

Original Article

Determination of iron levels in water samples in East Penfui Village, Central Kupang, Kupang Regency

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ABSTRACT

Water is needed to dissolve various types of substances that the body needs. For example, oxygen needs to be dissolved before it can enter the blood vessels around the alveoli. However, hazardous pollutants are often found in water, such as zinc (Zn), lead (Pb), cadmium (Cd), and iron (Fe). Iron (Fe) is naturally an abundant element in nature; Fe is corrosive, solid, and has a low melting point. If accumulated in the body, Fe can cause several health problems; for example, in humans, it causes irritation to the skin and eyes, interferes with breathing, and causes cancer in the long term. About 3% of human hemoglobin in erythrocytes undergoes auto-oxidation, thereby increasing free radicals in the body. This study aims to determine the amount of iron (Fe) in water samples in East Penfui Village, Central Kupang, Kupang Regency. The research was conducted in a laboratory with a true experimental randomized approach, using samples from three points of water sources at East Penfui Village, Central Kupang, Kupang Regency. The examination results with a spectrophotometer showed that the average level of iron in 3 points of water sources was 0.28 mg/L. Thus, it can be concluded that the iron content in water sources consumed by the community in East Penfui Village is still below the maximum standard level of Fe that is allowed in accordance with the Decree of the Minister of Health of the Republic of Indonesia, which is 0.3 mg/L.

Keywords: Iron, free radicals, water

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INTRODUCTION

Water is needed to dissolve various types of substances that the body needs. For example, oxygen needs to be dissolved before it can enter the blood vessels around the alveoli. However, there are many pollutants in the water that may harm the body. Pollutants are generally toxic which are harmful to organisms. Pollutants that are often found are zinc (Zn), lead (Pb), cadmium (Cd), and especially iron (Fe).^[1] Iron (Fe) is naturally an abundant element in nature; Fe is corrosive resistant, solid, and has a low melting point. If accumulated in the body, Fe can cause several health problems; for example, in humans, it causes irritation to the skin and eyes, interferes with breathing, and causes cancer in the long term.^[2]

Iron (Fe), apart from being a pollutant in the ecosystem, is the core of hemoglobin that binds four porphyrin rings to heme.

A body lacking iron will impact the lack of hemoglobin and oxygen in red blood cells. Through the glycolysis system, red blood cells have a defense system against free radicals (ROS). Approximately 3% of human hemoglobin in erythrocytes undergoes this auto-oxidation each day.^[3]

In the process of evaluating the importance of heme degradation in erythrocyte cells, it is also necessary to consider the functional effects that may occur on these erythrocytes caused by these heme degradation products. These can affect the composition of the membrane that affects the deformability of erythrocyte cells and the ability of these erythrocytes to transport oxygen. A research also stated that this degradation product plays a role in the exposure of the antigenic site of the erythrocyte membrane. This is thought to be responsible for the elimination of erythrocytes from blood circulation. This prolonged effect of the elimination of erythrocytes is a case of anemia.^[4]

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The location for water sampling was in East Penfui Village because there some residents who suffers from anemia. Therefore, we are determined to find whether there is correlation between this anemia case and the level of iron (Fe) in the water consumed by the residents of East Penfui Village.

MATERIALS AND METHODS

This study used a sample of drinking water sources from three location points in East Penfui Village, Central Kupang, Kupang Regency. The assay was carried out in the laboratory using colorimetric techniques. Iron level was measured with Elabscience Iron (Fe) Colorimetric Assay kit 96T.^[5]

The experiment began by initially taking 200 μ L of sample solution and put it in a 10 ml tube, after that, add 4.5 ml of cold PBS solution. Subsequently, take another 4 ml of the supernatant, and place it in a new tube, while add another 1 ml of 15% TCA solution. About 0.37% TBA solution was added in the 0.25 N HCl and then was heated in an 800°C – water bath for 15 min. After that, the tube was cooled at room temperature for 60 min and centrifuged at 3000 rpm for 15 min.^[5]

The supernatant was collected to measure its absorbance on a spectrophotometer, which was set at 520 nm for the wavelength of Fe. The sample solution was measured using the instrument, and the Fe level was calculated using the regression line equation standard curve of Fe solution.^[6]

RESULTS

As shown in Table 1, the result of Fe level from three location points in East Penfui Village, Central Kupang, Kupang Regency. Each location point was replicated 3 times. Most of the replications showed the Fe level <0.3 mg/L. However,

Table 1: Fe level examination results

Sample	Replication	Fe level (mg/L)
Sample 1	Replication 1	0.04
	Replication 2	0.07
	Replication 3	1.00
Sample 2	Replication 1	1.10
	Replication 2	0.06
	Replication 3	0.05
Sample 3	Replication 1	0.04
	Replication 2	0.06
	Replication 3	0.09
Mean		0.28

*The maximum standard level of Fe that is allowed in accordance with the Decree of the Minister of Health of the Republic of Indonesia is 0.3 mg/L

in one of the replications in both first and second samples of drinking water was detected an amount of iron >0.3 mg/L.

All in all, the Fe level found in three location points in East Penfui Village, Central Kupang, Kupang Regency was 0.28 mg/L.

DISCUSSION

Water is chemically a polar compound (H_2O), which has certain properties, such as being a solvent, being able to form hydrogen bond with organic compounds and other properties in the body's reaction mechanism. Water for drinking purposes is exactly the same as the definition of water chemically, because drinking water is H_2O (chemical) that contains certain elements (including minerals) that the body needs.^[7]

These mineral ingredients include calcium, magnesium, sodium, iron, and others. However, the amount of dissolved minerals in drinking water should not exceed the threshold required by the body. If these minerals are very high in number and exceed the threshold value, it can interfere with processes and mechanisms in the body. Inorganic contaminants are difficult to degrade into harmless species, so they can accumulate in the environment to reach toxic concentrations and subsequently cause ecological damage. There is a lot of iron content in groundwater, especially in well water.^[8]

Groundwater which generally has a high concentration of carbon dioxide can cause anaerobic conditions. This condition causes the concentration of iron in the form of insoluble minerals (Fe^{3+}) to be reduced to soluble iron in the form of two-valent ions (Fe^{2+}). The concentration of iron in groundwater varies from 0.01 mg/l to 25 mg/l.^[9] In surface water, it is rare to find Fe levels exceeding 1 mg/l, but in groundwater, Fe levels can be much higher.^[10] High concentrations of Fe can be felt and can stain fabrics and kitchen utensils. In water that does not contain oxygen such as groundwater, iron is present as Fe^{2+} which is quite high, while in flowing river water and aeration occurs, Fe^{2+} is oxidized to $Fe(OH)_3$, where $Fe(OH)_3$ is difficult to dissolve at pH 6 to 8. Iron in the form of Fe^{2+} ions is very soluble in water. Dissolved oxygen will oxidize Fe^{2+} to $Fe(OH)_3$ which is a precipitate. $Fe(OH)_3$ or one type of oxide which is a solid and can precipitate. Dissolved iron in the form of Fe^{2+} in water is usually produced by the release of Fe^{2+} ions from organic materials.^[10]

CONCLUSION

This study has demonstrated that the level of iron (Fe) in the source of drinking water used by the community in East Penfui Village, Kupang Regency is 0.28 mg/L. As the level of iron (Fe)

that is allowed in accordance with the Decree of the Minister of Health of the Republic of Indonesia is < 0.3 mg/L.

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CONFLICTS OF INTEREST

There are no conflicts of interest found during this study.

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