The effect of ratio of pineapple skin water and coconut water in cellulose membrane production and its application

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Abstract. Pineapple skin contains high carbohydrates and sugar, hence pineapple skin can be used as raw material for making chemicals, one of which is making cellulose membrane to further be utilized as peat water filtration. This study varied pineapple and coconut skin as the main ingredients of membrane production and varied starter volume or Acetobacter Xylinum. The formed membrane was further analyzed by using flux method, membrane tensile strength test, FTIR test and SEM test to see membrane morphology. From the results of the research, the best water flux data was 6.58 L / hr m2, the best tensile strength test of membrane was 22.1 Mpa and confirmation that cellulose was the composer of the membrane. The membrane was also applied for peat water filtration where peat water with its turbidity value of 10.3 NTU and its TDS 161 decreased the turbidity level to 0.34 NTU and TDS to 138.

1. Introduction

Pineapple is one of the most famous fruit and it is easily be found in many part of the world. Besides being consumed as fresh fruit, pineapple also can be processed as raw material in food processing industries. The products of pineapple processing that are mostly found in our daily live such as pineapple juice, pineapple jam, pineapple sweetmeat and also as the complementary in cooking process.

The pineapple production in Indonesia has developed rapidly year by year, so that it can be imagined the waste resulted from this pineapple process. Susanto et al found that the waste of the pineapple especially from the skin piled up and it caused many problems especially to the environment [1]. As far as we know, Indonesian people utilize only the meat of pineapple, while the skin are being unused. it because the physical structure of the skin which is hard and rough. Based on this reason, there is a chance to utilize the waste of pineapple skin and make it to a product that can be processed further. The result of previous study showed that pineapple skin contains 81,72 % water; 20,87 % rough fiber; 4,41 % protein; 17,53 % carbohydrate and 13,65 % reduction sugar. Considering the high content of sugar in the pineapple skin, it is quite possible to utilize the skin as raw material in making chemical material such as Nata [2]. Nata is a bacterial cellulose produced by Acetobacter xylinum in the process of fermentation [3-4]. Agus Susanto have studied that pineapple liquid waste can produce

nata de pina which it is the good quality and feasible product ecologically and economically [5]. Liquid waste from pineapple can obtain the cellulose film with assist of Acetobacter xylinum. Celluose film created to be membrane cellulose.

Membrane is a thin layer from a pored material that can be used to several separation process. Using membrane is one of the economical ways in separation process, it is also effective and will not change the compound both physically and chemically. Generally, membrane is made from natural polymer and its modification such cellulose and synthetic polymer such polysulfide and polyamide Cellulose is one of polysaccharide containing in plant and can be used as the material for membrane making. The main source of cellulose is wood porridge or cotton, but due to the raising amount of population and the development of technology causes the ring of life necessities. Therefore, the source of cellulose apart from wood is urgently needed. For this reason, the development of making cellulose from fruit juice, one of them is *nata de pina* which come from pineapple juice and in this research; the juice is resulted from the skin of pineapple. In 2005, Muhammad Adriansyah did a study about producing cellulose membrane from pineapple skin juice and got a very satisfied result [6]. Iskandar and friends in 2010 also did a research about producing cellulose film from *Nata De Pina* [7]. While Senny Widyaningsih in 2013 studied about utilizing nata de coco membrane as filtration media to recover used cooking oil [8].

This research will vary the juice of pineapple skin and coconut water as the coconut water also contains good cellulose for making membrane and a number of studies have been done about producing cellulose membrane using coconut water. Water is the most vital need in human life, lack of water will give great impact to both human health and social. Yet the fulfillment of clean water still becomes a general problem especially in Indonesia. Areas with no access to clean water usually use entrenchment well, river water which sometime the quality of the water do not fulfill the standard of clean water. Lately, complains are frequently heard from the people regarding to the quality of water from well which is quite far from the standard of clean water. Most often the water from the entrenchment well does not produce water with good quality, for example the color of the water is yellow and smelling.

