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THE EFFECTIVENESS OF CASSAVA PEEL (Manihot Esculenta Crantz) IN REDUCING IRON (Fe) LEVELS IN DUG WELL WATER.

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ABSTRACT

The Effectiveness of Cassava Peel (Manihot esculenta crantz) in Reducing Iron (Fe) Levels in Dug Well Water. This results in unsuitable water quality. A natural ingredient can be used to treat wastewater from cassava peel. This study aimed to ascertain the variation in iron (Fe) levels in dug well water before and after cassava peel treatment. This pure experimental research used a posttest-only control group design method. The research population consisted of water from a dug well in Sungai Tiung Village, Banjarbaru City, which contains high iron levels. The research sample was part of the dug-well water. The Kruskal-Wallis statistical test revealed a significant difference between treatments, prompting using the Mann-Whitney test. Further statistical tests yielded the asymptote value Sig. (2-tailed) < 0.05, indicating significant differences between doses of 0 grams and 1 gram, 1.5 grams, 2 grams, 2.5 grams, and 3 grams; the dose of 1 gram and 2.5 grams and 3 grams; and the dose of 1.5 grams and 2.5 grams and 3 grams. The study concluded that using cassava peel for water treatment effectively reduces iron content. Further research is recommended to achieve iron levels by quality standards by varying the time of the coagulation-flocculation process and conducting a preliminary test to determine the optimal dose variation.

INTRODUCTION

In Indonesia, the community primarily uses polluted water that is not suitable for bathing, washing, or consumption. Most people use groundwater on a daily basis, yet it still contains manganese, making it unusable. consumed without first being processed [1]. Groundwater occasionally contains iron (Fe) content in addition to manganese, disrupting daily activities due to the water's inability to meet sanitation standards.

If the heavy metal Fe enters the body at levels exceeding 1.0 mg/l, it will cause dangers such as intestinal damage, inflammation, vomiting, and headaches. [2]. Other problems that can arise if you consume water that contains high levels of iron include heart attacks, strokes, and even cancer [3]. Users of the water will experience eye and skin irritation if the iron level is more than 1.0 mg/l [4]. Cassava peel waste serves as a natural ingredient for purifying clean water.

Several researchers explained the results of their research, revealing that cassava peel contains protein, non-reduced cellulose, and crude fiber with cyanide acid (HCN). This collection of substances includes CN, NH2, SH, and OH groups, which function as metal binders. [5]. The functional group that can play a role in heavy metal adsorption is the hydroxyl functional group, with the possible reaction equation 2(OH) + Fe 2+ ↔ (O2Fe(2-2))+ + 2H+. [6].

Based on observations conducted at one location in the Sungai Tiung Village area, Banjarbaru City, we know that approximately 40 houses (100%) in the area use dug well water for their daily needs, including drinking water, bathing, washing, and other activities. Some individuals opt for commercially sold bottled water for their drinking needs, while some continue to rely on dug well water. However, a significant number of them struggle to obtain clean water under the Regional Drinking Water Company's (PDAM) management. Some factors, such as the flow not reaching the well and the presence of housing on newly developed land, contribute to the significance of dug wells in the area.

Researchers also conducted preliminary tests to determine the iron content in the area's dug well water. After inspection, the iron content of dug-well water was ± 2.5 mg/l. Naturally, when water surpasses quality standards and has high iron levels, it necessitates processing, which includes the use of cassava peel coagulant. Cassava peel is not only a water purifier; this natural ingredient is also useful for other uses [7].

Previous studies utilizing cassava peel as a natural ingredient to lower iron levels discovered that the majority of the peel underwent activation using specific chemicals, posing challenges to the community's ability to utilize cassava peel. If it is activated with chemicals and goes through certain processes, it becomes impractical. It would be interesting to conduct a study to compare the iron content of dug well water before and after the addition of cassava peel, both without activation and with the more practical preparation method.

MATERIALS AND RESEARCH METHODS

This research is a true experimental study, also known as a pure experiment. It involves two groups: the experimental group and the control group, both of which share the same variables. The study employed a posttest-only control group design method. According to [8], the method works by randomly selecting the control group and experimental group. In this study, the control group was not given treatment, while the experimental group was the group that was given treatment, after which measurements were taken on both groups. The control group acts as a comparison with the experimental group [9].

