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Analysis of Iron (Fe) Content and PH Content of Protected Well Water in Leubok Village, Aceh Barat District

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ABSTRACT

The provision of clean water is still a major problem in Indonesia and one of the reasons is that the available raw water is still limited. Even though it is recognized that water sources are closely related to the nutritional status of children, including stunting. The research objective was to analyze the water quality in protected deep wells in Leubok Village, Aceh Barat District. The method used is descriptive with an observational approach and laboratory examination. Two water sources, namely water from a drilled well with a depth of 12 meters and water from a drilled well with a depth of 6 meters are the research samples. The results of the physical test showed that the water was colorless, odorless and tasteless in both water sources. In the water of the drilled well at a depth of 12 meters, it was found that the content of Fe was 0.16 Mg/L and the pH was 7.9 Mg/L, while the water in the well, which was 6 meters deep, was found to contain Fe 0.06 Mg/L and the pH of the water was 7.5 Mg/L. The conclusion that can be drawn is that the sources of clean water from both water sources in Leubok Village meet the standard of maximum concentration for clean water for hygiene and sanitation purposes, as well as the requirements for drinking water, especially the physical and chemical criteria (particularly pH and Fe). To be truly suitable for consumption, further studies are needed on microbiological parameters, inorganic chemical parameters, and other chemical parameters.

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Introduction

Water is one of the main sources of life for all living things. For humans, water is a basic need that is used to complete daily activities, such as washing, cooking, bathing, drinking water and other activities. However, globally the fulfillment of clean water to meet people's needs has not run as expected. Predictions are currently 1.1 billion people in the world do not have access to clean water supply (World Health Organization., 2004). Or the Sustainable Development Goals (SDGs). The SDGs are a continuation of the Millennium Development Goals (MDGs) which ended in 2015. The achievement of clean water and sanitation is included in the sixth goal of SDGs, namely ensuring the availability of clean water and safe sanitation that is sustainable and affordable for everyone in the world (Elysia, V., 2018).

In Indonesia, the provision of clean water services is still a major problem. Limited raw water availability is one of the causes of the problem. In several areas, the sources of clean water used by regional drinking water companies (PDAMs) have been contaminated by industrial waste and domestic waste, resulting in an increased burden on clean water treatment (Lestari, L et al., 2020). However, the Indonesian government is committed to addressing the problem of availability of clean water in the community. Referring to the Sustainable Development Goals (SDGs), the Indonesian government is making efforts to develop clean water and sanitation. In 2030 it is hoped that the availability of sustainable clean water and

sanitation management for the community can be guaranteed.

It is recognized that water suitable for public use must meet a number of requirements (eg physical and chemical requirements). This is closely related to the source of water used. As a result, studies have proven that water sources have a very important role in the incidence of stunting (Ramdaniati, S.N., & Nastini, N. 2019). In addition, the use of water that does not meet health standards also risks diarrhea, decreased nutrition, and gastrointestinal infections and this can lead to stunting and malnutrition in children. Physically, water quality can be seen from turbidity, taste and smell. Assessment of chemical requirements including the level of acidity (PH) and iron content (Fe).

For safety, people who consume water from wells must go through a series of content tests such as PH and Fe. Water with a low pH level is considered acidic water and if consumed has a negative impact on health such as digestive disorders (tirtamandiri.com) and water with a non-neutral pH taste bitter (Sari, M., & Huljana, M., 2019). Adverse effects on health are also caused by consuming water that contains high iron metal (Muliasari, H., 2021) and if consumed continuously it can cause respiratory system disorders, such as shortness of breath, coughing, weakness, lung cyanosis and methemoglobinemia (Sunarsih et al., 2018).

Based on the Aceh Health Profile, of the 727,792 providers of drinking water facilities that will be supervised in 2021 in Aceh Province, only 3,118 facilities (38%) meet the requirements as drinking water, while the remaining 62% do not meet the requirements. Meanwhile, in Aceh Barat District there were 35,459 drinking water facilities, while only 326 drinking water facilities (0.9%) met the requirements. This figure indicates that the majority (more than 90%) of the drinking water facilities in the Aceh Barat District area do not meet the requirements (Dinas Kesehatan Aceh, 2021). This condition also indicates that the majority of people use these water facilities as a source of drinking water for consumed.

