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Tannin Extraction in Coconut Shell Powder (Cocodust) to Improve the Quality of Cocopeat and Obtain Tannin Products

Murni Yuniwati[1], Munadatin[2], Bambang Kusmartono[3], Muhammad Yusuf[4]

[1,2,3]Chemical Engineering, Universitas AKPRIND Indonesia

[4]Industrial Engineering, Universitas AKPRIND Indonesia

ABSTRACT: Coconut, as a plant that is widespread in Indonesia, produces fruit pulp which has high potential to be developed as a valuable food raw material, as does coconut water. The meat and water in coconuts contain high calories, so more and more people are using them. However, the more consumption of coconut meat and water, the more waste in the form of coconut shells accumulates. One of the components of coconut skin is coconut husk powder (cocodust) which contains many macro and micro nutrients including N (Nitrogen), (K) Potassium, (P) Phosphorus, (Ca) Calcium, (Mg) Magnesium and several minerals. others that can fertilize plants. However, coconut shell powder also contains chlorine gas which causes an acidic atmosphere, and tannin compounds which interfere with plant growth because they block the absorption of nutrients by plants. The process of separating coconut husk powder from coconut skin is usually done by soaking the coconut husk in water, so that it becomes soft so that the coconut husk powder is easily separated. Apart from that, soaking in water is expected to reduce the acid and tannin content in the powder, but it turns out that the reduction in tannin content is not very significant. In fact, tannin is a very important compound that is used in the health sector as an antioxidant that can bind free radicals. Apart from that, tannin is widely used in industry as a leather tanner, dye, adhesive and so on. If we can extract tannin optimally, we will obtain two products that can be used, namely tannin as an antioxidant, and a high quality planting medium (cocopeat) because of the tannin content. becomes very small. In this research, tannin was extracted using an extraction method with various variables, to be able to determine optimal process conditions in order to obtain the maximum percentage of tannin extraction. The results of the research show that by using a water solvent under atmospheric conditions, the best conditions are obtained using a process temperature of 100oC, a stirring speed of 500 rpm, a ratio of solvent volume to mass of material is 10:1 and a process time of 1.5 hours. With these process conditions, the tannin content in the powder Coconut shells can be extracted perfectly, or the percentage of tannin extraction in coconut shell powder reaches 100%.

KEYWORDS: cocodust, coconut, cocopeat, extraction, optimization, tannin.

I. INTRODUCTION

Coconut (Cocos nucifera) is a plantation crop in the form of a straight trunk tree from the Palmae family. Coconut trees are very useful for human life because almost all parts of the coconut can be utilized. Coconut fruit (see Figure 1) consisting of coir, shell, pulp and coconut water is not wasted and can be made to produce industrial products, including coconut coir can be made into mats, brooms, and mattresses (Widiyanti R.A., 2015). Coconut as a widespread plant in Indonesia, produces pulp that has high potential to be developed as a valuable food raw material, such as coconut milk for various foods, virgin coconut oil, cooking oil and so on. Likewise, the water in coconut fruit is often used as a fresh drink and can be utilized as raw material for nata decoco (Figure 2). The old coconut fruit contains high calories, amounting to 354 cal per 100 grams, which comes from oil approximately 33 percent, carbohydrates 15 percent and protein 3 percent. (Subagyo, 2011).

Figure 1. Coconut fruit

Figure 2. Coconut pulp and

Due to the benefits of coconut meat and water as high-value food ingredients, the consumption of coconut meat and water is increasing. Along with the utilization of coconut meat and coconut water, the waste in the form of coconut shells that we often see on the side of the road also accumulates. Some efforts to utilize this waste have been carried out by the community. Coconut husk has two components that can be separated from each other, namely coconut fiber and coconut husk powder (cocodust) (Figure 3 and Figure 4). Besides being used to make coconut fiber crafts, coconut fiber can

also be used as a composite material that can be used for various purposes. While coconut husk powder (Figure 5) can be separated from the husk and then utilized as a planting medium, although there are still some weaknesses that still need to be refined in order to become a better planting medium in helping plant growth and development.

