	No smell	Meets standard
Color	TCU	max. 15	1	Meets standard
Dissolved solids (Total Dissoved solid)	mg/l	max. 500	0.25	Meets standard
Temperature	°C	Air temperature ±3	28 ° C (same as air temperature)	Meets standard

2. Chemical Parameters

Test results on chemical parameters showed that all test parameters met the quality standards, except for the pH parameter (Table 2).

Table 2. Water Quality Test Results on Chemical Parameters

Parameter	Standard		Results	Information
	Units	Condition		
pH	mg/l	6.5-8.5	5,4	Does not meet the standard
Hardness	mg/l	Max 500	5,15	Meets standard
Iron	mg/l	Max 0.3	<0.0008	Meets standard
Fluoride	mg/l	Max 1.5	0.0625	Meets standard
DO (dissolved oxygen)	mg/l	-	7,46	Meets standard
Nitrate	mg/l	50	<0.1728	Meets standard
Nitrite	mg/l	3	<0.0043	Meets standard
Cyanide	mg/l	0.07	0.001	Meets standard
Detergent	mg/l	0.05	<0.0013	Meets standard
Manganese	mg/l	0.4	<0.0003	Meets standard

3. Biological Parameters

Test results on biological parameters show that all test parameters meet quality standards (Table 3).

Table 3. Results of Water Quality Test on Biological Parameters

Parameter	Units	Condition	Results
Total Coliforms	amount/100 ml of sample	0	1
E. coli	amount/100 ml of sample	0	0

DISCUSSION

1. Physical Parameters

The water in this spring is odorless, according to the requirements of RI Minister of Health No. 492 of 2010. Odor in water can be smelled if the water has a certain taste and color and

comes from the presence of microorganisms that form an anaerobic state (Kasana 2021) . Microorganisms generally come from household waste and other wastes that experience decay. This spring is far from housing so it is not polluted by household waste. Smelly water, in addition to disturbing health also causes discomfort for people who consume it. Some water sources, sometimes smell fishy, smell rust, or smell of mud. A fishy smell is generally caused by contamination from the environment, for example, the location of a well close to a river, while a rusty smell indicates that the aquifer may contain iron. (Permana 2019) . In the observations made, the element of iron in this water is <0.0008 mg /l, so it is very small and does not cause odor.

The water in this spring has a color size of 1 TCU, meeting the requirements of RI Minister of Health No. 492 of 2010 which tolerates a maximum limit of the color of drinking water up to 15 TCU. An abnormal color in water usually indicates pollution, be it the true color of the water or the apparent color (Widiyanto, Yuniarno, and Kuswanto 2015) . True colors are caused by dissolved materials, while apparent colors are caused by substances suspended in water.

The measurement results for dissolved solids in this water are 0.25 mg/l, meeting the requirements of RI Minister of Health No. 492 of 2010, which is a maximum of 500 mg/l. The emergence of dissolved solids is generally caused by inorganic materials in the form of ions which are commonly found in waters, such as wastewater containing soap, detergents, and surfactants (Tezia 2020) . This spring is very protected from these contaminants, because of its location far from the area where people live. So it is very unlikely that these ingredients will mix into this spring. Apart from that, this spring is also well maintained according to the prevailing customary norms. The designation of this spring is only permitted for drinking water sources, not allowed for other activities such as bathing and washing. The high TDS content in water can reduce water clarity and cause an increase in temperature (Widyastuti 2021) .

The result of measuring the water temperature in this spring is 28 °C, the same as the air temperature at the time the measurement was made. Based on RI Minister of Health No. 492 of 2010, the permissible drinking water temperature requirement is an air temperature of +3oC. Then the water temperature meets these requirements . Water temperature is influenced by various factors such as the intensity of sunlight, the physical processes that take place in the water, the surrounding atmosphere, and the presence of contaminants (Yoga, Astuti, and Sanjaya 2020) . This spring is in an oil palm plantation, located right under one of the palm trees. Thus blocking direct sunlight from penetrating the body of water. This water also looks clean from contaminants, so the temperature is quite cool.