As an illustration that geographically Aceh Barat District is located in the coastal area of the southwest coast region in Aceh Province. This district has 12 sub-districts with 322 Village and one of them is Samatiga sub-district. To meet the demand for clean water, the regency government through the Public Works and Spatial Planning (PUPR) Office is implementing a clean water supply program in Leubok village, Samatiga sub-district, namely building protected deep wells. This village is located in a lowland, swampy area and the available clean water facilities are very limited. Sources of water provided by residents personally, both in the form of shallow drilled wells and dug wells, are still inadequate. This condition can be seen from the majority of people who still use brackish water which is brown and turbid as a source of water for their daily needs besides drinking water. Therefore, knowledge about the quality of water sourced from protected wells built by the government is needed, whether it meets the eligibility requirements for drinking water or clean water. For this reason, this study examines the quality of water, especially its physical condition, Fe content and pH.

Method

The method used in this study is descriptive with an observation approach and laboratory tests to assess the air quality used by the community. The research sample was water from two sources, namely water from a drilled well with a depth of 12 meters and water from a drilled well with a depth of 6 meters in Leubok Village, Samatiga District, West Aceh Regency. Sampling and testing will be carried out from September to October 2022.

There are two types of water quality assessment conducted, namely physical quality and chemical quality. Physical assessment by testing the physical condition of the air using the five senses (eyes, nose and tongue) namely color by sight, taste by taste (tongue) and smell by smell. Furthermore, to assess air quality chemically, there are two types of tests, namely the degree of acidity (PH) and iron (Fe).

Iron (Fe)

For the assessment of Fe levels, the test was carried out at the Regional Technical Implementation Unit (UPTD) of the West Aceh District Health Laboratory. The test uses the Spectrophotometric test method which will be carried out in October 2022. The steps for using the spectrophotometric method in analyzing the iron content in water are,

1. Determine and set the wavelength of light to analyze the sample.
2. Calibrate the spectrophotometer with a blank solution.
3. Remove the blank and test the results of the spectrophotometer calibration.
4. Measure the absorbance of the sample.

pH

The pH test was carried out at the Laboratory of the Faculty of Public Health, University of Teuku Umar in September 2022. The pH measurement used a pH meter indicator using the CAPP PORTABLE method. To measure the acidity of an acid solution in water (pH) a water analysis tool is used which is commonly called a pH meter or digital pH pen. Before using a pH meter, it is best to carry out a calibration process first, namely setting the tool using a pH buffer (a solution with a known acidity value for various temperature levels). How to use a ph digital water meter, namely,

1. Take a sample of the water you want to measure the pH level (put it in a container).
2. Turn it on by pressing the on button on the pH meter.
3. Insert the pH meter into a container filled with water to be tested.
4. When immersed in water, the number scale will move randomly.
5. Wait until the numbers stop and don't change.
6. Results will appear on the digital display.

Results

Based on the results of observations of the physical quality of the water samples, it is known that the water is colorless, odorless and tasteless. Observations were made directly at the sampling location. The color of well water can be one of the parameters determining water quality. Water with good quality usually has no color, to find out the color of the water can be seen by naked eye. From the results of the reading, you can know the level of turbidity and then adjust it to the water turbidity standard (Harianti, H., & Nurasia, N., 2016). The smell in water can be known using the nose. The purpose of odor detection in water is to find out whether or not there is an odor caused by contaminants such as microorganisms or others. If the water has an odor, it can be categorized as water that does not meet the requirements and is not suitable for use in human activities (Quddus, R., 2014). The taste of water can be known using a flavoring tool (tongue) by tasting. The aim is to detect and determine abnormalities in the taste of water, and normal standards for the taste of water must be neutral or tasteless. The results of the assessment using physical parameters showed that the protected deep well water from the two water samples met the quality standards for hygiene and sanitation purposes.