Figure 1. Coconut skin

Figure 2. Coconut fiber

Figure 3. Coconut husk powder

Coconut shell powder contains many macro and micro nutrients including N (Nitrogen), (K) Potassium, (P) Phosphorus, (Ca) Calcium, (Mg) Magnesium, and several other minerals. However, coconut husk powder also contains chlor gas that causes an acidic atmosphere, and tannin compounds that interfere with plant growth because they block the absorption of nutrients by plants. The separation of coconut husk powder is usually done by first soaking the coconut husk in water for a long time. This is done so that the coconut skin becomes softer so that the powder is easily separated from the coconut skin. It is also expected to reduce the acid and tannin content in the powder, so that the powder can be made into a planting medium or fertilizer that is free of acid and tannin. However, this method did not significantly reduce the tannin content in the powder. On the other hand, tannin compounds are actually very important compounds that are used in the health sector as anti-oxidant producers that can capture free radicals in the body. In addition, tannins are often used for industrial purposes, among others as tanners, as adhesives, as dyes and so on.

Separation of tannins from coconut husk powder will bring two benefits at once. Coconut shell powder will become a powder that does not contain tannin or with minimal tannin content, so it will be able to be used as a good planting medium. Meanwhile, the tannin produced can be utilized for health purposes as well as for industrial purposes. It is necessary to learn how to separate tannin from coconut husk powder in a more effective way.

Growing media made from coconut husk powder is commonly called cocopeat. Coconut husk powder media has a high water storage capacity compared to soil media. Coconut husk powder has good water content and water storage capacity. Cocopeat has micro pores that are able to inhibit greater water movement resulting in higher water availability and also facilitate air exchange, and the entry of sunlight. . Cocopeat is also proven to save the use of fertilizers up to 50 percent (Istomo and Valentino, 2012). Its Trichoderma molds content, a type of enzyme from fungi, can reduce disease in the soil. Thus, cocopeat can keep the soil loose and fertile. Cocopeat is not only effective in accelerating plant growth performance. More than that, it also saves the use of fertilizers on plants by up to 50 percent. Cocopeat also has the same ability to increase the percentage of plant growth, plant height, number of leaves, shoot length and stem diameter (Hasriani, 2013). Cocopeat can retain the water content and chemical elements of fertilizers and neutralize soil acidity. These properties make cocopeat can be used as a good medium for plant growth and greenhouse plant media (Tyas, 2000). In solid organic fertilizer, coconut coir cocopeat functions as a bio pore for the soil, with the presence of cavities in the soil can improve air circulation carrying oxygen that is needed by plants. The disadvantage of cocopeat compared to other media is the content of tannin substances in it inhibits plant growth. The response given from the effect of using cocopeat on the growth of sengon seedlings is to make the size of the leaves smaller and yellowish in color, as a result sengon seedlings experience slow growth in height and diameter (Irawan and Kafiar, 2015).

Tannins (or plant-based tannins, as opposed to synthetic tannins) are plant-derived, bitter and astringent polyphenolic compounds that react by agglomerating proteins, or various other organic compounds including amino acids and alkaloids. Tannins can be found in certain foods and beverages, such as tea, coffee, chocolate, and wine. In tea, tannin content is said to be highest in black tea, while green tea is often considered to have the lowest concentration of tannins. Tannins are mainly used by people to tan leather to make it durable and easy to use. Tannins are also used to tan nets, ropes, and sails to make them more resistant to seawater. In addition, tannins are used as coloring agents, adhesives, and mordants (Lemmens, 1997). In the tanning process, tannins react with the proteins of the bones. This process will preserve the leather from bacterial attacks. In addition, tanning will give the leather a certain color, as well as forming different densities and flexibility of the tanned leather; depending on the properties of the original leather and on the tanning process used (Lemmens, 1997). One source of tannins for tanning leather is Acacia mangium bark (Nugraha, 1999). Tannins contained in mangrove and acacia plants can be extracted to be used as wood lamina adhesives. This adhesive is very good, with the value of wood shear strength similar to lamina wood using phenolformaldehyde and ureaformaldehyde adhesives (Susanti, 2000).