2. Chemical Parameters

The pH value measured this spring is 5.4, which does not meet the requirements for drinking water quality in the Minister of Health of the Republic of Indonesia Number 492 of 2010 which requires the pH range of drinking water to be 6.5-8.5. It can be said that this water is more acidic because the measured pH is below 6.5, so it will be corrosive to the organs of the body when consumed by humans it can cause several diseases such as diarrhea, stomach muscle contractions, damage to teeth, and skin diseases. (Asriza et al. 2018) . Consuming acidic water can also cause acidosis, which is a buildup of acid in the blood (Syauqy and S 2019) . Based on observations, the acidity level of this water is affected by shallow water holes, because surface water absorption affects the level of acidity. This is in line with the statement that shallow well holes make it easier for water to infiltrate from the surface, this high acidity of surface water can come from rainwater or organic and inorganic overflows on the soil surface (Singkam et al. 2021) . Acidic water can release metals from pipes such as copper (Cu), lead (Pb), and zinc (Zn) so that water will contain these substances. With the presence of metal content in water, it will indirectly cause a sour taste (Emilia 2019) . The community takes water from these springs directly without intermediary pipes, so that the presence of these metals is very unlikely to appear in the water. So

the taste of this water is not sour. However, a low pH is still not good for health. Therefore it is necessary to make efforts to increase the pH value of water before consumption, for example with alkaline resins such as in RO water treatment (Robbani and Setiadi 2019) . Another solution that can be offered is to install a pipe directly from where the water exits so that the water that comes out does not have time to mix with surface water which can increase the acidity level. However, before doing this, it is necessary to first measure the pH value of the water coming out of the pipe, whether it meets the standard water quality requirements or remains acidic like the water in the holding hole. In addition, Asriza experimented in 2018 by making multilevel filters based on eggshell waste in Teru Village, Central Bangka Regency, the results of which were able to increase the pH of well water from 4.16 to 6.72 (Asriza et al. 2018) .

The result of measuring hardness in this water is 5.15 mg/l. This indicates that the water hardness value is below the maximum limit requirements in accordance with the Minister of Health of the Republic of Indonesia Number 492 of 2010, namely 500 mg/l. High hardness is related to dissolved salts in water, especially Ca and Mg salts (Fajarini 2014) . Usually, these salts are found in soil containing lime, such as in the Cepu District which is a limestone mountain, in that location the water hardness is quite high even though it looks clear. Meanwhile, this spring is located in an area with clay and sandy soil types. The presence of Ca and Mg in the water you consume can cause blockages that can cause kidney stones (Kusuma, Lathifaturrohmah, and Lestari 2020) .

The results of measuring the iron content in this water were <0.0008 mg/l, far below the maximum requirement stated in the Minister of Health of the Republic of Indonesia Number 492 of 2010, namely 0.3 mg/l. The abundant iron content can be caused by pollution from industrial metal plating waste, such as Juawana District, and Pati Regency. Excessive levels of iron in the human body can damage the intestinal wall and cause death (Ai'ni, Triyantoro, and Abdullah 2020) . Naturally, Fe can also be sourced from the erosion of many mineral stones around water sources. Another danger from excess Fe in the body is that it can cause liver cancer and heart attacks (Auliah 2019) .

Fluoride measured in this spring water is 0.0625 mg/l, which is below the maximum limit required by the Minister of Health of the Republic of Indonesia No. 492 in 2010, namely 1.5. Appropriate fluoride levels are useful for preventing tartar, dental caries, and preventing cavities. If the fluoride level is too high, it will cause dental and bone fluorosis (Najib and Nuzlia 2019) . A good fluoride level is 0.5 mg/l, generally groundwater and surface water have a fluoride content of more than this value, while rainwater is lower than this size so water fluoridation is necessary (Putri and Abdullah 2019) . The open pool at this spring does not experience direct contact with the ground, but is covered with hard rock, sand and gravel. This is thought to be one of the causes of low levels of fluoride in the water. However, these fluoride levels are not harmful for consumption.

