

The Effectiveness Of Moringa Seed Coagulant Combination (Moringa Oleifera), Pumice Stone Filter And Activated Mangrove Charcoal (Rhizophora Sp.) In Reducing Tds Level In Barrang Caddi Island, Makassar City

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ABSTRACT

The limited clean water in small island is caused by contamination of sea water to clean water sources of society. This study aims to investigate the effectiveness of several methods of brackish water processing to reduce TDS level. This study is one group pretest-posttest design experiment, this study used water processing with coagulation method of Moringa seeds at dose of 350 mg/l, a pumice stone filter with thickness of 60 cm, an activated carbon filter (mangrove wood) with thickness of 60 cm, and combination method of coagulation-filtration in reducing Total Dissolved Solid (TDS) level. The sample of this study was dug well in Barrang Caddi Island, the data were analyzed using the effectiveness formula, Kruskal Wallis test. Brackish water processing with the coagulation method of Moringa seeds showed an average value of the effectiveness in reducing TDS level of 41.38%; pumice stone filtration of 28.82%; activated charcoal filtration was 63.53% and the combination of coagulation-filtration was 54.66% and there was a significant difference in the effectiveness between the four water treatment methods on TDS parameter ($p = 0.016$). There is fairly good effectiveness on the combination of coagulation and filtration method in reducing TDS level.



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1. Introduction

Small island has many problems such as geographical distribution, small size and limited land [1]. Problems that are often found in small island, one of them is the lack of clean water, this is because of large catchment area for rainwater and groundwater storage in small island are limited, so the chance for contamination of water source with seawater is very large which causes the water to be brackish [2].

Barrang Caddi Island is classified as a small island, 11 km from Makassar city with area of 4 ha, one of the most populated islands with total of 1263 people [3]. This island has brackish water source especially in the dry season. Poor water quality is caused by sea water intrusion which causes high salt content in the water. Based on data from Subsidiary Public Health Center, Barrang Caddi Island listed that there are several diseases caused by water including diarrhea, dermatitis, and ascariis [3].

Water processing aims to improve water quality before used. Several technologies have been developed in modern way to overcome these problems such as water processing with reverse osmosis (RO) system. However, its use requires high operational costs, making the processing be difficult to reach for people living in small island [4].

Alternative processing which appropriates with the condition of islands can be done with a simple and household-based water cultivating method namely coagulation method and filtration method. Coagulation is an addition of a coagulant material that has function as a binder of dirty or small particles dissolved in water so that it forms floc that can settle, while filtration is a process of filtering water by passing water from porous medium so that it can absorb dirt or pollutant [5], [6]. Processing with coagulation and filtration methods are two simple forms of water processing that can be combined to improve the quality of clean water in small island.

Therefore, this simple processing method can be carried out by taking advantage of local materials that are easily got in the coast or small island and low cost such as moringa seeds, pumice stone stone and mangrove wood. This study aims to find out the effectiveness of brackish water processing using combination method of Moringa seed coagulation, pumice stone filtration, activated mangrove charcoal filtration to the decrease of TDS (Total Dissolved Solid) level in dug well.

2. Methods

This study is quantitative research with a quasi-experimental design one group pretest-posttest. It is located in Barrang Caddi Island, Sangkarrang District, Makassar City.

