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UTILIZATION OF CELLULOSE POWDER FROM BANANA PEEL (*Musa Textilia*) TO REDUCE Fe (FERRUM) IN WATER

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ABSTRACT
Treatment of water containing high levels of Fe can be done by natural adsorption process using banana peel (*Musa textiles*) because it contains cellulose which can bind Fe levels. The purpose of this study was to determine the difference in levels of Fe in clean water by using variations in the concentration of cellulose powder of banana peel (*Musa textiles*). This research is a quasi-experimental type with the design used is a static group comparison design. There were 5 concentration groups of banana peel (*Musa textiles*) cellulose powder, namely7 gr/L, 10 gr/L, 13 gr/L, 16 gr/L, and control, with each group being replicated five times with a long contact in water for 2 hours. Preparation of cellulose extract of banana peel (*Musa textilia*) using maceration method. Water samples were obtained from well water from Gempol Village residents, Gempol Pasuruan District. The data analysis of this study used the Anova One away statistical test. Theresults showed that the percentage decrease in Fe levels in the 7 g/L, 10 g/L, 13 g/L, 16 gr/L banana peel (Musa textilia) cellulose powder concentration was 35.45%, 67.80%, 81.04%, and 98.70%.The results of the one-way ANOVA test analysis obtained a value of F = 9596.86 (p = 0.00) and then accepted the alternative hypothesis. So, there is a difference in the decrease in Fe content in water with various concentrations of cellulose powder of banana peel (*Musa textilia*). The most effective reduction in Fe content in water with cellulose powder of banana peel (*Musa textilia*) was at a concentration of 16 g/L of 98.70%. The presence of sediment and changes in the color of water in this study, it is suggested that a filtration process is needed as a further research process, to remove sediment and its color.
Keywords: Clean water, Fe (Ferrum), Adsorption, Banana peel (*Musa textilia*).

BACKGROUND
People still use a lot of clean water with shallow groundwater sources. It is not too deep on the ground. Thus, it facilitates the process of water infiltration (Bekti Oktiana et al., 2019). Shallow groundwater is not recommended according to the Minister of Health of the Republic of Indonesia Number 32 of 2017. Because it is easy for contamination to occur through seepage, it is necessary to treat it (Hardyanti et al., 2016).
Fe (Ferrum) levels are one of the problems found in the use of clean water. In this universe, metals are found on land that is dissolved together with water, so that they can pollute the water. This occurs due to sources of metal-related pollution such as metal smelting and mining (Maria A, 2017). High levels of Fe can be

found in one of the groundwater located in Gempol, Pasuruan Regency. According to Badan Pusat Statistik (BPS), the Village Potential Data Collection (Podes) 2020 contains 7 villages that use wells, namely Gempol, Kejapanan, Bulusari, Carat, Winong, Legok, and Randupitu villages where people use wells to provide clean water. From the preliminary survey conducted in 7 villages, Fe levels were 7.82 mg/l in Gempol village, 6.87 mg/l in Legok village, 0.08 mg/l in Bulusari village, 0.36 mg/l in the village of Carat, 0.01 mg/l in Winong village, 0.33 mg/l in Kejapanan village, and 0.12 mg/l in Randupitu village. So that the preliminary survey was carried out in Gempol Village, Gempol District with the number of samples that were chemically examined was found to have a high Fe content of 7.82 mg/l.

The presence of high levels of Fe in water can cause the walls of the bath and clothes to turn yellow due to contact with air and also have an unpleasant smell like metallic smell. (Nuryana, et al., 2019). Based on the Regulation of the Minister of Health of the Republic of Indonesia Number 32 of 2017, the permissible level of Fe is 1.0 mg/l. If the Fe level is above the quality standard, it will cause problems in humans such as health, economic and technical problems (Bekti Oktiana et al., 2019). So, water contaminated with high Fe content needs to be treated first.

Processing is done in two ways, namely chemical and physical. Physically, employing aeration, filtration, and adsorption. While chemically it can be done by adding alum and PAC (Mirwan & Wijayanti, 2011). The method commonly used is adsorption. The use of natural materials as adsorption has a simple concept, several advantages include being environmentally friendly, safe for health, and more economical so that it can be applied easily in the community (Dwi Arista N et al., 2016). One of the natural adsorption processes can be done using banana peels.

According to Badan Pusat Statistik (2013) bananas are one of the plants favored by the world's population, especially in Indonesia, with the availability of bananas at 2,074,305 stalks/year. Therefore, bananas are easy to obtain and have high nutritional value (Ekafitri et al., 2013). Bananas have various benefits ranging from fruit that is used as food, leaves as food wrappers, while the stems can be used in the medical world (Pramesti, 2016).