According to this research [10], The research revealed that the optimal dosage for adsorbing iron (Fe) levels using cassava peel coagulant was 2 grams. In this study, we treated dug well water with cassava peel in six different doses, varying from 1 gram to 1.5 grams, 2 grams, 2.5 grams, 3 grams, and 0 grams for the control group. The research utilized cassava skin of the Manggu type. We conducted this research in the Banjarbaru City area of South Kalimantan.

The population and sample in the study were water from one of the dug wells in the Sungai Tiung Village area, Banjarbaru City, which has a high iron (Fe) content and exceeds quality standards. In this research trial, there were four replications, so the total research sample would be 24. The research started by preparing the cassava skin, then proceeded to prepare a trial of dug well water. This involved administering various doses of cassava peel to each of the six beakers, carrying out the coagulation and flocculation processes, and checking the iron content, pH, and temperature of the dug well water. Then data analysis is carried out. Data analysis in this study used the Kruskal-Wallis test, which is a non-parametric test, and the Mann-Whitney test.

RESULTS OF RESEARCH AND DISCUSSION

Before conducting research on the dug well water, we conducted a field examination of the iron (Fe) content using a test kit to confirm that the iron (Fe) content was still high. We obtained the same examination results as the previous preliminary test, which were 2, 5 mg/L with a pH of 5.5 and a water temperature of 34.0 C. Table 1 below displays the iron (Fe), pH, and temperature levels in the dug well water prior to cassava peel treatment, based on the research results.

Table 1.Results of examination of iron (Fe) content, pH and temperature of dug well water Before being treated with cassava skin

No	Parameter	Examination Results Before Treatment	Quality standards (Permenkes No. 32 of 2017)
1.	Iron (Fe) content	2.01 mg/l	1.0 mg/l
2.	pH	5.5	6.5-8.5

Table 1 shows that the iron (Fe) levels before treatment were 2.01 mg/l. We also examined the pH and temperature of the dug well water before treatment, revealing a pH of 5.5 and a temperature of 31 C. The top layer of soil, up to a depth of 30 meters, contains a significant amount of chemical content, including iron. During its flow process, water that passes through rocks containing high levels of iron also contains iron or other chemical elements. If the contact time between water and the rocks it passes through is prolonged, the level of chemical elements in the water can increase. in Table 2. Most of the iron content While the iron content in well water tends to be low at the water surface, it can typically exceed 1.0 mg/l at certain groundwater depths [11]. the iron content of dug well water using cassava peel, which was also stirred using a coagulation-flocculation process, can be seen in Table 2 below.

Table 2. Results of examination of the iron (Fe) content of dug well water After being treated with cassava skin

Treatment Dosage (grams)	Treatment (Dose)	Repeat Treatment Iron Content (mg/l)				Average (mg/l)	Quality standards
		1	2	3	4		
0	0 grams	1.82	1.96	1.95	1.96	1.92	1.0 mg/l (RI Minister of Health Regulation Number 32 of 2017)
1	1 gram	1.59	1.72	1.72	1.70	1.68	
1.5	1.5 grams	1.73	1.66	1.61	1.61	1.65	
2	2 grams	1.66	1.59	1.50	1.70	1.61	
2.5	2.5 grams	1.40	1.54	1.54	1.63	1.52	
3	3 grams	1.63	1.44	1.55	1.49	1.52	

There was less iron (Fe) in the sample after it was treated with cassava peel four times using the coagulation-flocculation process, as shown in Table 2. The initial iron content was 2.0 mg/l. In the 0 gram treatment, the iron content decreased on average to 1.92 mg/l; in the 1 gram treatment, the iron content decreased on average to 1.68 mg/l; the 1.5 grams of iron content decreased on average to 1.65 mg/l; the treatment of 2 grams of iron content decreased on average to 1.61 mg/l; in the fourth treatment, with a dose of 2.5 grams, there was an average decrease in iron levels, with the average becoming 1.52 mg/l; and the final dose of 3 grams of iron content decreased with the average iron content being 1.52 mg/l.