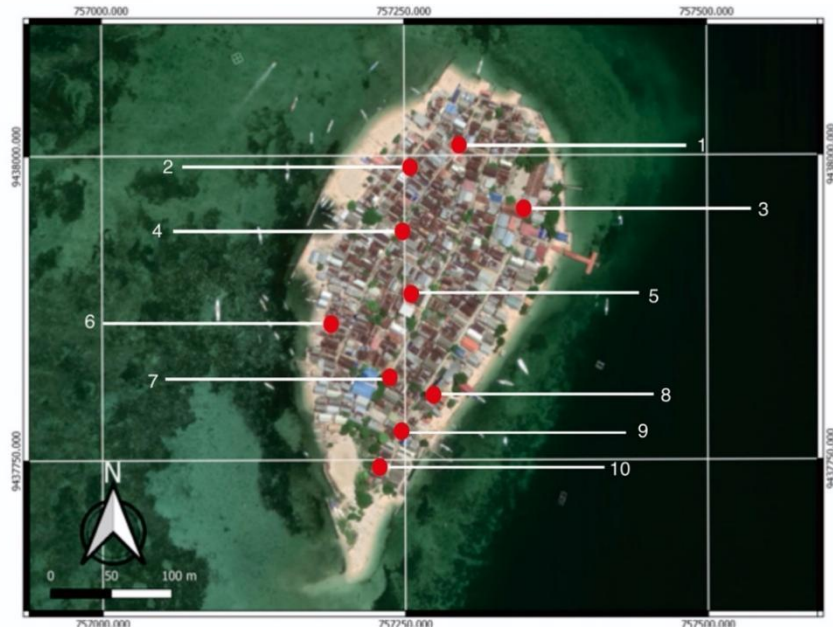


Figure 1. The location of dug well in Barrang Caddi island. The map shows the location of the first TDS level checking

The population of this study was dug well in Barrang Caddi Island, Sangkarrang District, Makassar City. The total of 10 water samples came from (Figure 1) dug wells, then the samples were selected based on purposive sampling technique with the criteria of dug well still being used, the closest distance to seawater. Furthermore, the sample that will be selected for processing is a sample of dug well with a Checking value of TDS > 1500 mg/l.

Table 1. The result of the first TDS (Total Dissolved Solid) level checking

Sample point	Total Dissolved Solid (mg/l)	Selected sample area
1	700	No
2	420	No
3	200	No
4	1450	No
5	1490	No
6	1400	No
7	459	No
8	1830	Yes
9	1210	No
10	1100	No

Based on the result of the first TDS (Total Dissolved Solid) level checking, point 8 as dug well that will be sample to do water processing in this study.

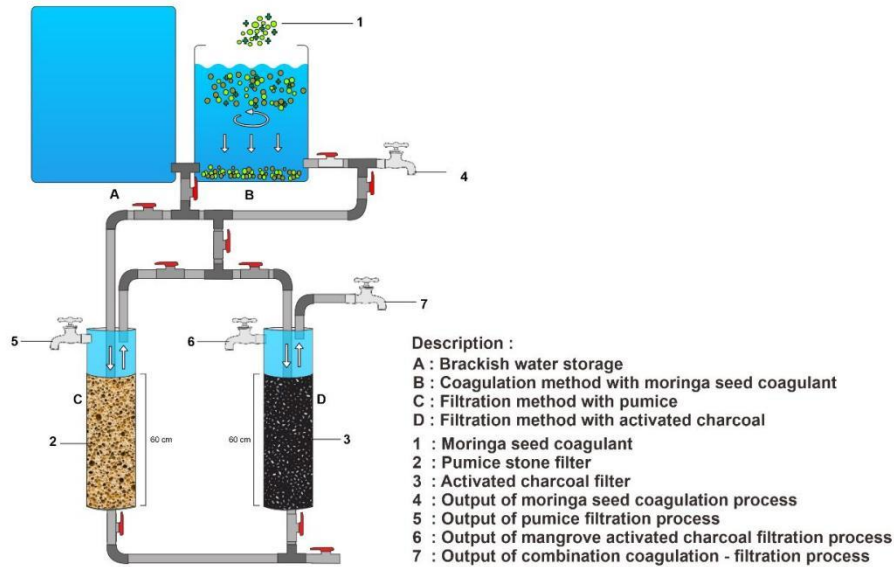


Figure 2. processing tool of Brackish water

The processing of brackish water in this study used a simple self-assembled tool (figure 2). This water processing used four processing methods namely coagulation using Moringa seed coagulant at dose of 350 mg/l, (B), pumice stone filtration with thickness of 60 cm (C), filtration of activated charcoal from mangroves with thickness of 60 cm (D), and a combination of coagulation-filtration. (B, C and D). The flow rate used was 1 L/min. Each processing method was repeated three times so that there were 24 samples (12 pretest samples and 12 posttest samples). the samples taken were put in a cold box and then brought and examined in the water laboratory of Makassar Health Polytechnic, while the determination of effectiveness was measured by equation (1).

$$\text{Effectiveness (\%)} = \frac{A_0 - A_n}{A_0} \times 100 \dots \dots \dots (1)$$

Description: A₀ = Level before processing
 A_n = Level after processing

Furthermore, the difference in the effectiveness of each processing method were analyzed by Kruskall Wallis test using SPSS. This study was conducted after accepting written approval by the ethics committee of Faculty of Public Health, Hasanuddin University with no. 6223/UN4.14.1/TP.01.02/2022.