In Wulandari's research (2013) it was stated that banana peels can be used as a medium for water purification. This is evidenced by the decrease in turbidity in river water, which was originally 7.51 NTU then to 3.01 NTU. In addition, based on Richfa Yani's research (2017) banana peels can be processed as raw material for making crackers because there are vitamins and minerals as raw materials.

There are many types of bananas in Indonesia, one of which is Banana Peel (Musa textilia). So far, Banana Peel has been thrown away for nothing, so it is necessary to use them for the benefit of the community. Banana peel contains cellulose, pectin, and hemicellulose which can bind heavy metals (Ongelina, 2013). Castro et al., (2011) in their research stated that banana peels contain active groups that can bind Fe, namely (-OH), (-COOH) and(-NH3).

This research was conducted to determine the difference in levels of Fe (Ferrum) in clean water by using variations in the concentration of cellulose powder of Banana Peel (*Musa textilia*)

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RESEARCH METHODS

This research was conducted at the Surabaya Industrial Research and Consulting Laboratory.

This type of research is analytical research with a Quasi-Experimental type with the design used is the static group comparison design.The experimental class received treatment while the control class did not receive treatment. The sampling technique used in this research is using Grab Samples.

Data collection technique

1. The stage of taking clean water samples in Gempol Village, Gempol District

   Prepare the equipment needed for clean water sampling. Taking clean water samples of the same age as SNI 6989.58:2008 regarding groundwater sampling methods
2. Stage of extracting cellulose powder of Banana Peel (*Musa textilia*) using the Maceration method (Jannah, 2017)

   Wash the skin of the Banana Peel (Musa textilia). Cut the Banana Peel (*Musa textilia*) with a size of ± 1 cm to simplify the drying process. Puree the dried Banana Peel (Musa textilia) until smooth into a powder using a blender. Put the sample (powder) into the maceration container and allow it to stand for 4 days and stirred every day. Filtered again and the residue was washed with Aquades and filtered using filter paper. Dry in the oven at 1050C for 1 hour. Hydrolysis process using 5% hydrochloric acid (HCL) for 3 hours. Washed again with Aquades. Dried in an oven at 105^{o}C for an hour. Sift using a 60 mesh sieve. Weighing the mass of cellulose powder of Banana Peel (*Musa textilia*) of 7 gr/L, 10 gr/L, 13 gr/L, and 16 gr/L.
3. Stage of Fe content reduction (adsorption process)

   Contacting Banana Peel cellulose powder (*Musa textilia*) with water containing Fe for 2 hours. Separating the adsorbent from well water containing Fe using filter paper.
4. Examination of Fe levels using the Spectrometry method

   Take 50 ml of the sample and put it in a 250 ml element. Add 2 ml of 4 N H2SO4 and 0.1 N KMnO4 drops until the color is rose. Add 20% KCNS, and shaken until homogeneous. Read on spectrophotometer with a wavelength of 450 nm

Data analysis was carried out after the results of the homogeneity of variance test showed that the data were homogeneous and used one way for data analysis.

RESULT

1. Measuring the decrease in Fe levels in clean water treated with cellulose powder of Banana Peel (Musa Textilia) with a concentration of 0 gr/L for 2 hours. The average yield was 9.39 mg/l. With the lowest level of 9.35 mg/l and the highest 9.43 mg/l (SD = 0.03), the distribution of Fe content has no deviation or is homogeneous.
2. Measuring the Decrease in Fe Levels in Clean Water Treated with Cellulose Powder of Banana Peel (Musa Textilia) with a Concentration of 7 gr/L for 2 hours. The average yield was 6.06 mg/l. With the lowest level of 5.98 mg/l and the highest 6.15 mg/l (SD = 0.06), the distribution of Fe content in the treatment of Banana Peel cellulose powder (Musa textilia) with a concentration of 7 g/L there were no deviations or homogeneous.