Tannins are secondary metabolite compounds that are generally found in various plants. Tannins are able to bind to proteins, so that proteins in plants can be resistant to degradation by protease enzymes (Kondo et al., 2004). In addition to binding proteins, tannins also protect proteins from degradation by microbial enzymes and protease

enzymes in plants, so tannins are very useful in maintaining silage quality (Oliveira et al., 2009). Tannins are chemical compounds that are classified as polyphenolic compounds (Deaville et al., 2010). Tannins have the ability to precipitate proteins, because tannins contain a number of strong functional bond groups with protein molecules which will then produce large and complex cross-links, namely protein tannins. Natural tannins are soluble in water and give color to water, the color of the tannin solution is very dependent on the source which has its own peculiarities. It usually varies from light color to dark red or brown color (Ahadi, 2003). Tannins in plants are classified as hydrolyzed tannins and condensed tannins. Tannins classified as condensed tannins are found in fruits, grains and food crops, while those classified as hydrolyzed tannins are found in non-food materials (Makkar, 1993).

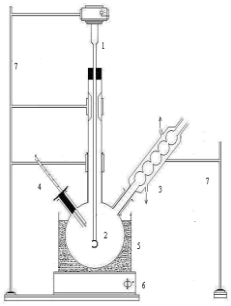
Tannins in coconut husk powder can be separated by liquid solid extraction. The principle of solid-liquid extraction is the ability to dissolve compounds in a complex matrix of solids, in the style of a particular solvent. Some things that must be considered to achieve optimum conditions for extraction include: the compound can be dissolved in the solvent in a short time, the solvent must selectively dissolve the desired compound, the analyte compound has a high concentration to facilitate extraction, and there is a method to separate the analyte compound back from the extracting solvent (Gamse 2002).

This study aims to determine the optimal process conditions in the extraction of tannins in coconut husk powder using water solvent. Water is a good and cheap solvent. Many factors affect the extraction process including temperature, stirring, solvent to material ratio, and process time. Temperature will increase the amount of solubility, usually the higher the temperature the greater the extracted. Stirring will increase the frequency of collisions between solid particles and the solvent so that the greater the stirring speed, the more effective the process of dissolving the material into the extract. . The greater the amount of solvent will be able to extract more solutes, but the more solvent the more it requires a long process and needs a lot of energy. The same applies to the process of separating the solute from the solvent. Sufficient time will provide a greater opportunity for the solute to dissolve into the solvent, so the greater the process time, the more will be dissolved.

II. RESEARCH METHODS

Coconut husk powder that has been separated from the fibers, sieved with a 20 mesh pass size, analyzed using the extraction method with soxchlet then the filtrate is titrated by the permanganometric method using indigovera indicator to determine the tannin period in coconut husk powder.

Tannins in coconut husk powder were extracted using water solvent. This process is carried out in a series of extraction tools in a flask equipped with a heater, stirrer, and counter-cooler (Figure 6). The extraction process is carried out by heating the mixture of coconut husk powder and water, stirring with a certain process time.



Picture Description
1. Stirrer
2.Triple neck flask
3. Counter cooler
4. Thermometer
5. Waterbath
6. Stove
7. Stative and clamps

Figure 6. Extraction circuit

The extraction results were filtered to separate the remaining powder until the filtrate containing tannin was obtained, then analyzed using the permangometric method with indigovera indicator. The analysis results were used to calculate the extracted tannin mass, then the percentage of tannin in the extracted coconut husk powder could be calculated.

The research was carried out with variations in temperature, stirrer speed, amount of solvent and process time, so that it can be seen how the effect of temperature, stirrer speed, amount of solvent and process time on the percentage of extracted tannin, then it can also be known the optimal process conditions to get the maximum percentage of extracted tannin.