3. Results

Table 2. Results of Effectiveness Measurement of Brackish Water processing Method in Reducing Total Dissolved Solid (TDS) Level

Water Treatment Method	Replication	Value of TDS (mg/l)		Effectiveness (%)
		Before	After	
Moringa seed coagulant	1	1884	1103	41,45
	2	1884	960	49,04
	3	1884	1250	33,65
	Mean	1884	1104	41,38
Pumice stone filtration	1	1780	1211	31,97
	2	1780	1320	25,84

	3	1780	1270	28,65
	Mean	1780	1267	28,82
Activated charcoal filtration	1	1890	720	61,90
	2	1890	670	64,55
	3	1890	678	64,13
	Mean	1890	689	63,53
Combination of coagulant - filtration	1	1750	880	49,71
	2	1750	670	61,71
	3	1750	830	52,57
	Mean	1750	793	54,66

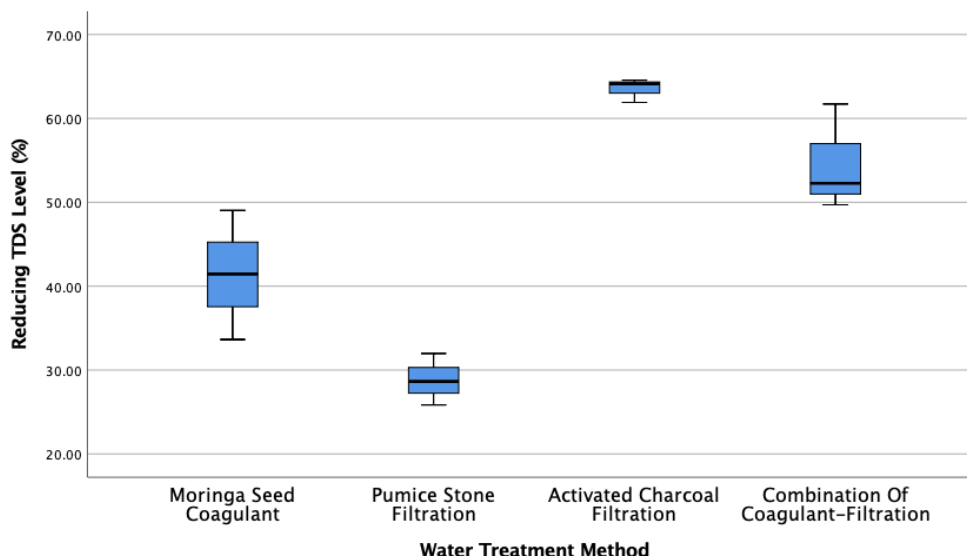


Figure 3. Comparison of Selection Percentage for TDS Parameter in Brackish Water processing in Barrang Caddi Island.

The results of TDS level checking showed that the coagulation of Moringa seeds obtained an effectiveness value for 41.38%, pumice stone filter for 28.82%; activated charcoal filtration for 63.53%; and the coagulation-filtration combination for 54.66% (Table 2, Figure 3).

Table 3. Difference in the Effectiveness of Brackish Water Culltivation Method in Reducing Total Dissolved Solid Test

No	Processing Method	n	Mean Rank	Sig.
1	Moringa seed coagulant	3	5.00	<i>p</i> = 0.016
2.	pumice stone Filtration	3	2.00	
3.	Activated Charcoal Filtration	3	11.00	
4.	Combination of coagulant - filtration	3	8.00	

*Significant stastics ($p < 0.05$) by Kruskall Wallis Test

Table 3 shows that there is significant difference among coagulant method of Moringa seeds, pumice stone filtration, activated charcoal filtration and combination of coagulation-filtration in removing TDS levels ($p = 0.016$). The activated charcoal (mangrove wood) filtration processing method was the most effective in reducing TDS level (Mean Rank = 11.00) compared to other processing methods.