3. Measuring the Decrease in Fe Levels in Clean Water Treated with Cellulose Powder of Banana Peel (Musa Textilia) with a Concentration of 10 gr/L for 2 Hours. The average yield was 3.02 mg/l. With the lowest level of 2.88 mg/l and the highest 3.11 mg/l (SD = 0.09), the distribution of Fe content has no deviation or is homogeneous.
4. Measuring the Decrease in Fe Levels in Clean Water Treated with Cellulose Powder of Banana Peel (Musa Textilia) with a Concentration of 13 gr/L for 2 hours. The average yield was 1.78 mg/l. With the lowest level of 1.65 mg/l and the highest 2.01 mg/l (SD = 0.14), the distribution of Fe content has no deviation or is homogeneous.
5. Measuring the Decrease in Fe Levels in Clean Water Treated with Banana Peel Cellulose Powder (Musa Textilia) with a Concentration of 16 gr/L for 2 hours. The average yield was 0.11 mg/l. With the lowest level of 0.09 mg/l and the highest 0.15 mg/l (SD = 0.02), the distribution of Fe content is not there is a deviation or homogeneity.
6. Differences in Fe Levels Decrease in Clean Water in Various Concentrations of Water King Banana Peel Cellulose Powder (*Musa Textilia*)
   a. Variance Homogeneity Test Results.
      Levene of statistic 2.552, ρ =0.071. It was found that the results of the calculation of the homogeneity of variance test showed the value of = 0.071 because the value was greater than = 0.05 so the data is said to be homogeneous and can be continued with the One Way ANOVA Statistical Test.
   b. One Way Anova Statistic Test.
      F calculate = 9596.86 and Probability = 0.00.
      The results of the one-way ANOVA test analysis obtained a value of F = 9596.86 (ρ = 0.00) then acceptedthe hypothesis alternative. So have differences in the decrease in Fe levels in water with various concentrations of cellulose powder of Banana Peel (*Musa textilia*).
7. The Effectiveness of ~~King~~ Banana Peel Cellulose Powder (Musa Textilia) in Reducing Fe Levels in Clean Water

Table 1 The Effectiveness of Fe Reduction in Levels

Concentration	Concentration Before Treatment	Concentration After Treatment	Difference before and after being given treatment	Effectiveness of Fe Reduction (%)
7	9.39	6.06	3.33	35.45
10	9.39	3.02	0.67	67.80
13	9.39	1.78	7.61	81.04
16	9.39	0.11	9.27	98.70

The results of the effectiveness of reducing the highest Fe level were found at a concentration of 16 g/L with a percentage reduction in Fe content of 98.70% and the lowest was found at a concentration of 7 g/L at 35.455%. At a concentration of 0gr/L to a concentration of 13gr/L the results of Fe levels are not following the standards and quality standards according to the

Minister of Health Regulation No. 32 of 2017 while at a concentration of 16 g/L following the standards and quality standards according to the Minister of Health Regulation No. 32 of 2017.

DISCUSSION

1. Fe Content in Clean Water Treated with Cellulose Powder of Banana Peel *(Musa Textilia*) with a Concentration of 0 gr/L for 2 hours.

   Based on the Regulation of the Minister of Health Number 32 of 2017, Fe levels are 1.00 mg/l. So the Fe content of clean water samples located in Gempol Village, Gempol District, Pasuruan Regency is above the standard quality set. High levels of Fe in water will cause several disturbances, namely technical problems with the appearance of yellow spots in the bath and sediment in the pipes, and physical disturbances with the emergence of unpleasant taste, color, and odor (Joko, 2010). So, the processing is needed that can reduce Fe levels in clean water so as not to cause health problems in the community who live in it make use of it.

2. Levels of Fe in Clean Water Treated with Banana Peel Cellulose Powder (*Musa Textilia*) with Concentrations of 7 gr/L, 10 gr/L, 13 gr/L, and 16 gr/L for 2 hours.

   Factors that affect the ability of the adsorption process rate include the form of the adsorbent media, the mass of the adsorbent, the contacting time, the ability of the adsorbent to absorb and bind heavy metals, and the type of adsorption. (Baroroh et al., 2017). The first factor is the shape of the adsorbent medium. The adsorbent medium referred to in this study is the size of the cellulose. In this study, the size used was 60 mesh and based on Baroroh's research (2017) on the reduction of heavy metal Ni using cacao hull cellulose powder. 60 mesh. The larger the surface area of the adsorbent, the more heavy metals will be adsorbed (Syauqiah et al., 2011). because the interaction between the adsorbent and the adsorbate only occurs on the surface of the adsorbent (Fatmawati, 2006). The second factor is the mass of the adsorbent. This research is in line with Khoiriyah's research (2018). This reduction process is due to the OH-active group found in Banana Peel cellulose that can bind Fe in clean water. However, there are deposits and color changes in this study, more cloudy color and deposits in the water so filtration is needed in further research. The third factor is contact time. This study uses a contact time of two hours which is following the study by Baroroh (2017) and Khoiriyah (2018) that the higher the collision frequency between the adsorbate and adsorbent particles, the longer the contract duration. After equilibrium is reached, the relationship between the active groups on the surface of the biosorbent and metal ions weakens, resulting in desorption. The fourth factor is the ability of the adsorbent to absorb and bind heavy metals. In this study, banana peel cellulose powder was used. Banana Peel contains cellulose content of 8.4 nmol/L. The active groups that can bind Fe are (-OH), (-COOH), and (-NH3) (Castro et al., 2011). In the cellulose of the Banana Peel powder, there is an active group OH- which causes the polar nature of the adsorbent. (Anggraeni et al., 2010). In the research, banana peel powder also contains a negative active side, namely OH- which can bind metal ions with a positive charge of Fe2+, resulting in interactions that form cellulose and Fe complexes.