III.RESULTS AND DISCUSSION

The effect of process conditions on the percentage of extracted tannins was studied by using coconut husk powder passed through a 20 mesh sieve and the process was run at atmospheric pressure. To study the effect of temperature on the percentage of extracted tannins, research was conducted with various temperatures, while the other variables were kept fixed.

Table 1. Effect of temperature, stirring speed, ingredient ratio, and time on the percentage of extracted tannins

Temperature (° C)	Mixer speed (rpm)	Vol ratio of solvent and ingredients	Process Time (hour)	Percentage of extracted tannins (%)
27	300	10	1	5,26
40	300	10	1	13,61
55	300	10	1	14,14
70	300	10	1	27,75
85	300	10	1	31,41

100	300	10	1	43,45
100	400	10	1	56,54
100	500	10	1	69,11
100	600	10	1	56,02
100	700	10	1	53,40
100	500	8	1	41,47
100	500	9	1	49,48
100	500	11	1	60,94
100	500	12	1	60,11
100	500	10	0,5	15,7
100	500	10	1,5	100
100	500	10	2	100
100	500	10	2,5	100

The same was done for the effect of other variables. The extraction results from each experiment in the form of yellow brown filtrate, then analyzed by permangometry using indigovera indicator to determine the tannin content in the filtrate, then calculate the percentage of tannin that can be extracted. The results of the study can be seen in Table 1.

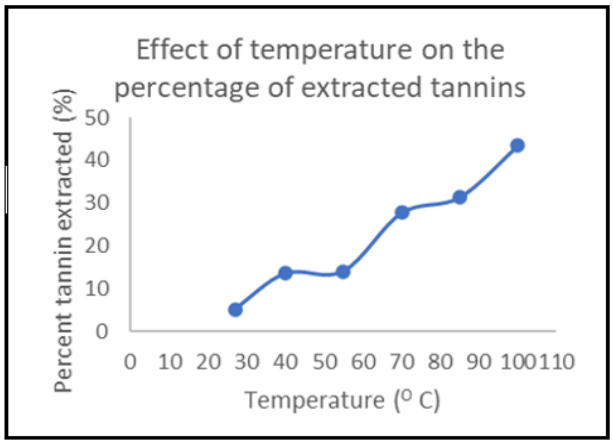


Figure 7. Effect of temperature on the percentage of extracted tannins

Figure 7 shows that the greater the temperature, the greater the percentage of tannins extracted, this is because the greater the temperature, the greater the solubility of tannins in water so that more are extracted into water. Because the solvent used is water then with atmospheric pressure, the best temperature is the highest temperature at atmospheric pressure which is at 100°C which is the boiling temperature of water.

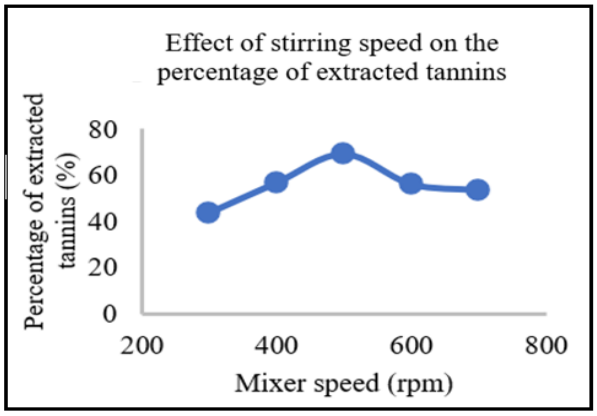


Figure 8. Figure 8. Effect of stirring speed on the percentage of extracted tannins

Figure 8 shows that the greater the stirring speed, the greater the percentage of tannins extracted up to 500 rpm stirring speed, because the contact between the coconut husk powder and the solvent is getting better. However, the stirring speed above 500 rpm decreased the percentage of extracted tannins. This is because the tool used is a three-neck flask with stirring without a baffle, so that at too high a stirring speed, there is a throwing of coconut husk powder to the flask wall which causes contact between coconut husk powder and solvent to be ineffective, and the extraction process does not run as expected. It is still possible to conduct further research using baffles so that the stirring will be more stable at high speeds.

