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The Effect of Variation on Solvent Type and Starch Extraction Time on the Increased Level of Reducing Sugar from Jackfruit Straw Waste

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Abstract : Jackfruit straw is a part of jackfruit that does not experience pollination in the form of yellow fibers. Jackfruit straw has a composition consisting of 13.45% starch, 65.05% water. The potential content of jackfruit straw starch can be used as an alternative fuel, it was, bioethanol. This material can be converted to bioethanol through hydrolysis and fermentation processes. This study aimed to determine the effect of variations in the type of solvent and extraction time, used the type of solvent H_2O, NaOH and $NaHCO_3$ for starch which was then hydrolyzed and produced glucose as a raw material for making bioethanol. The initial content of jackfruit straw was carbohydrate of 11.5%, fat of 16.22% and protein of 8.38%. The first step was drying so that the jackfruit straw became powder with a moisture content <14%. Then extraction with a solvent to dissolve compounds that can interfere with the hydrolysis process such as fats and proteins. This research was conducted by extracting jackfruit straw powder into starch. Variation of the extraction process was the type of solvent (H_2O, NaOH of 0.2%, and $NaHCO_3$ of 0.2%) and the extraction time (5, 10, 15, 20, and 25 minutes) at room temperature. The results showed that the highest reducing sugar concentration of 2.16% was in the type of NaOH solvent for 25 minutes.
Key words : Jackfruit straw, starch extraction, reducing sugar.

Introduction

Jackfruit (Artocarpus heterophyllus Lamk.) is a horticultural product that can be consumed as fresh fruit or in the form of processed products. One of the processed jackfruit products is fruit chips. However, processing jackfruit often creates waste, from the overall weight of jackfruit as much as 65-80% can become waste. In addition to the skin and seeds of the fruit, jackfruit straw is a part of jackfruit that is often discarded or is a waste. Jackfruit straw occupies a sizeable portion of 40-50% of the total waste produced. Jackfruit straw contains carbohydrates in the form of sugar, nutritional content such as jackfruit and cellulose. Jackfruit straw with carbohydrate content in the form of sugary ingredients and cellulose can be used as a basis for ethanol (Mardiyah, 2015).

Jackfruit straw which has a high carbohydrate element in its composition is also largely dominated by water. Jackfruit straw composition per 100 grams contains 65.05% of water, 13.45% of carbohydrates, 3.5% of ash, 1.5% of protein, 1.93% of fat, 3.55% of crude fiber and other compositions in the form of calcium potassium and others (Sharma et al, 2015).

The more products from jackfruit, the greater the intensity of the jackfruit waste. Therefore, further processing is carried out so that it has quality and does not pollute the environment. Jackfruit straw waste contains starch and coarse fiber which can be used as a main source of glucose. Glucose that is formed can be reprocessed into new products that are more useful, for example, such as alcohol and others (Indra, 2010).

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Starch is the main complex carbohydrate that is not soluble in water, which comes from plants or fruits, is tasteless and odorless. Starch is the main ingredient produced by plants to store excess glucose (as a product of photosynthesis) in the long run. Animals and humans also make starch as a very important source of energy in conducting activities (Wibowo, 2008). Carbohydrates can decompose at high temperature heating where carbohydrate compounds begin to break down at 84.5^0C. Various types of starch are not the same nature, depending on the length of the C chain and straight or branched chain molecules (Risnoyatiningsih, 2011).

Jackfruit straw which contains carbohydrates, which are potentially processed into bioethanol, needs to be carried out a series of processes such as extraction and hydrolysis. Before extracting the material in the form of jackfruit straw is dried first then made into jackfruit straw powder or flour. Jackfruit straw powder produced must have a moisture content that is still below the maximum moisture content requirement of 14.5%. Water content analysis is an important step in flour products, because high water content of more than 14.5% is a good medium for the growth of fungi, bacteria and insects that can damage flour during storage (Hartanto, 2012).