The dissolved oxygen level measured in this water is 7.46. At the RI Minister of Health No. 492 of 2010, dissolved oxygen is not included in the parameters required for drinking water. However, the dissolved oxygen content in drinking water is important. Dissolved oxygen is needed by all living bodies for respiration and body metabolic processes (Putra 2019) . Dissolved oxygen also indicates the degree of contamination of raw water, the higher the value, the smaller the degree of contamination. In Kelurahan Sukolilo, Surabaya, tests for dissolved oxygen levels have been carried out in several PDAM waters and well water. The test results show that the average oxygen level of PDAM water in the kelurahan is 3.52 mg/l while the average oxygen level of well water is 2.91 mg/l (Hayati 2016) . This value is lower when compared to dissolved oxygen levels in this spring. Based on PP No. 82 of 2001, the minimum DO concentration for class I water (for drinking water and/or other uses that require the same quality) is 6 mg/l (Asrori 2021) .

The measurement results for nitrate in spring water were <0.1728 mg/l, far below the maximum requirements stated in the RI Minister of Health Regulation No. 492 of 2010 which is

50 mg/l. This shows that in terms of nitrate, this water is safe for consumption. Increased concentrations of nitrate and nitrite compounds in water can be influenced by agricultural activities, namely the use of nitrogen fertilizers such as NPK and urea (Ardhaneswari and Wispriyono 2022) . Even though this spring is located in a palm oil plantation, the water is not polluted by nitrate compounds. The presence of excess nitrate when it enters the body will be carcinogenic (Mawaddah, Roto, and Suratman 2016) .

The measured nitrite level in this water quality test was <0.0043. The maximum requirement for nitrite levels allowed in drinking water is based on RI Minister of Health No. 492 of 2010, which is 3 mg/l. This shows that the nitrite content in this spring meets the requirements. Nitrites are naturally occurring organic ions that are part of the nitrogen cycle, just like nitrates. So discussions about nitrite and nitrate often coincide. Nitrite can be oxidized easily to become nitrate, so nitrate is most often found in groundwater and surface water (Emilia 2019) . Nitrite is very dangerous for the human body, especially infants under three months of age because it can cause methemoglominemia. This disease is a blood disorder caused by an excess of methemoglobin, namely hemoglobin which binds oxygen but does not deliver it to the body's cells, so the body lacks oxygen. Symptoms that appear are bluish skin color, especially around the lips and fingers (Rufaedah, Sriagustini, and Zulaehah 2021) .

The measurement result for cyanide in this water is 0.001 mg/l, meeting the requirements of RI Minister of Health No. 492 of 2010, which is a maximum of 0.07 mg/l. Cyanide is naturally produced by various bacteria, algae, fungi and various plant species such as nuts, fruits and vegetables. Cyanide can be found as a free compound in solution (HCN, CN-) or as a complex compound with metals. However, larger sources of cyanide usually come from anthropogenic cyanide compounds, for example from mining activities. This spring is located in an oil palm plantation and not close to a mining site, so very little cyanide is found in this water. Chronic poisoning of cyanide compounds can cause malaise and irritation (Siregar and Arbi 2020) .

The measured detergent level from spring water is <0.0013 mg/l, meeting the requirements of the RI Minister of Health Number 492 of 2010, which is a maximum of 0.05 mg/l. Detergents can enter and contaminate water from domestic and non-domestic waste. Domestic waste, which comes from household activities such as washing, can also be from laundry waste. As for non-domestic waste that can add detergent levels to water, for example from industry. Putting detergent into the water can reduce oxygen levels, make the water smelly and cloudy (Larasati et al. 2021) . The presence of detergents in drinking water can cause non-carcinogenic risks such as diarrhea, suppressed weight gain, relative liver weight gain and changes in other organ weights, changes in enzyme parameters (eg ATP, LDH and G6P enzymes) and serum biochemistry, mild degeneration, desquamation tubular epithelium in the kidney and others (Subhan, Birawida, and Hatta 2020) .