Table 4. Comparison of the Effectiveness of Brackish Water Treatment Methods in Reducing Total Dissolved Solids

Processing Method	Moringa Seed Coagulant	pumice stone Filtration	Activated Charcoal Filtration	Combination of coagulant - filtration
Moringa Seed Coagulant	-	0.019*	0.001*	0.015*
Pumice stone Filtration	0.019*	-	0.000*	0.000*
Activated Charcoal Filtration	0.001*	0.000*	-	0.070
Combination of coagulant - filtration	-	0.015*	0.000*	0.070

*Significant Difference ($p < 0,05$), by Post-Hoc Test

Table 4 shows that only the activated charcoal filtration method which does not have significant difference with the combined coagulation-filtration method ($P = 0.070$). so that processing with the combination coagulation-filtration method is also quite effective in reducing TDS levels.

4. Discussion

Water processing using the combined coagulation-filtration method showed the effectiveness in reducing TDS level by 54.66%. The combination of coagulation method and filtration method is considered better because it takes place simultaneously in two stages of water processing which are pretreatment stage and treatment stage [7]. At the pretreatment stage using coagulation method where there is a process of adding coagulant material which cause the formation of small flocs which then enlarge and settle to the bottom of water [8], while at the treatment stage using the filtration method where there is filtration of the remaining floc from the coagulation process, this can reduce the workload of filtration process [9], [10].

The pretreatment stage in water processing is the most commonly used in conventional water processing namely coagulation method, the coagulation process in this study used Moringa seed biocoagulants. In this study, coagulation of Moringa seeds showed the effectiveness in reducing TDS level by 41.38%. Moringa seeds contain cationic protein as an active substance of 4- α -4-rhamnosyloxy-benzyl-isothiocyanate. This protein will be positively charged if it dissolves in water so it can be used as a natural polymer coagulant that can absorb mud particles in water [11]. This is in accordance with research conducted by Rini that find Moringa seed powder can reduce TDS in brackish water by 33.97% [12].

Treatment stage is the next stage of first treatment (pretreatment). Generally, the filtration method is often carried out in various water processing, in this study used the activated charcoal filtration stage with the basic ingredient of mangrove wood. In this study, activated charcoal of mangrove wood showed the effectiveness in reducing TDS level by 63.53% is more effective than other processing methods. In mangrove, there are tannin compounds, these compounds are settled in water which contain phenol OH-groups so that they can bind heavy metal such as Fe [13]. Activated charcoal contains 85-95% carbon which has open pores as an adsorbent for color, odor, chemical and toxic substances in water [14].

Beside activated charcoal filtration, in this study pumice stone was also used as a filtration medium in the treatment stage of water processing, in this study pumice stone showed the effectiveness in reducing TDS level by 28.82%. pumice stone has a large porous structure so that it can act as adsorption in removing

organic materials and heavy metals [15]. but in this study, it has a low effectiveness, the ability of pumice stone can be affected by saturation level of the filtration medium due to protonation on the functional group of the pumice stone adsorbent so that the ability to adsorb ions to be less and pumice stone has not gone through the activation process [16].

From all the brackish water processing methods in this study, activated charcoal filtration (mangrove wood) was more effective than other processing methods. Processing using a combination of coagulation-filtration is also considered quite effective because there is no significant difference between the activated charcoal filtration method and the combination of coagulation-filtration.

The activated charcoal filtration method is more effective than the combined coagulation-filtration method, this is because there is pumice stone filtration in the coagulation-filtration method which has low effectiveness because the pumice stone is saturated and has not gone through the activation process so that the ability of pumice stone adsorbent to adsorb ions is not optimal [16].

The limitations in this research is that the combined processing method is not tested without pumice stone as filtration, while this research only focuses on processing efficiency and the selection of water processing method in Barrang Caddi Island so further research is needed on the characteristics, maintenance, and duration on the use of material.

5. Conclusion

Based on the result of four processing methods checking used in the brackish water processing, it shows that there is significant difference among four processing methods in reducing TDS level. The combination method of coagulation - filtration is effective in reducing TDS level but not as good as the activated charcoal (mangrove) filtration method.

6. Acknowledgements

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