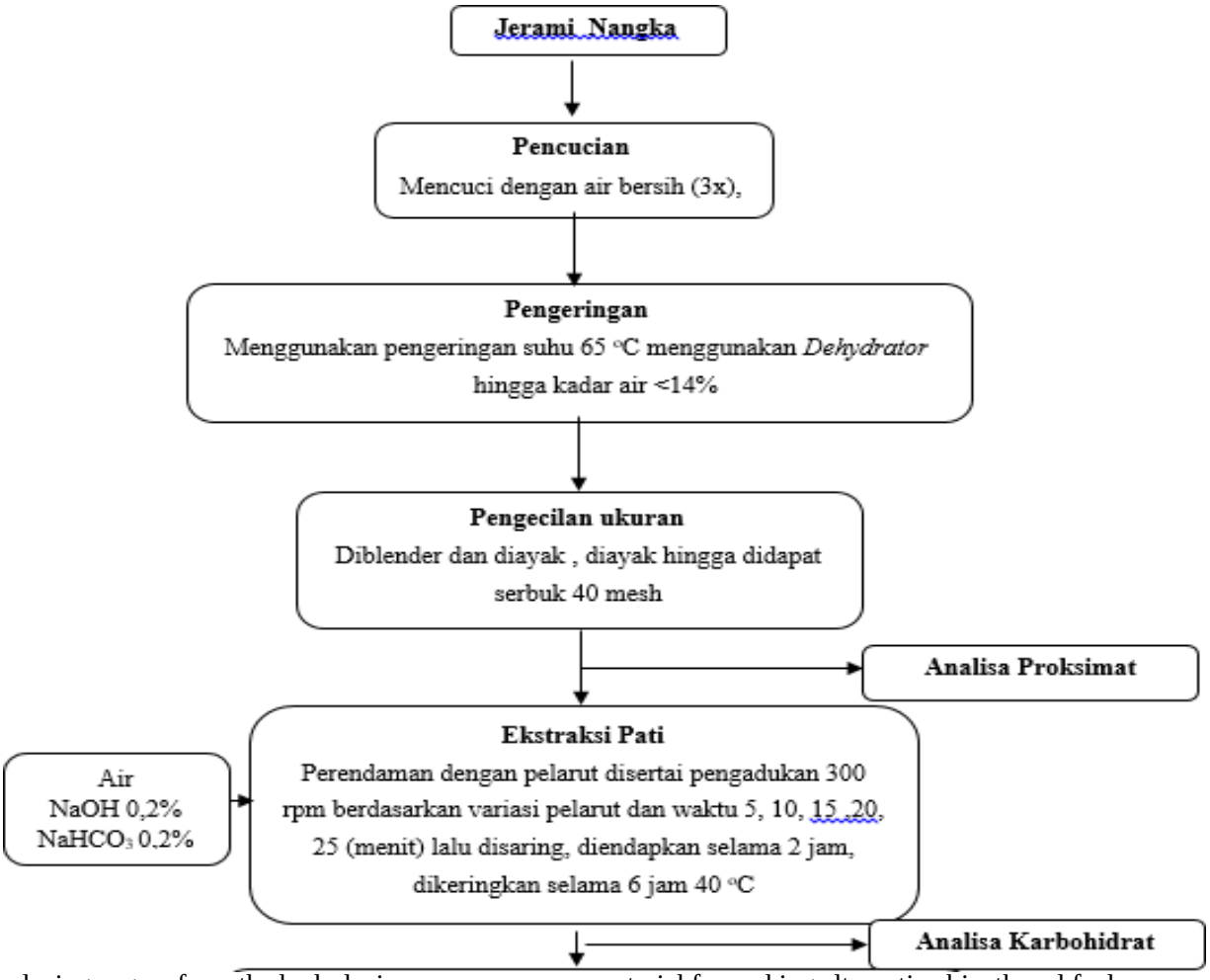
Extraction is a method that can be used to obtain starch. Where by extracting plants that are rich in carbohydrates such as sago, cassava, corn, wheat, and sweet potatoes, starch will be obtained. Starch extraction is a process to get starch from a plant by separating starch from other components contained in the plant (Sakinah, 2018).