This research will process peat water become clean water that is qualified for use by using the filtration of cellulose membrane. Peat water is one of water sources which mostly found in Kalimantan and Sumatera. Aceh, located in Sumatera, is one of the areas with lot of peat water. The color of peat water is brown till swarthy and usually contains high organic compound. Peat water requires special processing before being used as daily for domestic necessities. The aim of this research is to observe the ratio of pineapple skin whe filtration for peat water.

2. Research methodology

2.1. Tools and materials

The research used pineapple skin and coconut water as raw material gained from local traditional market. Sugar, acetic acid, aquades, starter *Acetobacter Xylinum*, and NaOH were also used for this study. The tools used were glasses, Ph paper, plastic trays, oven and mixer.

2.2. Work procedure

The pineapple skin was first blended and mixed with coconut water. Then sugar and ZA were added for each 50 gr and 4 gr and heated. After that, the coumpond was cooled and the PH was set untill 4, and next step was adding starter *Acetobacter Xylinum* and incubated for seven days. Nata de coco that had been formed was then washed with water soaked with 2 % NaOh for 24 hours and then rewashed untill its PH was neutral. The Nata was pressed by using *filter press* till the membrane of *nata de coco* was got. The membrane was dried in oven with 50˚C temperature to get dry membrane.

2.2.1. FTIR test. The pressed sample was cut in same size with the media and put in it. After the preparation process was done, the sample was then analysed and the formed spectrum was noted.

Tensile Test. The sample that was cut according to ASTM D-638 standard was set to the sample binder. Then the computer was turned on, and then the icon of TW elite was clicked as well as the interlock to set up the binder sample up and down. The sample that would be tested was set and ASTM D-638 Plastic Tension Test was chosen, then the thickness of sample and rate time was inserted. Next, click load and right click for zero signal, crosshead was chosen as well as zero signals. Before naming the sample, Run The Test icon was clicked. After that, the sample would be observed until it was cut and then the graph was saved, the result was saved in excel form. Scanning Electron Microscopy (SEM) Test. This test was conducted by cutting the sample into small pieces, and then they were adhered to the media. The sample then was placed in a tube to be coated with gold for twenty minutes. Next, the coated sample was put in SEM and the best enlargement was settled to find out the surface form. The picture met the requirement then was saved in the disk.

2.2.2. Turbidity test. The test was conducted by inserting 15 ml filtrate to a special turbidity glass bottle. The bottle was wiped by using dry paper to omit impurities during the filling to the input cell, the bottle then was reclosed. Next step was turning on the test equipment, and after several minutes the number showed up on the screen and the result was noted. This procedure was done in several times in order to get the accurate turbidity concentration. Total Dissolved Solid (TDS) Test. The test was done by filling the beaker glass with water and the equipment tool then was inserted the glass, then the result showed up on the tool and then noted.

3. Results and discussion

The study has been done in making cellulose membrane from pineapple skin waste and coconut water. During this time, ppineapple skin waste has rarely been used and also coconut water which is one of the products from coconut plants which is also not yet widely used. Cellulose membrane was ready obtained using pineapple skin and coconut water by adding Acetobacter xylinum to convert sugar in that materials to be nata and the next process becomes cellulose membrane.

This study made cellulose membrane from the mixture pineapple skin and coconut water to obtain the good quality of cellulose membrane. A graph at figure1 shows the relationship between variations in the ratio of pineapple skin water and coconut water with tensile strength values in Mpa units. Tensile strength test is carried out to determine a maximum load that can be borne by a specimen or material test. In this tensile strength test analysis using the UTM EXCEED tool. It can be seen that the membrane at a ratio of 1:0 is the best variation to obtain the tensile strength value where the tensile strength value is 22.1 Mpa and the elongation or elongation% is 15.83%.

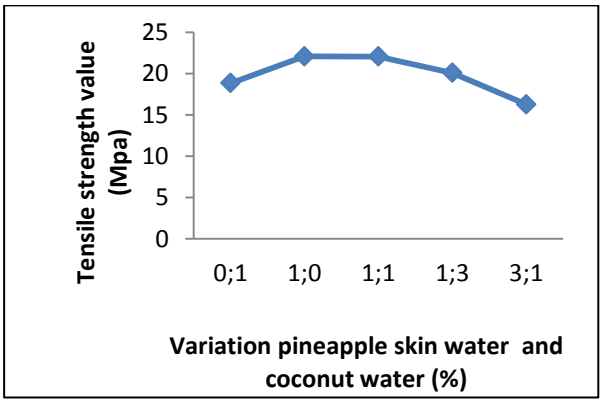

Figure 1. Tensile strength value of cellulose membranes in pineapple skin and coconut water water variations.

