UTILIZATION OF ACTIVATED CARBON OF THE CASSAVA (MANIHOT UTILISSIMA) PEEL IN DECREASING IRON (FE) AND MANGANESE (MN) CONCENTRATION IN THE DUG WELL WATER

Nelma
Politeknik Kesehatan Kementerian kesehatan Medan
Email : nelmahasibuan10@gmail.com

ABSTRACT
Water is a very vital requirement for an organism. Clean water is used for daily requirements whose quality meets health requirements and can be drunk after cooking. The carbonization stage of activated carbon is carried out using a furnace with temperature variation of 400˚C and 500˚C and then soaked for 24 hours with NaOH 0,5 N. Samples in the form of water were treated by adding cassava peel active carbon with levels of 0,1 gr, 0,5gr and 1,0gr in every 100 ml of water and 0 gr in each control performed 3 repetitions. The result achieved a decrease in Mn and Fe levels of each treatment temperature and adding different activated charcoal, the temperature of 500˚C decreased Fe levels between 33.8 % - 93.3 %, Mn 20 % - 92 % while at a temperature of 400˚C decreased Fe levels between 26.7 % - 92.8 %, Mn of 16.8 – 91.8%. The result of statistical analysis using ANOVA showed a significant difference in Fe and Mn level before and after the addition of activated carbon of cassava peel at 400℃ heating and at 500℃ heating of 0.1 g, 0.5 g, and 1.0 g.

Keywords *: dug well water; activated carbon of the peel of cassava; iron; manganese.*

INTRODUCTION

Water is a very vital requirement for living things and needed clean water. Clean water is water used for daily needs whose quality meets health requirements and can be drunk if it has been boiled [1]. Manganese (Mn) is a metal that is needed in the body but in small amounts. Excess of this metal in the body can cause health effects such as heart attacks, blood vessel disorders, and even liver cancer. This metal is accumulative, especially in the filtering organs so that it can interfere with the body's physiological functions. The aesthetic value can also be damaged by the presence of this metal because it can cause black spots on clothes. Water contaminated by this metal usually appears the high color intensity in water, yellow, and even brownish red, and feels bitter or sour [2].

Iron is one of the more important elements in surface and groundwater. Water containing iron is highly undesirable for household use because it can cause rust marks on clothes, porcelain, and other tools and cause an unpleasant taste in drinking water at a concentration of 0.3 mg /l [2].

Iron (Fe) and manganese (Mn) are metals that often co-exist in nature and water. This metal is needed in the body but in small amounts. Excess of this metal in the body can cause health effects such as heart attacks, blood vessel disorders, and even liver cancer. Water polluted by these metals usually appears the high color intensity in water, is yellow, and even brownish-red, and tastes bitter or sour [2][3].

The high concentration of the two heavy metals above was found in Tanjung Sari Village, Medan Selayang sub-district. Based on the preliminary survey, almost all dug well water used by the community as a source of clean water in the area has the same physical characteristics. The water is brownish yellow and has an odor that indicates the presence of iron (Fe) and manganese (Mn) content which exceeds the maximum levels of the water.

Regulation of the Minister of Health of the Republic of Indonesia Number 416 / Menkes / Per / IX / 1990 and SNI 01-3553 2006 concerning the requirements and monitoring of water quality have determined clean water quality standards which indicate that clean water meets health requirements. For iron and manganese metals, each has a quality standard of 0.3 mg / l and 0.1 mg / l. If the levels of the two heavy metals exceed the quality standard, then the clean water does not meet the requirements and must be processed before being used for daily needs, especially for consumption[1][17].

Activated carbon is carbon that has been activated so that the pore structure develops depending on the activation method used. Activated carbon has many functions, for example in water treatment, which can remove pollutants such as zinc, lead, chromium, iron, and ammonia vapor (Murti, 2008). Commonly activated carbon is made from corn cobs, dregs of milling sugar cane the pulp of papermaking, coconut shell, coconut husk, rice husks, sawdust, hardwood, and coal. Activated carbon can adsorb certain gases and chemical compounds and its adsorption properties are selective, depending on the size or volume of pores and surface area (Sembiring, 2003). Based on research conducted by (Rahayu (2004), activated carbon made from coconut shell is effective as an absorbent (absorbent) of iron and manganese in dug well water in Kartasura, Sukoharjo. According to Jannati in Rajagukguk (2011), cassava peels can also be used as activated carbon because the white peel of cassava contains 59.31% of carbon. Cassava cultivation areas in Indonesia have been scattered in many areas [4][7][18].