Table 1. Fe Test Results in Protected Deep Well Water in Leubok Village in 2022

No	Water sources	Unit	Test Method	Test result	Permenkes No. 492 / 2010	Permenkes No. 32 / 2017
1.	Fe well water depth of 12 meters	Mg/L	Spektrofotometri	0,16	0,3 Mg/L	1 Mg/L
2.	Fe well water depth of 6 meters	Mg/L	Spektrofotometri	0.06	0,3 Mg/L	1 Mg/L

The results of the Fe test (Table 1) for two water samples found that well water with a depth of 12 meters contained Fe 0.16 Mg/L, while well water with a depth of 6 meters contained Fe 0.06 Mg/L. These results indicate that there is a difference in Fe content between well water at a depth of 12 meters and a depth of 6 meters. The content of Fe in well water with a depth of 12 meters is higher than Fe in well water with a depth of 6 meters.

Table 2. Results of pH Tests in Protected Deep Well Water in Leubok Village in 2022

No	Water sources	Unit	Test Method	Test result	Permenkes No. 492 / 2010	Permenkes No. 32 / 2017	Information
1.	pH well water depth of 12 meters	Mg/L	Capp Portable	7,9	6,5 – 8,5	6,5 – 8,5	Netral
2.	pH well waterdepth of 6 meters	Mg/L	Capp Portable	7,5	6,5 – 8,5	6,5 – 8,5	Netral

The results of the pH test (Table 2) for a 12 meter deep well water sample obtained a pH of 7.9 Mg/L, while the pH of the water in a 6 meter deep well was 7.5 Mg/L. These results indicate that there is a

difference in pH between well water at a depth of 12 meters and a depth of 6 meters. Well water with a depth of 6 meters is more acidic than well water with a depth of 12 meters.

Discussion

Water is considered a crucial compound for living things on earth, including humans. Water is even the main and largest component of the human body. Humans can still survive without food, but cannot survive without water. It has been proven that a person has a higher risk of suffering from kidney stone disease if he consumes less than two liters of water per day (Mitra,P., et al., 2018). However, the source of water used for consumption must be of good quality and meet health requirements.

In this study, to determine whether water originating from protected deep wells (12 and 6 meters) meets the requirements or does not refer to the Minister of Health of the Republic of Indonesia Number 32 of 2017 concerning Environmental Health Quality Standards and Water Health Requirements for Sanitation Hygiene, Swimming Pools, Solus Per Aqua, and Public Baths. Permenkes RI Number 492 of 2010 is used as a reference whether water meets the requirements for drinking water. These two regulations are used as parameters for the assessment of physical and chemical requirements (Fe and pH).

Referring to the Minister of Health regulations, it is indicated that the Fe content in well water at a depth of 12 meters (0.16 mg/L) and the Fe content in well water at a depth of 6 meters (0.06 mg/L) meet the threshold for clean water requirements (below 1 mg/L) and for drinking water (below 0.3 mg/L). Drinking water containing Fe above the threshold value, if consumed in large quantities, can damage the intestinal walls. Death is often caused by damage to the intestinal wall, Fe levels of more than 1 mg/l will cause irritation to the eyes and skin. Fe is often found in groundwater or well water dissolved in the form of compounds or sulfate salts, bicarbonate salts, hydroxides and also in colloidal form or when combined with organic compounds (Setiyono, A., 2014). 4 Fe is an essential metal that is needed by humans. living organisms in the formation of blood cells / hemoglobin (Hb). Excessive amounts of Fe content can be toxic and harmful to health (Supriyantini, E., & Endrawati, H., 2018). 14 The government has set standards for Fe content for drinking water (less than 0.3 mg/l) (Permenkes No. 492 of 2010). Consumption of drinking water containing high Fe for a long time causes the flow of the blood capillary walls to increase. The impact of this increase causes blood plasma to seep out, damage the intestinal wall, and result in death (Jasman, J., 2011). Damage to the intestinal wall may interfere with the absorption of food nutrients by milk and this increases the risk of malnutrition. If it occurs in children for a long time, they are at a higher risk of experiencing stunting.