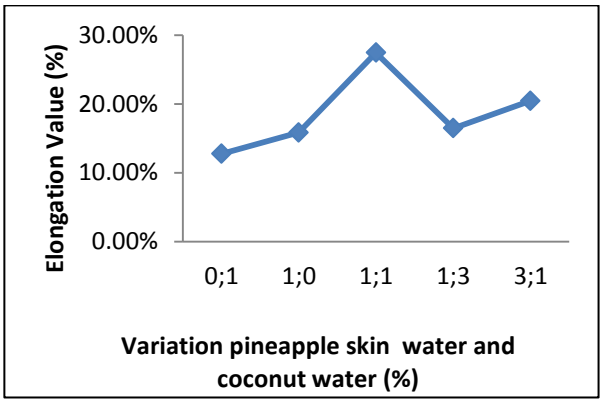

Figure 2. Precent elongation value of cellulose membranes in pineapple skin and coconut water water variations.

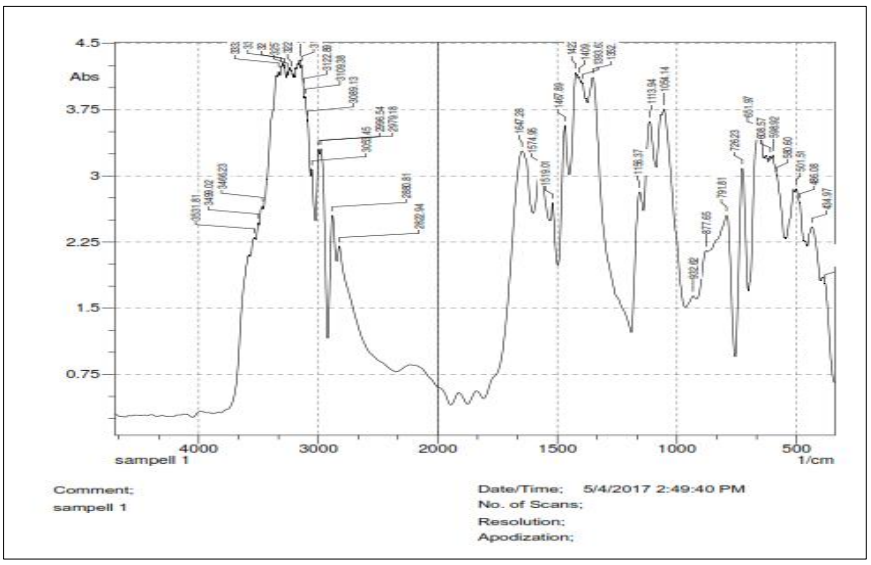

Figure 3. FTIR test of cellulose membrane.

The result of FTIR test on the cellulose membrane sample was aimed to observr the structure information of an organic compound. Rachmilda Pinnata and Alia Damayanti found out in their research ,which used water hyacinth as the cellulose membrane, that from FTIR test it identified C= O group, OH group in wave number 3364 cm^{-1} and also C-O group in wave number cm^{-1}. From picture 2. it can be seen the adsorption of OH group in wave number 3309,03 cm^{-1}. The adsorption also exist in C-O group in wave number 1054,14 cm^{-1} as well as in C= O in wave numebr 1647,28 cm^{-1}.