Table 3. Results of pH examination of dug well water After being treated with cassava skin

Treatment Dosage (grams)	Repeat water pH treatment 1	2	3	4	Average	Quality standards
0	5.7	5.3	5.7	5,6	5.5	6.5-8.5 (Permenkes RI Number 32 2017)
1	5.8	5.3	5.4	5.7	5.5	
1.5	5,6	5,6	5.4	5,6	5.5	
2	5.8	5.7	5.5	5,6	5,6	
2.5	5,6	5.5	5.7	5,6	5,6	
3	5,6	5.7	5.7	5.7	5,6	

Table 3 demonstrates that after treating the dug well water four times with cassava peel, the pH of the water averaged between 5.5 and 5.6 for each different dose of cassava peel. The initial pH check before treatment was around 5.5; this proves that there was no change in pH during treatment at a certain dose.

Table 4. Results of checking the water temperature of dug wells After being treated with cassava skin

Treatment Dosage (grams)	Treatment	Repeat Treatment Water Temperature (oC) 1	2	3	4	Quality standards
0	Dosage 0 grams	30.8	24.6	30.7	25.4	Air temperature ± 3 (RI Minister of Health Regulation Number 32 of 2017)
1	Dosage 1 gram	26.6	25.2	26.4	30.3	
1.5	Dosage 1.5 grams	30.4	25.3	26.6	30.1	
2	Dosage 2 grams	30.1	25.4	25.2	28.6	
2.5	Dosage 2.5 grams	25.1	25.3	30.5	25.1	
3	Dosage 3 grams	25.1	30.9	25.5	30.7	

Table 4 displays the temperature of water from a dug well following treatment with varying amounts of cassava peel and four cycles of the coagulation-flocculation process. It is known that the temperature of the dug well water after treatment ranges from 25.1°ºC to 30.8° ºC. BefBefore treating the dug-well water, we first examined it to determine its temperature. The examination results revealed that the dug well water's pre-treatment temperature was 31.9 °C, indicating a moderate difference between its pre- and post-treatment temperatures. Analyzing the iron content results allows for a comparison of the dug well water's iron content in various treatments, determining whether there is a significant difference between them. We first conducted a normalization test to analyze the iron content in various treatments, then proceeded with further analysis tests based on the results of the normality test.

Table 5. Normality test for reducing iron (Fe) levels in dug well water

Cassava Skin Dosage	Kolmogorov-Smimova Statistics	df	Sig.	Shapiro-Wilk Statistics	Df	Sig.
0 grams 1 gram	,406	4		,681	4	,007
1.5 grams	,360	4		,736	4	,028
2 grams	,273	4		,852	4	,233
2.5 grams	,206	4		,963	4	,800
3 grams	,302	4		,923	4	,553
- Decreased Iron Levels	,177	4		,984	4	,926

Based on the normality test using Shapiro-Wilk readings, Table 5 shows two data categories where the p value is less than 0.05, specifically in the 0 gram and 1 gram dose categories. This indicates that the data is not normally distributed, leading to the rejeOne of the requirements for conducting a one-way Anova difference test analysis on data from more than two groups is the presence of normally distributed data. If the data contains non-normally distributed categories or groups, we can proceed with an alternative analysis using the Kruskall-Wallis test.Wallis test.

Table 6. Kruskall-Wallis Test for Reducing Iron (Fe) Content in Dug Well Water
Test Statistics, b

	Decreased Iron Levels
Chi-square	15,639
Df	5
Asymp.Sig.	,008

a. Kruskal Wallis Test
b. Grouping Variable: Cassava Peel Dosage

Table 6's Kruskall-Wallis test results show that the Asymp Sig value (0.008) is less than 0.05, indicating rejection of H0, acceptance of Ha, or a difference in decreasing iron (Fe) levels between doses of 0 grams, 1 grams, 1.5 grams, 2 grams, 2.5 grams, and 3 grams.
We conducted the Mann-Whitney test after the Kruskall-Wallis test to determine which treatments differed.