In this study, it will also be seen the effective temperature when carbonization of cassava peels into activated carbon because the carbonization process affects the absorption ability of Mn and Fe metals.

METHOD

Location and Time of Research

This research was a quasi-experimental study with one group pre and post-test design. Using a group of subjects and take measurements before and after giving treatment to the subject [6].

The database was accessed on 20 Jan. The research location was in Tanjung Sari village, Medan Selayang sub-district, and the research was conducted in the Laboratory of Health Analyst Department and Center Laboratory of Medan Health Polytechnic of Ministry of Health. The preparation stage, including observations at the location of dug well water sampling obtained in the completion of the proposal which was carried out in April 2019.

The implementation stage includes taking samples of dug well water at the research location, namely in Tanjung Sari Village, Medan Selayang, and checking levels of Fe and Mn at the Health Analyst Department and Center Laboratory of Medan Health Polytechnic of Ministry of Health from May to August 2019. The completion stage, including processing data obtained from laboratory test results and analyzed descriptively in September - October 2019

RESULTS AND DISCUSSION

Research results can be seen in the following table:

Table 1. Percentage Difference of Iron and Manganese Level Decrease on Heated Activated Charcoal at 400^{0}C

Active Charcoal Weight (g)	Average Decrease In Iron Content (%)	Average Decrease In Manganese Levels (%)	Difference In Decreased Levels (%)
0.1	26.7	16.8	9.9
0.5	85.4	83.4	2
1.0	92.8	91.8	1

Table. 2. Average Distribution of Fe and Mn (Ppm) Level at Control Group and After Addition Activated Carbon of Cassava Peels at 400^{0}C

Groups of 400^{0}C	Fe Level (ppm)	Mn Level (ppm)	Sig
Activated Carbon of 0 g	86,70	9,76	
Activated Carbon of 0.1g	63,93	8,11	0,000
Activated Carbon of 0.5 g	12,71	1,61	0,000

Activated Carbon of 1.0 g	6,26	0,79	0,000

Table 3. Percentage of Difference Decreased Levels of Iron and Manganese on Heated Activated Charcoal

Active Charcoal Weight (g)	Average Decrease In Iron Content (%)	Average Decrease In Manganese Levels (%)	Difference In Decreased Levels (%)
0.1	33.8	20	13.8
0.5	86.8	84.1	3
1.0	93.3	92.1	1

Table. 4. Average Distribution of Fe and Mn (ppm) Level at Control Group and after addition Activated Carbon of Cassava peels At 500^{0}C

Groups of 500^{0}C	Fe Level (ppm)	Mn Level (ppm)	Sig
Activated Carbon of 0 g	86,70	9,76	
Activated Carbon of 0.1g	57,40	7,80	0,000
Activated Carbon of 0.5 g	11,39	1,47	0,000
Activated Carbon of 1.0 g	5,83	0,77	0,000

Discussions

Based on the results of the ANOVA test calculation, the average iron (Fe) content without activated charcoal from cassava peels was 86.70 ppm, with a standard deviation of 7.52. For the results of the average levels of Fe and Manganese in the provision of activated charcoal from cassava peels at 4000 C are as follows: For the addition of 0.1 gram of Fe content was 63.93 ppm, with a standard deviation of 5.33, for the average of 0.5 grams of cassava peel activated charcoal was 12.71 ppm, with a standard deviation of 1.24.

For the average application of cassava peel activated charcoal of 1.0 gram was 6.26 ppm, with a standard deviation of 57. For the average level of Manganese (Mn) without giving activated cassava peel activated charcoal was 9.76 ppm, with a standard deviation of 1, 99. For the average of 0.1 gram activated cassava peel activated charcoal was 8.11 ppm, with a standard deviation of 1.59. for the average of 0.5 grams of cassava peel activated charcoal was 1.61 ppm, with a standard deviation of 1.24. for the average of cassava peel activated charcoal, 1.0 gram was 0.79 ppm, with a standard deviation of 0.15.

From the series of research that has been carried out, the results of statistical tests are obtained, the p-value is obtained sig = (0.000), meaning that at 5% alpha, 0.05, Ho is rejected, so it can be concluded that there was a significant difference between iron and manganese before and after the addition of carbon. Active cassava peels were 0.1, 0.5, and 1.0 g at 400℃ heating.