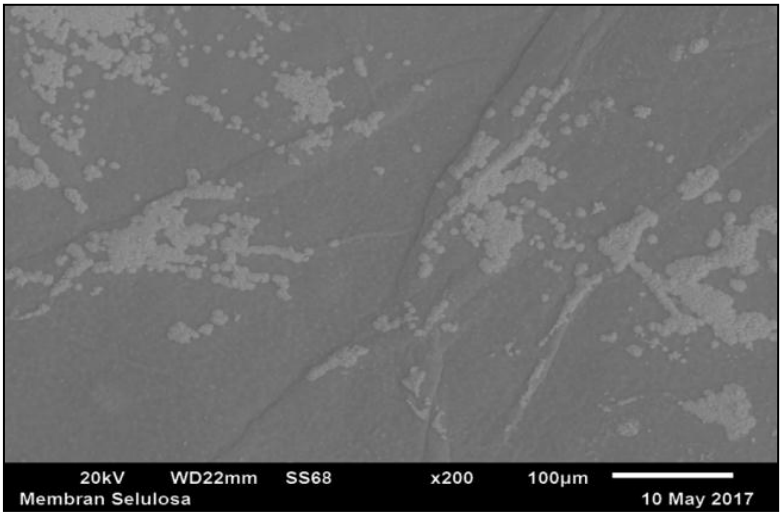

Figure 4. SEM test result.

SEM analysis is an appropriate method to observe the surface morphology of a membrane. This analysis is implemented to see the membranes pores. From picture 3 above, it can be seen the result of SEM analysis with 200 times enlargement that the structure of cellulose membrane is sufficiently tight. The tightly pore structure stating thatthe morphology of the membrane surface is not homogeneous and a tight layer formed after interfacial polymerization process. The more tightly structure cellulose membrane made solvent molecule diffusion so hard to produce a smaller pore size [9].

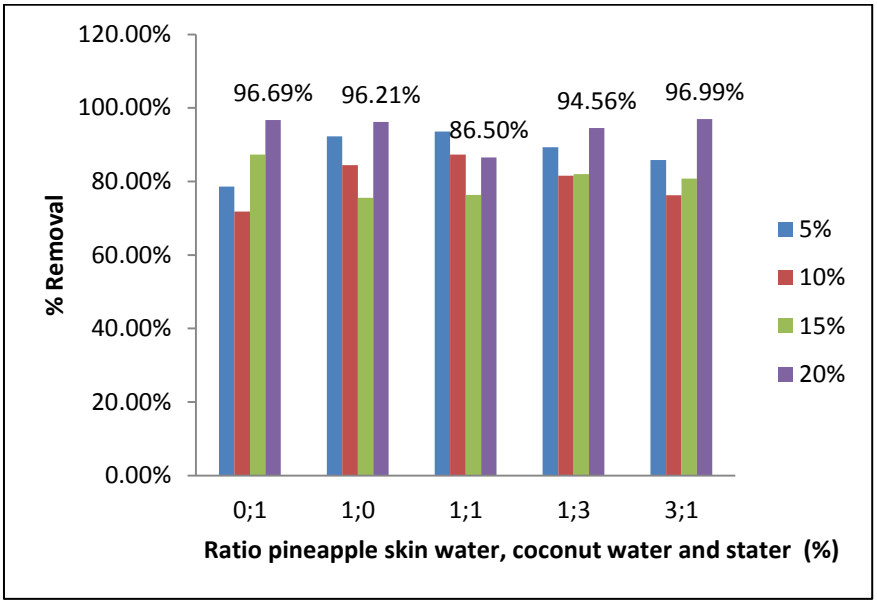

Figure 5. Efficiency decreases turbinity peat water after filtration with using cellulose membrane from pineapple skin water and coconut water.