The fifth factor is the type of adsorption. This study uses chemical adsorption. The interaction between adsorbate and adsorbent is carried out in the form of chemical bonds (Syauqiah et al., 2011). Chemical adsorption action is as follows:

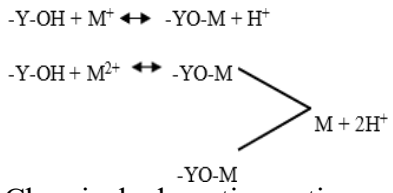

Figure 1 Chemical adsorption action

M+ and M2+ in this study are Fe ions, while -OH is the hydroxyl group, and Y is the matrix where the -OH group is attached. The metal ion Fe has an empty D orbital which will be filled by a free electron from the oxygen atom in the OH- group. Lignocellulose is the name used for materials containing lignin, cellulose, and hemicellulose. (Daulay, 2009). Cellulose (Betha Cellulose) acts as a ligand that can donate a free pair of electrons to metal ions, while the metal ion Fe acts as the central atom in the formation of complex compounds (Aprilini, 2010). The number of OH- groups makes the pH in this study alkaline, which is 9.

3. Differences in Fe Levels in Clean Water in Various Concentrations of Banana Peel Cellulose Powder (Musa Textilia)

The results showed that the level of Fe in clean water decreased with each addition of the concentration of cellulose powder of Banana Peel. At a concentration of 7 gr/L to 10 gr/L there was an increase in adsorption of 32.34% at a concentration of 10 gr/L to 13 gr/L there was an increase in adsorption of 13.24% different from the concentration of 13gr/L to 16 gr/L which only increased slightly, namely 17.65% in clean water in Gempol Village, Gempol District, Pasuruan Regency.

The use of the adsorption method is influenced by the surface area of the adsorbent. For

To optimize the absorption process between the adsorbent and the solution, the adsorbent used is in powder form, where solids react quickly when made into powder. The adsorbent has a large surface area which will create a large contact area between the adsorbent and the adsorbate so that more adsorbate is absorbed (Imtisal, 2015). The decrease in Fe content was directly proportional to the increase in the concentration of banana peel cellulose powder. The more concentration of bioadsorbent used in the adsorption process, the higher the decrease in Fe content.

4. The Effectiveness ofBanana Peel Cellulose Powder (Musa Textilia) in Reducing Fe Levels in Clean Water.

The results of reducing Fe levels in clean water using cellulose powder of Banana Peels ranging from a concentration of 7 g/L to 16 g/L were the most effective at concentrations 16 g/L with a percentage decrease in Fe content of 98.7% and the lowest is found at a concentration of 7 g/L of 35,455%. Thus, the greater the concentration of treatment, the greater the average decrease in Fe levels in clean water. Thus, the results of the effectiveness of Fe reduction

were obtained from the measurement of Fe levels before being given treatment, the concentration of powder reduced after being given treatment divided before being given treatment multiplied by one hundred percent (Moekarni, 2011). So from this formula, the concentration of 16 g/L of Banana Peel cellulose powder was obtained which was the most effective in reducing Fe levels in clean water.

CONCLUSION

There is a difference in the decrease in Fe content in water with various concentrations of cellulose powder of Banana Peel (*Musa textilia*).The most effective reduction in Fe content in clean water with cellulose powder of Banana Peel (*Musa textilia*) was at a concentration of 16 g/L of 98.70%.

RECOMMENDATION

1. Finding the saturation point concentration in reducing Fe levels in clean water by increasing the concentration of banana peel cellulose powder (*Musa textilia*)
2. The presence of sediment and changes in the color of clean water in this study, it is necessary to have a filtration process as a further research process, to remove sediment and its color.
3. The high pH in this study, so it is necessary to decrease the pH to neutral.

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