The measurement results for manganese in this water were <0003 mg/l, meeting the requirements of the RI Minister of Health Number 492 of 201, which is a maximum of 0.4 mg/l. High enough manganese sources can be found in water close to mining. Water containing excess manganese will taste brown, purple, or black and will be cloudy. Excess manganese that enters the body will be neurotoxic, characterized by symptoms of insomnia, weakness in the legs and facial muscles so that facial expressions become stiff. However, in small amounts manganese is useful for maintaining brain and bone health, plays a role in the growth of hair and nails, and helps produce enzymes for the body's metabolism to convert carbohydrates and proteins to form energy to be used (Febriana and Ayuna 2015) .

3. Biological Parameters

The total coliform measured in this water is 1 amount/100 ml of sample, which does not meet the drinking water standards of the Republic of Indonesia Minister of Health No. 492 of 2010, namely a maximum of 0 amount/100 ml of sample. Coliforms are gram-negative bacteria,

do not form spores, and can grow and develop at 37oC. Biochemical characteristics and Coliform growth are related to faecal contamination. However, the presence of Coliform in water does not always indicate faecal contamination, because several types of Coliform are not contaminated with faecal, for example Klebsilia, Enterobacter, and Cetrobacter. The presence of Coliform also indicates the potential for biofilm formation or the presence of other pathogens such as Shigella and Staphylococcus. Other examples that include Coiform are Eschericia coli and Seratia. Bacteria other than E.coli can live in soil or water much longer than E.coli (Agrippina 2019) .

Consumption of drinking water contaminated with coliform can cause digestive tract diseases such as diarrhea (Askerning and Yunus 2017) . Other types of coliforms such as Salmonella typhi can also cause typhoid fever (Zikra, Amir, and Putra 2018) . To kill coliform bacteria in water, you can boil the water until it boils for at least five minutes, but a longer duration is better, recommended for 20 minutes (Puspitasari and Mukono 2013) . Some people who consider spring water as a natural medicine, do not boil water first before drinking it. So that it can cause health problems.

The E.coli bacteria measured in this water were 0 amount/100 ml sample, fulfilling the requirements for drinking water quality stated in the Minister of Health of the Republic of Indonesia Number 492 of 2010, namely 0 amount/100 ml sample. Eschericia coli is a gram-negative, rod-shaped bacterium that does not form spores and lives in the intestine. The detection of E.coli does not rule out the possibility that there are also other enteric bacteria such as Salmonella and Shigella which are pathogenic to humans (Agrippina 2019) . The presence of E.coli bacteria in water indicates that the water is contaminated with faeces. The absence of E.coli bacteria found in the water in this spring indicates that this water is not contaminated with faeces. This is supported by the location of the springs which are far from people's homes and livestock pens. Water contaminated with E.coli can cause digestive-related diseases such as diarrhea, cholera, poliomyelitis, and others. E. coli must be watched out for because besides being able to cause disease, this bacterium also has the ability to be resistant to several types of antibiotics (Awuy, Sumampouw, and Boky 2018) .

CONCLUSION

Based on the research results, it can be concluded that these springs do not meet the requirements for drinking water quality according to the Minister of Health of the Republic of Indonesia Number 492 of 2010. The measured pH of the water shows quite high acidity and the total coliform also exceeds the maximum limit required. The other physical, chemical, and biological parameters have fulfilled the requirements even without prior processing. Therefore, Meurandeh people should be wiser to process the water before consumed. So, that no health risk can appear.

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