The Fe content in water can be sourced from the soil itself and other sources (Kamarati,K., et al., 2018). Mujianto, B., et al (2015) from his research found a close relationship between Fe content and water depth. He explained that the deeper the well is dug, the higher the Fe content in the water in the well. 19 Water with Fe concentrations above 1 Mg/L can cause a yellow-brown color, has a bitter taste, and can increase stains on clothes (Sandra, R.Y., et al., 2016). Another effect is irritation to the eyes and skin if the water is used continuously for bathing needs. This is in accordance with the results of Sunarsih's research and his colleagues found a link between length of exposure to skin disorders. People who frequently use water with a high Fe content have a 4.9 times risk of experiencing skin disorders compared to those who are rarely exposed (Sunarsih, E., et al., 2018). In addition, other findings show that populations exposed to Fe content through ingestion can cause digestive disorders and clinical symptoms such as nausea, vomiting, fatigue, abdominal pain and diarrhea (Putri, T.A., & Yudhastuti, R., 2013).

The results of the study also showed that the pH of well water with a depth of 12 meters (7.9 Mg/L) and well water with a depth of 6 meters (7.5 Mg/L) fulfilled the acidity level requirements for standard clean water and drinking water. The pH of water shows a close correlation with several water constituents such as EC concentration or saltiness.20 This means that the saltiness of water is also influenced by a non-neutral pH. Water with a pH <7 or below 6.5 indicates acidic water, while a pH > 7 or above 8.5 indicates alkaline water and will have a bitter taste (Sasongko,E.B., et al., 2014). The pH of water that is too low also causes the solubility and toxicity of metals to be higher, so that water is prone to containing heavy metals (Sari, M., & Huljana,M., 2019).

Consumption of water with a high salt content and a non-neutral pH can cause health problems, including the formation of kidney stones (Masriadi,M., et al, 2019). Meanwhile, the human body tends to be acidic, if you consume drinking water that has a low pH level it will be very

dangerous, because it can make the body have a condition that tends to be acidic. This is what causes a number of health problems such as increased stomach acid and blood viscosity problems (tirtamandiri.com).

Environmental sanitation is one of the important elements that need attention in the provision of clean water and drinking water. Well water sources for consumption should have a distance that is quite far from the source of pollution (minimum 10 meters), so that the water is safe for use as drinking water. The closer to the pollutant source, the higher the risk of the water source being polluted. Well water used as drinking water must be boiled first. A number of these efforts are a form of good water management, so it is feasible to be utilized. Conversely, improper management of water sources, especially drinking water, can have a negative impact on health, including nutritional status. This is evidenced by the research results of Khoirul Anwar and Lulu Indria Setyani. They found a significant relationship between drinking water processing behavior and the incidence of underweight, stunting and wasting (Anwar, K., & Setyani, L.I., 2022)

To lower the pH and Fe in water, filtering can be done using some materials from nature. Kiswanto has proven that continuous water treatment using natural materials such as sand, palm fiber, charcoal, and additional chemicals such as chlorine, alum and chlorine is able to remove organic materials and heavy metals in water (Kiswanto, K., et al., 2019). The results of the study showed significant changes in the Fe content and pH in peat water. He found a decrease in Fe reaching 94.6% and the pH of the water from 4.5 mg/l to 7.6 mg/l after processing. 2 Water treatment to reduce Fe levels can also be carried out by utilizing rice husk charcoal as a filtration medium such as testing performed by Jasman, J (2011) based on the thickness of the sieve. At a thickness of 70 cm, the decrease in Fe in water was lower than using a thickness of 80 cm. This study indicates that the thicker the filter, the lower the Fe content in the filtered water. Processing rice husk charcoal as a filtration medium may be easy to do, because this material is available in Leubok village which is a rice field area.

This study is only limited to the examination of pH and Fe content; therefore the other contents present in both water sources used by the community are unknown. To ensure the maintenance of public health in consuming water, it is necessary to conduct testing on several other parameters related to drinking water. These parameters include microbiological tests (E.coli and total coliform bacteria), inorganic chemical parameters (arsenic, fluoride, total chromium, cadmium, nitrite, citrate, cyanide, and selenium), and other chemical parameters (aluminum, hardness, chloride, manganese, zinc, sulfate, copper, and ammonia).

Conclusion

The research findings conclude that the Fe content and pH of the well water at depths of 12 meters and 6 meters in Leubok Village meet the criteria as a drinking water source, thus it can be consumed to fulfill daily needs. However, further studies are needed regarding other drinking water parameters, including microbiological parameters, organic chemical parameters (such as arsenic and fluoride), and chemical parameters (such as manganese and aluminum), to ensure that the water from both sources is truly suitable for use as drinking water by the community.

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