Starch extraction is carried out with the help of solvents. Solvents that can be used include water and ethanol. The use of water as a solvent is due to the availability of abundant and cheap water. If it is reviewed based on its polarity, it is a relatively good semi polar solvent in extracting components in foodstuffs (Sari, 2013).

In addition to the ethanol and water solvents, the use of sodium metabisulfite, sodium bicarbonate and sodium hydroxide solvents for starch extraction also contributes to the chemical composition of starch. This is because the ability of these solvents to denature proteins and remove lipid compounds so that the extracted starch levels increase (Alam, 2018).

Hydrolysis is a decomposition reaction between a compound with water so that the compound breaks or breaks down. In the reaction of hydrolysis of starch with water, the result is dextrin, syrup or glucose, depending on the degree of breakdown of the polysaccharide chain in starch. The reaction between starch and water takes place very slowly, so it needs the help of a catalyst, can be in the form of enzymes or acids (Yuniwati, 2011).

The purpose of this research was to determine the effect of variations in the type of solvent and time used on the process of extracting starch from jackfruit straw waste (Artocarpus heterophyllus) so as to produce high levels of



reducing sugars from the hydrolysis process as a raw material for making alternative bioethanol fuels.

Flow Diagram of Research

Research Methodology

This research aimed to determine variations in the type of catalyst in the hydrolysis process so that it can produce high levels of reducing sugar as a raw material for making bioethanol. This research used an incubator and Jackfruit waste samples. The materials used were Aquadest (H_2O), sodium bicarbonate ($NaHCO_3$), sodium hydroxide (NaOH), hydrochloric acid (HCl), jackfruit straw, filter cloth, pH paper, filter paper, and plastic.

Results and Discussion

Before conducting further research processes, a preliminary analysis test of the jackfruit straw sample was conducted. And the following was the results of preliminary analysis of jackfruit straw test:

Table I. Preliminary analysis data for the composition of 20 grams of Jackfruit Straw powder

Type of Test	Result of Test
Water content (FW)	89,64%
Moisture Content (DW)	10,90%
Ash content (DW)	7,32%
Insoluble fiber content (DW)	3,55%
Total fat (DW)	16,22%
Protein content (DW)	8,38%
Carbohydrate levels (DW)	11,50%

Note: FW (fresh weight)
DW (dry weight)

Based on the data it can be seen that fresh jackfruit straw has a fairly high-water content, so drying is needed to reduce the water content found in jackfruit straw. From the above data, the initial analysis of carbohydrate content in dry jackfruit carbohydrate is 11.5%. Carbohydrate content has the potential to be used as a raw material for making bioethanol where the hydrolysis process is needed first to get reducing sugars that can be broken down into bioethanol. The content of the jackfruit straw powder obtained shows the characteristics of the ingredients, each type of jackfruit can have different characteristics so that the initial analysis is needed to determine the composition of the ingredients. In the data it can be seen that jackfruit straw has a high level of fat and protein content, it requires an extraction process to reduce protein fat compounds and fats that can interfere with the process of carbohydrate hydrolysis in jackfruit straw.