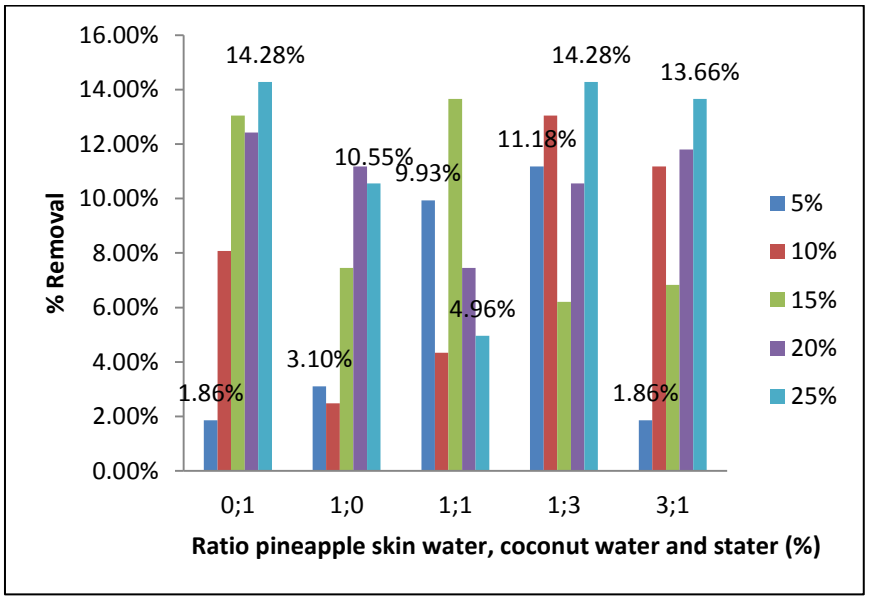

Figure 6. Efficiency decreases TDS peat water after filtration with using cellulose membrane from pineapple skin water and coconut water.

Table 1. The first result of peat water.

No	Sample	Turbinity (NTU)	TDS
1	Peat water	10,3	161

Tabel 2. The result of turbinity and TDS from peat water after filtered using cellulose membrane from pineapple skin water and coconut water.

No	Ratio pineapple skin water and coconut water	Ratio volume of stater	Turbidity (NTU)	TDS
		5%	2.2	158
		10%	2.9	148
1	0:01	15%	1.31	140
		20%	0.34	141
		25%	0.44	138
		5%	0.80	156
		10%	1.60	158
2	1:00	15%	2.52	149
		20%	0.39	143
		25%	1.52	144
		5%	0.66	145
		10%	1.31	154
3	1:01	15%	2.44	139
		20%	1.39	149
		25%	0.94	153
		5%	1.1	143
		10%	1.9	140
4	1:03	15%	1.85	151
		20%	0.56	144
		25%	0.90	138
		5%	1.46	158
		10%	2.45	143
5	3:01	15%	1.98	150
		20%	0.31	142
		25%	0.75	139

After that cellulose membrane applied as filter. The first study used to cellulose membrane as microfiltration process for fermented coconut oil and ultrafiltration for reducing Fe in water [10-11]. Therefore this research applied cellulose membrane from pineapple skin and coconut water to filter water peat. As a filter, cellulose membrane can reduce turbinity and tds from water peat. This result got at the figure 5 and 6. The Figure 5 shows the graph of the peat water turbidity water efficiency analysis after passing through the cellulose membrane. Turbidity analysis aims to see the level of turbidity of water because turbidity is usually caused by a number of things including microscopic particles such as microorganisms in the liquid, soluble solids and others. And the results after the water passes through the membrane, the turbidity value in the peat water decreases where the turbidity value of the water before passing through the membrane as seen in table 1. is 10.3 NTU and after passing through the membrane the turbidity value decreases (table 2.). And based on Figure 5 above,

the most efficient value is membrane at a ratio of 3: 1 with a starter volume of 20 % with a level of efficiency of 96.99 %.

Whereas Figure 6 above is a graph of the efficiency of peat water TDS analysis after passing through the membrane. TDS analysis aims to see the size of dissolved substances both organic and inorganic substances contained in a solution. Analysis of total dissolved solids (TDS) is used for indicator tests to determine the general quality of drinking water. Based on the graph above TDS value from peat water reduce after pass the cellulose membrane (table. 2). It showed that the cellulose membrane at a ratio of 0: 1 with a starter volume of 25% and 1: 3 starter volume of 25% is the most efficient in reducing TDS in peat water.

4. Conclusions

The ratio of pineapple skin water and cocnut water can be used as the material to produce cellulose membrane. The result of tensile strength test ,the ratio of 1: 0 is the best variation to gain the value of tensile strength where the value is 22,1 Mpa and the elongation is 15,83%. The result of FTIR analysis detected the interaction among C-O, OH and C=O group and cellulose membrane as filtre can decreases turbinity and TDS.

5. References

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6. Acknowledgments

The authors thank to P3M PNL the institution of research service center Politeknik Negeri Lhokseumawe for the financial support of this paper to publish and thank also to State of Polytechnic Lhokseumawe, Aceh, Indonesia.