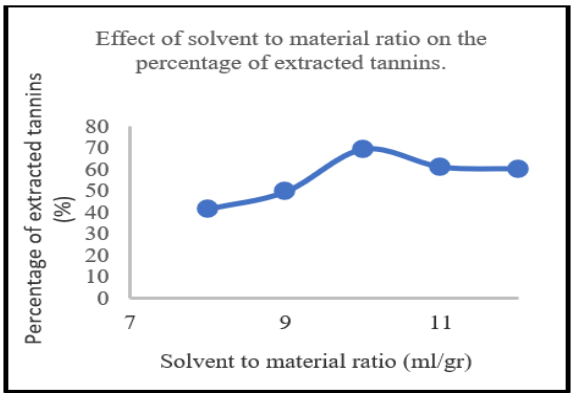


Figure 9. Effect of solvent & material percentage of extracted tannins

It can be seen in Figure 9. the greater the volume of solvent, the greater the percentage of tannins extracted because the contact between the material and the solvent is higher until the ratio of solvent to material is 10: 1, but above that number causes a decrease in the percentage of extracted tannins. This is because by using a tool of the same size, while the volume of solution increases, it will cause ineffective stirring, so that the collision between the solvent and the material becomes small. Furthermore, it can be studied further if the size of the tool adjusts. However, another consideration is that if the volume of solvent is greater, the cost of separating the

material from the solvent will be greater, if the separation uses distillation, it will require greater energy.

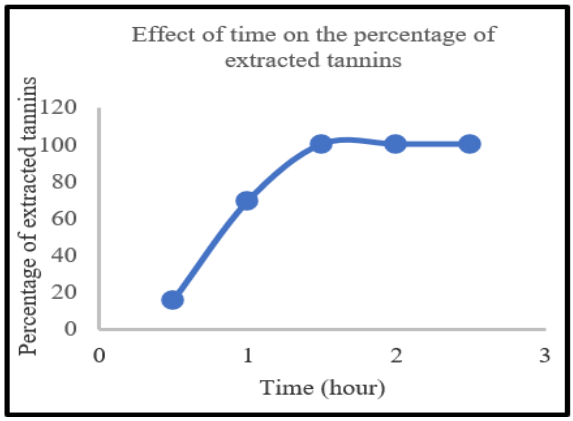


Figure 10. Effect of time on the percentage of extracted tannin

It can be seen in Figure 10. The greater the process time used, the greater the percentage of tannin extracted because the opportunity for contact between the material and the solvent is greater. Starting from 1.5 hours, all the tannin in coconut shell powder can be completely extracted. The results of this research indicate that the optimal conditions to produce the maximum percentage of extracted tannin are using an extraction temperature of 100ºC, stirring speed of 500 rpm, and solvent to material volume ratio of 10:1 ml /gr. And the processing time is 1.5 hours.

CONCLUSIONS

From the results of research and observations of the results of the tannin extraction process in coconut shell powder, it was found that coconut shell powder contains tannin which can be extracted with a water solvent. The greater the process temperature used, the greater the percentage of tannin extracted, and the best results are obtained at the boiling point. The greater the stirrer speed used, the greater the percentage of tannin extracted up to a stirrer speed of 500 rpm. After 500 rpm, increasing the stirrer speed will actually reduce the percentage of tannin extracted. The more the percentage of extracted tannin decreases, the more expensive it will be to separate the tannin from the solvent. The greater the processing time, the greater the percentage of tannin extracted, in this study 1.5 hours was able to extract perfectly. The optimal process conditions to produce the maximum percentage of extracted tannin are using an extraction temperature of 100ºC, stirring speed of 500 rpm, solvent to material volume ratio of 10:1 ml/gr. and a process time of 1.5 hours, the process of extracting tannin from coconut shell powder is useful for removing tannin in coconut shell powder as a raw material for planting media, and the tannin obtained can be used as a dye, adhesive, leather tanner and so on.

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