Table 7. Results of Mann Whitney Test Analysis

shows the asymptote value. The significance level (2-tailed) is less than 0.05, indicating a

Treatment (grams)	Value of Statistical Analysis	Information
Doses 0 and 1	Asymp Sig. (0.019) < 0.05	There are significant differences
Doses 0 and 1.5	Asymp Sig. (0.019) < 0.05	There are significant differences
Doses 0 and 2	Asymp Sig. (0.020) < 0.05	There are significant differences
Doses 0 and 2.5	Asymp Sig. (0.019) < 0.05	There are significant differences
Doses 0 and 3	Asymp Sig. (0.020) < 0.05	There are significant differences
Doses 1 and 1.5	Asymp Sig. (0.770) > 0.05	There is no significant difference
Doses 1 and 2	Asymp Sig. (0.142) > 0.05	There is no significant difference
Doses 1 and 2.5	Asymp Sig. (0.041) < 0.05	There are significant differences
Doses 1 and 3	Asymp Sig. (0.042) < 0.05	There are significant differences
Doses 1.5 and 2.5	Asymp Sig. (0.080) < 0.05	There are significant differences
Doses 1.5 and 3	Asymp Sig. (0.081) < 0.05	There are significant differences
Doses 2 and 1.5	Asymp Sig. (0.465) > 0.05	There is no significant difference
Doses 2 and 2.5	Asymp Sig. (0.245) > 0.05	There is no significant difference
Doses 2 and 3	Asymp Sig. (0.149) > 0.05	There are significant differences
Doses 2.5 and 3	Asymp Sig. (0.884) > 0.05	There is no significant difference

significant difference between the doses of 0 grams and 1 gram, 0 grams and 1.5 gram, 0 grams and 2 gram, 0 grams and 2.5 gram, doses of 0 grams and 3 grams, doses of 1 gram and 2.5 grams, doses of 1 gram and 3 grams, and doses of 1.5 grams and 3 grams. To find out the optimum dose of cassava peel for reducing the iron content of dug well water, you can see the range of iron levels after treatment at various doses, as shown in Table 8 below.

Table 8. Determination of Optimum Dosage for Iron (Fe) Content in Dug Well Water

Cassava Skin Dosage	Iron Content Range (mg/l)	Average Decrease in Iron Levels (mg/l)	% Decrease
0 grams	1.82 – 1.96	0.08	4.35
1 gram	1.59 – 1.72	0.32	16.28
1.5 grams	1.61 – 1.73	0.35	17.78
2 grams	1.50 – 1.70	0.39	19.77
2.5 grams	1.40 – 1.63	0.48	24
3 grams	1.49 – 1.63	0.48	24

According to Table 8, the lowest dose of cassava peel for reducing iron (Fe) levels in dug well water is 0 grams as a control, with a range of decreasing iron levels to 1.40 mg/l–1.63g/l. The highest dose (ptimum) for reducing iron levels is 2.5 grams, with a range of decreasing iron levels to 1.40 mg/l–1.63g/l. At this dose, the average iron content decreases by 0.48 mg/l. Typically, an additional dose of the adsorbent enhances its absorption capacity. However, if the dose surpasses the optimal level, the absorption capacity of each adsorbent closes and becomes weaker. to be Having analyzed the research results, we can provide the following research recommendations: given are:

Cassava peel can lower levels of iron (Fe). The clean water processing process, which uses coagulation and flocculation processes, reduces iron (Fe) levels to a maximum of 24%, but the iron content still does not meet the quality standards, as per the Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017.

In this study, a dose of 2.5 grams of cassava peel reduced the iron content of dug well water from 2.01 mg/l to an average of 1.52 mg/l, which is close to the quality standard of 1.0 mg/l but requires additional treatment. To meet quality standards, either increase the dosage or combine it with other processes.

When treating dug well water with cassava peel through the coagulation-flocculation process, it's well-known that the absence of cassava peel reduces the iron content in the water, thereby impacting the stirring process and allowing for time variations. during the coagulation-flocculation process.

CONCLUSIONS AND RECOMMENDATIONS

There was a significant difference in iron levels at the treatment dose, with the optimum dose occurring at a dose of 2.5 mg/l, with a range of reduction in iron levels being 1.40 mg/l–1.63 mg/l and a reduction percentage reaching 24%. You can either powder or extract cassava peel for use as a coagulant. Adding more doses or combining it with other processes is necessary to maximize the benefits of cassava skin.

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