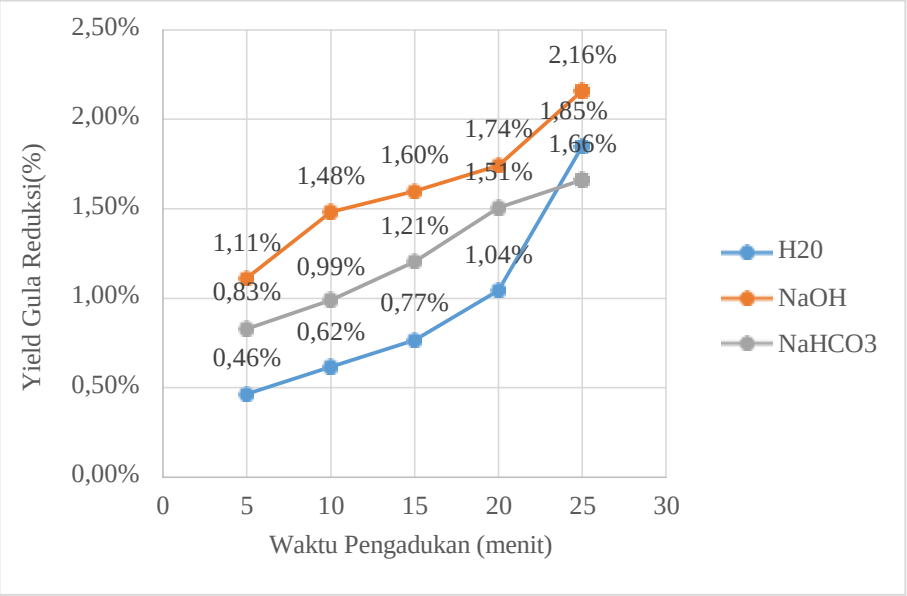


Figure 1. Relationship between Solvent Type and Stirring Time for Reducing Sugar Yield

Based on the graph above it can be seen that the longer the stirring time in the extraction process, the more carbohydrates are broken down into reducing sugars. This is because in the stirring process there is collision between the particles in the jackfruit straw powder solution so that the starch can come out and separate from plant cells in the jackfruit straw. This is in accordance with the theory from a research of Purwantana (2010) where the time and amount of pressure (stirring) that is given more and more extracts are obtained. The longer the time stressed by the stirring means more and more starch component opportunities to get out of the cell so that more starch is obtained. In addition, according to research conducted by Jeckson, et al. (2014) stirring functions to uniform contact in the liquid media so that the longer the stirring is carried out, the solvent used can work optimally on the raw material extracted.

Figure 1 also showed that each solvent produced a reducing sugar. The use of sodium solvents such as sodium bicarbonate ($NaHCO_3$) and sodium hydroxide (NaOH) for starch extraction contributes to the chemical composition of starch. Acid groups in sodium solvents will cause protein denaturation, so that the starch which was originally bound will be free of protein (Alam, 2008). So, it can be seen in the graph that the average yield obtained by sodium solvents (NaOH and $NaHCO_3$) is better than Aquadest (H_2O). H_2O solvent is a solvent based on its polarity, is a solvent that is classified as a good semi polar in extracting components in food that is what causes the H_2O solvent to produce still produce reducing sugar (Sari, 2013). The best reduction sugar of 2.16% was obtained from the NaOH solvent with a stirring time of 25 minutes. From the results of reducing sugars with solvents, it is found that NaOH is better than H_2O and $NaHCO_3$ solvents, this is because NaOH is a strong base compound which in addition can denaturate proteins can also react with lipid compounds so that it can separate starch from fat. Lipids in starch will affect the properties of starch. Lipids can form complex compounds with amylose and inhibit the swelling of starch granules, making starch difficult to gelatinate. The sodium hydroxide solution used for extracting starch will react with lipids to form soap and glycerol. When the starch is deposited and then separated from the solvent, both compounds are dissolved or wasted, so that the lipid content in the starch will decrease otherwise the level of the starch increases (Alam, 2008).

Conclusion

The best reducing sugar of 2.16% was produced from the extraction process using NaOH solvent accompanied by stirring for 25 minutes. Based on the results obtained it was known that the type of solvent affects the results of reducing sugars where strong base compounds can make the results of reducing sugars increase. While the stirring time in the extraction process was found that the longer the stirring time the more reducing sugar produced.

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