The results of checking the levels of Iron and Manganese before the addition of activated charcoal obtained an average level of Iron (Fe) 86.70 ppm, Manganese of 9.76 ppm did not meet the quality standards for clean water according to SNI 01-3553 2006. The addition of activated carbon from cassava peels caused the average level of Iron (Fe) and Manganese (Mn) that have decreased but still did not meet quality standards.

Based on the results of the ANOVA test calculation, the average iron (Fe) content without activated charcoal from cassava peels was 86.70 ppm, with a standard deviation of 7.52. For the average application of 0.1 gram of activated cassava peel charcoal at 500oC was 57.40 ppm, with a standard deviation of 5.25. For the average of 0.5 grams of cassava peel activated charcoal was 11.59 ppm, with a standard deviation of 0.99. For the average application of cassava peel activated charcoal, 1.0 gram was 5.83 ppm, with a standard of 0.56. For the average level of Manganese (Mn) without activated cassava peel charcoal was 9.76 ppm, with a standard deviation of 1.99. For the average of 0.1 gram activated charcoal, 0.1 gram of cassava peel was 7.80 ppm, with a standard deviation of 1.59.

For the average of 0.5 grams of cassava peel activated charcoal was 1.47 ppm, with a standard deviation of 0.33. For the average of 1.0 gram of activated charcoal, 1.0 gram of cassava peel was 0.77 ppm, with a standard deviation of 0.16. From a series of studies that have been carried out, the results of statistical tests are obtained, the p-value was obtained by the sig = (0.000), meaning that at 5% alpha (α 0.05), Ho is rejected, so it can be concluded that there was a significant difference between iron and manganese in the sample. Water wells dug before and after the addition of activated carbon of cassava peels of 0.1.0.5 and 1.0 gram at 5000C heating. Based on the results of the Anova test, the value of sig = (0.000) <0.05, Ho was rejected, which means that there was a significant difference between iron and manganese in dug well water samples before and after the addition of activated carbon of cassava peels of 1.0 gram at heating 5000C.

ANOVA test results for manganese (Mn) levels after the addition of activated carbon of cassava peels with various levels obtained a p-value (0.000) <0.05, so Ho was rejected. This showed that the sample data is normally distributed. The results of the variance test for manganese content (Mn) obtained a p-value (0.328)> 0.05, so Ho was accepted, meaning that the variance of the population data from which the sample data are drawn was homogeneous. The results of the Kruskal Wallis test for manganese (Mn) content obtained a p-value (0.003) <0.05, so Ho was rejected. That is, there was a significant difference between the manganese (Mn) content of dug well water before and after the addition of various levels of activated carbon from the cassava peel, so the follow-up test used the Least Significant Difference (LSD) test. In the Least Significant Difference (LSD) test, the results indicated that the average difference in the manganese (Mn) content of water samples and the activated carbon of cassava peels in the whole group of cassava peels activated carbon content was significantly different with each p-value (0.000) <0, 05.

Measurement of Fe Levels based on the results of measurements before receiving treatment, the average Fe content was 86.70 ppm. The Fe level has exceeded the drinking water quality standard, which is 0.3 mg / l based on the Minister of Health Decree on No. 492/MENKES/PER/IV/2010 and cleans water quality standards according to (SNI 01-3553 2006) of 0.3 ppm. Fe content in well water in the Medan Selayang sub-district of neighborhood 10 has exceeded the water quality standard so it needs to be processed before consumption. This processing is an effort to obtain clean and healthy water according to standards. One alternative water treatment that can be done is filtration[13][14]

Activated carbon functions for the adsorption process, namely the attachment of atomic and molecular ion particles to the surface of other substances. The adsorbent can absorb ferrous metal (Fe) ions better than manganese (Mn). This is due to the greater polarity of the iron (Fe) metal ion compared to manganese (Mn) so that this metal ion will more easily bind to the polar adsorbent. The wider the pore volume of the adsorbent, the more metal ions are absorbed [9][10][12][15][16].

CONCLUSION

Activated cassava peel charcoal is effective for reducing levels of iron (Fe) and Manganese (Mn) in dug well water. Cassava peel activated charcoal by 500°C heating is more effective to absorb Fe and Mn metals. The more activated charcoal is added, the smaller the difference in the presentation of reduction in Fe and Mn content between activated charcoal heated at 400°C and 500°C

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